

BLIGH TANNER

PF58 TRINDER PARK

ENGINEERING SERVICES REPORT

Company. Lutheran Services
Contact. Mark McConnell, RPS
Position. Project Manager, (RPSPM)
Date. 25 October 2017
RFQ # 2017.0289

DOCUMENT CONTROL SHEET

DOCUMENT

PF58 Trinder Park

JOB NUMBER

2017.0289

PROJECT ENGINEER

Matt Martin

CLIENT

Lutheran Services

CLIENT CONTACT

Mark McConnell, RPS

VERSION	AUTHOR	REVIEWED	APPROVED	DATE
DRAFT	Matt Martin	-	Matt Martin	27/09/2017
1	Matt Martin	Cameron Riach	Matt Martin RPEQ 13428	25/10/2017

© Bligh Tanner Pty Ltd October 2017

Bligh Tanner Pty Ltd
ABN 32 061 537 666

Level 9
269 Wickham Street
PO Box 612
Fortitude Valley
Qld 4006 Australia

T +61 7 3251 8555
F +61 7 3251 8599
blightanner@blightanner.com.au
blightanner.com.au

BLIGH TANNER

CONTENTS

1 INTRODUCTION 1

2 SITE CHARACTERISTICS 2

3 STORMWATER MANAGEMENT 2

4 SERVICES 3

5 BULK EARTHWORKS 5

6 CONCLUSION 6

FIGURES

Figure 1 BVN Masterplan dated 9 August 2017 1

APPENDICES

APPENDIX A [SITE PLANS] 7

APPENDIX B [LOGAN WATER TECHNICAL MEMORANDUM] 8

APPENDIX C [GEOTECHNICAL INVESTIGATION] 9

1 INTRODUCTION

1.1 Background

Bligh Tanner Pty Ltd was commissioned by RPS Project Management, c/- Lutheran Community Care, to prepare this Engineering Services Report for the proposed development at 10 Laurel Street, Woodridge.

1.2 Description of the Proposed Development

RPS, BVN and the design team have developed a masterplan for development of aged care facilities on the Trinder Park site. The proposed development is to consist of a new RACF building, new ILUs, botanic gardens, community plaza, retail and a new entry and exit from Acacia Road.

The project includes the following key components (refer to BVN documents for further information):

- Residential aged care (RAC) facility with 3 above ground levels and single storey basement
- Repurposed nursing home
- Existing chapel at the centre of the development
- Independent Living Units (ILUs)
- Enhancement of the existing Lake
- New access road provision
- Infrastructure replacement and upgrades

A layout plan of the proposed development is provided in Appendix A, an insert of which can be seen below, (with centrally placed existing chapel [03] and RAC building around [01]).



Figure 1 BVN Masterplan dated 9 August 2017

.

1.3 Report Objectives

This report has been prepared to address the concepts for the development of engineering infrastructure associated with the proposed development. The objective is for infrastructure to be developed in such a way that meets the requirements of Logan City Council, Brisbane City Council and Logan Water/Queensland Urban Utilities, whilst minimising impacts to the environment to the extent reasonably practical.

2 SITE CHARACTERISTICS

2.1 Location

The site is located within the Logan City Council jurisdiction, approximately 24 km south west of Brisbane's CBD in the suburb of Woodridge. Woodridge is predominantly Low Density Residential with small areas of Low-Medium Density Residential. There are also some neighbourhood centre zones throughout the suburb. The site is bound to the north, west and south by Karawatha Forest Park which is located within the Brisbane City Council Local Government Area. The north-eastern boundary of the site aligns with Acacia Road and is lined by residential allotments.

At the south end of the site there is a large easement associated with the Trinder Park Pump Station, (referred to as TPPS) and water main, located within this easement are two water storage tanks. The easement intersects the site and runs in a predominantly east/west direction along the ridgeline in the southern part of the site.

The site has two points of entry, the main entry point is from Laurel Street to the South and a secondary access point off Patricia Avenue towards the north of the site.

2.2 Topography

The site has a steep slope and falls from the highest point being at the pump station and water tanks to the south, in a northerly direction towards Acacia Road and the existing dam on site to the north east and Karawatha Forest to the north west. Ultimately, site runoff is conveyed overland towards Slacks Creek downstream. The site falls over 25 metres from above RL 70m AHD at the TPPS to RL 45m AHD at an existing dam to the north, fronting Acacia Road.

The existing facilities on site are represented predominantly by single storey brick buildings. These are made up of RAC, nursing home, administration and reception building. There is also a Community Hall and Chapel located in the middle of the site. The remaining development on the site is made up of single storey independent living units (ILU).

2.3 Vegetation

Vegetation comprises of manicured lawns and gardens across the existing developed site, with much of the remaining site consisting of bushland, with small to large trees and shrubs. Drainage is good, in consideration of the falls across the site, with the eastern portion of the site and the majority of the developed site, discharging to the man-made dam to the north-east corner of the site.

3 STORMWATER MANAGEMENT

The stormwater management plan for the site has been investigated, refer to the draft Site Based Stormwater Management Plan, it concludes:

- The development site is not affected by flooding from any source.

- The lawful point of discharge for the site is Acacia Road, with runoff overtopping the dam and discharging overland to the road reserve. The bushland area of the site discharges overland through Karawatha Forest Park and ultimately to Slacks Creek.
- The current State Planning Policy is triggered by the proposed works. As such, water quality treatment devices will be incorporated into the landscape and overland flow paths to mitigate site runoff.
- The development will implement a flow control / detention strategy to mitigate the possible runoff increase generated by the works. Although any increase in peak runoff off site is considered minimal in comparison to the total runoff from site, detention storage is anticipated and will be provided within the man-made dam to the north east, by increasing its current capacity.

4 SERVICES

4.1 Electricity and Telecommunications

The existing site is serviced from Laurel Street and Acacia Road, with Optus services present in the southern verge of Acacia Road and electrical conduits and street lighting present along Patricia Avenue, Laurel Street and Acacia Road.

For further details of the electrical and telecommunication services, refer to the electrical engineer.

4.2 Water and Sewer Supply

Logan Water has undertaken a water and sewer analysis for the proposed pre-lodgement application for the proposed redevelopment and expansion of the existing Trinder Park Rest Home. Refer to Logan Water Technical Memorandum -Pre-Lodgement Application at Trinder Park Aged Care Rest Home dated 25 August 2017 in Appendix B.

The analysis and advice requested included the following:

- Whether the existing sewerage system can cater for the additional wastewater flow from the increased level of development.
- Whether the existing water supply system can cater for the additional domestic and firefighting demands from the increased level of development.
- Water supply boundary conditions (residual pressure and flow) that would apply for the design of the internal reticulation systems.
- Any augmentation works that might be required to cater for the proposed development.

A review of the scale and timing of the development has slightly reduced the long-term proposed EP on the site, and clarified timings of the various stages of development. The revised development details are summarised below:

Development Stage	Cumulative Development (EP)		Anticipated Completion Timing
	Previous Estimate	Revised Estimate	
Existing	244	244	Existing
Stage 1a	285	238	Progressive demolition and construction between approx. 2019 and 2021
Stage 1b	419	323	
Future	644	599	Not known

Note that the Stage 1A EP is actually lower than the existing because the number of beds demolished is greater than the number of new beds created. As existing buildings must be demolished to allow the new construction, the total number of beds will initially reduce below the current level and only increase as Stage 2B develops.

4.2.1 Water

Logan Water's advice for the water supply is as summarised below:

- The external water supply system can supply the demands of the full proposed development (including 30 L/s fire flows) without augmentation.
- The metered connection to the Logan Water system and the internal water reticulation will need to be upgraded to meet the domestic and firefighting requirements of the expanded development, especially the multi-storey buildings. The metered connection will need to comply with the SEQ Water Supply and Sewerage Design and Construction Code and Logan Water's requirements. The internal reticulation will need to comply with the Plumbing and Drainage Code and will be subject to Council Plumbing Approval.

4.2.2 Sewerage

Logan Water was asked to review their August 2017 advice following the revised EP numbers, to confirm the following:

- Confirmation that the Stage 1A development will not trigger any sewerage upgrades.
- Whether the revised Stage 1B development will trigger the sewerage upgrades and to what extent.
- The impact on the sewerage augmentation requirement of the reduced future EP load.

Logan Water's response (email dated 18th October 2017) was that the revised numbers did not change the original advice.

Logan Water's advice for the sewerage connection is as summarised below:

- The Trinder Park site drains to the existing Louden St Sewage Pumping Station (SPS).
- The pumping station and downstream sewerage system is already overloaded under peak flow conditions based on Logan Water criteria.
- Any development of the site will trigger downstream sewer upgrades, which it is understood the developer will be expected to provide.
- Full development would also trigger an upgrade of the Louden St SPS.
- Two augmentation options have been identified:
  - Option 1 Maintain connection to Louden St SPS ($256k for sewerage upgrades plus $323k for the SPS upgrade = total $579k)
  - Option 2 Divert the Trinder Park flow to the Pilbi Street and Alfred Street SPS Catchment ($265k for sewerage upgrades)
  - Option 2 is the lowest cost, and preferred, option.
- Further discussions will be required with Logan Water regarding the exact timing of any augmentation works. Stage 1a will not result in a net increase in sewerage flow form the site as should not trigger any upgrades, though Logan Water is expected to argue that the upgrade is required anyway as the system is already overloaded. Discussions should also address the possibility of cost sharing for the augmentations based on the fact that the works may benefit more than just the Trinder Park development.

- Internal sewerage reticulation and the connection to the external sewer will need to be upgraded to meet the requirements of the expanded development. The external works and upgraded property connection will need to comply with the SEQ Water Supply and Sewerage Design and Construction Code and Logan Water's requirements. The internal reticulation will need to comply with the Plumbing and Drainage Code and will be subject to Council Plumbing Approval.

4.3 Gas

There is no gas infrastructure available, it is understood that all gas supply will be bottled.

5 BULK EARTHWORKS

5.1 Geotechnical Investigation

A preliminary geotechnical investigation has been undertaken by Soil Surveys and is appended for reference, (Project 117-19539, dated July 2017). The scope of geotechnical services provided by Soil Surveys Engineering Pty Limited was directed towards a preliminary evaluation (Phase 1 Study).

It should be noted that the findings in Soil Surveys' report are preliminary in nature and suitable for planning purposes only. A detailed geotechnical investigation should be carried out, following finalisation of development planning, for the purposes of detailed design.

5.2 Subsurface Profile

A total of seven boreholes were taken across the site including two deep bores where the proposed RAC building is to be located. Subsurface conditions were found to consist of fill material (considered uncontrolled fill material varying from 400mm to 1.6m), overlying natural silty sand, natural sandy clayey gravel and weathered siltstone and sandstone at depth.

5.3 Proposed Earthworks

The proposed development includes a basement carpark and significant earthworks will be required for this excavation, including the possible use of a rock breaker for the weathered rock. Limited filling is likely to occur as part of the development and therefore the majority of the excavated material will need to be disposed of off-site subject to restrictions on soil movement within fire ant zones, or kept on-site.

Significant retention systems are likely due to the 20 metre fall across the site. Construction sequencing, staging and various retention systems all need to be considered as part of the detailed design phase.

5.4 Erosion and Sediment Control

The investigation has confirmed an Emerson Class of 3 to 4 across the samples taken, indicating a medium to high potential for erosion and dispersity. An erosion and sediment control plan will be required as part of the approval process and is discussed further within the Site Based Stormwater Management Plan prepared by Bligh Tanner.

5.5 Man-made Lake

The construction of the existing detention lake was considered to have not been carried out under controlled conditions. The existing dam wall is considered steep in terms of long term stability and with material of variable quality.

It is proposed for the existing lake to be expanded and utilised for on-site attenuation, treatment of runoff and provide a sustainable, environmental solution that can be utilised as a feature for residents. Dewatering of the existing lake may be required as well as improving the long-term stability of the lake.

5.6 Other considerations

- Variability of ground conditions and rock level.
- Presence of uncontrolled fill (0.4m – 1.6m at RACF building location)
- Stability of man-made dam wall at detention lake.
- Cut and fill – potential for surplus spoil which will need to be managed on site to minimise costs.
- Fire Ant area – restrictions on soil movement off site / costs associated with same.
- Slope stability (temporary and long-term) – refer Geotechnical Report by Soil Surveys dated July 2017.
- Reactive soils and removal of existing trees – potentially leading to excessive ground movements.

6 CONCLUSION

The proposed development is located on existing residential blocks and as such has access to existing services including water, sewer, stormwater, electricity and telecommunications. Due to the increase in demand new connections or upgrades to these services may be required as outlined in this report.

Stormwater will be discharged overland via designated overland flow paths, utilising natural pathways wherever possible. Runoff from the proposed development will be conveyed to the existing man-made lake to the north-east corner, that will be expanded and stabilised in order to provide any attenuation storage necessary as well as being incorporated into the landscape master plan.

Treatment of runoff will be required during the construction and operational phases of the development. The soil is medium to highly dispersive and as such, appropriate measures for erosion and sediment control will be required during construction. The contractor will be responsible for the adoption and maintenance of these measures. For the operational phase of the facility, bioretention and irrigation of trees, open swales and the existing lake will all serve to mitigate runoff in order to achieve Logan City Council and Queensland's legislated water quality objectives.

Significant earthworks will be required across the site, particularly for the excavation of the basement car park, including the possible use of a rock breaker for the weathered rock. Limited filling is likely to occur as part of the development and therefore the majority of the excavated material will need to be disposed of off-site subject to restrictions on soil movement within fire ant zones, or kept on-site.

Significant retention systems are likely due to the 25 metre fall across the site. Construction sequencing, staging and various retention systems all need to be considered as part of the detailed design phase.

APPENDIX A
SITE LAYOUT PLANS



C:\REVIT_LOCAL\2017\1608013_TPW_SITE-MODEL_REV10_CNORMAN.rvt 22/09/2017 2:13:46 PM

Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
www.bvn.com.au

INTELLECTUAL PROPERTY

COPYRIGHT BVN ARCHITECTURE PTY LIMITED. UNLESS OTHERWISE AGREED IN WRITING,ALL RIGHTS TO THIS DOCUMENT ARE SUBJECT TO PAYMENT IN FULL OF ALL BVN CHARGES.THIS DOCUMENT MAY ONLY BE USED FOR THE EXPRESS PURPOSE AND PROJECT FOR WHICH IT HAS BEEN CREATED AND DELIVERED, AS NOTIFIED IN WRITING BY BVN.AND THIS DOCUMENT MAY NOT BE OTHERWISE USED, OR COPIED. ANY UNAUTHORISED USE OF THIS DOCUMENT IS AT THE USER'S SOLE RISK AND WITHOUT LIMITING BVN'S RIGHTS THE USER RELEASES AND INDEMNIFIES BVN FROM AND AGAINST ALL LOSS SO ARISING.

NOTE

CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK OR PREPARATION OF SHOP DRAWINGS. DO NOT SCALE THIS DRAWING

ISSUE	DATE	FOR
A	08.08.17	DRAFT MASTERPLAN
B	22.09.17	FOR INFORMATION

CONSULTANT

CONSULTANT

CONSULTANT

CONSULTANT

PROJECT MANAGER
RPS

CLIENT

LUTHERANS (LCC)
CLIENT NUMBER

PF58
PROJECT

TRINDER PARK - RACF
LAUREL ST, WOODRIDGE
BVN PROJECT NUMBER

b1608013
DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 2000 5000
SCALE

1 : 1000@A1
STATUS

PRE-DESIGN
DRAWING

SITE PLAN

AR-A-MP-01

ISSUE B



Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
www.bvn.com.au

INTELLECTUAL PROPERTY

COPYRIGHT BVN ARCHITECTURE PTY LIMITED. UNLESS OTHERWISE AGREED IN WRITING,ALL RIGHTS TO THIS DOCUMENT ARE SUBJECT TO PAYMENT IN FULL OF ALL BVN CHARGES.THIS DOCUMENT MAY ONLY BE USED FOR THE EXPRESS PURPOSE AND PROJECT FOR WHICH IT HAS BEEN CREATED AND DELIVERED, AS NOTIFIED IN WRITING BY BVN.AND THIS DOCUMENT MAY NOT BE OTHERWISE USED, OR COPIED. ANY UNAUTHORISED USE OF THIS DOCUMENT IS AT THE USER'S SOLE RISK AND WITHOUT LIMITING BVN'S RIGHTS THE USER RELEASES AND INDEMNIFIES BVN FROM AND AGAINST ALL LOSS SO ARISING.

NOTE

CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK OR PREPARATION OF SHOP DRAWINGS. DO NOT SCALE THIS DRAWING.

ISSUE	DATE	FOR
A	22.09.17	FOR INFORMATION
B	27.09.17	GENERAL UPDATE
C	20.10.17	GENERAL UPDATE

CONSULTANT

CONSULTANT

CONSULTANT

CONSULTANT

CONSULTANT

PROJECT MANAGER

CLIENT

Lutheran Services
There for you

LUTHERAN SERVICES

CLIENT NUMBER

-

PROJECT

TRINDER PARK - RACF
LAUREL ST, WOODRIDGE

BVN PROJECT NUMBER

b1608013

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE

0 2000 5000

SCALE

1 : 250@A1

STATUS

SKETCH DESIGN

DRAWING

FLOOR PLAN - LEVEL 00

AR-B-00-01 | C



BVN

Telephone +61 2 8297 7200
Facsimile +61 2 8297 7299
www.bvn.com.au

INTELLECTUAL PROPERTY
COPYRIGHT BVN ARCHITECTURE PTY LIMITED. UNLESS OTHERWISE AGREED IN WRITING ALL RIGHTS TO THIS DOCUMENT ARE SUBJECT TO PAYMENT IN FULL OF ALL BVN CHARGES.THIS DOCUMENT MAY ONLY BE USED FOR THE PURPOSE FOR WHICH IT WAS PREPARED AND IS NOT TO BE USED FOR ANY OTHER PURPOSE. IF IN ELECTRONIC FORM IT WAS CREATED AND DELIVERED AS SET OUT IN BVN'S PROTOCOL. BVN AND THIS DOCUMENT MAY NOT BE OTHERWISE USED, OR COPIED. ANY UNAUTHORISED USE OF THIS DOCUMENT IS AT THE USER'S SOLE RISK AND WITHOUT LIMITING BVN'S RIGHTS THE USER RELEASES AND INDEMNIFIES BVN FROM AND AGAINST ALL LOSS SO ARISING.

NOTE
CONTRACTOR TO CHECK AND VERIFY ALL DIMENSIONS ON SITE PRIOR TO COMMENCEMENT OF WORK OR PREPARATION OF SHOP DRAWINGS. DO NOT SCALE THIS DRAWING.

ISSUE	DATE	FOR
A	22.09.17	FOR INFORMATION
B	27.09.17	GENERAL UPDATE
C	20.10.17	GENERAL UPDATE

CONSULTANT

CONSULTANT

CONSULTANT

CONSULTANT

PROJECT MANAGER

CLIENT
Lutheran Services
There for you
LUTHERAN SERVICES

CLIENT NUMBER
-

PROJECT
TRINDER PARK - RACF
LAUREL ST, WOODRIDGE

BVN PROJECT NUMBER
b1608013

DRAWING KEY

TRUE NORTH PROJECT NORTH

GRAPHIC SCALE
0 2000 5000

SCALE
1 : 250@A1

STATUS
SKETCH DESIGN

DRAWING
FLOOR PLAN - LEVEL 01

AR-B-01-01 ISSUE C

C:\REVIT_LOCAL\2017\TRINDER PARK_RAC_170918_CHORMAN.rvt 20/10/2017 5:44:50 PM

APPENDIX B
LOGAN WATER TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM	
TO:	Daniel O'Brien – Water development Services Team leader
FROM:	Ian McDonald – Senior Hydraulic Engineer
ACTIONED BY:	Ian McDonald – Senior Hydraulic Engineer Purvi Shah – Water Planning Engineer
DATE:	25/08/2017
SUBJECT:	**Pre-Lodgement Application at Trinder Park Age Care Rest Home**

1. Overview

Council Water Development Services (WDS) requested Council Water Infrastructure Planning (WIP), as per service request 2634506, to undertake a water and sewer analysis for the proposed pre-lodgement application at 10 Laurel Street, Woodridge. Figure 1-1 shows the proposed redevelopment and expansion of the existing Trinder Park Rest Home.

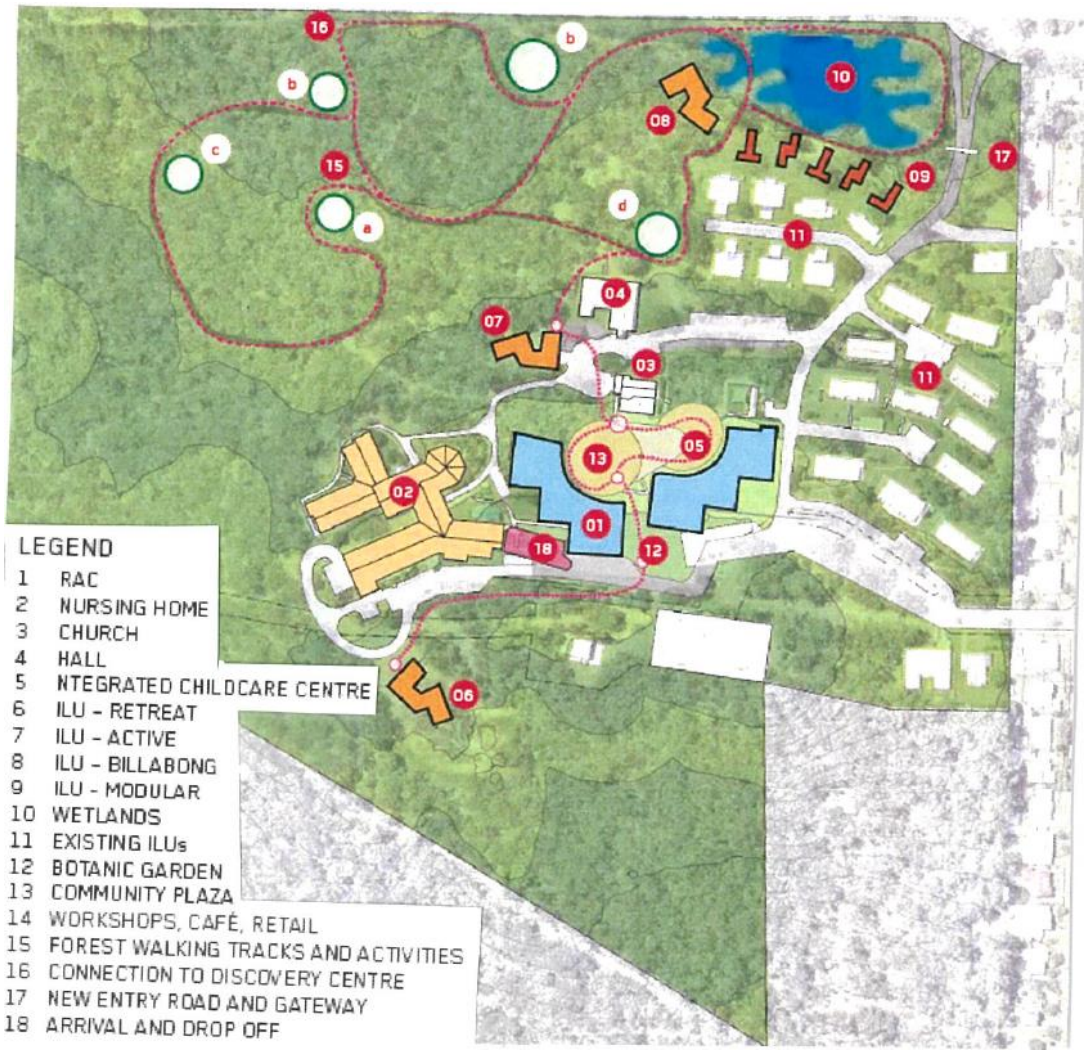


Figure 1-1: Proposed Development Masterplan Layout

Figures A1, A2, A3 in Appendix A show the existing site plan, proposed 3D perspective view and the existing services plan obtained from DM#11201146 and GIS.

The analysis and advise requested includes the following:

- Whether the existing sewerage system can cater for the additional wastewater flow from the increased level of development.
- Whether the existing water supply system can cater for the additional domestic and firefighting demands from the increased level of development.
- Water supply boundary conditions (residual pressure and flow) that would apply for the design of the internal reticulation systems.
- Any augmentation works that might be required to cater for the proposed development.

2. Population Details

2.1 Trinder Park Rest Home

Table 1 and Table 2 show the water and sewer population estimates at Trinder Park Rest Home respectively. These highlight the previous growth years predicted in the 2036 and 2051 (ultimate scenario) planning horizons.

Table 2-1 Water Population Estimates (2014 IDM)

Land Use	2013	2016	2021	2026	2031	2036	2051
Other_Beds	188.53	188.53	188.53	188.53	188.53	232.48	287.61
Res_Other	124.90	124.90	124.90	124.90	124.90	124.90	124.90
Total	**313.43**	**313.43**	**313.43**	**313.43**	**313.43**	**357.38**	**412.51**

Table 2-2 Sewer Population Estimates (2014 IDM)

Land Use	2013	2016	2021	2026	2031	2036	2051
Other_Beds	169.68	169.68	169.68	169.68	169.68	209.24	258.85
Res_Other	124.90	124.90	124.90	124.90	124.90	124.90	124.90
Total	**294.58**	**294.58**	**294.58**	**294.58**	**294.58**	**334.14**	**383.75**

Table 3 shows the developers forecast growth estimates for existing, Stage 1A and future stages. Note the future stages consists of Stage 1B, 2, 3 and 4. However, the timing of construction works has not been provided.

For the purpose of this report, the hydraulic analysis has investigated the following construction stages:

- 2017 - Existing scenario
- 2018 - Stage 1A to be completed
- 2023 - Future Stages to be completed in 5 years

A review of the Councils and the developer's population estimates shows the following discrepancies:

- Existing 2017 planning horizon. The Council's IDM population of 294.58 EP is higher than the developers 244.3 EP population by 50.28 EP. This is attributed to the independent living unit loading rates of 2.0 and 1.2 respectively. However, given these are 1 bedroom units, this report shall adopt the developer's 2017 estimates.
- Ultimate 2051 planning horizon. The Council's IDM population of 383.75 EP is lower than the developers 644 EP population by 260.25 EP. This report shall adopt the developer's 2051 estimates.

Table 3: Revised Development Population Estimates (Developer, DM11201146)

Trinder Park Water Supply and Sewerage
Development Details

Existing Development

Use	Scale	Gross Occupied Floor Area (m^2)	No.	Units	EP/unit	EP
House	3 bedroom		2	Houses	3	6.0
Independent Living Units	1 bedroom		58	ILUs	1.2	69.6
Barracks Buildings (Aged Care)	1 bedroom		65	Beds	1	65.0
Fuchsia House (Aged Care)	1 bedroom		8	Beds	1	8.0
Nursing Home	Beds		88	Beds	1	88.0
RAC Staff			39	Staff	0.2	7.7
Kitchen Dining Room			EP included above			
Laundry			Off-site			
					Total	244.3

Stage 1 Development

Use	Scale	Gross Occupied Floor Area (m^2)	No.		EP/unit	EP
House	Retained		2		3	6.0
Independent Living Units	Retained		58	ILUs	1.2	69.6
Barracks Buildings (Aged Care)	Demolished					
Fuchsia House (Aged Care)	Demolished					
Nursing Home	Retained		88	Beds	1	88.0
RAC Staff			50	Staff	0.2	10.0
Kitchen Dining Room	Demolished					
Laundry			Off-site			
Stage 1a (Western RAC Wing)	Multi-level					
- Aged Care		8400	112	Beds	1	112.0
- Kitchen/Dining			EP included above			
Stage 1b (Eastern RAC Wing)	Multi-level	4800	80	Beds	1	80.0
Childcare		1200	80	Children	0.5	40.0
Allied health		1000	67	Staff	0.2	13.4
					Total	419.0

Future Development

Use	Scale	Gross Occupied Floor Area (m^2)	No.		EP/unit	EP
House	Retained		2		3	6.0
Independent Living Units	Retained		58	ILUs	1.2	69.6
Barracks Buildings (Aged Care)	Demolished					
Fuchsia House (Aged Care)	Demolished					
Nursing Home	Retained		88	Beds	1	88.0
RAC Staff			50	Staff	0.2	10.0
Kitchen Dining Room	Demolished					
Laundry			Off-site			
Stage 1a (Western RAC Wing)	Multi-level					
- Childcare		1200	80	Children	0.5	40.0
- Allied health		500	67	Staff	0.2	13.4
- Aged Care		8400	112	Beds	1	112.0
- Kitchen/Dining			EP included above			
Stage 1b (Eastern RAC Wing)	Multi-level	4800	80	Beds	1	80.0
Stage 2 Future ILU	2 bedroom	6000	50	ILUs	1.5	75.0
Stage 3 Future ILU	2 bedroom	6000	50	ILUs	1.5	75.0
Stage 4 Future ILU	2 bedroom	6000	50	ILUs	1.5	75.0
					Total	644.0

2.2 Growth Analysis

Figure 2-1 shows the population growth projections within the study area from the *Development of the Infrastructure Demand Model 2013 (IDM, October 2014)*. This shows:

- The proposed site at Trinder Park Rest Home is forecast for growth in 2036
- Only minor growth (63.81 EP) at other lots in the Louden Street SPS catchment in 2051
- Significant growth in Elm Park SPS and Alfred Street SPS catchments

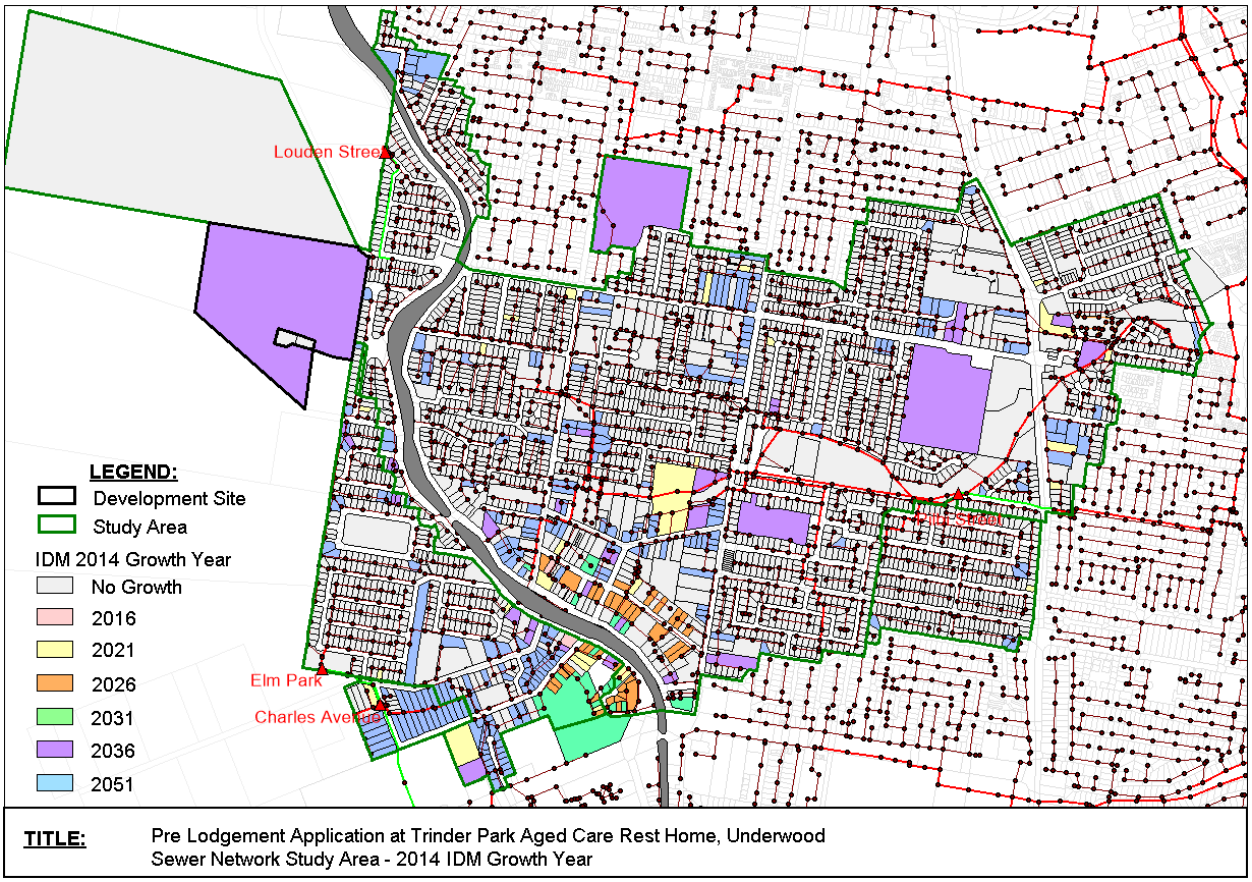


Figure 2-1 Population Growth Projections within the Study Area

3. Water Analysis

A hydraulic analysis of the water supply network has been carried out for the existing (2016) and ultimate (2051) master planning scenarios with the revised development water demand of 644 EP.

The hydraulic model results show both scenarios have sufficient capacity to cater for the proposed development for both MD and FF (30L/s). A summary of the hydraulic modelling results is shown below:

Water Supply Boundary Conditions and other information

- Under static condition the hydraulic grade had a minimum head of 95.65m (35.9m residual pressure, Demand 3L/s) at elevation 59.6mAHD
- Under a fire flow event (30L/s) the hydraulic grade had a minimum head of 95.5m (35.8m residual pressure, Demand 33.03L/s) at elevation 59.6mAHD
- Proposed demand tested in Hydraulic model (2016 MD and FF Scenario) on hydrant WFH020271 on DN250
- No augmentation required to accommodate the additional development for both max day and fire flow scenarios

4. Sewer Analysis

4.1 Background

(a) The Loganholme WWTP catchment sewer masterplan study (LWA task 90-12-54, April 2015) analysed the 2014 IDM population loadings for 2013, 2016, 2021, 2036 and 2051 planning horizons. Figure A4 in Appendix A shows the identified system augmentations required to cater for growth and system deficiencies. The models used in this project have been adopted as the base models for this development assessment.

(b) *Springwood Gravity Sewer Augmentation* (Task 90-11-72) created a calibrated model based on long term flow monitor package by ADS between 2007 and 2010 and short term flow survey by EDS 11 Feb to 15 Apr 2015.

(c) *Optimisation of the Slacks Creek Trunk Sewer Network* (LWA Task No. 90-13-05, April 2015) identified a $24 million capital works program to improve the containment standard of the network to a 1 year ARI storm event. This included $8.48 million of new infrastructure and $15.66 million of renewals in the Springwood catchment.
Figure A5 in Appendix A shows the proposed augmentations and system improvements related to this development assessment, including:

- a DN600 flow control facility located immediately downstream of Louden Street SPS rising main discharge manhole at SMH17018
- Two sewer cross connection improvement schemes along North Road and Bruce Road, Woodridge.
- A DN375 gravity main upsize along Defiance Road, Woodridge

(d) The Loganwia design and construction team have constructed the two proposed sewer cross connections along North Road and Bruce Road, Woodridge (as identified in the Optimisation project in 2015). However, the as-constructed drawings are still under review. Figures C1, C2 and C3 in Appendix C show the “Issue for Construction” drawings of the completed works.

(e) The Loganwia design team has updated the calibrated model for Slacks Creek Network with the proposed augmentations identified in the Optimisation project in 2015. However, the model was not available at the time of this assessment.

(f) Figure A4 in Appendix A shows the 72 Acacia Road Karawatha development application located within the Brisbane City Council boundary (DM9670479 in June 2015 and DM9539795 in July 2015). The 75 lot residential development proposal (233 EP) intended to transfer flows to Louden Street SPS. However, this required the developer to provide significant augmentation costs of $K 934 capital cost and $K 643 net present cost. An alternative solution was recommended by Council that diverted flows, under the Queensland railway, into the Alfred Street SPS catchment.

(g) Slacks Creek Trunk Sewer Capital Works Prioritisation (Loganwia Task PI008, Mar 2016). This report carried out further investigations from The *Optimisation of the Slacks Creek Trunk Sewer Network Task* (LWA Task No. 90-13-05). The main change in the proposed works was to reduce the DN600 storage pipe main to 140m length DN300 main with capital cost $164,125. This linear storage was given a priority 4 classification and is scheduled in the Capital Works Budget for delivery in 2024/25 and 2025/26. Figure 7 in Appendix A shows the plan of preferred optimised solution.

The proposed DN300 gravity main requires further review from recent flow survey undertaken in 2017 in the Woodridge catchment. Additional investigation is also required regarding site constraints, high infiltration and inflow issues at Louden Street SPS and new leachate flows from Brisbane land fill site

4.2 Asset Detail Assessment

4.2.1 Pump Capacity Assessment at Louden Street SPS

Table 4-1 shows the existing and future predicted PWWF at Louden Street SPS.

Table 4-1: Louden Street SPS Population and Flow Loadings

Planning Horizon	Population Estimate (EP)	Area (ha)	d	ADWF (L/s)	PDWF (L/s)	PWWF (L/s)
2017	841.44	41.5335	2.96	1.61	4.75	12.66
2018	1016.14	41.5335	2.96	1.94	5.74	15.29
2023	1241.14	41.5335	2.96	2.37	7.01	18.67
2026	1241.14	41.5335	2.96	2.37	7.01	18.67
2031	1241.14	41.5335	2.96	2.37	7.01	18.67
2036	1241.14	41.5335	2.96	2.37	7.01	18.67
2051	1304.95	41.5335	2.96	2.49	7.37	19.63

Notes:

1. ADWF assumes 165 L/EP/d
2. $d = 0.01(\log A)^4 - 0.19(\log A)^3 + 1.4(\log A)^2 - 4.66 \log A + 7.57$
   where A = gross plan area of development catchment, in hectares
3. PDWF = d x ADWF
4. PWWF assumes 1300 L/EP/d

Figure 4-1 shows the pump system curve analysis at Louden Street SPS with 2016 pump capacities determined from SCADA pump runtimes.

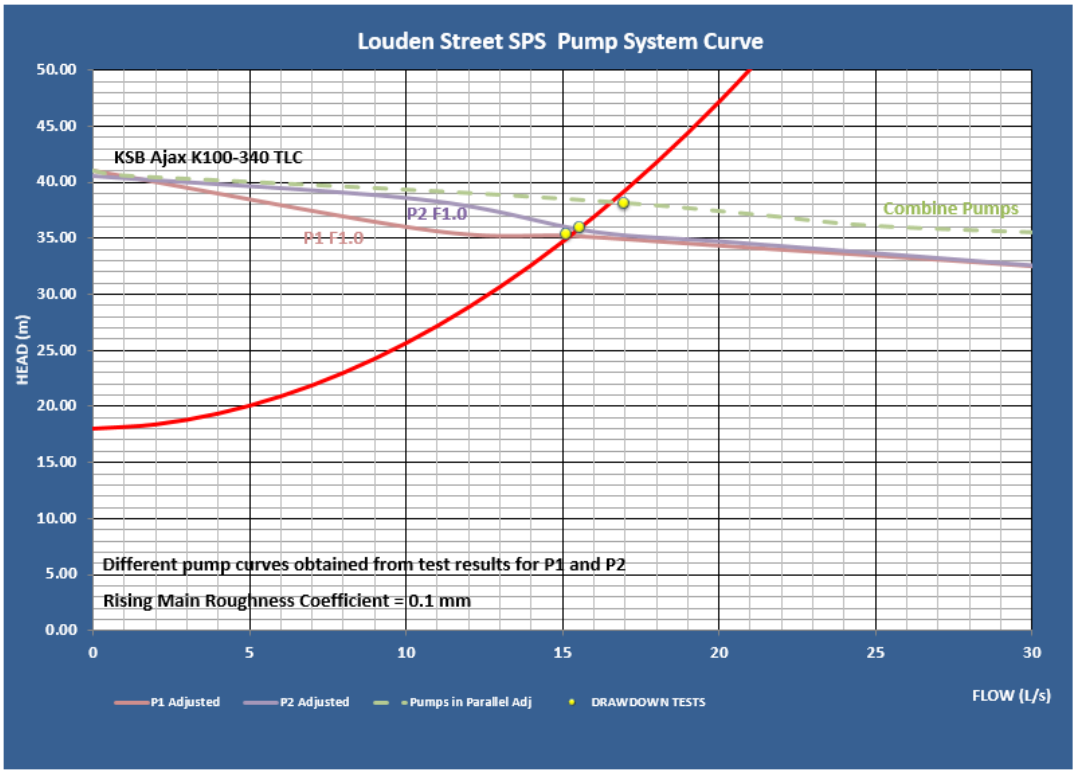


Figure 4-1 Louden Street SPS33 2016 Pump System Curve

Louden Street SPS has two KSB Ajax K100-340 pumps that are 41 years old (commissioned in 1974). Pump performance tests carried out in 1999 for both pumps found slightly varying head/discharge relationships as shown in the pump system curve above. Both pumps are operating at full capacity with no loss of performance observed from 2016 SCADA pump rates.

The pumps at Louden Street SPS are currently under tender for replacement. The determination of the pump manufacturer is part of the tender process so unavailable to specify pump specifics at the present time. However, the recommended duty/assist pump flow of 14.5 L/s is recommended to meet 2036 PWWF conditions with a velocity of 1.8 m/s. This will achieve self-cleansing and slime stripping of the rising main.

4.2.2 Emergency Storage Assessment at Louden Street SPS

Table 4-2 shows the operation settings at Louden Street SPS33 based on un-verified 0% and 100% settings. It is recommended that Council's Water Operations survey Louden Street SPS wet well to obtain the latest 0% and 100% SCADA settings, incoming pipe invert level, top of benching.

Table 4-2: Louden Street SPS33 Operation Settings on 1 Jan 2017

Setting	SCADA Setting (%)	RL (mAHD)
Cover Level	NA	37.475
SCADA 100%	100	36.745
Overflow Alarm	99.8	36.740
High Alarm	45	35.337
Stdby ON	40	35.209
Duty ON	35	35.081
Stdby OFF	10	34.441
Duty OFF	8	34.390
Low Alarm	2	34.236
SCADA 0%	0	34.185
Floor	NA	33.980

Notes:

1. The lowest incoming pipe to wet well is DN150 at IL35.38 mAHD (above the pump switch ON level)
2. The actual overflow level is at SGO29401 at DN150 IL36.750

Louden Street SPS33 has an existing 17.3m length DN1220 emergency storage tank (20.2 kL)

The total storage available in the sewer network between the SCADA high alarm and overflow level calculated using Infoworks ICM is 27.8 kL (emergency storage 20.2 kL, manholes 6.6 kL and pipes 1.0 kL).

Table 4-3 outlines the emergency storage requirements in accordance with estimated population staging provided in Table 4-1.

Table 4-3: Louden Street SPS33 Emergency Storage Requirements

Planning Horizon	Scenario	Population (EP)	4 Hrs ADWF Emergency Storage (kL)	2 Hrs PDWF Emergency Storage (kL)	Extra Storage Required (kL)
2017	Existing	841.44	24.61	25.22	Nil
2018	Stage 1A	1016.14	27.94	30.45	2.61
2023	Stage 1B,2,3&4	1241.14	34.13	37.20	9.35
2051	Ultimate	1304.5	35.89	39.11	11.26

Notes:

1. Emergency storage calculated at 4 hours with ADWF using 165 L/EP/d
2. Emergency storage calculated at 2 hours with PDWF using 165 L/EP/d and 95 percentile peaking factors normalized with average
3. Deficiencies highlighted in red

4.3 Hydraulic Analysis

The sewer analysis has been carried out using the "static" Infoworks ICM 2017 all-pipes model and future trunk models generated in the 2014 master planning project. These static models calculate PWWF using a population equivalent estimate and applying a peaking factor that accounts for inflow/infiltration and diurnal flows. The consumption values for residential lots within the Loganholme WWTP catchment is 1300 L/EP/d.

Note, a very course "calibrated" model was created in *Springwood Gravity Sewer Augmentation (LWA, 2015*). This was later used in *Slacks Creek Trunk Sewer Capital Works Prioritisation* (LoganWIA March 2016) to recommend augmentations included in the Capital Works budget. However, this has not been used in this study as it does not include future scenarios and the calibration was based on a single flow monitor. Therefore, the previous solutions adopted in the Capital Works budget will require further assessment and improvement when the 2017 flow monitoring data becomes available.

The following models were used in the hydraulic analysis of the sewer network:

- Existing 2017 all-pipes model (Task PI-099 model maintenance project)
- Future 2018 all-pipes model with Stage 1A development populations added
- Future 2023 trunk model with Stages 1B, 2, 3 and 4
- Ultimate (2051) master planning scenarios using the revised development population.

Table 4-4 shows the PWWF for the different stages during development at Trinder Park Rest Home, using 2014 DSS loading of 1300 L/EP/d.

Table 4-4: Trinder Park Rest Home PWWF

Planning Horizon	Stage	Population Estimate (EP)	PWWF (L/s)
2017	Existing	244.3	3.68
2018	Stage 1A	419.0	6.30
2023	Stage 1B, 2, 3 & 4	644.0	9.69
2026	Stage 1B, 2, 3 & 4	644.0	9.69
2031	Stage 1B, 2, 3 & 4	644.0	9.69
2036	Stage 1B, 2, 3 & 4	644.0	9.69
2051	Stage 1B, 2, 3 & 4	644.0	9.69

The maximum allowable development flows must meet the following hydraulic design requirements:

- Existing Network
  - The PWWF depth of flow in the manhole (otherwise known as Hydraulic Grade Level, HGL) requires 1m freeboard below manhole surface level and no spillage through overflow structures (Desired Standards of Service - DSS LWA Task 90-12-43, 2014).
  - The PDWF depth of flow should not surcharge the downstream pipe (good engineering practice)

- New Sewer Mains
  - The maximum PWWF depth of flow in the pipe is 75%. (SEQ D&C Code 2013)

This study does not include any consideration for leachate flows from Brisbane landfill site that pumps 2 L/s when Louden Street is not in operation. Note, Council does not have any real time SCADA data on the operation times and durations of this private pump station.

4.4 Existing System Performance

The *Optimisation of the Slacks Creek Trunk Sewer Network Report* (LWA Task No. 90-13-05, September 2015) in Appendix B shows the existing system performance with respect to the number of overflows and overflow volumes that occur during the 6-month, 1-year, 2-year and 5-year ARI design storms.

Table 4-5 summarises the sewer deficiencies identified in the existing 2017 PWWF model results. Figures B3, B4, B5 and B6 in appendix B show the 2017 PWWF longitudinal sections at these locations.

Table 4-5 Summary of Network Deficiencies in 2017 PWWF

MH Ref	Max Flood Depth (m)	System Failure	Action Recommended
SMH17018	-0.186	Pipe surcharged and depth within 1m	Yes
SMH17015	-0.660	Pipe surcharged and depth within 1m	Yes
SMH17335	-0.826	Pipe surcharged and depth within 1m	Yes
SMH17973	-0.358	Pipe surcharged and depth within 1m	Yes
SMH18040	-0.934	Pipe surcharged and depth within 1m	No
SMH17967	-0.503	Pipe surcharged and depth within 1m	Yes

Notes:
1. Manholes less than 1m deep are assumed to fail when the pipe becomes surcharged.
2. DSS failure only applies to standard manhole lid types with HGL < 1m fail. Sealed MH lids will need to be identified and checked on site to confirm status.

4.5 Future System Performance

Table 4-6 shows the change in system performance at different stages of the proposed development.

Table 4-6 Summary of PWWF Network Deficiencies adding Development to 2017 Network

MH Ref	2017 Existing	2017 with Stage 1A	2017 with all Stages
	Max Flood Depth (m)	Max Flood Depth (m)	Max Flood Depth (m)
SMH17007	-1.571	-1.571	-0.327
Louden SPS	-2.359	-2.266	-0.687
Louden O/F	No Spill	No Spill	Spill 1.57 L/s
SMH17018	-0.186	0.0 (Flooding)	0.0 (Flooding)
SMH17015	-0.660	-0.485	-0.483
SMH17335	-0.826	-0.818	-0.818
SMH17973	-0.358	-0.262	-0.262
SMH18040	-0.934	-0.935	-0.935
SMH17967	-0.503	-0.501	-0.501

Notes: Deficiencies highlighted in RED are sewer overflows to the environment

4.6 Options

This study investigates two options to provide connection into the existing sewer network:

- Option 1 - Augmentation/ upgrade of existing network
- Option 2 - Divert Trinder Park Rest Home into Pilbi Street SPS and Alfred Street SPS catchments

4.6.1 Option 1: Augmentation/ Upgrade of Existing Network

Figure 4-2 shows the augmentations required to the existing network to cater for proposed development loadings.

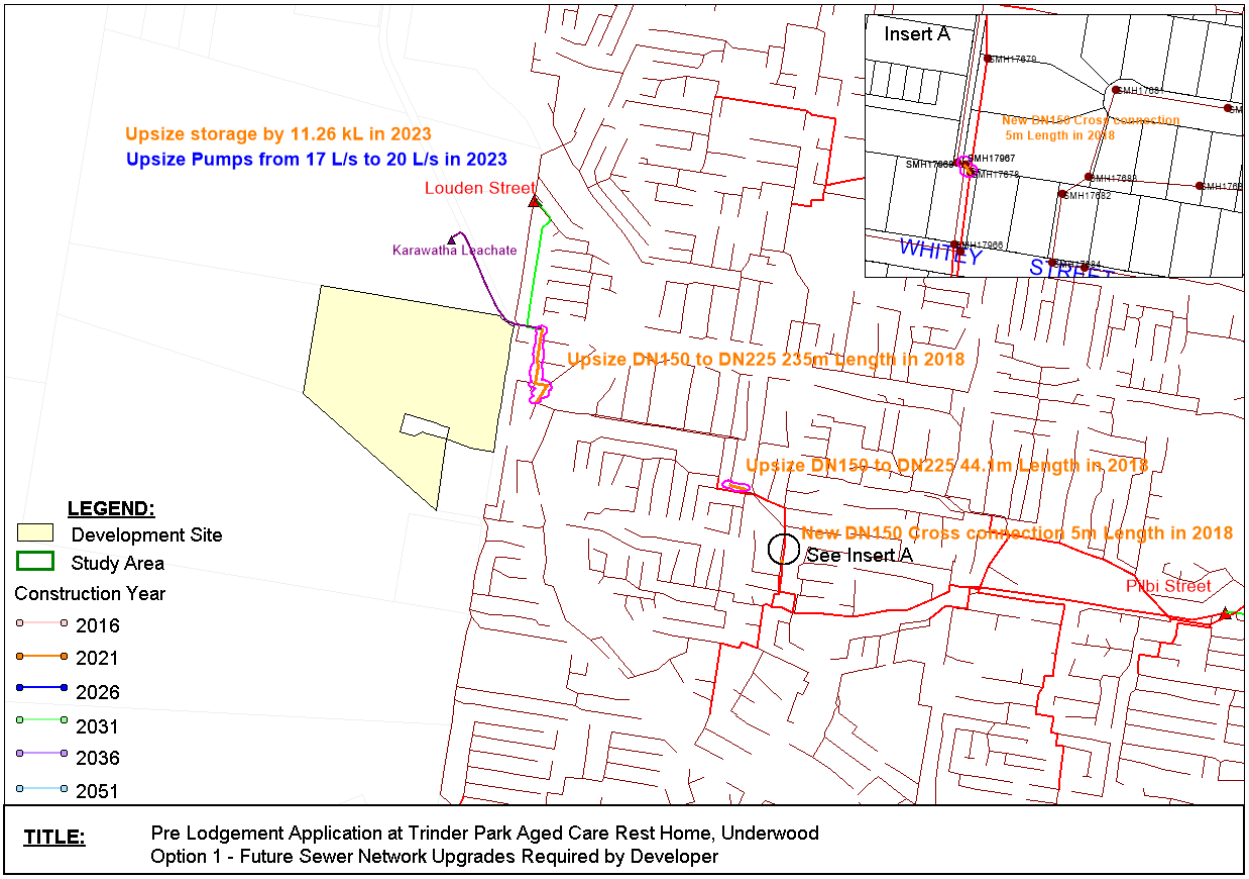


Figure 4-2: Option 1 Proposed Augmentation Works

4.6.2 Option 2: Divert Trinder Park Rest Home into Pilbi Street and Alfred Street SPS Catchments

Figure 4-3 shows the augmentations required to the existing network to cater for proposed development loadings.

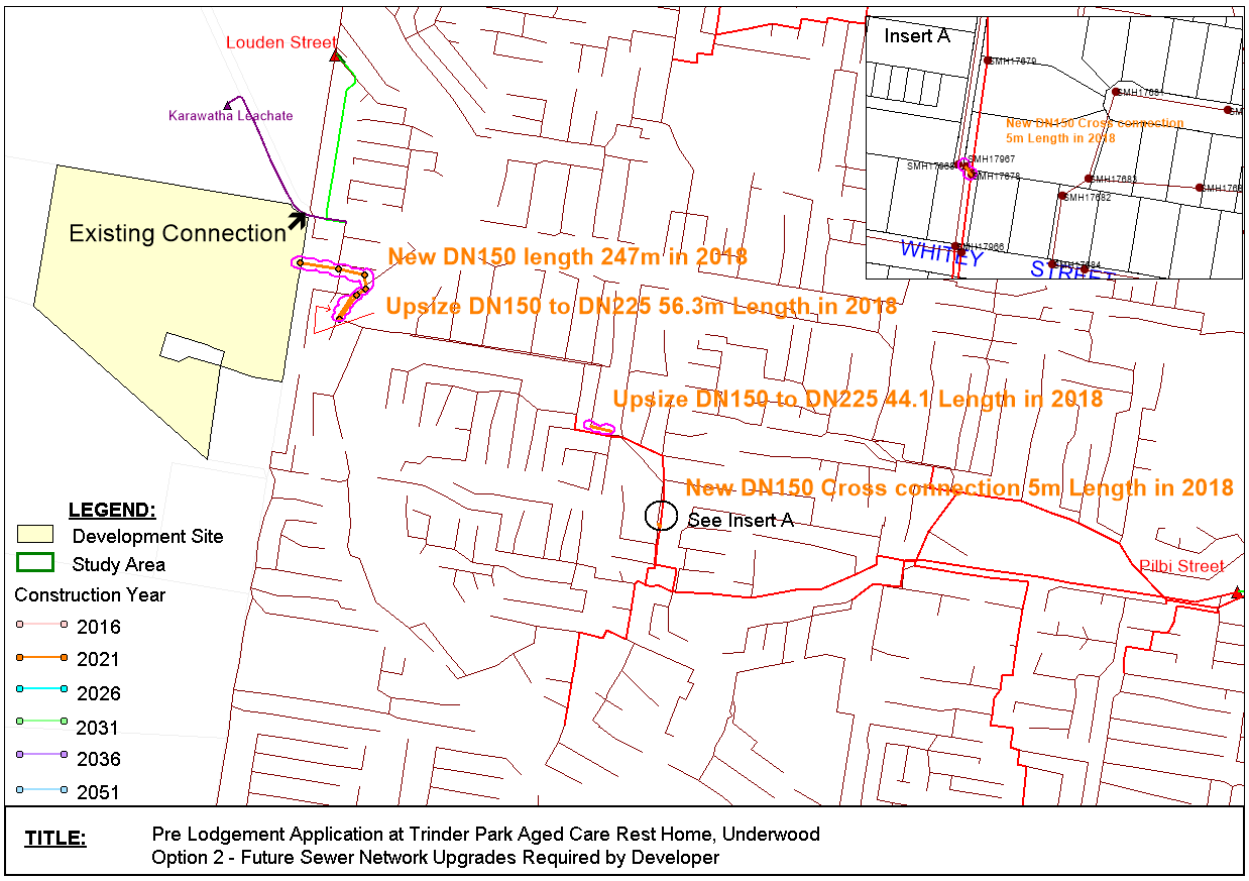


Figure 4-3: Option 2 Proposed Diversion Works

4.7 Costs

Cost estimates for Option 1 and Option 2 have been calculated using the adopted Infrastructure Planning Unit Rates (LWA 2014). These include full lifecycle costs including capital, operational and maintenance costs. Net present value (NPV) costs have applied inflation and discount rates over a nominal 60 year horizon.

The pump station costs only include new pumps for option 1 in 2023 as new pumps are proposed to be installed this financial year with a duty/assist pump rate of 14.65 L/s. The operation and maintenance costs have been ignored as there will be very minor cost difference between the two options.

Table 4-7 shows a summary of the capital and operational costs for options 1 and 2.

Table 4-7: Capital cost and NPV comparison (2017 base year costing)

Solution Description	OPTION 1 ($K)	OPTION 2 ($K)
CAPITAL COST & O-M Costs ($2017)		
Mains:	**255.6**	**265.4**
Gravity Main	205.7	265.4
Storage Pipes	50.0	0
Wastewater Pump Stations:	**323.3**	**0**
Miscellaneous Works:	**0**	**0**
Sub-total Capital Cost:	**578.9**	**265.4**
Operational & Maintenance Costs:		
Operational and maintenance	**0**	**0**
TOTAL:	**578.9**	**265.4**
Ranking	2	1
60 YEAR NET PRESENT VALUE ($2017)		
Mains:	**242.5**	**265.4**
Gravity Main	200.3	265.4
Storage Pipes	42.2	0
Wastewater Pump Stations:	**273.2**	**0**
Miscellaneous Works:	**0**	**0**
Sub-total Capital Cost:	**515.7**	**265.4**
Operational & Maintenance Costs:		
Operational and maintenance	**0**	**0**
TOTAL:	**515.7**	**265.4**
Ranking	2	1

5. Conclusion

This memorandum has investigated the proposed pre-lodgement application at Trinder Park Rest Home located at 10 Laurel Street, Woodridge. This existing aged care facility has 244.3 EP and is proposing to redevelop and expand the facility, in a number of stages, with an estimated population of 644 EP.

Water Analysis

The existing water supply network has adequate capacity to cater for the proposed development application loadings.

Sewer Analysis

Trinder Park development is located within Louden Street SPS catchment. This is almost fully developed and the proposed loadings from this application will result in extensive augmentation works, within and downstream, of Louden Street catchment. The following two options were analysed to determine augmentation works:

- Option 1: Augmentation / upsize of existing network
- Option 2: Diversion of Trinder Park Rest Home into Pibli Street SPS and Alfred Street SPS catchment

Both options have analysed three scenarios: existing 2017, Stage 1A and full development. The developer has not provided times for construction of each stage. Therefore, it has been assumed that the first and second stages will be completed in 2018 and 2023 respectively.

Option 1 keeps Trinder Park Rest Home connection point to the existing sewer network within Louden Street SPS catchment. The PWWF results found:

- Existing 2017 scenario (Trinder Park population = 244.3 EP)
  The existing 2017 sewer network currently fails to meet DSS criteria with the PWWF HGL water level within the 1m freeboard on Railway Parade, North Road and Whitey Street (located between Louden Street SPS and Pilbi Street SPS). The worst case is the discharge manhole for Louden Street SPS (SMH17018 freeboard 186mm). Also, the pumps at Louden are 41 years old and scheduled for replacement this financial year.

- 2018 scenario with development Stage 1A (Trinder Park population = 419.0 EP)
  The 2018 PWWF results shows the discharge manhole SMH17018 floods.

- 2023 scenario with all future development stages (Trinder Park population = 644.0 EP)
  The future stages consists of Stage 1B, 2, 3 and 4. The proposed development loadings will require the following additional upgrades at Louden Street SPS:
  - 11.26 kL additional emergency storage (extend DN1220 tank by 8m)
  - upsize the new pumps installed in 2017 from 17 L/s to 20 L/s.

Option 2 proposes to divert Trinder Park Rest Home connection point to a new location immediately upstream of the Queensland railway crossing. This option will require less augmentation works as this will reduce loadings to Louden Street SPS.

Option 2 includes the following works:

- Diversion of Trinder Park Rest Home site, via a new247m length DN150 main, to a new manhole located upstream of the Queensland railway sewer crossing (adjacent to SMH17422)
- Upsize DN150 main SGM17335 to DN225 of length 56.3m
- Upsize DN150 main SGM17973 to DN225 of length 44.1m
- New DN150 cross connection between SMH17967 and SMH17678

Table 5-1 summarises the two sewer options investigated using the Loganholme Master planning “static” models to service the proposed growth at Trinder Park Rest Home.

Table 5-1: Summary of Sewer Options

Option	Description	Capital Cost ($k)	Net Present Cost ($k)
1	Augment/Upgrade Existing Network	578.9	515.7
2	Divert Trinder Park Connection Point	265.4	265.4

6. Recommendations

It is recommended to:

- Recommend Option 2 as the preferred option
- Council’s Water Operations to survey Louden Street SPS wet well to obtain the latest SCADA 0% and 100% settings, incoming pipe invert level and top of benching.
- Reinvestigate the sewer network analysis using the ‘course’ calibrated model for Slacks Creek with improved information from 2017 flow monitoring data when this becomes available. This will need to assess whether the DN300 upgrade should proceed downstream of SMH17018.
- Request the developer to provide internal private reticulation drawings at Trinder Park Rest Home that are missing in Council records

_____

Ian McDonald
Senior Hydraulics Engineer

Appendix A Figures

A1 Existing Trinder Park Site Plan

A2 Trinder Park Rest Home Perspective 3D View

A3 Plan of Existing Services

A4 Proposed Augmentations in Loganholme Wastewater Master Planning (LWA, Task 90-12-54, April 2015)

A5 Revised Upgrades for Proposed Development at 72 Acacia Road, Karawatha Report (July 2015)

A6 Preferred Optimised Solution (1-year ARI) from Final Optimisation of Slacks Creek (LWA, Task 90-13-05, Sept 2015)

A7 Revised Optimised Solution for Final Optimisation of Slacks Creek (LoganWIA, Task PI-008, Apr 2016)

Figure A1 – Existing Trinder Park Site Plan

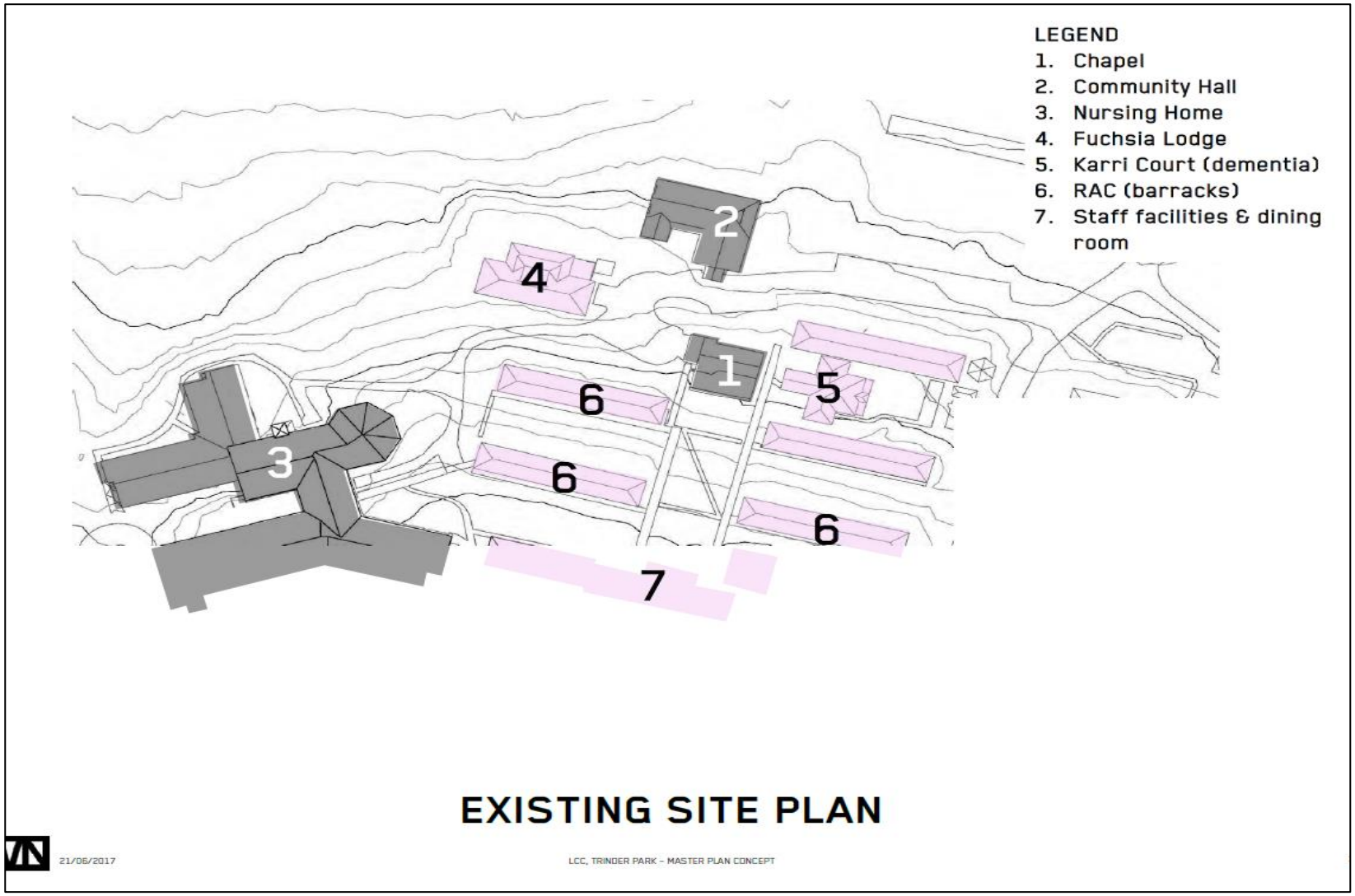


Figure A2 – Trinder Park Rest Home Perspective 3D View

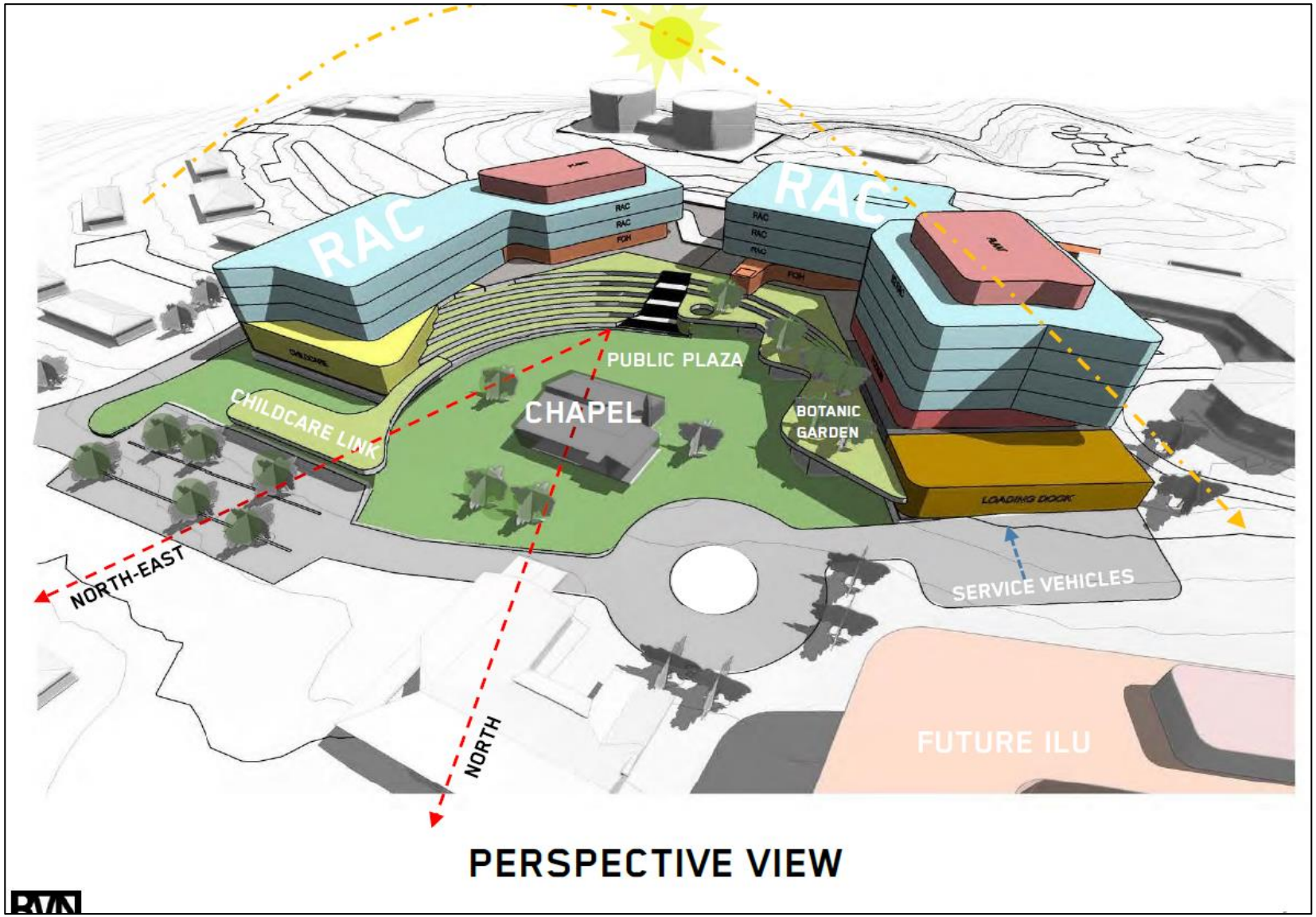


Figure A3 – Plan of Existing Services

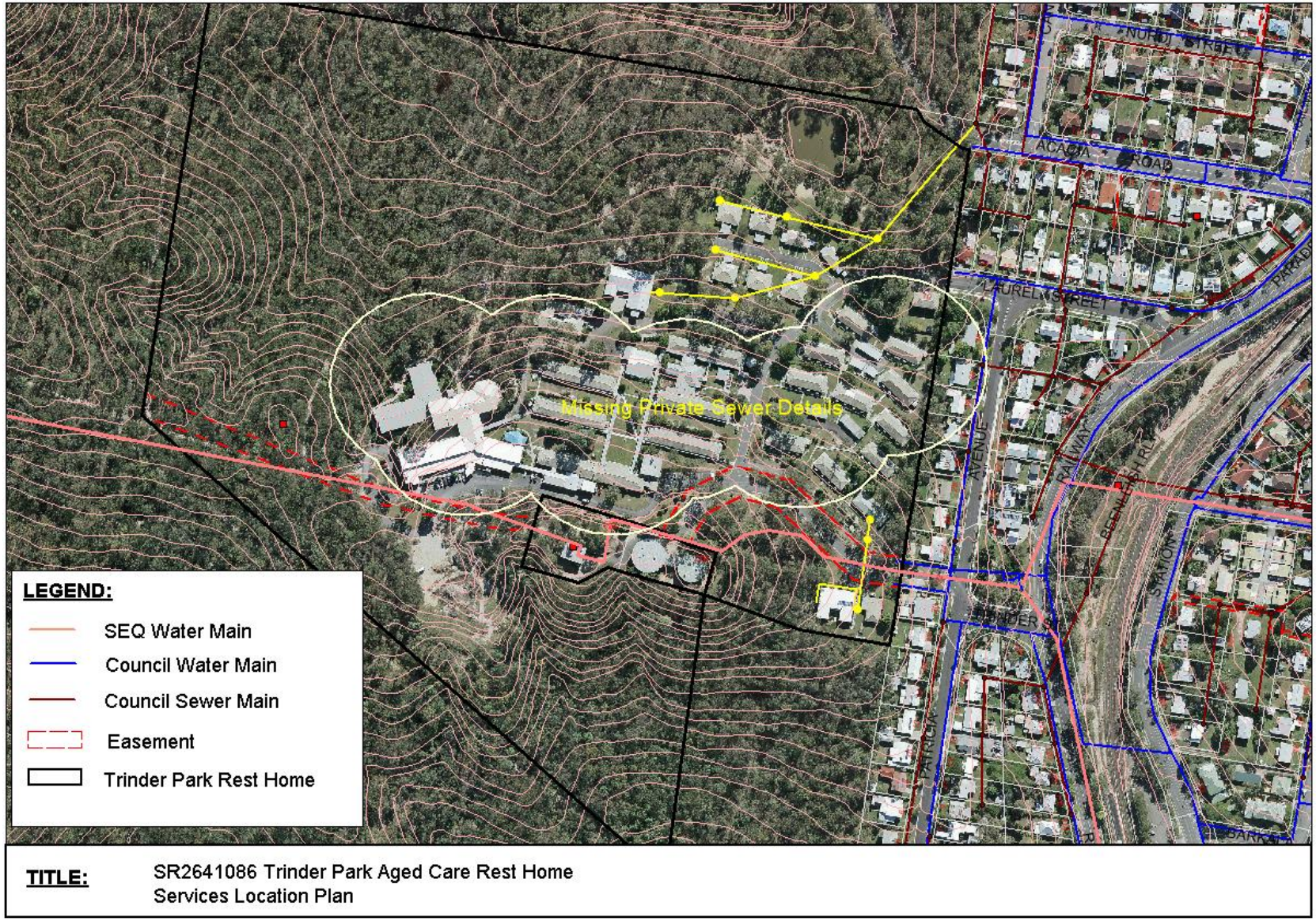


Figure A.4 Proposed Augmentations from Loganholme Wastewater Master Planning (LWA, Task 90-12-54, April 2015)

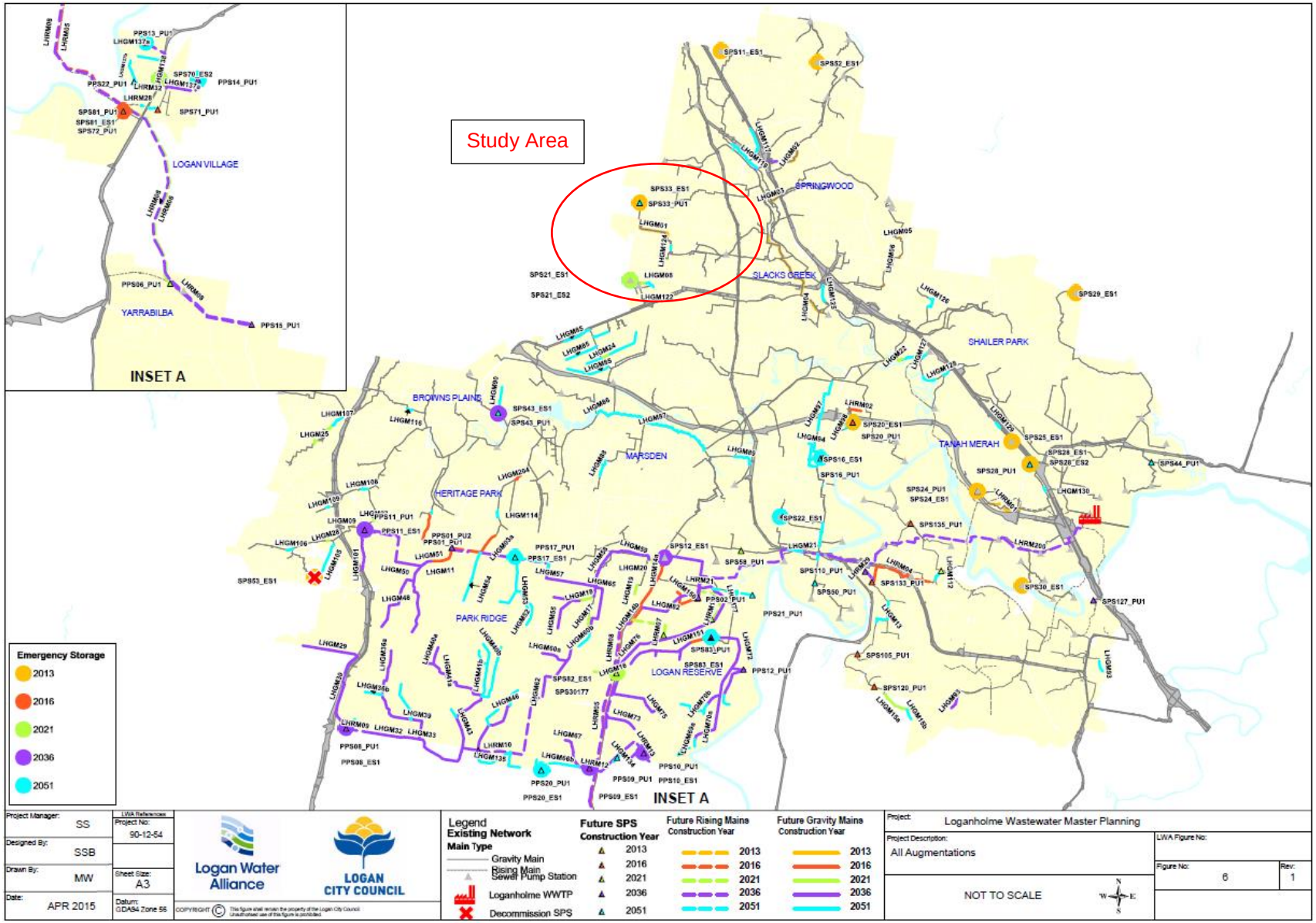


Figure A.5 Revised Upgrades for Proposed Development at 72 Acacia Road, Karawatha Report (July 2015)

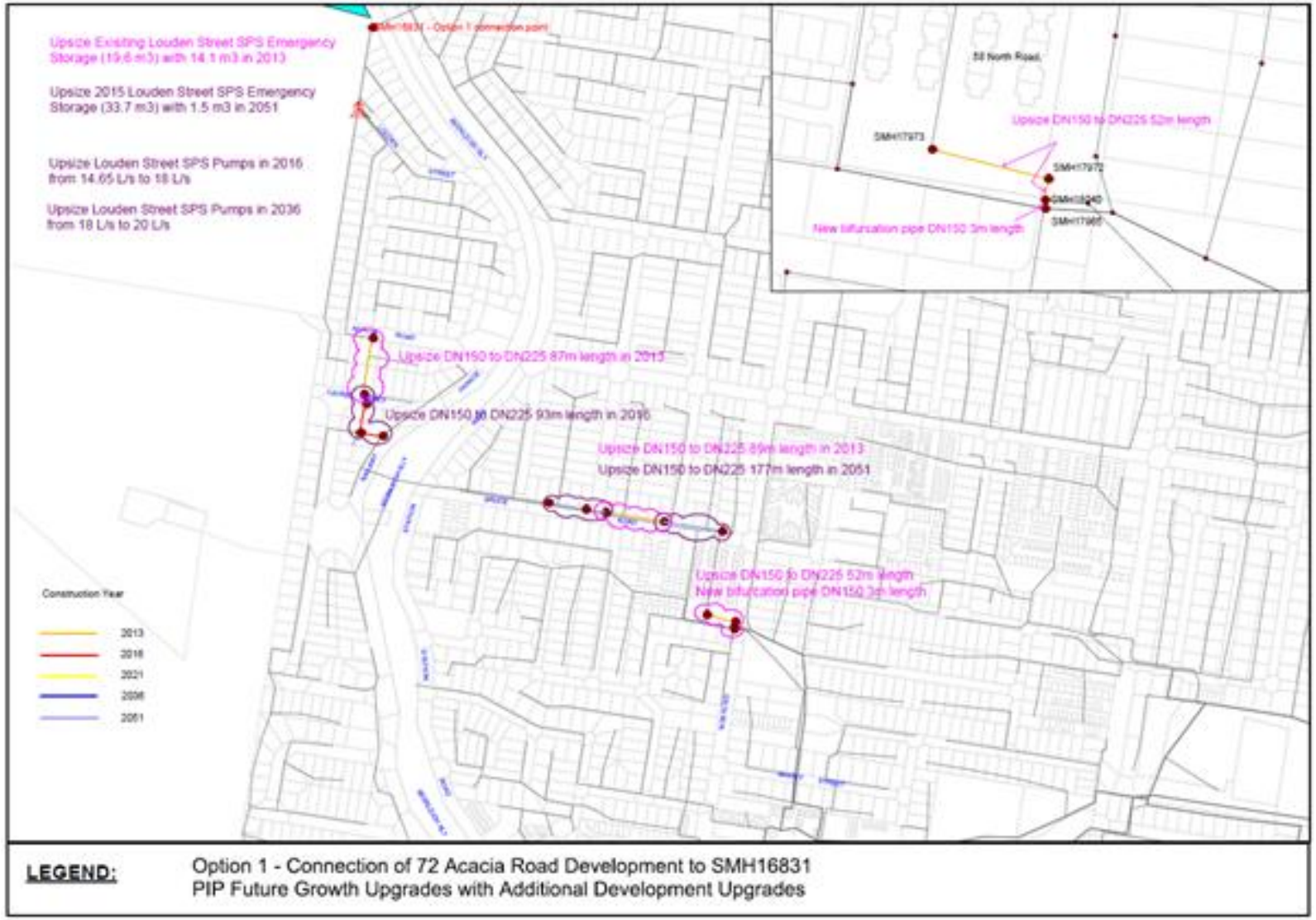


Figure A.6: Preferred Optimised Solution (1-year ARI) from Final Optimisation of Slacks Creek (LWA, Task 90-13-05, Sept 2015)

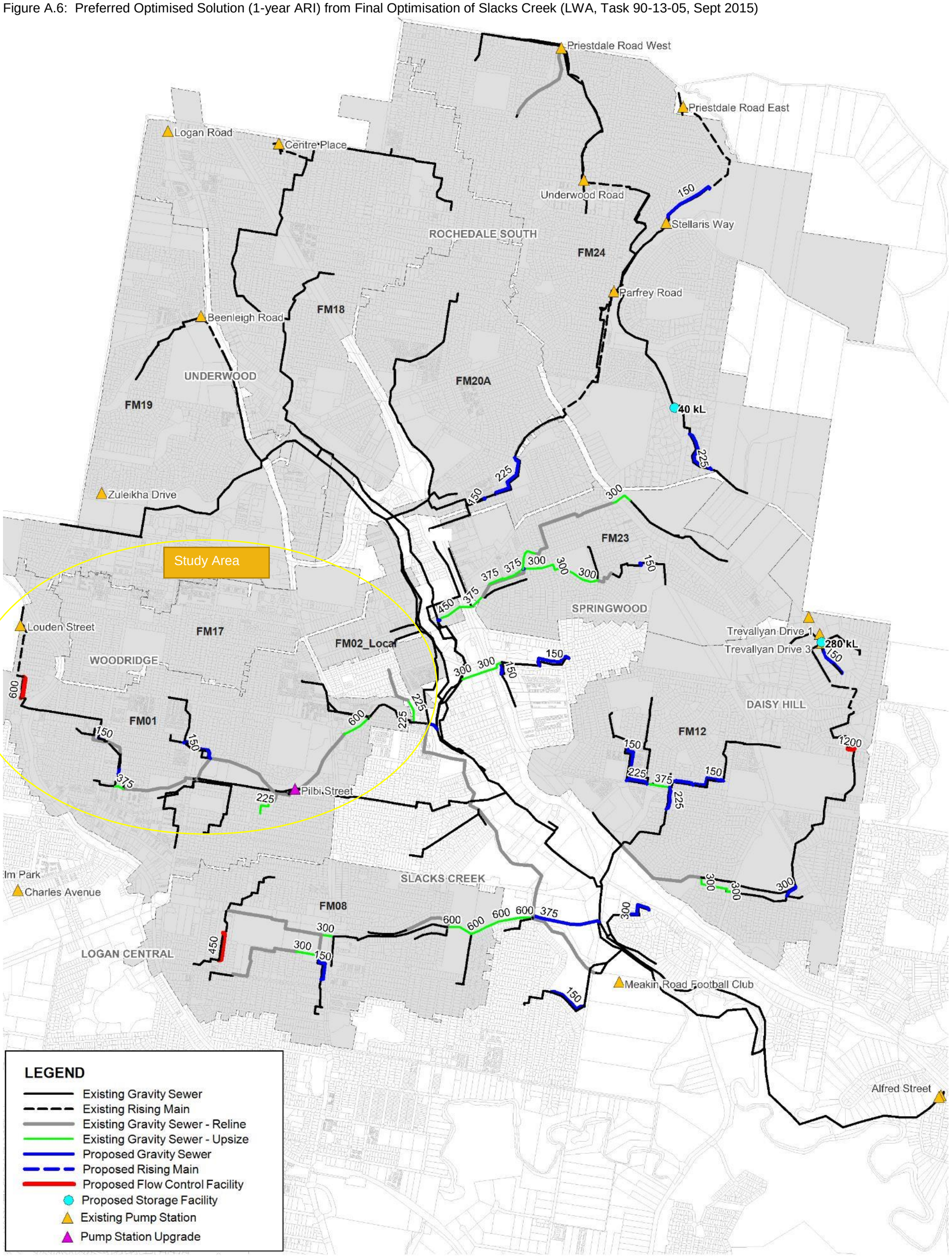
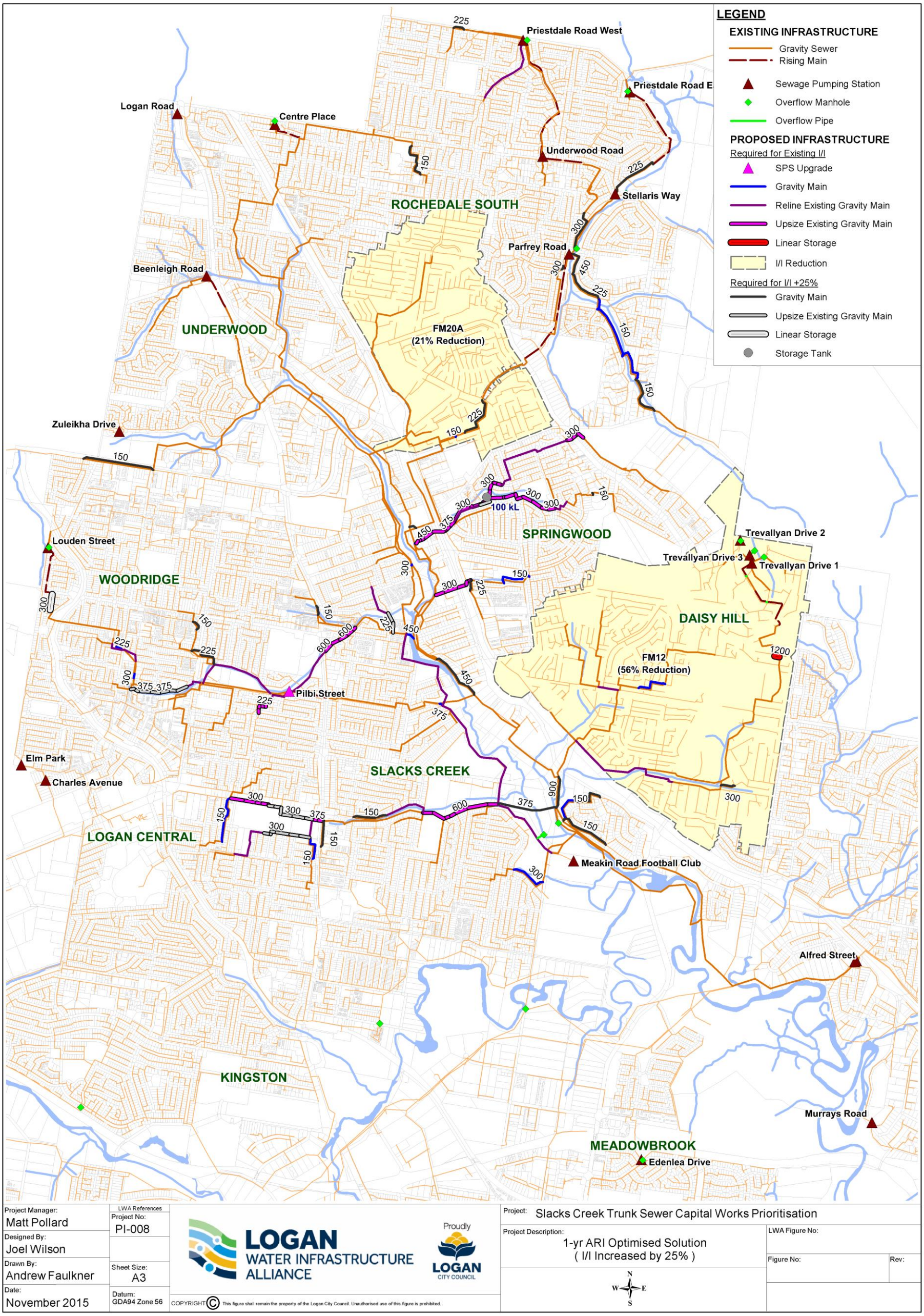
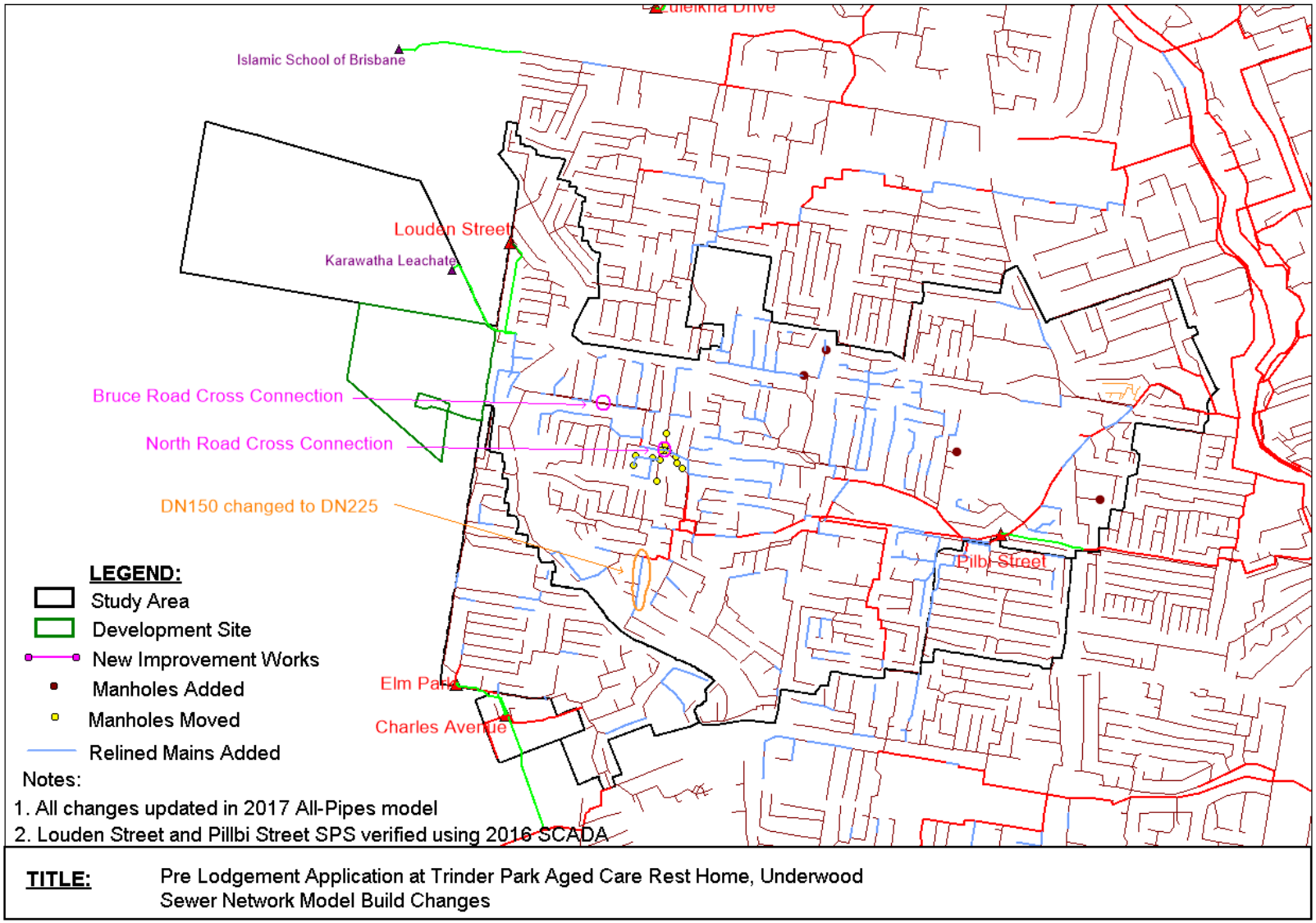


Figure A.7: Revised Optimised Solution for Final Optimisation of Slacks Creek (LoganWIA, Task PI-008, Apr 2016)



Appendix B Hydraulic Model Details

Figure B.1 Model Build Changes



Existing System Performance

The *Optimisation of the Slacks Creek Trunk Sewer Network Report* (LWA Task No. 90-13-05, September 2015) modelled the existing system performance with respect to the number of overflows and overflow volumes that occur during the 6-month, 1-year, 2-year and 5-year ARI design storms. **Error! Reference s ource not found.** shows that the overflows are wide spread, although the highest volume overflows are clustered around the central portion of the network, on the western side of Slacks Creek.

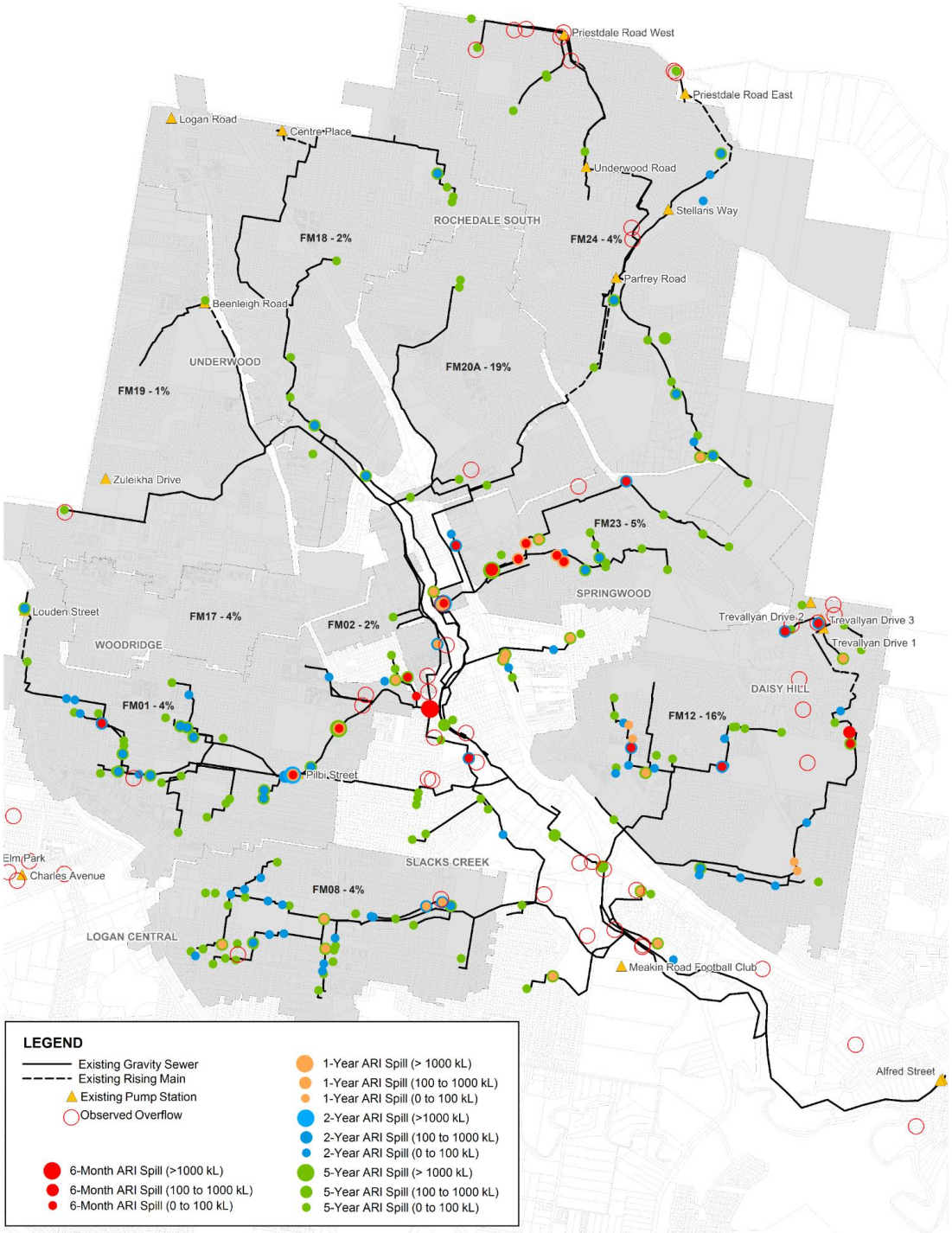


Figure B2: Model Overflow Locations (Slacks Creek Optimisation Report, Sept 2015)

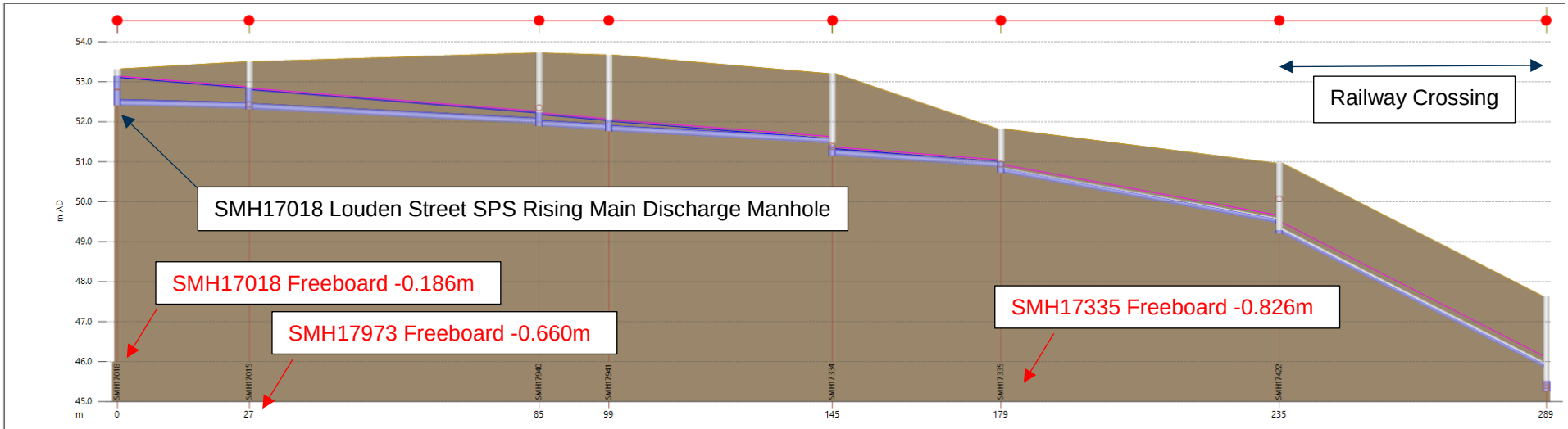
Figure B.3 Plan of 2017 PWWF Model Results with Identified Deficiencies



LOGAN WATER INFRASTRUCTURE ALLIANCE

Proudly LOGAN CITY COUNCIL

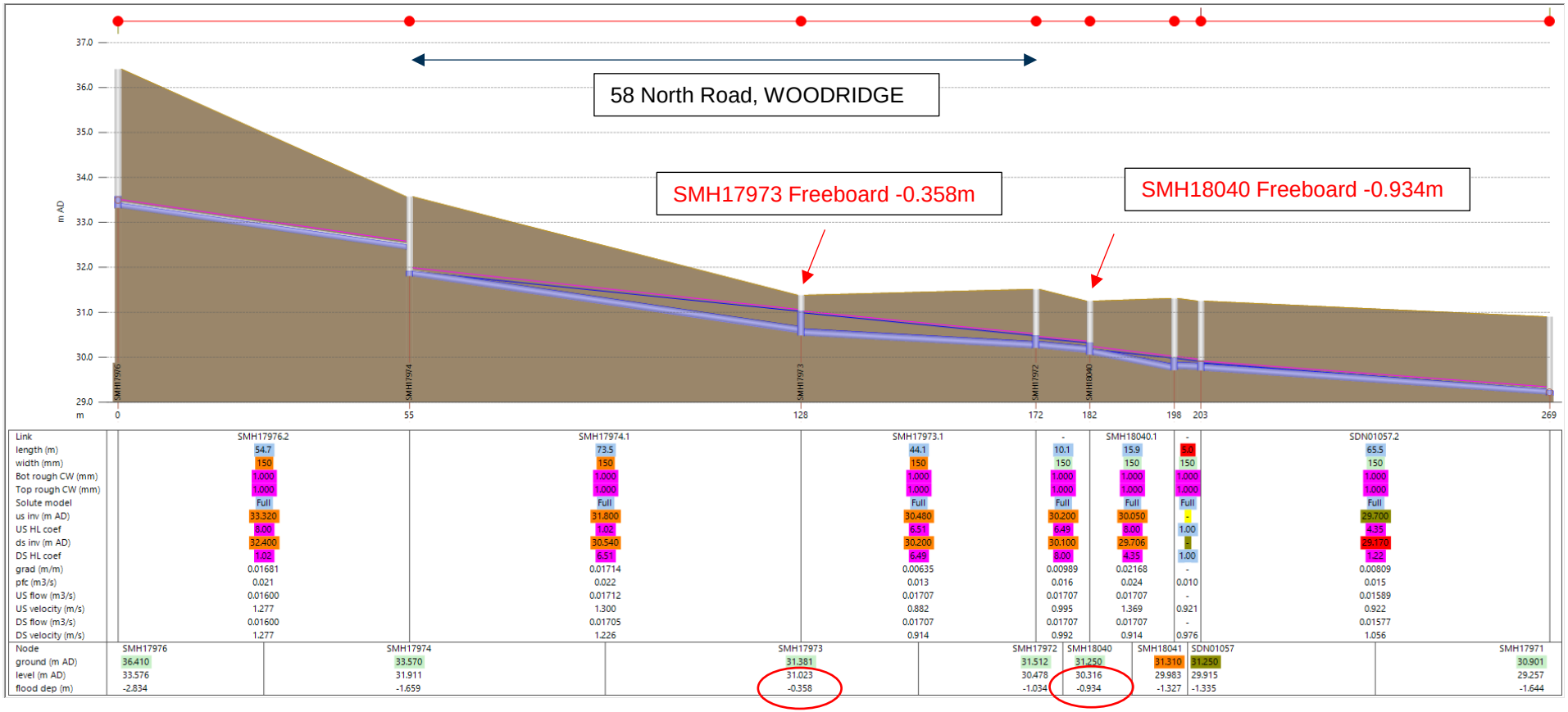
Figure B.4 Longitudinal Section 1 of 2017 PWWF Model Results with Identified Deficiencies



Link	SMH17018.1	SMH17015.1	SMH17940.1	SMH17941.1	SMH17334.1	SMH17335.1	SMH17422.1
length (m)	26.7	58.6	14.1	45.2	34.1	56.3	54.0
width (mm)	142	142	142	142	142	142	150
Bot rough CW (mm)	0.600	0.600	0.600	0.600	0.600	0.600	1.000
Top rough CW (mm)	0.600	0.600	0.600	0.600	0.600	0.600	1.000
Solute model	Full	Full	Full	Full	Full	Full	Full
us inv (m AD)	52.410	52.310	51.890	51.760	51.150	50.720	49.201
US HL coef	6.52	8.00	8.00	2.93	8.00	8.00	8.00
ds inv (m AD)	52.330	51.950	51.790	51.460	50.870	49.470	45.870
DS HL coef	1.15	2.81	2.93	8.00	8.00	8.00	1.76
grad (m/m)	0.00300	0.00614	0.00709	0.00664	0.00821	0.02220	0.06163
pfc (m3/s)	0.008	0.012	0.013	0.012	0.014	0.023	0.041
US flow (m3/s)	0.01473	0.01466	0.01473	0.01473	0.01501	0.01526	0.01543
US velocity (m/s)	1.053	0.897	0.928	0.882	0.970	1.475	2.015
DS flow (m3/s)	0.01470	0.01462	0.01473	0.01471	0.01494	0.01525	0.01543
DS velocity (m/s)	1.015	0.987	1.013	1.067	1.003	1.474	2.015

Node	SMH17018	SMH17015	SMH17940	SMH17941	SMH17334	SMH17335	SMH17422	SMH17336
ground (m AD)	53.320	53.500	53.720	53.670	49.201	51.820	50.960	47.630
level (m AD)	53.134	52.840	52.224	52.035	51.400	50.994	49.270	45.507
flood dep (m)	-0.186	-0.660	-1.496	-1.635	-1.801	-0.826	-1.690	-2.123

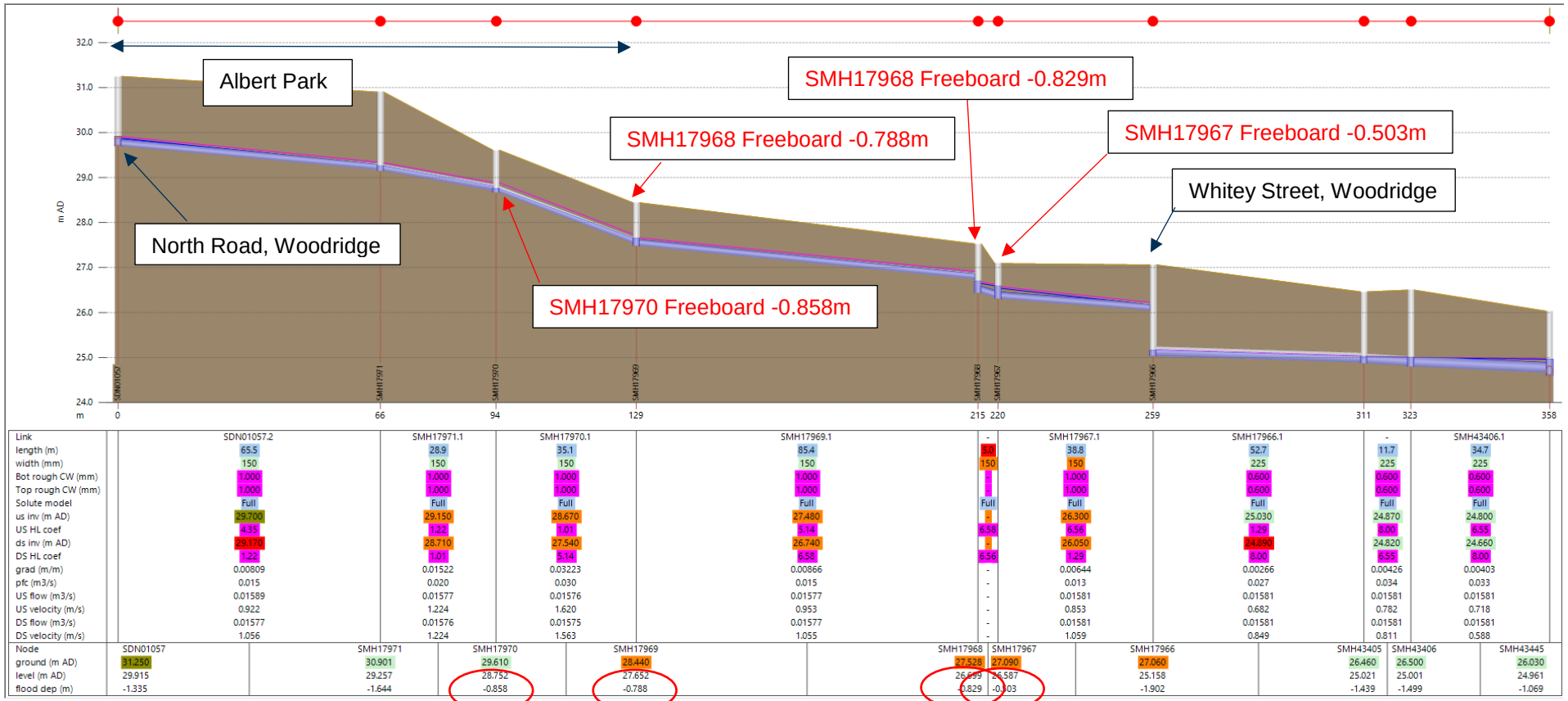
Figure B.5 Longitudinal Section 2 of 2017 PWWF Model Results with Identified Deficiencies



Link	SMH17976.2	SMH17974.1	SMH17973.1	-	SMH18040.1	-	SDN01057.2
length (m)	54.7	73.5	44.1	10.1	15.9	5.0	65.5
width (mm)	150	150	150	150	150	150	150
Bot rough CW (mm)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Top rough CW (mm)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Solute model	Full	Full	Full	Full	Full	Full	Full
us inv (m AD)	33.320	31.800	30.480	30.200	30.050	-	29.700
US HL coef	8.00	1.02	6.51	6.49	8.00	1.00	4.35
ds inv (m AD)	32.400	30.540	30.200	30.100	29.706	-	29.170
DS HL coef	1.02	6.51	6.49	8.00	4.35	1.00	1.22
grad (m/m)	0.01681	0.01714	0.00635	0.00989	0.02168	-	0.00809
pfc (m3/s)	0.021	0.022	0.013	0.016	0.024	0.010	0.015
US flow (m3/s)	0.01600	0.01712	0.01707	0.01707	0.01707	-	0.01589
US velocity (m/s)	1.277	1.300	0.882	0.995	1.369	0.921	0.922
DS flow (m3/s)	0.01600	0.01705	0.01707	0.01707	0.01707	-	0.01577
DS velocity (m/s)	1.277	1.226	0.914	0.992	0.914	0.976	1.056

Node	SMH17976	SMH17974	SMH17973	SMH17972	SMH18040	SMH18041	SDN01057	SMH17971
ground (m AD)	36.410	33.570	31.381	31.512	31.250	31.310	31.250	30.901
level (m AD)	33.576	31.911	31.023	30.478	30.316	29.983	29.915	29.257
flood dep (m)	-2.834	-1.659	-0.358	-1.034	-0.934	-1.327	-1.335	-1.644

Figure B.6 Longitudinal Section 3 of 2017 PWWF Model Results with Identified Deficiencies



Link	SDN01057.2	SMH17971.1	SMH17970.1	SMH17969.1	-	SMH17967.1	SMH17966.1	-	SMH43406.1
length (m)	65.5	28.9	35.1	85.4	5.0	38.8	52.7	11.7	34.7
width (mm)	150	150	150	150	150	150	225	225	225
Bot rough CW (mm)	1.000	1.000	1.000	1.000	-	1.000	0.600	0.600	0.600
Top rough CW (mm)	1.000	1.000	1.000	1.000	-	1.000	0.600	0.600	0.600
Solute model	Full	Full	Full	Full	Full	Full	Full	Full	Full
us inv (m AD)	29.700	29.150	28.670	27.480	-	26.300	25.030	24.870	24.800
US HL coef	4.35	1.22	1.01	5.14	6.58	6.56	1.29	8.00	6.55
ds inv (m AD)	29.170	28.710	27.540	26.740	-	26.050	24.890	24.820	24.660
DS HL coef	1.22	1.01	5.14	6.58	6.56	1.29	8.00	6.55	8.00
grad (m/m)	0.00809	0.01522	0.03223	0.00866	-	0.00644	0.00266	0.00426	0.00403
pfc (m3/s)	0.015	0.020	0.030	0.015	-	0.013	0.027	0.034	0.033
US flow (m3/s)	0.01589	0.01577	0.01576	0.01577	-	0.01581	0.01581	0.01581	0.01581
US velocity (m/s)	0.922	1.224	1.620	0.953	-	0.853	0.682	0.782	0.718
DS flow (m3/s)	0.01577	0.01576	0.01575	0.01577	-	0.01581	0.01581	0.01581	0.01581
DS velocity (m/s)	1.056	1.224	1.563	1.055	-	1.059	0.849	0.811	0.588

Node	SDN01057	SMH17971	SMH17970	SMH17969	SMH17968	SMH17967	SMH17966	SMH43405	SMH43406	SMH43445
ground (m AD)	31.250	30.901	29.610	28.440	27.528	27.090	27.060	26.460	26.500	26.030
level (m AD)	29.915	29.257	28.752	27.652	26.699	26.587	25.158	25.021	25.001	24.961
flood dep (m)	-1.335	-1.644	-0.858	-0.788	0.829	-0.503	-1.902	-1.439	-1.499	-1.069

Appendix C As-Constructed Drawings

SLACKS CREEK GRAVITY NETWORK AUGMENTATION

WP015-05 - NORTH ROAD AND BRUCE ROAD, WOODRIDGE

LoganWIA DRAWINGS

DRAWING NO#	TITLE
WP015-05-S-DWG-ND-0000	COVER SHEET, LOCALITY PLAN AND DRAWING LIST
WP015-05-S-DWG-CI-2000	NORTH ROAD, WOODRIDGE, SEWER MAINTENANCE HOLE, PLAN AND TYPICAL DETAILS
WP015-05-S-DWG-CI-2010	BRUCE ROAD, WOODRIDGE, SEWER GRAVITY MAIN, PLAN AND TYPICAL DETAILS

LoganWIA - GENERAL DRAWING SET

DRAWING No	TITLE
WP015-00-S-DWG-ND-0000	COVER SHEET AND DRAWING LIST
WP015-00-S-DWG-ND-0020	GENERAL NOTES, SHEET 1 OF 2
WP015-00-S-DWG-ND-0021	GENERAL NOTES, SHEET 2 OF 2
WP015-00-S-DWG-ND-0022	TRENCHLESS NOTES
WP015-00-S-DWG-ND-0030	LEGEND
WP015-00-S-DWG-ND-0040	STRUCTURAL NOTES
WP015-00-S-DWG-ND-0050	TYPICAL TRENCH DETAILS
WP015-00-S-DWG-ND-0060	PROPOSED LAYDOWN AREA
WP015-00-S-DWG-ND-0070	TYPICAL LARGE INTERNALLY LINED MAINTENANCE HOLE DETAILS
WP015-00-S-DWG-ND-0071	TYPICAL MAINTENANCE STRUCTURE DETAILS ON EXISTING GRAVITY SEWER

SEQ CODE - STANDARD DRAWINGS

DRAWING NO#	TITLE
SEQ-SEW-1300-1	MAINTENANCE HOLES ≤DN300 SEWER TYPES P1, P2 & P3 TYPICAL PRE-CAST
SEQ-SEW-1301-1	CAST IN-SITU MAINTENANCE HOLE TYPICAL COPING & ANCHOR BRACKET DETAILS
SEQ-SEW-1313-1	MAINTENANCE HOLE SEWER CONNECTION DETAILS ALL PIPE MATERIALS
SEQ-SEW-1302-1	MAINTENANCE HOLES CAST IN-SITU AND PRE CAST TYPICAL PIPE CONNECTION DETAILS
SEQ-SEW-1305-1	MAINTENANCE HOLE TYPICAL CHANNEL DETAILS

SITE SPECIFIC NOTES

1. FOR GENERAL NOTES REFER TO DWG WP015-00-S-DWG-ND-0020 & 0021.
2. FOR INDICATIVE FLOW RATES REFER TO INDICATIVE FLOW RATES TABLE ON DWG CI-2000 & 2010.



LOCALITY PLAN
N.T.S.

FOR CONSTRUCTION

COPYRIGHT © THIS DRAWING SHALL REMAIN THE PROPERTY OF LOGAN CITY COUNCIL. UNAUTHORISED USE OF THIS DRAWING IS PROHIBITED.

REV. No.	DESCRIPTION	DRAWN	DESIGNED	APPR.	DATE
0	ISSUED FOR CONSTRUCTION	RZ	SH	AH	16/05/16

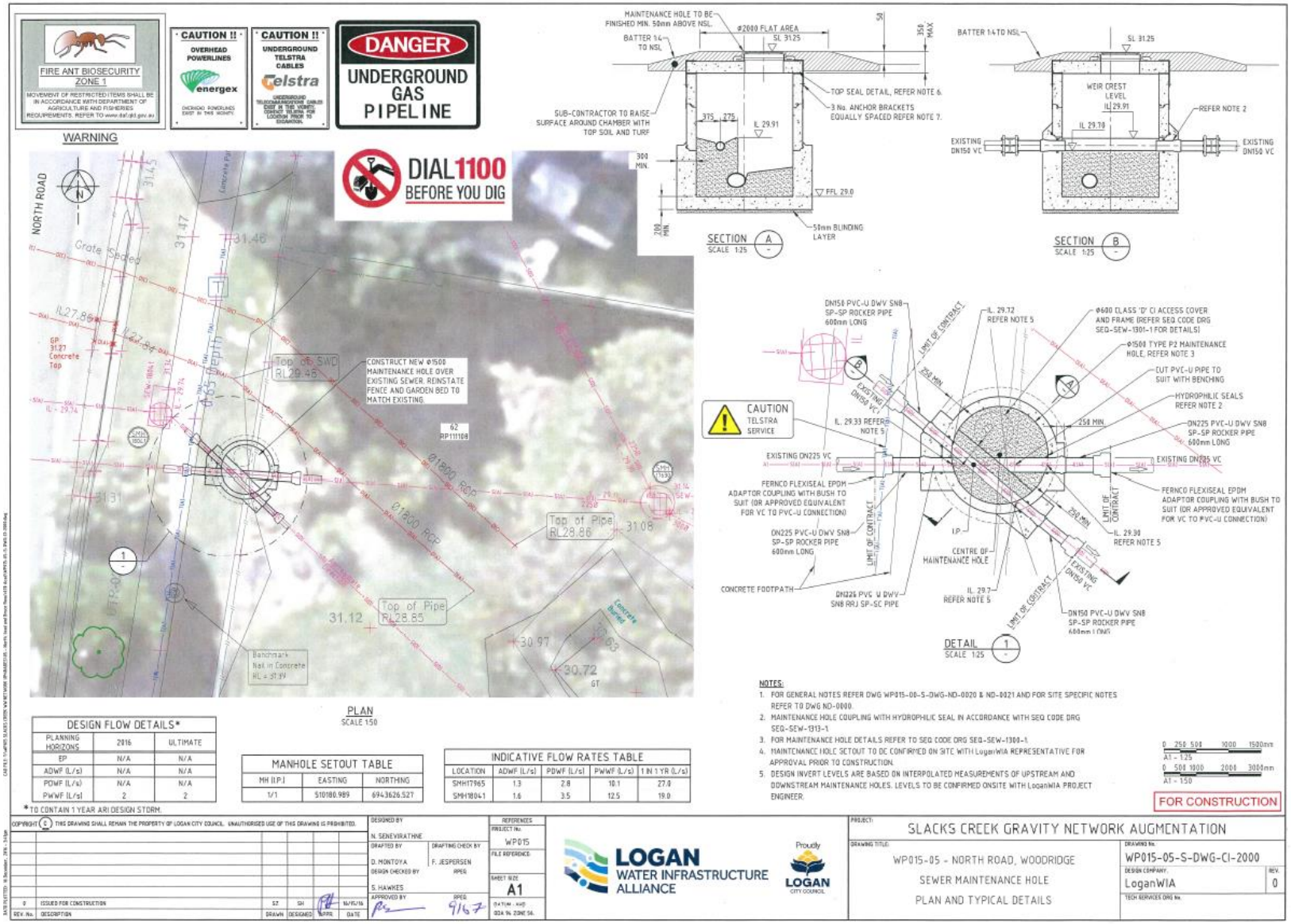
DESIGNED BY: N. SENEVIRATHNE
DRAFTED BY: G. MEJAK
DRAFTING CHECK BY: F. JESPERSEN
DESIGN CHECKED BY: RPEQ
S. HAWKES
APPROVED BY: RPEQ 9907

REFERENCES
PROJECT No.: WP015
FILE REFERENCE:
SHEET SIZE: A1
DATUM - AHD / GDA 94 ZONE 56

LOGAN WATER INFRASTRUCTURE ALLIANCE
Proudly LOGAN CITY COUNCIL

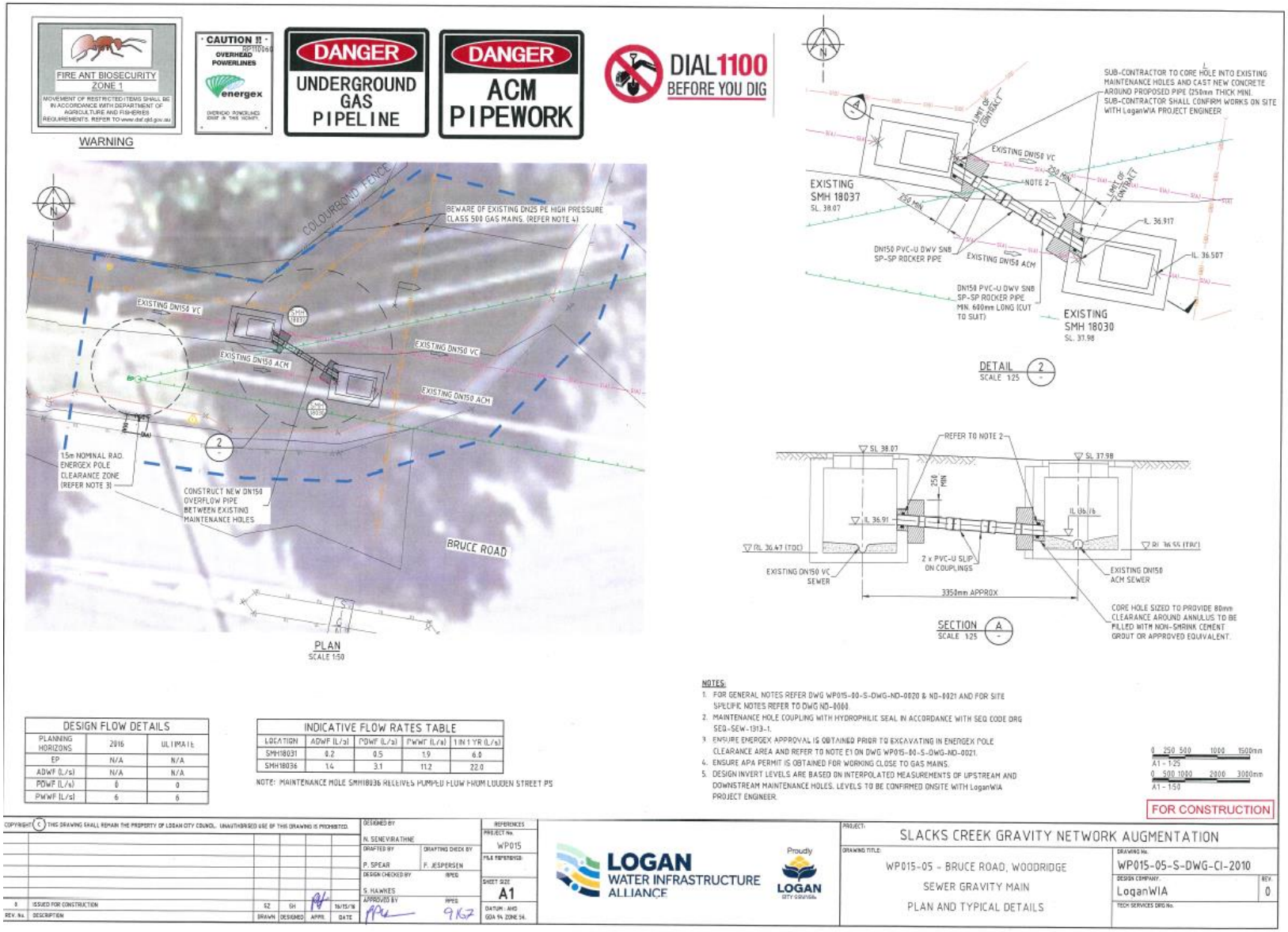
PROJECT: SLACKS CREEK GRAVITY NETWORK AUGMENTATION
DRAWING TITLE: WP015-05 - NORTH RD AND BRUCE RD, WOODRIDGE
COVER SHEET, LOCALITY PLAN AND DRAWING LIST
DRAWING No.: WP015-05-S-DWG-ND-0000
DESIGN COMPANY: LoganWIA
REV.: 0
TECH SERVICES DRG No.:

LOGAN WATER INFRASTRUCTURE ALLIANCE
Proudly LOGAN CITY COUNCIL



LOGAN WATER INFRASTRUCTURE ALLIANCE

Proudly LOGAN CITY COUNCIL



LOGAN WATER INFRASTRUCTURE ALLIANCE

Proudly LOGAN CITY COUNCIL



evelopment & Expansion

David Hamlyn-Harris
Principal Consultant Water and Environment

BLIGH TANNER

david.hamlyn-harris@blightanner.com.au
Direct 07 3251 8507
Mobile 0412 497 337
Office 07 3251 8555

ISO9001 Quality Approved JAS-ANZ

From: He, Sarah [mailto:SarahHe@logan.qld.gov.au]
Sent: Wednesday, 18 October 2017 3:17 PM
To: David Hamlyn-Harris <David.hamlyn-harris@blightanner.com.au>
Subject: FW: NFAR: RE: Trinder Park Aged Care Redevelopment & Expansion

Hi David

Please find the discussion as below between our Senior Engineer – **Anthony Morris** and Logan Water Alliance where the analysis has been carried out. If you have any further questions regarding the analysis in the report that I sent to you previously, **Ian McDonald** might be the best one to talk to and may give you a help to explain any details shown in the report.

Kind Regards

Sarah He | Development Services Engineer | Water Infrastructure Branch | **Logan City Council**
Phone: 07 3412 4697 | PO Box 3226 Logan City DC Qld 4114 | sarahhe@logan.qld.gov.au
www.logan.qld.gov.au | facebook.com/logancitycouncil | twitter.com/logancc

City of Logan: Innovative, Dynamic, City of the Future

From: Morris, Anthony
Sent: Thursday, 21 September 2017 5:22 PM

To: McDonald, Ian <IanMcDonald@logan.qld.gov.au>
Cc: WaterDA <WaterDA@logan.qld.gov.au>; O'Brien, Daniel <DanielO'Brien@logan.qld.gov.au>; He, Sarah <SarahHe@logan.qld.gov.au>; Moorthy, Vijaya <VijayaMoorthy@logan.qld.gov.au>
Subject: NFAR: RE: Trinder Park Aged Care Redevelopment & Expansion

Thanks Ian

Confirming our discussion, we will advise customer that there are no changes to recommendations even with reduced demands. No further action required. Thank you.

Regards

Anthony Morris | Senior Water Development Services Engineer | **Logan City Council**
Phone: 07 3412 5695 | PO Box 3226 Logan City DC Qld 4114 | anthonymorris@logan.qld.gov.au
www.logan.qld.gov.au | facebook.com/logancitycouncil | twitter.com/logancc

City of Logan: Innovative, Dynamic, City of the Future

From: McDonald, Ian
Sent: Thursday, 21 September 2017 12:49 PM
To: Morris, Anthony <AnthonyMorris@logan.qld.gov.au>
Cc: WaterDA <WaterDA@logan.qld.gov.au>; O'Brien, Daniel <DanielO'Brien@logan.qld.gov.au>; He, Sarah <SarahHe@logan.qld.gov.au>; Moorthy, Vijaya <VijayaMoorthy@logan.qld.gov.au>
Subject: RE: Trinder Park Aged Care Redevelopment & Expansion

Anthony,

The existing 2017 scenario fails to meet DSS criteria at a number of locations. There is no spare capacity.
Table 4-5 in the report shows the HGL freeboard at SMH17018 is 0.186m < 1.0m
Note, the analysis for this report was undertaken using a static model using 1300 L/EP/d.

If you want to use the 'course' calibrated model then this will require a new WDS request as the current job number is full ($6950 < $7,000) and now closed.
This "course" calibrated model has been prepared by Matt Pollard, Simon Hawkes and Optimatics – I think Simon has the latest model but there is no copy in the file register library.

The work would require the following:

- Insert new Louden Street SPS pumps. However, the tender process has still not been finalised and we would request not proceeding until commission tests carried out
- Determine Louden Street SCADA 0% and 100% settings and wet well internal details
- Undertake model updates such as relined pipes and recent network improvements
- The Woodridge model calibration process has not started. As part of this task analysis, some parts of the catchment would need to be carried out prior to study: i.e. calibrate the model between Louden Street and the Slacks Creek Trunk Main
- Recalculate emergency storage details.

Without seeing the "course" calibrated model it is difficult to estimate time required for analysis. I would think the analysis would take a few weeks analysis –beyond the scope of WDS service request.

As a side issue – have we obtained the internal private sewer details at Trinder ParkRest Home?

Regards,

Ian McDonald

From: Morris, Anthony
Sent: Thursday, 21 September 2017 11:25 AM
To: Shah, Purvi <PurviShah@logan.qld.gov.au>
Cc: McDonald, Ian <IanMcDonald@logan.qld.gov.au>; WaterDA <WaterDA@logan.qld.gov.au>; O'Brien, Daniel <DanielO'Brien@logan.qld.gov.au>; He, Sarah <SarahHe@logan.qld.gov.au>
Subject: FW: Trinder Park Aged Care Redevelopment & Expansion

Purvi,

This correspondence relates to PI-151-07 and your Tech Memo dated 21/08/2017. The applicant is proposing to reduce the demands and hoping to defer infrastructure augmentations.

Can you please have a quick review and let me know your thoughts, including how much work is involved for you and whether we need to discuss a variation.

Regards

Anthony Morris | Senior Water Development Services Engineer | **Logan City Council**
Phone: 07 3412 5695 | PO Box 3226 Logan City DC Qld 4114 | anthonymorris@logan.qld.gov.au
www.logan.qld.gov.au | facebook.com/logancitycouncil | twitter.com/logancc

City of Logan: Innovative, Dynamic, City of the Future

From: He, Sarah
Sent: Tuesday, 19 September 2017 3:18 PM
To: WaterDA <WaterDA@logan.qld.gov.au>
Subject: FW: Trinder Park Aged Care Redevelopment & Expansion

Water DA:

I'll be away for the rest of the week and now still having two more urgent OP works application to finalise by COB today. Could you please forward to Anthony for advice to the customer? Thanks.

Regards

Sarah He | Development Services Engineer | Water Infrastructure Branch | **Logan City Council**
Phone: 07 3412 4697 | PO Box 3226 Logan City DC Qld 4114 | sarahhe@logan.qld.gov.au
www.logan.qld.gov.au | facebook.com/logancitycouncil | twitter.com/logancc

City of Logan: Innovative, Dynamic, City of the Future

From: David Hamlyn-Harris [mailto:David.hamlyn-harris@blightanner.com.au]
Sent: Tuesday, 19 September 2017 2:55 PM
To: He, Sarah <SarahHe@logan.qld.gov.au>
Subject: RE: Trinder Park Aged Care Redevelopment & Expansion

Sarah

Thank you for your email of 25 August with the attached water and sewerage advice from Logan Water.

The proponent has completed a review of the scale and timing of the development, which has slightly reduced the long-term proposed EP on the site, and clarified the timing of the various stages of development. The revised development details are shown on the attached spreadsheet and summarised below:



Development Stage	Cumulative Development (EP)		Anticipated Completion Timing
	Previous Estimate	Revised Estimate	
Existing	244	244	Existing
Stage 1a	285	238	Progressive demolition and construction between approx. 2019 and 2021
Stage 1b	419	323	
Future	644	599	Not known

(Note that the Stage 1A EP is actually lower than the existing because the number of beds demolished is greater than the number of new beds created. As existing buildings must be demolished to allow the new construction, the total number of beds will initially reduce below the current level and only increase as Stage 2B develops.)

Sewerage

In the light of these revised numbers, can we please request a review of the previous Logan Water advice regarding the need for augmentation of the sewerage collection system as follows:

- Confirmation that the Stage 1A development will not trigger any sewerage upgrades.
- Whether the revised Stage 1B development will trigger the sewerage upgrades and to what extent.
- The impact on the sewerage augmentation requirement of the reduced future EP load.

Water Supply

In addition to the above, can we request clarification regarding Logan Water's requirements for metering of fire services, whether as a separate fire main or a combined fire / domestic service.

Thank you for your help with this.
Regards
David

David Hamlyn-Harris
Principal Consultant Water and Environment

BLIGH TANNER

david.hamlyn-harris@blightanner.com.au
Direct 07 3251 8507
Mobile 0412 497 337
Office 07 3251 8555

ISO9001 Quality Approved JAS-ANZ

From: He, Sarah [mailto:SarahHe@logan.qld.gov.au]
Sent: Friday, 25 August 2017 2:18 PM

To: David Hamlyn-Harris <David.hamlyn-harris@blightanner.com.au>
Subject: FW: Trinder Park Aged Care Redevelopment & Expansion

Hi David

Please find attached report that I just received from Logan Water Alliance.

Kind Regards

Sarah He | Development Services Engineer | Water Infrastructure Branch | **Logan City Council**
Phone: 07 3412 4697 | PO Box 3226 Logan City DC Qld 4114 | sarahhe@logan.qld.gov.au
www.logan.qld.gov.au | facebook.com/logancitycouncil | twitter.com/logancc

City of Logan: Innovative, Dynamic, City of the Future

From: He, Sarah
Sent: Monday, 21 August 2017 11:11 AM
To: 'David Hamlyn-Harris' <David.hamlyn-harris@blightanner.com.au>
Cc: WaterDA <WaterDA@logan.qld.gov.au>
Subject: RE: Trinder Park Aged Care Redevelopment & Expansion

Hi David

I just called Logan Water Alliance to check the progress of the modelling analysis in relation to the proposed development. The draft report should be ready today or tomorrow and will be reviewed by their program leader before releasing at the end of the week. Water network seems OK at this stage, however, sewerage network may become a problem. I'll send to you as soon as I receive their final report.

Kind Regards

Sarah He | Development Services Engineer | Water Infrastructure Branch | **Logan City Council**
Phone: 07 3412 4697 | PO Box 3226 Logan City DC Qld 4114 | sarahhe@logan.qld.gov.au
www.logan.qld.gov.au | facebook.com/logancitycouncil | twitter.com/logancc

City of Logan: Innovative, Dynamic, City of the Future

From: David Hamlyn-Harris [mailto:David.hamlyn-harris@blightanner.com.au]
Sent: Wednesday, 26 July 2017 4:23 PM
To: WaterDA <WaterDA@logan.qld.gov.au>
Cc: Cameron Riach <cameron.riach@blightanner.com.au>
Subject: Trinder Park Aged Care Redevelopment & Expansion

Sarah
I refer to recent conversations regarding the potential impact of the proposed redevelopment and expansion of the Trinder Park aged care facility located at Laurel St Woodridge on the existing water supply and sewerage systems.

Please find the following information attached:

- Summary of Development Details

- Masterplan Drawings
- Concept RAC/Village Podium Drawings

In summary the proposal is to demolish a number of old accommodation units and construct two new multi-story buildings housing aged care beds and associated facilities, as well as new Independent Living Units. The existing development is estimated to be equivalent to 244 EP (see attached spreadsheet); Stage 1 of the redevelopment will increase this to 419 EP and Future developments will further increase the load to 644 EP.

Can you please provide advice as follows:

- Whether the existing sewerage system can accommodate the wastewater flow from the increased level of development.
- Whether the existing water supply system can accommodate the domestic and firefighting demands from the increased level of development.
- Water supply boundary conditions (residual pressure and flow) that would apply for the design of internal reticulation systems.
- Any augmentation works that might be required to accommodate the additional development.

Please contact me if you have any questions or require any further in formation.

Thanks
David

David Hamlyn-Harris
Principal Consultant Water and Environment

BLIGH TANNER

david,hamlyn-harris@blightanner.com.au
Direct 07 3251 8507
Mobile 0412 497 337
Office 07 3251 8555



ISO9001 Quality Approved JAS-ANZ

****
The contents of this email message and any attachments are intended only for the addressee and may be confidential, private or the subject of copyright. If you have received this email in error please notify Logan City Council, by replying to the sender or calling +61 7 3412 3412 and delete all copies of the e-mail and any attachments.

To view Logan City Council's Privacy Collection Notice, please visit www.logan.qld.gov.au or click on the following link http://www.logan.qld.gov.au/home/terms-of-use.

****
The contents of this email message and any attachments are intended only for the addressee and may be confidential, private or the subject of copyright. If you have received this email in error please notify Logan City Council, by replying to the sender or calling +61 7 3412 3412 and delete all copies of the e-mail and any attachments.

To view Logan City Council's Privacy Collection Notice, please visit www.logan.qld.gov.au or click on the following link http://www.logan.qld.gov.au/home/terms-of-use.

APPENDIX C
GEOTECHNICAL INVESTIGATION

SOIL SURVEYS

PRELIMINARY GEOTECHNICAL INVESTIGATION

PROJECT NO. 117-19539

JULY, 2017

LUTHERAN CHURCH OF AUSTRALIA QLD

LUTHERAN COMMUNITY CARE – TRINDER PARK

10 LAUREL STREET, WOODRIDGE

Soil Surveys Engineering Pty Limited
A.B.N. 70 054 043 631
www.soilsurveys.com.au

Ph +617 3369 6000
Fax +617 3369 6660
PO Box 317, Paddington, QLD, 4064, Australia
info@soilsurveys.com.au

Brisbane
Level 2, 19 Finchley Street, Milton, QLD, 4064, Australia

Gold Coast
Unit 8, 140 Millaroo Drive, Helensvale, QLD, Australia

Document Information

Project Number	**117-19539**
Document Title	**Preliminary Geotechnical Investigation - Lutheran Community Care – Trinder Park**
Site Address	**10 Laurel Street, Woodridge**
Client	**Lutheran Church of Australia QLD**
File ref	**1-19539, 2017-07-24, BR VER 1**
Author	**Shane Cottle/mg**

Review

Ver No.	Document Type	Reviewed By	Approved for Issue	
			Name	Date
1	Final	Murray Geale	Murray Geale	08/08/2017

Distribution List

Ver No.	Organisation	Contact	Email	Date Sent
1	Lutheran Church of Australia QLD	John De Angelis	John.DeAngelis@lccqld.org.au	08/08/2017
1	RPS Project Management	Nathan Vinall	Nathan.Vinall@rpspm.com.au	08/08/2017

TABLE OF CONTENTS

1.0 INTRODUCTION 1
2.0 SCOPE OF GEOTECHNICAL SERVICES 2
3.0 SITE DESCRIPTION 3
4.0 GEOTECHNICAL INVESTIGATION 7
4.1 Field Investigation 7
4.2 Laboratory Testing 8
5.0 GEOTECHNICAL MODEL 8
5.1 Subsurface Profile 8
5.2 Groundwater 9
6.0 ENGINEERING ASSESSMENT 10
6.1 Trafficability – Light Weight Construction Vehicles 10
6.2 Excavatability 11
6.3 Excavation Retention 12
6.3.1 General 12
6.3.2 Detailed Design 12
6.3.3 Pier and Panel System 12
6.3.4 Retaining Walls 14
6.3.5 Dilapidation Survey 14
6.4 Earthworks 15
6.4.1 Erosion & Sediment Control 15
6.4.2 Earthworks Procedures 17
6.4.3 Earthworks Supervision 19
6.4.4 Detention Lake Construction 20
6.5 Landslip Hazard Assessment 21
6.5.1 Review of Published Information 21
6.5.2 Preliminary Risk Assessment 21
6.5.3 Preliminary Stability Recommendations 23
6.6 Site Classification 24
6.6.1 General 24
6.6.2 Trees 24
6.7 Building Foundations 25
6.7.1 General 25
6.7.2 Stiffened Raft 25
6.7.3 High Level Footings 26
6.7.4 Deep Foundations - Piers 26
6.7.5 Basement Slab 27
6.7.6 Adjacent Feature/Excavation Considerations 27
6.7.7 Inspections 27
6.8 Articulation and Detailing 27
6.9 Site Management 27
6.10 Pavements 28
6.10.1 General 28
6.10.2 Design CBR 28
7.0 FURTHER INVESTIGATION 'NEXT STEPS' 29
8.0 LIMITATIONS 30

Appendices

Appendix A
Notes Relating to this report
Appendix B
Borehole Record Sheets
Appendix C
Laboratory Test Certificates
Appendix D
Site Plan

1.0 INTRODUCTION

This report presents the results of the preliminary geotechnical investigation (Phase 1) carried out by Soil Surveys Engineering Pty Limited for the proposed Lutheran Community Care – Trinder Park redevelopment at 10 Laurel Street, Woodridge.

This Phase 1 study was commissioned by Nathan Vinall of RPS Project Management on behalf of the Lutheran Church of Australia QLD.

It is understood that the proposed development will occur in stages and comprise the following:-

- 200 bed multilevel residential aged care facility (RACF), incorporating two levels of basement.
- Three 50 bed independent living unit (ILU's) buildings with basements.
- New Module ILU's.
- Extension to existing detention lake, or new detention lake.
- New entry roads and bus interchange.
- Parking facilities.

Refer Figure 1.



FIGURE 1 - PROPOSED DEVELOPMENT

Note that numbering from Figure 1 has been used to identify specific aspects of the proposed redevelopment for the purposes of this report.

2.0 SCOPE OF GEOTECHNICAL SERVICES

The scope of geotechnical services provided by Soil Surveys Engineering Pty Limited was directed towards preliminary evaluation (Phase 1 Study) of the following items as detailed in our proposal 117-19539, 2017-06-09, PR VER 2 dated 12th June, 2017:-

- Investigation of the subsurface profile by drilling, sampling and insitu testing.
- Carry out a site walkover.
- Laboratory testing on selected samples to assess engineering properties of the subsurface material.
- Engineering analysis of site investigation and laboratory test results to carry out preliminary evaluation of:-
    - Earthworks recommendations
    - Landslip hazard
    - Foundation recommendations
    - Excavation retention system options
    - Retaining wall design recommendations
    - CBR design recommendation
    - Phase 2 investigation recommendations i.e. “next steps”

Note that the findings in this report are preliminary in nature and suitable for planning purposes only. Detailed geotechnical investigation should be carried out, following finalisation of development planning, for the purposes of detailed design.

3.0 SITE DESCRIPTION

The site of the proposed development is located 10 Laurel St, Woodridge. Refer Figure 2.

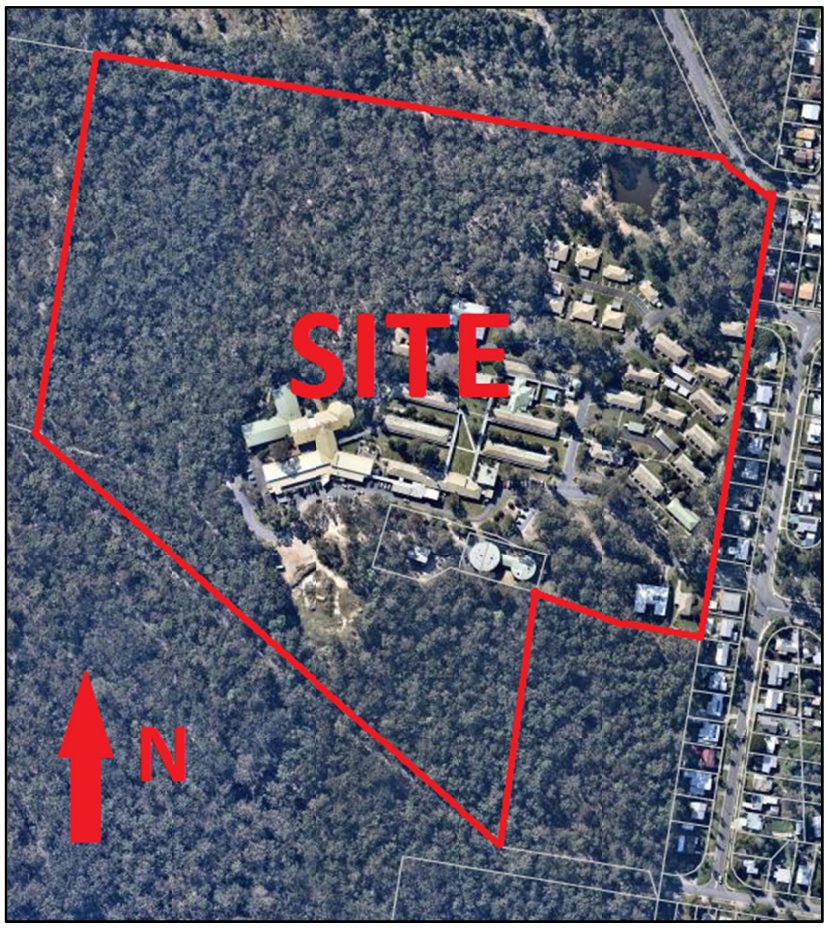


FIGURE 2

At the time of investigation the site was an operational aged care facility. A number of low rise accommodation buildings were located across the site with some larger facilities/amenities buildings concentrated around the existing administration area. The buildings are connected by a series of internal roads and pathways.

A Brisbane City Council Water Main and easement intersect the site and run predominately east/west along the ridgeline in the southern part of the site. Large water storage tanks mark the location of the easement and are situated at the approximate high point of the site.

A man-made detention lake was located in the north east corner of the site.

Vegetation comprised manicured lawns and gardens across the developed (existing aged care) portion of the site with bushland (small to large tress and shrubs) dominating the remainder of the site

Provided survey indicates that ground surface levels range from approximately RL 70m (water tank location) to approximately RL 47m (detention lake location).

Drainage conditions are considered to be fair to good.

Photographs 1 to 7 indicate typical site conditions.



PHOTOGRAPH 1 – ROADWAY SOUTH OF PROPOSED RACF WITH BATTER (LHS) SLOPING UP TO THE SOUTHERN RIDGELINE (WATER MAIN EASEMENT)



PHOTOGRAPH 2 – TOP OF RIDGELINE WITH WATER TANKS IN BACKGROUND



PHOTOGRAPH 3 – BUSHLAND IN APPROX. AREA OF PROPOSED 6.ILU (REFER FIGURE 1)



PHOTOGRAPH 4 – TYPICAL CONDITIONS IN APPROX. AREA OF PROPOSED 7.ILU (REFER FIGURE 1)



PHOTOGRAPH 5 – BUSHLAND IN APPROX. AREA OF PROPOSED 8.ILU ADJACENT EXISTING POND (REFER FIGURE 1)



PHOTOGRAPH 6 – MAN-MADE DAM WALL FOR THE EXISTING DETENTION LAKE



PHOTOGRAPH 7 – TYPICAL CONDITIONS IN APPROX. AREA OF PROPOSED 9. MODULE ILU (REFER FIGURE 1)

4.0 GEOTECHNICAL INVESTIGATION

4.1 Field Investigation

Subsurface conditions at the site were investigated by drilling and sampling:-

- Three shallow bores (BH1, BH2 and BH3), in areas corresponding to the proposed ILU buildings, to depths up to 4.50m using a 4WD mounted drilling rig.
- Two shallow bores (BH4 and BH5), to the east and west of the lake and in the general area of the proposed Module ILU's, to depths up to 3.00m using a 4WD mounted drilling rig.
- Two deep boreholes (BH6 and BH7), in the area of the proposed 200 bed multilevel aged care facility (RACF), to depths of 12.30m (BH6) and 12.55m (BH7) using a truck mounted drilling rig.

The soil classification descriptions, field and laboratory testing were carried out in general accordance with the following Australian Standards:-

- AS 1726-1993 "Geotechnical Site Investigations"
- AS 1289 "Methods of Testing Soils for Engineering Purposes"

A description of the investigation method, borehole records and a site plan showing investigation locations are included in the Appendices. Borehole coordinates were recorded using a hand held GPS device, with accuracy consistent with such devices.

4.2 Laboratory Testing

Laboratory testing was carried out on selected samples retrieved from the site investigation program and was directed towards assessing engineering properties of the subsurface material.

Laboratory testing included:-

- Shrink Swell Index - to assess the reactivity of the subsurface material.
- California Bearing Ratio - to assess the subgrade characteristics of the subsurface material under soaked conditions.
- Emerson Class Number – to assess the dispersiveness of the upper level subsurface material.

The results of the laboratory testing are summarised in Table 1 with certificates contained in Appendix C.

TABLE 1 LABORATORY TEST RESULTS

Borehole No.	Depth (m)	Results
BH2	1.80-1.88	Iss = 1.8%
BH3	0.60-0.74	Iss = 1.4%
BH4	0.40-0.52	Iss = 3.3%
BH1	0.60-1.20	Soaked CBR = 5.0%
BH3	0.15-0.60	Soaked CBR = 3.5%
BH5	0.50-1.00	Soaked CBR = 4.0%
BH1	0.00-0.15	Emerson Class Number = Class 3
BH3	0.00-0.15	Emerson Class Number = Class 4
BH5	0.00-0.25	Emerson Class Number = Class 4

5.0 GEOTECHNICAL MODEL

Published geological maps for Brisbane/Logan indicate that the site subsurface conditions comprise residual soils over weathered sandstone, siltstone, shale and conglomerate associated with the Bundamba Group (Woogaroo Sub-Group).

5.1 Subsurface Profile

Subsurface conditions encountered are consistent with conditions described on geological maps; subsurface conditions can be broadly grouped into five material types:-

- Fill Material - Fill material was encountered in Boreholes 1, 2 5, 6 and 7 to depths between 0.15m (BH1) and 1.60m (BH7) and comprised silty and clayey sand, sandy gravel, sandy clay and ash (BH2). The fill is considered ‘uncontrolled’.
- Natural Silty Sand - Medium dense silty sand was encountered in Boreholes 2 and 5, underlying the fill material, to depths of 1.60m (BH1) and 0.50m (BH5).
- Natural Sandy/Clayey Gravel - Dense sandy gravel and dense/very dense clayey gravel was encountered in Borehole 1 at depths between 0.15m and 2.80m. The clayey gravel was described as tending to sandstone or conglomerate rock.
- Natural Sandy and Silty Clay - Very stiff and hard silty clay and hard sandy clay was encountered at all borehole locations except BH1 and BH6.
- Weathered Siltstone/Sandstone – Extremely weathered to slightly weathered siltstone/sandstone was encountered at all borehole locations, except Borehole 5.

A summary of the subsurface profile is presented in Table 2.

TABLE 2 SUBSURFACE PROFILE

BH No.	Proposed Development[3]	Fill Material (m)	Silty Sand (m)	Sandy/ Clayey Gravel (m)	Silty/ Sandy Clay (m)	Weathered Rock (m)	Termination Depth (m)
BH 1	ILU (06)	0.00-0.15	NE	0.15-2.80	NE	2.80-4.50	4.50
BH 2	ILU (07)	0.00-1.10	1.10-1.60	NE	1.60-2.60	2.60-3.20	3.20[4]
BH 3	ILU (08)	NE	NE	NE	0.00-1.60	1.60-2.50	2.50[4]
BH 4	Detention Lake (10) Module ILU (9)	NE	NE	NE	0.00-1.70	1.70-2.50	2.50[4]
BH 5	Detention Lake (10) Module ILU (9)	0.00-0.25	0.25-0.50	NE	0.50-3.00	NE	3.00
BH 6	RACF (1)	0.00-0.40	NE	NE	NE	0.40-12.30	12.30
BH 7	RACF (1)	0.00-1.60	NE	NE	1.60-5.60	5.60-12.55	12.55

Notes:-
1. NE – Not Encountered.
2. All depths below existing ground surface level as of date of investigation.
3. Refer Figure 1
4. Borehole terminated at drill rig refusal.

5.2 Groundwater

Groundwater was not encountered at borehole locations at the time of the investigation. However, seepage may be encountered, particularly within the fill material and at the fill/natural and soil/rock interfaces, particularly following rainfall. It should also be noted that groundwater levels can vary both seasonally and with prevailing weather conditions.

6.0 ENGINEERING ASSESSMENT

6.1 Trafficability – Light Weight Construction Vehicles

The fieldwork for this investigation was carried out following dry weather conditions with both lightweight and truck mounted drilling rigs. Trafficability conditions were considered to be fair. However, some problems may be anticipated during wet weather for even light weight 4WD vehicles.

The soils on site are sensitive to repetitive vehicle loading and water (i.e. they will lose strength through repetitive vehicle loading or if they become overly moist or wet). Further, seepage may also result in a subsequent loss of strength. This may limit trafficability for light weight construction vehicles and create difficulties for construction. This situation would be more pronounced if rainfall followed demolition, clearing, stripping, etc.

Problems may also arise from disturbance of the upper level soil fabric with removal of any existing structures, services, vegetation, etc. Depressions could be formed resulting in water traps and potential softening of adjacent and underlying soils.

It is recommended that after demolition, stripping, clearing, etc., the exposed surface in the construction areas be proof rolled (where appropriate) to assist in identifying weak areas and to improve trafficability for light weight construction vehicles.

An important aspect of maintaining fair trafficability conditions is seepage/drainage control.

Maintaining adequate drainage conditions is essential. It should be ensured that runoff is diverted away from the construction areas to prevent ponding of water. In addition, the earthworks pad should be "sealed" at the completion of each day and in the event of rain.

Nevertheless, the contractors (earthworks, building, etc.) should fully inform themselves of the ground conditions on site prior to commencement of construction. This requirement should be explicit in any specifications or contract.

Basement Subgrade

Basements are proposed for the RACF and ILU towers. To assist trafficability and to level any areas of ‘overbreak’ (where weathered rock forms the basement subgrade), placement of a working platform (say 150mm min. layer of sub-base) across the basement subgrade (and above drainage material) is recommended. The sub-base material should be compacted to a density (say) of 95% of maximum dry density in accordance with AS 1289 5.2.1 (Modified compaction). Sub-base material should be of good quality conforming to requirements (minimum) of Material Type 2.4 as specified in the Queensland Department of Transport and Main Roads, Technical Specification MRTS05, Unbound Pavements (April, 2011).

Demolition and Clearing Activities

Extreme care should be exercised during demolition and the clearing phase to ensure that excessive subgrade disturbance is not caused during removal of existing structures, trees, services, etc.

Working Platforms For Tracked Plant and Heavy Construction Vehicles

The scope of Soil Surveys Engineering's study **DOES NOT** include the design of a working platform for heavy construction vehicles or heavy tracked plant.

Detailed design of a working platform should be carried out following detailed design and considering the operation of actual machinery proposed to be used. This is particularly important when considering the use of **heavy** piling rigs and **heavy** cranes - the piling/crane contractor should be consulted regarding their requirements.

6.2 Excavatability

Basement excavations are proposed for the RACF (advised as two levels of basement) and the ILU buildings (depth/levels not advised). Bulk excavation may also be required to create a new detention lake.

Subsurface conditions between development areas are variable and comprise fill, natural soils and weathered rock.

Considering the findings of the geotechnical investigation, the following preliminary comments can be made on excavation characteristics:-

- Soils – soils will be within the excavation limits of a medium sized backhoe or small dozer.
- Weathered Rock - we recommend that planning considers that rock excavation will require the use of large excavators (say 30 tonne), with use of rock breakers and/or single tyne for efficient excavation.
- Bored Piers - the ability to drill piers in the rock is not only dependent on material characteristics but also the type (power and size) of the bored pier drilling rig, drilling teeth, size of pier, etc. **It is recommended that the drilling contractors be consulted on this matter.** However, we recommend that planning considers that the use of large tracked mounted bored pier machines (say 30 tonne machines) will be required for piers extending into the weathered rock stratum

Vibrations

The effect of vibrations on adjacent structures/services from excavation works, particularly the use of rock breakers, must be carefully considered. Regardless, adequate vibration monitoring and control is recommended.

Inspection of Core

Soil Surveys Engineering hold rock core recovered from the site.

It is recommended that tender documents include a requirement to inspect retrieved core so that intending contractors can make their own assessment and judgement on the excavatability of the rock stratum.

* * *

The above excavatability recommendations are preliminary only. Note that further investigation (Phase 2), suitable for detailed design, is to be carried out. Further deep borehole drilling (with coring of rock encountered) should be carried out as part of the Phase 2 study, particularly at

the location of the ILU towers where details (depth, finalised location etc.) were not available at the time of this investigation.

6.3 Excavation Retention

6.3.1 General

At the time of writing basement excavations for the RACF (2 levels) and the ILU Towers (depth unknown) were proposed. Excavation support will be required. A pier and panel wall system could be considered. The retention system must be installed prior to excavation works.

In areas where excavation is minor, say less than 1.0m, or the opportunity to adopt a temporary cut battered excavation is available, the requirement for a pier and panel wall could be relaxed, i.e. a temporary cut battered excavation could be considered where sufficient space exists to allow for safe batter angles can be accommodated and where surcharge conditions are favourable. However, the suitability of a temporary cut battered excavation is highly dependent on proximity to existing site features (e.g. water main, roadways, structures etc), surcharge conditions, encountered profile and available space. However, it is considered that the temporary batters are **not** suitable from a practical and financial perspective.

The retention system design is also dependent on deflection/settlement effects, height of cut, proximity of adjacent structures/features, adjacent structure footing systems, etc.; the magnitude of deflection/settlement that may be acceptable will be subject to boundary conditions (e.g. proximity of adjacent structures, services, etc.) and detailed design by the retention system designer (Soil Surveys Engineering is not the retention system designer).

6.3.2 Detailed Design

Detailed retention system design is required (which is outside the scope of Soil Surveys Engineering's commission and study); a detailed soil-structure analysis must be carried out to determine an effective retention support system. This design would follow the detailed geotechnical investigation.

The requirement to limit deflections to acceptable levels should be explicit in the brief to retention system designers.

The effect of potential vertical and horizontal movements (resulting from deflection of the retention system) on existing adjacent structures, services, road etc. must be carefully considered. Services locations and adjacent building foundation systems must be considered in the retention system design.

The design of a support system should take into account overexcavation possibly associated with foundation construction, earthworks, services installation, etc.

Further, it is recommended that several monitoring stations be set up to check for movement during excavation. A regular monitoring program of these stations should be implemented e.g. twice daily during excavation and daily at any other time.

6.3.3 Pier and Panel System

In this option, piers are drilled (either at close spacing or more widely spaced, up to four diameters), with infill panels; piers are joined at the surface using a capping beam.

The following general construction procedure would be applicable:-

- Install bored piers **with a suitable embedment** into the weathered rock stratum. This pier and panel option is dependent on suitable pier embedment below final platform level being achieved.
- Construct panels - excavate, install reinforcement between piers and spray with shotcrete.
- Install temporary ground anchors through each pier (as required).
- Continue panel construction (i.e. excavation, installation, reinforcement and shotcrete).

Figure 3 refers.

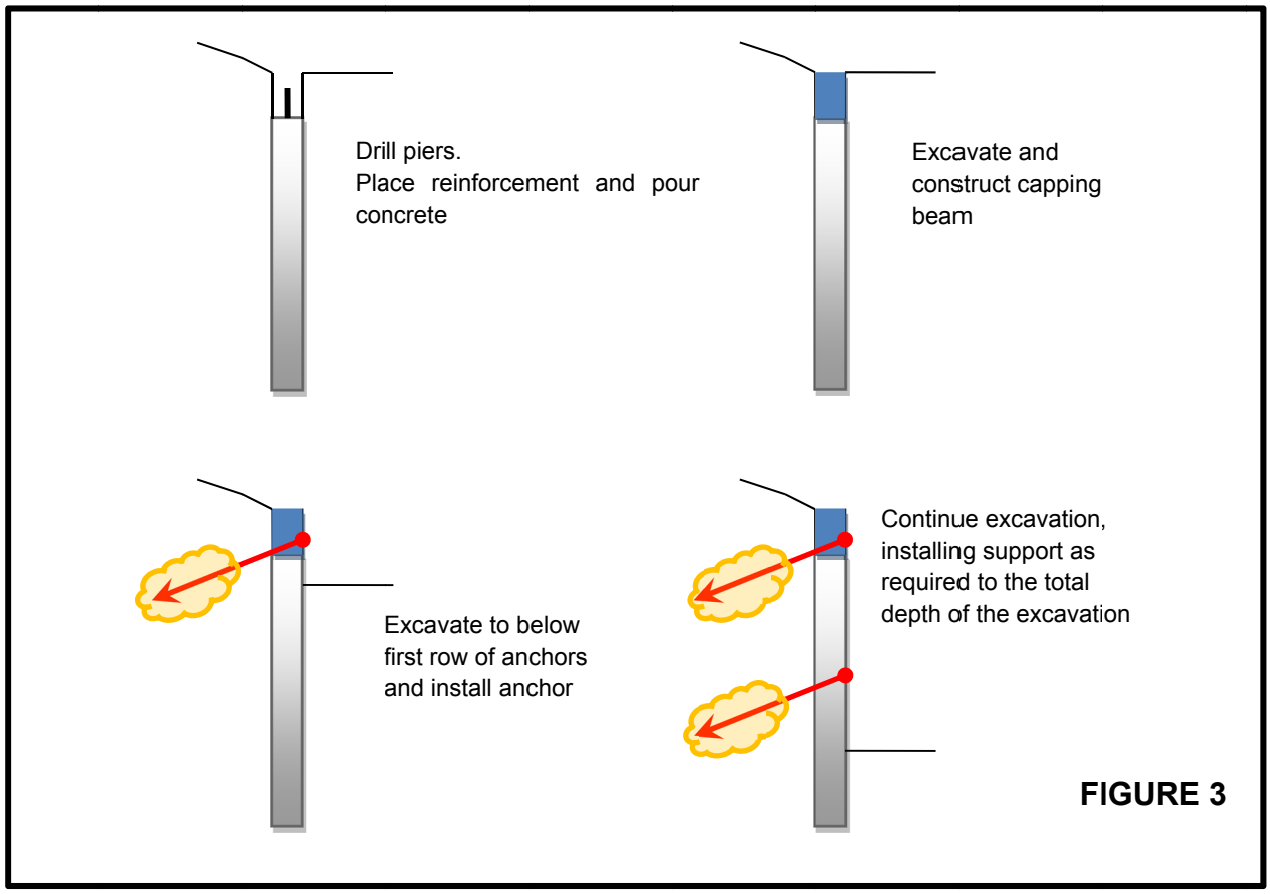


FIGURE 3

A minimum pier diameter of 0.60m should be adopted for anchored piers, however, pier diameter is dependent on the moment capacity of the pier section, lateral deflection requirement, boundary conditions, etc.

The ability to install anchors would be dependent upon boundary conditions (ie the location of exiting services etc.). The use of temporary internal struts may be required where anchors are not able to be installed.

To reduce size (or need) of anchors, the pier spacing could be reduced. Please note that permission to install anchors into adjacent properties/easements would be required.

A maximum panel height of 2.0m is recommended; inspection by Soil Surveys Engineering is recommended at the commencement of construction to confirm panel height.

It is recommended that a capping beam be incorporated into the design. A capping beam has the advantage of:-

- Provides a convenient location for the first row of anchors (if required), allowing an increase in anchor spacing and not restricting the anchor points to the post positions only.
- Provides a larger bearing surface for the top row of anchors and allows the adoption of larger anchors in the top row.
- Joins the tops of the posts together thereby reducing the possibility of excessive movement of the top of a single post which could increase the potential for toe "kick out" before the placement of the lower anchor.

  This movement would also reduce the tension within the anchor thereby down grading its effectiveness at minimising movement within the wall of the excavation.

6.3.4 Retaining Walls

Retaining walls should be designed in accordance with AS 4678-2002 "Earth Retaining Structures".

The following parameters (unfactored) may be adopted for preliminary basement wall design (Table 3).

TABLE 3 PARAMETERS FOR USE IN RETAINING WALL DESIGN

Material	Density (kN/m^3)	Earth Pressure Coefficient Vertical Wall			Long Term Drained Ø (degrees)
		Ko	Ka	Kp	
Fill/Natural Soils	19	0.53	0.36	2.77	28
Weathered Rock	21	0.43	0.27	3.70	35

Any backfill placed behind the wall should be loose granular material. The backfill should not be heavily compacted since research has shown that compaction can raise the earth pressure to above the 'at rest' pressure.

Adequate surface and subsoil drainage should be provided for all retaining walls on the site. Cut-off / interceptor drains should also be provided around the high side of the wall to ensure stormwater runoff from the area above the wall is suitably diverted.

The placement of a filter fabric between the retained soil and the drainage material (eg. granular backfill) for protection against silting of the drainage material is recommended. The outlets to subsoil pipe drains must be located beyond the ends of the walls and connected to a proper drainage system. It is suggested the pipes be wrapped in filter fabric to minimise silting.

6.3.5 Dilapidation Survey

Adjacent buildings, roads and underground services are/may be located adjacent to proposed works, noting the council water main adjacent the proposed RACF basement excavation.

It is recommended that a dilapidation survey of adjoining structures, roads, etc. be carried out in order to establish their present condition prior to commencement of construction.

This survey should include the following:-

- The general condition of the structure, i.e. condition of all exposed walls, pavement condition, etc.
- The extent of existing damage (if any)
- Photographs/video

6.4 Earthworks

As the time of writing the site was still in the early planning stage and, as such, the extent of earthworks was unknown. However, based on the provided early stage drawings and our site walkover, we envisage that earthworks could include, but not be limited to, the following:-

- Excavation and filling for the detention lake construction
- Minor cuts and fills for the Modular ILU building pads
- Subgrade preparation for new roadways
- Basement excavation
- Backfilling of retaining walls
- Trench excavation and backfilling

Earthwork procedures should be carried out in a responsible manner in accordance with AS 3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments".

6.4.1 Erosion & Sediment Control

To allow assessment of erosion potential, Emerson Class Number laboratory testing was undertaken:-

The results of laboratory testing are presented in Table 1 with test certificates attached.

Emerson Class Number

Selected samples retrieved from the field investigation program were tested for dispersiveness using the Emerson Class Number test method, i.e. AS 1289.3.8.1.

The test method AS 1289.3.8.1 divides soils into seven classes on the basis of their coherence in water, with one further class being distinguished by the presence of calcium - rich minerals, i.e.:-

- Class 1 – slaking and complete dispersion of natural soil crumbs in still water
  – very high potential for erosion
- Class 2 – slaking and some dispersion of natural soil crumbs in still water
  – very high potential for erosion
- Class 3 – slaking but no dispersion of natural soil crumbs in still water
  – dispersion of moistened, remoulded soil crumbs in still water
  – high potential for erosion

- Class 4 – slaking but no dispersion of natural soil crumbs in still water
  – no dispersion of moistened, remoulded soil crumbs in still water
  – calcite or gypsum present
  – medium potential for erosion
- Class 5 – slaking but no dispersion of natural soil crumbs in still water
  – no dispersion of moistened, remoulded soil crumbs in still water
  – no calcite or gypsum present
  – dispersion of soil/water suspension after shaking
  – medium potential for erosion
- Class 6 – slaking but no dispersion of natural soil crumbs in still water
  – no dispersion of moistened, remoulded soil crumbs in still water
  – no calcite or gypsum present
  – flocculation of soil/water suspension after shaking
  – medium potential for erosion
- Class 7 – no slaking and swelling of natural soil crumbs in still water
  – low potential for erosion
- Class 8 – no slaking and no swelling of natural soil crumbs in still water
  – low potential for erosion

Laboratory testing indicates that the soils have a medium to high potential for erosion.

Erosion and Sediment Control Recommendations

An erosion control program should include but not be limited to the following preliminary recommendations:-

- Minimise disturbance.
- Slope runoff should be diverted around the development site.
- Drainage controls should be installed early in the site development.
- Install sediment barriers as required; barriers to also be positioned around soil stockpiles.
- Entry and exit points are to be minimal and stabilised with coarse gravel and stone. Limit site entry and on-site traffic movement.
- All drainage, erosion and sediment control measures should be regularly checked and maintained throughout the construction period.
- Re-vegetation is to be carried out promptly and progressively during construction.
- It is essential that batters be suitably protected from erosion and scour by the establishment of ground cover and shrubs, installation of surface drains, placement of rock protection, placement of gravel capping, etc. Runoff should not be allowed to discharge directly across unprotected batters.

- Clearly define flow/drainage paths on development drawings. Establishment of vegetation along flow/drainage paths is recommended - vegetation will reduce flow velocity.
- Avoid concentration of flow from multiple drainage paths.

The Institution of Engineers, Australia, Queensland Division's publication (dated June, 1996), "Soil Erosion and Sediment Control – Engineering Guidelines for Queensland Construction Sites" should also be referenced in earthworks planning.

6.4.2 Earthworks Procedures

Earthwork procedures should be carried out in a responsible manner in accordance with AS 3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments "incorporating the following:-

- Clearing, stripping and grubbing should be carried out in areas subject to earthworks (as trafficability conditions allow). Also all soils containing organic matter should be stripped from the construction area; this material is not considered suitable for use as structural fill.
- Depressions formed by the removal of existing structures, vegetation, underground elements etc. should have all disturbed weakened soil cleaned out and be backfilled with compacted select material.
- The subgrade should be proof rolled (where appropriate) under the supervision of Soil Surveys Engineering in accordance with methods and equipment as per Clause 5.5 of AS 3798-2007. In areas of cut, proof rolling may be deferred until after the cut operation. Areas demonstrating excessive movement should be treated (dried and recompacted) or removed and replaced with compacted fill.
- **Any fill material encountered should be considered uncontrolled and requiring treatment (i.e. excavate/condition/replace/compact as required).**
- Sloping ground, etc. should be benched to "key in" fill material and optimise compaction. The benches should slope back at 1V:10H and be at least 0.5m wide. Wider benches to accommodate the width of the roller may need to be adopted in some situations (Figure 4).

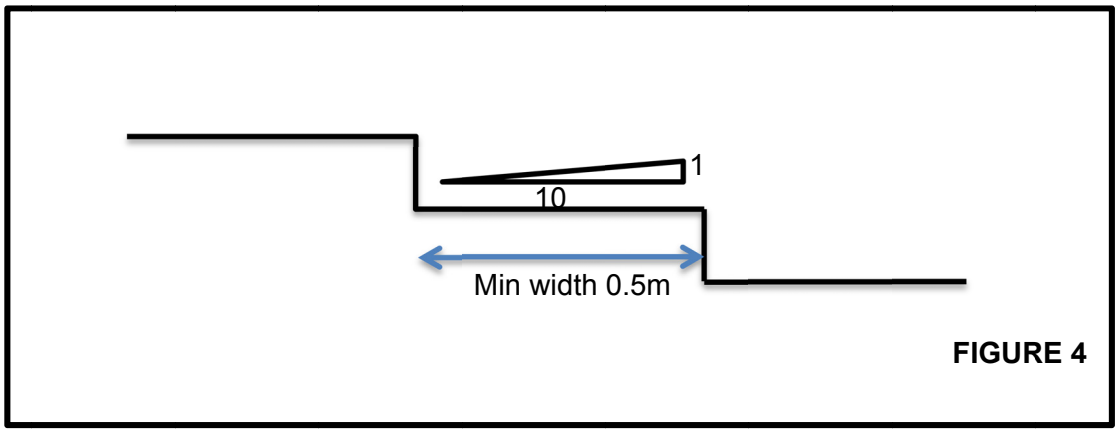


FIGURE 4

- Due to the water sensitive nature of the silty sand soils (fill and natural), **it is recommended that insitu silty sand NOT be used as structural fill.**

- The insitu soils, where free of organic and deleterious material (note the presence of ash within the existing fill material in BH2), may be used for structural fill provided the moisture content of the soils on placement approximates the optimum moisture content required for compaction.

  This will require conditioning to bring the soils to optimum. However, it should be noted that the on site soils could be expected to present difficulties in handling, placement and compaction if the appropriate moisture content could not be achieved, particularly if the soils were overly moist. The designer should consider the effect of earthworks on site classification.

- Close control of moisture content during placement and compaction is required so as to minimise the potential for swelling and shrinkage movement. A moisture content within the range of OMC (Standard Optimum Moisture Content) -1% to OMC +2% is recommended. Foundation design must reflect the use of the potentially reactive clays if they are used as structural fill.

- For detention lake construction, silty and sandy clay soils, are recommended for any dam wall construction. More permeable granular soils (gravelly clays, sands, gravels etc.) are not considered suitable.

- Weathered sandstone and siltstone will be won from site excavations. It is considered that any extremely and distinctly weathered material will break down sufficiently during the earthworks operations using large compactors.
  The weathered rock, where broken down on extraction, may be used in areas of structural fill provided no rock over 75mm greatest dimension is included above a plane 300mm below the final subgrade/platform. Below this plane, rocks up to 150mm greatest dimension may be used. These rocks should however not represent more than 20% of the fill make-up.

  Rocks over 150mm greatest dimension, which cannot be broken down, should be removed. Consideration should be given to the exclusion of rock pieces with a greatest dimension of 35mm or greater from areas where trenching and piling may occur, as larger rock pieces could impede any trenching and piling operations. Please note that the percentage retained on the 37.5mm sieve should not exceed 20%; standard field density testing is not able to be carried out if the percentage on the 37.5mm sieve was to exceed 20%. Quality testing to confirm particle size limits should be carried out; frequency of testing is subject to assessment by Soil Surveys Engineering, however, a sufficient number of tests should be carried out so that all parties are confident of material characteristics. Quality test results should be reviewed by Soil Surveys Engineering.

- Blending of site materials (clays, sands and weathered rock) may be required to produce appropriate fill materials.

- **Imported GENERAL fill** material (if required) should be cohesive and non-dispersive in nature, and be a good quality low plasticity (Liquid Limit of less than 45%, Plasticity Index of less than 15%) select fill material with a Soaked CBR >10%, a maximum particle size of 75mm with at least 80% passing the 19mm sieve.

- Quality testing to confirm imported fill quality should be carried out prior to delivery to site; frequency of testing is subject to assessment by Soil Surveys Engineering, however, a sufficient number of tests should be carried out so that all parties are confident of material characteristics. Quality test results should be reviewed by Soil

Surveys Engineering prior to construction.
Contractors should submit details of their proposed fill source (with quality certificates) with their tender submission. The proposed fill source should be reviewed by Soil Surveys Engineering prior to awarding the earthworks contract.

- Pavement gravels should comply with appropriate local authority quality specifications for base, sub-base and blanket materials.
- Provided the placement moisture content of the imported fill or select insitu material approximates the optimum moisture content for compaction, suitable compaction should be achievable using typical compaction machinery.

  Fill material should be compacted in layers not exceeding 250mm, loose thickness. However, layer thicknesses will be dependent on the compaction plant type and size, use of vibration, material type and condition. Final maximum placement layer thicknesses will need to be determined when compaction plant as well as material type and conditions are known. Fill batters should be overfilled and cut-back.
- Guidelines for minimum relative compaction values for insitu soils and imported general fill for the building and pavements are presented in Table 4.

TABLE 4 MINIMUM RELATIVE COMPACTION

Location	Minimum Dry Density Ratio (%)
Building Area	98
Pavement Area	
a) >0.3m below pavement subgrade	95
b) <0.3m below pavement subgrade	98
Base Course	98(2)
Subbase	95(2)

Notes:
1. The recommended compactions are percentages of the maximum dry density determined by Australian Standard 1289 5.1.1 (Standard Compaction).
2. For processed pavement gravels, minimum density requirements should be a percentage of maximum dry density in accordance with AS 1289 5.2.1, Modified Compaction.

- Field density testing should be carried out to check the standard of compaction achieved and the placement moisture content. The frequency and extent of testing should be as per guidelines in AS 3798-2007, Section 8.0.
- Backfilling for service trenches, etc. should use good quality material. The backfill should be placed in uniform layers over the full width of the excavations with the layers not exceeding 200mm thickness, loosely placed using wheeled plant and 100mm loose thickness using hand held vibrating plates. The backfill material should be compacted to the specifications outlined above for insitu or imported cohesive material.
- Shoring of any deep trench excavations is recommended. Suitable precautions to satisfy Health & Safety requirements must be adopted. Construction procedures (i.e. operation of plant, storage of materials, etc.) should also consider the nature of the site soils.

6.4.3 Earthworks Supervision

Engineering supervision of the earthworks operations by Soil Surveys Engineering Pty Limited is recommended.

Following production of AS 3798-2007, the terms "Level 1 and 2 Supervision" have been adopted in earthworks specifications to describe what could also be termed Engineering Supervision. Whilst there is no particular problem with using these terms, there does not seem to be wide agreement as to what Level 1 or 2 Supervision actually means or entails.

Regardless of terminology, it should be made clear in any earthworks specification as to what is actually required in terms of engineering certification.

It is recommended that the following objectives (as a minimum) be incorporated into the earthworks specification:-

- Engineering certification that all general earthworks operations (i.e. stripping, proof rolling of subgrade, subgrade treatment, etc.) have been carried out in accordance with the earthworks specification.
- Engineering certification that fill has been placed and compacted to the required minimum density in accordance with the earthworks specification.
- Engineering certification that the controlled fill material is suitable to support a conventional slab on ground floor.
- Engineering certification that the quality of any imported fill complies with the earthworks specification requirements.

Engineering certification should be provided by a Registered Professional Engineer of Queensland.

6.4.4 Detention Lake Construction

Inspection of the existing detention lake was carried out during the site walkover. The construction (filling of the dam wall etc.) of the existing detention lake was considered to have not been carried out under controlled conditions. The existing dam wall was considered steep in terms of long term stability and appeared to have been constructed with material of variable quality. Scouring of the existing dam wall was also noted. It is recommended that review of the existing dam be carried out to assess the adequacy of existing dam walls, etc.

Any construction works associated with the existing detention lake should be carried out as per Section 6.4.2 and include the following:-

- Dewatering of the existing lake may be required.
- Water affected materials should then be removed to a suitable base to allow commencement of filling. Should the base be found to comprise weak, water affected soils the use of a bridging layer and geotextile/geogrid may be necessary to enable successful trafficking and compaction of fills. Coarse gravel could be used for the bridging layer with the thickness to be determined at the time of construction.
- Depending on the rate of water inflow from surrounding areas after dewatering, allowance should be made for incorporation of several sumps in the lake base to keep water out of the filling until such stage as the water no longer influences the compaction process.

6.5 Landslip Hazard Assessment

A site walkover and preliminary stability assessment were carried out to assess potential stability hazards with respect to the proposed development, in particular in the area of the proposed RACF.

The site walkover noted the following:-

- The proposed RACF development is situated at the southern side of the facility, on the northern side of a low knoll type feature (refer Figure 2).
- Slopes in the area of the proposed RACF area fall to the north north west at overall slope angles of approx. 5º to 8º (8% to 14%).
- The site currently comprises several existing buildings, some of which include minor batters cut into soil and/or rock, located either beneath the two story structures or adjacent within landscaping areas.
- A larger batter exists along the southern side of the site adjacent to an access road. The batter comprises predominantly an approx. 30º to 40º slope (refer Photograph 1) approx. 3.0m to 5.0m high, cut into extremely to distinctly weathered rock (sandstone and conglomerate).
- Areas of fill batters also appear to have been constructed at the downslope sides of several structures (refer Photograph 4).
- The majority of the site surrounding the existing buildings is either paved, landscaped or well grassed (refer Photograph 2).
- Outside of the structures, the natural bush landscape comprises generally poorly grassed areas, exposed sand and gravel soil with small to large sized trees .

6.5.1 Review of Published Information

Given the above, a review of published data was undertaken which indicated that a several small portions of the site (which appear to coincide with existing batters) are located within the Logan City Council Landslide Hazard and Steep Slopes Area Trigger zone (refer Figure 4.)

In addition, given that areas of slopes of >15% (8.5º) exist on the site, the State Planning Policy (July, 2014) will also apply in terms of natural hazards.

As a result of the above assessment, to fulfil the current local government and state planning policy requirements, our recommendation would be for a more detailed assessment of the site to be undertaken in relation to slope stability with respect to the proposed development, existing hazards, potential consequence and potential risk. Discussions with town planners and the local Council may also be able to provide further recommendations in relation to the requirement for any further stability assessments.

6.5.2 Preliminary Risk Assessment

In addition to the above, a preliminary risk assessment has been undertaken for the proposed development. For the purposes of this preliminary study, the assessment of Risk for the site has been based on risk to property and risk to persons, where Risk is the product of Likelihood and Consequence.

This method is based on the method outlined in the “Practice Note Guidelines for Landslide Risk Management 2007” (PNGLRM), produced by the Australian Geomechanics Society, 2007.

Hazard Identification

At this stage, based on the site walkover, a review of the site information and experience on similar sites, potential shallow landslide hazards have been identified for assessment. It should be noted that additional potential hazards are likely to exist on the site and would be the subject of a further detailed assessment.

Likelihood Estimation

The site was assessed and zoned using the method as outlined in MacGregor and Taylor (2001). The method has been adopted as a slope stability assessment tool and used in both the Gold Coast and Redlands Shire regional stability assessments.

The preliminary zoning indicates that the overall site has a maximum hazard rating of Very Low to Low, with small areas of Low to Moderate associated with existing batters. This equates to a Likelihood Descriptor (according to PNGLRM, 2007c) of generally **Barely Credible to Unlikely** with small areas of **Unlikely to Possible.**

Consequence Analysis

As part of the assessment of the risk of slope instability, the analysis of the consequence of any failure must also be considered.

This analysis is based on the effect on the following for each type of hazard:-

i) Consequence to Property (proposed development)
ii) Consequence to Persons within and around the proposed development

For the purposes of this study, a semi-qualitative measure of consequence to property will be adopted, as outlined in Appendix C of PNGLRM 2007c.

If slope instability were to occur, the aspect of property most at risk would be the proposed development. Based on Appendix A of PNGLRM 2007c the structures at risk would be classified as Importance Level 3 (buildings or structures that as a whole may contain people in crowds).

Considering the above information, the consequence to property for the identified hazards could be assessed as **Medium** (moderate damage to some of the structure and/or significant part of the site requiring stabilisation works – approximate cost of damage of 20%).

For consequence to persons, for the purposes of this study, the methodology as outlined in Section 7 of PNGLRM 2007 has been adopted with various assumptions.

Risk Determination and Evaluation

Appendix C of "PNGLRM (2007)" outlines a method of assessing Risk to Property. The calculation of likelihood is based on the estimate outlined above. The consequence is based on the proposed development and the effects on the property of the specific hazard as per above.

The risk to property is then assessed based on the Risk Matrix from LRMPNG, 2007. The risk to persons must be carried out on a quantitative basis to be consistent and for comparison with acceptance criteria. To do this, the indicative probabilities given in Appendix C of PNGLRM (2007) may be adopted as there are no other frequency/probability data.

Based upon the above, the following preliminary Risk Assessment has been undertaken:-

- Risk to Property – **Very Low to Low and Low to Moderate**
- Risk to Persons –**Tolerable to Acceptable**

As some areas of the site produce risks which are considered to be outside of the PNGLRM (2007) guidelines for acceptable risk (i.e. areas of moderate risk), it is therefore our recommendation that a more thorough and detailed Risk Assessment be undertaken on the development site to identify and mitigate potential hazards and risks associated with the proposed development.

6.5.3 Preliminary Stability Recommendations

Based upon the preliminary stability assessment above and findings of the preliminary geotechnical investigation of the site, the following engineering comments apply specifically to the development to minimise the potential for slope instability. It should be noted that these are regarded as preliminary and should be refined by a more detailed slope stability assessment.

For the development and in addition to the preliminary foundation recommendations in Section 6.7, we recommend that to minimise the potential for stability hazards to affect the foundations, the footings for any structures located above existing or proposed batters take into account the potential for instability and should be extended through fill and natural clay soils to found into weathered rock.

Maximum batter angles will be required to be met, which are currently outside of the scope of this report. All batters will be required to be protected from potential scour and erosion.

We therefore recommend that as part of further geotechnical investigation works on the site, that a more detailed slope stability assessment be conducted to confirm suitable proposed batter slopes as well as a more detailed risk assessment based upon the final proposed development.

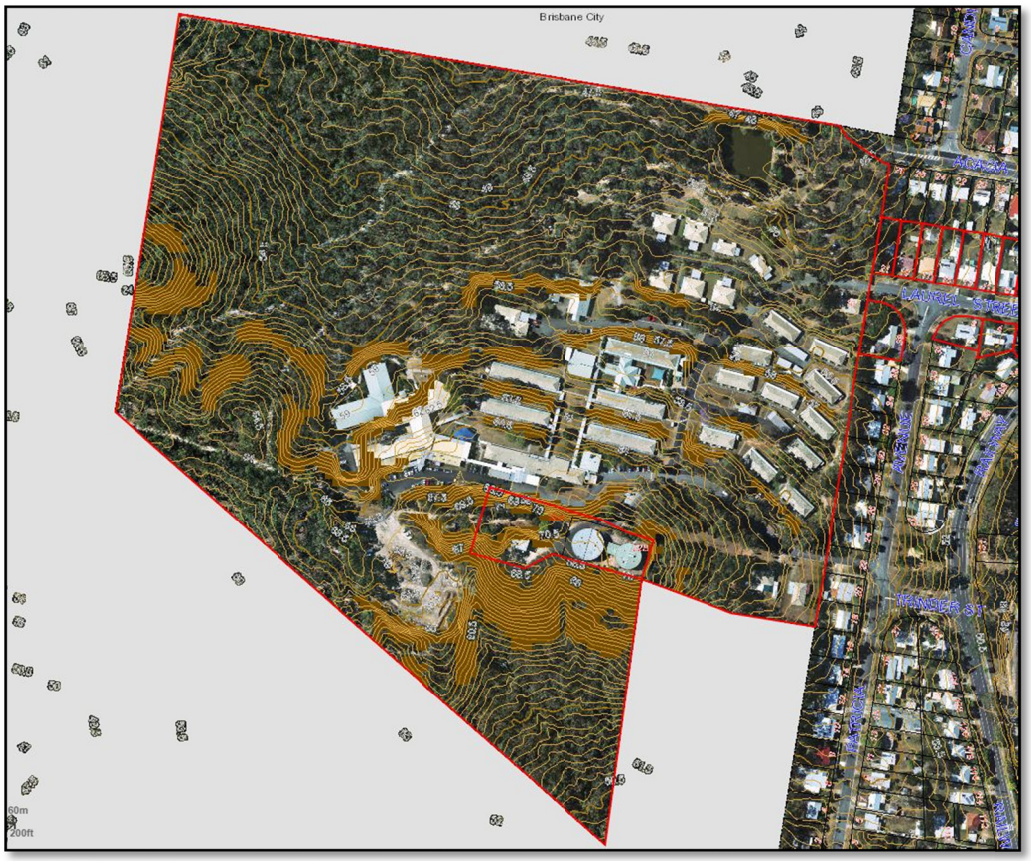


FIGURE 5 – LOGAN CITY COUNCIL LANDSLIDE HAZARD AND STEEP SLOPE AREA TRIGGER ZONES (SHADED BROWN)

6.6 Site Classification

6.6.1 General

While a site classification in accordance with AS 2870 'Residential Slabs and Footings' relates to residential type construction and is not directly applicable to some aspects of this development (apart from areas where modular ILU construction is proposed), it is, however, a valuable method of classification.

Where clay based soils were encountered (e.g. Boreholes 4 and 5), and where slab on ground construction is envisaged (i.e. modular ILUs) the site is considered a reactive site. The reactive site has been assessed to be subject to **abnormal moisture conditions** predominately due to the presence of trees on the building site and the proposed removal of existing structures.

On the basis that the reactive site is subject to abnormal moisture conditions the site is classified as Class 'P'.

6.6.2 Trees

If existing trees are left in place or removed prior to construction, or new trees subsequently planted 'close' to the future building locations, greater movements than what would be expected may occur. It is essential that the site be maintained at "stable moisture conditions", with "extremes of wetting and drying prevented" – refer AS 2870-2011, Appendix B. This includes

attention to such matters including limitations on gardens and restrictions on trees and shrubs. Alternatively, the footing system may be designed for the effect of trees.

AS 2870-2011 includes an informative section (refer Appendix H) on the design of footings for trees and in particular the calculations of the maximum potential surface movement due to the tree-induced suction change (that is in addition to the normal design suction profile). The Designer should refer to AS 2870-2011 for detailed discussion on this matter.

6.7 Building Foundations

6.7.1 General

A number of different building types are proposed (i.e single level ILU's, ILU towers with basements, RACF with possible combination of basement and slab on ground construction). A number of foundation and slab on ground options could be considered dependant on the building type proposed, and the ground conditions encountered.

Based on the preliminary investigation results, foundation and slab on ground systems that could be considered include:-

- Modular ILU's (single level)
    - stiffened raft founded in natural soils
- ILU Buildings
    - basement slab on ground with high level footings; bored piers could also be considered
- RACF
    - basement slab on ground with high level footings; bored piers could also be considered

6.7.2 Stiffened Raft

A stiffened raft comprises perimeter and internal beams and is designed to accommodate potential ground surface movements.

For preliminary design, Class 'H2' conditions (excluding tree induced movement) could be considered for stiffened raft design.

Our recommendation is that footings be founded at a minimum depth of 500mm below platform level and at least 100mm into natural soils (other than silty sand).

Footings founded in the natural soils (other than silty sand) may be dimensioned for an allowable bearing pressure of at least 100kPa. Where footings are partly founded in weathered rock, and in order to provide a uniform founding base, all footings should be deepened to found in weathered rock

For economy of construction in areas of fill or in order to found in weathered rock as above, footings may be constructed over mass concrete filled, backhoe excavated pedestals or short bored piers.

Field and laboratory test results indicate that the existing natural soils, along with any controlled fill, are suitable for slab on ground construction provided that earthworks are carried out in accordance with Section 6.4 and that appropriate engineering certification is provided. However, the existing fill is not considered to be suitable in its current state to support any slab on ground floor. Should earthworks operations not result in a subgrade suitable for slab support, any slab on ground floor should be supported on pedestals/piers founding in competent natural soils.

6.7.3 High Level Footings

Borehole data suggests that the basement subgrade for the ILU and RACF buildings will comprise weathered rock. A footing system comprising pad and strip footings could be considered in this case.

Footings founded in the weathered rock stratum may be dimensioned for an allowable bearing pressure of 400kPa to 600kPa (subject to inspection by Soil Surveys Engineering).

6.7.4 Deep Foundations - Piers

It is recommended that the bored pier foundation system on this project be designed in accordance with AS 2159-2009 'Piling - Design and Installation'. This code uses the limit state design method.

Compressional Capacity

The design of a single pier or a pier group must be such that both the design geotechnical strength $R_{d,g}$ and the structural strength $R_{d,s}$, are greater than or equal to the design action effect E_d, i.e.

$$R_{d,g} \geq E_d \text{ and } R_{d,s} \geq E_d$$

The design geotechnical strength ($R_{d,g}$) can be calculated as the ultimate design geotechnical strength ($R_{d,ug}$) multiplied by the geotechnical strength reduction factor $Ø_g$. Preliminary ultimate design geotechnical strength ($R_{d,ug}$) parameters for the materials encountered on the site are outlined in Table 5.

TABLE 5 PRELIMINARY ULTIMATE GEOTECHNICAL STRENGTH ($R_{d,ug}$) PARAMETERS

Material	fb - Base Bearing (kPa)	fm,s - Skin Friction (kPa)
Fill Material	NR	NC
Natural Soils	NR	30-60
Weathered Rock	1800-2250	60-75

Notes:
1. NR - Not Recommended; NC - Not Considered in skin friction calculations.
2. Ultimate geotechnical strength for compression can be determined from $R_{d,ug} = f_{m,s} A_s + fbAb$.
3. For determination of geotechnical strength reduction factor (Øg) refer Section 4.3.2 AS 2159-2009.
4. Considering limit state analysis (AS 2159-2009), the design geotechnical strength $R_{d,g}$ is calculated by multiplying the ultimate geotechnical strength $R_{d,ug}$ by the geotechnical strength reduction factor Øg, i.e. $R_{d,g} = R_{d,ug} \times Øg$.
5. Should a "working stress" approach be adopted, a minimum factor of safety of 3.0 on base and 2.0 on skin friction is recommended.
6. Skin friction contribution from clays in the upper 1.8m of the profile should be ignored.
7. Piers should found at a minimum depth of four times the pier diameter.
8. The above parameters are for single piers. If piers are spaced at closer than three diameters, a reduction factor (Group Efficiency Ratio) may apply.
9. Base bearing and skin friction parameters to be confirmed by inspection.

It should be ensured that all loose material is removed from the base of bored piers prior to pouring of concrete. The use of a 'clean-out' bucket or vacuum truck should be explicit in instructions to the drilling contractor. The practice of 'using water and spinning the augers' to remove loose material from the pier base is generally unacceptable.

6.7.5 Basement Slab

For preliminary design purposes, it is recommended that the basement slabs be designed adopting principles as contained in the Cement & Concrete Association of Australia, Industrial Floors & Pavements, Guidelines for Design, Construction & Specification.

It is envisaged that a weathered rock subgrade will be exposed at basement level over the site. For design (but subject to inspection), a design CBR value of 8% may be adopted where weathered rock forms the subgrade.

Inspections and testing should be carried out during bulk excavation work to fully assess subgrade conditions and CBR values.

6.7.6 Adjacent Feature/Excavation Considerations

Where proposed or existing (e.g. adjacent structures) footings/piers are located adjacent to proposed or existing feature/excavations (e.g. retaining walls, underground service trenches, footing excavations, unsupported batters etc.), the effect of the feature/excavation on proposed or existing footings/piers must be carefully considered.

Soil Surveys Engineering and the Structural Engineer should be consulted on this matter prior to construction.

6.7.7 Inspections

It is recommended that inspections be undertaken by an experienced and qualified geotechnical engineer from Soil Surveys Engineering during footing and pier excavations to confirm the adequacy of the founding material. Inspections should be carried out prior to placement of reinforcing steel and ordering of concrete.

6.8 Articulation and Detailing

It is recommended that any masonry walls be articulated. This articulation may be achieved by the use of full height (footings to eaves) openings or vertical construction joints at regular intervals. Guidelines on articulation are contained in the Cement and Concrete Association's Technical Note 61, 'Articulated Walling'.

6.9 Site Management

It is important that proper site management methods be observed for the existing soil conditions by both the builder at the time of the construction and the owner(s) throughout the life of the proposed development.

Particular reference to site management matters is set out in AS 2870-2011, particularly Appendix B of this Australian Standard. It should be noted that where proper site management, particularly with respect to change in moisture conditions, is not followed, the foundation recommendations contained in this report could be considered void.

The following are some general comments with respect to site management. However, the reader is directed to AS 2870-2011 (particularly Appendix B) and the CSIRO publication, "Foundation Maintenance and Footing Performance: A Homeowners Guide" (Building Technology File 18), for a complete discussion and further information on foundation performance and maintenance:-

- It is important that the site be well drained. The ground around the structures should slope away at 1 in 50 and then fall to the stormwater system to prevent ponding of water against or near to the structures.
- Roof downpipes and garden taps should not be allowed to wet founding soils.
- It is recommended that service trenches under the building be minimised as disruption or breakage of these service lines could lead to saturation of the under slab material resulting in an increase to moisture condition. If this were to occur, all footing recommendations contained within this report would be void.
- Footings should be placed with minimal delay after excavation to avoid desiccation or wetting of the founding soils. If footings cannot be poured on the same day as excavation, a blinding layer of 75mm thickness is recommended. Piers should be poured immediately.
- Do not let the slab subgrade "dry out" prior to casting.
- Future shrubs and trees should be planted at a distance from the buildings to avoid shrinkage movement in the potentially expansive founding soils. Also refer Section 6.6.

6.10 Pavements

6.10.1 General

It is understood that flexible pavements are proposed for the new internal roadways and carparking areas.

6.10.2 Design CBR

Laboratory testing was carried out on the natural clay material sampled from Boreholes 1, 3 and 5 to determine this material's California Bearing Ratio (CBR); the CBR value represents the 'strength' of this material, compacted to 98% standard density ratio, under saturation. The Soaked CBR tests produced values of 5.0%, 3.5% and 4.0% respectively.

For preliminary design a Soaked CBR value of 3.0% is recommended.

Uncontrolled fill material exists on site. For pavement construction full subgrade treatment is recommended in areas where uncontrolled fill exists.

Full subgrade treatment involves complete removal of uncontrolled fill so that a controlled/certified fill platform is created.

* * *

Along with recommendations contained in Sections 6.1 and 6.4, the following general earthworks recommendations are made:-

i) Incorporate a perimeter drain at the pavement edges to prevent possible deterioration under wet weather.

ii) Pavements should be well drained both during and upon completion of construction. Water should not be allowed to pond on or near pavement surfaces.

iii) Pavement gravel should comply with the local authority quality specifications for sub base and base course material.

iv) Subgrades should be compacted to achieve the minimum density ratios as outlined in Section 6.4 'Earthworks'.

v) **It is recommended that inspection and testing be carried out following general earthworks to fully assess subgrade conditions.**

7.0 FURTHER INVESTIGATION 'NEXT STEPS'

A Phase 2 detailed geotechnical investigation is recommended. The scope of this study should (at least) include:-

- Additional borehole drilling following finalisation of planning details is required, i.e. deep boreholes at ILU basement locations, shallow boreholes at final module ILU locations, shallow holes along finalised roadway alignment, etc.
- Detailed Landslip Assessment is expected to be required by Council following finalisation of planning.

8.0 LIMITATIONS

We have prepared this report for the use of **Lutheran Church of Australia QLD**, for design purposes in accordance with generally accepted geotechnical engineering practices. No other warranty, expressed or implied, is made as to the professional advice included in this report. This report has not been prepared for use by parties other than **Lutheran Church of Australia QLD**; it may not contain sufficient information for purposes of other parties or for other uses. Please note that any third party relying on the information contained in this report for any purpose whatsoever does so entirely at its own risk, and any duty of care to that third party is excluded.

Any interpretation or recommendation given by Soil Surveys Engineering shall be understood to be based on judgement and experience and not on greater knowledge of the facts than the reported investigations would imply. The interpretation and recommendations are therefore opinions provided for our Client's sole use in accordance with the specific brief. As such they do not necessarily address all aspects of ground behaviour on the subject site. Information provided by others has been taken in good faith, but no liability can be accepted for information provided by others.

The preliminary nature of this study is emphasised.

This report is not suitable or adequate for detailed design.

Your attention is drawn to 'Appendix A', 'Notes Relating to this Report'. Interpretation of factual data given in this report is based on judgement, not a greater knowledge of facts other than those reported.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes, the method of drilling, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes. Subsurface conditions between boreholes may vary significantly from conditions encountered at the borehole locations.

In the event that conditions encountered on site during construction appear to vary from those expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are more readily resolved when conditions are exposed than at some later stage, after the event.

Soil Surveys Engineering consider that a documentation review service (during the design phase and prior to construction) to verify that the intent of geotechnical recommendations is properly reflected in the design, along with construction inspections, forms a very important component of the geotechnical engineering design service/process.

The geotechnical review ensures geotechnical risks to our Client and their project are minimised at the design and tender stage of the project. Further, with Soil Surveys Engineering being commissioned to carry out geotechnical construction inspections, an opportunity at the time of construction to confirm any assumptions made in the preparation of the report and allow the effect of any normally occurring variation in ground conditions to be assessed with respect to construction becomes available.

The above statements are not intended to reduce the level of responsibility accepted by Soil Surveys Engineering in accordance with our commission, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in doing so and the risks they accept should they decline to have Soil Surveys Engineering carry out a geotechnical documentation review and geotechnical construction inspections.

It is highly recommended that the Client avail themselves of these review and inspection services; our standard rates will apply.

M. V. GEALE (RPEQ 3839)
PRINCIPAL ENGINEER

for and on behalf of
SOIL SURVEYS ENGINEERING PTY LIMITED

APPENDICES

APPENDIX A

NOTES RELATING TO THIS REPORT

INTRODUCTION

These notes are provided by Soil Surveys Engineering Pty Limited (the Company) to complement the geotechnical report in regard to classification methods and field procedures. Not all notes are necessarily relevant to all reports.

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited information about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such information obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and at the time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

Soils - The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726-1993 (Geotechnical Site Investigations), where appropriate. In general, descriptions cover the following properties - soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the dominant particle size and behaviour as set out in AS 1726-1993.

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, shear vane, laboratory testing or engineering examination. The strength terms are defined in AS1726-1993 Table A4.

Non-cohesive soils are classified on the basis of relative density usually based on insitu testing or engineering examination (see AS1726-1993 Table A5).

Rocks - Rock types are classified by their geological names (AS1726-1993 Table A6), together with descriptive terms regarding weathering (AS1726-1993 Table A9), strength (refer Table 1 below), defects (AS1726-1993 Table A10), etc. Where strength testing (ie Point Loads) is carried out, AS1726-1993 Table A8 is used. Where relevant, further information regarding rock classification is attached.

Table 1 Estimated strength descriptions given to rock based on engineering examination

Strength Term	Approximate Qu (MPa)
Extremely Weak	< 1.0
Very Weak	1.0 - 5.0
Weak	5.0 - 25
Medium Strong	25 - 50
Strong	50 - 100
Very Strong	100 - 250
Extremely Strong	> 250

Ref ISRM "Suggested Methods for the Quantitative Description of Discontinuities in Rock Masses"

SAMPLING

Sampling is carried out during drilling or from other excavations to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon sample disturbance, (information on strength and structure).

Undisturbed samples are taken by pushing a thin walled sample tube, usually 50mm diameter (U50), into the soil and withdrawing it with a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength, volume change potential and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

TEST LOCATIONS

Test locations (e.g. boreholes, CPT's, test pits etc.) were based on available access at the time of testing (access may need to be provided "by others"). Test locations may have been shifted if access was not suitable.

Unless noted otherwise, accuracy of test locations are to the accuracy of hand held GPS equipment.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application.

Test Pits - These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling - A borehole of 50 to 100mm diameter is advanced by manually operated equipment. Refusal of the augers can occur on a variety of materials such as hard clay, gravel or rock fragments and does not necessarily indicate rock level.

Continuous Spiral Flight Augers - The borehole is advanced using 75 to 300 mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the augers. Information from the drilling (as distinct from specific sampling) is of relatively lower reliability due to remoulding, inclusion of cuttings from above or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table has a lower reliability than augering above the water table. Various drill bits are attached to the base of the augers during the drilling. The depth of refusal of the different bit types can provide information as to the strength of the material encountered. Generally two different bit types are used. The 'V' bit is a V shaped steel bit and the 'TC' bit is a tungsten carbide tipped screw type bit.

Wash Boring - The borehole is usually advanced by a rotary bit with water or fluid pumped down the hollow drill rods and returned up in the space between the rods and the soil or casing, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from "feel" and rate of penetration. More accurate information on soil strata is gained by regular testing and sampling using the Standard Penetration Test (SPT) and undisturbed thin walled tube samples (U50).

Mud Stabilized Drilling - Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilize the borehole. The term "mud" encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from regular intact sampling (eg. from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling - A continuous core sample is obtained using a diamond or tungsten carbide tipped core barrel. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable method of investigation. In rocks, NMLC coring (nominal 52 mm diameter) is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses is determined on site by the supervisor. If the location of the loss is uncertain, it is placed at the top end of the run, when the core is placed in a storage tray and recorded on the log.

Standard Penetration Tests - Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils, as a means of indicating density or strength. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" - Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm, the upper 150 mm being neglected due to possible disturbance from the drilling method. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued at a reduced penetration.

In the case where full penetration is obtained with successive blow counts for each 150 mm of, say 4, 6 and 7 blows, the record shows,

4, 6, 7 N = 13

In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm, the record shows:

15, 30/40mm

The results of the test can be related empirically to the engineering properties of the soil.

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, it is noted on the borehole logs.

A modification to the SPT test is where the same driving system is used with a solid 60^0 tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid SPT are shown as "N_c" on the borehole logs, together with the number of blows per 150 mm penetration.

Cone Penetration Tests - Test Method - Cone Penetration Tests (CPT) are carried out in accordance with AS 1289 Test 6.5.1-1977, using an electrical friction-cone penetrometer.

The test essentially comprises the measurement of resistance to penetration of a cone of 35.7 mm diameter pushed into the soil at a rate of 10-20 mm per second by hydraulic force. The resistance to penetration is recorded in terms of pressure on the end area of the cone (cone resistance, q_c, in MPa) and friction on the side of the 135 mm long sleeve immediately above the top of the cone (friction resistance, f_s, in kPa). These forces are measured by electrical transducers (strain gauges) within the cone device. The ratio between friction resistance and cone resistance is also calculated as a percentage, ie.-

$$Friction\ Ratio\ (FR) = \frac{Friction\ Resistance, f_s\ (kPa) \times 100}{cone\ resistance,\ q_c\ (kPa)}$$

The friction ratio, FR, is generally low in sands (less than 1% or 2%) and generally higher in clays (say 3% or more). The interpretation of sandy clays, clayey sands and material with a high silt content is more difficult, but intermediate values (between 1% and 3%) would be expected. Highly organic clays and peats generally have a friction ratio in excess of 5%.

Static cone data is recorded in the field on disc for later presentation using computer aided drafting.

The equipment can be operated from any conventional drill rig. A total applied load in the range of 4 to 10 tonnes is required for practical purposes, although lighter loads may be used. The cone penetrometers are available with various capacities of cone resistance ranging up to 100 MPa for general purpose investigations, while a range of 0 to 10 MPa can be used where more sensitive investigations of soft clay are required.

The cone resistance value provides a continuous measure of soil strength or density, and together with the friction ratio, provide very useful indications of the presence of narrow bands of geotechnically significant layers such as thin, soft clay layers or lenses of sand which might otherwise be missed using conventional drilling methods.

The lithology of the encountered soils is interpreted from static cone data and is generally presented on the static cone log sheets.

It is important to note that the lithology is interpreted information and is based on research by Schmertmann (1970), Sanglerat (1972), Robinson and Campinalli (1986), modified to suit local conditions as indicated by borehole information and laboratory testing.

As soils generally change gradually it is sometimes difficult to accurately describe depths of strata changes, although greater accuracy is obtained with the static cone compared with conventional drilling. In addition, friction ratios decrease in accuracy with low cone resistance values, and in desiccated soils. As a result, some overlap and minor discrepancies may

exist between static cone and nearby borehole information.

Portable Dynamic Cone Penetrometers - Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 100mm increments of penetration.

The DCP comprises a Cone of 20 mm diameter with 30 degree taper attached to steel rods of smaller section.

The cone end is driven with a 9 kg hammer falling 510 mm (AS. 1289 Test 6.3.2). The test was developed initially for pavement subgrade investigations, and empirical correlations of the test results with California Bearing Ratio have been published by various Road Authorities. The Company has developed their own correlations with Standard Penetration tests and Density Index tests in sands.

LOGS

The borehole or test pit logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will enable the most reliable assessment but is not always practicable or possible to justify on economic grounds. In any case, the boreholes or test pits represent only a very small sample of the total subsurface conditions.

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems.

- Although groundwater may be present in lower permeability soils, it may enter the hole slowly or perhaps not at all during the time the hole is open.
- A localized perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be bailed out of the bore and mud must be washed out of the hole or "reverted" if water observations are to be made.

More reliable measurements can be made by use of standpipes which are read after stabilizing at periods ranging from several days to perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg. bricks, steel, etc.) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is important to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms and the attached explanatory notes summarize important aspects of the Laboratory Test Procedures adopted.

ENGINEERING REPORTS

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. The information provided in Soil Surveys Engineering reports is opinion and interpretation and not factual. The client/contractor increases their risk by not retaining the person who authored the geotechnical report, to carry out site inspection and review (overseeing role) during construction, to confirm opinion and interpretation expressed in the report is accurate. Where the report has been prepared for a specific design proposal the information and interpretation may not be relevant if the design proposal is changed. If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical aspects and recommendations or suggestions for design and construction. Since the test sites in any exploration represent a very small proportion of the total site and since the exploration only identifies actual ground conditions at the test sites, even under the best circumstances actual conditions may vary from those inferred to exist. No responsibility is taken for:-

- Unexpected variations in ground and/or groundwater conditions.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of other persons.
- Any work where the company is not given the opportunity to supervise the construction using the Companies designs/recommendations.

If differences occur, the Company will be pleased to assist with investigation or advice to resolve any problems occurring.

SITE ANOMALIES

In the event that conditions encountered on site during construction appear to vary from those expected from the information contained in the report, the Company requests that it immediately be notified. Most problems are more readily resolved when conditions are exposed than at some later stage, well after the event.

Extreme events including but not limited to the results of climate change, eg. flood levels above previously identified levels, beach scour or erosion beyond normal expectations (as identified by local authorities) extreme rainfall events, war, espionage, sabotage may result in different conditions between time of investigation and time of construction.

REPRODUCTION OF INFORMATION FOR CONTRACTUAL PURPOSES

Attention is drawn to the document “Guidelines for the Provision of Geotechnical Information in Construction Contracts (1987)”, published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances, where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

REVIEW OF DESIGN

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer. We would be happy to assist in this regard as an extension of our investigation commission. Construction drawings should be reviewed by Soil Surveys Engineering, with sufficient time to allow changes if required, prior to inspections.

Otherwise Soil Surveys Engineering reserves the right to refuse to carry out inspections.

SITE INSPECTION

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

i) Site visits during construction to confirm reported ground conditions

ii) Site visits to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, the stability of a filled or excavated slope; or

iii) Full-time engineering presence on site.

In the vast majority of cases it is advantageous to the principal for the geotechnical engineer who wrote the investigation report to be involved in the construction stage of the project.

The geotechnical engineer cannot take responsibility for variations in encountered conditions, where he is not given the opportunity to review plans for the proposed development with sufficient time to allow review and make changes to the proposed development if required, and where he is not given the opportunity to inspect the site and oversee construction methods with regard to site conditions with sufficient time to observe all relevant site conditions and operations.

RESPONSIBLE USE OF GEOTECHNICAL INFORMATION

Recommendations in our report are for design purposes only and provided on the basis that inspections are carried out to allow finalisation of opinions and recommendations contained in our report.

The geotechnical investigation consisting of field and laboratory testing has been carried out to indicate typical conditions by indicating conditions and parameters at the specific locations of boreholes/test pits. Subsurface conditions are indicated at these locations only and the inference of conditions between or away from these locations (interpolation and extrapolation) involves a certain degree of risk. Persons inferring such conditions or carrying out such inferences should do so with a degree of caution and conservatism which is commensurate with the consequences of the risk of error.

Estimates of volumes based on our findings require interpolation and extrapolation between test locations and as such may be significantly different from actual volumes.

APPENDIX B

BOREHOLE RECORD SHEETS

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

BOREHOLE RECORD SHEET

Location Number: BH 01

Project Number: 117-19539
Project Name: Trinder Park Aged Care Facility
Location: 10 Laurel Street, Woodridge
Client: Lutheran Community Care
Date: 28/06/2017

Easting: 509168 Northing: 6943804 RL:
Logger: RH Operator: RH Machine: EVH1750

Drilling Method (TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 0 6 12 18 24 30	Samples and Remarks
	0.15		FILL Sandy GRAVEL (GP) Medium dense, fine to coarse sized, dark brown, fine to coarse grained sand, with low plasticity fines, moist.		D
	0.60		NATURAL Sandy GRAVEL (GP) Dense, fine to medium sized, dark brown, fine to coarse grained sand, trace of low plasticity fines, moist.		D
	1.0		Clayey GRAVEL (GC) Dense, fine to medium sized, dark brown mottled light grey, low to medium plasticity fines, with fine to coarse grained sand, moist; tending to sandstone (XW).		D B
	2.0				
	2.10		Clayey GRAVEL (GC) Dense, fine to medium sized, dark brown mottled light grey, low to medium plasticity fines, with fine to coarse grained sand, moist; tending to conglomerate (XW) very weak.		
	2.80		SANDSTONE (XW) Extremely weathered, very weak, mottled light grey light brown.		
	3.0				
	4.0				
	4.50		BOREHOLE BH 01 TERMINATED AT 4.50 m		
	5.0				
	6.0				
	7.0				
	8.0				
	9.0				
	10.0				

Comments:
1. Groundwater not encountered.
2. DCP refusal at 0.28m, 1.39m and 1.57m.

Water First Noted Water Steady Level

Weathering Grades
RS - Residual Soil
XW - Extremely weathered
DW - Distinctly weathered
SW - Slightly weathered
FR - Fresh

Rock Strength
RS - Residual Soil
VW - Very weak
W - Weak
MS - Medium Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Samples
U50
SPT
Disturbed Sample
Bulk Sample

Approved: MG
Date: 8/08/2017

SOIL SURVEYS 2.00 LIB 2017-07-13.GLB Log SOIL_SURVEY_AUGER_LOG 1-19539 GINT.GPJ <<DrawingFile>> 08/08/2017 14:37 10.0.000 Developed by Datgel

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

BOREHOLE RECORD SHEET

Location Number: BH 02

Project Number: 117-19539
Project Name: Trinder Park Aged Care Facility
Location: 10 Laurel Street, Woodridge
Client: Lutheran Community Care
Date: 28/06/2017

Easting: 509280 Northing: 6943993 RL:
Logger: RH Operator: RH Machine: EVH1750

Depth	Description	Samples and Remarks
0.20	FILL Sandy GRAVEL (GP) Medium dense, fine sized, dark brown, fine to coarse grained sand, trace of low to medium plasticity fines, with organics, moist.	D
0.45	FILL Sandy CLAY (CI-CH) Hard, medium high plasticity, mottled red brown dark brown, fine to coarse grained sand, trace of fine to medium sized gravel, moist.	D
1.10	FILL ASH, Dark grey black, with silty sand bands, moist.	
1.60	NATURAL Silty SAND (SM) Medium dense, fine to coarse grained, dark brown, with fine to medium sized gravel, moist.	
2.60	Silty CLAY (CH) Hard, high plasticity, red brown mottled light grey, trace of fine to medium sized gravel, moist.	D U50 PP>600 Rec = 534%
3.20	SANDSTONE (XW) Extremely weathered, very weak, mottled red brown light grey.	
	BOREHOLE BH 02 TERMINATED AT 3.20 m	

Drilling Method: TC, WB, RR, NMLC, Casing

DCP Test (blows/100mm): 0, 6, 12, 18, 24, 30

Comments:
1. Groundwater not encountered.
2. DCP refusal at 2.58m.
3. Maximum 'TC' bit limit at 3.20m.

Water First Noted Water Steady Level

Weathering Grades
RS - Residual Soil
XW - Extremely weathered
DW - Distinctly weathered
SW - Slightly weathered
FR - Fresh

Rock Strength
RS - Residual Soil
VW - Very weak
W - Weak
MS - Medium Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Samples
U50
SPT
Disturbed Sample
Bulk Sample

Approved: MG
Date: 8/08/2017

SOIL SURVEYS 2.00 LIB 2017-07-13.GLB Log SOIL_SURVEY_AUGER_LOG 1-19539 GINT.GPJ <<DrawingFile>> 08/08/2017 14:37 10.0.000 Developed by Datgel

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

BOREHOLE RECORD SHEET

Location Number: BH 03

Project Number: 117-19539
Project Name: Trinder Park Aged Care Facility
Location: 10 Laurel Street, Woodridge
Client: Lutheran Community Care
Date: 28/06/2017 Page: 1 OF 1

Easting: 509382 Northing: 6944094 RL:
Logger: RH Operator: RH Machine: EVH1750

Drilling Method (TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 0 6 12 18 24 30	Samples and Remarks
	0.15		NATURAL Silty CLAY (CI-CH) Hard, medium to high plasticity, dark brown, trace of fine to medium sized gravel, moist.		D
			Silty CLAY (CH) Hard, high plasticity, mottled red brown light grey, trace of fine to medium sized gravel, moist.		D B
	1.0				U50 PP>600 Rec = 94%
	1.15		Silty CLAY (CH) Hard, medium high plasticity, light grey mottled red brown, trace of fine to medium sized gravel, moist.		U50 PP>600 Rec = 67%
	1.60		SANDSTONE (XW) Extremely weathered, very weak, dark brown.		D
	2.0				
	2.40				
	2.50		SANDSTONE (DW) Distinctly weathered, weak, dark brown.		
			BOREHOLE BH 03 TERMINATED AT 2.50 m		
	3.0				
	4.0				
	5.0				
	6.0				
	7.0				
	8.0				
	9.0				
	10.0				

Comments:
1. Groundwater not encountered.
2. DCP refusal at 1.57m.
3. Maximum 'TC' bit limit at 2.50m.

Water First Noted Water Steady Level

Weathering Grades
RS - Residual Soil
XW - Extremely weathered
DW - Distinctly weathered
SW - Slightly weathered
FR - Fresh

Rock Strength
RS - Residual Soil
VW - Very weak
W - Weak
MS - Medium Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Samples
U50
SPT
Disturbed Sample
Bulk Sample

Approved: MG
Date: 8/08/2017

SOIL SURVEYS 2.00 LIB 2017-07-13.GLB Log SOIL_SURVEY_AUGER_LOG 1-19539 GINT.GPJ <<DrawingFile>> 08/08/2017 14:37 10.0.000 Developed by Datgel

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

BOREHOLE RECORD SHEET

Location Number: BH 04

Project Number: 117-19539
Project Name: Trinder Park Aged Care Facility
Location: 10 Laurel Street, Woodridge
Client: Lutheran Community Care
Date: 28/06/2017

Easting: 509411 Northing: 6944074 RL:
Logger: RH Operator: RH Machine: EVH1750

Drilling Method (TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 0 6 12 18 24 30	Samples and Remarks
	0.13		NATURAL Silty CLAY (CI-CH) Hard, medium to high plasticity, dark brown, trace of fine to medium sized gravel, moist.		U50 PP>600 Rec = 80%
			Silty CLAY (CH) Hard, high plasticity, mottled red brown light grey, trace of fine to medium sized gravel, moist.		U50 PP>600 Rec = 67%
	0.90		Silty CLAY (CL-CI) Hard, low to medium plasticity, light grey mottled light brown, trace of fine to medium sized gravel, moist.		
	1.70		SANDSTONE (XW) Extremely weathered, very weak, mottled light grey light brown.		
	2.30				
	2.50		SANDSTONE (DW) Distinctly weathered, weak, mottled light grey light brown.		
			BOREHOLE BH 04 TERMINATED AT 2.50 m		

1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0

Comments:
1. Groundwater not encountered.
2. DCP refusal at 1.67m.
3. Maximum 'TC' bit limit at 2.50m.

Water First Noted Water Steady Level

Weathering Grades
RS - Residual Soil
XW - Extremely weathered
DW - Distinctly weathered
SW - Slightly weathered
FR - Fresh

Rock Strength
RS - Residual Soil
VW - Very weak
W - Weak
MS - Medium Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Samples
U50
SPT
Disturbed Sample
Bulk Sample

Approved: MG
Date: 8/08/2017

SOIL SURVEYS 2.00 LIB 2017-07-13.GLB Log SOIL_SURVEY_AUGER_LOG 1-19539 GINT.GPJ <<DrawingFile>> 08/08/2017 14:37 10.0.000 Developed by Datgel

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

BOREHOLE RECORD SHEET

Location Number: BH 05

Project Number: 117-19539
Project Name: Trinder Park Aged Care Facility
Location: 10 Laurel Street, Woodridge
Client: Lutheran Community Care
Date: 28/06/2017

Easting: 509466 Northing: 6944040 RL:
Logger: RH Operator: RH Machine: EVH1750

Drilling Method (TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	DCP Test (blows/100mm) 0 6 12 18 24 30	Samples and Remarks
	0.25		FILL Sandy GRAVEL (GP) Medium dense, fine to medium sized, dark brown, fine to coarse grained sand, moist.		D
	0.50		NATURAL Silty SAND (SM) Medium dense, fine to coarse grained, dark grey, with low to medium plasticity fines, moist		D
	1.0		Sandy CLAY (CH) Hard, high plasticity, red brown mottled light grey, fine to coarse grained sand, trace of fine to medium sized gravel, moist.		B
	1.30		Sandy CLAY (CH) Hard, high plasticity, mottled light grey red brown, fine to coarse grained sand, trace of fine to medium sized gravel, moist.		U50 PP>600 Rec = 75% U50 PP>600 Rec = 67%
	2.0				
	2.30		Sandy CLAY (CI-CH) Hard, medium to high plasticity, mottled light grey red brown, fine to coarse grained sand, trace of fine to medium sized gravel, moist.		
	3.0	3.00			
			BOREHOLE BH 05 TERMINATED AT 3.00 m		
	4.0				
	5.0				
	6.0				
	7.0				
	8.0				
	9.0				
	10.0				

Comments:
1. Groundwater not encountered.
2. DCP refusal at 2.19m.

Water First Noted Water Steady Level

Weathering Grades
RS - Residual Soil
XW - Extremely weathered
DW - Distinctly weathered
SW - Slightly weathered
FR - Fresh

Rock Strength
RS - Residual Soil
VW - Very weak
W - Weak
MS - Medium Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Samples
U50
SPT
Disturbed Sample
Bulk Sample

Approved: MG
Date: 8/08/2017

SOIL SURVEYS 2.00 LIB 2017-07-13.GLB Log SOIL_SURVEY_AUGER_LOG 1-19539 GINT.GPJ <<DrawingFile>> 08/08/2017 14:37 10.0.000 Developed by Datgel

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

BOREHOLE RECORD SHEET

Location Number: BH 06

Project Number: 117-19539
Project Name: Trinder Park Aged Care Facility
Location: 10 Laurel Street, Woodridge
Client: Lutheran Community Care
Date: 11/07/2017

Easting: 509306 Northing: 6943841 RL:
Logger: BM Operator: BM Machine: Scout 1

Depth	Graphic	Description	Weathering	Strength (Estimated)	Defect Spacing	Rec (%)	RQD	Samples and Remarks
0.10		FILL Silty SAND (SM) Loose, fine to medium grained, dark brown, moist.						
0.40		FILL Gravelly Sandy CLAY (CH) Very stiff, high plasticity, light brown yellow grey mottled, fine to medium grained sand, fine sized gravel, moist.						SPT 26, 30/110mm N=R
1.0								
1.20		NATURAL SILTSTONE (XW) Extremely weathered, very weak, light grey red yellow mottled.						
		SILTSTONE, fine grained, white and orange, granular, with extremely closely to very closely spaced fractures, with some limonite staining, fragmented from 1.74m and 1.86m.	DW					1.23 m; J, **0°**, P, R, O, Z 1.27 m; J, **0°**, P, R, O, Z 1.36 m; J, **10°**, S, V, O, L/W 1.50 m; J, **0°**, S, V, O, L/W 1.60 m; J, **70°**, S, R, O, Z 1.68 m; J, **5°**, S, V, O, W 1.73-1.85 m; J, D, V, O, W 1.94m, Is50 = 0.04 MPa 2.06 m; J, **5°**, P, R, O, Z 2.09 m; J, **5°**, S, R, O, Z
2.0								
2.17								
		CORE LOSS 1.33m (2.17-3.50)				42	0	
3.0								
3.50								
		SILTSTONE, fine grained, grey and dark grey, granular, with very closely to closely spaced fractures, with some limonite staining, with a fine grained sandstone bed 35mm thick at 4.29m.	SW					3.61 m; J, **0°**, P, R, O, Z 3.76m, Is50 = 0.14 MPa 3.70 m; J, **0°**, P, R, O, Z 3.90 m; J, **0°**, P, R, O, Z 3.93 m; J, **0°**, P, R, O, Z 3.96 m; J, **0°**, P, R, O, Z 4.20 m; J, **0°**, S, V, O, L/W 4.25 m; J, **5°**, S, V, O, L/W 4.30 m; J, **0°**, S, V, O, L/W 4.38 m; J, **0°**, P, R, O, L 4.54 m; J, **0°**, P, R, O, W 4.94m, Is50 = 0.04 MPa 4.88 m; J, **5°**, P, V, O, W/L 5.11 m; J, **15°**, S, R, O, W/L
4.0			DW - SW			90	38	
5.0								
5.25								
5.45		CORE LOSS 0.20m (5.25-5.45)						
		INTERBEDDED SANDSTONE/SILTSTONE, fine grained, grey and orange, granular, thinly laminated, with very closely to closely spaced fractures, with some limonite staining.	SW					5.49 m; B, **0°**, P, R, O, Z 5.54 m; B, **0°**, P, R, O, Z 5.66 m; J, **70°**, S, R, O, W/L 5.70 m; B, **5°**, P, R, O, L 5.81m, Is50 = 0.05 MPa 5.87 m; B, **5°**, P, R, O, W/L 6.08 m; B, **5°**, P, R, O, L 6.22 m; B, **5°**, P, R, O, L 6.49 m; J, **0°**, P, R, O, W/L 6.78 m; J, **0°**, P, R, O, L/W 6.95m, Is50 = 0.12 MPa 6.89 m; B, **0°**, P, R, O, L 7.12 m; B, **5°**, P, R, O, Z
6.0								
7.0						87	61	
7.38								
		SANDSTONE, fine grained, grey mottled orange, granular, with moderately widely spaced fractures.						7.96m, Is50 = 0.06 MPa 7.89 m; J, **0°**, P, V, O, W/L
8.0								
8.05								
		CORE LOSS 0.40m (8.05-8.45)						
8.45								
		SANDSTONE, medium grained, grey mottled orange, granular, with very closely spaced fractures, with a clay seam 80mm thick at 9.74m, with some limonite staining.	DW					8.70 m; J, **0°**, P, V, O, W
9.0			DW - SW			80	41	9.08m, Is50 = 0.09 MPa
9.88			DW					9.52 m; J, **15°**, P, R, O, Z 9.59 m; J, **15°**, P, R, O, Z 9.64 m; J, **15°**, P, R, O, Z 9.69 m; J, **5°**, P, R, O, Z 9.75 m; C, **0°**, P, C, C
10.0								

Comments:
1. Groundwater not encountered.

Chainage : m Offset : m
Water First Noted Water Steady Level

Defects - 1.54m : F,60°,P,R,O,C
Depth (m) | Type: B - Bedding, C - Clay seam, F - Foliation, H - Schistosity, J - Joint, L - Cleavage, R - Fracture, S - Shear zone, T - Contact, V - Vein, Z - Decomposed Zone, DI - Drilling Induced break | Dip (deg) | Planarity: C - Curvilinear, D - Discontinuous, P - Planar, S - Subplanar, T - Stepped, U - Undulating | Roughness: L - Slickensides, P - Polished, R - Rough, S - Smooth, V - Very rough | Aperture: C - Closed, F - Filled, N - Clean, O - Open, S - Stain | Infill: C - Clay, F - Iron Oxide, K - Calcite, L - Limonite, Q - Quartz, S - Secondary mineral, U - Unidentified mineral, W - Weathered rock, X - Carbonaceous, Z - Clean

Weathering Grades
RS - Residual Soil
XW - Extremely weathered
DW - Distinctly weathered
SW - Slightly weathered
FR - Fresh

Rock Strength
RS - Residual Soil
VW - Very weak
W - Weak
MS - Medium Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Samples
U50
SPT
Disturbed Sample
Bulk Sample

Approved: MG
Date: 8/08/2017

SOIL SURVEYS 2.00 LIB 2017-07-13.GLB Log SOIL_SURVEY_BOREHOLE_LOG 1-19539 GINT.GPJ <<DrawingFile>> 08/08/2017 14:37 10.0.000 Developed by Datgel

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

BOREHOLE RECORD SHEET

Location Number: BH 06

Project Number: 117-19539
Project Name: Trinder Park Aged Care Facility
Location: 10 Laurel Street, Woodridge
Client: Lutheran Community Care
Date: 11/07/2017

Easting: 509306 Northing: 6943841 RL:
Logger: BM Operator: BM Machine: Scout 1

Drilling Method (TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	Weathering	Strength Estimated (RS VW W MS S VS)	Defect Spacing (20 60 200 600)	Rec (%)	RQD	Samples and Remarks
NMLC	10.65		SILTSTONE. fine grained, dark grey mottled orange, granular, with extremely closely to very closely spaced fractures, with some clay seams up to 25mm thick. *(continued)*	DW			80	41	9.84 m; J, **0°,** S, R, O, W 9.95 m; J, **0°,** P, R, O, Z 10.06-10.31 m; J, **80°,** S, V, O, W/L 10.40 m; J, **5°,** P, R, O, Z 10.45 m; J, **0°,** S, R, O, W 10.51-10.65 m; J, S, V, O, W
	11.0		CORE LOSS 0.55m (10.65-11.20)						
	11.20		SILTSTONE, fine grained, dark grey and white, granular, with very closely to closely spaced fractures, with some clay seams up to 40mm thick, with trace of limonite staining.	DW - SW			100	59	11.26 m; J, **5°,** P, R, O, Z 11.31 m; C, **0°,** P, C, C 11.47 m; J, **0°,** P, R, O, Z 11.62 m; C, **0°,** S, C, C 11.71 m; J, **0°,** S, V, O, W 11.75 m; C, **0°,** P, C, C 11.79 m; S, **0°,** P, R, O, Z 11.92m, Is50 = 0.05 MPa 12.14 m; B, **0°,** P, R, O, Z 12.17 m; J, **0°,** S, V, O, W 12.23 m; J, **5°,** P, R, O, Z
	12.0								
	12.30		BOREHOLE BH 06 TERMINATED AT 12.30 m						
	13.0								
	14.0								
	15.0								
	16.0								
	17.0								
	18.0								
	19.0								
	20.0								

Comments:
1. Groundwater not encountered.

Chainage : m Offset : m
Water First Noted Water Steady Level

Defects - 1.54m : F,60°,P,R,O,C

Depth (m) | Type: B - Bedding, C - Clay seam, F - Foliation, H - Schistosity, J - Joint, L - Cleavage, R - Fracture, S - Shear zone, T - Contact, V - Vein, Z - Decomposed Zone, DI - Drilling Induced break | Dip (deg) | Planarity: C - Curvilinear, D - Discontinuous, P - Planar, S - Subplanar, T - Stepped, U - Undulating | Roughness: L - Slickensides, P - Polished, R - Rough, S - Smooth, V - Very rough | Aperature: C - Closed, F - Filled, N - Clean, O - Open, S - Stain | Infill: C - Clay, F - Iron Oxide, K - Calcite, L - Limonite, Q - Quartz, S - Secondary mineral, U - Unidentified mineral, W - Weathered rock, X - Carbonaceous, Z - Clean

Weathering Grades
RS - Residual Soil
XW - Extremely weathered
DW - Distinctly weathered
SW - Slightly weathered
FR - Fresh

Rock Strength
RS - Residual Soil
VW - Very weak
W - Weak
MS - Medium Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Samples
U50
SPT
Disturbed Sample
Bulk Sample

Approved: MG
Date: 8/08/2017

SOIL SURVEYS 2.00 LIB 2017-07-13.GLB Log SOIL_SURVEY_BOREHOLE_LOG 1-19539 GINT.GPJ <<DrawingFile>> 08/08/2017 14:37 10.0.000 Developed by Datgel

Soil Surveys Engineering Pty. Limited
Specialists in Applied Geotechnics

SOIL SURVEYS

ph +61 7 3369 6000 brisbane@soilsurveys.com.au

CORE PHOTOGRAPHS

Location Number: BH06
Project Number: 117-19539
Project Name: Lutheran Community Care – Trinder Park
Client: Lutheran Church of Australia



Box 1: 1.20m - 6.00m



Box 2: 7.00m – 12.35m

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

BOREHOLE RECORD SHEET

Location Number: BH 07

Project Number: 117-19539
Project Name: Trinder Park Aged Care Facility
Location: 10 Laurel Street, Woodridge
Client: Lutheran Community Care
Date: 11/07/2017

Easting: 509236 Northing: 6943856 RL:
Logger: BM Operator: BM Machine: Scout 1

Drilling Method TC	WB	RR	NMLC	Casing	Depth	Graphic	Description	Weathering	Strength Estimated RS V W MS S VS	Defect Spacing 20 60 200 600	Rec (%)	RQD	Samples and Remarks
					0.07		FILL Bitumen.						
					0.30		FILL Clayey SAND (SC) Medium dense, fine to coarse grained, red brown, high plasticity fines, with fine to medium sized gravel, moist.						
					1.0		FILL Sandy CLAY (CH) Very stiff, high plasticity, grey red yellow brown, fine to medium grained sand, with fine sized gravel, moist.						SPT 15, 19, 28 N=47
					1.20		FILL Sandy CLAY (CH) Very stiff, high plasticity, grey red yellow brown, fine to medium grained sand, with fine to coarse sized gravel, moist.						
					1.60		NATURAL Silty CLAY (CH) Very stiff, high plasticity, light grey mottled yellow brown, moist.						SPT 8, 9, 12 N=21
					2.0		Silty CLAY (CH) Hard, high plasticity, light grey mottled yellow brown, moist.						
					2.10		Silty CLAY (CH) Hard, high plasticity, light grey mottled yellow brown, with some bands of ironstone, moist.						
					2.60		Silty CLAY (CH) Hard, high plasticity, light grey mottled yellow brown, with some bands of ironstone, moist; tending to weathered siltstone.						
					3.0		Silty CLAY (CH) Hard, high plasticity, dark grey, moist.						SPT 12, 22, 28 N=50
					3.30		Silty CLAY (CH) Hard to very hard, high plasticity, light grey, moist.						
					3.70		SILTSTONE (XW) Extremely weathered, very weak, grey yellow brown.						
					4.0		SILTSTONE (XW) Extremely weathered, very weak, brown.						U50 PP>600 Rec = 90%
					4.10		SILTSTONE (XW) Extremely weathered, very weak, dark grey brown; tending to mudstone.						
					5.0								
					5.60								
					6.0								SPT 30/110mm N=R
					6.00								
					7.0								
					7.20								SPT 29, 30/100mm N=R
					8.0								
					9.0								SPT 30/130mm N=R
					10.0								
					10.00								

Comments:
1. Groundwater not encountered.

Chainage : m Offset : m
Water First Noted Water Steady Level

Defects - 1.54m : F,60°,P,R,O,C

Depth (m)	Type	Dip (deg)	Planarity	Roughness	Aperature	Infill
	B - Bedding C - Clay seam F - Foliation H - Schistosity J - Joint L - Cleavage R - Fracture S - Shear zone T - Contact V - Vein Z - Decomposed Zone DI - Drilling Induced break		C - Curvilinear D - Discontinuous P - Planar S - Subplanar T - Stepped U - Undulating	L - Slickensides P - Polished R - Rough S - Smooth V - Very rough	C - Closed F - Filled N - Clean O - Open S - Stain	C - Clay F - Iron Oxide K - Calcite L - Limonite Q - Quartz S - Secondary mineral U - Unidentified mineral W - Weathered rock X - Carbonaceous Z - Clean

Weathering Grades
RS - Residual Soil
XW - Extremely weathered
DW - Distinctly weathered
SW - Slightly weathered
FR - Fresh

Rock Strength
RS - Residual Soil
VW - Very weak
W - Weak
MS - Medium Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Samples
U50
SPT
Disturbed Sample
Bulk Sample

Approved: MG
Date: 8/08/2017

SOIL SURVEYS 2.00 LIB 2017-07-13.GLB Log SOIL_SURVEY_BOREHOLE_LOG 1-19539.GINT.GPJ <<DrawingFile>> 08/08/2017 14:37 10.0.000 Developed by Datgel

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

BOREHOLE RECORD SHEET

Location Number: BH 07

Project Number: 117-19539
Project Name: Trinder Park Aged Care Facility
Location: 10 Laurel Street, Woodridge
Client: Lutheran Community Care
Date: 11/07/2017

Easting: 509236 Northing: 6943856 RL:
Logger: BM Operator: BM Machine: Scout 1

Drilling Method (TC / WB / RR / NMLC / Casing)	Depth	Graphic	Description	Weathering	Strength Estimated (RS VW W MS S VS)	Defect Spacing (20 60 200 600)	Rec (%)	RQD	Samples and Remarks
NMLC	10.70		INTERBEDDED SILTSTONE/SANDSTONE, fine grained, grey mottled orange, granular, with thinly laminated to laminated bedding, with very closely to closely spaced fractures, with some limonite staining.	DW - SW					10.07m, Is50 = 0.2 MPa
NMLC	11.0		INTERBEDDED SILTSTONE/SANDSTONE, fine grained, dark grey, granular, with thinly laminated bedding, with closely spaced fractures, trace of limonite staining.	SW			100	65	10.13 m; B, **0°,** P, R, O, Z 10.17 m; B, **0°,** P, R, O, Z 10.26 m; B, **0°,** S, R, O, Z 10.30 m; B, **0°,** P, R, O, Z 10.38 m; B, **0°,** P, R, O, Z 10.40 m; J, **90°,** S, R, O, Z 10.47 m; J, **30°,** P, R, O, L 10.56 m; B, **5°,** P, R, O, Z 10.60 m; J, **8°,** P, R, O, Z 10.63 m; B, **5°,** P, R, O, Z 10.69 m; B, **5°,** P, R, O, Z 10.79 m; J, **5°,** P, R, O, Z 10.89 m; B, **0°,** P, V, O, W 11.04m, Is50 = 0.08 MPa 11.10 m; B, **0°,** P, C, L 11.17 m; B, **5°,** P, C, L
NMLC	12.0								11.71 m; B, **5°,** P, R, O, Z 11.76 m; B, **5°,** S, R, O, Z 12.11m, Is50 = 0.05 MPa 12.19 m; B, **0°,** P, R, O, Z
NMLC	12.55			DW - SW					12.36 m; B, **5°,** P, R, O, Z 12.44 m; B, **5°,** P, R, O, Z
	13.0		BOREHOLE BH 07 TERMINATED AT 12.55 m						
	14.0								
	15.0								
	16.0								
	17.0								
	18.0								
	19.0								
	20.0								

Comments:
1. Groundwater not encountered.

Chainage : m Offset : m
Water First Noted Water Steady Level

Defects - 1.54m : F,60°,P,R,O,C

Depth (m) | Type: B - Bedding, C - Clay seam, F - Foliation, H - Schistosity, J - Joint, L - Cleavage, R - Fracture, S - Shear zone, T - Contact, V - Vein, Z - Decomposed Zone, DI - Drilling Induced break | Dip (deg) | Planarity: C - Curvilinear, D - Discontinuous, P - Planar, S - Subplanar, T - Stepped, U - Undulating | Roughness: L - Slickensides, P - Polished, R - Rough, S - Smooth, V - Very rough | Aperature: C - Closed, F - Filled, N - Clean, O - Open, S - Stain | Infill: C - Clay, F - Iron Oxide, K - Calcite, L - Limonite, Q - Quartz, S - Secondary mineral, U - Unidentified mineral, W - Weathered rock, X - Carbonaceous, Z - Clean

Weathering Grades
RS - Residual Soil
XW - Extremely weathered
DW - Distinctly weathered
SW - Slightly weathered
FR - Fresh

Rock Strength
RS - Residual Soil
VW - Very weak
W - Weak
MS - Medium Strong
S - Strong
VS - Very Strong
ES - Extremely Strong

Samples
U50
SPT
Disturbed Sample
Bulk Sample

Approved: MG
Date: 8/08/2017

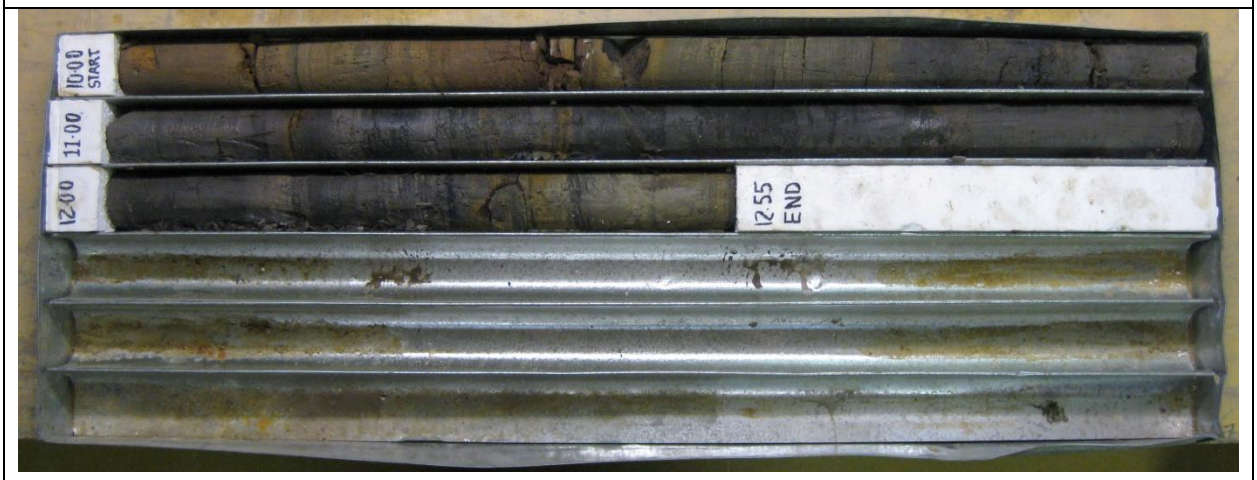
SOIL SURVEYS 2.00.LIB 2017-07-13.GLB Log SOIL_SURVEY BOREHOLE LOG 1-19539.GINT.GPJ <<DrawingFile>> 08/08/2017 14:37 10.0.000 Developed by Datgel

Soil Surveys Engineering Pty. Limited
Specialists in Applied Geotechnics

ph +61 7 3369 6000 brisbane@soilsurveys.com.au

CORE PHOTOGRAPHS

Location Number: BH07
Project Number: 117-19539
Project Name: Lutheran Community Care – Trinder Park
Client: Lutheran Church of Australia



Box 1: 10.00m – 12.25m

APPENDIX C

LABORATORY TEST CERTIFICATES

Helensvale Lab
Gold Coast
Unit 8, 140 Millaroo Drive
Helensvale QLD 4212
Australia
Ph:+61 7 5502 6795
Fax:+61 7 5502 6724

SOIL SURVEYS

Material Test Report

Report No: MAT:WHL17-0738-S1
Issue No: 1

Client: Lutheran Community Care
C/O 2/19 Finchley Street
Milton QLD 4064

Project: Trinder Park Aged Care Facility

Project Location: 10 Laurel Street, Woodridge

Project Number: 1-19539

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 15301

Approved Signatory: Rod Lucas (Senior Tech)
Date of Issue: 18/07/2017

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: WHL17-0738-S1
Field Sample ID:
Date Sampled: 28/06/2017
Source: Borehole
Material: Unknown
Specification: 98% STD
Sampling Method: As Supplied
Soil Description: Sandy Silty Clay with Trace of Gravel (CL) Red/Brown
Sampled By: SSE
Location Description: BH1
0.6-1.2m

Test Results

Description	Method	Result	Limits
Moisture Content [AS 1289.2.1.1]			
Moisture Content (%)		9.2	
Date Tested		11/07/2017	
Maximum Dry Density - Standard [AS 1289.5.1.1]			
Standard Maximum Dry Density (t/m³)		1.91	
Standard Optimum Moisture Content (%)		12.5	
Oversize Sieve (mm)		N/A	
Oversize Material (%)		N/A	
Date Tested		11/07/2017	
California Bearing Ratio [AS 1289.6.1.1]			
CBR At 5.0mm (%)		**5.0**	
Maximum Dry Density (t/m³)		1.91	
Optimum Moisture Content (%)		12.5	
Dry Density before Soaking (t/m³)		1.89	
Density Ratio before Soaking (%)		99	
Moisture Content before Soaking (%)		11.8	
Moisture Ratio before Soaking (%)		95	
Dry Density after Soaking (t/m³)		1.83	
Density Ratio after Soaking (%)		96	
Swell (%)		3.0	
Moisture Content of Top 30mm (%)		19.1	
Moisture Content of Remaining Depth (%)		14.7	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material (%)		0.0	
Date Tested		17/07/2017	

Comments

N/A

© 2000-2012 QESTLab by SpectraQEST.com

Helensvale Lab
Gold Coast
Unit 8, 140 Millaroo Drive
Helensvale QLD 4212
Australia
Ph:+61 7 5502 6795
Fax:+61 7 5502 6724

SOIL SURVEYS

Material Test Report

Report No: MAT:WHL17-0738-S2
Issue No: 1

Client: Lutheran Community Care
C/O 2/19 Finchley Street
Milton QLD 4064

Project: Trinder Park Aged Care Facility

Project Location: 10 Laurel Street, Woodridge

Project Number: 1-19539

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 15301

Approved Signatory: Rod Lucas (Senior Tech)
Date of Issue: 18/07/2017

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: WHL17-0738-S2
Field Sample ID:
Date Sampled: 28/06/2017
Source: Borehole
Material: Unknown
Specification: 98% STD
Sampling Method: As Supplied
Soil Description: Silty Sandy Clay (CH) Brown/Grey
Sampled By: SSE
Location Description: BH3
0.15-0.60m

Test Results

Description	Method	Result	Limits
Moisture Content [AS 1289.2.1.1]			
Moisture Content (%)		15.0	
Date Tested		11/07/2017	
Maximum Dry Density - Standard [AS 1289.5.1.1]			
Standard Maximum Dry Density (t/m³)		1.63	
Standard Optimum Moisture Content (%)		20.5	
Oversize Sieve (mm)		N/A	
Oversize Material (%)		N/A	
Date Tested		11/07/2017	
California Bearing Ratio [AS 1289.6.1.1]			
CBR At 2.5mm (%)		**3.5**	
Maximum Dry Density (t/m³)		1.63	
Optimum Moisture Content (%)		20.5	
Dry Density before Soaking (t/m³)		1.61	
Density Ratio before Soaking (%)		99	
Moisture Content before Soaking (%)		20.5	
Moisture Ratio before Soaking (%)		100	
Dry Density after Soaking (t/m³)		1.57	
Density Ratio after Soaking (%)		96	
Swell (%)		2.5	
Moisture Content of Top 30mm (%)		25.8	
Moisture Content of Remaining Depth (%)		23.3	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material (%)		0.0	
Date Tested		17/07/2017	

Comments

N/A

© 2000-2012 QESTLab by SpectraQEST.com

Helensvale Lab
Gold Coast
Unit 8, 140 Millaroo Drive
Helensvale QLD 4212
Australia
Ph:+61 7 5502 6795
Fax:+61 7 5502 6724

SOIL SURVEYS

Material Test Report

Report No: MAT:WHL17-0738-S3
Issue No: 1

Client: Lutheran Community Care
C/O 2/19 Finchley Street
Milton QLD 4064

Project: Trinder Park Aged Care Facility

Project Location: 10 Laurel Street, Woodridge

Project Number: 1-19539

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 15301

Approved Signatory: Rod Lucas (Senior Tech)
Date of Issue: 18/07/2017

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: WHL17-0738-S3
Field Sample ID:
Date Sampled: 28/06/2017
Source: Borehole
Material: Unknown
Specification: 98% STD
Sampling Method: As Supplied
Soil Description: Silty Sandy Clay (CH) Red/Grey
Sampled By: SSE
Location Description: BH5
0.5-1.0m

Test Results

Description	Method	Result	Limits
Moisture Content [AS 1289.2.1.1]			
Moisture Content (%)		15.7	
Date Tested		11/07/2017	
Maximum Dry Density - Standard [AS 1289.5.1.1]			
Standard Maximum Dry Density (t/m³)		1.73	
Standard Optimum Moisture Content (%)		20.0	
Oversize Sieve (mm)		N/A	
Oversize Material (%)		N/A	
Date Tested		11/07/2017	
California Bearing Ratio [AS 1289.6.1.1]			
CBR At 2.5mm (%)		**4.0**	
Maximum Dry Density (t/m³)		1.73	
Optimum Moisture Content (%)		20.0	
Dry Density before Soaking (t/m³)		1.71	
Density Ratio before Soaking (%)		99	
Moisture Content before Soaking (%)		19.3	
Moisture Ratio before Soaking (%)		96	
Dry Density after Soaking (t/m³)		1.66	
Density Ratio after Soaking (%)		96	
Swell (%)		2.5	
Moisture Content of Top 30mm (%)		24.2	
Moisture Content of Remaining Depth (%)		20.5	
Compactive Effort		Standard	
Surcharge Mass (kg)		4.50	
Period of Soaking (Days)		4	
Oversize Material (%)		0.0	
Date Tested		17/07/2017	

Comments

N/A

© 2000-2012 QESTLab by SpectraQEST.com

Helensvale Lab
Gold Coast
Unit 8, 140 Millaroo Drive
Helensvale QLD 4212
Australia
Ph:+61 7 5502 6795
Fax:+61 7 5502 6724

Report No: SSI:WHL17-0738-S4
Issue No: 1

Shrink Swell Index Report

Client: Lutheran Community Care
C/O 2/19 Finchley Street
Milton QLD 4064

Project: Trinder Park Aged Care Facility

Project Location: 10 Laurel Street, Woodridge

Project Number: 1-19539

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 15301

Approved Signatory: C.Ferguson-Hannah (Senior Technician)
Date of Issue: 14/07/2017

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	WHL17-0738-S4	**Sampling Method:**	As Supplied
Field ID:	N/A	**Material:**	N/A
Date Sampled:	28/06/2017	**Source:**	Borehole
Date Submitted:	N/A	**Specification:**	N/A
Project Location:	10 Laural Street, Woodridge		
Sample Location:	BH2, 1.80-1.88m		
Borehole Number:	N/A		
Borehole Depth (m):	N/A		

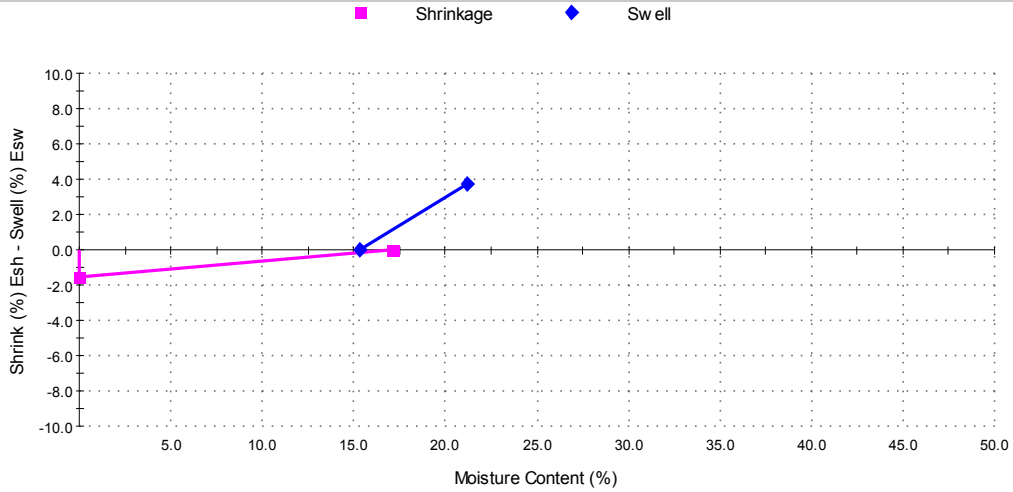
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	3.7
Moisture Content before (%):	15.3
Moisture Content after (%):	21.2
Est. Unc. Comp. Strength before (kPa):	N/A
Est. Unc. Comp. Strength after (kPa):	N/A

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	1.5
Shrinkage Moisture Content (%):	17.1
Est. inert material (%):	10
Crumbling during shrinkage:	N/A
Cracking during shrinkage:	Slight

Shrink Swell



Shrink Swell Index - Iss (%): 1.8

Comments

DESCRIPTION: SILTY CLAY(CH) GREY / ORANGE BROWN, SOME GRAVEL
UNIT WEIGHT:2.08 t/m3

© 2000-2012 QESTLab by SpectraQEST.com

Helensvale Lab
Gold Coast
Unit 8, 140 Millaroo Drive
Helensvale QLD 4212
Australia
Ph:+61 7 5502 6795
Fax:+61 7 5502 6724

Report No: SSI:WHL17-0738-S5
Issue No: 1

Shrink Swell Index Report

Client: Lutheran Community Care
C/O 2/19 Finchley Street
Milton QLD 4064

Project: Trinder Park Aged Care Facility

Project Location: 10 Laurel Street, Woodridge

Project Number: 1-19539

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 15301

Approved Signatory: C.Ferguson-Hannah (Senior Technician)
Date of Issue: 14/07/2017

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	WHL17-0738-S5	**Sampling Method:**	As Supplied
Field ID:	N/A	**Material:**	N/A
Date Sampled:	28/06/2017	**Source:**	Borehole
Date Submitted:	N/A	**Specification:**	N/A
Project Location:	10 Laural Street, Woodridge		
Sample Location:	BH3, 0.60-0.74m		
Borehole Number:	N/A		
Borehole Depth (m):	N/A		

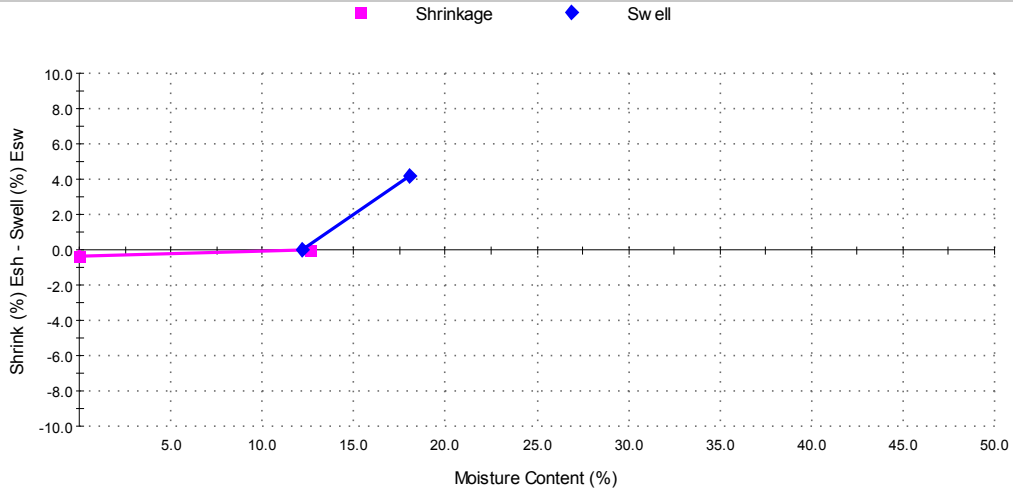
Swell Test AS 1289.7.1.1

Swell on Saturation (%):	4.1
Moisture Content before (%):	12.2
Moisture Content after (%):	18.1
Est. Unc. Comp. Strength before (kPa):	N/A
Est. Unc. Comp. Strength after (kPa):	N/A

Shrink Test AS 1289.7.1.1

Shrink on drying (%):	0.4
Shrinkage Moisture Content (%):	12.6
Est. inert material (%):	2
Crumbling during shrinkage:	N/A
Cracking during shrinkage:	Slight

Shrink Swell



Shrink Swell Index - Iss (%): 1.4

Comments

DESCRIPTION: SILTY CLAY(CI) RED BROWN, GREY MOTTLED, TRACE OF GRAVEL
UNIT WEIGHT: 1.91 t/m3

© 2000-2012 QESTLab by SpectraQEST.com

Helensvale Lab
Gold Coast
Unit 8, 140 Millaroo Drive
Helensvale QLD 4212
Australia
Ph:+61 7 5502 6795
Fax:+61 7 5502 6724

Report No: SSI:WHL17-0738-S6
Issue No: 1

Shrink Swell Index Report

Client: Lutheran Community Care
C/O 2/19 Finchley Street
Milton QLD 4064

Project: Trinder Park Aged Care Facility

Project Location: 10 Laurel Street, Woodridge

Project Number: 1-19539

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 15301

Approved Signatory: C.Ferguson-Hannah (Senior Technician)
Date of Issue: 14/07/2017

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID:	WHL17-0738-S6	**Sampling Method:**	As Supplied
Field ID:	N/A	**Material:**	N/A
Date Sampled:	28/06/2017	**Source:**	Borehole
Date Submitted:	N/A	**Specification:**	N/A
Project Location:	10 Laural Street, Woodridge		
Sample Location:	BH4, 0.40-0.52m		
Borehole Number:	N/A		
Borehole Depth (m):	N/A		

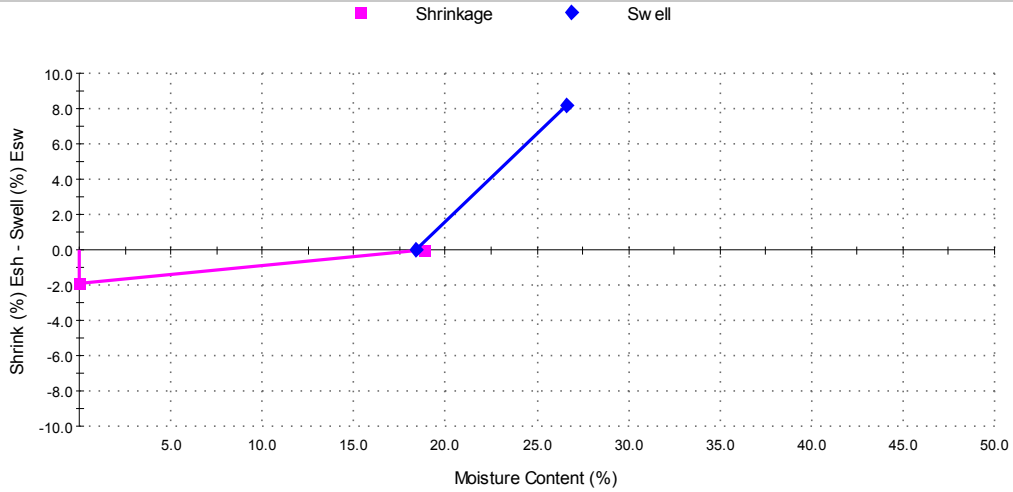
Swell Test — AS 1289.7.1.1

Swell on Saturation (%):	8.2
Moisture Content before (%):	18.4
Moisture Content after (%):	26.6
Est. Unc. Comp. Strength before (kPa):	N/A
Est. Unc. Comp. Strength after (kPa):	N/A

Shrink Test — AS 1289.7.1.1

Shrink on drying (%):	1.9
Shrinkage Moisture Content (%):	18.8
Est. inert material (%):	N/A
Crumbling during shrinkage:	N/A
Cracking during shrinkage:	Slight

Shrink Swell



Shrink Swell Index - Iss (%): 3.3

Comments

DESCRIPTION: SILTY CLAY(CH) GREY, RED BROWN MOTTLED
UNIT WEIGHT: 2.07 t/m3

© 2000-2012 QESTLab by SpectraQEST.com

Helensvale Lab
Gold Coast
Unit 8, 140 Millaroo Drive
Helensvale QLD 4212
Australia
Ph:+61 7 5502 6795
Fax:+61 7 5502 6724

Report No: MAT:WHL17-0738-S7
Issue No: 1

Material Test Report

Client: Lutheran Community Care
C/O 2/19 Finchley Street
Milton QLD 4064

Project: Trinder Park Aged Care Facility

Project Location: 10 Laurel Street, Woodridge

Project Number: 1-19539

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 15301

Approved Signatory: C.Ferguson-Hannah (Senior Technician)
Date of Issue: 14/07/2017

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: WHL17-0738-S7
Field Sample ID:
Date Sampled: 28/06/2017
Source: Borehole
Material:
Specification:
Sampling Method: As Supplied
Soil Description: Silty Clay(CI) Grey Brown, Orange Mottled, Some Gravel
Sampled By: SSE
Location Description: BH1
0.00-0.15m

Test Results

Description	Method	Result	Limits
Emerson Class Number [AS 1289.3.8.1]			
Emerson Class Number		Class 3	
Soil Description		N/A	
Type of Water		Distilled	
Temperature of Water (°C)		22.0	
Date Tested		14/07/2017	

Comments

N/A

© 2000-2012 QESTLab by SpectraQEST.com

Helensvale Lab
Gold Coast
Unit 8, 140 Millaroo Drive
Helensvale QLD 4212
Australia
Ph:+61 7 5502 6795
Fax:+61 7 5502 6724

Report No: MAT:WHL17-0738-S8
Issue No: 1

Material Test Report

Client: Lutheran Community Care
C/O 2/19 Finchley Street
Milton QLD 4064

Project: Trinder Park Aged Care Facility

Project Location: 10 Laurel Street, Woodridge

Project Number: 1-19539

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 15301

Approved Signatory: C.Ferguson-Hannah (Senior Technician)
Date of Issue: 14/07/2017

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: WHL17-0738-S8
Field Sample ID:
Date Sampled: 28/06/2017
Source: Borehole
Material:
Specification:
Sampling Method: As Supplied
Soil Description: Silty Clay(CI) Grey Brown, Orange Mottled
Sampled By: SSE
Location Description: BH3
0.00-0.15m

Test Results

Description	Method	Result	Limits
Emerson Class Number [AS 1289.3.8.1]			
Emerson Class Number		Class 4	
Soil Description		N/A	
Type of Water		Distilled	
Temperature of Water (°C)		22.0	
Date Tested		14/07/2017	

Comments

N/A

© 2000-2012 QESTLab by SpectraQEST.com

Helensvale Lab
Gold Coast
Unit 8, 140 Millaroo Drive
Helensvale QLD 4212
Australia
Ph:+61 7 5502 6795
Fax:+61 7 5502 6724

Report No: MAT:WHL17-0738-S9
Issue No: 1

Material Test Report

Client: Lutheran Community Care
C/O 2/19 Finchley Street
Milton QLD 4064

Project: Trinder Park Aged Care Facility

Project Location: 10 Laurel Street, Woodridge

Project Number: 1-19539

Accredited for compliance with ISO/IEC 17025 - Testing

NATA Accredited Laboratory Number: 15301

Approved Signatory: C.Ferguson-Hannah (Senior Technician)
Date of Issue: 14/07/2017

THIS DOCUMENT SHALL NOT BE REPRODUCED EXCEPT IN FULL

Sample Details

Sample ID: WHL17-0738-S9
Field Sample ID:
Date Sampled: 28/06/2017
Source: Borehole
Material:
Specification:
Sampling Method: As Supplied
Soil Description: Silty Gravelly Clay(CL) Grey / Orange Brown Mottled
Sampled By: SSE
Location Description: BH5
0.00-0.25m

Test Results

Description	Method	Result	Limits
Emerson Class Number [AS 1289.3.8.1]			
Emerson Class Number		Class 4	
Soil Description		N/A	
Type of Water		Distilled	
Temperature of Water (°C)		22.0	
Date Tested		14/07/2017	

Comments

N/A

© 2000-2012 QESTLab by SpectraQEST.com

Soil Surveys Engineering Pty. Limited
Specialist in Applied Geotechnics
PO Box 317, Paddington, 4064
+61 7 3369 6000
info@soilsurveys.com.au
www.soilsurveys.com.au
SOIL SURVEYS

POINT LOAD INDEX TEST REPORT

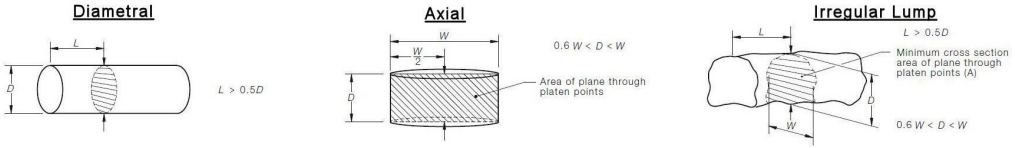
as per AS4133.4.1-2007

Project Number : 117-19539 **Project Name : Preliminary Geotechnical Investigation**

Project Location : Trinder Park Aged Care Facility

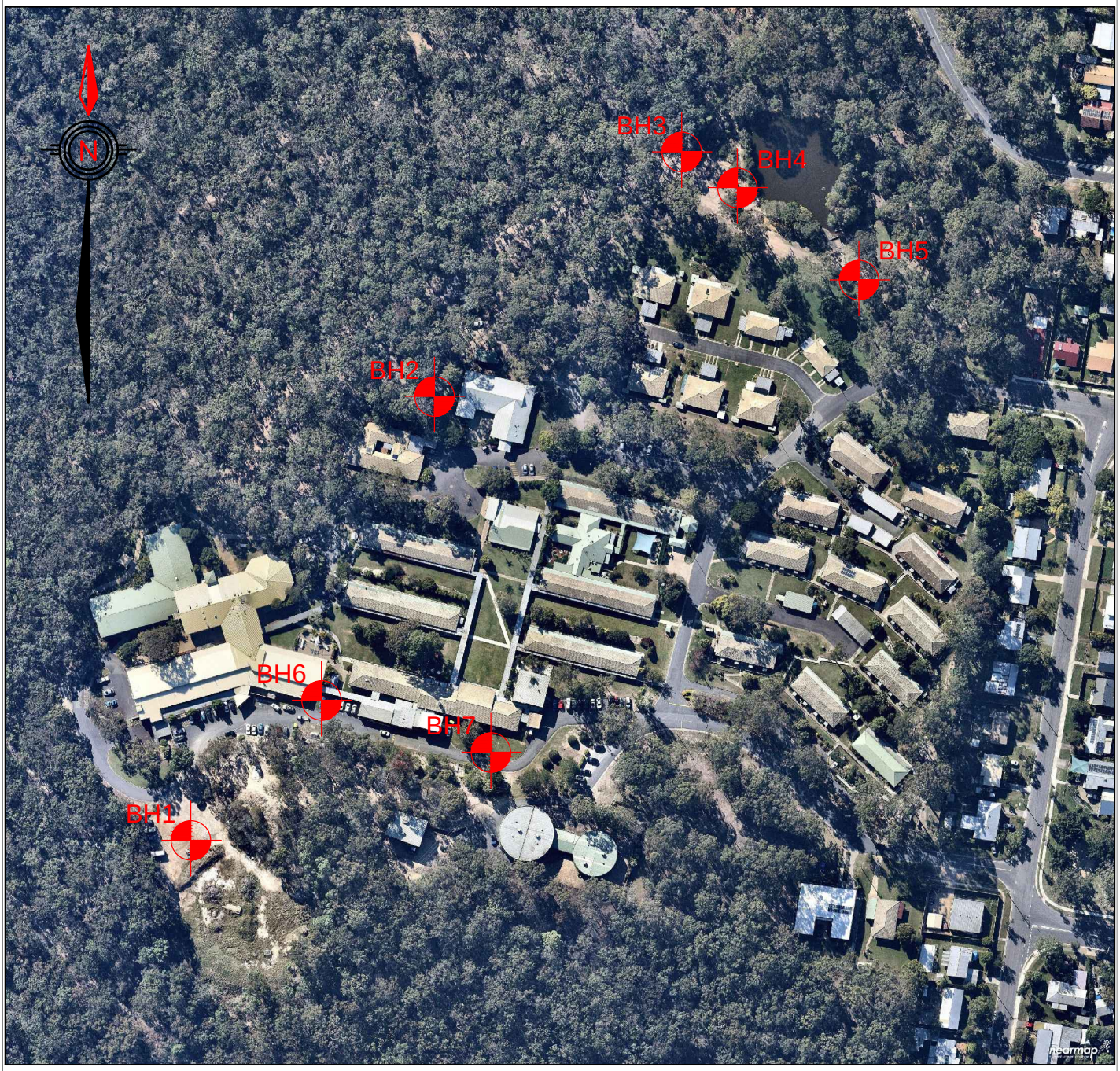
Project Client : Lutheran Community College

Borehole	Depth	Rock Type	Weathering Grade	Moisture Condition	Test Method	Core Size (mm)	Date Drilled	Date Tested	Failure Type	Failure Load (kN)	Is (MPa)	Is50 (MPa)	AS1726 Classification	Operator
BH 06	1.94	SILTSTONE	DW	Field	Axial	52	11/07/2017	26/07/2017	Along joint	0.1	0.03	0.04	VERY LOW	OH
BH 06	3.76	SILTSTONE	SW	Field	Diametral	52	11/07/2017	26/07/2017	Through rock mass	0.4	0.13	0.14	LOW	OH
BH 06	4.94	SILTSTONE	DW-SW	Field	Axial	52	11/07/2017	26/07/2017	Through rock mass	0.1	0.04	0.04	VERY LOW	OH
BH 06	5.81	SILTSTONE	SW	Field	Diametral	52	11/07/2017	26/07/2017	Through rock mass	0.1	0.04	0.05	VERY LOW	OH
BH 06	6.95	SANDSTONE	SW	Field	Axial	52	11/07/2017	26/07/2017	Through rock mass	0.4	0.11	0.12	LOW	OH
BH 06	7.96	SILTSTONE	SW	Field	Diametral	52	11/07/2017	26/07/2017	Through rock mass	0.2	0.06	0.06	VERY LOW	OH
BH 06	9.08	SANDSTONE	DW-SW	Field	Axial	52	11/07/2017	26/07/2017	Through rock mass	0.3	0.08	0.09	VERY LOW	OH
BH 06	11.92	SILTSTONE	DW-SW	Field	Diametral	52	11/07/2017	26/07/2017	Through rock mass	0.1	0.05	0.05	VERY LOW	OH
BH 07	10.07	SILTSTONE	DW-SW	Field	Diametral	52	11/07/2017	26/07/2017	Through rock mass	0.5	0.2	0.2	LOW	OH
BH 07	11.04	SILTSTONE	SW	Field	Axial	52	11/07/2017	26/07/2017	Through rock mass	0.3	0.08	0.08	VERY LOW	OH
BH 07	12.11	SILTSTONE	SW	Field	Diametral	52	11/07/2017	26/07/2017	Through rock mass	0.1	0.05	0.05	VERY LOW	OH



APPENDIX D

SITE PLAN



CLIENT
LUTHERAN COMMUNITY CARE

LOCATION
10 LAUREL ST, TRINDER PARK

TITLE
TRINDER PARK AGED CARE FACILITY
BOREHOLE LOCATION PLAN

SCALE 1:2500
25 0 100

A4	DRAWING NO.	DATE	CHECKED
	117-19539-01	01/08/17	MG

Soil Surveys
SOIL SURVEYS ENGINEERING PTY.LTD.
CONSULTING GEOTECHNICAL ENGINEERS

Level 9, 269 Wickham St
PO Box 612 Fortitude Valley
|QLD 4006, Australia

T +61 7 3251 8555
F +61 7 3251 8599
blightanner@blightanner.com.au
www.blightanner.com.au

