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PROPOSED 198 LOT RESIDENTIAL DEVELOPMENT, GRACEMERE SPRINGS ESTATE 70 WASHPOOL ROAD, GRACEMERE

ENGINEERING REPORT

FOR GRACEMERE SPRINGS PTY LTD

April 2013
Report No. R12166

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ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with Development Permit No. D588-2012
Dated 05/04/2016

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2012

DOCUMENT CONTROL

Engineering Report - 2012

Issue	Date	Issue Details	Author	Checked	Approved
1	14/11/12	Original Issue	MD	RS	
2	15/04/13	Information Request Response	MD	RS	

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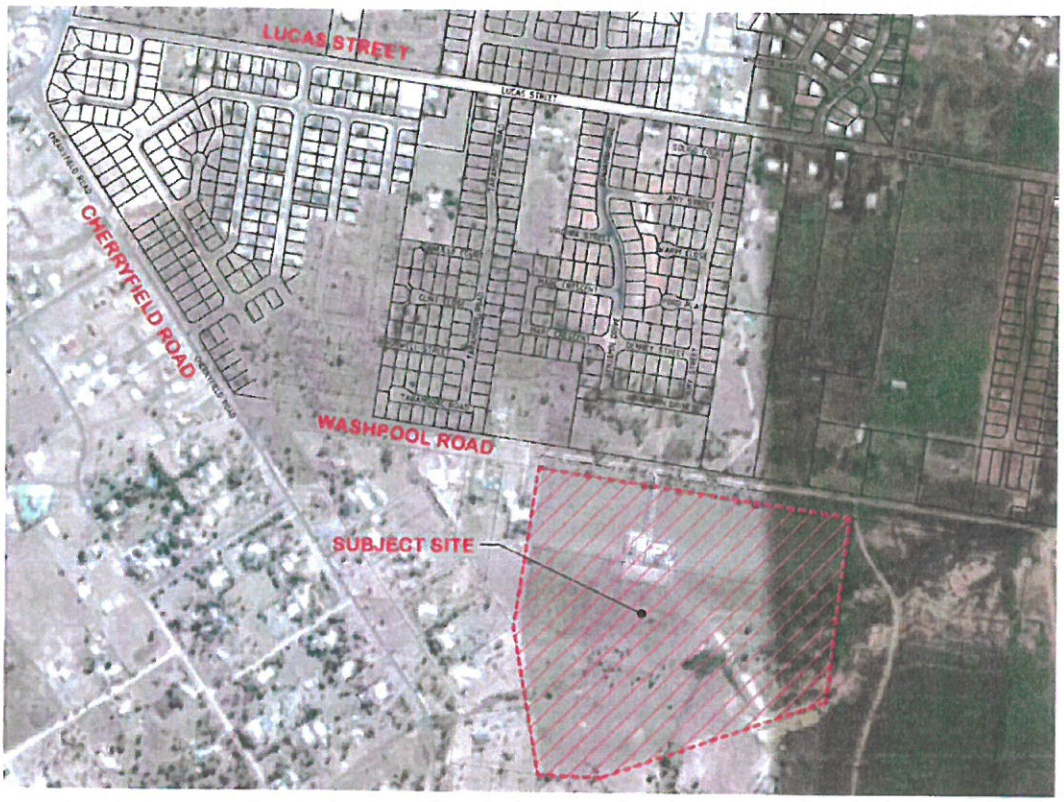
1 INTRODUCTION

Brown Consulting (QLD) Pty Ltd has prepared the following report to address the civil engineering issues associated with the "Development Permit for Reconfiguration of a Lot" Application for the development of Lot 4 on SP119672 into a 198 lot residential subdivision titled 'Gracemere Springs Estate' fronting Washpool Road, Gracemere. This proposed residential subdivision is located on the southern side of Washpool Road adjacent to the recently constructed residential subdivisions fronting Lucas Street and Washpool Road. The locality of the subject site can be seen in the following illustration.



2 STAGING

This proposal is for a 198 lot residential subdivision to be constructed over 7 stages (refer Appendix B). Stage 1A consists of the 'Reconfiguration of a Lot' for a 1 into 2 lot subdivision and an access easement in order to separate the existing dwelling on the site from the balance lot. The existing dwelling has a suitable allotment of which has been strategically planned and incorporated into the lot layout and staging for the proposed subdivision. The remainder of the subdivision consists of stages 1B, 2, 3, 4, 5, 6, and 7. These stages will comprise of different sized residential allotments. The number of allotments in each stage of the subdivision including the staging layout is illustrated in Appendix B.

Development plans prepared by Capricorn Survey Group is included in Appendix A and a staging plan prepared by Brown Consulting is enclosed in Appendix B.

3 GOOD PRACTICE URBAN DESIGN PRINCIPLES

The proposed development has been master-planned to incorporate best practices for urban developments, which are as follows:

- A mixture of gentle grade blocks, sloping allotments and elevated allotments will be incorporated into the proposed development. This ensures that the majority of the community is catered for from first home owners, to investors to luxury dwellings.

- Single access to Washpool Road (upgraded to a Major Collector Road) for the entire development with suitable approaches and sight distances. No allotments in the proposed subdivision will gain access from Washpool Road.

- Loop/ring and short cul-de-sac's roads are used throughout the layout providing short, safe access and manoeuvrability around the development.

- Pedestrian links are strategically positioned throughout the development joining roadways, while providing good access to amenities within the development and also to external roadway networks.

- Stormwater drainage strategies will be incorporated and consist of natural vegetated swales and channels and bio-retention systems, providing low maintenance stormwater polishing and ensuring runoff is managed and discharged with minimal impact to the environment, whilst adding to the appearance of the development.

4 SITEWORKS/EROSION CONTROL/GROUND CONDITIONS

Siteworks for the development will consist of the following stages:

- Clearing and grubbing
- Bulk earthworks
- Underground services installation
- Roadworks and stormwater drainage works
- Final detailed works
- Vegetation establishment and landscaping

A preliminary earthworks plan for the development has been included in Appendix C1 of this report.

All stockpiles are to be segregated into topsoil, pavements, sands and protected with appropriate silt traps and fences. All stockpiles are to be accessed from the upstream side to reduce erosion and maintain consistency throughout the project construction phase. Erosion control measures are to be implemented during construction in accordance with the Capricorn Municipal Development Guidelines requirements (refer Appendix C2). All erosion control measures are to be closely monitored by the Principal Contractor and re-established after all rain events or due to any vandalism.

5 SEWERAGE RETICULATION

A sewerage reticulation strategy has been prepared for the proposed residential development (Refer Appendix D).

The development is located within the vicinity of the recently installed Washpool Road gravity sewer trunk main which was established to service the residential subdivisions fronting Washpool Road and the southern side of Lucas Street. The Washpool Road sewer trunk main discharges into a recently constructed sewage pump station which is located approximately 280m east along Washpool Road from the eastern boundary of the proposed subdivision.

The Washpool Road sewer trunk main has been designed to cater for the Washpool catchment and therefore we see no issues with connecting all of the 198 residential allotments in this subdivision to the existing trunk main. Due to the proposed subdivision being in close proximity to the existing trunk main, a Sewerage Network Analysis has not been requested from Fitzroy River Water. If council require a Sewerage Network Analysis this can be completed with the future Operational Works application.

A preliminary design of the sewerage infrastructure to service all lots within the development has been completed and shown in Appendix D. The gravity sewer for the entire subdivision will fall towards the north eastern corner to connect into the Washpool Road gravity sewer trunk main. There seems to be no engineering difficulties in obtaining sufficient grade and cover for the proposed sewerage network.

6 WATER RETICULATION

A water reticulation strategy has been prepared for the subject land (refer Appendix E1).

Included in Appendix E2 of this report is an email from a Rockhampton Regional Council officer regarding trunk water infrastructure along Washpool Road for a future neighbouring development. It was proposed in the email and the attached drawing that a 200mm trunk main be constructed in Washpool Road to service the future neighbouring development. Therefore, it is proposed as part of this residential subdivision, that a 200mm trunk main be installed in the road reserve of Washpool Road up to the connection of the internal water supply network for the proposed subdivision. The 200mm trunk main is proposed to be positioned on the northern boundary in the road reserve of Washpool Road and connect into the existing 200mm trunk main in the road reserve of Cherryfield Road.

A water supply network analysis has been requested from Fitzroy River Water, to ensure that the advice given by Rockhampton Regional Council for the future neighbouring development as stated above is applicable for this proposed subdivision. The water supply layout and sizing for the subdivision will be consistent with the findings from the requested network analysis and will be incorporated into the future operational works design. A copy of the letter requesting this water network analysis is included in Appendix E3.

All internal allotments will be serviced by new reticulation mains situated in all new road reserves and designed to provide good loop connections throughout the site. Internal fire hydrants will be installed on all new watermains at 80m centres and in accordance with the requirements of the Capricorn Municipal Development Guidelines.

7 STORMWATER MANAGEMENT

The aim of the stormwater strategy is to try to maintain the natural flowpaths that flow through the development site with minimal realignment. Water quantity and quality objectives are to be met in accordance with the QUDM, CMDG & Healthy Waterways ensuring the surrounding environment, allotments and infrastructure are not adversely affected due to this residential subdivision. Please refer to the Stormwater Management Report for details regarding water quantity and quality measures to be implemented in the development works.

8 ROADWORKS/PEDESTRIAN NETWORKS

The proposed development will be accessed from Washpool Road (refer Appendix F).

Washpool Road currently has a 40.0m wide road reserve and has been designated to be upgraded to a Major Urban Collector road as part of some of the residential subdivisions constructed on land fronting Lucas Street and Washpool Road. It was a condition of the negotiated decision notice for the recently developed 'Parkside on Lucas' residential subdivision that Washpool Road be constructed to 1/2 width of a 10m wide road for the frontage of the 'Parkside on Lucas' site. As stated in the Capricorn Municipal Development Guidelines, a 10.0m wide road (invert to invert) is equivalent to a Major Urban Collector standard road. From the 'Parkside on Lucas' subdivision onwards, Washpool Road is a rural gravel road up to approximately the location of the existing sewage pump station, east of the proposed development site. Therefore, it is proposed that Washpool Road will be upgraded to a full width Major Urban Collector road from the intersection of Cherryfield Road to the intersection of the proposed Road A of this residential subdivision. The construction of Washpool Road to a Major Urban Collector road will accommodate up to 600 allotments which will service this subdivision and also cater for future developments along Washpool Road. Pedestrian pathways will be constructed along the full length of the Major Urban Collector standard road of Washpool Road in accordance with the requirements of the Capricorn Municipal Development Guidelines.

Road A of this proposed residential subdivision will be constructed as a Major Urban Collector road from the intersection of Washpool Road (Major Urban Collector) to the intersection of Road B within the development. This has been designed to service a traffic flow catchment up to 600 allotments, allowing for future neighbouring developments to access using this proposed road corridor whilst catering for the proposed 198 allotments in this development. For this portion of the road, Road A will be constructed at 10.0m wide (invert to invert) in a 20.0m wide road reserve. Two 1.2m pedestrian pathways will be constructed for the Major Urban Collector section of Road A in accordance with the Capricorn Municipal Development Guidelines.

From the intersection of Road B through the development, Road A will be developed as a Minor Urban Collector road in accordance with the Capricorn Municipal Development Guidelines. With a Minor Urban Collector road able to service a traffic flow catchment between 76 – 300 allotments, Road A will have the capacity to service this proposed development as well as future neighbouring developments. Road A will be constructed at 7.5m wide (invert to invert) in a 20.0m wide road reserve. A 1.2m pedestrian pathway will be constructed along the full length of Road A in accordance with the Capricorn Municipal Development Guidelines.

Road B has been designed to vary in road classification to accommodate the different traffic volumes that will utilise the road. It is proposed that Road B is to be constructed to a Minor Urban Collector road from chainage 0 to chainage 230.474 as the traffic flow catchment for this portion of Road B is greater than 75 allotments. With a Minor Urban Collector having the capacity to cater for a number of dwellings between 76 – 300 and an AADT of between 751 – 3000, a Minor Urban Collector will be able to satisfy the traffic flow requirements of this portion of Road B. Therefore, Road B will be constructed at 7.5m wide (invert to invert) from chainage 0 to chainage 230.474 in a minimum 18.0m wide road reserve.

A 1.2m pedestrian pathway will be constructed for the full length of the Minor Collector standard portion of Road B with the pathway linking through the easement between proposed lots 24 and 25 to Washpool Road. This encourages safe and easy accessible pedestrian movements from the subdivision to external road corridors.

Road B will transition to an Urban Access Street standard road at chainage 230.474 and continue through to chainage 1015.371 where Road B intersects again with Road A. With Road B intersecting with Road A in two places, the traffic catchment for Road B will be divided. Therefore, an Urban Access Street standard road is capable of managing traffic flow for Road B between the chainage 230.474 to chainage 1015.371 at the intersection of Road B and Road A. It will be constructed as a 7.5m wide (invert to invert) in an 18.0m wide road reserve. No pedestrian pathways will be constructed between these chainages in accordance with the Capricorn Municipal Development Guidelines.

It is proposed that Road J will be constructed as an Urban Access Street standard road as per the requirements of the Capricorn Municipal Development Guidelines. With an Urban Access Street having the capacity to service up to 75 allotments, this will allow future neighbouring developments to connect into the road network for this development which can cater for traffic volumes generated from this development and neighbouring developments. Road J will be constructed at 7.5m wide (invert to invert) in a minimum 16.0m wide road reserve. No pathway will be constructed along the proposed roadway.

Road F will be constructed as an Urban Access Street to accommodate a traffic flow catchment of approximately 30 – 40 allotments generating between 300 – 400 AADT. It will be constructed at 7.5m wide (invert to invert) in a minimum 16.0m wide road reserve. No pathway will be constructed along the proposed roadway.

Roads C, D, E, G, H, and I will be constructed as an Urban Access Place in accordance with the Capricorn Municipal Development Guidelines. All of these aforementioned roadways service under 25 allotments and have a traffic flow no greater than 250 AADT. They will be constructed at 5.5m wide (invert to invert) in a minimum 16.0m wide road reserve. No pathway is required for these streets.

To ensure that all allotments can be accessed in a quick, safe and convenient manner in case of an emergency situation, a standby (secondary) access provision to the development site has been included as part this residential subdivision. The secondary access is located within the public use land adjacent to Lot 36 and will gain access from the road reserve of Washpool Road and link onto Road B within the proposed development. This emergency access will be constructed to a rural access standard providing all weather access.

All allotments are in suitable distance for access to Public Transport in accordance with the geometric road design requirements included in the Capricorn Municipal Development Guidelines. Road B has been designed to adequately service as a Bus Route to enter and exit the site through Road A. The bus route has been designed to comply with the turning movements of a 12.5m long typical bus in accordance with the Capricorn Municipal Development Guidelines. The turnpath plan included in Appendix F of this report details the movements of a typical bus along the proposed bus route within the development.

Preliminary longitudinal sections of all roads are illustrated in Appendix F. These indicate that all proposed roads will be built in accordance with the Capricorn Municipal Development Guidelines with all public roads having a maximum slope of 1:6. Private driveways will have a maximum longitudinal grade of 1:5 in accordance with the Capricorn Municipal Development Guidelines. The cross sectional profiles of each road will be as per standard drawings in the Capricorn Municipal Development Guidelines. Detailed longitudinal and cross sections will be included in the future Operational Works Application.

The proposed road hierarchy plan is included in Appendix F as well as the preliminary typical sections of all roads in the proposed subdivision.

9 ELECTRICAL AND TELECOMMUNICATION

Existing overhead electrical and underground telecommunication services are currently available along Washpool Road (refer Appendix G). The existing overhead electrical services extend from the intersection of Washpool Road and Cherryfield Road to approximately the western boundary of our subject site. Electrical reticulation design plans will be completed by Ergon Energy, which will be included with the future Operational Works Applications. NBN Co will be engaged to supply a telecommunications offer of supply for ensuring the most up to date services are available for this development.

10 CONCLUSION

There appears to be no engineering infrastructure difficulties with the proposed 198 lot residential subdivision 'Gracemere Springs Estate' located at 70 Washpool Road, Gracemere. A review of the services proposed for this development and their impact on surrounding services, indicates that there is no impediment to development.

There is a workable design strategy for traffic and access, stormwater drainage, sewerage reticulation, water supply, electricity and telecommunications. Minor alterations in design may eventuate from future applications, however the fundamentals of the design strategy ensures that service provisions will not pose a serious constraint to development.

If you should have any questions regarding this report, please do not hesitate to contact the Brown Consulting Office in Rockhampton.

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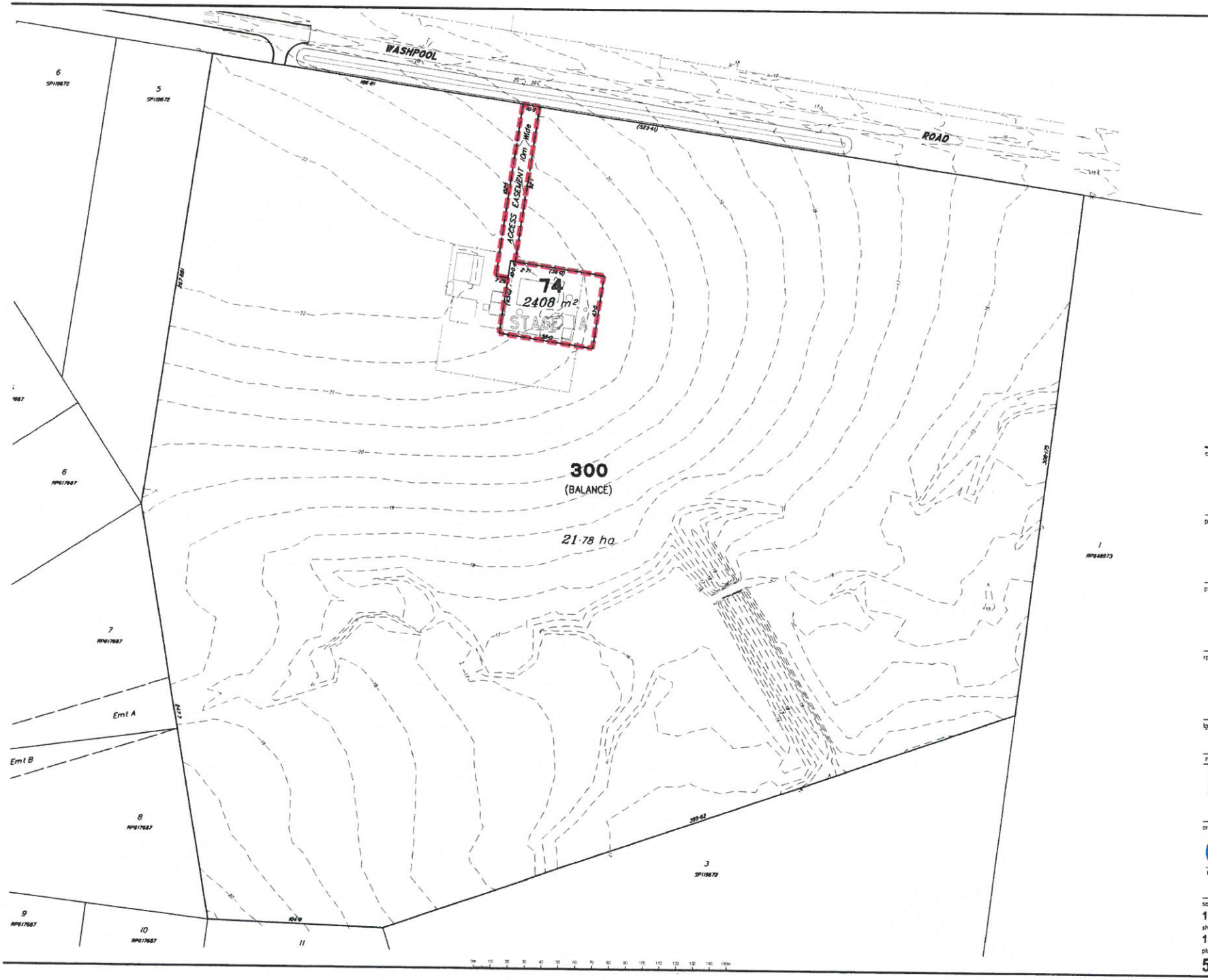
APPENDIX A

Development Plans



IMPORTANT NOTE

This plan was prepared to accompany a reconfiguration of a lot application to Rockhampton Regional Council and should not be used for any other purpose.

The dimensions and areas shown hereon are subject to field survey and also to the requirements of council and any other authority which may have requirements under any relevant legislation.

In particular, no reliance should be placed on the information on this plan for any financial dealings involving the land.

This note is an integral part of this plan.

client
Homecorp Developments Pty Ltd

project
Washpool Road Gracemere

plan of
Lot Reconfiguration Stage 1A (1 Retention Lot + Balance)

rpd
Lot 4 on SP119672 Parish of Gracemere County of Livingstone

lga
Rockhampton Regional Council

rev	date	details	authorised
A	31-10-2012	Initial Issue	RJKF
B	7-11-2012	Lots 92-98 amended	RJKF
C	11-11-2012	Lots 39 & 183-173 shifted	RJKF
D	5-04-2013	Lots 37-38 removed, Lots 1 & 2 combined	RJKF

created
CSG capricorn survey group (cq)

scale
1:1000 @ A1

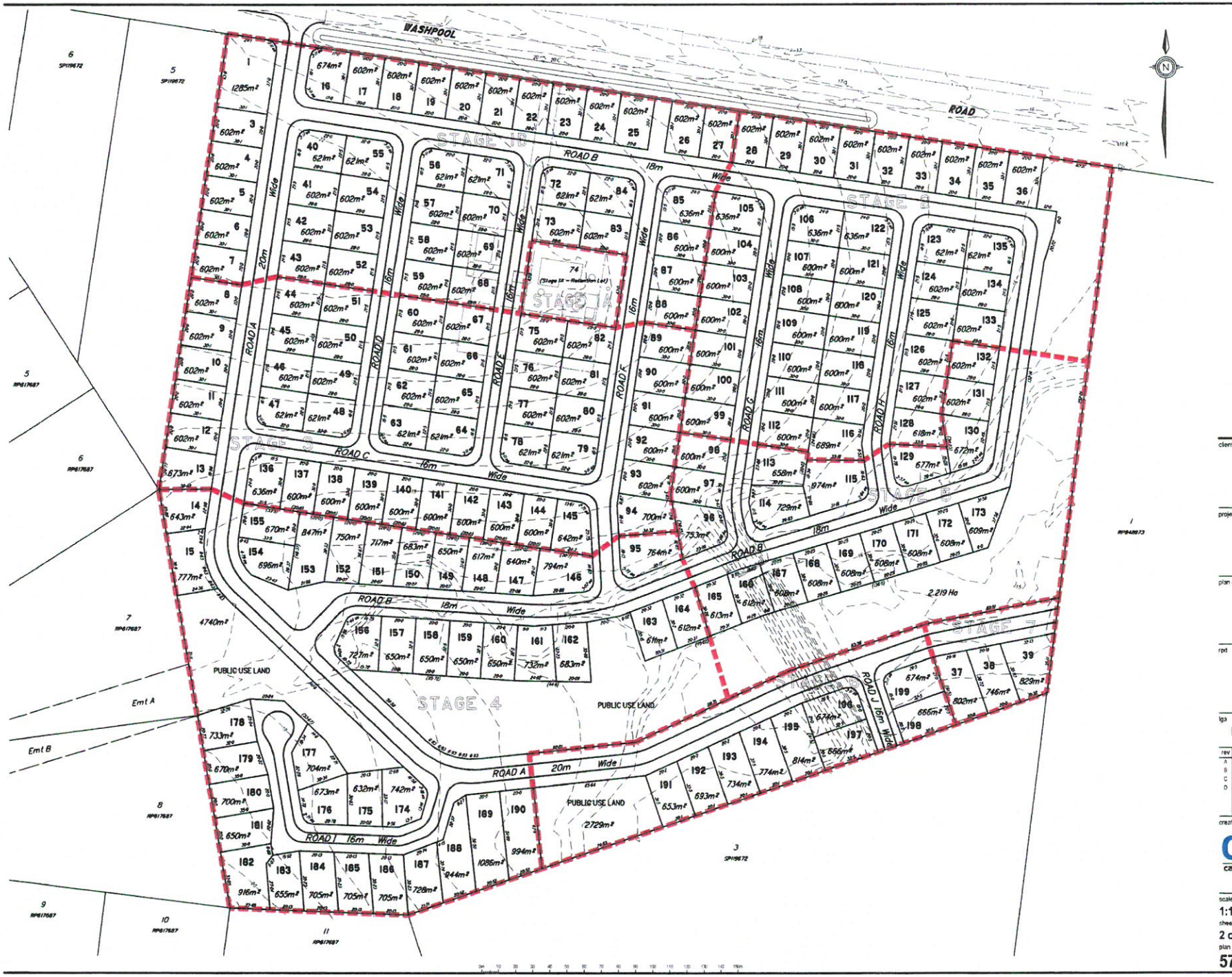
datum
AHD

sheet no.
1 of 2

cad file
5798-00-ROL-D

plan no.
5798-00-ROL

revision
D



Stage	No.
Ex Stage 1A	1
Stage 1B	42
Stage 2	39
Stage 3	46
Stage 4	39
Stage 5	19
Stage 6	9
Stage 7	3
Total	198

IMPORTANT NOTE

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The dimensions and areas shown hereon are subject to field survey and also to the requirements of council and any other authority which may have requirements under any relevant legislation.

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client
Homecorp Developments Pty Ltd

project
Washpool Road Gracemere

plan of
Lot Reconfiguration Stages 1B - 7 (197 Lots)

rpd
Lot 4 on SP119672 Parish of Gracemere County of Livingstone

lga
Rockhampton Regional Council

rev	date	details	authorised
A	31-10-2012	Initial Issue	RJKF
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created

CSG capricorn survey group (cq)

scale **1:1000 @ A1**
datum **AHD**
sheet no. **2 of 2**
cad file **5798-00-ROL-D**
plan no. **5798-00-ROL**
revision **D**

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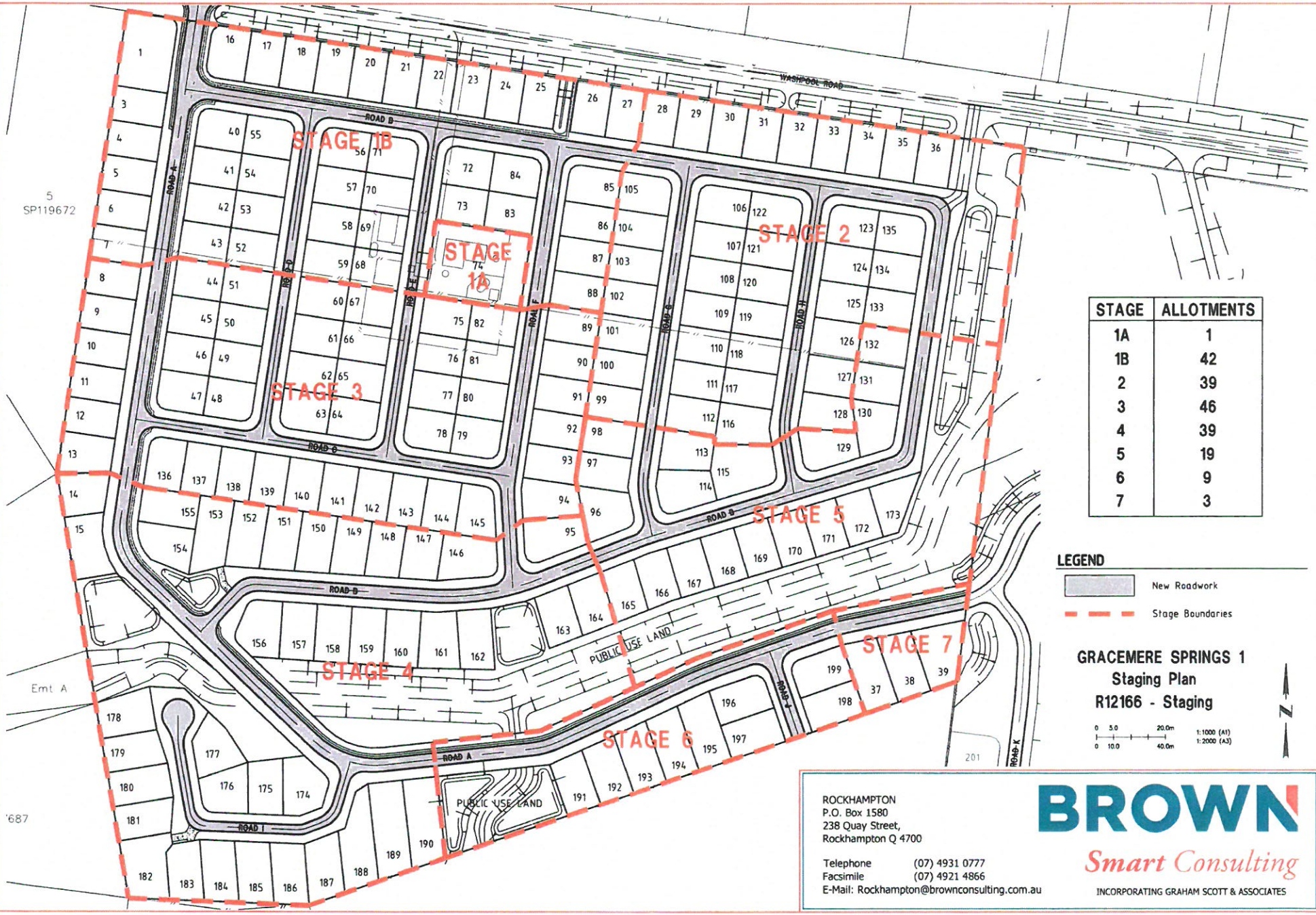
APPENDIX B

Staging Plan



STAGE	ALLOTMENTS
1A	1
1B	42
2	39
3	46
4	39
5	19
6	9
7	3

LEGEND

New Roadwork

Stage Boundaries

GRACEMERE SPRINGS 1
Staging Plan
R12166 - Staging

0 5.0 20.0m 1:1000 (A1)
0 10.0 40.0m 1:2000 (A3)

N

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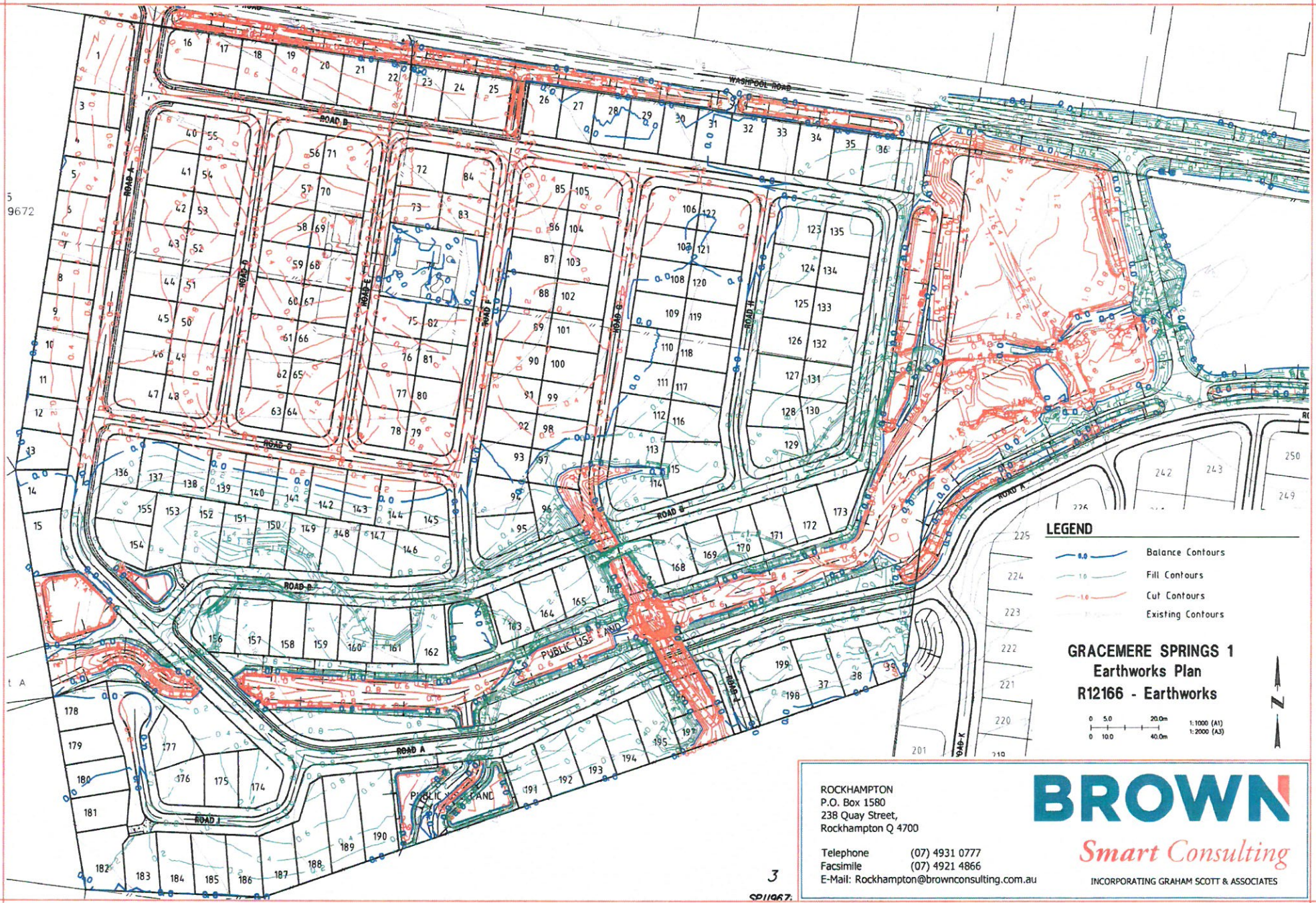
APPENDIX C1

Preliminary Earthworks Plan



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APPENDIX C2

CMDG Erosion Requirements

CAPRICORN MUNICIPAL DEVELOPMENT GUIDELINES

CONTROL OF EROSION AND SEDIMENTATION

C211

CONSTRUCTION SPECIFICATION

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Keeping the Capricorn Municipal Development Guidelines up-to-date

The Capricorn Municipal Development Guidelines are living documents which reflect progress of municipal works in the Capricorn Region. To maintain a high level of currency that reflects the current municipal environment, all guidelines are periodically reviewed with new editions published and the possibility of some editions to be removed. Between the publishing of these editions, amendments may be issued. It is important that readers assure themselves they are using current guideline, which should include any amendments which may have been published since the guideline was printed. A guideline will be deemed current at the date of development approval for construction works.

GENERAL

C211.01 SCOPE

1. The work to be executed under this Specification consists of the construction of structures and the implementation of measures to control erosion and sedimentation. These may be temporary or permanent.

2. The Contractor shall plan and carry out the whole of the Works to avoid erosion and sedimentation of the site, surrounding country, watercourses, waterbodies and wetlands in compliance with the requirements of the Environmental Protection Act, 1994 and Amendments, Regulations and Policies, and Local Government's Adopted Policies where available.

C211.02 REFERENCE DOCUMENTS

1. Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

Documents Standards Test Methods

(a) Council Specifications

C212	-	Clearing and Grubbing
C213	-	Earthworks
C273	-	Landscaping

(b) QLD State Legislation

The Environmental Protection Act, 1994 and Amendments, Regulations and Policies

(c) Other

Institution of Engineers Australia, Queensland Division (IEAQ)
- Soil Erosion and Sediment Control - Engineering Guidelines for Queensland Construction Sites, 1996.

Brisbane City Council (BCC)
- Integrated Environmental Management System Manual, 1997.

C211.03 EROSION AND SEDIMENTATION CONTROL STRATEGY

1. For consideration of erosion and sedimentation control measures, the site shall be divided into sections based on the catchment area draining to each permanent drainage structure in the works. In addition to the area bounded by the road reserve, the sections shall include:

Site Sections

(a) access and haulage tracks,

(b) borrow pits and

(c) compound areas, such as Contractor's facilities and concrete batching areas.

2. Prior to pre-start meeting, the Contractor shall submit to Local Government an Erosion and Sedimentation Control Strategy for each of the nominated sections. This Strategy shall be superimposed on half-sized Erosion Control and Stormwater Management drawings of the works and shall be detailed for each catchment area of the works. The Strategy should incorporate the measures included on the plan to protect adjoining landowners, significant areas and receiving waters. The contractor shall incorporate into the Strategy those additional measures deemed necessary to accommodate the proposed construction methods and construction sequence to be employed for the construction of the works.

Section Plan

3. The Strategy shall consist of scale diagrams indicating:

Plan Inclusions

(a) features of the site including contours and drainage paths,

(b) relevant construction details of all erosion and sedimentation control structures to be employed,

(c) all permanent and temporary erosion and sedimentation control measures, including the control measures to be implemented in advance of, or in conjunction with, clearing and grubbing operations as required under the Specification for CLEARING AND GRUBBING C212,

(d) an order of works based upon construction and stabilisation of all culverts and surface drainage works at the earliest practical stage, and

(e) proposed time schedules for construction of structures and implementation of measures to control erosion and sedimentation.

(f) Strategies for identification and protection of vegetation as required by Local Government.

4. The IEAQ Guidelines and the Brisbane City Council Manual provides guidance on typical permanent and temporary erosion and sedimentation control measures which may be required and guidance in the preparation of an Erosion and Sedimentation Control Plan.

Guidance

5. No work shall commence until Local Government has approved the Erosion and Sedimentation Control Strategy. Such approval shall not relieve the Contractor of the full responsibility to provide whatever measures are required for effective erosion and sedimentation control at all times. The strategy shall be provided to Local Government prior to the pre-start meeting.

Contractor's Responsibility

6. The Contractor shall adhere to the approved Erosion and Sedimentation Control Strategy. The Contractor shall submit a revised Strategy for approval by Local Government in advance of intended variation from the approved Strategy.

Adherence to Plan

C211.04 EROSION AND SEDIMENTATION CONTROL MEASURES

1. Erosion and sedimentation control measures shall include, but shall not be limited to, the following:

Scope

(a) The minimisation of disturbance of the natural ground and retention of vegetation.

(b) The installation of permanent drainage structures before the removal of topsoil and commencement of earthworks for formation within the catchment area of each structure.

(c) The prompt completion of all permanent and temporary drainage works, once commenced, to minimise the period of exposure of disturbed areas.

(d) The stabilisation of diversion and catch drains to divert uncontaminated runoff from outside the site, clear of the site. Catch drains shall be installed and lined before the adjacent ground is disturbed and the excavation is commenced.

(e) The passage of uncontaminated water through the site without mixing with contaminated runoff from the site.

(f) The provision of contour and diversion drains across exposed areas before, during and immediately after clearing and the re-establishment and maintenance of these drains during soil removal and earthworks operations.

(g) The provision of sediment filtering or sediment traps, in advance of and in conjunction with earthworks operations, to prevent contaminated water leaving the site.

(h) The restoration of the above drainage and sedimentation control works on a day to day basis to ensure that no disturbed area is left without adequate means of containment and treatment of contaminated water.

(i) The limitation of areas of erodible material exposed at any time to those areas being actively worked.

(j) The minimisation of sediment loss during construction of embankments by means such as temporary or reverse superelevations during fill placement, constructing berms along the edge of the formation leading to temporary batter flumes and short term sediment traps.

(k) The progressive vegetation of the site, in accordance with the Specification for LANDSCAPING, as work proceeds.

PERMANENT EROSION AND SEDIMENTATION CONTROL

C211.05 EARTHWORKS FOR PERMANENT EROSION AND SEDIMENTATION CONTROL BASINS

Planned Levels

1. Earthworks for permanent erosion and sedimentation control basins shall be constructed to the planned levels and dimensions shown on the Drawings or such levels and dimensions as determined by the Superintendent.

Site Preparation

2. The entire storage and embankment foundation area of permanent erosion and sedimentation control basins shall be cleared in accordance with the Specification for CLEARING AND GRUBBING C212 and shall be stripped of topsoil and any unsuitable material under embankments removed in accordance with the Specification for EARTHWORKS C213.

Compaction Requirements

3. The embankments shall be constructed in accordance with the Specification for EARTHWORKS C213.

C211.06 INLETS, SPILLWAYS AND LOW FLOW OUTLETS FOR SEDIMENTATION CONTROL BASINS AND SEDIMENT TRAPS

Rock Mattresses

1. Inlets and spillways shall be constructed using rock filled woven galvanised steel mattresses laid on a needle punched, mechanically bonded, non-woven geotextile filter fabric, unless detailed otherwise shown on the Drawings. The rock filled mattresses shall be laid in accordance with the manufacturer's instructions and Specification.

Plastic Pipe Outlet

2. A low flow outlet consisting of a 150 mm diameter plastic pipe shall be installed unless detailed otherwise as shown in the Drawings.

C211.07 CLEANING SEDIMENTATION CONTROL STRUCTURES

Contractor's Responsibility

1. The Contractor shall clean out permanent sedimentation control structures, cleaning out whenever the accumulated sediment has reduced the capacity of the structure by 50 per cent or more, or whenever the sediment has built up to a point where it is less than 300 mm below the spillway crest. All permanent sedimentation control structures shall be cleaned out by the Contractor prior to Practical Completion of the Works.

Removal of Sediment

2. Accumulated sediment shall be removed from permanent sedimentation control structures in such a manner as not to damage the structures. The sediment removed shall be disposed of in such locations that the sediment will not be conveyed back into the construction areas or into watercourses. The Contractor shall provide and maintain suitable access to permanent sedimentation control structures to allow cleaning out in all weather conditions.

TEMPORARY EROSION AND SEDIMENTATION CONTROL

C211.08 GENERAL

Contractor's Responsibility

1. The Contractor shall ensure that effective erosion and sedimentation control is provided at all times.

Pollutant Free

2. Runoff from all areas where the natural surface is disturbed by construction, including access roads, depot and stockpile sites, shall be free of pollutants before it is either dispersed to stable areas or directed to natural watercourses. The Contractor shall be responsible for all temporary erosion and sedimentation control measures required for this purpose.

Maintenance by Contractor

3. The Contractor shall provide and maintain slopes, crowns and drains on all excavations and embankments to ensure satisfactory drainage at all times. Water shall not be allowed to pond on the works unless such ponding is part of an approved Erosion and Sedimentation Control Strategy.

C211.09 TEMPORARY DRAINS

Control of Runoff

1. Runoff from areas exposed during the work shall be controlled by construction of temporary contour drains and/or temporary diversion drains. Generally, a temporary contour drain or temporary diversion drain takes the form of a channel constructed across a slope with a ridge on its lower side. They may require progressive implementation and frequent alteration as the work progresses.

Contour Drains

2. Contour drains, which follow points on the natural surface of approximately the same elevation, shall be provided immediately after a construction site is cleared to intercept and divert runoff from the site to nearby stable areas at non-erosive velocities. Contour drains shall be formed with a grade of neither less than 1 per cent nor more than 1.5 per cent and shall be spaced at intervals of neither less than 20 m nor more than 50 m, depending on the erodibility of the exposed soil.

Diversion Drains

3. Diversion drains shall be provided across haul roads and access tracks when such roads and access tracks are identified as constituting an erosion hazard due to their steepness, soil erodibility or potential for concentrating runoff flow. Diversion drains shall be formed to intercept and divert runoff from the road or track to stable outlets. Spacing of diversion drains shall not be greater than that required to maintain runoff at non-erosive velocities.

C211.10 TEMPORARY SEDIMENT TRAPS

1. Temporary sediment-trapping devices shall be provided during construction to remove sediment from sediment-laden runoff flowing from areas of 0.5 hectares or more before the runoff enters natural watercourses or adjacent land. ***Sediment Traps***

C211.11 BATTER PROTECTION

1. The Contractor shall take all necessary action to protect batters from erosion. ***Contractor's Responsibility***

2. Scour of newly-formed fill batters during and after embankment construction shall be minimised by diverting runoff from the formation away from the batter until vegetation is established. ***Scour Control***

C211.12 MAINTENANCE AND INSPECTION

1. The Contractor shall inspect all temporary erosion and sedimentation control works after each rain period and during periods of prolonged rainfall. Any defects revealed by such inspections shall be rectified immediately and these works shall be cleaned, repaired and augmented as required, to ensure effective erosion and sedimentation control thereafter. ***Contractor's Responsibility***

2. The Contractor shall provide and maintain access for cleaning out sedimentation control works. ***Access***

C211.13 REMOVAL

1. All temporary erosion and sedimentation control works shall be removed by the Contractor when revegetation is established on formerly exposed areas before the end of the Contract. All materials used for the temporary erosion and sedimentation control works shall be removed from the site or otherwise disposed by the Contractor. ***Contractor's Responsibility***

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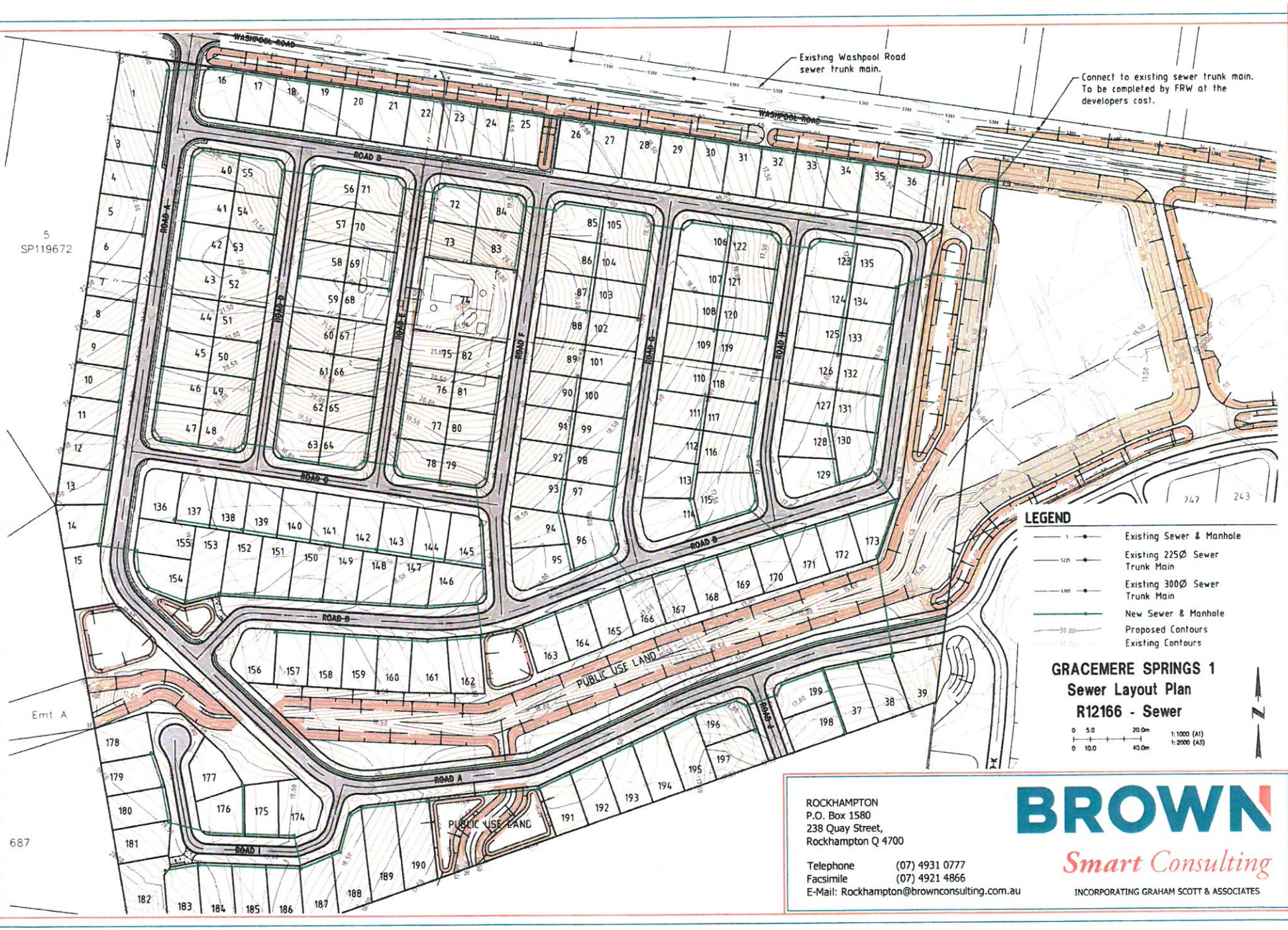
APPENDIX D

Preliminary Sewerage Layout Plan



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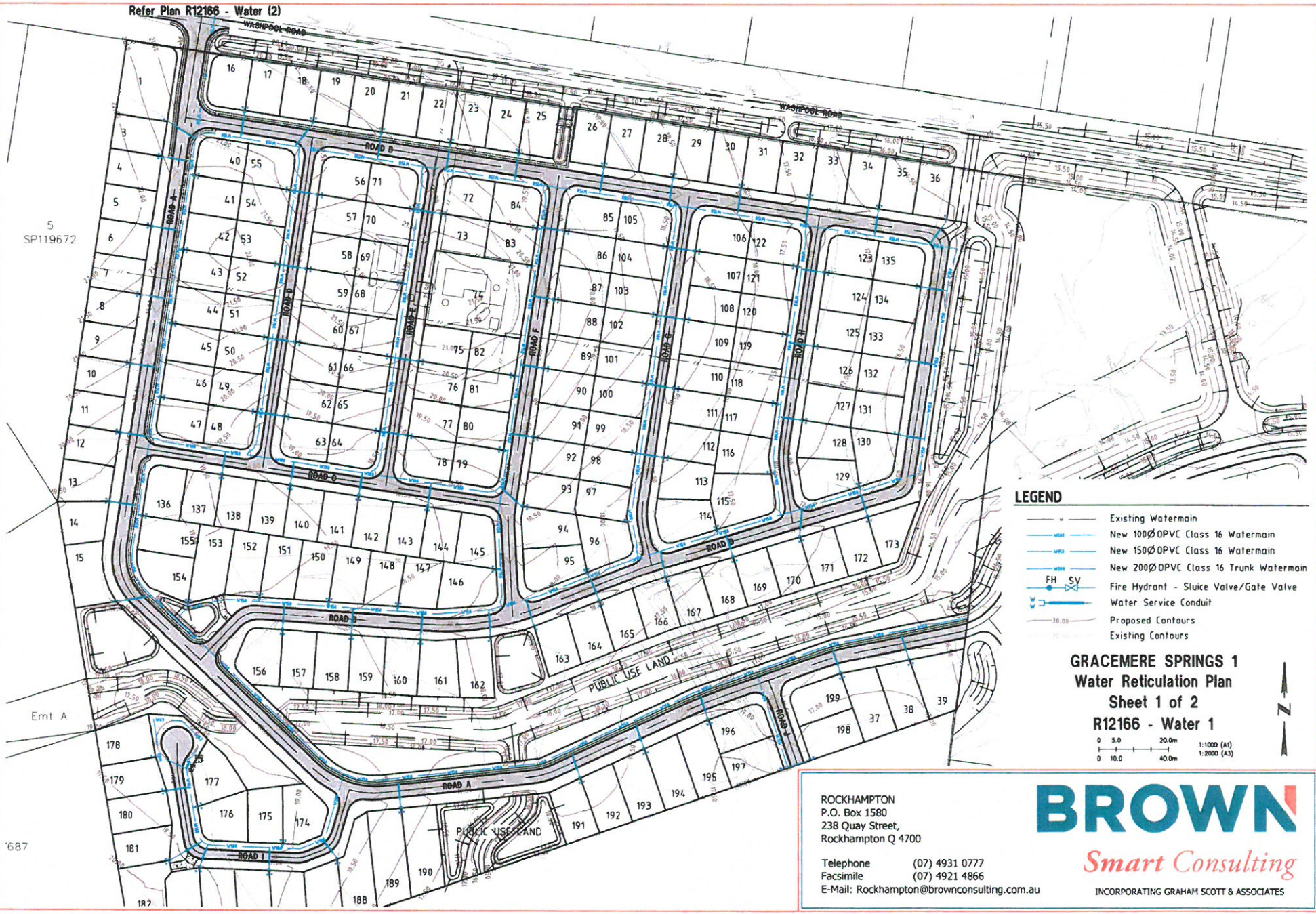
APPENDIX E1

Preliminary Water Reticulation Plans



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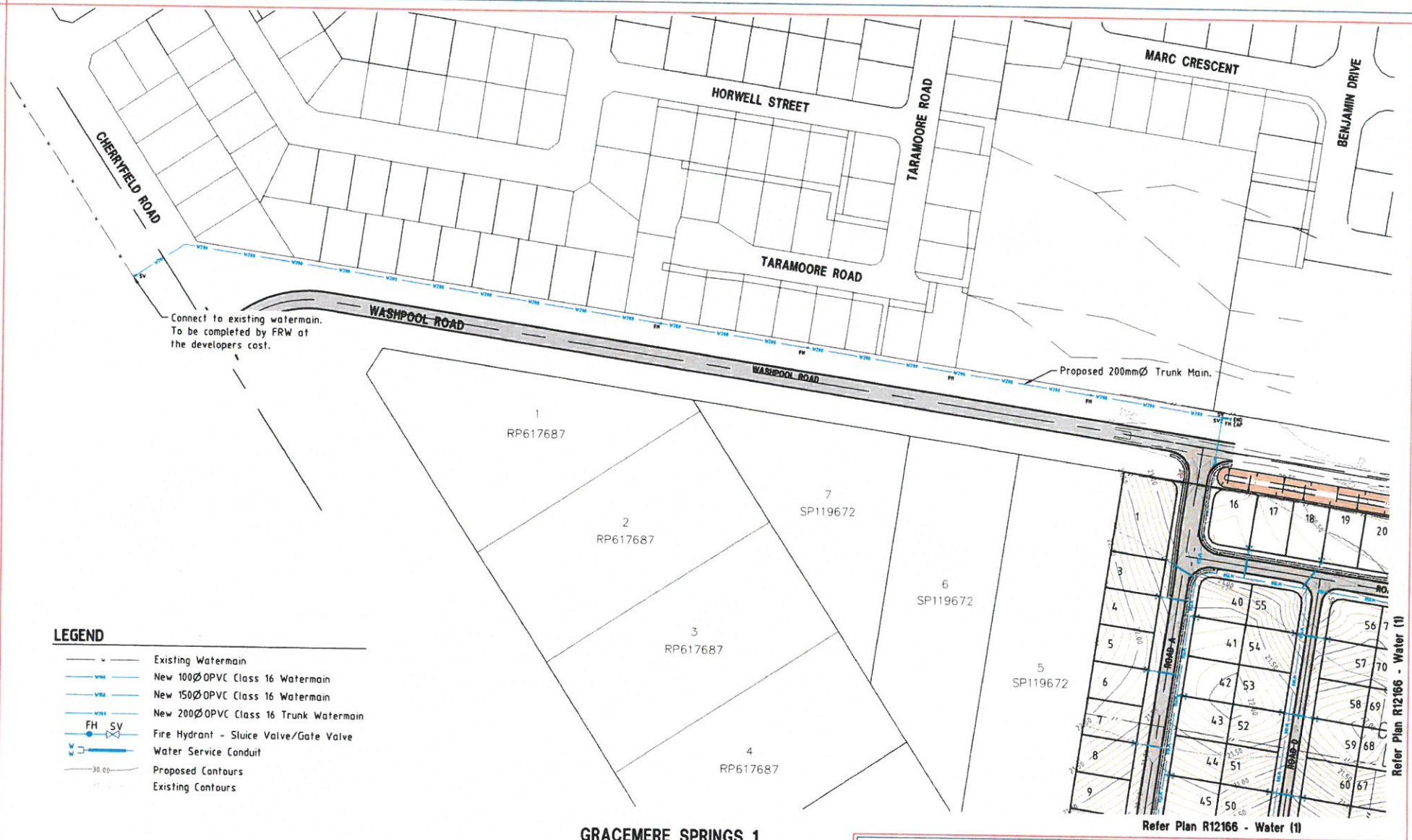

LEGEND

- Existing Watermain
- New 100ØOPVC Class 16 Watermain
- New 150ØOPVC Class 16 Watermain
- New 200ØOPVC Class 16 Trunk Watermain
- FH SV — Fire Hydrant - Sluice Valve/Gate Valve
- Water Service Conduit
- 30.00 — Proposed Contours
- Existing Contours

GRACEMERE SPRINGS 1
Water Reticulation Plan
Sheet 2 of 2
R12166 - Water 2

0 5.0 20.0m
0 10.0 40.0m
1:1000 (A1)
1:2000 (A3)

N

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APPENDIX E2

Advice regarding Water Infrastructure on Washpool Road

Matthew Dennis

From: Scott Beaumont <sbeaumont@smrlaw.com.au>
Sent: Wednesday, 21 March 2012 12:07 PM
To: Graham Scott
Subject: Fwd: RE: 104 Washpool Road, Gracemere
Attachments: 104 Washpool Rd Proposal for discussion.jpg

Read & callme please

Scott Beaumont
Swanwick Murray Roche
PO Box 111 Rockhampton 4700
74 Victoria Pde Rockhampton 4700
Phone: (07) 4931 1888
Facsimile: (07) 4931 1899
Email: sbeaumont@smrlaw.com.au

SWANWICK MURRAY ROCHE - NOTICE: Please notify us if this communication has been sent to you by mistake. If it has been, Client Legal Privilege is not waived or lost and you are not entitled to use it in any way.

www.smrlaw.com.au

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>>> Peter Wheelhouse <Peter.Wheelhouse@rrc.qld.gov.au> 21/03/2012
>>> 11:10:39 am >>>
Scott

I refer to our recent discussion regarding potential water and sewer infrastructure costs associated with the proposed 150 allotments at 104 Washpool Rd.

I can confirm the Washpool Road sewer pump station could accommodate the proposed development affectively via a gravity main across the road.

With respect to the water supply we have put together a potential option for further discussion that would ultimately need to be developed into an infrastructure agreement and endorsed by Council. This option would see your potential contribution towards the proposed 200mm water main to the site being in the order of $200,000. I must emphasis this option is presented for the benefit of further discussion only.

In addition to the $200,000 towards the 200mm pipeline, there would also be the usual water and sewer infrastructure charges applicable to this area. An estimate of these contributions per lot can be calculated if required. As the site is located outside the PIA there is also the potential for Council to request you pay the full $450,000 for the construction of the main with the additional $250,000 to be offset through infrastructure credits.

Regards

Peter Wheelhouse
Senior Asset and Systems Engineer Commercial Services Rockhampton Regional Council - Fitzroy River Water Office
Ph: 07 4936 8713 Fax: 1300 22 55 79 Email: peter.wheelhouse@rrc.qld.gov.au
Address: PO Box 1860, Rockhampton Q 4700 Web:
www.rockhamptonregion.qld.gov.au

-----Original Message-----
From: Scott Beaumont [mailto:sbeaumont@smrlaw.com.au]
Sent: Monday, 12 March 2012 5:21 PM
To: Peter Wheelhouse
Subject: 104 Washpool Road, Gracemere

Good afternoon Pete,

I am currently completing investigations in relation to this site with a potential yield of 150 residential allotments. I have had discussions with Bruce Russell regarding roads and some discussion with Brett Bacon.

I am aware of the location of the new sewerage pump station from my previous dealings with a parcel in Lucas Street Gracemere and I assume that given proximity there is no significant cost issue with the sewerage. Please confirm.

In relation to the water though I am aware that it currently goes to Gracemere Green which is corner of Washpool and Cherryfield Road.

I have previously paid for the modeling to be done and I am happy to do that again so that I can get a reasonable idea of costs for water.

Can you confirm the costs for the modeling and the time frame. Unfortunately I have to make a decision in the next 14 days.

Can you give me a call on 49311888 once you have had a chance to read this.

Many thanks.

Scott Beaumont
Swanwick Murray Roche
PO Box 111 Rockhampton 4700
74 Victoria Pde Rockhampton 4700
Phone: (07) 4931 1888
Facsimile: (07) 4931 1899
Email: sbeaumont@smrlaw.com.au

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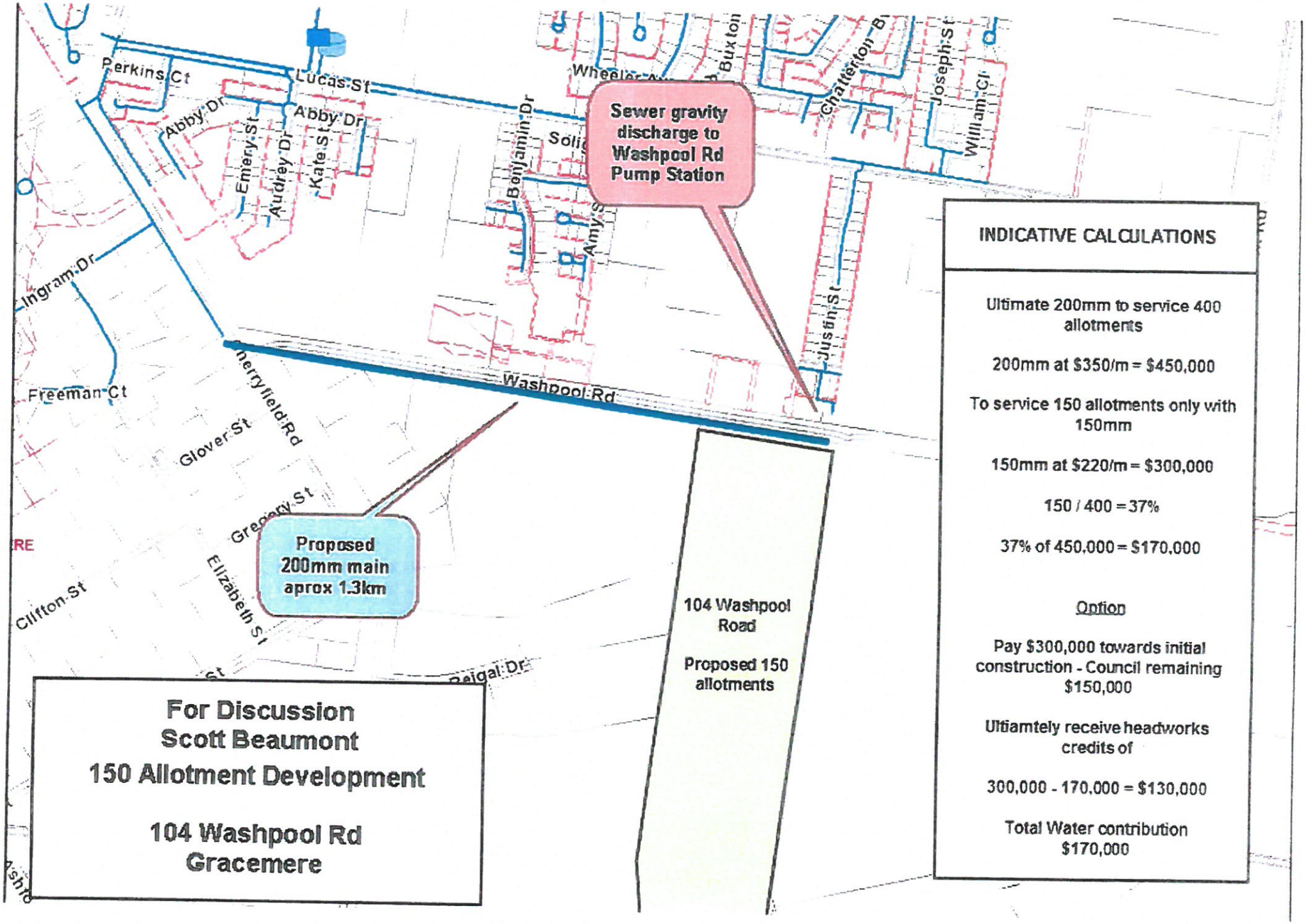
Perkins Ct
Lucas St
Abby Dr
Abby Dr
Emery St
Audrey Dr
Kate St
Benjamin Dr
Amy St
Wheeler
Buxton
Chatterton
Joseph St
William Cl
Justin St
Sewer gravity discharge to Washpool Rd Pump Station
Ingram Dr
Freeman Ct
Washpool Rd
Cherryfield Rd
Glover St
Gregory St
Elizabeth St
Clifton St
Proposed 200mm main aprox 1.3km
104 Washpool Road
Proposed 150 allotments
Reigal Dr
For Discussion
Scott Beaumont
150 Allotment Development
104 Washpool Rd
Gracemere
INDICATIVE CALCULATIONS
Ultimate 200mm to service 400 allotments
200mm at $350/m = $450,000
To service 150 allotments only with 150mm
150mm at $220/m = $300,000
150 / 400 = 37%
37% of 450,000 = $170,000
Option
Pay $300,000 towards initial construction - Council remaining $150,000
Ultiamtely receive headworks credits of
300,000 - 170,000 = $130,000
Total Water contribution $170,000

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APPENDIX E3

Letter requesting Water Network Analysis

Our Ref: R12166/RS:smr/Ltr.FRW.RFPWQ
Contact: Russell Schirmer

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Fitzroy River Water
PO Box 1860
ROCKHAMPTON QLD 4700

4 April 2012

Attention: Mr Peter Wheelhouse

Dear Peter,

Request for Private Works Quotation
Gracemere Springs – Washpool Road, Gracemere
199 Lot Residential Development

On behalf of our client, Gracemere Springs 1 Pty Ltd, we hereby request Rockhampton Regional Council/Fitzroy River Water to prepare a Private Works Quotation to carry out a water supply network analysis for the above-mentioned development.

To assist you with this application we have enclosed the following:

- A plan of the proposal showing the ultimate development.
- Preliminary email correspondence regarding neighbouring allotment (eastern neighbour) from Fitzroy River Water.

Please note your Quotation should be addressed to:-

Gracemere Springs 1 Pty Ltd
C/- Brown Consulting QLD Pty Ltd
PO Box 1580
ROCKHAMPTON QLD 4700

Should you have any questions at all, please do not hesitate to contact our office and speak with Russell Schirmer.

Yours sincerely
Brown Consulting (Qld) Pty Ltd

Russell Schirmer
Civil Manager - Rockhampton

Encl. Preliminary Water Reticulation Plans
Preliminary email correspondence from FRW

Cc Gracemere Springs 1 Pty Ltd

238 Quay Street, Rockhampton, Queensland 4700
Incorporating **Graham Scott & Associates**
Telephone +61 7 4931 0777 **Facsimile** +61 7 4921 4866

Brown Consulting (QLD) Pty Ltd
ABN 38 109 428 506
BrownConsulting.com.au/GrahamScott

Private Works
Application for Water and Sewerage Services

ABN 59 923 523 766

FITZROY RIVER WATER
Business Unit of RRC

Phone: 4932 9000 or 1300 22 55 77 **Fax:** 4936 8862 or 1300 22 55 79
Address: PO Box 1860, Rockhampton QLD 4700
Email: enquiries@rrc.qld.gov.au
www.frw.com.au

PRIVACY NOTICE: Rockhampton Regional Council is collecting the personal information you supply on this form for the purpose of processing your application for water and sewerage services. Your personal details will not be disclosed to any other person or agency external to Council without your consent unless required or authorised by law.

Separate application forms to be completed for water and sewerage requests			
Applicant's Name:	Mr Russell Schirmer		
Company Name:	Gracemere Springs Pty Ltd		
Postal Address:	C:/ Brown Consulting 238 Quay St Rockhampton QLD 4700		
Telephone:	4931 0777	**Mobile:**	0418 743 523
Fax:	4921 4866	**Email:**	Russell.Schirmer@brownconsulting.com.au
Property Owner's Name:	Gracemere Springs Pty Ltd		
Work Site Address:	70 Washpool Rd, Gracemere		
Site Description: (e.g. plan number)	Lot 4 SP119672		

Full description of work request. ***Please attach applicable site plans and drawings.***
(Note: 50% deposit is payable on acceptance of a private works quotation)

Water Supply Network Analysis

Applicant's Signature:		**Date:**	9/4/13

Please return completed form to: Customer Service, Rockhampton Regional Council,
PO Box 1860 Rockhampton QLD 4700
Fax: 4936 8862 or 1300 22 55 79
Email: enquiries@rrc.qld.gov.au

OFFICE USE ONLY	Date Rec'd	Pathways Application No.	CSO Initials

Customer Service>Dataworks>Network Services Administration Officer

Form No. FRW-05-03-F01 Rev No. 2

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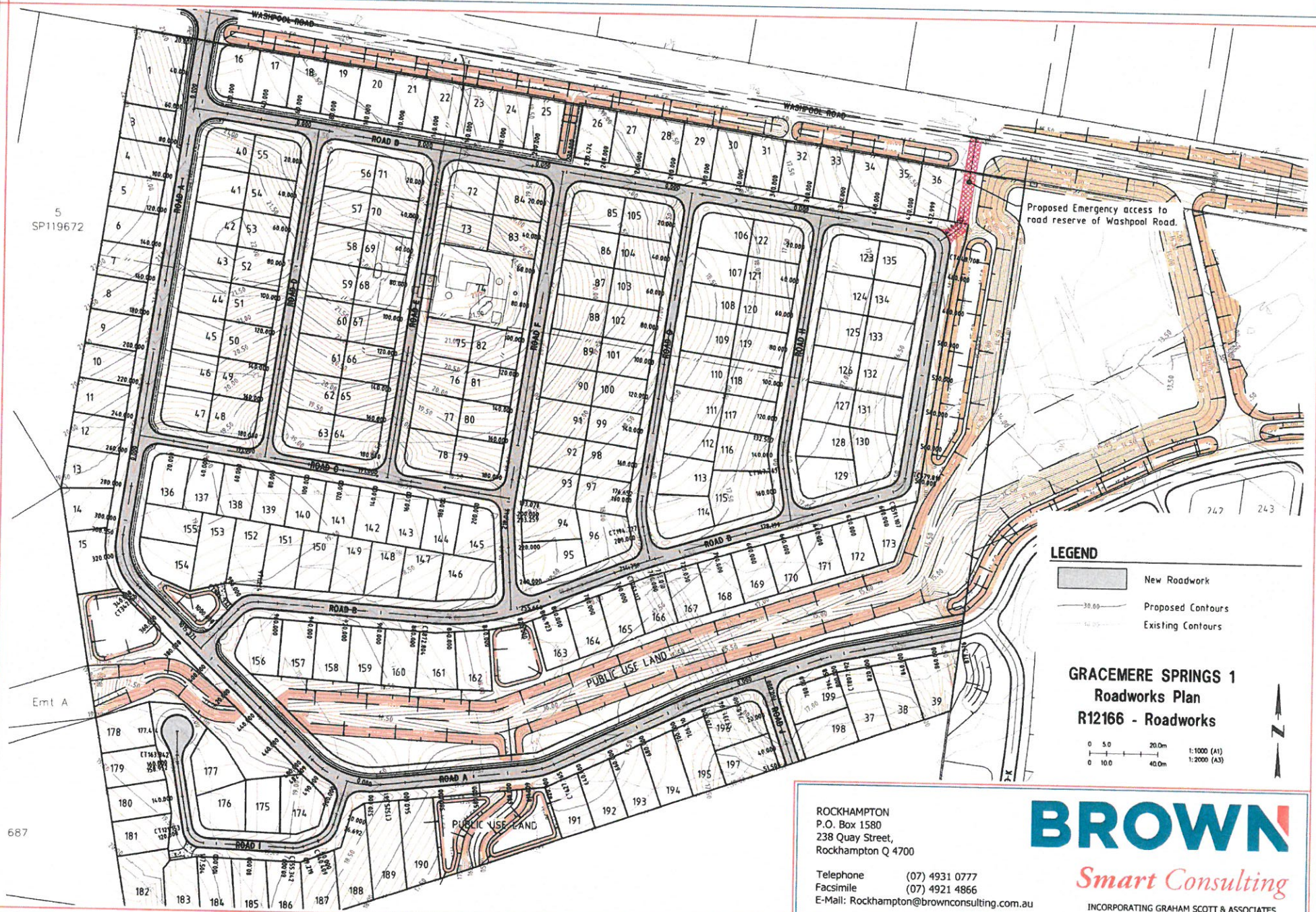
APPENDIX F1

Roadworks Plan



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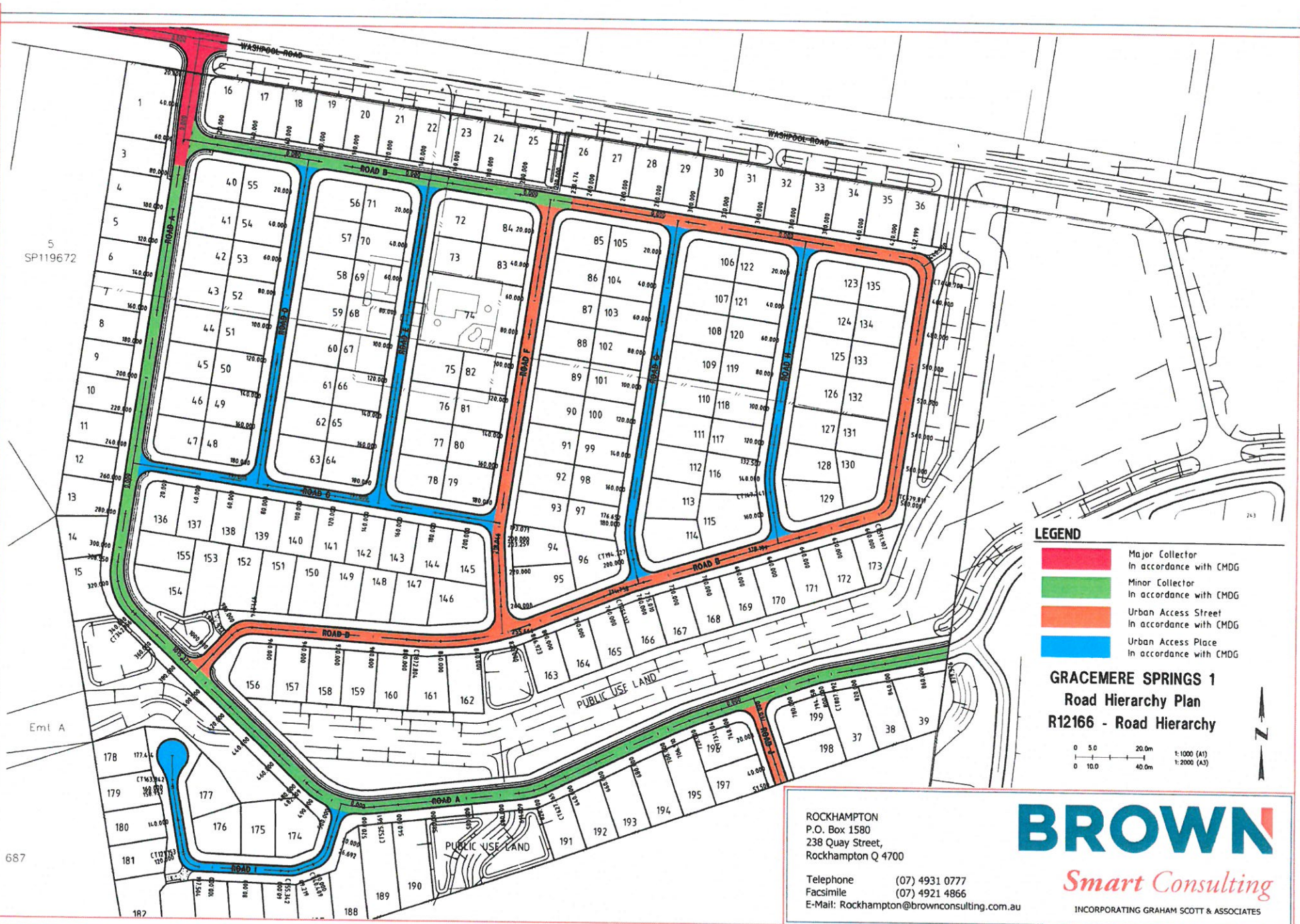
APPENDIX F2

Road Hierarchy Plan



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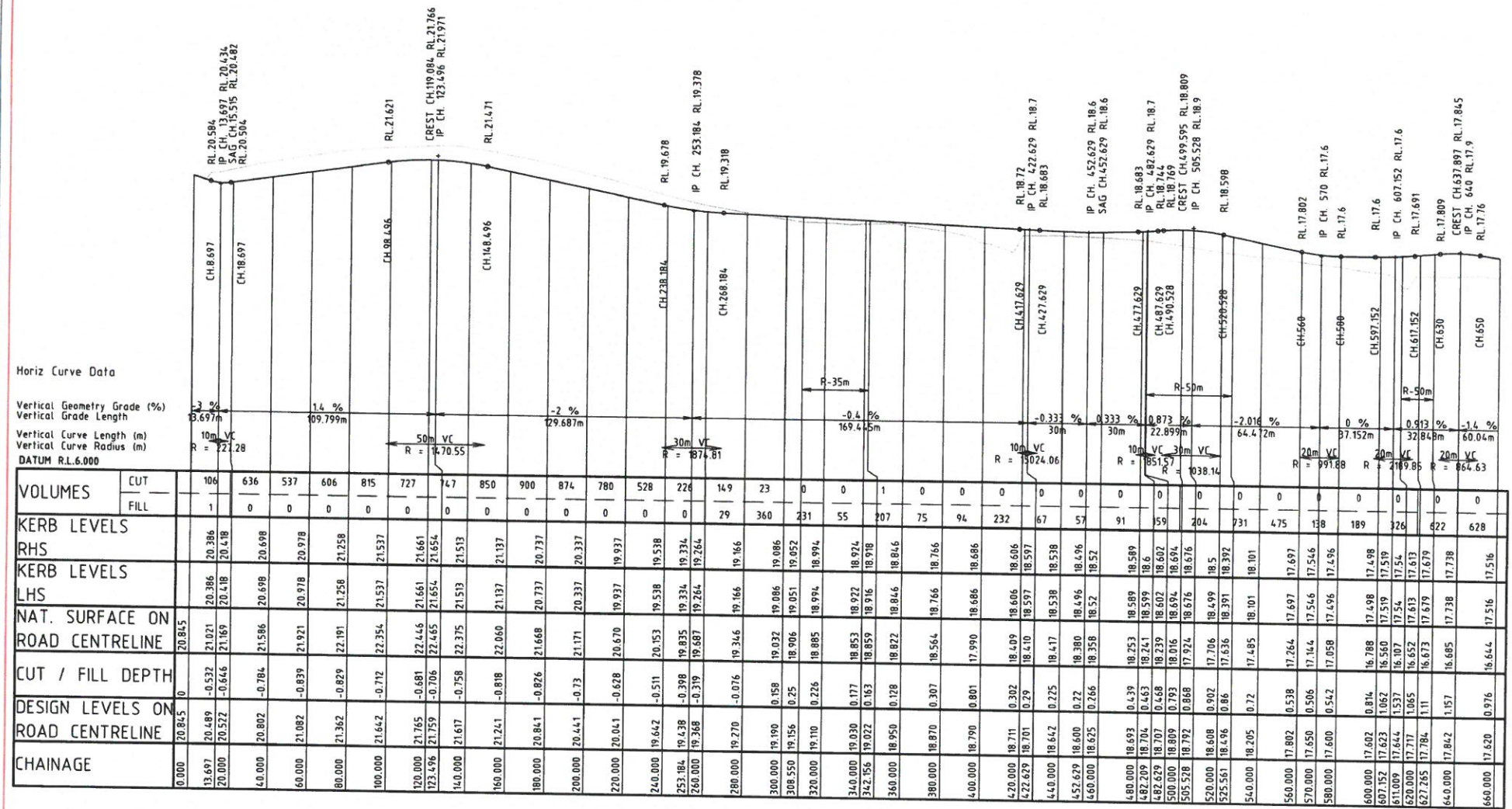
APPENDIX F3

Roadworks Preliminary Longitudinal Sections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SAG CH.15.515 RL.20.482
RL.20.504
CH.8.697
CH.18.697
RL.21.621
CH.98.496
CREST CH.119.084 RL.21.766
IP CH. 123.496 RL.21.971
RL.21.471
CH.148.496
RL.19.678
IP CH. 253.184 RL.19.378
RL.19.318
CH.238.184
CH.268.184
RL.18.72
IP CH. 422.629 RL.18.7
RL.18.683
IP CH. 452.629 RL.18.6
SAG CH.452.629 RL.18.6
RL.18.683
IP CH. 482.629 RL.18.7
RL.18.744
RL.18.769
CREST CH.499.595 RL.18.809
IP CH. 505.528 RL.18.9
RL.18.598
CH.417.629
CH.427.629
CH.477.629
CH.487.629
CH.490.528
CH.520.528
RL.17.802
IP CH. 570 RL.17.6
RL.17.6
RL.17.6
IP CH. 607.152 RL.17.6
RL.17.691
RL.17.809
CREST CH.637.897 RL.17.845
IP CH. 640 RL.17.9
RL.17.76
CH.560
CH.580
CH.597.152
CH.617.152
CH.630
CH.650
R-35m
R-50m
R-50m
Horiz Curve Data
Vertical Geometry Grade (%)
Vertical Grade Length
Vertical Curve Length (m)
Vertical Curve Radius (m)
DATUM R.L.6.000
-3 %
13.697m
10m VC
R = 221.28
1.4 %
109.799m
50m VC
R = 1470.55
-2 %
129.687m
30m VC
R = 1874.81
-0.4 %
169.445m
10m VC
R = 1024.06
-0.333 %
30m
0.333 %
30m
10m VC
R = 851.57
0.873 %
22.899m
30m VC
R = 1038.14
-2.016 %
64.472m
20m VC
R = 991.88
0 %
37.152m
20m VC
R = 2169.85
0.913 %
32.848m
20m VC
R = 864.63
-1.4 %
60.04m

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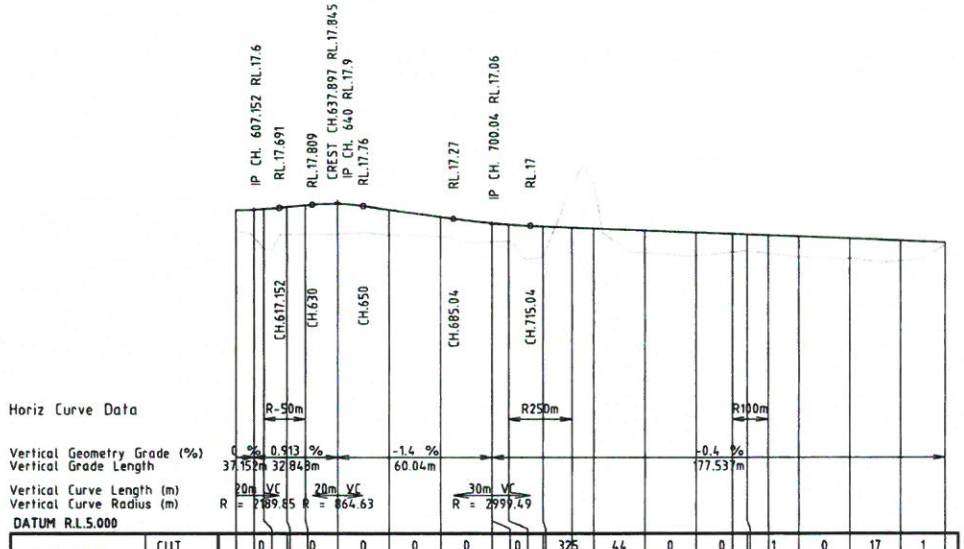

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KERB LEVELS RHS		17.498	17.519	17.54	17.679	17.738	17.516	17.236	16.993	16.942	16.876	16.83	16.796	16.716	16.636	16.579	16.556	16.524	16.476	16.396	16.316	
KERB LEVELS LHS		17.498	17.519	17.54	17.679	17.738	17.516	17.236	16.993	16.942	16.876	16.83	16.796	16.716	16.636	16.579	16.556	16.524	16.476	16.396	16.316	
NAT. SURFACE ON ROAD CENTRELINE		16.788	16.560	16.107	16.652	16.673	16.685	16.644	16.576	16.374	16.374	16.395	15.819	18.487	18.622	15.951	15.842	15.975	16.035	15.928	15.784	15.735	15.647	16.240
CUT / FILL DEPTH		0.814	1.062	1.537	1.065	1.11	1.157	0.976	0.764	0.724	0.723	0.651	1.161	-1.552	-1.722	0.869	0.898	0.708	0.625	0.7	0.797	0.765	0.774	0.11
DESIGN LEVELS ON ROAD CENTRELINE		17.602	17.623	17.644	17.717	17.784	17.842	17.620	17.340	17.097	17.097	17.046	16.980	16.935	16.980	16.820	16.740	16.683	16.660	16.628	16.580	16.500	16.420	16.350
CHAINAGE		600.000	607.152	611.009	620.000	627.265	640.000	660.000	680.000	700.000	700.040	706.510	720.000	731.304	740.000	760.000	780.000	794.158	800.000	807.992	820.000	840.000	860.000	877.576

ROAD A

GRACEMERE SPRINGS 1

Road Longitudinal Sections 2

R12166 - Long Sections 2

0 10.0 40.0m 1:2000 H

0 1.0 4.0m 1:200 V

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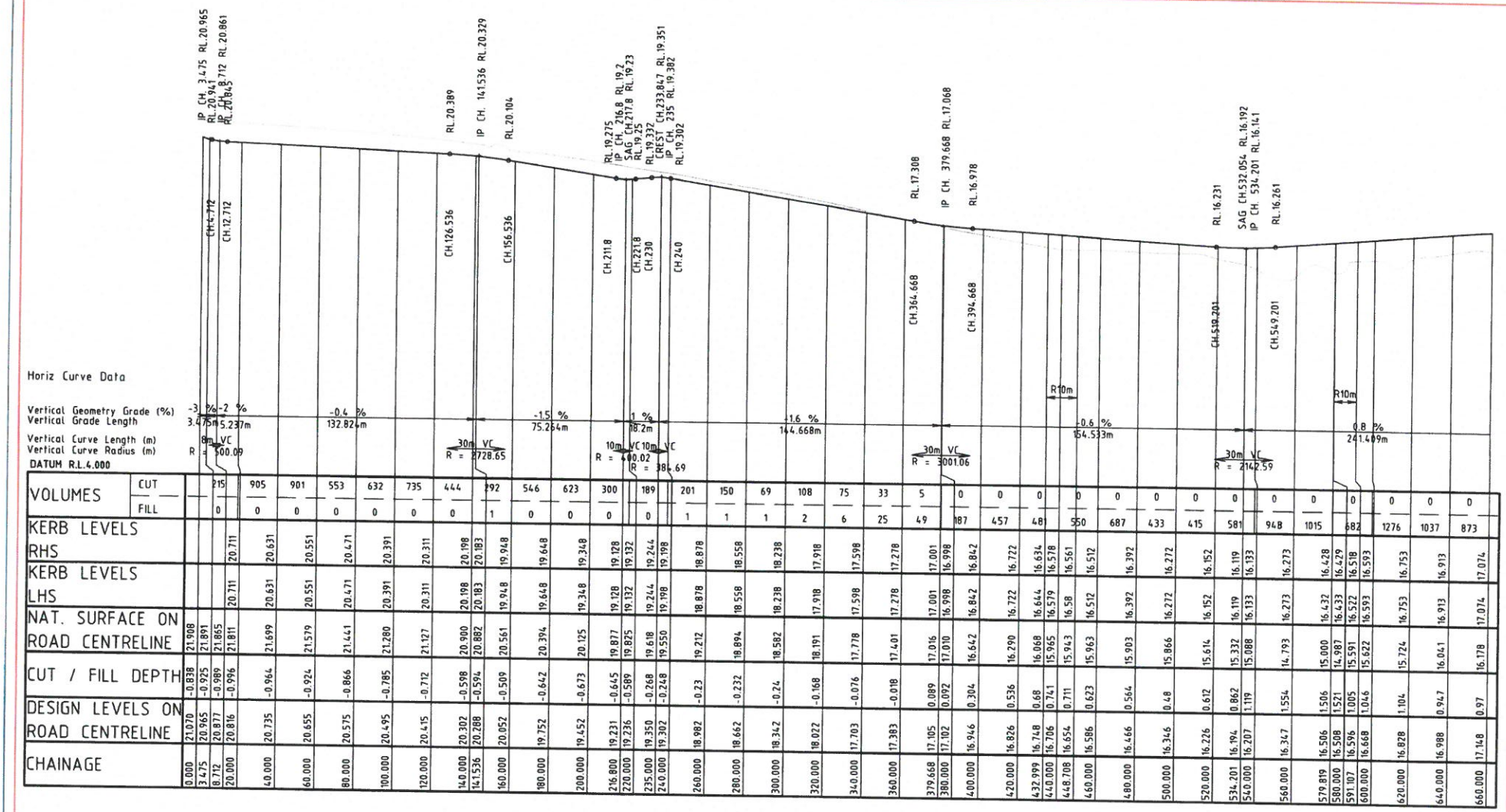
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RL.20.941
IP CH. 8.712 RL.20.861
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CH.4.712
CH.12.712
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IP CH. 141.536 RL.20.329
RL.20.104
RL.19.275
IP CH. 216.8 RL.19.2
SAG CH.217.8 RL.19.23
RL.19.25
RL.19.332
CREST CH.233.847 RL.19.351
IP CH. 235 RL.19.382
RL.19.302
RL.17.308
IP CH. 379.668 RL.17.068
RL.16.978
RL.16.231
SAG CH.532.054 RL.16.192
IP CH. 534.201 RL.16.141
RL.16.261
CH.126.536
CH.156.536
CH.211.8
CH.221.8
CH.230
CH.240
CH.364.668
CH.394.668
CH.519.201
CH.549.201
Horiz Curve Data
Vertical Geometry Grade (%)
Vertical Grade Length
Vertical Curve Length (m)
Vertical Curve Radius (m)
DATUM R.L.4.000
-3 %
3.475m
-2 %
5.237m
8m VC
R = 500.09
-0.4 %
132.824m
30m VC
R = 4728.65
-1.5 %
75.264m
10m VC
R = 440.02
1 %
18.2m
10m VC
R = 384.69
+1.6 %
144.668m
30m VC
R = 3001.06
R10m
-0.6 %
154.533m
30m VC
R = 2142.59
R10m
0.8 %
241.409m

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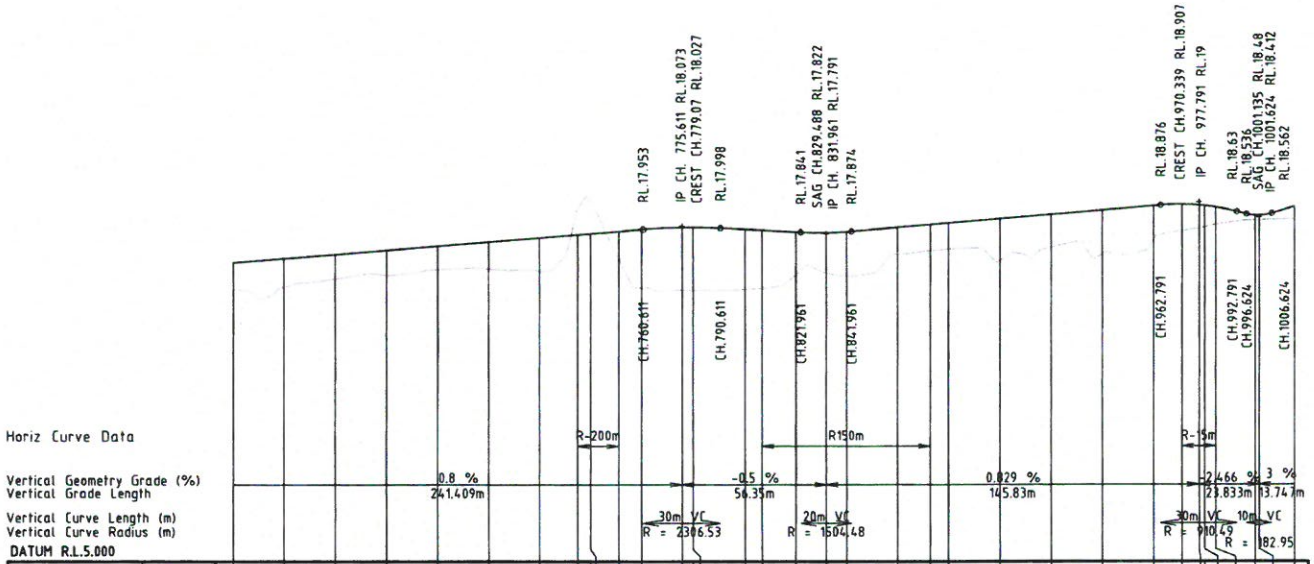

VOLUMES	CUT	0	0	0	0	0	0	463	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FILL	1276	1037	873	1133	1287	1326	496	1532	2607	2327	1650	459	1551	1635	1825	1931	1986	1878	1209	437	9		
KERB LEVELS RHS	16.593	16.753	16.913	17.074	17.234	17.394	17.554	17.674	17.803	17.874	17.95	17.952	17.877	17.841	17.769	17.736	17.767	17.923	18.025	18.085	18.251	18.417	18.582	18.748	18.802	18.772	18.751	18.694	18.379	18.377	
KERB LEVELS LHS	16.593	16.753	16.913	17.074	17.234	17.394	17.554	17.674	17.714	17.803	17.874	17.95	17.952	17.877	17.842	17.77	17.737	17.768	17.924	18.026	18.085	18.251	18.417	18.582	18.748	18.802	18.772	18.751	18.694	18.379	18.377	
NAT. SURFACE ON ROAD CENTRELINE	15.622	15.724	16.041	16.178	16.405	16.428	16.353	18.758	19.010	16.802	15.693	15.601	15.602	15.628	15.669	16.184	16.266	16.134	16.990	17.118	17.183	16.744	17.258	17.004	17.583	17.888	17.992	18.040	18.118	18.295	18.300	18.341
CUT / FILL DEPTH	1.046	1.104	0.947	0.97	0.903	1.04	1.275	-1.01	-1.222	1.075	2.255	2.423	2.424	2.323	2.248	1.667	1.558	1.724	1.033	1.012	1.006	1.611	1.263	1.683	1.27	1.018	0.884	0.816	0.68	0.188	0.181	0.484
DESIGN LEVELS ON ROAD CENTRELINE	16.668	16.828	16.988	17.148	17.308	17.468	17.628	17.748	17.788	17.877	17.948	18.024	18.027	17.951	17.916	17.851	17.824	17.859	18.024	18.130	18.189	18.355	18.521	18.687	18.853	18.907	18.876	18.856	18.799	18.483	18.481	19.825
CHAINAGE	600.000	620.000	640.000	660.000	680.000	700.000	720.000	735.010	740.000	751.117	760.000	775.611	780.000	800.000	806.923	820.000	831.961	840.000	860.000	872.804	880.000	900.000	920.000	940.000	960.000	971.224	977.791	980.000	984.377	1000.000	1001.624	1015.371

ROAD B

GRACEMERE SPRINGS 1

Road Longitudinal Sections 4

R12166 - Long Sections 4

0 10.0 40.0m 1:2000 H
0 1.0 4.0m 1:200 V

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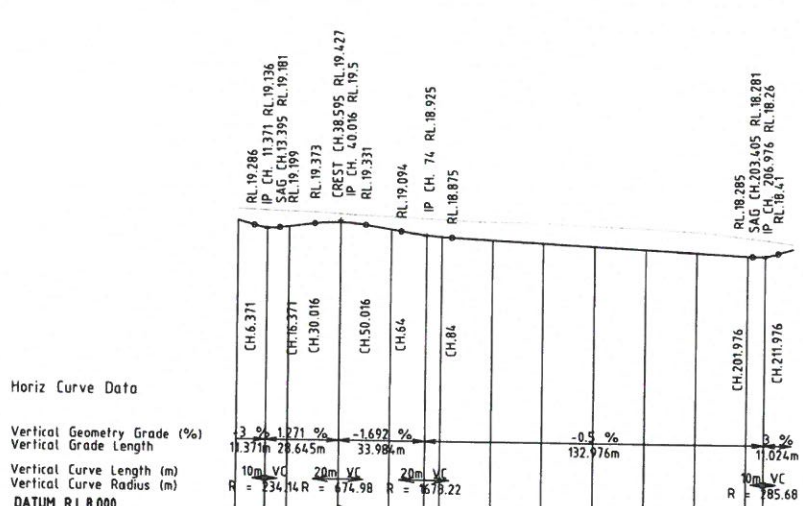
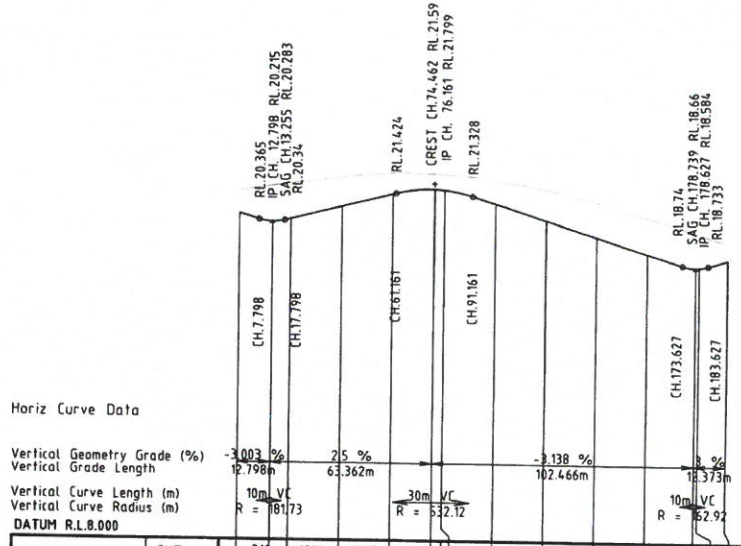


VOLUMES	CUT		110	314	280	150	346	622	398	236	551	530	91		
	FILL		0	56	209	189	167	155	139	106	86	42	0		
KERB LEVELS RHS				19.171	19.352	19.352	19.088	18.881	18.826	18.721	18.621	18.521	18.421	18.321	18.22		
KERB LEVELS LHS				19.171	19.352	19.352	19.088	18.881	18.826	18.721	18.621	18.521	18.421	18.321	18.22		
NAT. SURFACE ON ROAD CENTRELINE	19.910	19.864	19.835		19.746	19.746	19.659	19.602	19.580	19.511	19.485	19.388	19.313	19.197	19.001	18.922	18.778
CUT / FILL DEPTH	-0.433	-0.675	-0.589		-0.32	-0.32	-0.497	-0.647	-0.68	-0.716	-0.79	-0.793	-0.818	-0.803	-0.706	-0.618	
DESIGN LEVELS ON ROAD CENTRELINE	19.477	19.189	19.246		19.426	19.426	19.162	18.955	18.900	18.795	18.695	18.595	18.495	18.395	18.295	18.304	
CHAINAGE	0.000	11.371	20.000		40.000	40.016	60.000	74.000	80.000	100.000	120.000	140.000	160.000	180.000	200.000	206.976	218.046

ROAD C



VOLUMES	CUT		310	1204	1045	623	739	1125	1420	1555	1065				
	FILL		0	0	0	0	0	0	0	0	0				
KERB LEVELS RHS			20.21	20.321	20.821	21.321	21.513	21.487	20.977	20.349	19.721	19.094	18.586		
KERB LEVELS LHS			20.21	20.321	20.821	21.321	21.513	21.487	20.977	20.349	19.721	19.094	18.586		
NAT. SURFACE ON ROAD CENTRELINE	21.486	21.679	21.784	22.037	22.230	22.208	22.188	21.965	21.614	21.152	20.569	20.001	19.957	19.602	
CUT / FILL DEPTH	-0.887	-1.395	-1.389	-1.142	-0.835	-0.62	-0.626	-0.914	-1.191	-1.356	-1.401	-1.341	-1.292	-0.647	
DESIGN LEVELS ON ROAD CENTRELINE	20.599	20.284	20.395	20.895	21.395	21.588	21.561	21.051	20.423	19.796	19.168	18.660	18.665	18.955	
CHAINAGE	0.000	12.798	20.000	40.000	60.000	76.161	80.000	100.000	120.000	140.000	160.000	178.627	180.000	191.000	

ROAD D

GRACEMERE SPRINGS 1

Road Longitudinal Sections 5

R12166 - Long Sections 5

0 10.0 40.0m 1:2000 H

0 1.0 4.0m 1:200 V

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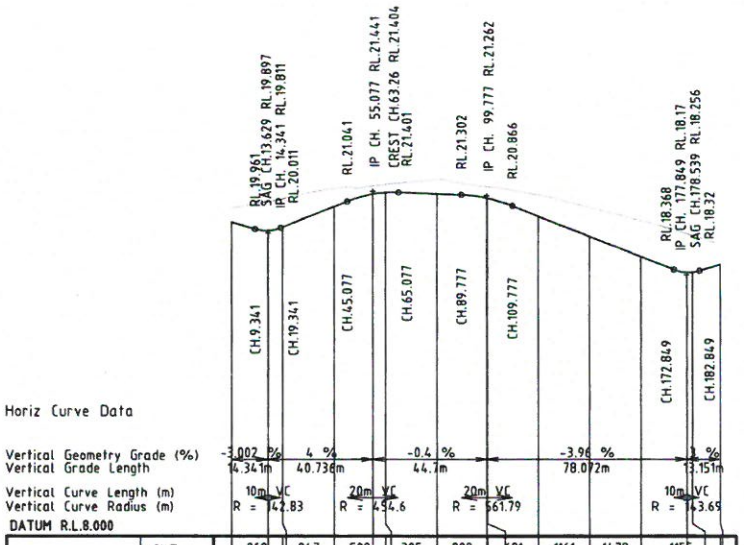
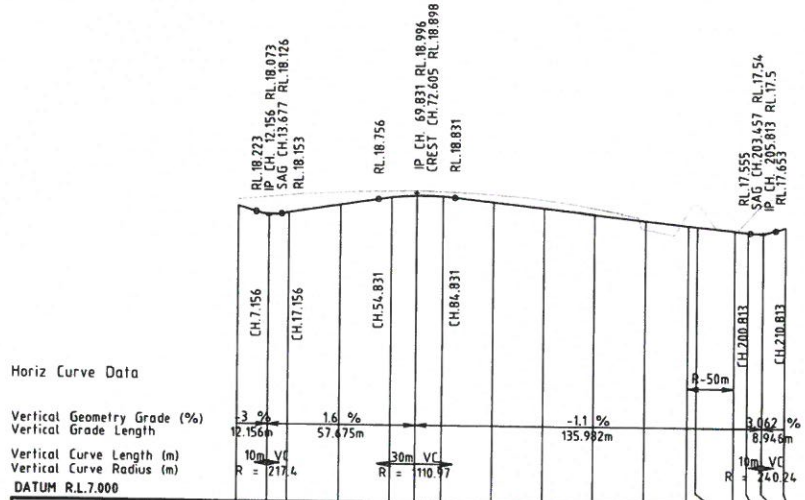


Horiz Curve Data

Vertical Geometry Grade (%)	-3.002 %	4 %		-0.4 %		-3.96 %		3 %		
Vertical Grade Length	14.341m	40.736m		44.1m		78.072m		13.151m		
Vertical Curve Length (m)	10m VC	20m VC		20m VC				10m VC		
Vertical Curve Radius (m)	R = 142.83	R = 454.6		R = 561.79				R = 143.69		

DATUM R.L.8.000

| VOLUMES | | | | | | | | | |



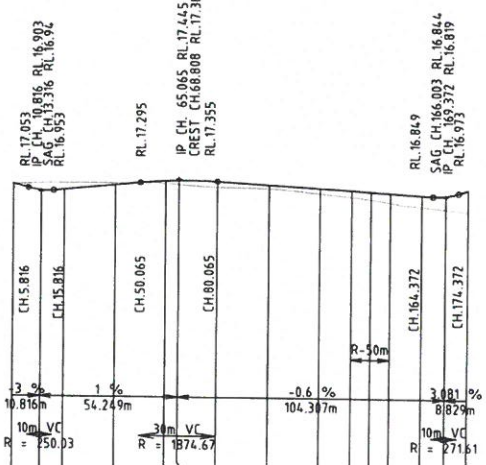
Horiz Curve Data

Vertical Geometry Grade (%)	-3 %	1.6 %		-1.1 %		3.062 %
Vertical Grade Length	12.156m	57.675m		135.982m		8.946m
Vertical Curve Length (m)	10m VC	30m VC				10m VC
Vertical Curve Radius (m)	R = 217.4	R = 1110.97				R = 240.24

DATUM R.L.7.000

VOLUMES															
	CUT		142	444	313	193	302	416	376	229	95	303	60		
	FILL		0	2	2	23	10	15	64	224	385	218	7		
KERB LEVELS RHS				18.125	18.445	18.753	18.821	18.8	18.59	18.37	18.15	17.93	17.747	17.71	17.548	17.49	
KERB LEVELS LHS				18.125	18.445	18.753	18.821	18.8	18.59	18.37	18.15	17.93	17.747	17.71	17.548	17.49	
NAT. SURFACE ON ROAD CENTRELINE		18.686	18.811	18.881	19.000	19.071	19.088	19.058	18.958	18.771	18.459	17.653	18.391	18.640	17.664	18.081	18.691	19.221
CUT / FILL DEPTH		-0.247	-0.68	-0.682	-0.481	-0.244	-0.193	-0.185	-0.294	-0.327	-0.235	0.351	-0.57	-0.856	-0.042	-0.517	-1.139	-1.447
DESIGN LEVELS ON ROAD CENTRELINE		18.438	18.131	18.199	18.519	18.827	18.895	18.874	18.664	18.444	18.224	18.004	17.821	17.784	17.622	17.564	17.552	17.774
CHAINAGE		0.000	12.156	20.000	40.000	60.000	69.831	80.000	100.000	120.000	140.000	160.000	176.652	180.000	194.727	200.000	205.813	214.758

ROAD G



Horiz Curve Data

Vertical Geometry Grade (%)	-3 %	1 %		-0.6 %		3.081 %
Vertical Grade Length	10.816m	54.249m		104.307m		8.829m
Vertical Curve Length (m)	10m VC	30m VC				10m VC
Vertical Curve Radius (m)	R = 250.03	R = 1874.67				R = 271.61

DATUM R.L.6.000

VOLUMES															
	CUT		49	93	27	0	0	0	0	0	0				
	FILL		4	112	229	385	380	418	636	828	159				
KERB LEVELS RHS				16.92	17.12	17.294	17.311	17.281	17.161	17.041	16.966	16.874	16.801				
KERB LEVELS LHS				16.92	17.12	17.294	17.311	17.281	17.161	17.041	16.966	16.874	16.801				
NAT. SURFACE ON ROAD CENTRELINE		17.206	17.252	17.265	17.274	17.263	17.225	17.130	17.083	16.916	16.799	16.707	16.588	16.426	16.340	16.249		
CUT / FILL DEPTH		0.021	-0.299	-0.27	-0.079	0.105	0.16	0.226	0.152	0.2	0.241	0.288	0.361	0.449	0.525	0.842		
DESIGN LEVELS ON ROAD CENTRELINE		17.227	16.953	16.995	17.195	17.368	17.385	17.355	17.235	17.115	17.040	16.995	16.949	16.875	16.865	17.091		
CHAINAGE		0.000	10.816	20.000	40.000	60.000	65.065	80.000	100.000	120.000	132.507	140.000	147.741	160.000	169.372	178.199		

ROAD H

GRACEMERE SPRINGS 1

Road Longitudinal Sections 7

R12166 - Long Sections 7

0 10.0 40.0m 1:2000 H

0 1.0 4.0m 1:200 V

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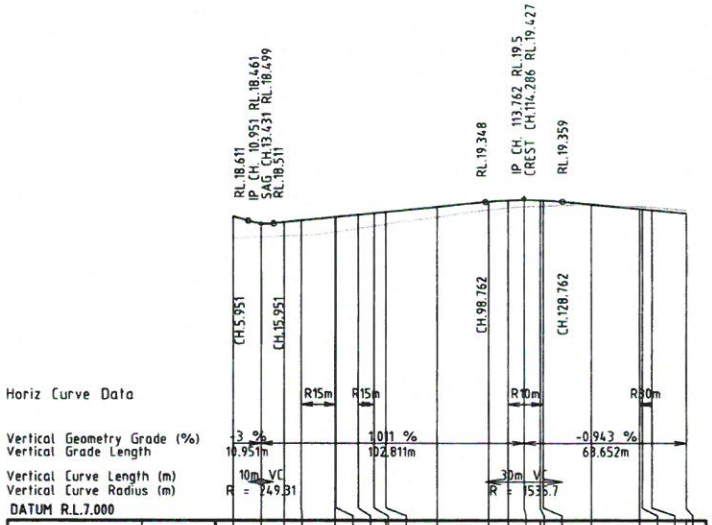
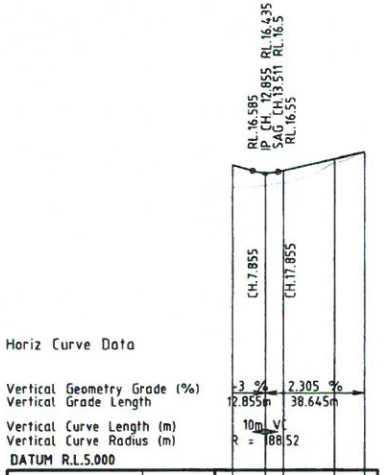


VOLUMES	CUT	0		0		0		0	0	1	1	40		
	FILL	53		214		447		702	305	185	89	110		
KERB LEVELS RHS					18.478	18.544	18.678	18.683	18.773	18.835	18.882	19.084	19.286	19.331	19.331	19.331	19.178	
KERB LEVELS LHS					18.478	18.546	18.68	18.684	18.773	18.835	18.882	19.084	19.286	19.338	19.331	19.339	19.178	19
NAT. SURFACE ON ROAD CENTRELINE	17.918	17.968		18.003	18.029	18.165	18.171	18.306	18.402	18.473	18.746	19.034	19.121	19.167	19.184	19.189	19.223	19.172
CUT / FILL DEPTH	0.872	0.543		0.549	0.591	0.59	0.587	0.541	0.508	0.483	0.413	0.326	0.291	0.26	0.232	0.222	0.03	-0.098
DESIGN LEVELS ON ROAD CENTRELINE	18.789	18.511		18.552	18.620	18.754	18.758	18.848	18.909	18.957	19.159	19.360	19.412	19.427	19.416	19.411	19.253	19.074
CHAINAGE	0.000	10.951		20.000	26.692	40.000	40.409	49.219	55.342	60.000	80.000	100.000	107.504	113.762	120.000	121.153	140.000	158.952

VOLUMES	CUT	19.165	19.137	19.026
	FILL	-0.101	-0.109	-0.126
KERB LEVELS RHS				
KERB LEVELS LHS				
NAT. SURFACE ON ROAD CENTRELINE		19.165	19.137	19.026
CUT / FILL DEPTH		-0.101	-0.109	-0.126
DESIGN LEVELS ON ROAD CENTRELINE		19.064	19.028	18.900
CHAINAGE		163.842	177.414	

ROAD I



VOLUMES	CUT	4		238	117
	FILL	78		253	92
KERB LEVELS RHS			16.427	16.525	16.986	
KERB LEVELS LHS			16.427	16.525	16.986	
NAT. SURFACE ON ROAD CENTRELINE	15.952		16.022	16.120	16.881	
CUT / FILL DEPTH	0.869		0.479	0.479	0.179	
DESIGN LEVELS ON ROAD CENTRELINE	16.820		16.501	16.599	17.060	17.325
CHAINAGE	0.000		12.855	20.000	40.000	51.500

ROAD J

GRACEMERE SPRINGS 1

Road Longitudinal Sections 8

R12166 - Long Sections 8

0 10.0 40.0m 1:2000 H

0 1.0 4.0m 1:200 V

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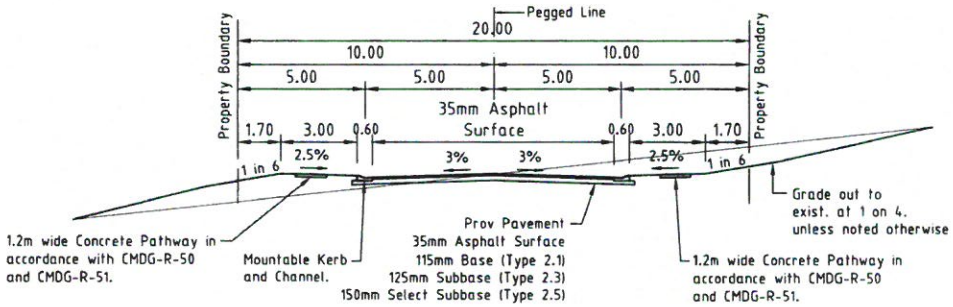
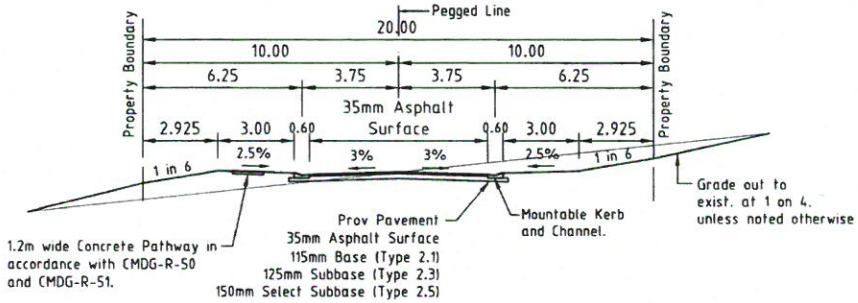
APPENDIX F4

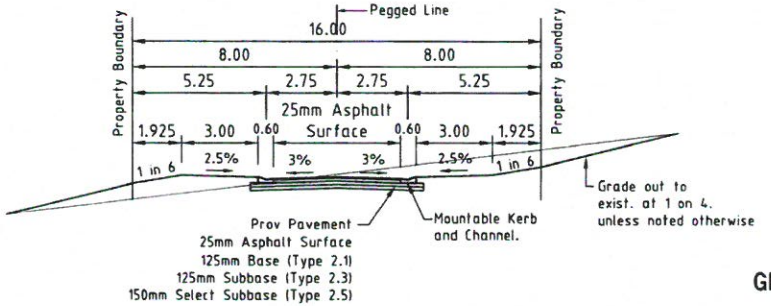
Roadworks Typical Sections



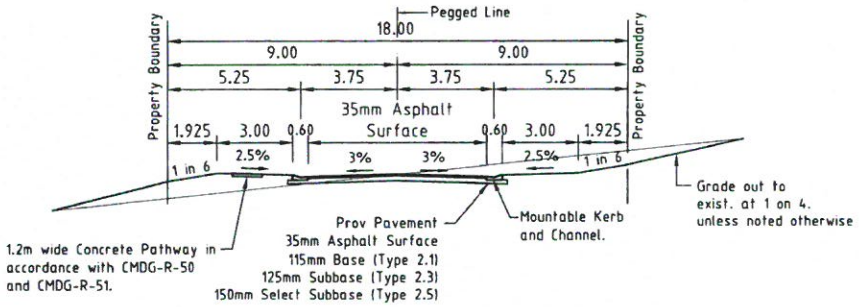
ROAD A (CH 0.000 - CH 74.091)
MAJOR URBAN COLLECTOR



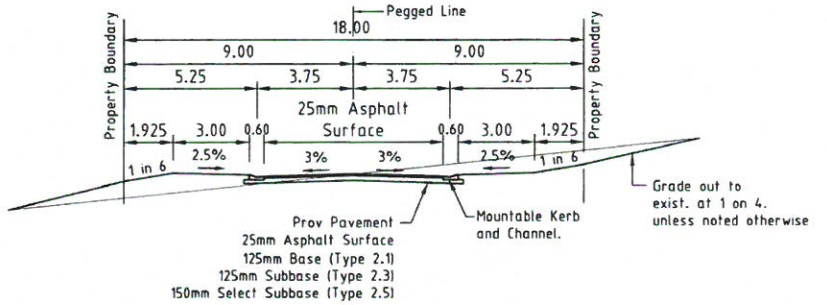
ROAD A (CH. 74.091 - 877.576)
MINOR URBAN COLLECTOR



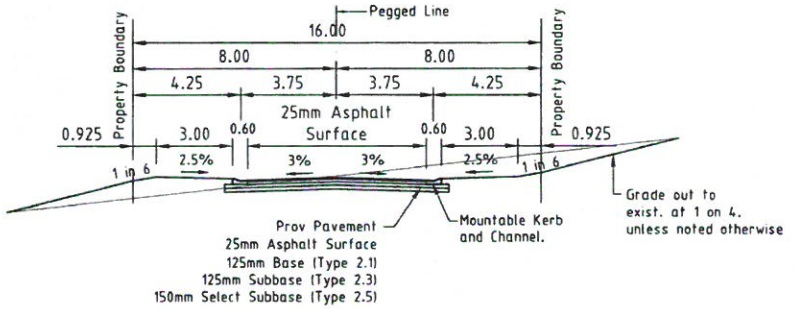
ROAD C, ROAD D, ROAD E, ROAD G, ROAD H AND ROAD I
URBAN ACCESS PLACE



ROAD B (CH. 0.000 - CH. 230.474)
MINOR URBAN COLLECTOR



ROAD B (CH. 230.474 - CH. 1015.371)
URBAN ACCESS STREET



ROAD F AND ROAD J
URBAN ACCESS STREET

GRACEMERE SPRINGS 1

Typical Sections

R12166 - Typical Sections

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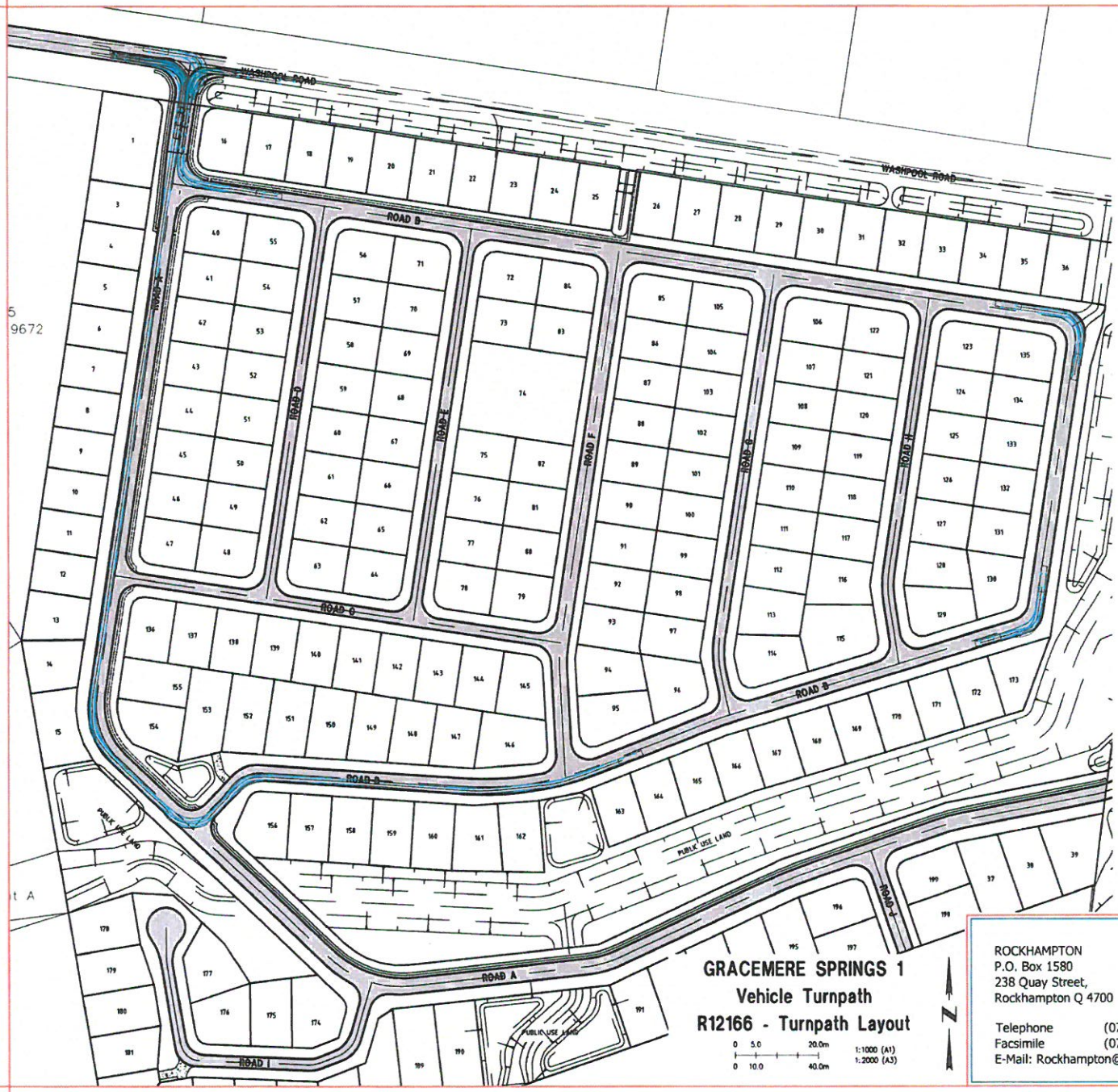
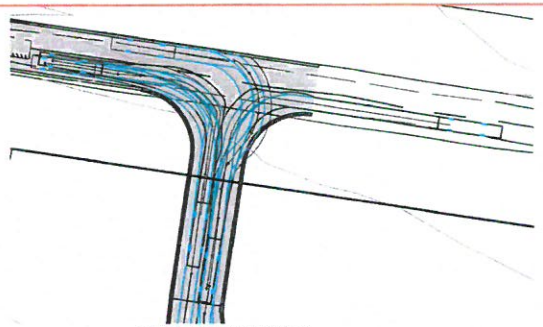
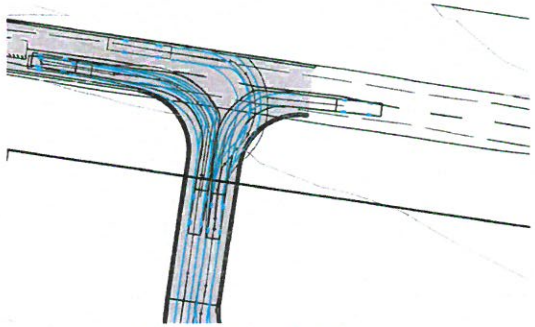
APPENDIX F5

Turnpath Layout Plan

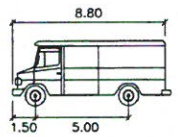




BUS TURN PATH

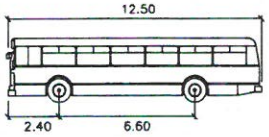


TRUCK TURN PATH



SVEH

	meters
Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 26.2



BUS1

meters	
Width	: 2.50
Track	: 2.50
Lock to Lock Time	: 6.0
Steering Angle	: 35.2

GRACEMERE SPRINGS 1

Vehicle Turnpath

R12166 - Turnpath Layout

0 5.0 20.0m
0 10.0 40.0m
1:1000 (A1)
1:2000 (A3)

N

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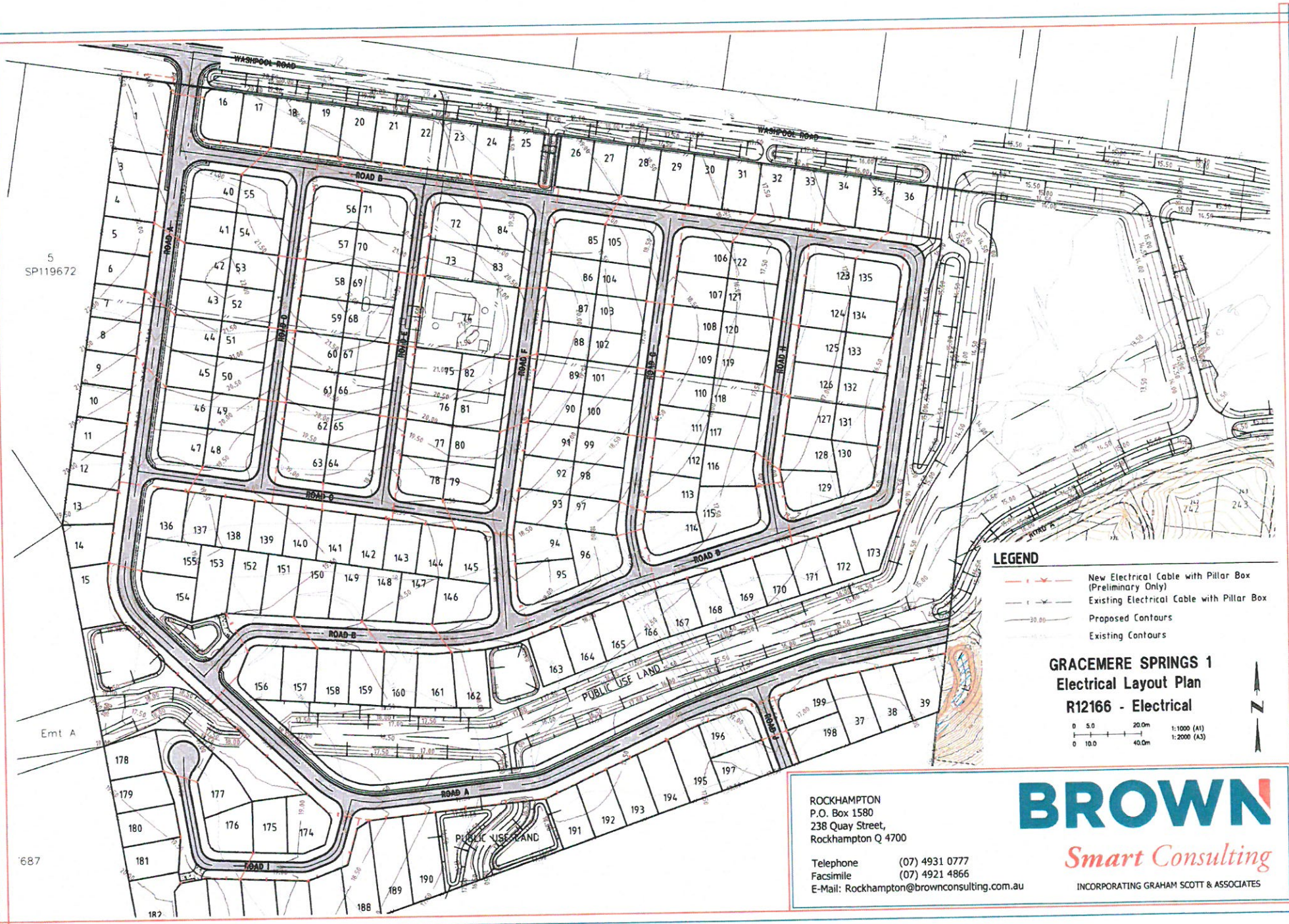
APPENDIX G

Preliminary Electrical Layout Plan



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GRACEMERE
SPRINGS

GRACEMERE SPRINGS LOCAL PLAN

REVISION A, JULY 2013

ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with Development Permit No. D588-2012
Dated 5/04/2016

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TOWN PLANNING + DEVELOPMENT

GRACEMERE SPRINGS
LOCAL PLAN

PRELIMINARY APPROVAL FOR A MATERIAL CHANGE OF USE FOR RESIDENTIAL PURPOSES

70 & 104 WASHPOOL ROAD, GRACEMERE

LOT 4 ON SP119672 & LOT 1 ON RP848973

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1 Introduction

1.1 Citation

1. This document should be cited as the **"Gracemere Springs Local Plan Revision A July 2013"** (hereafter the **"Local Plan"**).

1.2 Subject Land

2. The preliminary approval applies to land described as Lot 4 on SP119672 and Lot 1 on RP848973 ("the subject land"), located at 70 & 104 Washpool Road, Gracemere, respectively. Refer to the attached plans provided in **Schedule 2 (Mapping)**

1.3 Varying effect of the Preliminary Approval: Section 242 *Sustainable Planning Act 2009*

3. For the purpose of section 242(3) and (5) of the *Sustainable Planning Act 2009*, in relation to:

   (a) the material changes of use;
   (b) development relating to the material changes of use; and
   (c) the development.

4. This preliminary approval states development that is:

   (a) exempt development;
   (b) self-assessable development;
   (c) development requiring compliance assessment;
   (d) code assessable development; and,
   (e) impact assessable development.

   and identifies the relevant codes for the development.

5. For the purpose of section 242(6) of the *Sustainable Planning Act 2009*, to the extent this preliminary approval

   states development that is:
   (a) exempt development;
   (b) self-assessable development;
   (c) development requiring compliance assessment;
   (d) code assessable development; and,
   (e) impact assessable development.

6. and identifies the relevant codes for the development.

7. In a way that the above is different from a local planning instrument, this preliminary approval prevails.

1.4 When Development Approval Lapses if Development is not started: Section 341 *Sustainable Planning Act 2009*

8. For the purpose of section 341(1)(b) of the *Sustainable Planning Act 2009*, to the extent this development approval is for a material change of use, this development approval lapses if the first change of use under this development approval does not start within 10 years starting on the day this development approval takes effect.

9. For the purpose of section 341(2)(c) of the *Sustainable Planning Act 2009*, to the extent this development approval is for reconfiguring a lot, this development approval lapses if a plan for the reconfiguration is not given to the local government within 10 years starting on the day this development approval takes effect.

10. For the purpose of section 341(3)(b) of the *Sustainable Planning Act 2009*, to the extent this development approval is for development other than a material change of use of premises or reconfiguring a lot, this development approval lapses if the development does not substantially start within 15 years starting on the day this development approval takes effect.

1.5 No condition requiring completion within a particular time: Section 346(1)(e) *Sustainable Planning Act 2009*

11. For the purpose of section 346(1)(e) of the *Sustainable Planning Act 2009*, there is no condition requiring the completion of the development within a particular time.

2 Using the Preliminary Approval

2.1 Assessment Levels

12. This Local Plan has been prepared in accordance with the *Sustainable Planning Act 2009* (the "Act") as a framework for managing development in a way that advances the purpose of the Act.

13. In seeking to achieve this purpose, the Local Plan sets out the intention for the future development in the subject land.

14. The Local Plan applies to the subject land including all premises, roads, drainage reserves, parks and internal waterways.

2.2 Definitions and Interpretation

15. Where the Local Plan uses terms which are defined in the *Sustainable Planning Act 2009*, they are taken to have the same meaning as defined in the *Sustainable Planning Act 2009.*

16. The use definitions listed in **Schedule 1** are the definitions for the purpose of the "Local Plan".

2.3 Assessment Levels for Development

17. This preliminary approval identifies self assessable, compliance assessable, code assessable and impact assessable development through:

    a) Tables of Development Assessment for material change of use; and,
    b) Tables of Development Assessment for other development.

18. If a development proposal is identified as having a different assessment level under any of the Tables mentioned above, the higher assessment level applies.

2.4 Variations to the Planning Scheme

19. The following table provides detail of which sections of the Fitzroy Shire Planning Scheme 2005 (as amended 25 September 2009) are to be varied, including the Development Assessment Tables that will be affected by this Preliminary Approval application.

Table 1 Proposed Variations to Planning Scheme

FITZROY SHIRE PLANNING SCHEME 2005	PROPOSED VARIATION
Zoning and Interpretation	
Rural Zone	Variations are sought to nominate the subject site as the following zones: ◗ Low Density Residential Zone ◗ Open Space Zone The permitted uses within these zones varying from those permitted in the Rural Zone.
Use and Administrative definitions	All use and administrative definitions have been adopted in accordance with the QPPs (version 3.0). The following definitions have been specifically adopted as part of this Local Plan: ◗ Advertising device ◗ Community use ◗ Dual occupancy ◗ Dwelling house ◗ Home based Business ◗ Park ◗ Multiple dwelling ◗ Outdoor sport and recreation ◗ Sales office ◗ Utility installation
Overlays	
Economic Resources Overlays ◗ The Agricultural Land Class Overlay Natural Features and Conservation Overlays ◗ The Wetlands Overlay	The Preliminary Approval is to override these two overlays. ***The Agricultural Land Class Overlay*** Despite part of the subject land being mapped as under the planning scheme, the site is not considered to be 'Strategic Cropping Land' or 'Potential Strategic Cropping Land' as defined under the *Strategic Cropping Land Act 2011*. The development of the subject site for residential purposes will not result in a loss of good quality agricultural land and will not result in any negative impacts on nearby 'potential' strategic cropping land. The subject site represents an appropriate and logical extension of urban residential land

	due to its location in close proximity to the newly established residential estates to the north of the site. The availability of essential urban infrastructure (water, sewerage, roads, electricity and telecommunications) provides an 'in-sequence' extension to the existing Residential Precinct. ***The Wetlands Overlay*** The planning scheme identifies an inland wetland on the subject land; however, the mapped wetland is actually a man-made dam and provides no environmental value or significance. This existing dam will be filled as part of the proposed development. The proposed stormwater management strategy seeks to maintain the natural flowpaths through the site where possible and minimise the realignment of existing flowpaths.
Codes	
Rural Zone Code Home Based Business Code House Code Development Standards Code Development Standards – Reconfiguring a Lot Code Reconfiguring a Lot Code Residential Accommodation Code	The Local Plan proposes alternate design outcomes for the above mentioned land uses, to those proposed in the Codes of the planning scheme, and seeks to replace/override the planning scheme codes. Supporting technical reports and planning merit that has been included as part of this development application, provides justification for the proposal.
Development Assessment Tables	
Rural Zone ◗ Material Change of Use ◗ Other Development Overlays	The Development Assessment Tables provided within the Local Plan override those assessment tables within the planning scheme. The key variations include changes to use definitions in accordance with the QPPs (version 3.0) and overlays not being applicable for future applications as a result of a nominated development footprint and associated zones. Dual occupancies, home-based businesses and sales offices (includes display homes) within the proposed estate will be Self Assessable, where complying with the relevant self assessment outcomes. Multiple dwellings will be code assessable, where complying with minimum lot size requirements. Provisions for code assessable small lots (of less than 600m^2) have been included, where satisfying specific small lot design criteria.

	The level of assessment for rearranging boundaries has been lowered to self assessable. Reconfiguring of lots in accordance with schedule 4, table 3 of the *Sustainable Planning Regulation 2009* has been nominated as exempt. Reconfiguring of lots in accordance with schedule 18, table 1 of the *Sustainable Planning Regulation 2009* has been nominated as compliance assessment.

3 Gracemere Springs Local Plan Code

3.1 Code Applicability

20. This code applies to assessable development:

(a) within the Local Plan area as shown on the proposed Lot Reconfiguration Plans contained within **Schedule 2 (Mapping);** and
(b) identified as requiring assessment against the Local Plan by the tables of assessment in **Section 2.3 – Assessment Levels for Development**.

3.2 Compliance with the Code

20. The following rules apply in determining compliance with the Gracemere Springs Local Plan Code for selfassessable development:

(a) Development must comply with the applicable acceptable outcomes of the Gracemere Springs Local Plan Code.
(b) Where development does not comply with the applicable acceptable outcome of the applicable code the development becomes assessable development.

21. The following rules apply in determining compliance with the Gracemere Springs Local Plan Code for code and impact assessable development:

(a) development complies with the code if it complies with the intent of the code;
(b) development which complies with the performance criteria complies with the code and the intent of the code;
(c) where acceptable solutions are identified for a performance criteria, development which complies with the acceptable solution complies with the performance criteria and the intent of the code; and,
(d) where development requiring impact assessment does not comply with the code it is inconsistent with the code.

3.3 Levels of assessment – Material change of use

22. The following tables identify the levels of assessment for development being a material change of use in a zone and the applicable assessment criteria.

Table 2 Levels of assessment - Low Density Residential Zone

Low Density Residential Zone		
Note: 1. For self assessable development only the acceptable outcomes of an applicable code apply. 2. Development identified in this table of assessment as self assessable that does not comply with the acceptable outcomes of the applicable code is code assessable.		
Use	**Level of assessment**	**Assessment criteria**
Residential activities		
Dual occupancy	**Self assessable**	Gracemere Springs Local Plan Code
Dwelling house	**Exempt**	
Secondary dwelling	**Self assessable**	Gracemere Springs Local Plan Code
Multiple dwelling	**Code assessable** where located on a lot with an area of at least 900m^2	Gracemere Springs Local Plan Code
All other defined uses in the residential activity group	**Impact assessable**	
Business activities		
Home based business	**Exempt** if for a home office.	
	Self assessable	Gracemere Springs Local Plan Code
Sales office	**Self assessable**	Gracemere Springs Local Plan Code
All other defined uses in the business activity group	**Impact assessable**	
Industrial activities		
All defined uses in the industry activity group	**Impact assessable**	
Community activities		
Community use	**Self assessable** if:- (a) located on Council owned or controlled land; and (b) undertaken by or on behalf of the Council.	Gracemere Springs Local Plan Code
Emergency services	**Code assessable**	Gracemere Springs Local Plan Code
All other defined uses in the Community activity group	**Impact assessable**	
Sport and recreation activities		
Park	**Exempt**	
All other defined uses in the sport and recreation activity group	**Impact assessable**	

Rural activities		
All defined uses in the rural activity group	**Impact assessable**	
Other activities		
Utility installation	**Exempt**	
	Impact assessable if not otherwise specified.	
All other defined uses in the other activity group	**Impact assessable**	
Undefined uses		
Any use not defined in Schedule 1 (Definitions)	**Impact assessable**	

Table 3 Levels of assessment – Open Space Zone

Open Space Zone		
Note: 1. For self assessable development only the acceptable outcomes of an applicable code apply. 2. Development identified in this table of assessment as self assessable that does not comply with the acceptable outcomes of the applicable code is code assessable.		
Use	**Level of assessment**	**Assessment criteria**
Residential activities		
All defined uses in the residential activity group	**Impact assessable**	
Business activities		
Food and drink outlet	**Self assessable** if:- (a) located on Council owned or controlled land; (b) conducted in association with an open space use on the same site; (c) not including a drive-through facility; and (d) having a gross leasable floor area not exceeding 150m^2.	Gracemere Springs Local Plan Code
Market	**Exempt if:-** (a) conducted by a not-for-profit organisation; and (b) located on Council owned or controlled land.	
	Code assessable if not otherwise specified.	Gracemere Springs Local Plan Code
All other defined uses in the business activity group	**Impact assessable**	
Industrial activities		
All defined uses in the industry activity group	**Impact assessable**	
Community activities		
Community use	**Self assessable** if:- (a) located on Council owned or controlled land; and (b) undertaken by or on behalf of the Council.	Gracemere Springs Local Plan Code
Emergency services	**Code assessable**	Gracemere Springs Local Plan Code
All other defined uses in the Community activity group	**Impact assessable**	

Sport and recreation activities		
Outdoor sport and recreation	**Self assessable** if:- (a) located on Council owned or controlled land; (b) undertaken by or on behalf of the Council or a not-for profit community organisation; and (c) the gross floor area of any building associated with the use does not exceed 150m^2.	Gracemere Springs Local Plan Code
Park	**Exempt**	
All other defined uses in the sport and recreation activity group	**Impact assessable**	
Rural activities		
All defined uses in the rural activity group	**Impact assessable**	
Other activities		
Utility installation	**Exempt**	
	Impact assessable if not otherwise specified.	
All other defined uses in the other activity group	**Impact assessable**	
Undefined uses		
Any use not defined in Schedule 1 (Definitions)	**Impact assessable**	

3.4 Levels of assessment – Other development

23. The following tables identify the level of assessment for reconfiguring a lot, operational work and building work.

Table 4 Levels of assessment – Reconfiguration of a lot

Reconfiguration of a Lot		
Note: 1. For self assessable development only the acceptable outcomes of an applicable code apply. 2. Development identified in this table of assessment as self assessable that does not comply with the acceptable outcomes of the applicable code is code assessable.		
Zone	**Level of assessment**	**Assessment criteria**
If the Sustainable Planning Regulation 2009, schedule 4, table 3 applies.	**Exempt**	
If rearranging the boundaries of a lot by registering a plan of subdivision.	**Self assessable**	Gracemere Springs Local Plan Code
If the Sustainable Planning Regulation 2009, schedule 18, table 1 applies.	**Compliance assessment**	As per Sustainable Planning Regulation 2009, schedule 18.
Low density residential zone	**Impact assessable** if:- (a) creating one or more additional lots in the Low Density Residential Zone; and (b) not complying with the minimum lot size specified in the Gracemere Springs Local Plan Code.	
All Zones	**Code assessable** if:- (a) involving the subdivision of an existing or approved building that subdivides land; or (b) not otherwise specified in this table as being impact assessable development.	Gracemere Springs Local Plan Code

Table 5 Levels of assessment – Operational work

Operational Work – All Zones		
Note: 1. For self assessable development, only the acceptable outcomes of an applicable code apply. 2. Development identified in this table of assessment as self assessable that does not comply with the acceptable outcomes of an applicable code is code assessable.		
Development	**Level of assessment**	**Assessment criteria**
Operational work – engineering work and/or landscaping work		
Operational work involving engineering work and/or landscaping work associated with a material change of use	**Self assessable** if the associated material change of use is self assessable.	Gracemere Springs Local Plan Code
	Code assessable if the associated material change of use is self assessable.	Gracemere Springs Local Plan Code
Operational work involving engineering work and/or landscaping work associated with reconfiguring a lot	**Code assessable**	Gracemere Springs Local Plan Code
Operational work – excavation or filling		
Operational work involving excavation and filling associated with a material change of use or reconfiguring a lot	**Exempt** if involving cumulative excavation or filling of not more than 50m^3 of material.	
	Self assessable if the associated material change of use is self assessable.	Gracemere Springs Local Plan Code
	Code assessable if not otherwise specified.	Gracemere Springs Local Plan Code
Excavating or filling (other than the placement of topsoil) not associated with a material change of use or reconfiguring a lot	**Exempt** if:- (a) on a lot having an area greater than 5,000m^2; and; (b) cumulatively involving not more than 150m^3 of material.	
	Code assessable if not otherwise specified.	Gracemere Springs Local Plan Code
Operational work – placing an advertising device on premises		
	Self assessable if for a sign type described in the Gracemere Springs Local Plan Code.	
	Code assessable if not otherwise made self assessable or impact assessable.	Gracemere Springs Local Plan Code
	Impact assessable if a third party sign erected on land other than land owned or controlled by the Council and used for sport and recreation purposes.	

Operational work – vegetation clearing		
Operational work involving vegetation clearing	**Exempt**[1] if:- (a) exempt vegetation clearing; or (b) in accordance with the conditions of a current development approval:- (i) for material change of use, reconfiguring a lot or other operational work; or (ii) for building work associated with the establishment of a new dwelling house.	
Operational work – not otherwise specified in this table		
Operational work not otherwise specified in this table.	**Exempt**	

[1] Vegetation clearing which is exempt for the purposes of the Gracemere Springs Local Plan Code may be subject to assessment under State and/or Federal legislation.

Table 6 Levels of assessment – Building work

Building Work – All Zones		
Note: 1. This table only applies to building work not associated with a material change of use. 2. For self assessable development only the acceptable outcomes of an applicable code apply. 3. Development identified in this table of assessment as self assessable that does not comply with the acceptable outcomes of the applicable code is code assessable.		
Development	**Level of assessment**	**Assessment criteria**
Building work	**Exempt** if involving minor building work.	
	Self assessable if the applicable use code identifies acceptable outcomes applicable to self assessable development.	Gracemere Springs Local Plan Code
	Code assessable if not otherwise specified above.	Gracemere Springs Local Plan Code

3.5 Zones

3.5.1 Preliminary

24. Zones organise the Local Plan area in a way that facilitates the location of preferred or acceptable land uses.

25. Zones are mapped and included in **Schedule 2 (Mapping)**.

26. The levels of assessment for development in a zone are in **Section 2.3 – Assessment Levels for Development**.

27. Assessment criteria for zones are contained in a zone code.

28. Each zone code identifies the following:
    (a) the purpose of the code; and
    (b) the overall outcomes that achieve the purpose of the code.
    (c) The following are the zone codes for the Local Plan:
        (i) Low Density Residential Zone; and
        (ii) Open Space Zone

3.5.2 Low Density Residential Zone Code

Application

This code applies to assessable development:-

(a) within the Low Density Residential Zone as identified on the zoning maps contained within **Schedule 2 (Mapping)**; and
(b) identified as requiring assessment against the Low Density Residential Zone Code by the tables of assessment in **Section 2.3 – Assessment Levels for Development**.

Purpose and Overall Outcomes

(1) The purpose of the Low Density Residential Zone Code is to provide for predominantly low density, low-rise residential activities on conventional sized urban residential lots. Whilst primarily intended to accommodate dwelling houses, dual occupancies and multiple dwellings may also be located in identified areas, along with other residential activities and small-scale services and facilities that cater for local residents.

(2) The purpose of the Low Density Residential Zone Code will be achieved through the following overall outcomes:-
    (a) development provides for an attractive, open and low density form of urban residential living;
    (b) development provides for low density housing types, primarily in the form of dwelling houses, dual occupancies and limited multiple dwellings;
    (c) home based businesses that integrate work and family and are compatible with local residential amenity are also encouraged to establish in the zone;
    (d) development provides for an efficient pattern of land use and infrastructure that:-
        (i) creates walkable and legible residential neighbourhoods that integrate with active transport networks and are well connected to activity centres, employment nodes, open space and recreational areas, community facilities and educational opportunities; and,

(ii) maximises the efficient extension and safe operation of infrastructure;

(e) development provides for a range of lot sizes, including small residential lots;

(f) development is designed and located in a manner which makes a positive contribution to the streetscape and is sympathetic to the existing and intended scale and character of surrounding development;

(g) development incorporates a high level of residential amenity, personal health and safety and protection for property;

(h) development for residential activities adjacent to rural land does not interfere with the existing or ongoing use of rural land for productive agricultural purposes;

(i) development is located, designed and operated to be responsive to the region's sub-tropical climate and minimises the consumption of energy and water;

(j) development avoids as far as practicable, or where avoidance is not practicable minimises and otherwise mitigates, adverse impacts on ecologically important areas, including creeks, gullies, waterways, wetlands, coastal areas, habitats and vegetation through location, design, operation and management;

(k) development is designed and sited to sensitively respond to the physical characteristics and constraints of land, including flooding, steep slopes, landslide hazard and bushfire hazard where applicable;

(l) development is provided with the full range of urban services to support the needs of the community, including parks, roads and transport corridors, pedestrian and cycle paths, reticulated water and sewerage (where available or planned to be made available), stormwater drainage and electricity and telecommunication infrastructure; and,

(m) development does not adversely impact on the continued operation, viability and maintenance of existing infrastructure or compromise the future provision of planned infrastructure.

3.5.3 Open Space Zone Code

Application

This code applies to assessable development:-

(a) within the Open Space Zone as identified on the zoning maps contained within **Schedule 2 (Mapping)**; and

(b) identified as requiring assessment against the Open Space Zone Code by the tables of assessment in **Section 2.3 – Assessment Levels for Development**.

Purpose and Overall Outcomes

(1) The purpose of the Open Space Zone Code is to provide open space and park functions and those uses which are associated with the safe and comfortable public use of those areas. The zone may also accommodate open space required for drainage or amenity purposes. Where required to meet community needs, development may include shelters, amenity facilities, picnic tables, and playgrounds and infrastructure to support safe access and essential management.

(2) The purpose of the Open Space Zone Code will be achieved through the following overall outcomes:-

- (a) development predominantly provides for parks and other small scale and low intensity recreation activities that primarily cater for the informal active recreation needs of residents and visitors;
- (b) limited other uses which are ancillary to and support the use and enjoyment of open space may also be established in the zone;
- (c) open space may be also used for temporary or periodic uses or events, such as markets or outdoor entertainment events, where these uses are of a scale that can be reasonably accommodated by the existing open space facilities and do not unduly impact on the amenity and character of the surrounding area;
- (d) existing and planned open space is protected from the intrusion of incompatible uses that may compromise or conflict with the primary use of the open space for small scale and low intensity recreation activities;
- (e) where practicable, areas of open space are connected to other parts of the broader regional open space network;
- (f) development provides a high level of amenity and mitigates the potential for land use conflicts with existing and planned development in the locality;
- (g) the scale, intensity and built form of development is compatible with the existing and intended scale and character of the streetscape and surrounding area;
- (h) development is located, designed and operated to be responsive to the region's sub-tropical climate and minimises the consumption of energy and water;
- (i) development protects and enhances the informal character and amenity of open space;
- (j) development avoids any adverse impacts on ecologically important areas, including creeks, gullies, waterways, wetlands, coastal areas, habitats and vegetation through location, design, operation and management;
- (k) development is designed and sited to sensitively respond to the physical characteristics and constraints of land, including flooding, steep slopes, landslide hazard and bushfire hazard where applicable;
- (l) development encourages public transport accessibility and use and provides for pedestrian, cycle and vehicular movement networks that maximise connectivity, permeability and ease of movement within and to open space areas;

(m) development provides for infrastructure and services that are commensurate with the location and setting of the open space and the nature and scale of development that is intended to occur in the zone; and,

(n) development does not adversely impact on the continued operation, viability and maintenance of existing infrastructure or compromise the future provision of planned infrastructure.

4 Assessment Criteria

The following table provide the assessment criteria for assessable development within the Gracemere Springs Local Plan area.

Table 7 Criteria for assessable development

Performance Outcomes		Acceptable Outcomes	
Development in the Gracemere Springs Local Plan Area Generally (All Zones)			
PO1	Development in the Gracemere Springs Local Plan area contributes to the creation of high quality, attractive, environmentally responsible and sustainable residential neighbourhoods which:- (a) are integrated with existing neighbourhoods; (b) have legible and permeable local road systems; (c) provide for the coordinated provision of infrastructure; and (d) retain, enhance and connect native vegetation areas and other ecologically important areas, and avoid development of land otherwise subject to constraints.	**AO1**	No acceptable outcome provided.
PO2	Development in the Gracemere Springs Local Plan area provides for the establishment of a mix of lot sizes and dwelling types, including dual occupancies and multiple dwellings in a configuration that does not adversely impact upon the character or amenity of the surrounding area.	**AO2**	No acceptable outcome provided.
PO3	Development improves local connectivity by providing pedestrian and cycle connections to and between key local destinations, employment areas and recreational facilities.	**AO3**	No acceptable outcome provided.
Development in the Low Density Residential Zone Generally			
PO4	Development in the Low Density Residential Zone provides for lot sizes and a configuration of lots that is sympathetic to the character and identity of the Gracemere Springs Local Plan area.	**AO4**	No acceptable outcome provided.
PO5	Development within the Low Density Residential Zone:- (a) is designed to sensitively respond to site characteristics; and (b) provides for an interconnected, legible and permeable system of local roads, pedestrian, cycle and open space areas.	**AO5**	No acceptable outcome provided.

Performance Outcomes		Acceptable Outcomes	
Landscaping in the Gracemere Springs Local Plan Area Generally (All Zones)			
Landscape Design			
PO6	Development in the Gracemere Springs Local Plan area provides for landscaping that contributes to and creates a high quality landscape character for the site, street and local area by:- (a) being sensitive to site conditions, natural landforms and landscape characteristics; (b) protecting and enhancing native vegetation; and, (c) being of an appropriate scale to integrate successfully with development.	**AO6**	No acceptable outcome provided.
Site Stability and Soil Quality			
PO7	Development provides for landscaping which is designed and sited to ensure the stability of soils and minimise erosion.	**AO7**	No acceptable outcome provided.
Protection of Infrastructure			
PO8	Landscaping within Gracemere Springs Local Plan area does not have the ability to compromise the function or integrity of essential infrastructure.	**AO8**	Any landscaping proposed adjacent to water supply or sewerage infrastructure must be located a minimum of 1.0 metre clear of the infrastructure. Small shrubs and groundcover is acceptable.
Stormwater Management in the Gracemere Springs Local Plan Area Generally (All Zones)			
Stormwater Drainage Systems			
PO9	Development within the Gracemere Springs Local Plan area is provided with a stormwater drainage system which:- (a) makes adequate provision for drainage of the premises to a lawful point of discharge; and (b) ensures the development is adequately drained, and stormwater is managed and lawfully discharged without altering stormwater drainage characteristics external to the site.	**AO9**	Development is provided with a stormwater drainage system which is designed and constructed in accordance with the Stormwater Management Plan for the Gracemere Springs Local Plan area.
Stormwater Quality			
PO10	Development protects or enhances the environmental values and water quality objectives of receiving waters or buffer areas within or downstream of a Gracemere Springs Local Plan area.	**AO10**	Stormwater discharges are in accordance with the Stormwater Management Plan for the Gracemere Springs Local Plan area.
PO11	Treatment systems that use natural processes and materials are used wherever practicable	**AO11**	No acceptable outcome provided.

Performance Outcomes		Acceptable Outcomes	
	to enhance biodiversity and landscape benefits.		
Transport and Parking in the Gracemere Springs Local Plan Area Generally (All Zones)			
Car Parking Requirements			
PO12	Development within the Gracemere Springs Local Plan area provides on-site car parking for the demand anticipated to be generated by the development.	**AO12**	Development provides on-site car parking spaces at the minimum rates outlined in **Table 9** and design standards in accordance with **Table 10**.
Pedestrian and Cycle Network			
PO13	Development provides a conveniently located network of footpaths, shared pathways and cycleways that:- (a) achieve a high level of safety and accessibility; (b) provide for safe and convenient joint usage; do not compromise the operation of or access to other infrastructure and services; and, (c) are well lit and located where there is casual surveillance from nearby premises and / or roads.	**AO13**	(a) Footpaths, shared pathways and cycleways are provided in accordance with relevant reconfiguration of a lot approvals; and, (b) Where not otherwise address the Capricorn Municipal Development Manual.
Works, Services and Infrastructure in the Gracemere Springs Local Plan Area Generally (All Zones)			
Site Works			
PO14	Site works are designed and undertaken having regard to the following aims; (a) Efficient and economical design; (b) Enhancement of the environmental character of the site whilst maintaining the natural features of the site; (c) Provision of safe conditions for construction commensurate with the proposed purpose of the development; (d) Equality of building conditions for residential development; and (e) Minimal impact on adjoining properties and developments.	**AO14**	All site works are designed in accordance with: (a) The relevant reconfiguration of a lot approvals; and, (b) Where not otherwise addressed, the Capricorn Municipal Development Manual: (i) Design Guideline D1 (Geometric Road Design); (ii) Design Guideline D5 (Stormwater Drainage Design); (iii) Design Guideline D6 (Site Regrading); and (iv) Design Guideline D7 (Erosion Control and Stormwater Management).
Infrastructure, Services and Utilities			
PO15	Development is provided with infrastructure, services and utilities appropriate to its setting and commensurate with its needs.	**A15.1**	Appropriate connections are provided to reticulated sewerage, water supply, stormwater drainage, electricity and telecommunications services at no cost to the Council, including provision by way of

Performance Outcomes		Acceptable Outcomes	
			dedicated road, public reserve or as a minimum by way of easements to ensure continued access is available to these services.
		A15.2	(a) All water supply infrastructure is designed in accordance with relevant reconfiguration of a lot approvals; and; (b) Where not otherwise address the Capricorn Municipal Development Manual Design, Guideline D11 (Water Reticulation).
		A15.3	(a) All sewer infrastructure is designed in accordance with relevant reconfiguration of a lot approvals; and; (b) Where not otherwise address the Capricorn Municipal Development Manual Design, Guideline D12 (Sewerage System).
		A15.4	All roads are designed in accordance with:- (a) The relevant reconfiguration of a lot approvals; and, (b) Where not otherwise addressed, the Capricorn Municipal Development Manual: (i) Design Guideline D1 (Geometric Road Design); (ii) Design Guideline D2 (Pavement Design); and (iii) Design Guideline D4 (Subsurface Drainage Design).
		A15.5	All vehicle accesses are designed in accordance with the Fitzroy Shire Council Standard Drawings Nos. 13, 14 and 26 as appropriate.
		A15.6	Each newly created lot is provided with the necessary conduits, cables, meters and poles for the connection of electricity; the standard of which is specified by the relevant electricity authority.
		A15.7	Each newly created lot is provided with the necessary cables and connections for the supply of telecommunications; the standard of which is specified by the relevant telecommunication authority.
Filling and Excavation			
PO16	Filling and excavation:- (a) does not cause environmental harm;	**AO16**	Development provides that:- (a) on sites of:-

Performance Outcomes		Acceptable Outcomes	
	(b) does not impact adversely on visual amenity or privacy; (c) maintain natural landforms as far as possible; and (d) is stable in both the short and long term.		(i) On slopes greater than 15% the extent of excavation (cut) and fill does not involve a total change of more than 1.5 metres relative to the natural ground level at any point; or (ii) in other areas, the extent of excavation (cut) and fill does not involve a total change of more than 1.0m relative to the natural ground level at any point; (b) retaining walls are no greater than 1.0 metre high; (c) all stored material is:- (i) contained wholly within the site; (ii) located in a single manageable area that does not exceed 50m^2. (d) any batter or retaining wall is structurally adequate.
PO17	Filling or excavation does not result in any contamination of land or water, or pose a health or safety risk to users and neighbours of the site.	**AO17**	Development provides that:- (a) no contaminated material is used as fill; (b) for excavation, no contaminated material is excavated or contaminant disturbed
Advertising Devices			
Estate Advertising devices			
PO18	The amenity of an adjacent area is not detrimentally affected by any development.	**AO18.1**	An advertising device must be temporary in nature and relate to the sale of land or the development of the Gracemere Springs local plan area.
		AO18.2	The estate advertising device is consistent with the requirements of Table 14 – Advertising Device Requirements.
Advertising devices within the Low Density Residential Zone			
PO19	The size and location of an advertising device associated with a non-residential use is not to adversely affect the visual amenity of the locality	**AO19.1**	An advertising device is a maximum sign face of 3m^2 in size where not affixed to a structure.
		AO19.2	An advertising device is not illuminated.
Dual Occupancy[2]			
Location and Site Suitability			
PO20	The dual occupancy is located on a site which is convenient to local services and has sufficient area and dimensions to accommodate the dual occupancy and associated access, parking, landscaping and setback requirements.	**AO20**	The dual occupancy is located on a corner site **OR** The dual occupancy is located on a site with a minimum lot size of 800m^2 and a minimum

[2] In accordance with Schedule 1 (Definitions) a reference to a 'dual occupancy' in the Local Plan includes a reference to any home office and all outbuildings, structures and works normally associated with a dual occupancy.

Performance Outcomes		Acceptable Outcomes	
			width of 15 metres (measured 4.5 metres back from the primary frontage of the site).
Height of Buildings and Structures			
PO21	The height of the dual occupancy is consistent with the preferred character of a local area and does not adversely impact on the amenity of adjacent premises having regard to:- (a) overshadowing; (b) privacy and overlooking; (c) views and vistas; (d) building appearance; and (e) building massing and scale as seen from neighbouring premises.	**AO21**	Buildings do not exceed two (2) storeys and 8.5m in height.
Site Cover			
PO22	The dual occupancy:- (a) is of a scale that is compatible with surrounding development; (b) does not present an appearance of bulk to adjacent premises, road or other areas in the vicinity of the site; (c) maximises opportunities for the retention of existing vegetation and allows for soft landscaping between buildings; (d) allows for adequate area at ground level for outdoor recreation, entertainment, clothes drying and other site facilities; and (e) facilitates on-site stormwater management and vehicular access.	**AO22**	The site cover of the dual occupancy does not exceed 50%.
Streetscape Character			
PO23	The dual occupancy is designed and constructed to: (a) provide an attractive address to all street frontages; (b) make a positive contribution to the preferred streetscape character of the locality; (c) provide shading to walls and windows of the dual occupancy; (d) minimise opportunities for residents to overlook the private open space areas of neighbouring premises; and (e) maximise the retention of existing mature trees within the frontage setback to retain streetscape character.	**AO23.1**	The dual occupancy is setback at least 4.5 metres from any street frontage with any associated garage or carport setback at least 6 metres.
		AO23.2	The dual occupancy, including any garage or carport associated with the dual occupancy, is setback from any side or rear property boundary in accordance with the following: (a) 1.5 metres for any part of the building that is 4.5 metres in height or less; (b) 2 metres for any part of the building that is higher than 4.5 metres but not higher than 7.5 metres; and (c) 2 metres plus 0.5 metres for every 3 metres of any part of the building that exceeds 7.5 metres in height.

Performance Outcomes		Acceptable Outcomes	
Private Open Space			
PO24	Sufficient private open space is provided to allow for the amenity and reasonable recreation needs of the occupants of the dual occupancy.	**AO24**	Each dwelling has a clearly defined outdoor living space which: (a) has an area of at least 16m^2; and (b) has no dimension less than 4m; and (c) has access from a living area and (d) has a slope of not more than 1 in 10; and (e) provides visual privacy from another outdoor living space by a window/balcony screen
Landscaping			
PO25	The dual occupancy incorporates site landscaping that: (a) provides an attractive landscape setting for the enjoyment and appreciation of residents; (b) integrates the development into the surrounding urban landscape; (c) effectively defines and screens private open space and service areas; (d) utilises native endemic vegetation as the major planting theme; and (e) maximises the retention of existing mature trees in order to retain the landscape character of the area.	**AO25.1**	The site is fully landscaped with turf and tree and shrub species.
		AO25.2	A minimum 1 metre wide landscape buffer strip is provided along the full length of the street frontage (excluding driveways and pathways).
		AO25.3	A 1.8 metre high solid screen fence is provided along the full length of all side and rear boundaries of the site.
		AO25.4	Fences are not provided along street frontages. **OR** Fences to street frontages are not more than 1.2 metres high or 1.8 metres high with 50% transparency.
Safety and Security			
PO26	The dual occupancy including buildings and outdoor spaces is designed to protect the personal security and safety of residents by allowing for natural surveillance	**AO26**	Each dual occupancy unit has an entrance, which is clearly identifiable and visible from the street and driveway.
Access and Car Parking			
PO27	Sufficient parking spaces are provided on the site to cater for residents and visitors.	**AO27**	A minimum of 1 car parking spaces is provided per unit plus 0.25 spaces per unit for visitors (tandem parking is acceptable where the vehicles are wholly within the site).
PO28	The design and management of access, parking and vehicle movement on the site facilitates the safe and convenient use of the dual occupancy by residents and visitors.	**AO28**	The design and construction of car parking areas and driveways complies with AS2890.1
Services and Utilities			
PO29		**AO29.1**	The dual occupancy is connected to the following in accordance with relevant

Performance Outcomes		Acceptable Outcomes	
	The dual occupancy is provided with and connected to essential infrastructure and services.		standards set by Council / the relevant agency : (a) reticulated water supply infrastructure; (b) reticulated sewerage infrastructure; (c) a sealed road; (d) a lawful point of discharge and any stormwater infrastructure adjacent to the subject site; (e) electricity and telecommunications infrastructure.
		AO29.2	Buildings, structures and driveways are not located over water, sewer, stormwater or electricity easements.
Waste Management			
PO30	The dual occupancy is provided with adequate areas for the storage of waste and recyclable items, in appropriate containers, which are convenient to use and service.	**AO30**	A separate waste storage area is provided for each dwelling to accommodate the permanent storage of waste and recyclable items in standard waste containers
Home Based Business			
Operation as bona fide working from home activity			
PO31	The home based business is conducted as a bona fide working from home activity.	**AO31.1**	The home based business is conducted within:- (a) a dwelling house or another enclosed structure such as a shed or a garage on the same site as a dwelling house; or (b) a dual occupancy; or (c) a multiple dwelling. **And** The total gross floor area used for the home based business does not exceed 50m^2.
		AO31.2	An occupant of the dwelling house conducts the home based business.
Appearance As Residential Dwelling			
PO32	The home based business is conducted such that buildings on the site retain a residential appearance and character.	**AO32**	The external appearance and character of the dwelling is not modified to accommodate the home based business.
Scale of Use and Protection of Residential Amenity			
PO33	Home-based business has a form and appearance that does not significantly detract from local amenity.	**AO33.1**	Any new building work to establish the home based business: (i) does not result in a building or structure that exceeds a maximum height of 8.5 metres, and (ii) does not increase the area covered by buildings and structures to greater than 50% of the site area.

Performance Outcomes		Acceptable Outcomes	
		AO33.2	Display goods and stored goods or materials are not visible at the property boundary.
		AO33.3	There is only one sign related to the business activity and the sign is: (i) not greater than 0.3m² in sign face; (ii) not illuminated; and (iii) wholly within the premises or on a fence facing the road.
		AO33.4	Activities do not include hiring out of materials, goods, appliances or vehicles.
		AO33.5	There is no repairing, servicing, cleaning or loading of vehicles not normally associated with use of premises as a dwelling unit.
		AO33.6	Inclusive of vehicle trips associated with the use of the dwelling house, no more than 10 vehicle trips per day (where 1 vehicle trip equals arriving and departing the site) are generated.
		AO33.7	In Residential Zones, any commercial vehicle parked on the site: (i) does not exceed 2.5 tonnes, and (ii) is garaged within the curtilage of the dwelling unit behind the building line.
Market			
Locational and Site Suitability			
PO34	Markets operate on a regular but infrequent basis, so as not to compromise the viability of centre activities in centres and townships.	**AO34.1**	The market does not operate more frequently than two days per week (whether the operating days are successive or separate).
	Markets provide, or have access to, adequate and convenient carparking.	**AO34.2**	Carparking may be provided: (a) on-site; or (b) in public off-street carparks within 200 metres of the markets; or (c) on-street carparks, not including arterial roads, within 200 metres of the markets.
	Markets avoid creating adverse amenity impacts for adjoining properties and maintain the visual and general amenity of the area.	**AO34.3**	Permanent and temporary structures, active outdoor use area, car parking areas and access ways and storage areas are set back a minimum of 6 metres from any boundary adjoining a property within a residential zone.
		AO34.4	Where within 50 metres of a property within a residential zone, the market operates within the hours of 6:30am to 6:30pm.
	Markets are designed to provide for: (a) comfortable pedestrian movement; and (b) emergency vehicle access.	**AO34.5**	A clear movement path with a minimum width of 3 metres is provided through or around the market to enable emergency vehicle access.

Performance Outcomes		Acceptable Outcomes	
Multiple dwellings			
Location and Site Suitability			
PO35	Multiple dwellings are sited and designed so as to:- (a) take account of its setting and site context; (b) create an attractive living environment for residents; and (c) make a positive contribution to the character of the street and local area.	**AO35**	No solution specified.
PO36	Multiple dwellings are located on a site which has an area and dimensions capable of accommodating a well-designed and integrated multiple dwelling residential development incorporating:- (a) vehicle access, parking and manoeuvring areas; (b) private open space areas and landscaping; and (c) any necessary buffering to incompatible uses or sensitive environments.	**AO36**	Multiple dwellings are located on a site with a minimum lot size of 900m^2.
Height			
PO37	The height of the multiple dwellings is consistent with the preferred character of a local area and does not adversely impact on the amenity of adjacent premises having regard to: (a) overshadowing; (b) privacy and overlooking; (c) views and vistas; (d) building appearance; and (e) building massing and scale as seen from neighbouring premises.	**AO37**	The height of multiple dwellings does not exceed two (2) storeys and 8.5 metres.
Site Cover & Setbacks			
PO38	Multiple dwellings are sited and designed in a manner which:- (a) maximises the retention of existing vegetation and allows for spaces and landscaping between buildings; and (b) allows sufficient area at ground level for communal open space, site facilities, resident and visitor parking, landscaping and maintenance of a residential streetscape.	**AO38.1**	The site cover of multiple dwellings buildings does not exceed 50%.
		AO38.2	Building setbacks comply with the following: (a) Minimum setback of 2 metres to side and rear boundaries (b) Minimum setback of 6 metres to the Primary Frontage (c) Minimum setback of 4 metres to the Secondary Frontage

Performance Outcomes		Acceptable Outcomes	
Privacy and Amenity			
PO39	All dwellings, rooming units, private open spaces and adjoining residential uses are provided with a reasonable level of privacy	**AO39**	Windows to habitable rooms are not located opposite one another unless views are controlled by screening devices, landscaping or design of the opening (e.g. sill height).
Streetscape Character			
PO40	Multiple dwellings are sited and designed to: (a) provide a visibly clear pedestrian entrance to and from the building; (b) minimise the potential for pedestrian and vehicular conflict; (c) provide an active frontage to the street or adjacent parkland or other public areas; and (d) promote casual surveillance of public and semi-public spaces.	**AO40**	Multiple dwellings are sited and designed such that: (a) the main pedestrian entrance to the building (or group of buildings) is located on the primary street frontage; (b) access from the street to the entrance of the building(s) or individual dwellings is easily discerned; (c) vehicular access to the site is separate from the pedestrian access; and (d) street and parkland frontages comprise "semi-active uses/spaces" such as habitable rooms of dwellings or rooming units, common recreation areas (indoor and outdoor) and landscaped areas, to facilitate casual surveillance.
PO41	Multiple dwelling uses address the street, contribute to a residential character and achieve a high level of amenity for dwellings within the Gracemere Springs Estate.	**AO41**	The number of dwellings, rooming units, windows and balconies of habitable rooms that address adjoining streets, communal recreation areas and open spaces is optimised.
Open Space and Landscaping			
PO42	Multiple dwellings use provide communal and private open space and landscaping such that residents have sufficient area to engage in communal activities, enjoy private and semi-private spaces, and accommodate visitors.	**AO42**	For all Multiple dwellings: (a) At least 15% of the site area is provided as communal open space exclusive of required buffer strips. (b) A 2 metre wide landscaped buffer strip is provided along the full frontage of the site. (c) Each ground floor dwelling unit has a courtyard or similar private open space of not less than 15m² with a minimum dimension of 3 metres directly accessible from the main living area. (d) Each dwelling unit above ground level has a balcony or similar private open space area of not less than 9m² with a minimum dimension of 2.5 metres directly accessible from the living area of the dwelling or rooming unit.

Performance Outcomes		Acceptable Outcomes	
			(e) A minimum 1.8 metre high solid screen fence is provided and maintained along the full length of any side or rear boundary.
Sales Office			
Operational Characteristics			
PO43	The duration of the use of premises for a sales office:- (a) in the case of a display dwelling, display village or sales office does not extend beyond a reasonable period required to construct and complete sales within the residential development or the applicable stage of the residential development; or (b) in the case of dwelling offered as a prize, does not extend beyond a reasonable period of time to allow for promotion of the prize.	**AO43.1**	Where a display dwelling, display village or sales office the use operates for a maximum period of 2 years. **OR** Where a dwelling offered as a prize, the use operates for a maximum period of 3 months.
		AO43.2	Any temporary building or structure associated with the operation of the sales office is removed from the site within 14 days of the end of the period of operation and the site is left in a clean and tidy condition.
PO44	The hours of operation of the sales office does not adversely affect the amenity of nearby residential premises.	**AO44**	The hours of operation of the sales office do not commence before 8.00am or extend later than 6.00pm.
PO45	The number of employees engaged in the operation of the sales office does not adversely affect the amenity of nearby residential premises.	**AO45**	Where a display dwelling, dwelling offered as a prize or sales office, a maximum of 2 employees are engaged in the operation of the sales office at any one time. **OR** Where a display village, a maximum of 2 employees per display home are engaged in the operation of the sales office at any one time.
Landscaping			
PO46	The sales office incorporates site landscaping and fencing that:- (a) provides an attractive landscape setting for the enjoyment and appreciation of staff and visitors; (b) integrates the development into the surrounding landscape; (c) effectively defines and screens private open space and service areas; (d) protects the amenity of adjoining dwellings.	**AO46.1**	Private and public open space areas are turfed and landscaped.
		AO46.2	A 1.8 metre high solid screen fence is provided to each side and rear boundary that has residential uses adjoining.
		AO46.3	Fences to street frontages are not more than 1.2 metres high or 1.8 metres high with 50% transparency.
Access and Car Parking			
PO47	Sufficient parking spaces are provided on the site to cater for staff and visitors.	**AO47**	A minimum of 2 car parking spaces is provided (parking spaces may be provided in tandem).

Performance Outcomes		Acceptable Outcomes	
PO48	The design and management of access, parking and vehicle movement on the site facilitates the safe and convenient use of the house by staff and visitors.	**AO48**	The design and construction of car parking areas and driveways complies with AS2890.1.
Signage			
PO49	Signage associated with the sales office is small, unobtrusive and appropriate to its setting.	**AO49**	Advertising devices:- (a) do not exceed a total sign face of 3m²; (b) are only erected on the same lot on which the sales office is established; and (c) do not include the use of bunting.
Public Convenience Facilities			
PO50	The sales office provides appropriate public convenience facilities for users of the sales office.	**AO50**	Public toilet facilities are provided where a street contains 4 or more sales offices.
Secondary Dwellings			
PO51	Any secondary dwelling established in association with the dwelling house is:- (a) small in scale and clearly ancillary to the dwelling house; and (b) physically and visually integrated with and connected to the dwelling house.	**AO51.1**	The secondary dwelling does not exceed a gross floor area of 60m². The secondary dwelling shares a common wall and roof with the dwelling house. **OR** The secondary dwelling is attached to the dwelling house by a covered walkway not longer than 2 metres.
		AO51.2	The secondary dwelling is located under, to the side, or at the rear of the main dwelling.
Sport and Recreation Uses			
Location and Facility Design			
PO52	The sport and recreation use is located and designed so as to be:- (a) convenient to users; and (b) compatible with the preferred character of the local area.	**AO52**	No acceptable outcome provided.
PO53	The sport and recreation use:- (a) is effectively designed to meet the needs of users having regard to the scale and nature of the use; and, (b) has buildings and structures that are fit for purpose.	**AO53**	No acceptable outcome provided.
PO54	The sport and recreation use ensures that mechanical plant and equipment and storage areas associated with the use are designed and screened so as to provide an attractive address to streets and adjoining properties.	**AO54**	No acceptable outcome provided.
Road System			
PO55	The surrounding road system is capable of accommodating the additional traffic	**AO55**	No acceptable outcome provided.

Performance Outcomes		Acceptable Outcomes	
	generated by the sport and recreation use without adverse impacts.		
Reconfiguration of a Lot			
Lot Layout and Neighbourhood / Estate Design			
PO56	Development provides for a lot layout, land use and infrastructure configuration that:- (a) provides for an efficient land use pattern; (b) effectively connects and integrates the site with existing or planned development on adjoining sites; (c) provides for the safe and efficient movement of pedestrians, cyclists, public transport and private motor vehicles in that order of priority; (d) creates legible and interconnected movement and open space networks; (e) provides defined edges to public open space and avoids direct interface between public open space and freehold lots; (f) provides for the creation of a diverse range of lot sizes capable of accommodating a mix of housing types and other uses required to support the community as appropriate to the zone and local plan area; (g) provides for a high level of amenity having regard to potential noise, dust, odour and lighting nuisance sources; (h) accommodates and provides for the efficient and timely delivery of infrastructure appropriate to the site's context and setting; (i) avoids the sporadic or out-of sequence creation of lots; and (j) protects ecologically important areas.	**AO56**	No acceptable outcome provided.
Size and Dimensions of Lots			
PO57	Development provides for the size, dimensions and orientation of lots to:- (a) be compatible with the preferred character of the Gracemere Springs Local Plan area; (b) provide suitable building envelopes and safe pedestrian, bicycle and vehicular access without the need for major earthworks and retaining walls;	**AO57**	Newly created lots have a minimum lot size and lot dimensions as follows: (i) For **standard residential lots**: (a) 600m² minimum lot size (b) 15m minimum frontage **OR** (ii) For **small residential lots** (of less than 600m²): (a) 300m² minimum lot size

Performance Outcomes		Acceptable Outcomes	
	(c) provide for the efficient use of land whilst including sufficient area for suitable and useable private open space; and (d) take account of and respond to the natural values and site constraints.		(b) 10m minimum frontage
Works, Services and Infrastructure			
PO58	Development provides that each lot is provided with appropriate development infrastructure and services commensurate with the nature and location of the subdivision.	**AO58**	Subdivision design and development within the Gracemere Springs Local Plan area complies with **PO14-PO17** of this code.
Pedestrian and Cycle Network			
PO59	Development provides a conveniently located network of footpaths, shared pathways and cycleways that:- (a) achieve a high level of safety and accessibility; (b) provide for safe and convenient joint usage; do not compromise the operation of or access to other infrastructure and services; and, (c) are well lit and located where there is casual surveillance from nearby premises	**AO59**	(a) Footpaths, shared pathways and cycleways are provided in accordance with relevant reconfiguration of a lot approvals; and, (b) Where not otherwise address the Capricorn Municipal Development Manual.
Landscape Design			
PO60	Development in the Gracemere Springs Local Plan area provides for landscaping that contributes to and creates a high quality landscape character for the site, street and local area by:- (a) being sensitive to site conditions, natural landforms and landscape characteristics; (b) protecting and enhancing native vegetation; and, (c) being of an appropriate scale to integrate successfully with development.	**AO60**	Subdivision design and development within the Gracemere Springs Local Plan area complies with **PO6-P08** of this code.
Public Parks and Open Space Infrastructure			
PO61	Development provides for parks and open space infrastructure that:- (a) provides for a range of passive and active recreation settings and can accommodate adequate facilities to meet the needs of the community;	**AO61**	Subdivision design and development within the Gracemere Springs Local Plan area complies with **PO6-P08** of this code.

Performance Outcomes		Acceptable Outcomes	
	(b) is well distributed and contributes to the legibility, accessibility and character of the locality; (c) creates attractive settings and focal points for the community; (d) incorporates appropriate measures for stormwater management; (e) facilitates the retention of native vegetation and other ecologically important areas; (f) is cost effective to maintain; and (g) is dedicated as public land in the early stages of the subdivision.		
Stormwater Drainage Systems & Stormwater Quality			
PO62	Development within the Gracemere Springs Local Plan area is provided with a stormwater drainage system which:- (a) makes adequate provision for drainage of the premises to a lawful point of discharge; and (b) ensures the development is adequately drained, and stormwater is managed and lawfully discharged without altering stormwater drainage characteristics external to the site.	**AO62**	Development is provided with a stormwater drainage system which is designed and constructed in accordance with the Stormwater Management Plan for the Gracemere Springs Local Plan area.
PO63	Development protects or enhances the environmental values and water quality objectives of receiving waters or buffer areas within or downstream of a Gracemere Springs Local Plan area.	**AO63**	Stormwater discharges are in accordance with the Stormwater Management Plan for the Gracemere Springs Local Plan area.
PO64	Treatment systems that use natural processes and materials are used wherever practicable to enhance biodiversity and landscape benefits.	**AO64**	No acceptable outcome provided.
Development Staging			
PO65	Staged development is planned, designed and constructed to ensure that:- (a) each stage of the development can be constructed without interruption to services and utilities provided to the previous stages; (b) transport infrastructure provided is capable of servicing the entire development; and, (c) materials used are consistent throughout the development.	**AO65**	No acceptable outcome provided.
Small Residential Lots			

Performance Outcomes		Acceptable Outcomes	
PO66	Small residential lots (of less than 450m²) are developed in accordance with a plan of development, which demonstrates that:- (a) most lots are provided with a north-south outlook to optimise opportunities for passive solar design; (b) an appropriate building envelope can be accommodated; (c) any building contained within the building envelope is unlikely to impact adversely upon the amenity of adjoining premises as a result of overshadowing, privacy and access to sunlight; and (d) landscape planting can be accommodated in deep soil zones to soften built form elements, improve micro climate and contribute to the quality of the public realm.	**AO66.1**	The land does not have a slope greater than 10%.
		AO66.2	Not more than 4 small lots are located in a row.
		AO66.3	A maximum of 50% of all lots within any neighbourhood block are small lots.
		AO66.4	A plan of development complies with the design criteria for small residential lots specified in **Table 10** Design criteria for small residential lots.
Rearrangement of Lot Boundaries			
PO67	Development provides that the rearrangement of lot boundaries:- (a) does not result in the creation, or in the potential creation of, additional lots; and (b) is an improvement on the existing situation	**AO67**	The rearrangement of lot boundaries results in an improvement to the existing situation and at least one of the following is achieved:- (a) the rearrangement of lots remedies an existing boundary encroachment by a building or areas; (b) the rearranged lots will be made more regular in shape; (c) access is provided to a lot that previously had no access or an unsuitable access; and, (d) the rearranged lots better meet the overall outcomes for the zone and the Gracemere Springs Local Plan.

Table 8 Car Parking Requirements

Column 1 Purpose	Column 2 Minimum Car Parking Requirement	Column 3 Service Vehicle Requirements
Community Use	Sufficient spaces to accommodate the amount of vehicle traffic likely to be generated by the particular use	N/A
Dual Occupancy	1 space per unit plus 0.25 spaces per unit for visitors (tandem parking is acceptable where the vehicles are wholly within the site)	N/A
Home Based Business	1 space, in addition to those required for the residential use	Occasional access for VAN
Food and Drink Outlet	1 space / 15m^2 GFA	VAN
Multiple dwelling	1 space / dwelling + 1 visitor space / 4 dwellings	MRV + VAN + WCV
Residential Care Facility	1 space / 4 beds	MRV + VAN + WCV + ambulance
Retirement Facility	1 space per unit, plus 0.25 spaces per unit for visitors	MRV + VAN + WCV + ambulance
Sales Office	2.0 spaces (parking spaces may be provided in tandem)	N/A

Table 9 Design Standards for On-site Car parking and Movement Spaces

Column 1 Aspects	Column 2 Design Standards
Parking Spaces	b) *Australian Standard AS2890.1-1993: Parking Facilities – Off-street Carparking*
Provision for Disabled Access and Parking	c) *Australian Standard AS1428.1-20O1: Design for access and mobility – General requirements for access – New building work;* and d) *Australian Standard AS2890.1-1993: Parking Facilities – Off-street Carparking*
Vehicle Movement Spaces (including circulation driveways and turning areas)	e) *Australian Standard AS2890.1-1993: Parking Facilities – Off-street Carparking*: and f) *Australian Standard AS2890.2-1993: Off-street parking – Commercial vehicle facilities*; and g) Development meets the minimum design service vehicle access requirements for driveways, on-site circulation, loading and unloading and manoeuvring on-site for the design service vehicle for the particular purpose specified in **Column 3 in Table 9** of this Local Plan Code.

Column 1 Aspects	Column 2 Design Standards
Service Vehicle Loading/Unloading Areas	h) *Australian Standard AS2890.2-1993: Off-street parking – Commercial vehicle facilities; and* i) Development meets the minimum design service vehicle access requirements for driveways, on-site circulation, loading and unloading and manoeuvring on-site for the design service vehicle for the particular purpose specified in **Column 3 in Table 8** of this Local Plan Code.
Vehicle Queuing Facilities	j) *Australian Standard AS2890.1-1993: Parking Facilities – Off-street Carparking*

Table 10 Design criteria for small residential lots

Design element	Design requirement
Lot Width	Minimum 10 metres
Maximum Site Cover	60%
Minimum Front Setback	5.5 metres to garage door and 4 metres to house wall
Minimum Rear Setback	4 metres where abutting another residential lot
Minimum Side Setback	1 metre where not nominated as built to boundary on the plan of development.
Minimum Parking	(a) 1 covered space; and (b) single garage door only.
Minimum Private Open Space	Each dwelling has a clearly defined outdoor living space which: (a) has an area of at least 16m^2; and (b) has no dimension less than 4m; and (c) has access from a living area and (d) has a slope of not more than 1 in 10; and (e) provides visual privacy from another outdoor living space by a window/balcony screen
Minimum Planting	30m^2 with access to deep soil and sky with 15m^2 at primary street frontage.
Front Entry	Pedestrian entry and door visible and accessible from primary street frontage.
Street Surveillance	Minimum 1 living space overlooking the primary street frontage.
Front Fence	(a) Maximum of 1.8 metres high; and (b) 50% transparent where exceeding 1.2 metres high.

Table 11 Advertising Device Requirements

Advertising Device Type	Advertising Device Requirement
Billboard Identification Sign	A billboard identification sign or pylon identification sign:- a) is mounted as a freestanding structure in a landscape environment; b) is situated at least 3 metres from any adjoining lot; c) does not project beyond the front alignment of the lot; d) has a maximum thickness not exceeding 75mm per metre of height above ground level; e) is permitted up to a maximum height of 8.5 metres and a maximum signface area of 32m' per signface; and f) only I Billboard or Pylon Identification sign is permitted per lot.
Estate Entry Sign	An estate entrance sign:- g) is placed at the entrance of an estate and indicates only the name of the estate; h) is set at or within 500mm of ground level; i) is mounted as a freestanding structure in a landscape environment;

	j) does not obstruct pedestrian/bicycle access to the estate; k) is constructed of durable and low maintenance materials; l) is permitted up to a maximum height of 6 metres; and m) has a sign face area appropriate to its setting.
Third Party Sign	A Third Party Sign is permitted to be erected on land owned or under the control of the Homecorp Group, and intended to advertise the proposed Gracemere Springs master planned community.

Schedule 1 Definitions

The following table lists the terms of development that are relevant to this Local Plan and which differ from those in the planning scheme. The following definitions have been adopted in accordance with the Draft Queensland Planning Provisions version 3.0.

Any use not listed in below has the meaning specified in the Draft Queensland Planning Provisions version 3.0.

Use Definitions

Column 1 Use	Column 2 Defintion	Column 3 Examples include	Column 4 Does not include the following examples
Advertising device	Any permanent structure, device, sign or the like intended for advertising purposes. It includes any framework, supporting structure or building feature which is provided exclusively or mainly as part of the advertisement.	billboard, pylon sign	
Community use	Premises used for providing artistic, social or cultural facilities and community support services to the public and may include the ancillary preparation and provision of food and drink.	Art gallery, community centre, community hall, library, museum	Cinema, club, hotel, nightclub, place of worship
Dual occupancy	Premises containing two dwellings on one lot (whether or not attached) where the use is primarily residential.	Duplex	Dwelling house, multiple dwelling
Dwelling house	A residential use of premises for one household which contains a single dwelling. The use includes out-buildings and works normally associated with a dwelling and may include a secondary dwelling.		Caretaker's accommodation, dual occupancy, hostel, short-term accommodation, Student accommodation, multiple dwelling
Dwelling unit	A single dwelling within a premises containing non residential use(s).	"Shop-top" apartment	Caretaker's accommodation, dwelling house
Emergency services	Premises used by government bodies or community organisations to provide essential emergency services, disaster management services including management support facilities for the protection of persons, property and the environment.	State emergency service facility, ambulance station, rural fire brigade, auxiliary fire and rescue station, urban fire and rescue station, police station, emergency management support facility	Community use, hospital, residential care facility
Food and drink outlet	Premises used for preparation and sale of food and drink to the public for consumption on or off the site. The use may include the	Bistro, café, coffee shop, drive-through facility, kiosk, meals on wheels	Bar, club, hotel, shop, theatre, nightclub

Column 1 Use	Column 2 Defintion	Column 3 Examples include	Column 4 Does not include the following examples
	ancillary sale of liquor for consumption on site.	distribution centre, milk bar, restaurant, snack bar, takeaway, tea room	
Home based business	A dwelling used for a business activity where subordinate to the residential use.	Bed and breakfast, farm stay, home office, home based childcare	Hobby, office, shop, warehouse transport
Major electricity infrastructure	All aspects of development for either the transmission grid or electricity supply networks as defined under the Electricity Act 1994. The use may include ancillary telecommunication facilities.	Powerlines greater than 66kV	Minor electricity infrastructure, substation
Multiple dwelling	Premises which contains three or more dwellings where the use is primarily residential.	Apartments, flats, units, townhouses	Rooming accommodation, dual occupancy, duplex, granny flat, residential care facility, retirement facility
Outdoor sport and recreation	Premises used for a recreation or sport activity that is carried on outside a building and which requires areas of open space and may include ancillary works necessary for safety and sustainability. The use may include ancillary food and drink outlet(s) and the provision of ancillary facilities or amenities conducted indoors such as changing rooms and storage facilities.	Driving range, golf course, swimming pool, tennis courts, football ground, cricket oval, pony club	Major sport, recreation and entertainment facility, motor sport, park
Park	Premises used by the public generally for free recreation and enjoyment, and may be used for community events. Facilities may include children's playground equipment, informal sports fields and ancillary vehicle parking and other public conveniences.	Urban common	Tourist attraction, outdoor sport and recreation
Residential care facility	A residential use of premises for supervised accommodation where the use includes medical and other support facilities for residents who cannot live	Convalescent home, nursing home	Community residence, dwelling house, dual occupancy, hospital, multiple dwelling, retirement facility

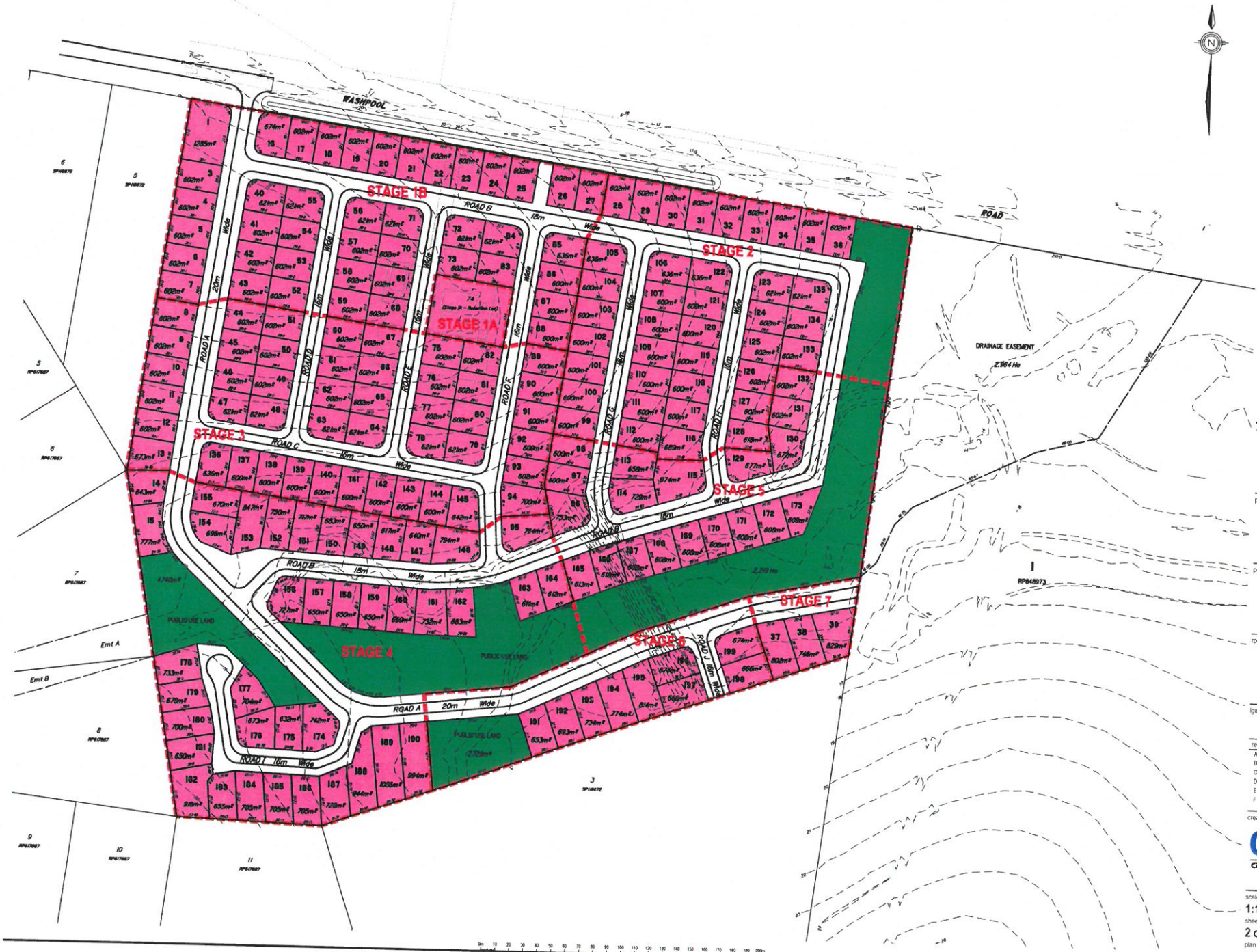
Column 1 Use	Column 2 Defintion	Column 3 Examples include	Column 4 Does not include the following examples
	independently and require regular nursing or personal care.		
Retirement facility	A residential use of premises for an integrated community and specifically built and designed for older people. The use includes independent living units and may include serviced units where residents require some support with health care and daily living needs. The use may also include a manager's residence and office, food and drink outlet, amenity buildings, communal facilities and accommodation for staff.	Retirement village	Residential care facility
Sales office	The temporary use of premises for displaying a land parcel or buildings that can be built for sale or can be won as a prize. The use may include a caravan or relocatable dwelling or structure.	Display dwelling	Bank, office
Secondary dwelling	A dwelling used in conjunction with, and subordinate to, a dwelling house on the same lot. A secondary dwelling may be constructed under a house, be attached to a house or be free standing.		
Substation	Premises forming part of a transmission grid or supply network under the Electricity Act 1994, and used for: • converting or transforming electrical energy from one voltage to another; or • regulating voltage in an electrical circuit; or • controlling electrical circuits; or • switching electrical current between circuits; or • a switchyard; or • communication facilities for "operating works" as defined under the Electricity Act 1994;	Substations, switching yards	Major electricity infrastructure, minor electricity infrastructure

Column 1 Use	Column 2 Defintion	Column 3 Examples include	Column 4 Does not include the following examples
	and for workforce operational and safety communications.		
Telecommunications facility	Premises used for systems that carry communications by means of radio, including guided or unguided electromagnetic energy, whether such facility is manned or remotely controlled.	Telecommunication tower	Aviation facility, "lowimpact telecommunications facility" as defined under the Telecommunications Act 1997
Utility installation	Premises used to provide the public with the following services: supply of water, hydraulic power, electricity or gas; sewerage, drainage or stormwater services; transport services including road, rail or water; waste management facilities; network infrastructure. The use includes maintenance and storage depots and other facilities for the operation of the use.	Sewerage treatment plant, mail depot, pumping station	Telecommunications tower, major electricity infrastructure, minor electricity infrastructure, substation, renewable energy facility, transport depot

Administrative Definitions

Administrative definitions assist with the interpretation of the Local Plan but do not have a specific land use meaning. All administrative definitions for the purpose of the Local Plan are to be in accordance with the Draft Queensland Planning Provisions version 3.0.

Schedule 2 Mapping



Low Desity Residential Zone

Open Space Zone

Stage	No.
Ex Stage 1A	1
Stage 1B	42
Stage 2	39
Stage 3	46
Stage 4	39
Stage 5	19
Stage 6	9
Stage 7	3
Total	198

IMPORTANT NOTE

This plan was prepared to accompany a reconfiguration of a lot application to Rockhampton Regional Council and should not be used for any other purpose.

The dimensions and areas shown hereon are subject to field survey and also to the requirements of council and any other authority which may have requirements under any relevant legislation.

Contours within the subject parcel, being lot 4 on SP119672, are on AHD at 0.5m intervals. Contours within the adjoining parcel, being Lot 1 on RP848973, are on AHD at 1.0m intervals.

In particular, no reliance should be placed on the information on this plan for any financial dealings involving the land.

This note is an integral part of this plan.

client

Homecorp Developments Pty Ltd

project

Gracemere Springs Estate
Washpool Road, Gracemere

plan of

Lot Reconfiguration
Stages 1B - 7
(197 Lots)

rpd

Lot 4 on SP119672 &
Lot 1 on RP848973
Parish of Gracemere
County of Livingstone

lga

Rockhampton Regional Council

rev	date	details	authorised
A	31-10-2012	Initial Issue	RJKF
B	7-11-2012	Lots 92-98 amended	RJKF
C	11-11-2012	Lots 39 & 153-173 shifted	RJKF
D	5-04-2013	Lots 37-39 removed, Lots 1 & 2 combined	RJKF
E	18-04-2013	Emt over adjoining lot to east added	RJKF
F	2-07-2013	Zoning added	RJKF

created

CSG
capricorn survey group (cq)

scale
1:1250 @ A1

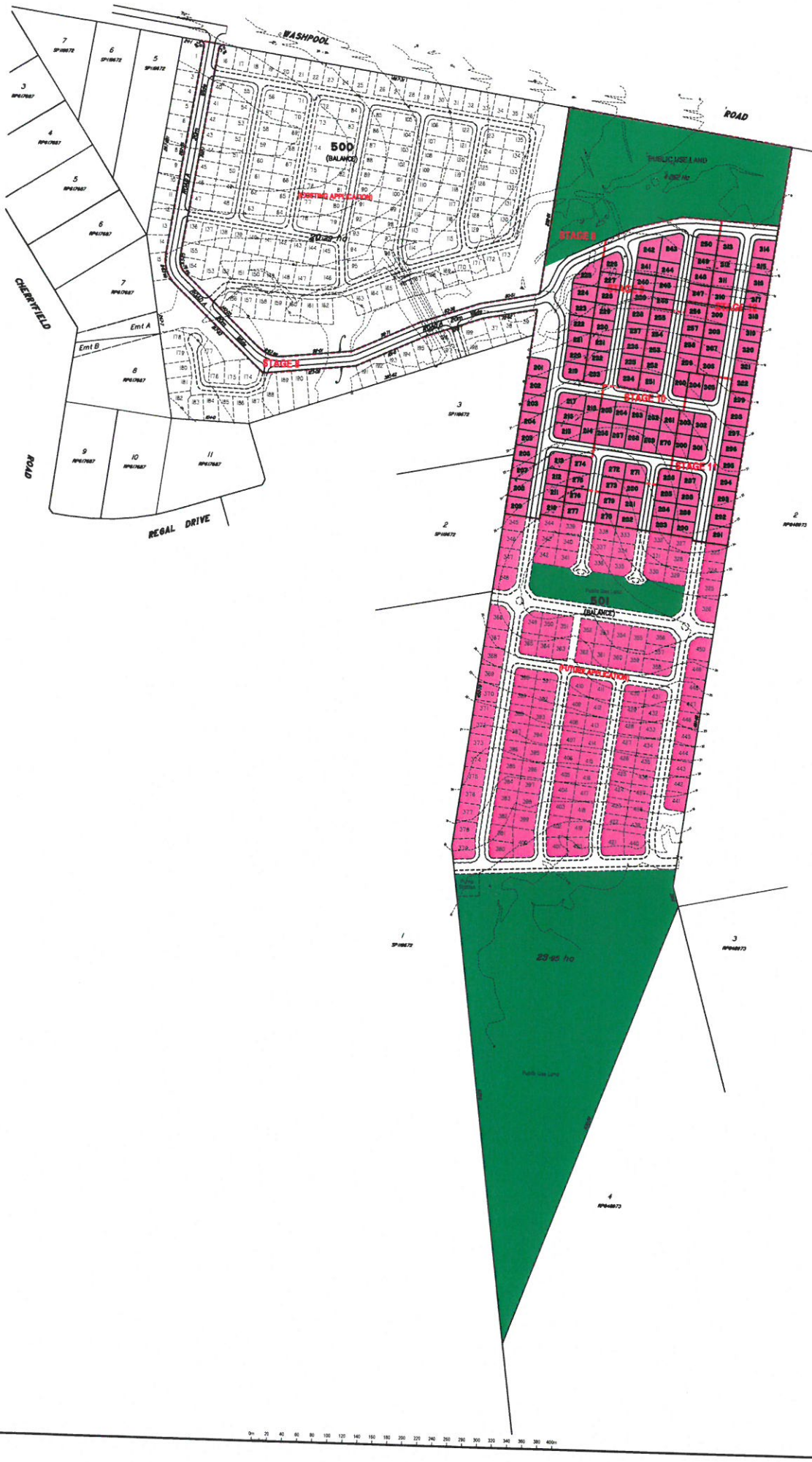
datum
AHD

sheet no.
2 of 2

cad file
5798-00-ROL-F

plan no
5798-00-ROL

revision
F



Low Desity Residential Zone

Open Space Zone

Stage	No.
Stage 8	25
Stage 9	25
Stage 10	25
Stage 11	30
Stage 12	17
Total	122

IMPORTANT NOTE

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This note is an integral part of this plan.

client
Homecorp Developments Pty Ltd

project
Gracemere Springs Estate Washpool Road, Gracemere

plan of
Lot Reconfiguration Stages 8 - 12 (122 Lots)

rpd
Lot 1 on RP848973 &
Lot 4 on SP119672
Parish of Gracemere
County of Livingstone

lga
Rockhampton Regional Council

rev	date	details	authorised
A	25-03-2013	Initial issue	RJKF
B	12-04-2013	Lot 225 amended	RJKF
C	2-07-2013	Zoning added	RJKF

created
CSG capricorn survey group (cq)

scale
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datum
AHD

sheet no
1 of 2

cad file
5843-08-ROL-C

plan no
5843-08-ROL

revision
C

WASHPOOL ROAD

500

501

502

7·351 ha

6·887 ha

7·776 ha

2·748 Ha

DRAINAGE EASEMENT

2·09 Ha

DRAINAGE EASEMENT

2·123 Ha

Emt A

Emt B

6 SP119672

5 SP119672

5 RP617687

6 RP617687

7 RP617687

8 RP617687

9 RP617687

10 RP617687

11 RP617687

3 SP119672

1 RP848973

0m 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150m

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These plans are approved subject to the current conditions of approval associated with Development Permit No. D588-2012
Dated 5/04/2016

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This note is an integral part of this plan.

client
Homecorp Developments Pty Ltd

project
Gracemere Springs Estate Washpool Road, Gracemere

plan of
Lot Reconfiguration (3 Management Lots + 3 Drainage Emts)

rpd
Lot 4 on SP119672 & Lot 1 on RP848973 Parish of Gracemere County of Livingstone

lga
Rockhampton Regional Council

rev	date	details	authorised
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C	11-11-2012	Lots 39 & 163-173 shifted	RJKF
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E	18-04-2013	Emt over adjoining lot to east added	RJKF
F	2-07-2013	Zoning added	RJKF
G	17-07-2014	Layout & staging amended	RJKF

created

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scale
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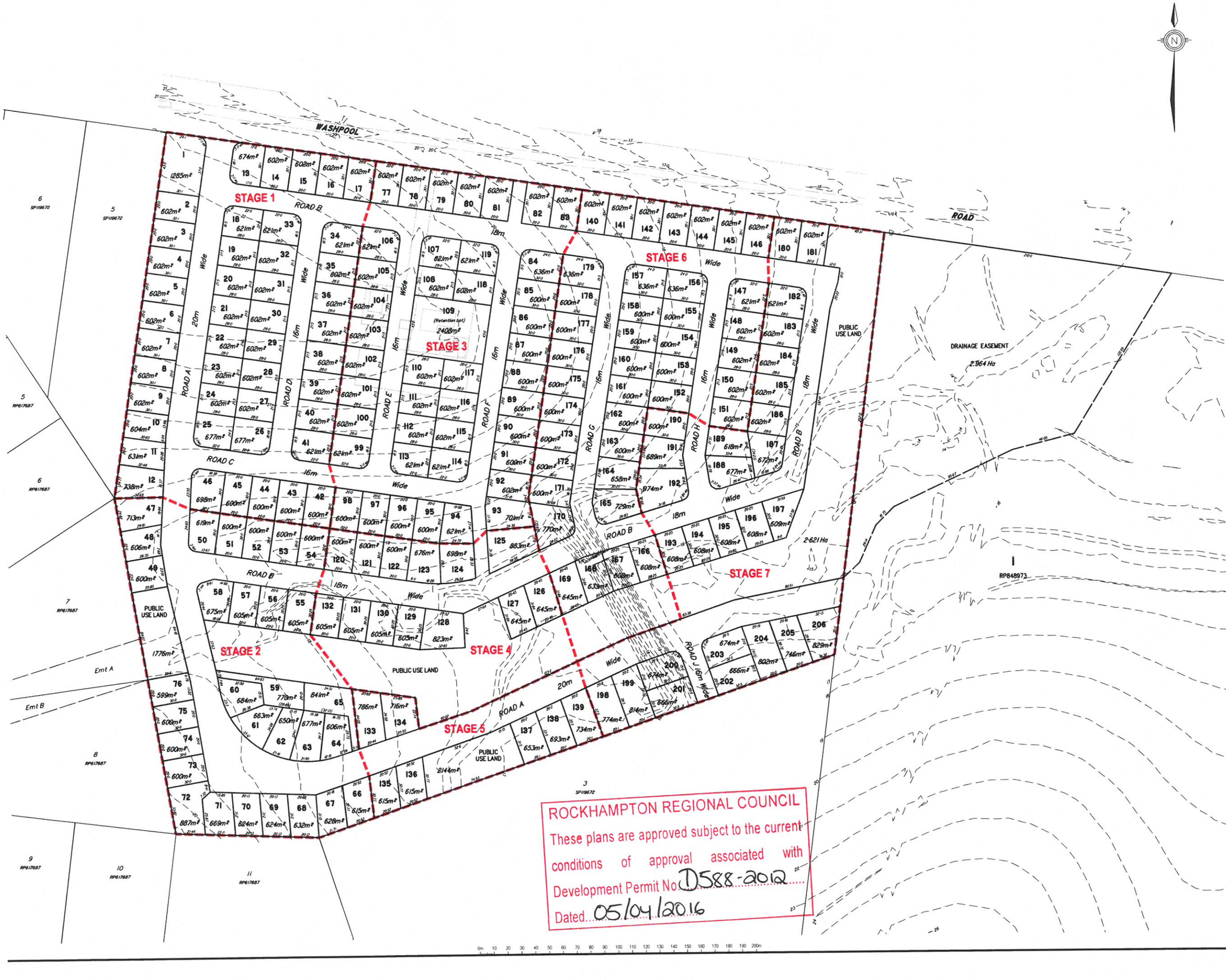
cad file
5798-00-ROL-G

plan no.
5798-00-ROL

revision
G



Stage	No.
Stage 1	46
Stage 2	30
Stage 3	43
Stage 4	13
Stage 5	7
Stage 6	40
Stage 7	27
Total	206

IMPORTANT NOTE

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Dated 05/04/2016

client
Homecorp Developments Pty Ltd

project
Gracemere Springs Estate
Washpool Road, Gracemere

plan of
Lot Reconfiguration
Stages 1 - 7
(206 Lots)

rpd
Lot 4 on SP119672 &
Lot 1 on RP848973
Parish of Gracemere
County of Livingstone

lga
Rockhampton Regional Council

rev	date	details	authorised
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G	17-07-2014	Layout & staging amended	RJKF

created
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datum **AHD**
sheet no. **2 of 2**
cad file **5798-00-ROL-G**
plan no. **5798-00-ROL**
revision **G**

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Dated 05/04/2016

WASHPOOL ROAD

ROAD A

ROAD B

ROAD C

ROAD D

ROAD E

ROAD F

ROAD G

ROAD H

Channel 1
Section 1

Channel 1
Section 2

Channel 2

A

A

LEGEND

- Proposed Q100 Inundation Channel
- Proposed Contours
- Existing Contours

GRACEMERE SPRINGS 1
Q100 Inundation Channel Plan
R12166 - Inundation Channel Plan

0 5.0 20.0m
0 10.0 40.0m
1:1000 (A1)
1:2000 (A3)

N

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Smart Consulting
INCORPORATING GRAHAM SCOTT & ASSOCIATES

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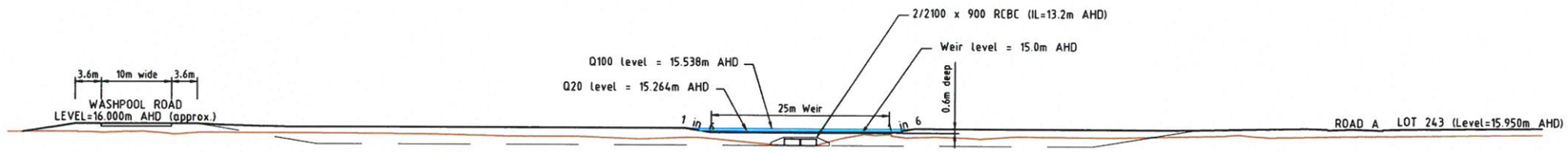
Dated. 05/04/2016



SECTION A - A

GRACEMERE SPRINGS 1
Q100 Inundation Channel

R12166 - Weir SECTION A-A

0 2.0 8.0m 1:400 H
0 2.0 8.0m 1:400 V

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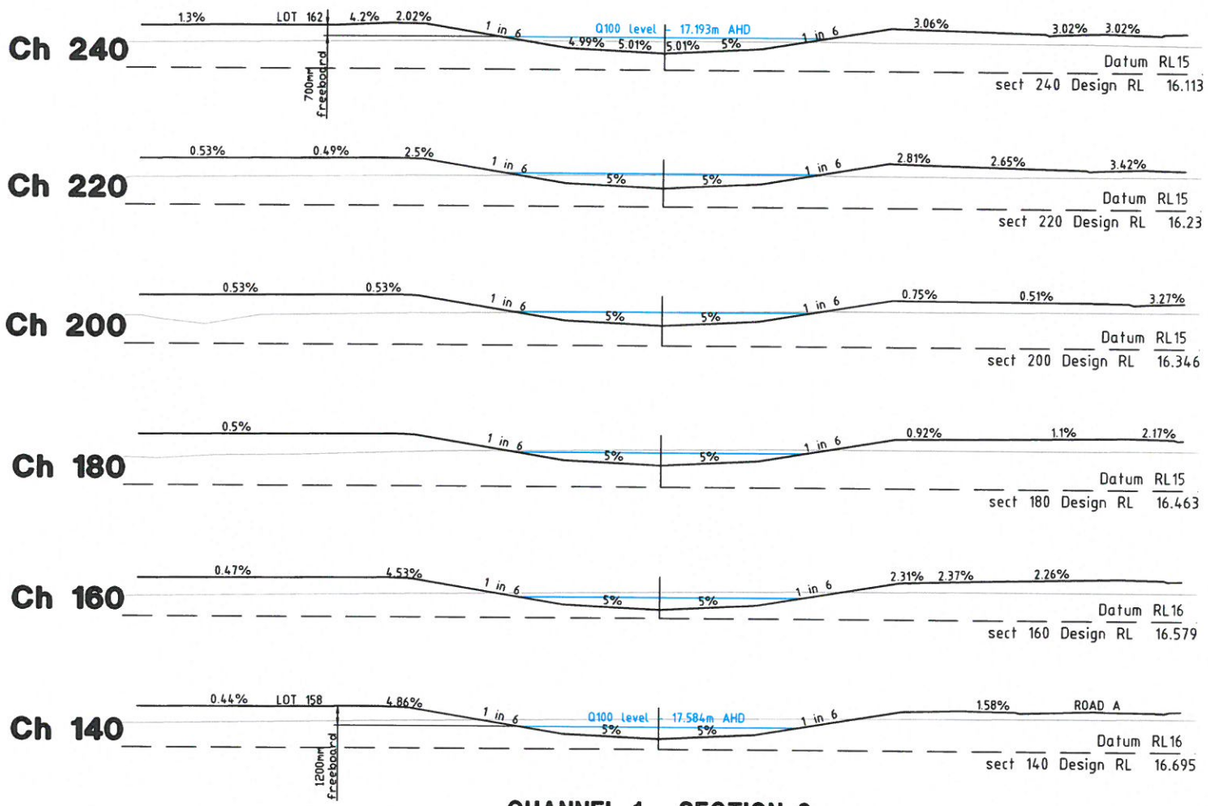
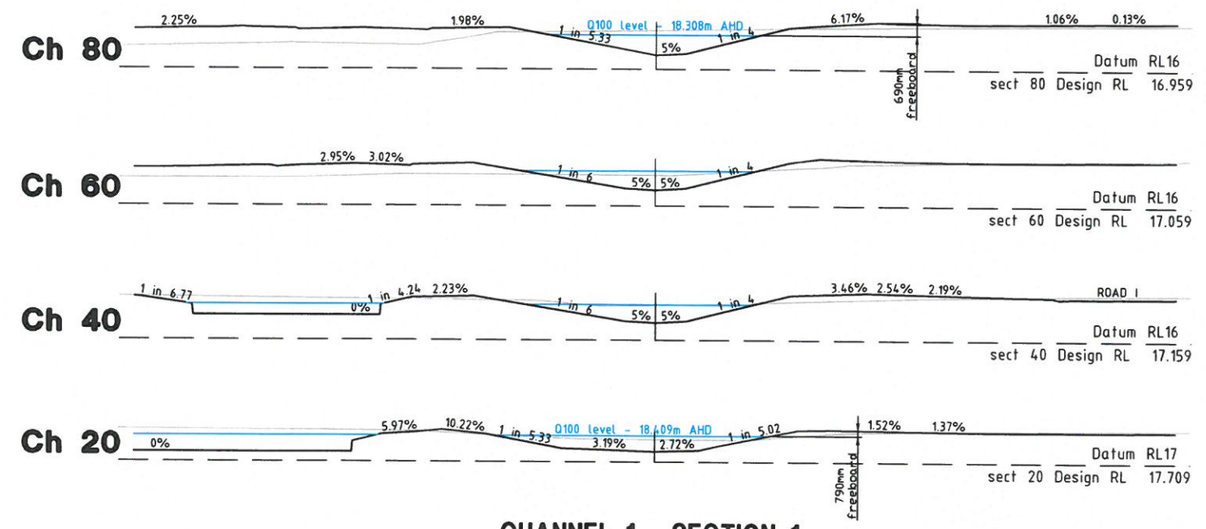


CHANNEL 1 - SECTION 2



CHANNEL 1 - SECTION 1

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Dated 05/04/2016

GRACEMERE SPRINGS 1
Q100 Inundation Channel
Cross Sections 1
R12166 - Inundation Cross Sections 1

0 1.0 4.0m 1:200 H
0 1.0 4.0m 1:200 V

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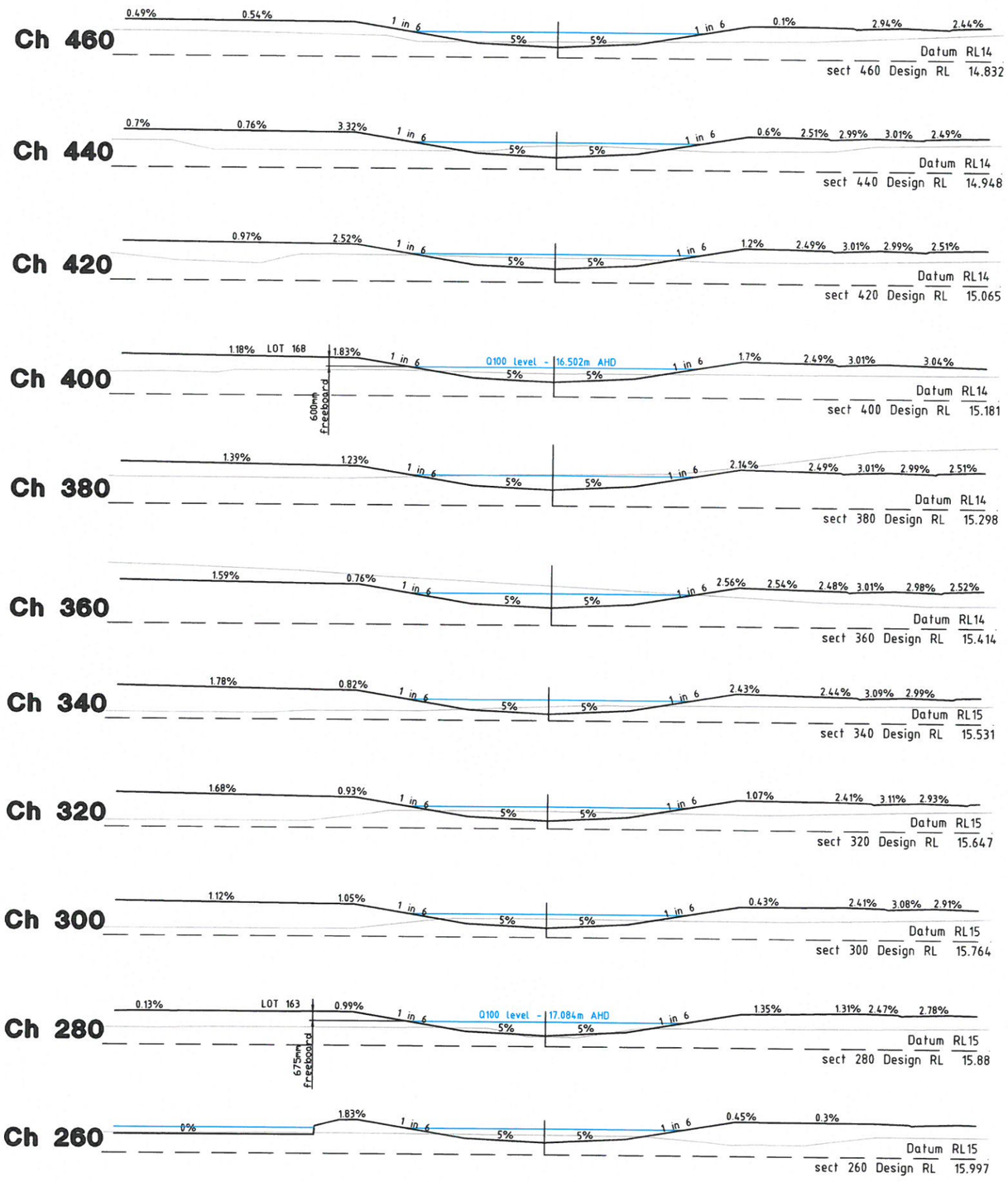

CHANNEL 1 - SECTION 2

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Dated 05/04/2016

GRACEMERE SPRINGS 1
Q100 Inundation Channel
Cross Sections 2
R12166 - Inundation Cross Sections 2

0 1.0 4.0m 1:200 H
0 1.0 4.0m 1:200 V

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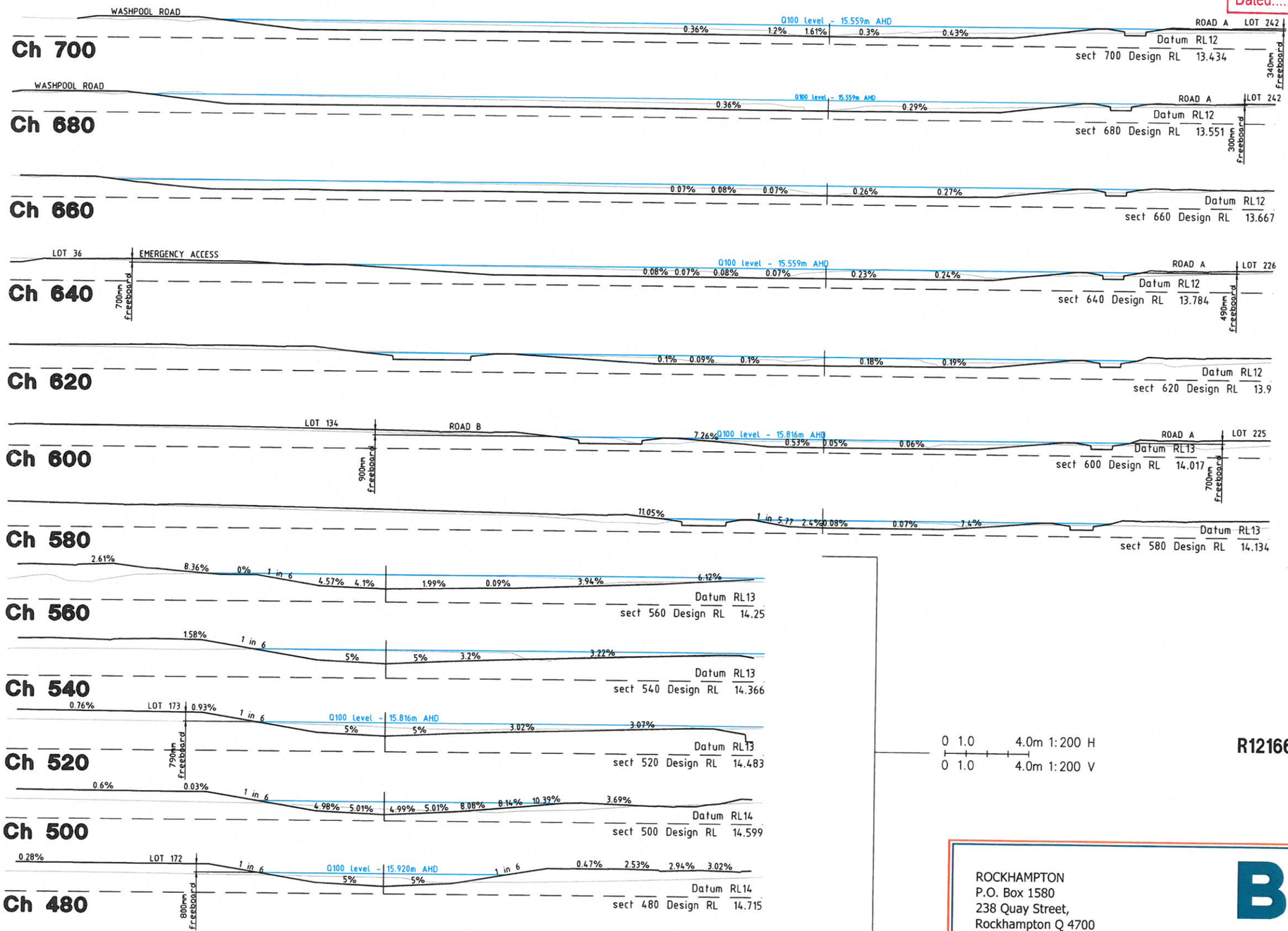

CHANNEL 1 - SECTION 2

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0 2.0 8.0m 1:400 V

0 1.0 4.0m 1:200 H
0 1.0 4.0m 1:200 V

GRACEMERE SPRINGS 1
Q100 Inundation Channel
Cross Sections 3
R12166 - Inundation Cross Sections 3

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Existing Washpool Road sewer trunk main.

Connect to existing sewer trunk main. To be completed by FRW at the developers cost.

WASHPOOL ROAD

ROAD A

ROAD B

ROAD C

ROAD D

ROAD E

ROAD F

ROAD G

ROAD H

ROAD I

ROAD J

PUBLIC USE LAND

5
SP119672

687

LEGEND

- Existing Sewer & Manhole
- Existing 225Ø Sewer Trunk Main
- Existing 300Ø Sewer Trunk Main
- New Sewer & Manhole
- Proposed Contours
- Existing Contours

Sewer Layout Plan
R12166 - Sewer

0 5.0 20.0m
0 10.0 40.0m
1:1000 (A1)
1:2000 (A3)

N

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Dated 05/04/2016

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Dated 05/04/2016

BROWN
Smart Consulting

Stormwater Quantity Management Plan and Flood Investigation

Gracemere Springs Development at Washpool Road Gracemere

Prepared for Gracemere Springs Pty Ltd

Report No. B13021.W-01A

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2013

DOCUMENT CONTROL

B13021.W-01

Issue	Date	Issue Details	Author	Checked	Approved
A	15/04/2013	For Council Approval	BF/AH	AMcP (RPEQ 6921)	

Level 6, 199 Grey Street, South Brisbane Qld 4101
Telephone: (07) 3895 3444

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1. INTRODUCTION

Brown Consulting (Qld) Pty Ltd has been commissioned by Gracemere Springs Pty Ltd to prepare a Stormwater Quantity Management Plan (SMP) and Flood Investigation for the proposed Gracemere Springs Developments. This report has been prepared to:

- Respond to the stormwater quantity and flooding items of Rockhampton Regional Council (RRC) Information Request dated 21 December 2012 (RRC Ref: D/588-2012) for the proposed development at 70 Washpool Road, Gracemere (referred to as Gracemere Springs 1).

  A detailed response to each item is provided in the *Response Letter to Information Request (Development Application: D/588-2012)* prepared by Brown Consulting (Rockhampton) 2013.

- Detail the proposed stormwater quantity management strategy for the proposed Beaumont Land Development at 104 Washpool Road, Gracemere (referred to as Gracemere Springs 2).

The stormwater quantity management and flood investigation components of this report have been split into two sections:

1. **Northern Waterway**: Detailed analysis has been undertaken for the northern waterway to support the Material Change of Use (MCU) and Reconfiguring a Lot (RAL) applications for the Gracemere Springs Developments.

   It is proposed to construct an online detention basin in the northern waterway to provide peak flow mitigation for both the Gracemere Springs developments.

2. **Southern Portion Gracemere Springs 2**: The lots that drain to the southern waterway in the Gracemere Springs 2 development are part of a future development application and do not form part of the MCU application for the site. Preliminary hydrological and hydraulic analysis has been undertaken for this portion of the development in order to identify the hydrological and hydraulic constraints.

This report does not address stormwater quality measures.

1.1. Previous Investigations

Brown Consulting (Rockhampton) Pty Ltd has previously prepared the *Stormwater Management Report* (Report No. R12166, November 2012). This report outlined the proposed stormwater quantity management strategy for 70 Washpool Road. RRC Information Request relates to the information within this report.

The previous stormwater quantity management strategy outlined in the previous report is superseded by the revised analysis undertaken for this report.

2. SITE CHARACTERISTICS

2.1. Location & Site Details

Located within the suburb of Gracemere, in the Rockhampton Regional Council local government area, the Gracemere Springs Developments are located in 70 and 104 Washpool Road, as shown in **Figure 2.1** below.

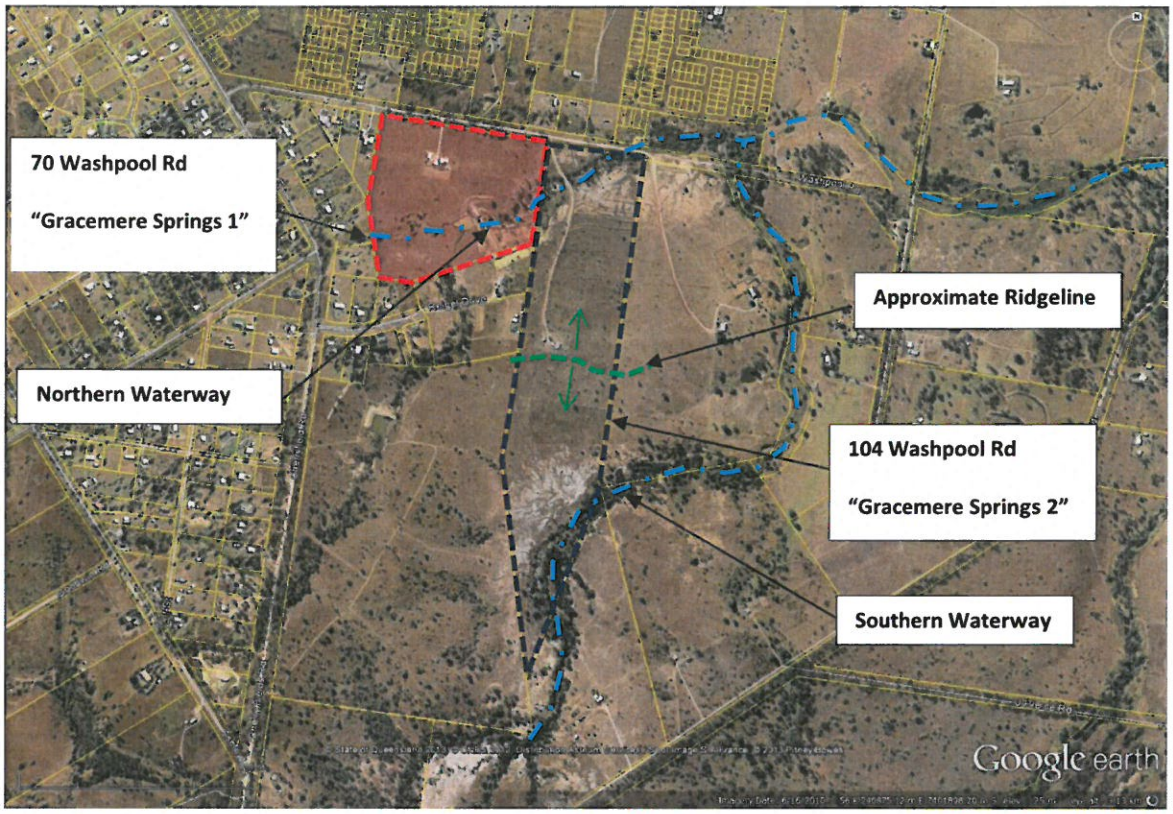


Figure 2.1: Approximate Site Location (Source Google Earth)

2.2. Existing Topography & Site Drainage

The Gracemere Springs 1 development is split by a ridgeline that run east west through the site. Flows from the southern portion of the site discharges to a waterway that flows from the west to the eastern boundary of the site. Flows on the northern side of the ridge are conveyed along the Washpool Road reserve and ultimately discharge to the same waterway to the north east of the site.

The Gracemere Springs 2 developed is split roughly in half by a ridge as shown in **Figure 2.1** above. Flows on the southern part of the site discharge to the waterway located along the southern site boundary. Flow from the northern part discharge to the same waterway as the Gracemere Springs 1 development.

3. FLOOD INVESTIGATION OF NORTHERN WATERWAY

It is proposed to construct a detention basin in the northern waterway for both Gracemere Springs developments, this detention basin will replace the nine basins previously proposed for the Gracemere Springs 1 development.

A flood investigation for the northern waterway was undertaken in order to determine:

- The existing flood levels and flows within the northern waterway;
- The required detention basin volume and outlet configuration to mitigate any increase in peak flow as a result of the proposed developments;
- The developed flood levels within the proposed channel; and
- The required culvert sizes within Gracemere Springs 1.

Analysis has been undertaken using an XPSWMM Hydrological and Hydraulic model. XPSWMM incorporates dynamic modelling of hydrological and hydraulic components of stormwater through simulating rainfall runoff process and the performance of natural or engineered drainage systems. The following sections outline the development and verification of the XPSWMM model.

3.1. Catchment Details

Catchment boundaries for the existing and developed scenarios are generally as per the previous report, however additional catchments have been added in order to account for the Gracemere Springs 2 Development. Catchments for the developed scenario have been lumped at critical inflow points in order to reduce the complexity of the model.

Existing and Developed catchment boundaries are shown below in **Figure 3.1** and **Figure 3.2**.

Table 3.1 and **Table 3.2** show the modelled catchments areas for the existing and developed scenario. Percent impervious values have been determined in accordance with the *Queensland Urban Drainage Manual Volume 1 Second Edition 2007* (QUDM, NRW 2007).

Note that the area modelled in the developed scenario is slightly less than the existing scenario, as the ridgeline within Gracemere Springs 2 will be moved to the north during development. This is due to the earthworks proposed as part of the development.

Table 3.1: Existing Catchment Properties

Catchment	Area (ha)	% Impervious
A	3.14	15%
B	11.65	6%
C	1.43	15%
D	5.80	6%
E	1.35	1%
F	17.63	0%
G	0.80	4%
1	57.61	14%
2	67.52	15%
3	0.75	15%
4	95.73	10%
5	26.15	10%
6	1.42	0%
7	4.04	0%
8	18.83	7%
9	1.45	15%

Table 3.2: Developed Catchment Properties*

Catchment	Area (ha)	% Impervious
Basin 1	4.02	60%
Basin 2	4.71	60%
Basin 3	4.37	60%
Basin 4	1.02	60%
Basin 5	1.05	60%
Basin 6	0.60	60%
Basin 7	0.66	60%
Basin 8	0.66	57%
Basin 9	0.69	60%
Channel 1	0.36	34%
Channel 2	2.85	34%
S1	0.48	60%
S2	0.20	60%
S3	0.39	40%
S4	0.09	60%
S5	0.82	60%
F1	7.68	60%
Det	2.70	0%
F2	6.45	60%
F2a	1.79	0%

*- Catchments 1 – 9 are as per the existing scenario, and are not shown in the table above, refer **Table 3.1**.

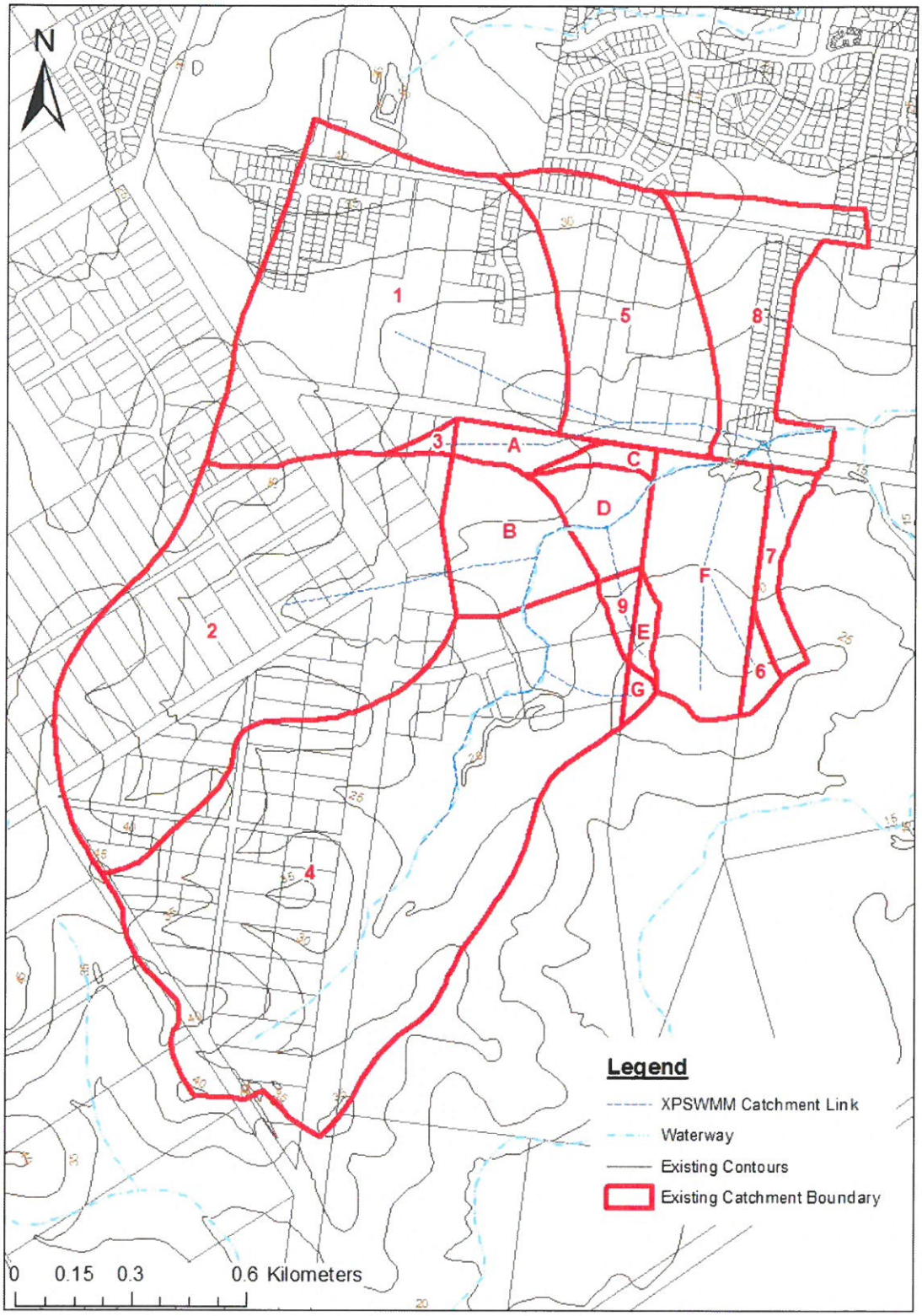


Figure 3.1: Existing Catchment Plan

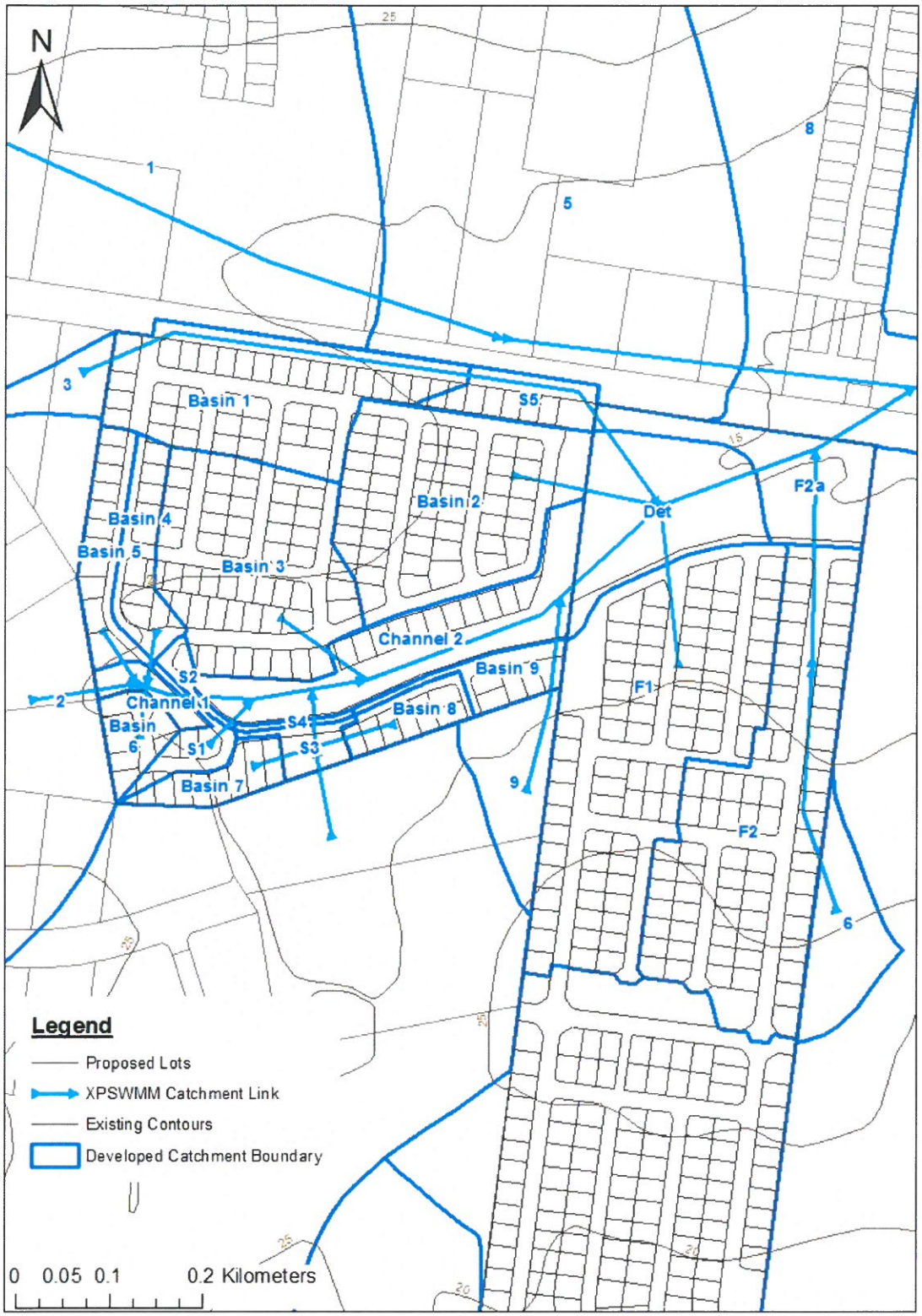


Figure 3.2: Developed Catchment Plan (Site Focus)

3.2. XPSWMM Parameters and Verification

The following losses were adopted in the XPSWMM model:

- Initial loss of 25 mm (for all ARI's); and
- Continuing loss rate of 2.5mm/hr (for all ARI's).

A comparison of the peak flows produced by the XPSWMM model at the downstream extent of the Gracemere Springs 1 development (refer **Figure 3.3** for verification location) compared to the flow specified in the RRC Information Request was undertaken in order to confirm the flows produced by XPSWMM were reasonable.

As specified by the RRC Information Request dated 21 December 2012 (RRC Ref: D/588-2012);

> *"..the total existing flow peak flow (Q100) discharging to the existing flow path traversing the development site shall be 27.29m³/s"*

The peak 100 year ARI existing flow determined by the XPSWMM model at the downstream extent of the Gracemere Springs 1 development was determined to be 27.76m³/s which is comparable to the RRC flow, therefore the adopted model parameters are considered acceptable. Refer **Section 3.3.1**.

3.2.1. Hydraulic Analysis Boundary Conditions and Parameters

The following boundary conditions were adopted for the hydraulic analysis of the Northern Waterway:

- Upstream: inflow hydrographs as determined by XPSWMM; and
- Downstream:
  - Normal depth for the 1 to 50 year ARI events;
  - Tailwater level of 14.09m for the 100 year ARI event adopted from the WRM *Washpool Creek Flood Study, Gracemere* (2011).

Manning's roughness values have been adopted in accordance with the Capricorn Municipal Development Guidelines *Stormwater Drainage Design D5* (2007). **Table 3.3** details the adopted roughness values.

Table 3.3: Adopted Manning Roughness Values

Surface Classification	Manning's 'n'
Roads	0.020
Short Grass	0.033
Long Grass	0.045
Long Grass with Scattered Trees/Shrubs	0.060

3.3. Existing Scenario

All catchments listed in **Table 3.1** were modelled in order to determine the existing peak flows. Detailed hydraulic analysis of the waterway through the site to downstream of Washpool Road was undertaken for the area shown in the model schematic in **Figure 3.3.**

3.3.1. Results

The resulting water surface levels and flows are shown in **Table 3.4**. These results are at the reporting location shown in **Figure 3.3**. Results shown are for the critical duration storm event. Refer to **Appendix B** for detailed XPSWMM results.

Table 3.4: Existing Scenario Results (Critical Storm Duration)

Location	5 Year ARI		100 Year ARI	
	Flow (m^3/s)	WSL (m AHD)	Flow (m^3/s)	WSL (m AHD)
1	5.00	19.24	11.79	19.44
2	5.63	17.41	14.27	17.74
3 (Washpool Road)	14.03	14.05	22.87	14.37
4 (Downstream Extent)	20.04	12.86	39.32	14.09
5 (Verification)*	10.86	15.70	27.76	15.94

*- Reported in Existing Scenario Only For Verification Purposes

Existing flood levels through the site are shown in **Figure 3.4** below.

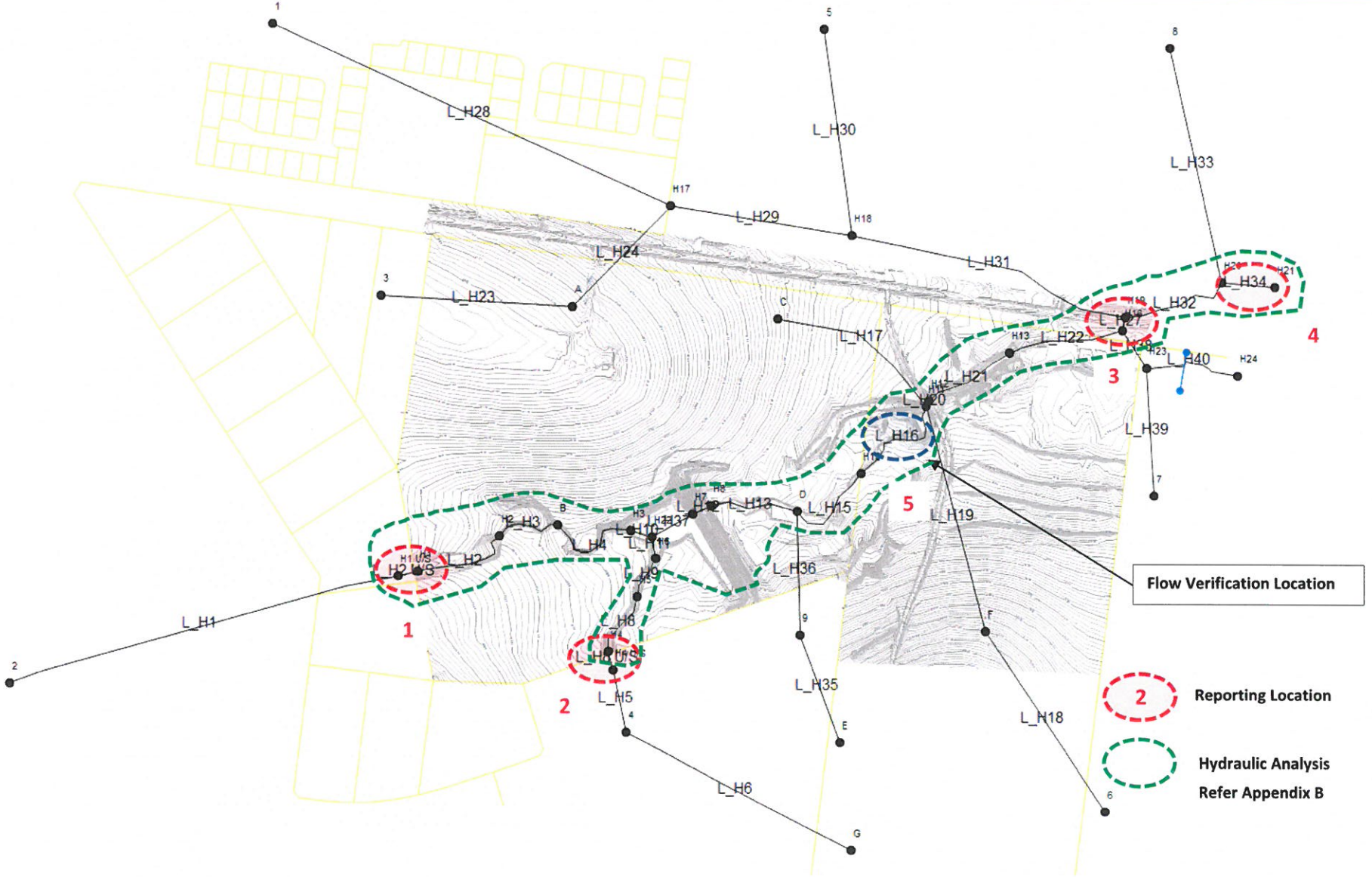


Figure 3.3: Existing XPSWMM Schematic

Existing (Flood Levels)

Node	1 Y ARI	2 Y ARI	5 Y ARI	10 Y ARI	20 Y ARI	50 Y ARI	100 Y ARI
H8	16.31	16.515	16.642	16.693	16.755	16.83	16.885
H7	16.542	16.772	17.014	17.138	17.294	17.473	17.589
H6	16.547	16.777	17.019	17.144	17.3	17.48	17.596
H5	16.635	16.868	17.051	17.161	17.31	17.487	17.602
H4	17.051	17.211	17.396	17.447	17.523	17.618	17.7
H4 U/S	17.193	17.296	17.405	17.524	17.589	17.666	17.735
H3	16.547	16.776	17.019	17.143	17.299	17.479	17.595
H23	14.037	14.053	14.077	14.091	14.12	14.165	14.256
H22	16.545	16.775	17.016	17.141	17.296	17.475	17.591
H21	12.786	12.823	12.863	12.887	12.911	12.947	14.09
H20	13.183	13.237	13.305	13.344	13.384	13.446	14.109
H2	17.636	17.693	17.792	17.835	17.887	17.958	18.016
H19	13.902	13.957	14.03	14.073	14.116	14.188	14.345
H16	13.914	13.971	14.047	14.092	14.136	14.212	14.367
H13	14.116	14.221	14.36	14.425	14.496	14.59	14.688
H12	14.328	14.5	14.785	14.873	14.98	15.099	15.167
H11	14.545	14.589	14.797	14.887	14.995	15.118	15.188
H10	15.449	15.564	15.698	15.749	15.806	15.886	15.944
H1 U/S	19.293	19.331	19.391	19.427	19.478	19.542	19.586
H1	19.136	19.177	19.239	19.284	19.338	19.399	19.441
D	15.794	15.92	16.06	16.12	16.19	16.27	16.323
C	14.545	14.589	14.797	14.887	14.995	15.118	15.188
B	17.372	17.425	17.506	17.542	17.59	17.679	17.758
2	19.46	19.5	19.566	19.603	19.659	19.73	19.784

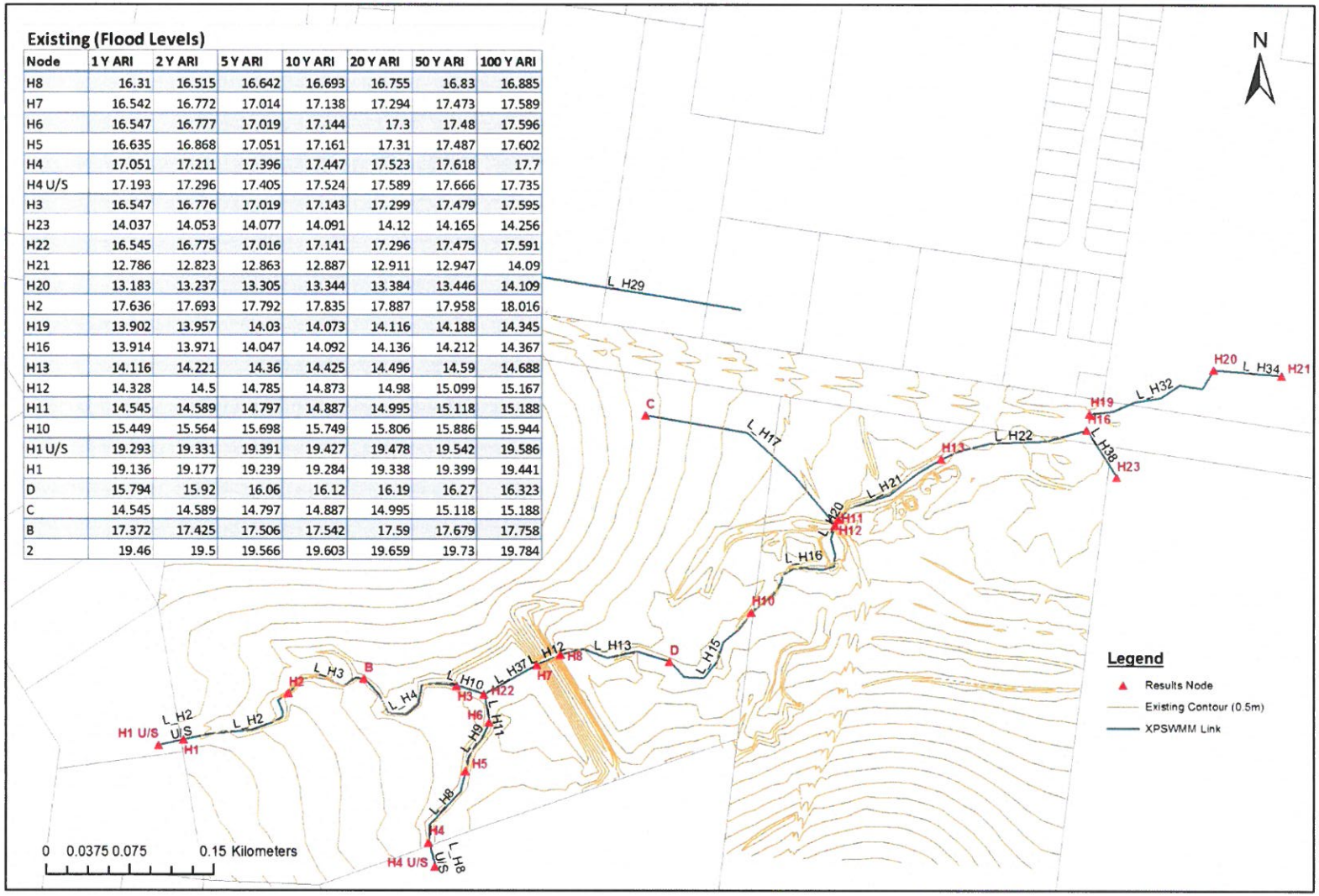


Figure 3.4: Existing Flood Levels (Critical Storm Duration)

3.4. Developed Scenario (with Mitigation)

Modelling of developed scenario was undertaken with the updated catchments as shown in **Table 3.2** and **Figure 3.2**. The proposed channels, culverts and new detention basin have been included in the XPSWMM model. The filling proposed in the north eastern corner of the site has been considered as part of the hydraulic analysis undertaken for the developed scenario.

A schematic of the developed scenario XPSWWM model is shown in **Figure 3.5**. Inundation sketches for the proposed channel in the 100 year ARI event are provided in **Appendix D**.

3.4.1. Proposed Culvert Crossing

The proposed culverts as shown in **Figure 3.5** below have been included in the XPSWMM Model. The configuration of these culverts is as follows:

- Culvert A – 3/1800x900 RCBC; and
- Culvert B – 4/2100x1200 RCBC

A sensitivity analysis has been undertaken and considers 50% blockage of the proposed culvert structures in the 100 year ARI event. Refer to **Section 3.4.4** for details.

3.4.2. Proposed Detention Basin

Details of the proposed detention basin are shown in **Table 3.5** below.

Table 3.5: Detention Basin Details

Parameter	Value
Volume* (RL 13.2 to 15.60) (m^3)	33,300
Outlet Culvert	2/2100x900 RCBC
Overflow Weir	25m IL 15.00
100 year ARI WSL	15.60

*- This volume excludes the channel storage upstream of H_S7, therefore actual volume of detained water will be greater

3.4.3. Results

Results of the developed scenario are presented in **Table 3.6** and **Table 3.7** below. As shown the resulting water surface levels and peak flows are generally less than the existing scenario. In the 5 year ARI storm there is a minor increase in peak flow at Location 1 and 2. The increase of 0.01m^3/s is insignificant and is probably a model rounding error, as the sub catchments upstream have not changed. The drop in water surface level at these locations is a result of the proposed channel works downstream.

Downstream of the site (Locations 3 and 4) the peak flows and water surface levels have reduced as a result of the proposed detention basin. Therefore, it is considered that the proposed detention basin effectively mitigates any increase in peak flow as a result of the Gracemere Springs Developments, site 1 and 2.

Table 3.6: Developed Scenario Results – 5 year ARI

Location	Flow (m^3/s)		WSL (m AHD)	
	Existing	Developed	Existing	Developed
1	5.00	5.01	19.24	19.05
2	5.63	5.64	17.41	17.30
3 (Washpool Road)	14.03	13.16	14.05	14.04
4 (Downstream Extent)	20.04	19.68	12.86	12.86

Table 3.7: Developed Scenario Results – 100 year ARI

Location	Flow (m^3/s)		WSL (m AHD)	
	Existing	Developed	Existing	Developed
1	11.79	11.79	19.44	19.22
2	14.27	14.27	17.74	17.58
3 (Washpool Road)	22.87	22.30	14.37	14.36
4 (Downstream Extent)	39.32	38.99	14.09	14.09

Developed flood levels through the site are shown in **Figure 3.6**.

3.4.4. Sensitivity Analysis – Culvert Blockage

As mentioned previously a sensitivity analysis considering 50% blockage of the proposed culverts in the 100 year ARI event has been undertaken. It should be noted that this degree of blockage is considered unlikely. The analysis has been undertaken as a sensitivity check only.

The results indicated that WSLs increased within the two proposed channels located upstream of the culvert crossings. Despite this increase the maximum WSLs are still below the proposed minimum allotment levels.

The results for the culvert blockage analysis also indicated that the culvert crossings are overtopped. Refer to **Table 3.8** for details of the road flow conditions.

Table 3.8: Road Flow Conditions – 50% Blockage Analysis 100 Year ARI

Location	Max. Flow (m^3/s)	Max. Velocity (m/s)	Max. Flow Depth (m)	Max. Depth*Velocity Product (m^2/s)
Culvert A	5.20	0.56	0.18	0.09
Culvert B	2.52	0.50	0.13	0.06

As indicated above in **Table 3.8** the depth of flooding over the road does not exceed the maximum recommended depth of 0.25m in accordance with *QUDM* (2007). In addition the depth velocity products are well below the maximum depth velocity product of $0.6m^2/s$. Therefore the roads above the culvert crossings will remain trafficable under a 50% culvert blockage scenario in the 100 year ARI.

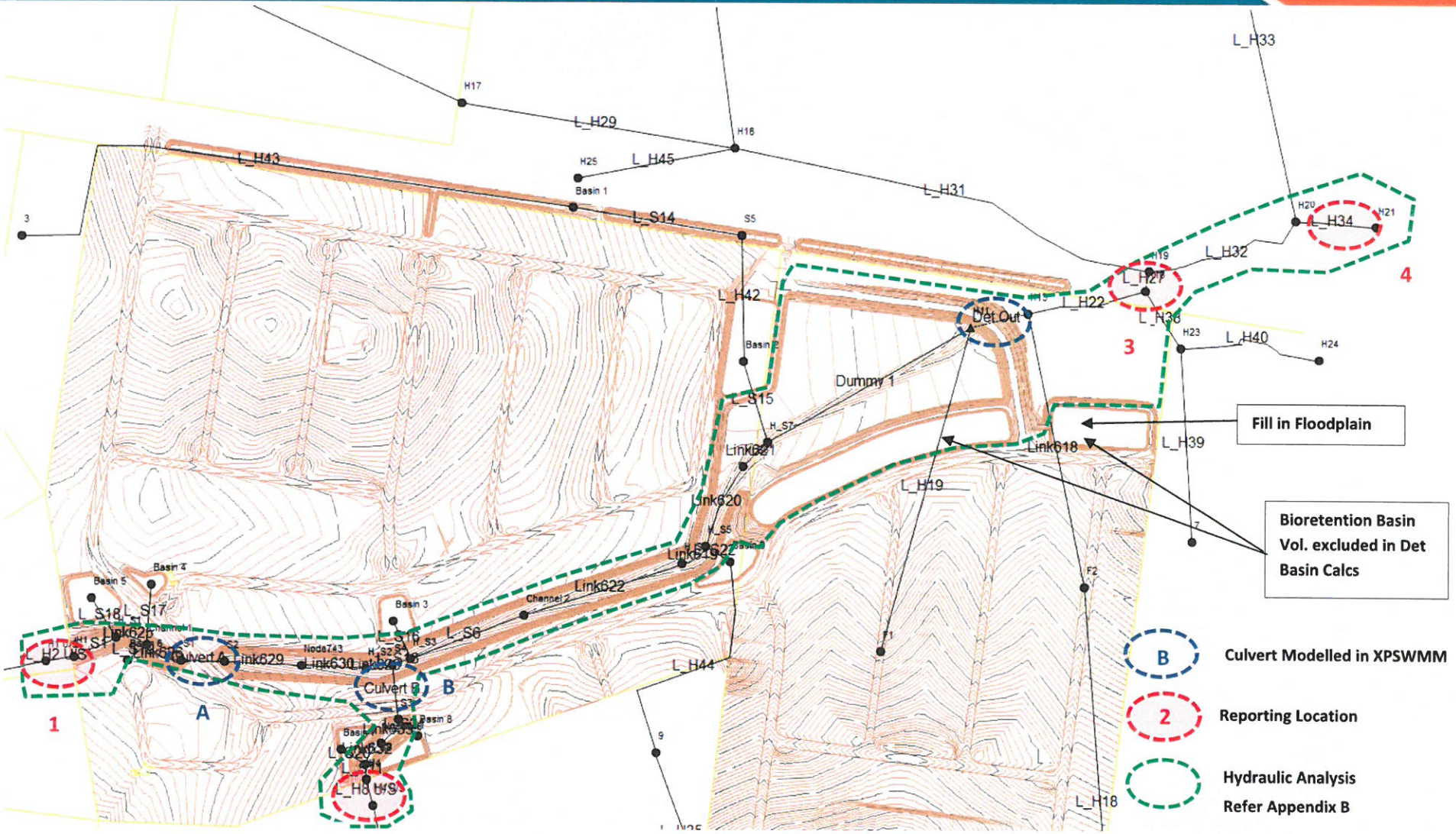


Figure 3.5: Developed XPSWMM Schematic

Developed (Flood Levels)

Node	1 Y ARI	2 Y ARI	5 Y ARI	10 Y ARI	20 Y ARI	50 Y ARI	100 Y ARI
S4	16.639	16.708	16.813	16.876	16.97	17.088	17.171
S3	16.667	16.747	16.87	16.971	17.096	17.254	17.367
S2	17.241	17.285	17.358	17.399	17.465	17.522	17.584
S1	17.479	17.58	17.744	17.839	17.99	18.13	18.308
Node746	16.702	16.781	16.913	17.014	17.137	17.295	17.408
Node743	16.909	16.96	17.041	17.089	17.165	17.241	17.319
H4 U/S	17.139	17.186	17.295	17.35	17.421	17.533	17.582
H4	16.765	16.837	16.974	17.067	17.187	17.34	17.45
H23	14.037	14.054	14.075	14.086	14.109	14.166	14.253
H21	12.787	12.825	12.861	12.878	12.903	12.947	14.09
H20	13.184	13.24	13.301	13.33	13.369	13.446	14.108
H19	13.903	13.957	14.022	14.057	14.099	14.189	14.341
H16	13.915	13.972	14.038	14.076	14.119	14.213	14.363
H13	13.928	13.993	14.064	14.117	14.171	14.278	14.411
H11	14.072	14.36	14.865	15.134	15.264	15.441	15.538
H1 U/S	19.273	19.305	19.357	19.385	19.429	19.482	19.524
H1	18.961	18.993	19.045	19.074	19.12	19.178	19.222
H_S8	16.747	16.823	16.963	17.059	17.181	17.335	17.446
H_S7	14.582	14.661	14.889	15.148	15.28	15.461	15.559
H_S6	14.768	14.813	14.932	15.159	15.289	15.468	15.566
H_S5	15.231	15.304	15.41	15.47	15.577	15.726	15.816
H_S4	15.352	15.425	15.532	15.593	15.694	15.832	15.92
H_S3	16.555	16.626	16.732	16.791	16.886	17.001	17.084
H_S2	16.686	16.75	16.85	16.907	16.998	17.11	17.193
H_S1	17.746	17.823	17.95	18.024	18.143	18.255	18.409
Channel 2	16.055	16.128	16.237	16.298	16.394	16.507	16.591
Channel 1	17.639	17.721	17.858	17.939	18.071	18.195	18.357

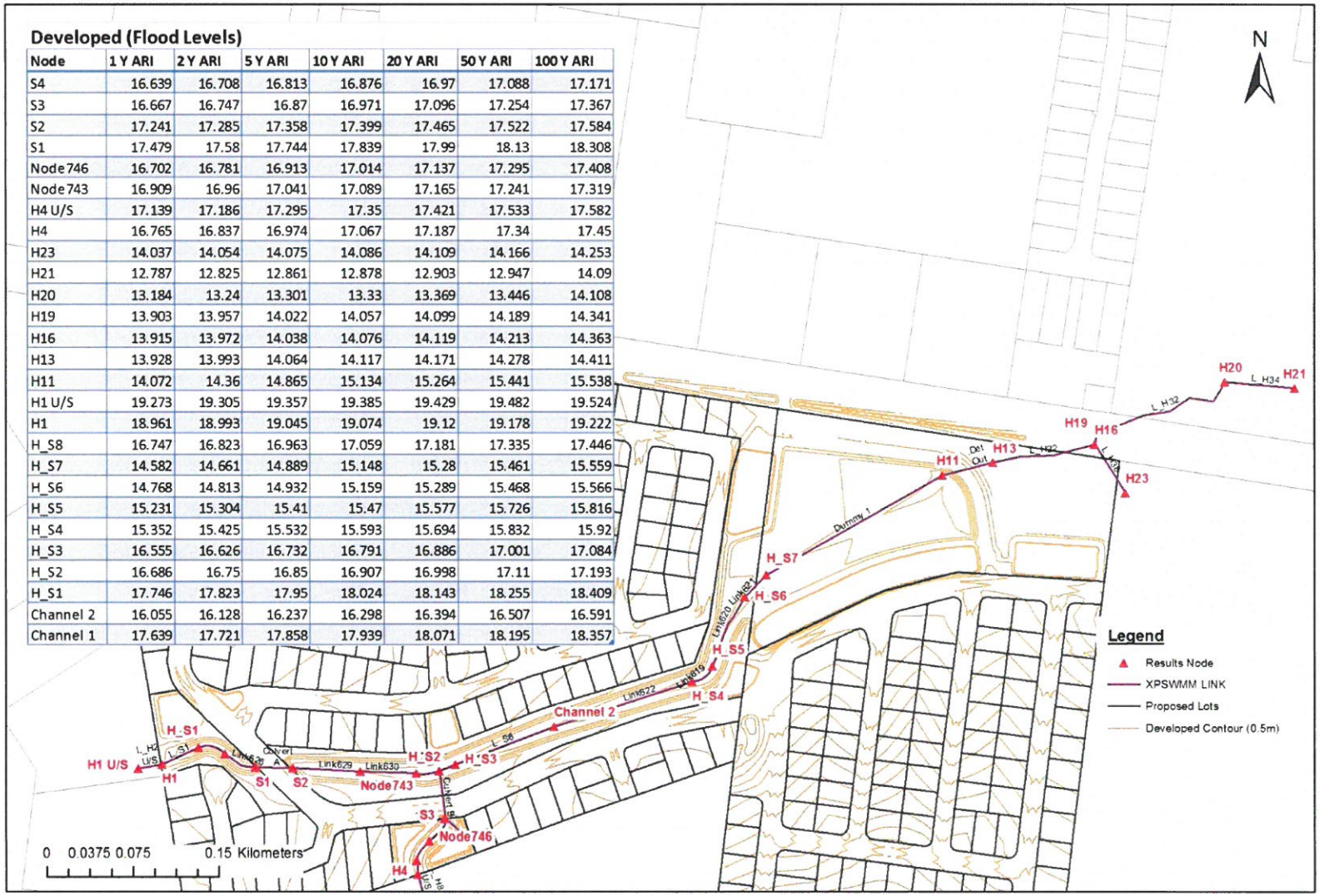


Figure 3.6: Developed Flood Levels (Critical Duration Storm)

4. SOUTHERN PORTION OF GRACEMERE SPRINGS 2

Preliminary stormwater quantity and flood investigations were undertaken for the southern portion of the Gracemere Springs 2 development in order to determine:

- Required detention basin volume to mitigate any increase in peak flow; and
- The existing 100 year ARI flood levels for the waterway along the southern site boundary.

4.1. Stormwater Quantity Analysis

As the proposed development of the southern portion of the site has the potential to increase peak flows discharging from the site, Queensland Rational Method (QRM) calculations were undertaken in order to determine the change in peak flow.

4.1.1. Catchment Details

Catchment boundaries for the existing and development QRM calculations were determined based on site survey and the proposed lot layout. The coefficient of runoff and time of concentrations have been determined in accordance with *QUDM* (2007).

The time of concentration (tc) for the existing scenario was determined to be 30mins, the flow time is dictated by the overland sheet flow component, refer to **Appendix C** for details. In the developed scenario the time of concentration has reduced to 9mins as a result of the change from overland sheet flow to predominantly piped and kerb and channel flow.

Table 4.1 details the resulting catchment parameters.

Table 4.1: Catchment Details

Scenario	Area (ha)	% Impervious	C10	tc (mins)
Existing	11.73	0%	0.59	30
Developed	12.87	64%	0.79	9

4.1.2. Design Rainfall Intensities

Rainfall Intensities were adopted from the *Stormwater Drainage Design D5* (2007) guidelines.

4.1.3. Peak Flow Results

The resulting peak flows for the existing and developed scenario are shown in **Table 4.2**. Detailed QRM calculations are provided in **Appendix C**.

Table 4.2: Peak Flow Results

ARI	Existing (m^3/s)	Developed (m^3/s)
1	0.76	1.93
2	1.05	2.65
5	1.50	3.85
10	1.81	4.62
20	2.20	5.65
50	2.87	7.43
100	3.37	8.77

As shown in the table above the proposed development result in an increase in peak flow, therefore a detention basin is required to mitigate this increase.

4.1.4. Preliminary Detention Basin Size

The Boyd's method calculation from Section 5.05.1 of *QUDM* (2007) was used to determine the preliminary detention basin volume to mitigate the increase in peak flow as a result of the development.

It was determined that a detention basin with a volume of **4,700m³** is required to mitigate the increase in peak flow for the southern catchment of the Gracemere Springs 2 development. Refer to **Appendix C** for further details of the Boyd's calculations.

4.2. Existing Flood Levels Southern Waterway

Analysis has been undertaken to determine the existing 100 year ARI flood levels for the waterway along the southern site boundary of Gracemere Springs 2. QRM calculations and a HEC-RAS model were undertaken to determine the existing 100 year ARI flood levels.

4.2.1. Catchment Details

The catchment for the southern waterway to the most downstream extent of the southern portion of the site has been determined from site survey and Airborne Laser Scanning (ALS) Survey. The catchment is shown in **Figure 4.1** below. The coefficient of runoff and time of concentration have been determined in accordance with *QUDM* (2007).

The time of concentration (tc) for the catchment was calculated to be 225 mins, determined using the Bransby Williams Equation. For details refer to **Appendix C**.

Table 4.3 details the resulting southern waterway catchment parameters.

Table 4.3: Southern Waterway Catchment Details

Area (ha)	% Impervious	C100	tc (mins)
1267	4%	0.72	225

4.2.2. Design Rainfall Intensities

Rainfall Intensities were adopted from the *Stormwater Drainage Design D5* (2007) guidelines.

4.2.3. Peak Flow Results

The resulting 100 year ARI peak flow for the southern waterway for the catchment detailed above is shown in **Table 4.4** below. Detailed QRM calculations are provided in **Appendix C**.

Table 4.4: Southern Waterway 100 Year ARI Peak Flow Results

ARI	Peak Flow (m^3/s)
100	112.3

4.2.4. Hydraulic Investigation

Analysis has been undertaken using a steady state HEC-RAS model to determine flood levels and flood extents for the southern portion of the Gracemere Springs 2 development.

The HEC-RAS model was created from site survey. Modelling was undertaken from approximately the most southern point of the Gracemere Springs 2 development to the waterways most downstream extent at the southern portion of the site.

Manning's roughness values have been adopted based on aerial imagery. **Table 4.5** below shows the adopted roughness values.

Table 4.5: Adopted Manning's Roughness Values

Surface Description	Value
Long Grass	0.045
Long Grass with Scattered Trees/Shrubs	0.060

The following boundary conditions were adopted for the HEC-RAS model:

- Downstream: normal depth (slope 0.1% adopted); and
- Upstream: normal depth (slope 0.1% adopted).

4.2.5. Hydraulic Investigation Results

Results for the 100 year ARI flood level at various locations are presented in **Table 4.6** below.

Table 4.6: HEC-RAS Model Results

Location	Cross Section	Existing 100 Year ARI Flood Level (m AHD)
Upstream Extent of Model (Southern Extent of Site)	830	17.53
Adjacent South-Western Corner of Development Extent	288	16.11
Approximate Centre of Development Extent to the South	164	16.06
Downstream Extent of Model (South-Eastern Corner of Development)	41	15.94

Minimum lot levels for the development shall have a minimum of 300mm freeboard above the 100 year ARI flood level adjacent the south-western corner of the development. The minimum lot level proposed for the southern portion of the Gracemere Springs 2 development is therefore 16.45m AHD.

Flood extents of the southern waterway for the 100 year ARI are shown in **Figure 4.2** below. A detailed HEC-RAS output summary is presented in **Appendix C**.

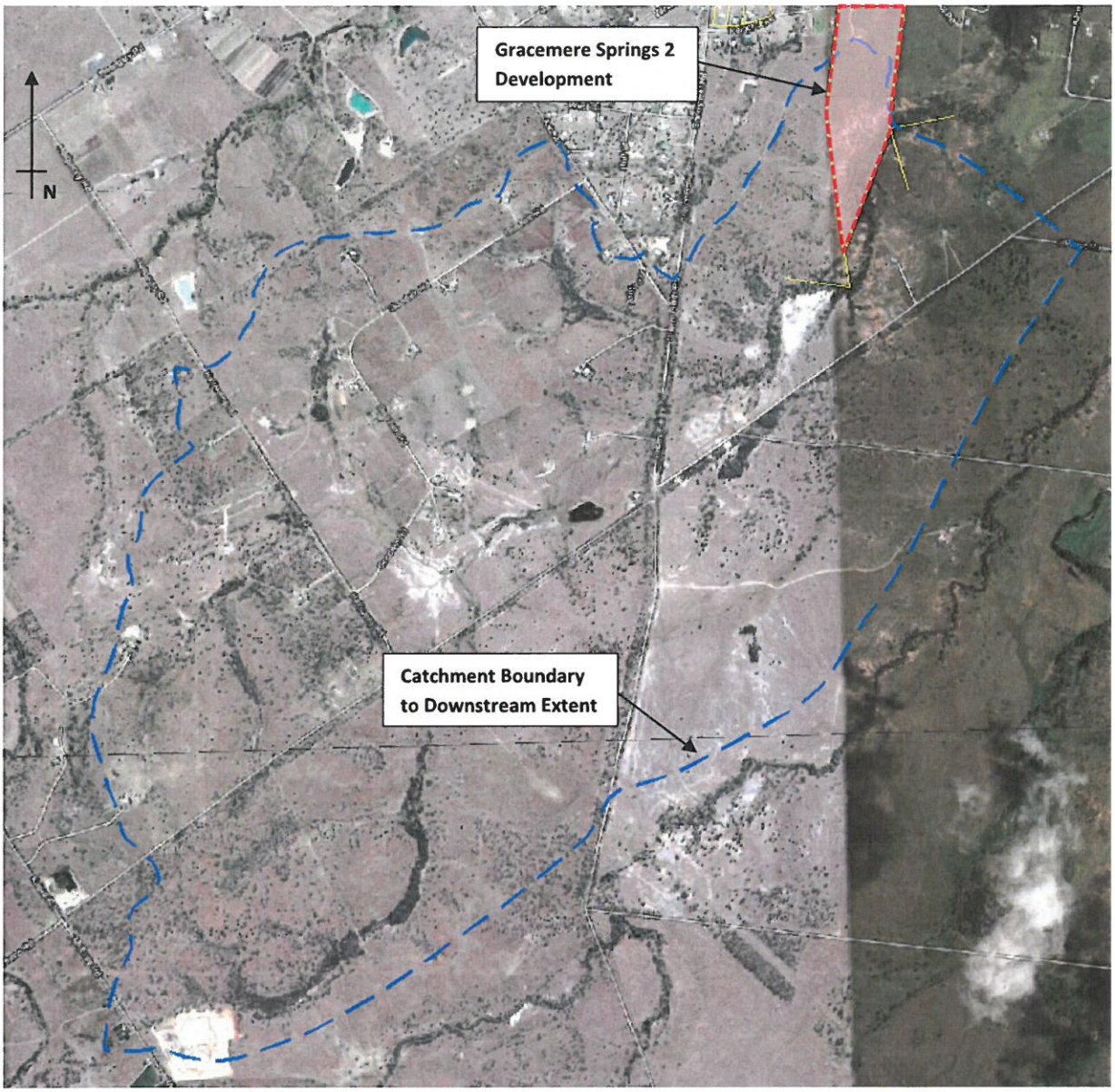


Figure 4.1: Southern Waterway Catchment – Gracemere Springs 2

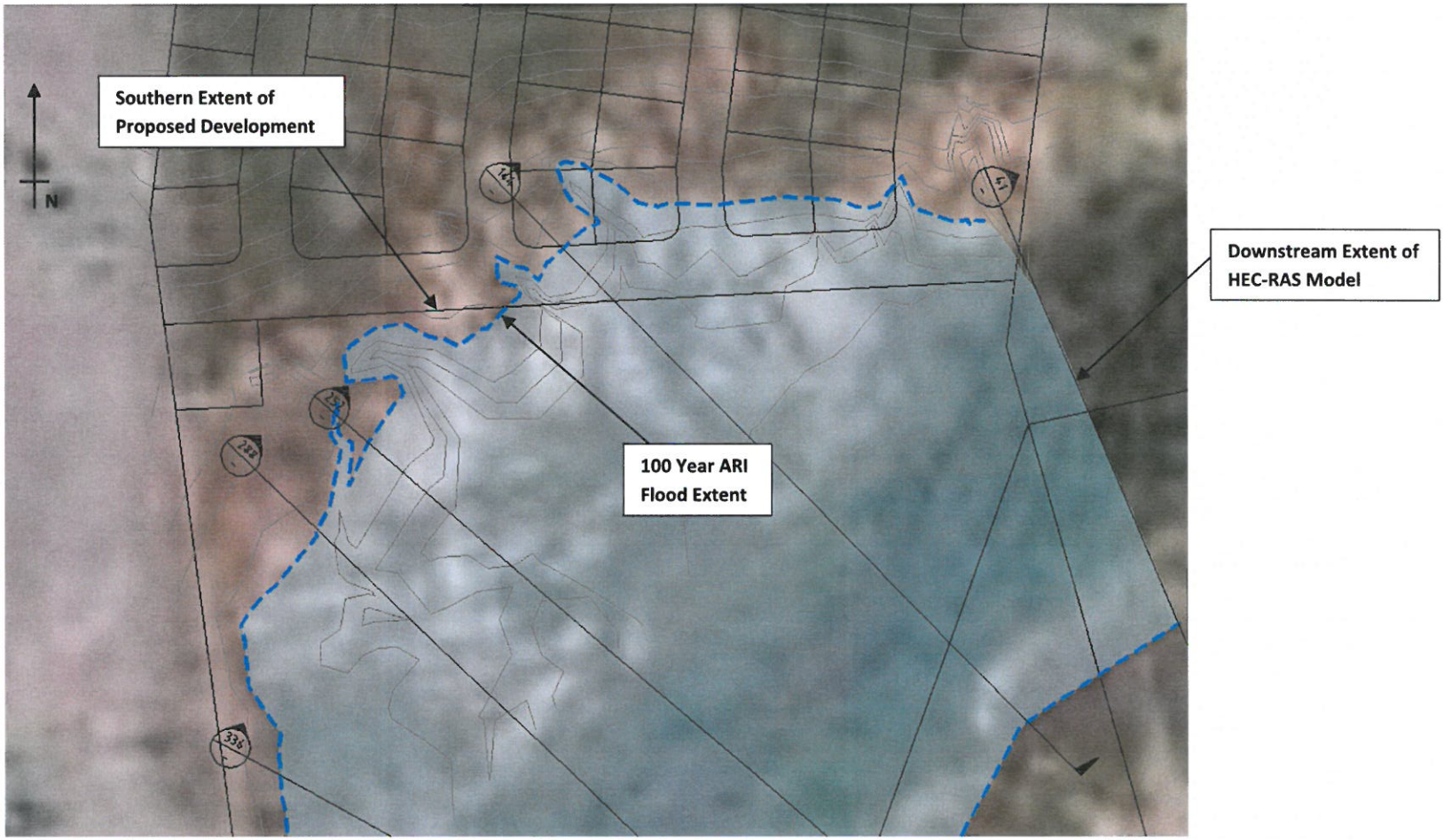


Figure 4.2: Southern Waterway 100 Year ARI Flood Extent – Gracemere Springs 2

5. CONCLUSIONS

This Stormwater Quantity Management Plan and Flood Investigation has been prepared to respond to the stormwater quantity and flooding items of Council's Information Request, dated 21 December 2012 (RRC Ref: D/588-2012) for the proposed development at 70 Washpool Road, Gracemere and also detail the proposed stormwater quantity management strategy for the proposed development at 104 Washpool Road, Gracemere. The outcomes of the investigations are outlined below:

- The proposed online detention basin for the northern waterway effectively mitigates any increase in peak flow and water surface levels as a result of the Gracemere Springs developments Site 1 and 2;
- The proposed culverts within the Gracemere Springs 1 development have sufficient capacity to convey flows in a 50% blockage scenario in the 100 year ARI whilst ensuring the roads above remain trafficable and no allotments are inundated;
- A detention basin for the southern portion of Gracemere Springs 2 has been preliminarily sized to ensure no increase in peak flows due to the development; and
- A preliminary flood investigation has been undertaken for the southern waterway along the southern site boundary of the Gracemere Springs 2 development. Flood extents and flood levels have been determined.

6. RECOMMENDATIONS

It is recommended that the northern waterway online detention basin be incorporated into the Operational Works drawings for the Gracemere Springs developments. The northern waterway management strategies identified within this report should be adopted; specifically:

- Providing an online detention basin within the northern waterway with a detention storage of 33,300m^3; and
- Provide culvert configurations of 3/1800x900 RCBC for Culvert A and 4/2100x1200 RCBC for Culvert B.

It is also recommended that the preliminary hydrological and hydraulic constraints identified for the southern portion of the Gracemere Springs 2 development be incorporated into the future Operational Works detailed design. Detailed design may result in changes to the preliminary constraints analysis, however design criteria will be followed.

7. REFERENCES

- Department of Natural Resources and Water (2007), *Queensland Urban Drainage Manual Volume 1 Second Edition*;
- Capricorn Municipal Development Guidelines (2007), *Stormwater Drainage Design D5*;
- Brown Consulting (Rockhampton) Pty Ltd (2012), *Stormwater Management Report*;
- Rockhampton Regional Council (2012), *Information Request* (RRC Ref: D/588-2012);
- WRM Water and Environment (2011), *Washpool Creek Flood Study, Gracemere*.

8. DISCLAIMER

This report has been prepared on behalf of and for the exclusive use of Gracemere Springs Pty Ltd and is subject to and issued in accordance with the agreement between Brown Consulting (QLD) Pty Ltd.

Our investigation and analysis has been specifically catered for the particular requirements of Gracemere Springs Pty Ltd and may not be applicable beyond this scope. For this reason, any other third parties are not authorised to utilise this report without further input and advice from Brown Consulting (QLD) Pty Ltd.

Brown Consulting (QLD) Pty Ltd accepts no liability or responsibility whatsoever for the report in respect of any use of or reliance upon this report by any third party.

The investigation and analysis has relied on information provided by others. We accept no responsibility for accuracy of material supplied by others. The accuracy of the investigation, analysis and report is dependent upon the accuracy of this information.

9. APPENDICES

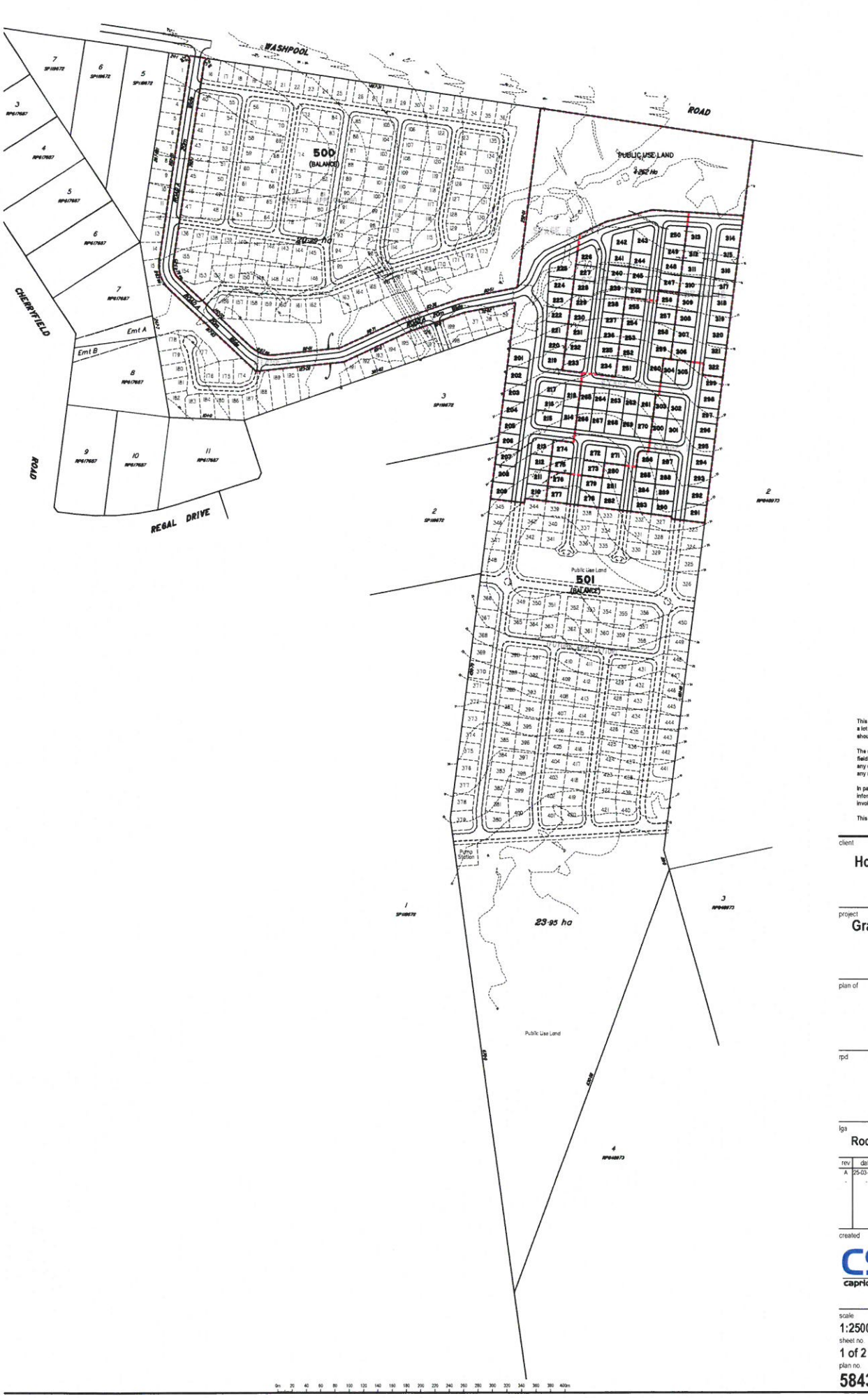
Appendix A: Proposed Site Layout

Appendix B: Flood Investigation – Northern Waterway

Appendix C: Preliminary Constraints Analysis – Gracemere Springs 2

Appendix D 100 Year ARI Inundation Sketches

APPENDIX A: PROPOSED SITE LAYOUT



Stage	No.
Stage 8	25
Stage 9	25
Stage 10	25
Stage 11	30
Stage 12	17
Total	122

IMPORTANT NOTE

This plan was prepared to accompany a reconfiguration of a lot application to Rockhampton Regional Council and should not be used for any other purpose.

The dimensions and areas shown hereon are subject to field survey and also to the requirements of council and any other authority which may have requirements under any relevant legislation.

In particular, no reliance should be placed on the information on this plan for any financial dealings involving the land.

This note is an integral part of this plan.

client

Homecorp Developments Pty Ltd

project

Gracemere Springs Estate
Washpool Road,
Gracemere

plan of

Lot Reconfiguration
Stages 8 - 12
(122 Lots)

rpd

Lot 1 on RP848973 &
Lot 4 on SP199672
Parish of Gracemere
County of Livingstone

lga

Rockhampton Regional Council

rev	date	details	authorised
A	25-03-2013	Initial Issue	RJKF

created

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ABN: 82 154 830 565

scale
1:2500 @ A1

datum
AHD

sheet no.
1 of 2

cad file
5843-08-ROL-A

plan no.
5843-08-ROL

revision
A

APPENDIX B: FLOOD INVESTIGATION – NORTHERN WATERWAY

XPSWMM Detailed Results - Gracemere Springs Development, Gracemere

File: H:\B13\001-049\B13021.W\Stormwater\[B13021.W XPSWMM Results.xlsx]RESULTS
Date: 15/04/2013
User: AH

1. Western Boundary

ARI	Flow (m^3/s)			WSL (m AHD)	
	Existing	Developed	Increase (%)	Existing	Developed
1	2.69	2.71	0%	19.14	18.96
2	3.50	3.52	0%	19.18	18.99
5	**5.00**	**5.01**	**0%**	**19.24**	**19.05**
10	5.95	5.96	0%	19.28	19.07
20	7.55	7.56	0%	19.34	19.12
50	9.84	9.84	0%	19.40	19.18
100	**11.79**	**11.79**	**0%**	**19.44**	**19.22**
		Average (%)	0%		

2. Southern Boundary

ARI	Flow (m^3/s)			WSL (m AHD)	
	Existing	Developed	Increase (%)	Existing	Developed
1	2.52	2.65	5%	17.19	17.14
2	3.43	3.44	0%	17.30	17.19
5	**5.63**	**5.64**	**0%**	**17.41**	**17.30**
10	7.01	7.02	0%	17.52	17.35
20	9.16	9.16	0%	17.59	17.42
50	12.04	12.05	0%	17.67	17.53
100	**14.27**	**14.27**	**0%**	**17.74**	**17.58**
		Average (%)	1%		

3. Washpool Road

ARI	Flow (m^3/s)			WSL (m AHD)	
	Existing	Developed	Increase (%)	Existing	Developed
1	8.23	8.31	1%	13.91	13.92
2	10.57	10.52	0%	13.97	13.97
5	**14.03**	**13.16**	**-6%**	**14.05**	**14.04**
10	15.91	15.38	-3%	14.09	14.08
20	17.41	16.82	-3%	14.14	14.12
50	21.70	21.69	0%	14.21	14.21
100	**22.87**	**22.30**	**-2%**	**14.37**	**14.36**
		Average (%)	-2%		

4. Downstream Model Extent

ARI	Flow (m^3/s)			WSL (m AHD)	
	Existing	Developed	Increase (%)	Existing	Developed
1	10.54	10.63	1%	12.79	12.79
2	14.40	14.62	2%	12.82	12.83
5	**20.04**	**19.68**	**-2%**	**12.86**	**12.86**
10	23.69	22.28	-6%	12.89	12.88
20	27.70	26.07	-6%	12.91	12.90
50	35.00	35.06	0%	12.95	12.95
100	**39.32**	**38.99**	**-1%**	**14.09**	**14.09**
		Average (%)	-2%		

5. Verification

ARI	Flow (m^3/s)	WSL (m AHD)
	Existing	Existing
1	3.92	15.45
2	6.53	15.56
5	10.86	15.70
10	13.66	15.75
20	17.68	15.81
50	23.28	15.89
100	**27.76**	**15.94**

APPENDIX C: PRELIMINARY CONSTRAINTS ANALYSIS – GRACEMERE SPRINGS 2

C1 Stormwater Quantity Analysis Queensland Rational Method Calculations

C2 Boyd's Calculations

C3 Southern Waterway Queensland Rational Method Calculations

C4 Detailed HEC-RAS Output Summary

C1 Stormwater Quantity Analysis Queensland Rational Method Calculations

Southern Portion Gracemere Springs 2 - Existing

File: H:\B13\001-049\B13028.W\Stormwater\[B13028.W Site QRM Calculations.xlsx]Site Existing
Date: 15/04/2013
Job: B13028.W
By: BF
Locality: RRC
IFD Ref: IFD_RRC
IFD Source: Capricorn Municipal Development Guidelines

Time of Concentration Calculations

Reference	Equation Type / Method	Area (ha)	Length (m)	Av. Slope (%)	Pipe Diameter (mm)	Velocity (m/s)	Wetted Area (m^2)	Wetted Perimeter (m)	Hydraulic Radius R	Roughness (Mannings/ Hortons)	Sub Total (mins)	tc (min)
4.06.6 QUDM	Overland Sheet Flow - Friends Equation	11.73	150	3.1						0.06	27	
4.06.3 a(iv) QUDM	Assumed Channel Velocity		280			1.5					3	30
											Adopted tc	30

C10 VALUE

Enter Fraction Impervious	Development Category	f_I	$1I_{10}$ (mm/hr)
Table 5.04.2 QUDM		0%	64

C10
0.59
Adopted C10 0.59

Flow Calculations (QUDM 4.03.1)

tc (min) 30

ARI	Cy	$^{tc}I_y$	A (ha)	Q (m3/s)
1	0.47	49	11.7	0.76
2	0.50	64	11.7	1.05
5	0.56	82	11.7	1.50
10	0.59	94	11.7	1.81
20	0.62	109	11.7	2.20
50	0.68	130	11.7	2.87
100	0.71	146	11.7	3.37

Southern Portion Gracemere Springs 2 - Developed

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Date: 15/04/2013
Job: B13028.W
By: BF
Locality: RRC
IFD Ref: IFD_RRC
IFD Source: Capricorn Municipal Development Guidelines

Time of Concentration Calculations

Reference	Equation Type / Method	Area (ha)	Length (m)	Av. Slope (%)	Pipe Diameter (mm)	Velocity (m/s)	Wetted Area (m^2)	Wetted Perimeter (m)	Hydraulic Radius R	Roughness (Mannings/ Hortons)	Sub Total (mins)	tc (min)
Table 4.06.2 QUDM	QUDM Roof to Main System Connection	12.87									5	
4.06.3 a(iii) QUDM	Assumed Pipe Flow Velocity		424			2.0					4	9
											Adopted tc	9

C10 VALUE

Enter Fraction Impervious	Development Category	f_i	$1I_{10}$ (mm/hr)
Table 5.04.2 QUDM		64%	64

	C10
	0.79
Adopted C10	0.79

Flow Calculations (QUDM 4.03.1)

tc (min) 9

ARI	Cy	$^{tc}I_y$	A (ha)	Q (m3/s)
1	0.63	85	12.9	1.93
2	0.67	110	12.9	2.65
5	0.75	143	12.9	3.85
10	0.79	163	12.9	4.62
20	0.83	190	12.9	5.65
50	0.91	228	12.9	7.43
100	0.95	258	12.9	8.77

C2 Boyd's Calculations

Southern Portion Gracemere Springs 2 - Boyd's Calculation

File: H:\B13\001-049\B13028.W\Stormwater\[B13028.W Site QRM Calculations.xlsx]Detention Boyd's
Date: 15/04/2013
Job: B13021.W
By: BF

BOYD's Calc						Basin Volume	Vs+FOS (m3)
ARI	Qo	Qi	Increase	r	Vi (m3)	Vs (m3)	1.2
1	0.76	1.93	1.17	0.61	1388	840	1008
2	1.05	2.65	1.60	0.61	1908	1155	1386
5	1.50	3.85	2.35	0.61	2772	1693	2032
10	1.81	4.62	2.81	0.61	3326	2024	2429
20	2.20	5.65	3.45	0.61	4071	2486	2983
50	2.87	7.43	4.56	0.61	5350	3280	3936
100	3.37	8.77	5.40	0.62	6317	3892	**4670**
						tc	9.0

C3 Southern Waterway Queensland Rational Method Calculations

Gracemere Springs 2 - Southern Waterway

File: H:\B13\001-049\B13028.W\Stormwater\[B13028.W FS QRM Method Calculations.xlsx]Catchment Flood Study
Date: 15/04/2013
Job: B13028.W
By: BF
Locality: RRC
IFD Ref: IFD_RRC
IFD Source: Capricorn Municipal Development Guidelines

Time of Concentration Calculations

Reference	Equation Type / Method	Area (ha)	Length (m)	Av. Slope (%)	Pipe Diameter (mm)	Velocity (m/s)	Wetted Area (m^2)	Wetted Perimeter (m)	Hydraulic Radius R	Roughness (Mannings/ Hortons)	Sub Total (mins)	tc (min)
4.06.11 (a) QUDM	Bransby Williams Equation	1267	6651	0.4							225	225
											Adopted tc	225

C10 VALUE

Enter Fraction Impervious	Development Category	f_i	$1I_{10}$ (mm/hr)
Table 5.04.2 QUDM		4%	64

C10
0.60
Adopted C10 0.60

Flow Calculations (QUDM 4.03.1)

tc (min) 225

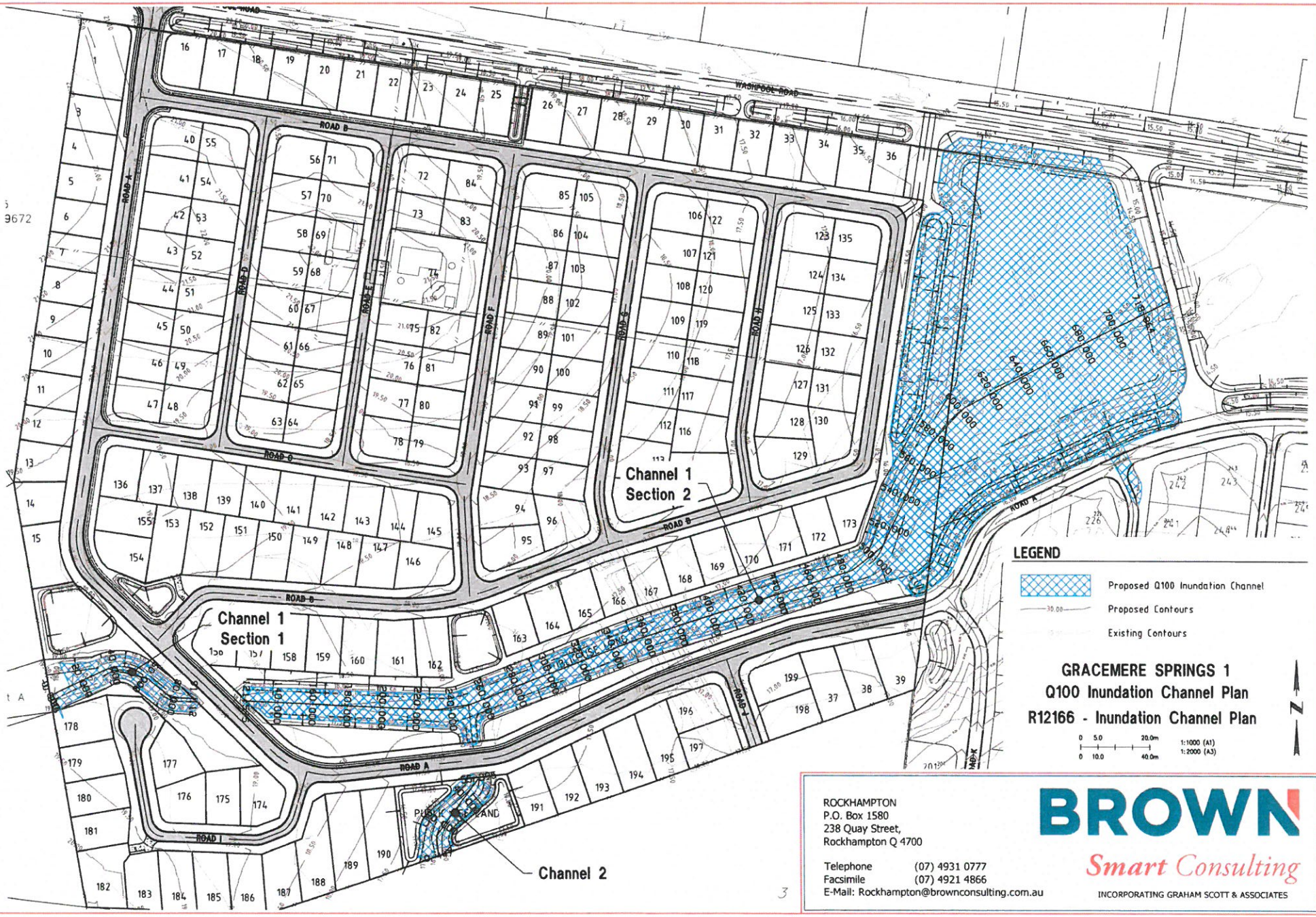
ARI	Cy	$^{tc}I_y$	A (ha)	Q (m3/s)
100	0.72	44	1267	112.3

C4 Detailed HEC-RAS Output Summary

100 Year ARI

River Sta	Profile	Q Total (m^3/s)	W.S. Elev (m)	Crit W.S. (m)	Vel Left (m/s)	Vel Chnl (m/s)	Vel Right (m/s)	Area (m^2)	Top Width (m)	Froude # Chl	Conv. Ratio
830.27	Q100	112.3	17.53	16.94	0.64	1.44	0.47	99.45	121.92	0.36	0.95
778.08	Q100	112.3	17.46	16.47	0.49	1.16	0.31	118.91	125.37	0.28	1.04
700.14	Q100	112.3	17.3	16.99	0.71	1.31	0.51	110.24	179.81	0.4	1
591.01	Q100	112.3	16.88	16.75	0.99	1.82	0.53	98.53	201.58	0.52	0.94
472.12	Q100	112.3	16.27	15.5	0.45	1.01	0.55	157.42	198.6	0.27	0.88
386.43	Q100	112.3	16.2	15.47	0.53	0.91	0.56	172.47	179.22	0.24	1.03
335.81	Q100	112.3	16.14	15.57	0.34	1.01	0.65	163.91	232.42	0.27	0.92
288.24	Q100	112.3	16.11	15.26	0.37	0.75	0.5	225.21	256.51	0.19	0.83
251.5	Q100	112.3	16.09	15.32	0.41	0.61	0.42	245.79	257.1	0.16	1.02
164.43	Q100	112.3	16.06	15.14	0.39	0.5	0.4	275.45	230.85	0.12	1.07
40.54	Q100	112.3	15.94	15	0.29	0.71	0.61	181.57	155.26	0.18	

APPENDIX D 100 YEAR ARI INUNDATION SKETCHES



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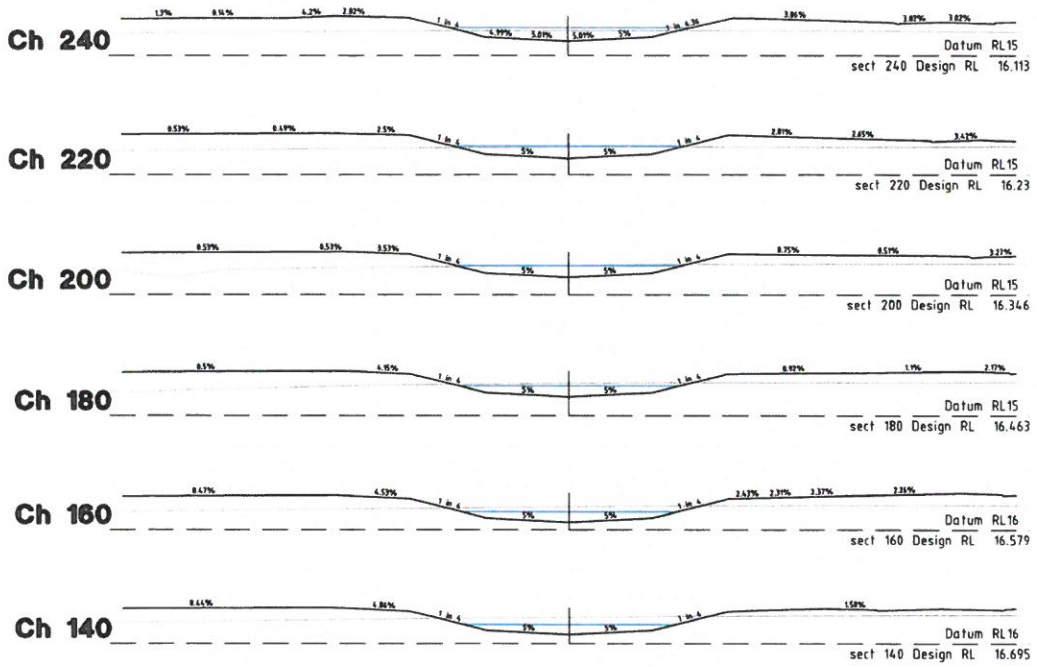
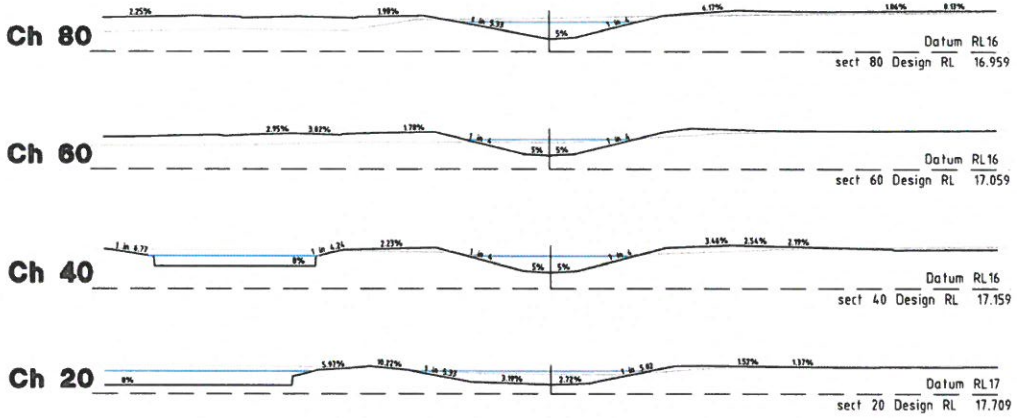


CHANNEL 1 - SECTION 2



CHANNEL 1 - SECTION 1

GRACEMERE SPRINGS 1
Q100 Inundation Channel
Cross Sections 1
R12166 - Inundation Cross Sections 1

0 1.0 4.0m 1:200 H
0 1.0 4.0m 1:200 V

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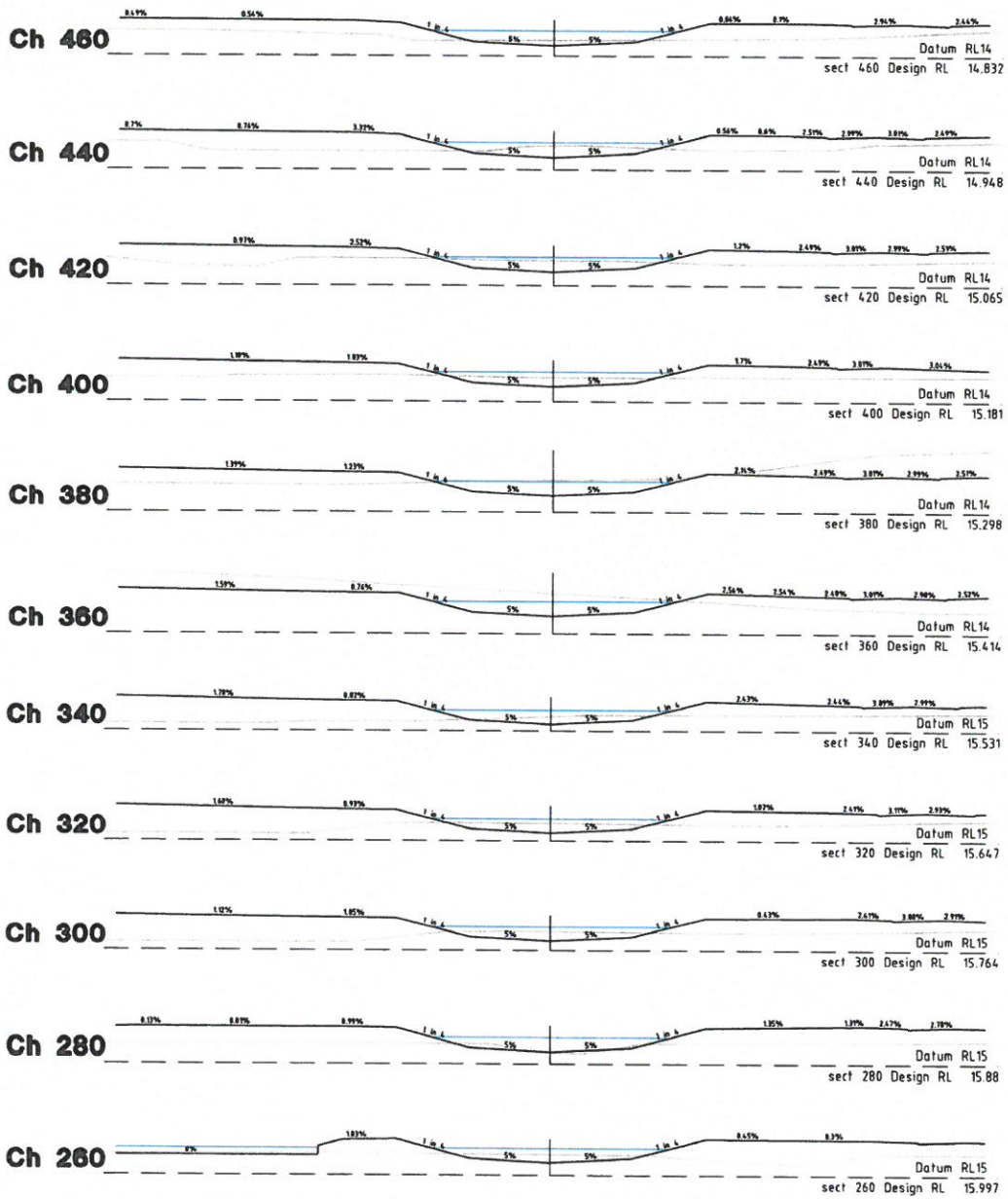

CHANNEL 1 - SECTION 2

GRACEMERE SPRINGS 1
Q100 Inundation Channel
Cross Sections 2
R12166 - Inundation Cross Sections 2

0 1.0 4.0m 1:200 H
0 1.0 4.0m 1:200 V

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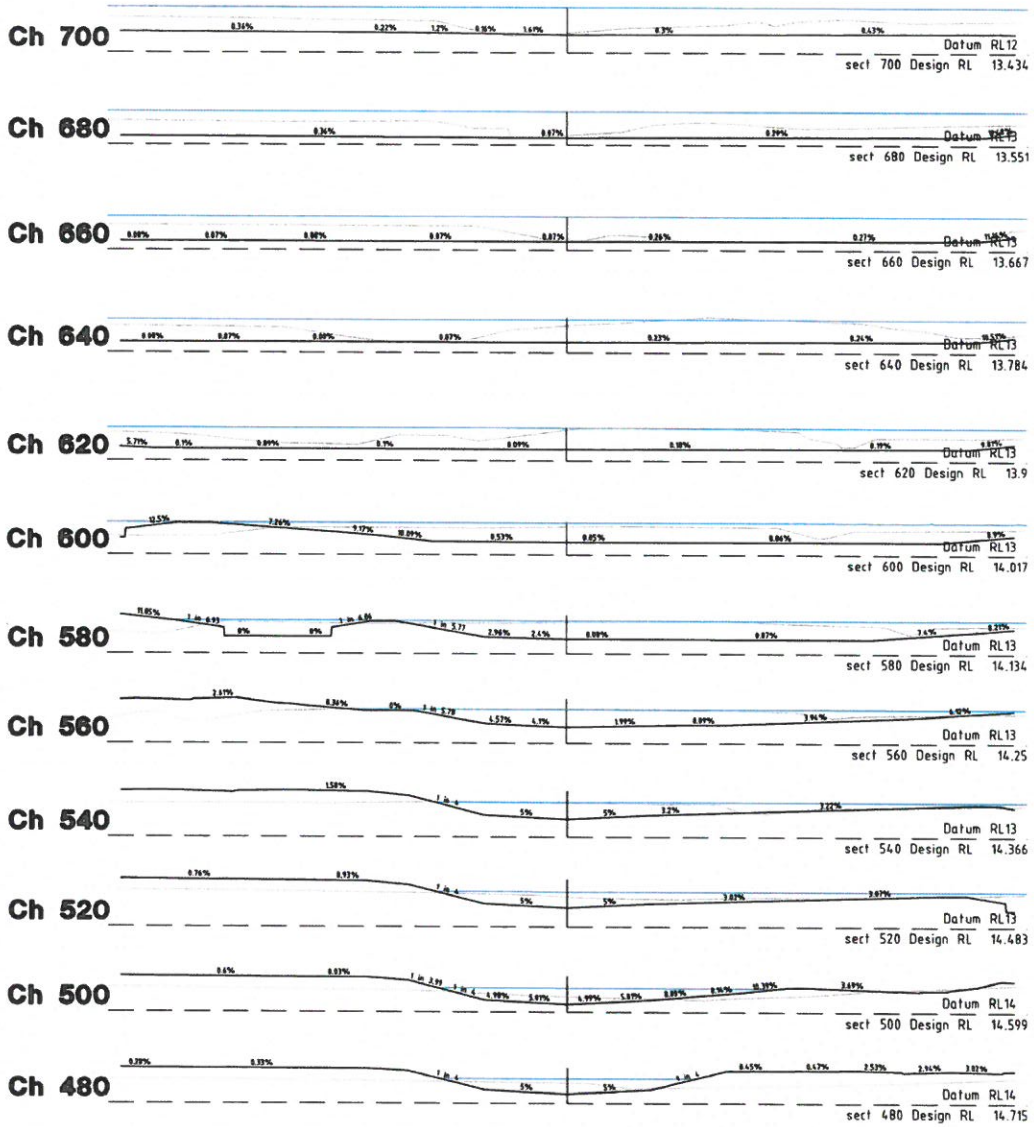

CHANNEL 1 - SECTION 2

GRACEMERE SPRINGS 1

Q100 Inundation Channel

Cross Sections 3

R12166 - Inundation Cross Sections 3

0 1.0 4.0m 1:200 H

0 1.0 4.0m 1:200 V

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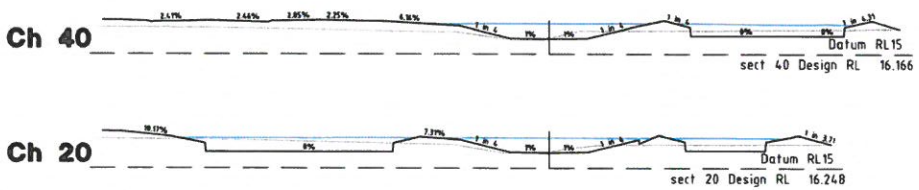

CHANNEL 2

GRACEMERE SPRINGS 1

Q100 Inundation Channel

Cross Sections 4

R12166 - Inundation Cross Sections 4

0 1.0 4.0m 1:200 H

0 1.0 4.0m 1:200 V

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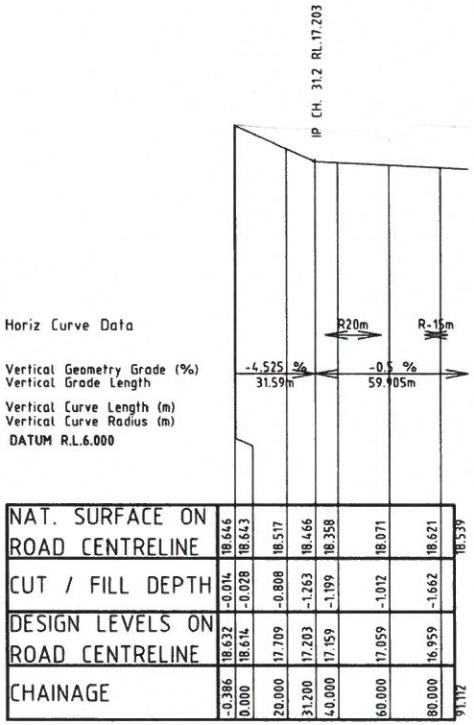

LONGITUDINAL SECTION CHANNEL 1 - SECTION 1

GRACEMERE SPRINGS 1
Q100 Inundation Channel
Longitudinal Sections 1
R12166 - Inundation Long Sections 1

0 10.0 40.0m 1: 2000 H
0 1.0 4.0m 1: 200 V

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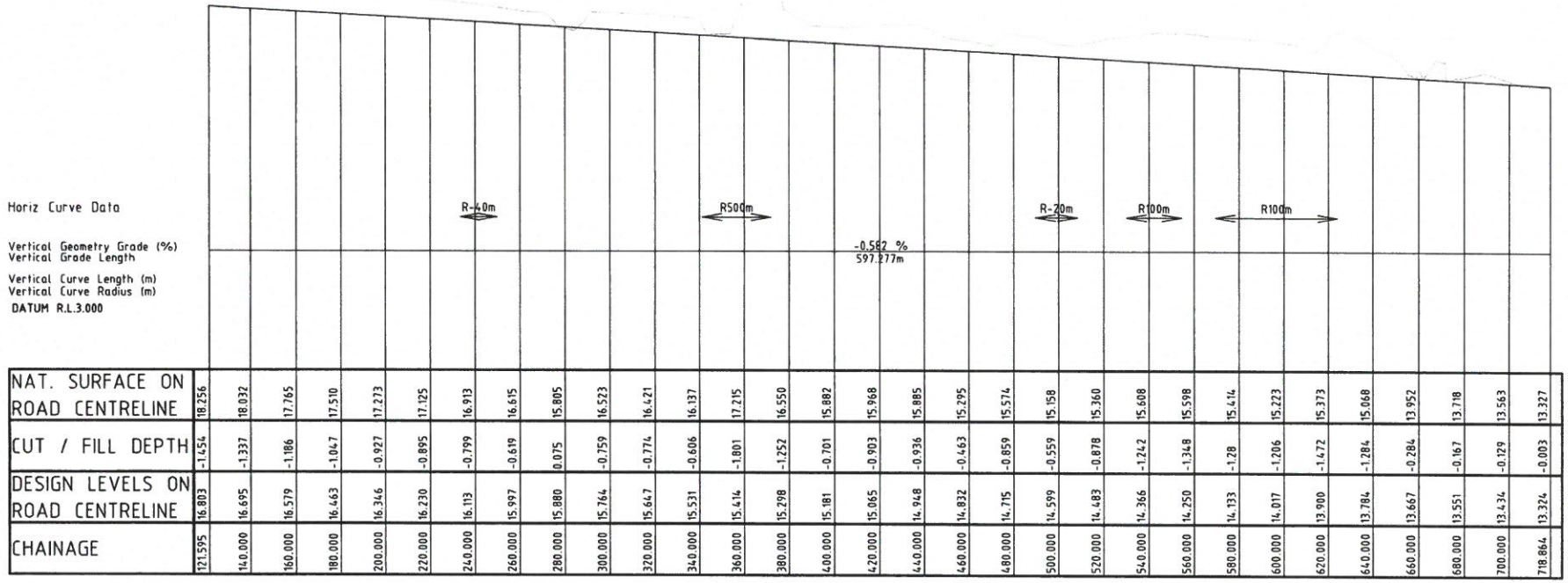

NAT. SURFACE ON ROAD CENTRELINE	18.256	18.032		17.765	17.510	17.273	17.125	16.913	16.615	15.805	16.523	16.421	16.137	17.215	16.550	15.882	15.968	15.885	15.295	15.574	15.158	15.360	15.608	15.598	15.414	15.223	15.373	15.068	13.952	13.718	13.563	13.327
CUT / FILL DEPTH	-1.454	-1.337		-1.186	-1.047	-0.927	-0.895	-0.799	-0.619	0.075	-0.759	-0.774	-0.606	-1.801	-1.252	-0.701	-0.903	-0.936	-0.463	-0.859	-0.559	-0.878	-1.242	-1.348	-1.28	-1.206	-1.472	-1.284	-0.284	-0.167	-0.129	-0.003
DESIGN LEVELS ON ROAD CENTRELINE	16.803	16.695		16.579	16.463	16.346	16.230	16.113	15.997	15.880	15.764	15.647	15.531	15.414	15.298	15.181	15.065	14.948	14.832	14.715	14.599	14.483	14.366	14.250	14.133	14.017	13.900	13.784	13.667	13.551	13.434	13.324
CHAINAGE	121.595	140.000	160.000	180.000	200.000	220.000	240.000	260.000	280.000	300.000	320.000	340.000	360.000	380.000	400.000	420.000	440.000	460.000	480.000	500.000	520.000	540.000	560.000	580.000	600.000	620.000	640.000	660.000	680.000	700.000	718.864		

LONGITUDINAL SECTION CHANNEL 1 - SECTION 2

GRACEMERE SPRINGS 1
Q100 Inundation Channel
Longitudinal Sections 2
R12166 - Inundation Long Sections 2

0 10.0 40.0m 1: 2000 H
0 1.0 4.0m 1: 200 V

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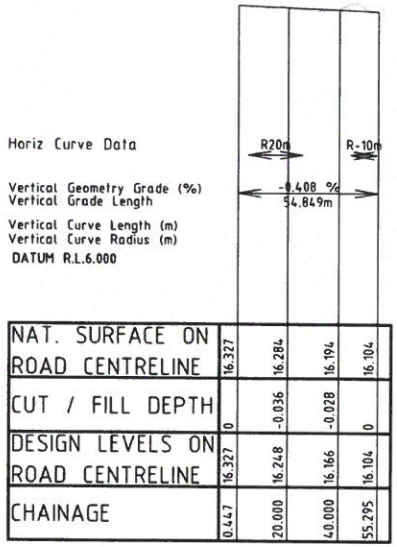

LONGITUDINAL SECTION CHANNEL 2

GRACEMERE SPRINGS 1
Q100 Inundation Channel
Longitudinal Sections 3
R12166 - Inundation Long Sections 3

0 10.0 40.0m 1: 2000 H
0 1.0 4.0m 1: 200 V

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ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with Development Permit No. D588-2012
Dated 05/04/2016

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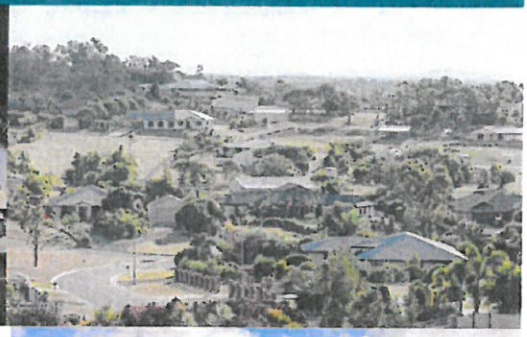

Stormwater Quality Management Report

Civil Engineering Consultancy Services

Gracemere Springs 1 & 2

Gracemere Springs Pty Ltd

Report No / Project No. R13018
Date: April 2013

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Document1

Issue	Date	Issue Details	Author	Checked	Approved
A	12-04-13	Report	LM	JD RPEQ 8386	

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APPENDICES

A Gracemere Springs 1 - Stormwater Quality Concept Plan

B Gracemere Springs 2 - Stormwater Quality Concept Plan

1. INTRODUCTION/BACKGROUND

This stormwater quality assessment has been prepared on behalf of Gracemere Springs Pty Ltd. The following report has been written to address the Gracemere Springs 1 Information Request at 70 Washpool Road, Gracemere in support of the Material Change of Use application D/588-2012 will supersede the previous Stormwater Quality Management Report. This report will also provide a stormwater quality strategy for the adjacent Gracemere Springs 2 development of 104 Washpool Rd, Gracemere, and will form part of the Reconfiguring a Lot submission to the Rockhampton Regional Council.

The intent of the Stormwater Quality Report is to demonstrate that the proposed stormwater quality management strategy will achieve the required annual load reduction percentages for this development in accordance with the Rockhampton Regional Council requirements.

GRACEMERE SPRINGS 1

2. WATER QUALITY ASSESSMENT

2.1. Site Specific Objects

Due to the site's proximity to Washpool Creek, it is important that the site presents no worsening in terms of water quality following development. As the development is residential in character, the water quality parameters of relevance to the site are suspended solids, nutrients (nitrogen and phosphorus), litter and faecal coliforms.

Of these parameters, the detailed modelling of litter and faecal coliforms is not possible at present, using the industry standard analysis package (MUSIC – refer below) due to the lack of information regarding export rates.

The modelling of defined water quality objectives has therefore necessarily focused on suspended solids and nutrients (nitrogen and phosphorus).

In the absence of Rockhampton Regional Council water quality objectives, load reduction targets stated in the "Urban Stormwater Quality Planning Guidelines 2010" were adopted and are stated below:

85% Reduction of Total Suspended Solids

70% Reduction in Total Phosphorus

45% Reduction in Total Nitrogen

90% Reduction in Gross Pollutants

These targets are measured against the pollutant load generated for the untreated developed scenario. Load reduction targets will be modelled as they more closely represent effects on Washpool Creek.

2.2. MUSIC Water Quality Analysis Methodology

In order to determine the effectiveness of different water quality treatment measures and meeting the water quality objectives, a stormwater quality analysis was performed using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Version 3.02.

The models consist of three types of nodes:

- Source nodes representing different land uses and defining size of sub catchments
- Treatment Node representing different types of water quality treatment measures
- Receiving nodes represent the outlet point for the catchment under consideration. Each model only has one receiving node

The model requires the user to specify meteorological data (rainfall and evaporation), soil properties and pollutant loads for each catchment. Suitable parameters for the MUSIC model were adopted in accordance with the recommendations of Mackay Regional City Council MUSIC Guidelines Version 1.1 2008 in the absence of Rockhampton Regional Council MUSIC Guidelines.

Climate data for the catchment was sourced from the Rockhampton rainfall data using the November 1989 to October 1998 rainfall events and the Rockhampton monthly Potential Evapo-transpiration (PET) with a 6-minute rainfall time step. The hydrologic routing option for the modelling was the "No Routing" option. This option generates more conservative results from the treatment measures as the runoff is modelled reaching the treatment measure all at the same time rather than allowing for travel and detention stages as the runoff progresses through the catchment.

A MUSIC model was created to determine the post development scenario with no WSUD and post development scenario with WSUD treatments. The source nodes for the post-development scenario were based upon the site master plan and have been shown in Tables 2.1 & 2.2. Ultimately; the receiving node for sites' catchments is Washpool Creek.

In accordance with Mackay Regional Council Water Quality Guidelines typical percentage impervious when splitting residential land uses recommends the following:

Table 2.1

Land Use Category	% Overall Catchment	% Impervious
Roof	35%	100%
Road Reserve	25%	70%
Remainder	40%	19%
Overall	100%	60%

Tables 2.2: Post Development Sub-Catchments

Catchment	Area (ha)	Public Use Land	Lots	% Impervious
WQ1	3.33	0.03	37	60
WQ2	0.539	0	8	60
WQ3	1.050	0.220	9	60
WQ4	1.022	0.041	10	60
WQ5	4.370	0.077	47	60
WQ6	4.71	0.105	5	60
WQ7	0.358	0.358	0	19
WQ8	0.269	0	1	60
WQ9	0.600	0	5	60
WQ10	0.405	0	4	60
WQ11	0.662	0	8	60
WQ12	0.740	0.740	0	19
WQ13	0.364	0.300	1	19
WQ14	2.300	1.508	11	60
WQ15	0.438	0	7	60
WQ16	0.839	0	4	60

Refer to the Water Sensitive Urban Design (WSUD) concept drawing in Appendix A for identification of sub catchment zones / areas for post development condition. The MUSIC model is based on a split catchment approach and will incorporate various treatment nodes. All the 16 sub-catchments ultimately discharge into Washpool Creek.

The Mackay Regional Councils' MUSIC Runoff Generation Parameters used for the modelling are detailed in Table 2.3.

Table 2.3: Runoff Generation Parameters

Parameter	Lowland
Field Capacity (mm)	100
Infiltration Capacity Coefficient a	200
Infiltration Capacity Exponent b	1
Rainfall Threshold (mm)	1
Soil Capacity (mm)	250
Initial Storage (%)	10
Daily Recharge Rate (%)	4
Daily Baseflow Rate (%)	2
Initial Depth (mm)	10
Daily Deep Seepage (%)	0.4

Table 2.4: Pollutant Export Relationships

Land Use for MUSIC Source Node (Residential)	Parameter	Total Suspended Solids (Log10 mg/L)		Total Phosphorus (Log10 mg/L)		Total Nitrogen (Log10 mg/L)	
		Base Flow	**Storm Flow**	**Base Flow**	**Storm Flow**	**Base Flow**	**Storm Flow**
Road	Mean	1.0	2.43	-0.97	-0.30	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23
Roof	Mean	-	1.30	-	-0.89	-	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23
Ground Level	Mean	1.0	2.18	-0.97	-0.47	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23

***Source: Mackay MUSIC Guidelines 1.1*

2.3. Proposed Treatment Train

It is proposed to use a combination of open swales, small buffer strips and Bio-Retention Basins to treat post development runoff from the site. The development can be separated into two main contributing catchments. For the purpose of this water quality analysis the site has been divided into 16 sub-catchments (refer Table 2.2) which ultimately all end up discharging to Washpool Creek.

The northern catchment comprises of two sub-catchments being WQ1 & WQ2. The combined area for these two catchments is approximately 3.874ha. The remaining 14 sub-catchments (WQ3-WQ16) form the southern portion of the development with a combined area of approximately 18.137ha. (See WSUD drawing Appendix A)

As part of the post development scenario the combined catchments WQ1 & WQ2 (northern catchments) will direct all stormwater flows into the vegetated swale drain (Swale 7A & 7B). This swale drain is to be located within the proposed drainage reserve to the north bounding the Washpool Road reserve. Stormwater flows will then be collected at the end of the swale drain by Bio-Retention Basin (1) and discharge to Washpool Creek.

The post development scenario for the remaining sub-catchments WQ3 to WQ16 (southern catchments) will direct all stormwater flows into a series Bio-Retention Basins (3-7) which are all located in the areas designated as public usable land (See WSUD drawing-Appendix A). All post development flows will discharge from these Bio-Retention basins (3-7) into a Main Channel (A, B, C & D) situated in the southern portion of the development and runs in a west to east direction and will ultimately discharge into Washpool Creek.

In order to meet the water quality objectives, the filtration area within these Bio-Retention Basins have been preliminarily sized to have minimum areas as represented in Table 2.5 below. These basins have all been sized to have a minimum 400mm depth layer of filtration material with an additional 100mm transition layer to prevent filtration media blocking the subsoil drains over time and a further 200mm drainage layer in which the subsoil drain is to be laid. Post development flows from Catchments WQ3; WQ4; WQ12 & WQ16 will have the added benefit of utilising grassed buffer strips to assist in the treatment of sheet flows from these catchments. It is anticipated that approximately 30-50% of the upstream catchments will sheet flow over these grassed areas.

The MUSIC model screen print showing drainage links and treatment devices is identified in the below image – Figure 1.

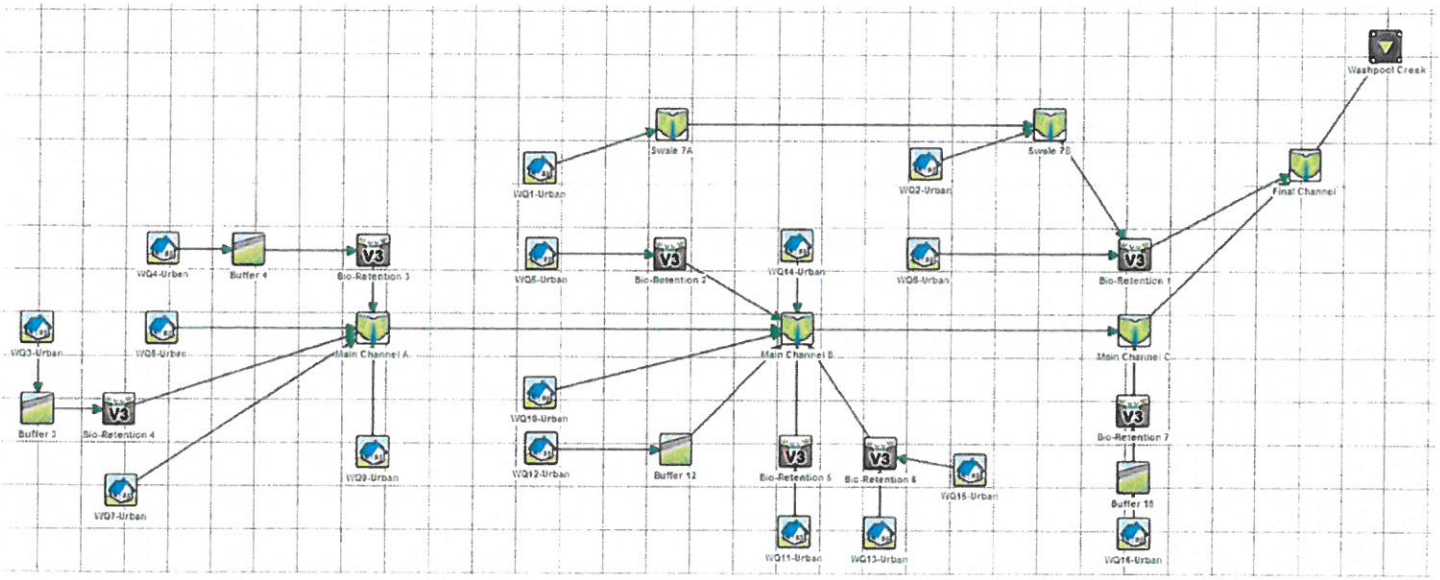


Figure. 1 – Treatment Train

Bio Retention Basins

Table 2.5: Bio-Retention Basin Properties

Basin	Contributing Catchments	Extended Detention Depth (m)	Infiltration Filter Area (m^2)	Filter Depth (m)
Basin 1	WQ1; WQ2; WQ6	0.500	1000	0.400
Basin 2	WQ5	0.500	600	0.400
Basin 3	WQ4	0.500	200	0.400
Basin 4	WQ3	0.500	600	0.400
Basin 5	WQ11	0.500	200	0.400
Basin 6	WQ13; WQ15	0.500	150	0.400
Basin 7	WQ16	0.500	150	0.400

Swale Drains

All stormwater flows contributing from the northern portion of the development (WQ1 & WQ2) are to discharge into a series of vegetated swale drains (Swale 7A & 7B) and convey flows to the east into Basin 1. These swales are to be situated on the northern boundary of the development within the road reserve of Washpool Road. Figure 2 below indentifies the typical swale propertied used for this analysis.

The main channel will convey all stormwater flows from both the upstream external catchments as well as the southern catchments of the development (WQ3-WQ16) and ultimately dicharge into Washpool Creek. For the purposes of this analysis this main channel has been seperated into 4 sections (Main Channel A, B, C & D). Figure 3 & 4 indentifies the properties used for this analysis

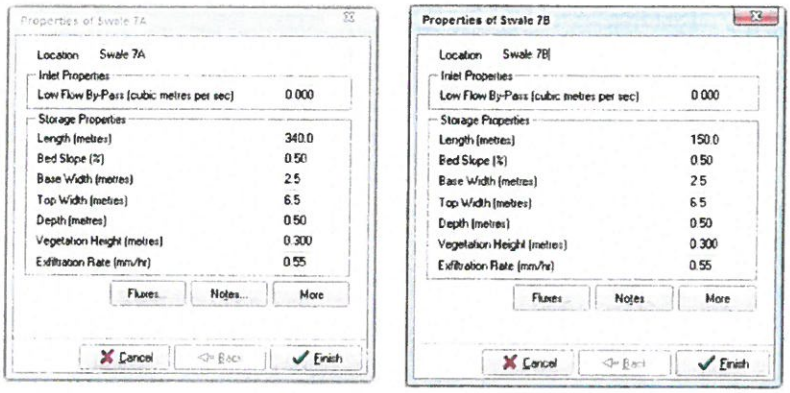


Figure 2 – Swale 7A; 2B

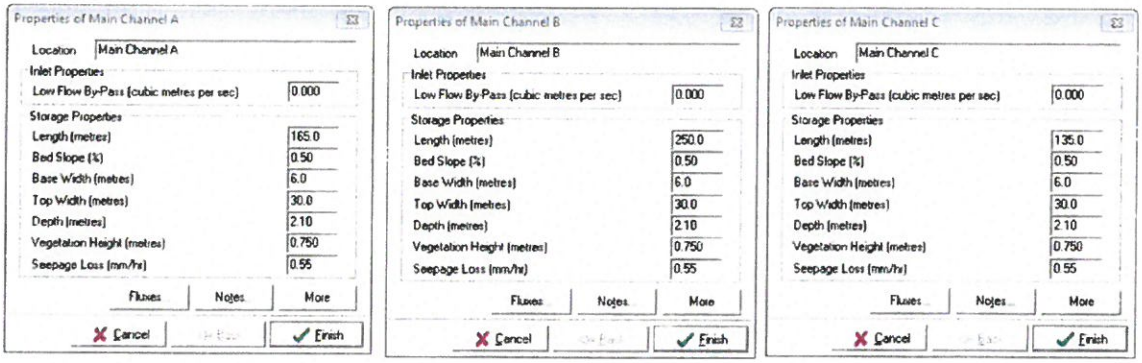


Figure 3 – Main Channel A; B & C

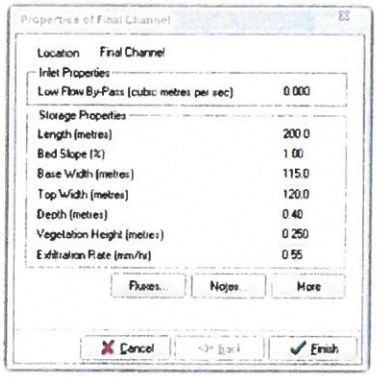


Figure 4 – Final Channel D

2.4. Quality Modelling Results

The properties of the treatment devices shown above are based on default values in MUSIC and some recommended values in the MUSIC guidelines.

Scenario 1 – Fully Developed site with and without Water Sensitive Urban Design Techniques.

The detailed results produced by the model for the development are presented in Table 2.6.

The treatment train modelling results for the modelled scenario with all catchments shows that the development with utilisation of Water Sensitive Urban Design techniques effectively reduces the pollutant loads to levels compliant with the annual pollutant load reductions stated earlier in the Site Specific Objectives.

Total Suspended Solids target reduction achieved ~94.7%

Total Phosphorus target reduction achieved ~75.31%

Total Nitrogen target reduction achieved ~45.4%

Gross Pollutants target reduction achieved ~100%

Table 2.6: MUSIC Water Quality Results – Total Annual Loads

Catchment WQ1 – WQ16 - Total Annual Load (kg/year)									
Flow ML/year		**Total Suspended Solids (TSS)**		**Total Phosphorus (TP)**		**Total Nitrogen (TN)**		**Gross Pollutants (GP)**	
Dev. No mitigation	WSUD	Dev. No mitigation	WSUD	Dev. No mitigation	WSUD	Dev. No mitigation	WSUD	Dev. No mitigation	WSUD
94.0	75.4	20,100	1060	39.7	9.81	195	107	2,530	0
Target Reduction		85% of Developed		70% of Developed		45% of Developed		90% of Developed	
Achieved Reduction		94.7% of Developed		75.3% of Developed		45.4% of Developed		100% of Developed	

2.5. Management Methodology

The following methodology will be followed through the construction and operational phase of the Bio-Retention Basins proposed as part of the development.

2.5.1. Construction Phase

Construction of the development and the following building works on site has the potential to mobilise large quantities of sediment in runoff. For Bio-Retention Basins to perform as designed there is a need to protect filter media and basin vegetation during this phase of the development. Therefore a Staged Construction and Establishment Method for construction of the Bio-Retention Basin will be followed. The stages for construction and establishment will be as follows:

1. Functional Installation – Initially Bio-Retention Basins can be used as Sediment Basins. Once the majority of site construction works have been completed earthworks and shaping to create the layout and functional elements of the basin will be undertaken. This includes the installation of inlets, outlet structures, subsoil drainage, transition layers and filter media. The filter media is to be covered with a protective geofabric which is top-soiled and turfed or grass seeded. Silt fences are to be erected around the outside of the basins to exclude silt and restrict access to the basins.
2. Building Construction – Protective erosion and sediment control measures are to remain in place as the basins are to function as temporary Sediment Basins for the duration of the Building Construction Phase. Access to the basins is to be restricted throughout building construction phase.
3. Operational Establishment - Following completion of the Building Construction Phase turf, topsoil and protective geofabric is removed and each basin re-planted with vegetation and landscaping as proposed. For vegetation to establish properly regular watering and removal of weeds is required following planting.

2.5.2. Operational Phase

Following construction activities regular inspections of the Bio-Retention Basin are required in order to ensure vegetation establishes and the properties of the filter media remain effective. Procedures to be adopted for the carrying out inspections and maintenance of the basin are presented in Table 2.7 on the following page.

Table 2.7: Bio-Retention Basin Inspection & Maintenance Requirements

Treatment Device / Property	Inspection	Inspection Frequency	Maintenance
Bio-Retention Basin			
Litter & Weeds	Visually check for litter, weeds and debris within the Bio-Retention Basin.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove litter, weeds and debris from basin and dispose of at approved waste disposal facility.
Inlet and Outlet	Visually check for blockages within the inlet and outlet pits and blocked weep holes within inlet pits.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove any blockages or debris within inlet pits or blockages to weep holes.
Sedimentation	Visually check surface of Bio-Retention Basin for accumulation of sediment.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove accumulated sediment where it is smothering vegetation.
Scour, Erosion and Vehicle Damage	Visually check Bio-Retention Basin surface for scouring and areas of erosion or vehicle damage.	Quarterly for first year then annually after establishment. Also after flood events.*	Repair damage to Bio-Retention Basin surface and filter media if exposed. Undertake replanting if necessary and maintain frequent watering of area until vegetation has established.
Vegetation	Visually check for any planted vegetation that has died.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove dead vegetation and replace with stock of equivalent size and species as detailed in plant schedule. Maintain frequent watering until new vegetation has established.
	Photograph Bio-Retention Basin from same location for yearly review.	Annually during summer months.	N/A
	Map propagation of Bio-Retention Basin vegetation for yearly review.	Annually during summer months.	N/A
Filter Media	Check surface of Bio-Retention Basin for any isolated "boggy" areas.	Annually.	Increase infiltration rate by tilling the surface of the filter media.
	Visually check and determine time of ponding within basin after a storm event.	Annually during wetter periods.	If duration of ponding exceeds 48 hours trail tilling of the surface of the filter media. If no improvement occurs then dispose and replace the top 100 to 150mm layer of filter media.
Subsoil Drainage	Check subsoil drainage for blockages.	Every 5 years during dry periods.	If blockage discovered remove by flushing subsoil drainage pipe. Collecting and dispose flushed material appropriately.

***Source: Water by design Maintaining Vegetated Stormwater Assets, February 2012.*

** Note that inspections are to take place monthly and following flood events for first six (6) months of operation. Flood Event defined as period of rainfall with intensity greater than 2 year Average Recurrence Interval (ARI).*

3. CONCLUSION

The proposed Water Quality strategy for the Gracemere Springs 1 development confirms that stormwater discharged from site can be managed in accordance with the current best industry practices and in accordance with State Planning Policy 4/10 – Healthy Waters to achieve the required annual load reduction percentages.

Should further information be required regarding the Stormwater Quality Report, please don't hesitate to contact BROWN Consulting Rockhampton Office on 07 4931 0777.

GRACEMERE SPRINGS 2

4. - WATER QUALITY ASSESSMENT

4.1. Site Specific Objects

Due to the site's proximity to Washpool Creek, it is important that the site presents no worsening in terms of water quality following development. As the development is residential in character, the water quality parameters of relevance to the site are suspended solids, nutrients (nitrogen and phosphorus), litter and faecal coliforms.

Of these parameters, the detailed modelling of litter and faecal coliforms is not possible at present, using the industry standard analysis package (MUSIC – refer below) due to the lack of information regarding export rates.

The modelling of defined water quality objectives has therefore necessarily focused on suspended solids and nutrients (nitrogen and phosphorus).

In the absence of Rockhampton Regional Council water quality objectives, load reduction targets stated in the "Urban Stormwater Quality Planning Guidelines 2010" were adopted and are stated below:

85% Reduction of Total Suspended Solids

70% Reduction in Total Phosphorus

45% Reduction in Total Nitrogen

90% Reduction in Gross Pollutants

These targets are measured against the pollutant load generated for the untreated developed scenario. Load reduction targets will be modelled as they more closely represent effects on Washpool Creek.

4.2. MUSIC Water Quality Analysis Methodology

In order to determine the effectiveness of different water quality treatment measures and meeting the water quality objectives, a stormwater quality analysis was performed using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) Version 5.1.

The models consist of three types of nodes:

- Source nodes representing different land uses and defining size of sub catchments
- Treatment Node representing different types of water quality treatment measures
- Receiving nodes represent the outlet point for the catchment under consideration. Each model only has one receiving node

The model requires the user to specify meteorological data (rainfall and evaporation), soil properties and pollutant loads for each catchment. Suitable parameters for the MUSIC model were adopted in accordance with the recommendations of Mackay Regional City Council MUSIC Guidelines Version 1.1 2008 in the absence of Rockhampton Regional Council MUSIC Guidelines.

Climate data for the catchment was sourced from the Rockhampton rainfall data using the November 1989 to October 1998 rainfall events and the Rockhampton monthly Potential Evapo-transpiration (PET) with a 6-minute rainfall time step. The hydrologic routing option for the modelling was the "No Routing" option. This option generates more conservative results from the treatment measures as the runoff is modelled reaching the treatment measure all at the same time rather than allowing for travel and detention stages as the runoff progresses through the catchment.

A MUSIC model was created to determine the post development scenario with no WSUD and post development scenario with WSUD treatments. The source nodes for the post-development scenario were based upon the site master plan and have been shown in Tables 4.1 & 4.2. Ultimately; the receiving node for sites' catchments is Washpool Creek.

In accordance with Mackay Regional Council Water Quality Guidelines typical percentage impervious when splitting residential land uses recommends the following:

Table 4.1

Land Use Category	% Overall Catchment	% Impervious
Roof	35%	100%
Road Reserve	25%	70%
Remainder	40%	19%
Overall	100%	60%

Tables 4.2: Post Development Sub-Catchments

Catchment	Area (ha)	Lots	% Impervious
WQA1	3.822	37	60
WQA2	1.652	17	60
WQB1	4.920	51	60
WQB2	1.602	17	60

Refer to the Water Sensitive Urban Design (WSUD) concept drawing in Appendix B for identification of sub catchment zones / areas for post development condition. The MUSIC model is based on a split catchment approach and will incorporate various treatment nodes. All 4 sub-catchments ultimately discharge into Washpool Creek.

The Mackay Regional Councils' MUSIC Runoff Generation Parameters used for the modelling are detailed in Table 4.3.

Table 4.3: Runoff Generation Parameters

Parameter	Lowland
Field Capacity (mm)	100
Infiltration Capacity Coefficient a	200
Infiltration Capacity Exponent b	1
Rainfall Threshold (mm)	1
Soil Capacity (mm)	250
Initial Storage (%)	10
Daily Recharge Rate (%)	4
Daily Baseflow Rate (%)	2
Initial Depth (mm)	10
Daily Deep Seepage (%)	0.4

Table 4.4: Pollutant Export Relationships

Land Use for MUSIC Source Node (Residential)	Parameter	Total Suspended Solids (Log10 mg/L)		Total Phosphorus (Log10 mg/L)		Total Nitrogen (Log10 mg/L)	
		Base Flow	**Storm Flow**	**Base Flow**	**Storm Flow**	**Base Flow**	**Storm Flow**
Road	Mean	1.0	2.43	-0.97	-0.30	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23
Roof	Mean	-	1.30	-	-0.89	-	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23
Ground Level	Mean	1.0	2.18	-0.97	-0.47	0.20	0.26
	Std Deviation	0.34	0.39	0.31	0.31	0.20	0.23

***Source: Mackay MUSIC Guidelines 1.1*

4.3. Proposed Treatment Train

It is proposed to use a combination of a large grassed channel area and Bio-Retention Basins to treat post development runoff from the site. The development can be separated into two main contributing catchments. For the purpose of this water quality analysis the site has been divided into 4 sub-catchments (refer Table 4.2) which ultimately all end up discharging to Washpool Creek.

The western catchment comprises of two sub-catchments being WQA1 & WQA2. The combined area for these two catchments is approximately 5.474ha. The remaining 2 sub-catchments (WQB1 & WQB2) form the eastern portion of the development with a combined area of approximately 6.522ha. (See WSUD drawing Appendix B)

As part of the post development scenario the combined catchments WQA1 & WQA2 (western catchments) will direct all flows via the stormwater network and discharge into Bio-Detention Basin (1). Which will then be treated and filter through to the Main Channel, where it will then ultimately discharge to Washpool Creek.

The post development scenario for the remaining sub-catchments WQB1 & WQB2 (eastern catchments) will piped via the stormwater network to Bio-Retention Basins (2) which will bypass the Main Channel and discharge directly into Washpool Creek.

In order to meet the water quality objectives, the filtration area within these Bio-Detention Basins have been preliminarily sized to have minimum areas as represented in Table 4.5 below. These basins have all been sized to have a minimum 400mm depth layer of filtration material with an additional 100mm transition layer to prevent filtration media blocking the subsoil drains over time and a further 200mm drainage layer in which the subsoil drain is to be laid.

The MUSIC model screen print showing drainage links and treatment devices is identified in the below image – Figure 1.

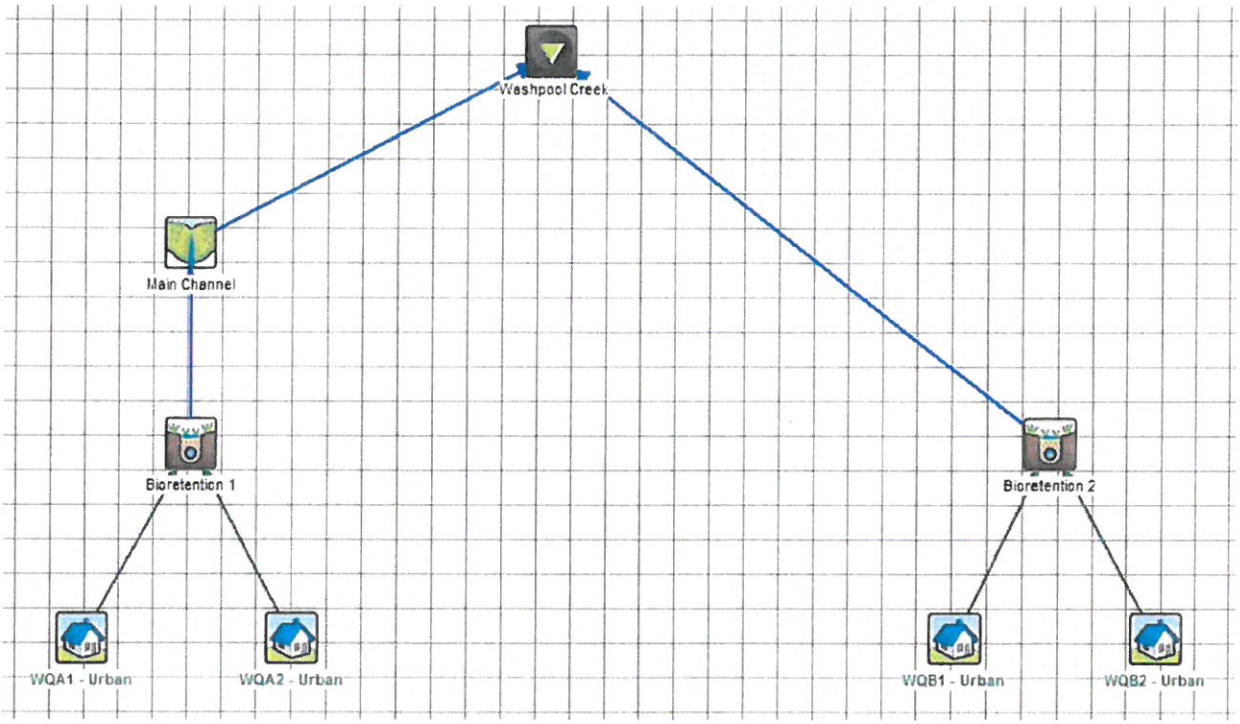
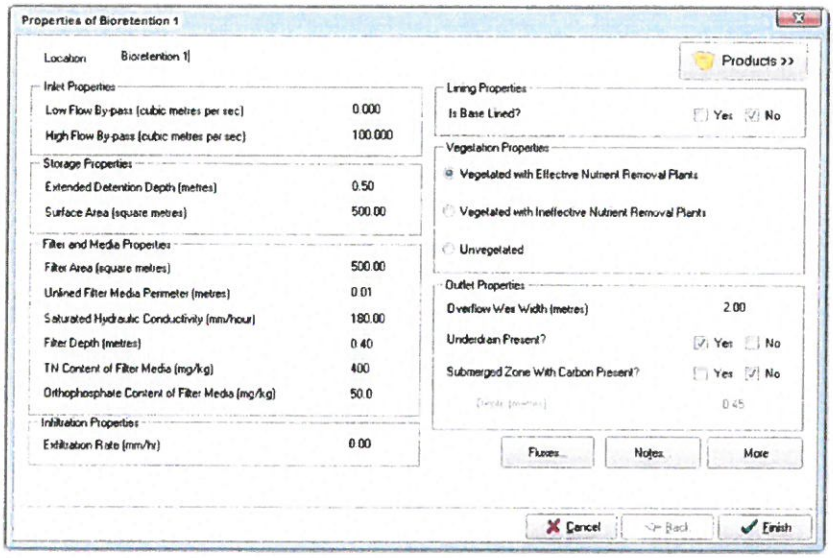


Figure. 1 – Treatment Train

Bio Retention Basins

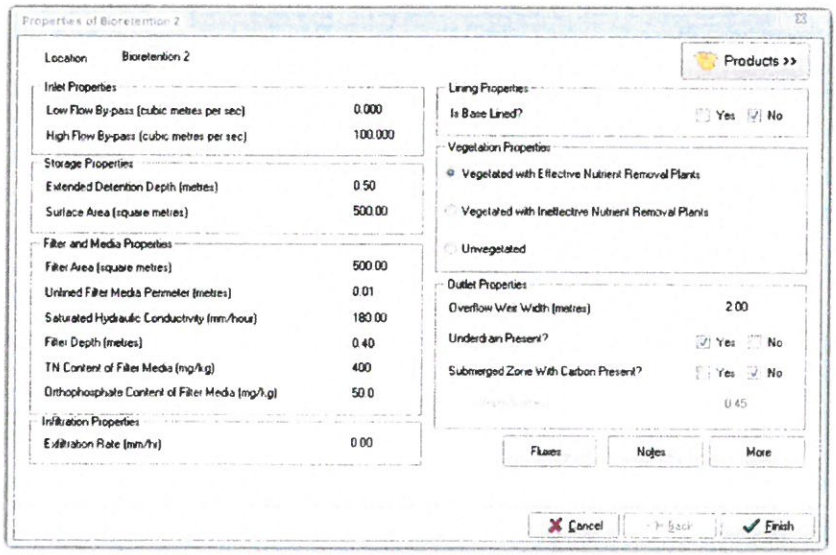
Table 4.5: Bio-Retention Basin Properties

Basin	Contributing Catchments	Extended Detention Depth (m)	Infiltration Filter Area (m^2)	Filter Depth (m)
Basin 1	WQA1; WQA2	0.500	500	0.400
Basin 2	WQB1; WQB2	0.500	500	0.400



**Parameters for TN & Orthophosphate Content set by Water by Design Interim Bio-Retention Treatment Node*

Figure 2 –Bio-Detention Basin 1



**Parameters for TN & Orthophosphate Content set by Water by Design Interim Bio-Retention Treatment Node*

Figure 3 –Bio-Detention Basin 2

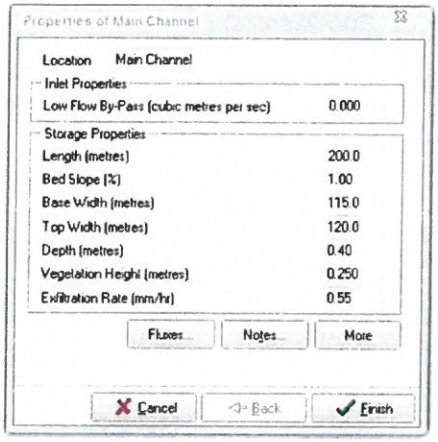


Figure 4 – Main Channel

4.4. Quality Modelling Results

The properties of the treatment devices shown above are based on default values in MUSIC and some recommended values in the MUSIC guidelines.

Scenario 1 – Fully Developed site with and without Water Sensitive Urban Design Techniques.

The detailed results produced by the model for the development are presented in Table 4.6.

The treatment train modelling results for the modelled scenario with all catchments shows that the development with utilisation of Water Sensitive Urban Design techniques effectively reduces the pollutant loads to levels compliant with the annual pollutant load reductions stated earlier in the Site Specific Objectives.

Total Suspended Solids target reduction achieved ~91.2%

Total Phosphorus target reduction achieved ~73.3%

Total Nitrogen target reduction achieved ~58.3%

Gross Pollutants target reduction achieved ~100%

Table 4.6: MUSIC Water Quality Results – Total Annual Loads

Catchment WQA – WQB - Total Annual Load (kg/year)									
Flow ML/year		**Total Suspended Solids (TSS)**		**Total Phosphorus (TP)**		**Total Nitrogen (TN)**		**Gross Pollutants (GP)**	
Dev. No mitigation	WSUD	Dev. No mitigation	WSUD	Dev. No mitigation	WSUD	Dev. No mitigation	WSUD	Dev. No mitigation	WSUD
109	89.0	21,400	1,880	43.5	11.6	223	93	2,470	0
Target Reduction		85% of Developed		70% of Developed		45% of Developed		90% of Developed	
Achieved Reduction		91.2% of Developed		73.3% of Developed		58.3% of Developed		100% of Developed	

4.5. Management Methodology

The following methodology will be followed through the construction and operational phase of the Bio-Retention Basins proposed as part of the development.

4.5.1. Construction Phase

Construction of the development and the following building works on site has the potential to mobilise large quantities of sediment in runoff. For Bio-Retention Basins to perform as designed there is a need to protect filter media and basin vegetation during this phase of the development. Therefore a Staged Construction and Establishment Method for construction of the Bio-Retention Basin will be followed. The stages for construction and establishment will be as follows:

4. Functional Installation – Initially Bio-Retention Basins can be used as Sediment Basins. Once the majority of site construction works have been completed earthworks and shaping to create the layout and functional elements of the basin will be undertaken. This includes the installation of inlets, outlet structures, subsoil drainage, transition layers and filter media. The filter media is to be covered with a protective geofabric which is top-soiled and turfed or grass seeded. Silt fences are to be erected around the outside of the basins to exclude silt and restrict access to the basins.
5. Building Construction – Protective erosion and sediment control measures are to remain in place as the basins are to function as temporary Sediment Basins for the duration of the Building Construction Phase. Access to the basins is to be restricted throughout building construction phase.
6. Operational Establishment - Following completion of the Building Construction Phase turf, topsoil and protective geofabric is removed and each basin re-planted with vegetation and landscaping as proposed. For vegetation to establish properly regular watering and removal of weeds is required following planting.

4.5.2. Operational Phase

Following construction activities regular inspections of the Bio-Retention Basin are required in order to ensure vegetation establishes and the properties of the filter media remain effective. Procedures to be adopted for the carrying out inspections and maintenance of the basin are presented in Table 4.7 on the following page.

Table 4.7: Bio-Retention Basin Inspection & Maintenance Requirements

Treatment Device / Property	Inspection	Inspection Frequency	Maintenance
Bio-Retention Basin			
Litter & Weeds	Visually check for litter, weeds and debris within the Bio-Retention Basin.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove litter, weeds and debris from basin and dispose of at approved waste disposal facility.
Inlet and Outlet	Visually check for blockages within the inlet and outlet pits and blocked weep holes within inlet pits.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove any blockages or debris within inlet pits or blockages to weep holes.
Sedimentation	Visually check surface of Bio-Retention Basin for accumulation of sediment.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove accumulated sediment where it is smothering vegetation.
Scour, Erosion and Vehicle Damage	Visually check Bio-Retention Basin surface for scouring and areas of erosion or vehicle damage.	Quarterly for first year then annually after establishment. Also after flood events.*	Repair damage to Bio-Retention Basin surface and filter media if exposed. Undertake replanting if necessary and maintain frequent watering of area until vegetation has established.
Vegetation	Visually check for any planted vegetation that has died.	Quarterly for first year then annually after establishment. Also after flood events.*	Remove dead vegetation and replace with stock of equivalent size and species as detailed in plant schedule. Maintain frequent watering until new vegetation has established.
	Photograph Bio-Retention Basin from same location for yearly review.	Annually during summer months.	N/A
	Map propagation of Bio-Retention Basin vegetation for yearly review.	Annually during summer months.	N/A
Filter Media	Check surface of Bio-Retention Basin for any isolated "boggy" areas.	Annually.	Increase infiltration rate by tilling the surface of the filter media.
	Visually check and determine time of ponding within basin after a storm event.	Annually during wetter periods.	If duration of ponding exceeds 48 hours trail tilling of the surface of the filter media. If no improvement occurs then dispose and replace the top 100 to 150mm layer of filter media.
Subsoil Drainage	Check subsoil drainage for blockages.	Every 5 years during dry periods.	If blockage discovered remove by flushing subsoil drainage pipe. Collecting and dispose flushed material appropriately.

***Source: Water by design Maintaining Vegetated Stormwater Assets, February 2012.*

** Note that inspections are to take place monthly and following flood events for first six (6) months of operation. Flood Event defined as period of rainfall with intensity greater than 2 year Average Recurrence Interval (ARI).*

5. CONCLUSION

The proposed Water Quality strategy for the Gracemere Springs 2 development confirms that stormwater discharged from site can be managed in accordance with the current best industry practices and in accordance with State Planning Policy 4/10 – Healthy Waters to achieve the required annual load reduction percentages.

Should further information be required regarding the Stormwater Quality Report, please don't hesitate to contact BROWN Consulting Rockhampton Office on 07 4931 0777.

APPENDIX A –

BASIN	CATCHMENT	EXTENDED DETENTION DEPTH (m)	INFILTRATION FILTER AREA (m²)	FILTER DEPTH (m)
1	WQ1;WQ2;WQ6	0.500	1000	0.400
2	WQ5	0.500	600	0.400
3	WQ4	0.500	200	0.400
4	WQ3	0.500	600	0.400
5	WQ11	0.500	200	0.400
6	WQ13;WQ15	0.500	150	0.400
7	WQ16	0.500	150	0.400

CATCHMENT	AREA (ha)	% IMPERVIOUS
WQ1	3.33	60
WQ2	0.539	60
WQ3	1.050	60
WQ4	1.022	60
WQ5	4.370	60
WQ6	4.71	60
WQ7	0.358	19
WQ8	0.269	60
WQ9	0.600	60
WQ10	0.406	60
WQ11	0.662	60
WQ12	0.740	19
WQ13	0.364	19
WQ14	2.300	60
WQ15	0.438	60
WQ16	0.413	60

NOTE: For typical sections of stormwater channel/swales, refer stormwater typical sections plan.

LEGEND

- Proposed Water Quality Catchments
- Proposed Stormwater Main Channel A
- Proposed Stormwater Main Channel B
- Proposed Stormwater Main Channel C
- Proposed Stormwater Main Channel D
- Proposed Stormwater Detention Basins
- Proposed Swale Drains
- Proposed Direction of Fall
- Proposed Contours
- Existing Contours

Gracemere Springs 1

Stormwater Management Plan
Water Quality
R12166 - Stormwater Quality

0 10.0 40.0m 1:2000 (A1)
0 20.0 80.0m 1:4000 (A3)

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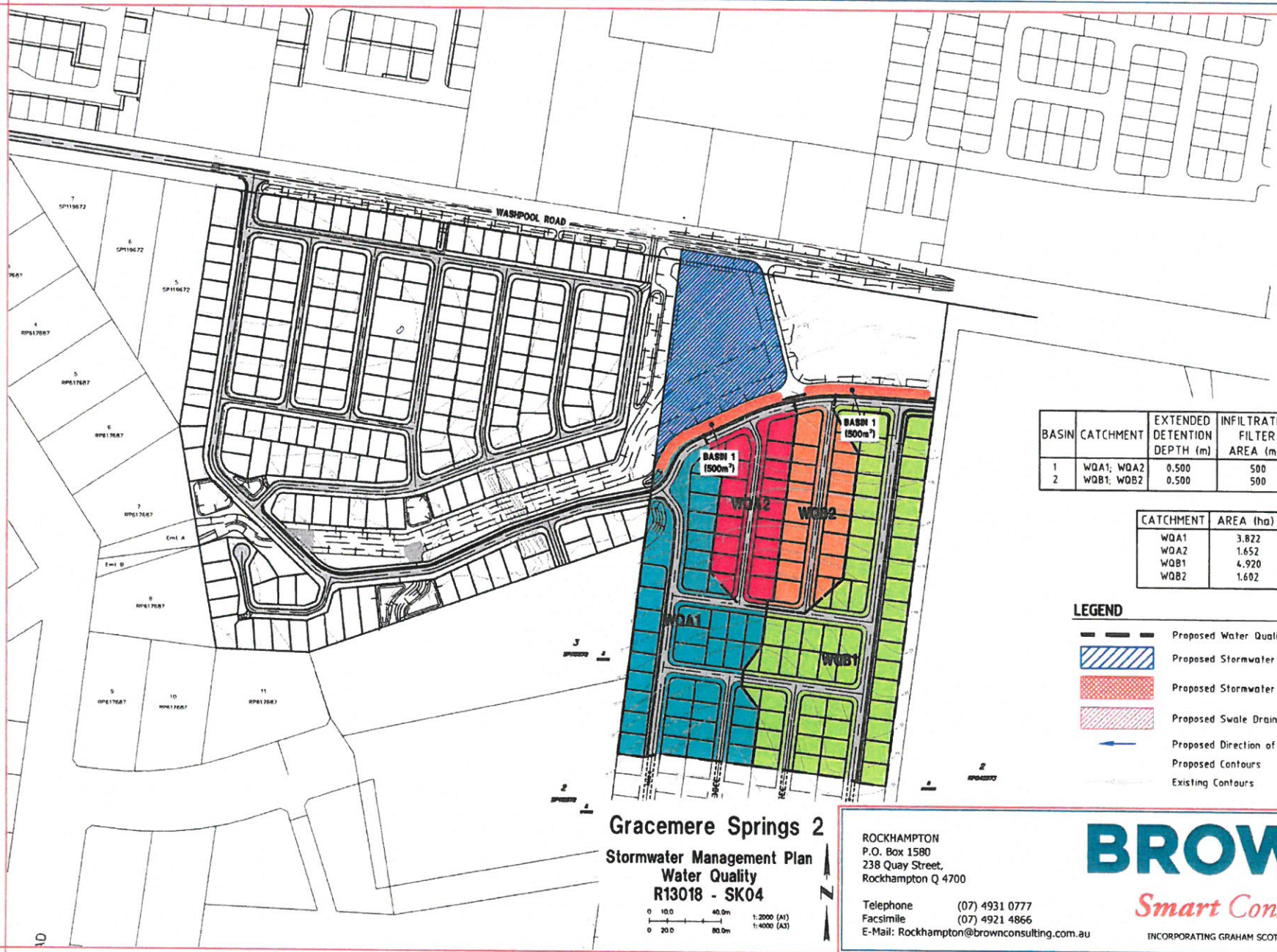
APPENDIX B -



BASIN	CATCHMENT	EXTENDED DETENTION DEPTH (m)	INFILTRATION FILTER AREA (m²)	FILTER DEPTH (m)
1	WQA1; WQA2	0.500	500	0.400
2	WQB1; WQB2	0.500	500	0.400

CATCHMENT	AREA (ha)	% IMPERVIOUS
WQA1	3.822	60
WQA2	1.652	60
WQB1	4.920	60
WQB2	1.602	60

LEGEND

- Proposed Water Quality Catchments
- Proposed Stormwater Main Channel
- Proposed Stormwater Detention Basins
- Proposed Swale Drains
- Proposed Direction of Fall
- Proposed Contours
- Existing Contours

Gracemere Springs 2

Stormwater Management Plan
Water Quality
R13018 - SK04

N

0 10.0 40.0m
0 20.0 80.0m
1:2000 (A1)
1:4000 (A3)

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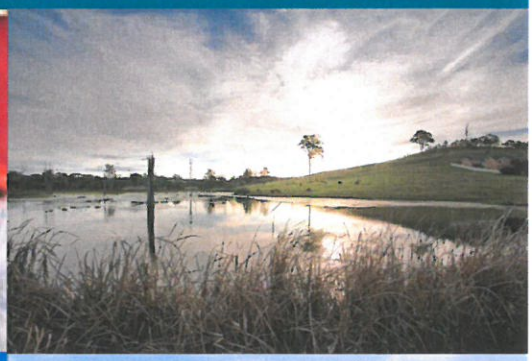

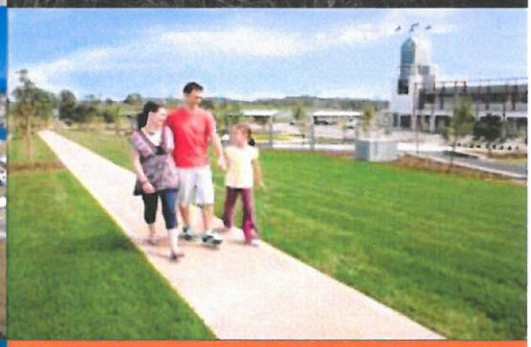

Traffic Impact Assessment

Civil Engineering Consultancy Services

Gracemere Springs 1 & 2

Prepared for Gracemere Springs 1 Pty Ltd

Gracemere Springs 2 Pty Ltd

ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with Development Permit No. D588-2012
Dated 05/04/2016

July 2013
Report No / Project No. R12166 & R13018

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2013

DOCUMENT CONTROL

R13018 - Network Traffic Impact Assessment Report - June 2013

Issue	Date	Issue Details	Author	Checked	Approved
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A Intersection Count Data

B SIDRA Output

C Transport Network Infrastructure Map

D Gracemere Springs 2 Traffic Catchment Plan

1. INTRODUCTION

This report has been prepared for Gracemere Springs 1 & 2 Pty Ltd to present findings and respond to the two Rockhampton Regional Council (RRC) Information Requests both dated 31 May 2013. These requests have been issued following the earlier submission to RRC of an initial Traffic Impact Assessment in April 2013. The original traffic impact assessment focused on potential impacts upon the Ranger Street / Lawrie Street Intersection of the proposed Gracemere Springs 1 (198 Lots) and Gracemere Springs 2 (122 Lots) subdivision located off Washpool Road, Gracemere.

Amongst other Roadworks and Transport Planning information request sections, this report will primarily focus on Section 5.1 on the Gracemere Springs 1 and Section 4.1 on the Gracemere Springs 2 Information Requests. These sections include the analysis of:

- Impact of Road A of Gracemere Springs 1
- Impact on intersection of Washpool Road / Cherryfield Road
- Impact on Cherryfield Road
- Impact on Intersection of Cherryfield Road / Johnson Road
- Impact on Intersection of Lucas Street / Johnson Road
- Impact on Intersection of Middle Road / Johnson Road
- Impact on Intersection of Breakspear Street / Johnson Road

2. BACKGROUND

2.1. Intersection Locations

The intersections noted by the Rockhampton Regional Council are situated along the accepted course of travel from the proposed developments into Gracemere's Town Centre or on to Rockhampton City. During the AM peak hour, the primary route from the proposed development will include travelling west down along Washpool Road, where at the intersection with Cherryfield Road, motorists will make a right turn movement up towards Johnson Road. Once on Johnson Road, traffic will travel north towards Ranger Street which connects onto Lawrie Street. The intersections identified, as shown in Figure 2, are located along this route and have the potential to be effected by development traffic.

2.2. Points of Interests

Points of interest which have the potential to skew traffic data include Waraburra State School being located from south of the Breakspear Street intersection on Johnson Road up to and down Middle Road, as shown in Figure 1. The effects of this school result in some traffic not proceeding to the Ranger Street / Lawrie Street Intersetion, with the school being the final destination for many motorists. In Addition, the two intersections closest to the school (Breakspear Street & Middle Road) will be subjected to 40km/h school zones.

Figure 1: Aerial image of Breakspear Street and Middle Road Intersections showing school location.

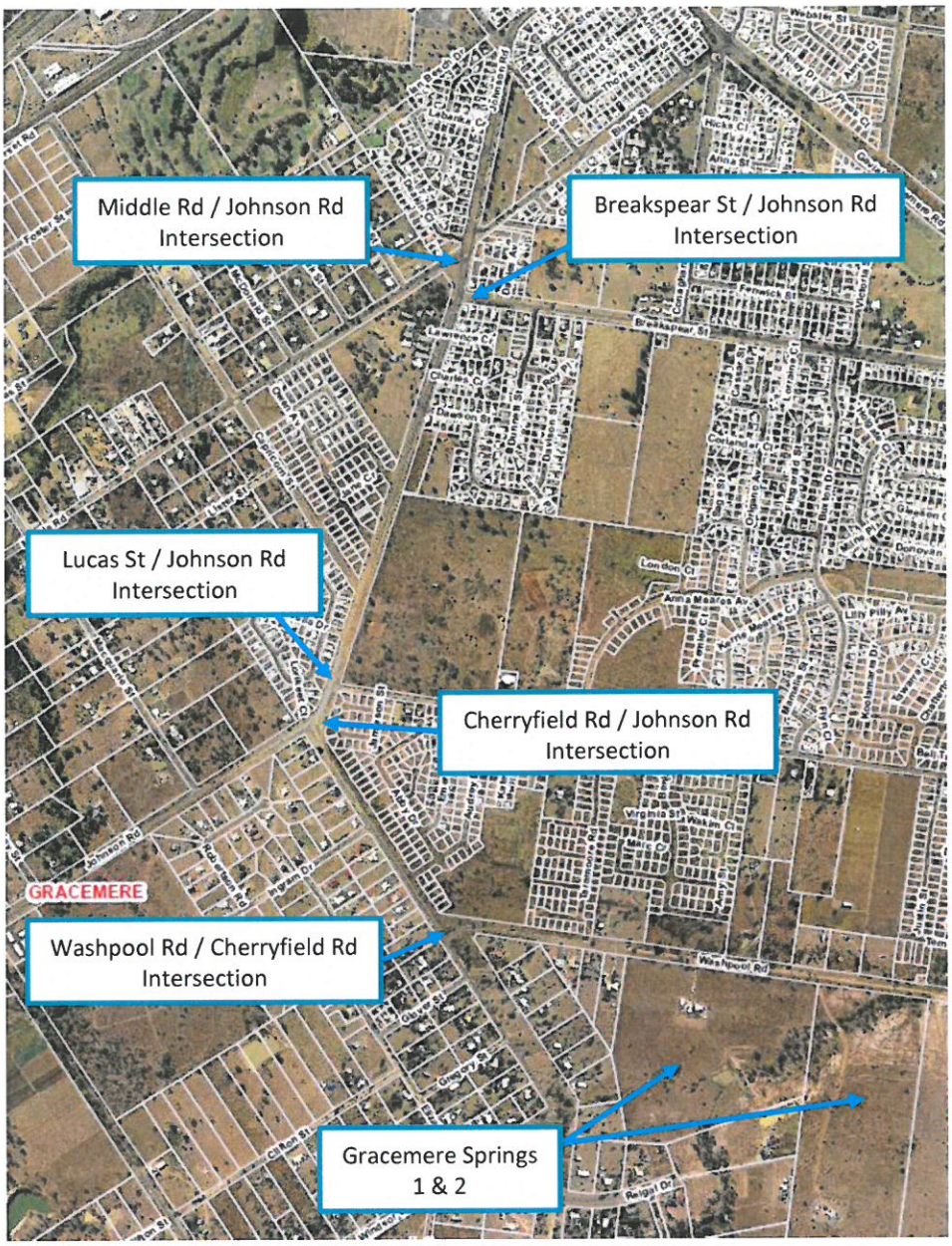


Figure 2: Intersection Locations (GIS Imagery courtesy of RRC).

3. TRAFFIC GENERATION AND DISTRIBUTION

3.1. Existing Traffic Generation

Existing traffic generation has incorporated intersection count data supplied by Rockhampton Regional Council, all of which were conducted in 2011, see Appendix A. A growth rate of 3% (compounding yearly) has been adopted in the calculation of present day 2013 and future 2025 traffic volume data (pre-development).

3.2. Development Traffic Generation

Traffic generation from the proposed developments (Gracemere Springs 1 & 2) have been calculated through the adoption of 0.85 vehicle movements during peak hour per dwelling and a daily traffic generation of 9.0 trips per dwelling, as recommended by the RTA Guide to Traffic Generating Developments. A breakdown of this generation can be found below in Table 1.

Table 1: Proposed Development Traffic Generation

Development	Allotments	Peak Hour Movements	Daily Movements
Gracemere Springs 1	198	169	1782
Gracemere Springs 2	120	102	1080
TOTAL	**318**	**271**	**2862**

3.3. Traffic Distributions

In order to effectively assess the most likely traffic distribution scenario, several traffic splits and distributions have been created.

3.3.1. Destination Splits

As mentioned previously, the route along Cherryfield Road and Johnson Road includes several points of interest which may have an impact upon the destination of the traffic. In order to accommodate these destinations into the traffic data for the intersection analysis, directional splits have been incorporated into each intersection.

AM Peak Destination Splits include:

- **Washpool Road / Cherryfield Road Intersection** – 95% of traffic makes a right turn and travels north west up Cherryfield Road, 5% turn left and travel south.
- **Cherryfield Road / Johnson Road Intersection** – Of the 95% development traffic which travelled north west from Washpool Road, it is assumed that 95% of this traffic turns right travelling north up Johnson Road and 95% will turn left down Johnson Road, travelling towards Kabra.

- **Lucas Street / Johnson Road Intersection** – Of the 95% development traffic that turned right up Johnson Road, it is assumed that the entirety of development traffic which enters this intersection travels through and north up Johnson Road.

- **Breakspear Street / Johnson Road Intersection** – As this intersection is closely situated to the nearby Waraburra State School, it has been assumed that 5% of development traffic traveling to this intersection will turn right down Breakspear Street with the remaining 95% travelling through the intersection.

- **Middle Road / Johnson Road Intersection** – As with Breakspear Street Intersection, 95% of development traffic entering the intersection is assumed to travel through the in intersection and continue onto the Gracemere Town Centre or Rockhampton City. It has been assumed 5% of traffic will divert from Johnson Road down Middle Road.

These destination splits are reversed throughout the PM peak hour.

3.3.2. In/Out Direction Split

An In/Out directional split of 70% exiting and 30% entering the development has been assumed for AM Peak traffic generation. This split in reversed throughout the PM Peak Period and represented in the below table.

Direction	AM	PM
IN	30%	70%
OUT	70%	30%
TOTAL	**100%**	**100%**

4. INFORMATION REQUEST RESPONSE

The following intersections have been analysed to assess the impacts upon the existing road infrastructure network by the introduction of traffic generated through the proposed developments. In addition, impacts upon Cherryfield Road and Road A of Gracemere Springs 1 has been requested.

The impact upon all intersections have been analysed using SIDRA Traffic Engineering Software Version 5.1. In addition, turn warrant treatments have been assessed in accordance with Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections.

4.1. Washpool Road / Cherryfield Road Intersection

4.1.1. Existing Intersection

The existing intersection of Washpool Road and Cherryfield Road, as shown below, consists of a standard Giveway T-Intersection where Washpool Road (minor leg) connects onto Cherryfield Road (80 km/h speed zone).

Figure 3: Intersection layout of Washpool Road and Cherryfield Road.

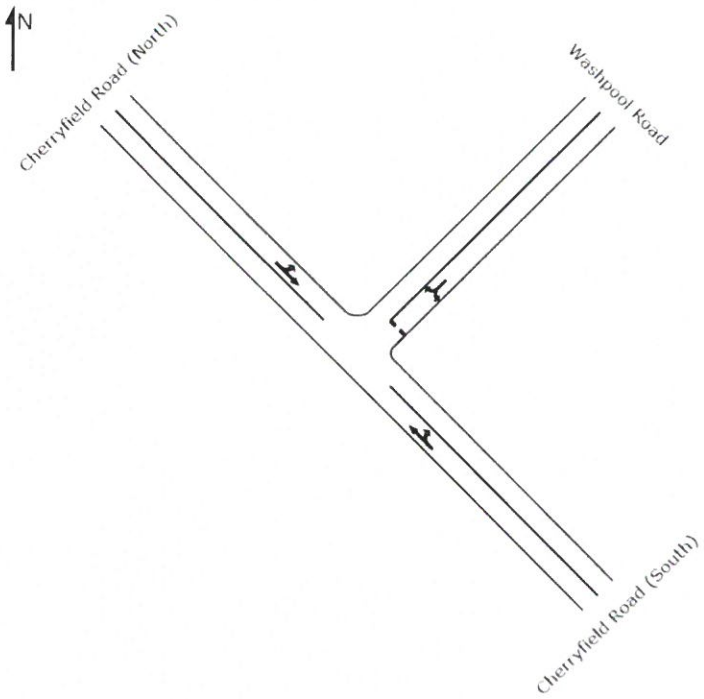


Figure 4: SIDRA representation of the existing Washpool Road / Cherryfield Road Intersection.

4.1.2. Traffic Volumes

The below traffic volumes have been utilised within the intersection analysis and SIDRA software. Traffic volumes presented below have been approximated through several means. The 2011 traffic was initially based upon the intersection count conducted at Cherryfield Road / Johnson Road (approximately 700m from Washpool Road). This existing 2011 traffic was assumed to travel down Cherryfield Road and through the intersection (no left or right into Washpool Road). Traffic volumes on the Washpool Road Leg were based on the 14 allotments which contained dwellings which feed onto Washpool Road. These dwellings were assumed to create 0.85 traffic movements during peak hour before being subjected to destination and directional splits, as described in Section 3.3. The resulting 2011 base traffic volumes were then grown 3% per year (compounding) to establish current day and 2025 future traffic counts. Post-development traffic counts incorporated 2025 pre-development traffic volumes calculated with traffic generated by the development shown in Section 3.3.3.

Table 2: Traffic volumes utilised for intersection assessment.

Cherryfield Rd & Washpool Rd Intersection		Leg 1				Leg 2				Leg 3			
		Cherryfield Road(To Town Centre)				Washpool Road				Cherryfield Road (South)			
		Left		Thru		Left		Right		Thru		Right	
		LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV
AM	2011	1	0	25	2	1	0	8	0	92	8	1	0
	2013	1	0	27	2	1	0	8	0	98	8	1	0
	2025 Pre-Development	2	0	38	3	2	0	12	0	139	12	2	0
	Additional From Development	78	0	0	0	10	0	181	0	0	0	4	0
	2025 Post-Development	79	0	38	3	11	0	193	0	139	12	6	0
PM	2011	8	0	92	8	1	0	1	0	25	2	1	0
	2013	8	0	98	8	1	0	1	0	27	2	1	0
	2025 Pre-Development	12	0	139	12	2	0	2	0	38	3	2	0
	Additional From Development	181	0	0	0	4	0	78	0	0	0	10	0
	2025 Post-Development	193	0	139	12	6	0	79	0	38	3	11	0

4.1.3. SIDRA Output

Standard SIDRA intersection analysis is commonly utilised to evaluate an intersections degree of saturation, Level of Service (LOS), queues and average delays. Under a standard sign controlled intersection, the desired ultimate practical degree of saturation is 0.8 with a minimum level of service of D.

A SIDRA intersection analysis has been conducted under four alternative scenarios for each intersection in the year 2025. They include AM Pre-Development, AM Post-Development, PM Pre-Development and PM Post-Development. The intersection analysis results are summarised below with full lane summaries published in Appendix B.

Scenario	Degree of Saturation	Min. Level of Service	Average Delay (sec)
2025 AM Pre-Development	0.088	B	3.1
2025 AM Post-Development	0.341	B	7.6
2025 PM Pre-Development	0.093	B	1.2
2025 PM Post-Development	0.195	B	7.0

From the above parameters, it is apparent that the existing intersection can sustain both background traffic growth and the proposed development traffic without triggering any requirements for the intersection to be upgraded.

4.1.4. Turn Warrants

Turn warrant checks have been performed to determine the adequacy of the existing/need for future upgrade of the turn warrants for this intersection. The checks accounted for AM/PM traffic peaks, and compared results between 2025 pre and post development traffic volumes. There is currently no existing turning infrastructure at this intersection.

AM Turn Warrants		PM Turn Warrants	
2025 Pre-Development	2025 Post-Development	2025 Pre-Development	2025 Post-Development
QR= 2	QR= 6	QR= 2	QR= 11
QM= 194	QM= 271	QM= 204	QM= 385
QL= 2	QL= 79	QL= 12	QL= 193
QM= 41	QM= 41	QM= 151	QM= 151

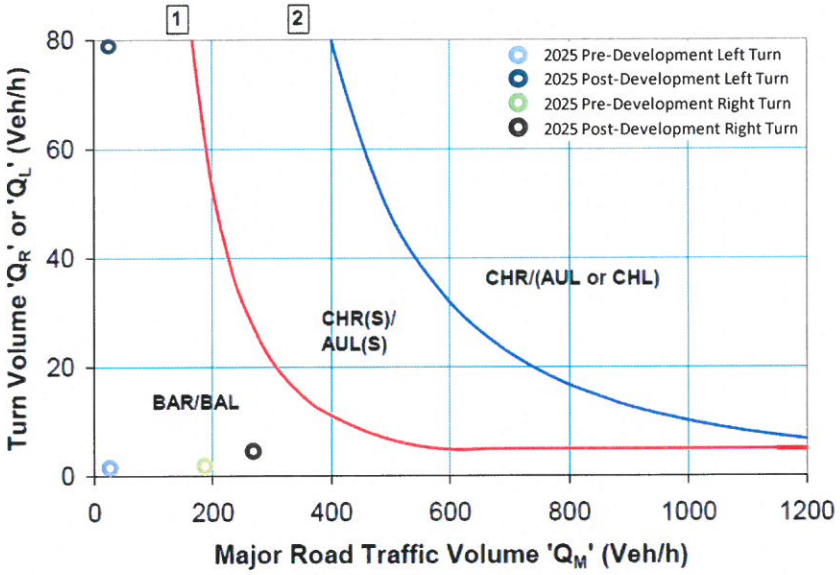


Figure 5: AM Turn Warrants for Washpool Road / Cherryfield Road Intersection.

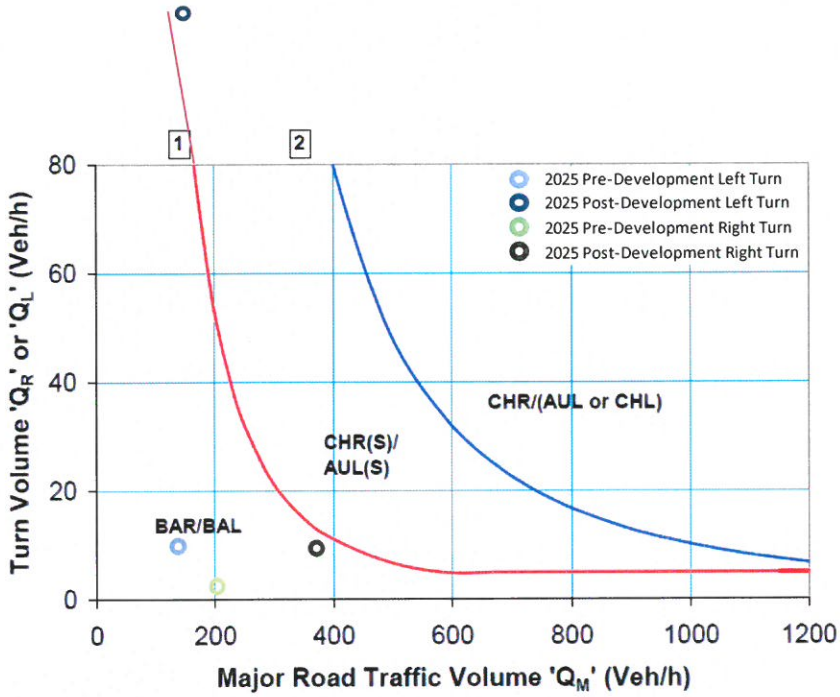


Figure 6: PM Turn Warrants for Washpool Road / Cherryfield Road Intersection.

Results from the turn warrant checks indicate that under 2025 pre-development traffic volumes a BAL and BAR turning arrangement is required to be incorporated within this intersection. Additional traffic generation by the proposed development under PM peak conditions show that an upgrade from a BAL to an AUL(S) is required under 2025 ultimate conditions in order to satisfy turn warrant requirements.

4.2. Cherryfield Road / Johnson Road Intersection

4.2.1. Existing Intersection

The existing intersection of Cherryfield Road and Johnson Road has been recently upgraded in the previous years to include both an auxiliary left and right turn lanes into Cherryfield Road off Johnson Road. Both legs on Johnson Road have included painted chevron traffic medians. Currently, both Johnson Road legs are signed 60km/h with Cherryfield Road being signed at 80km/h.

Figure 7: Aerial image of Cherryfield Road / Johnson Road Intersection.

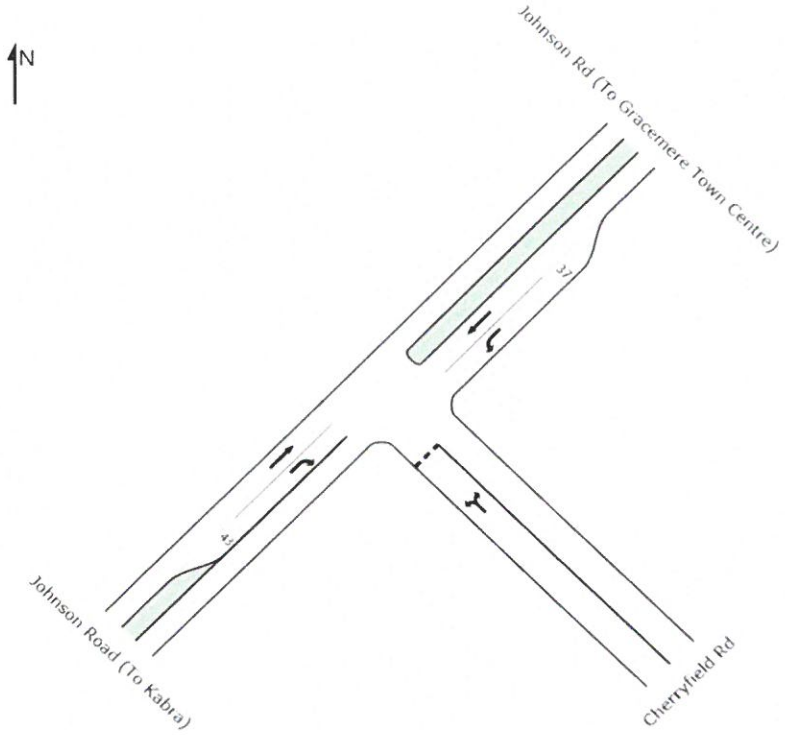


Figure 8: SIDRA representation of the existing Cherryfield Road / Johnson Road Intersection.

4.2.2. Traffic Volumes

Estimated 2025 traffic volumes have been derived from an intersection report recorded and supplied by RRC on 21 July 2011. From the 2011 traffic volumes, a compounding growth rate of 3% has been incorporated to achieve present day and future 2025 pre-development traffic volumes.

Background growth has been applied to all legs with the full development traffic being superimposed without additional growth. These traffic flows have been subjected to destination and directional traffic splits, as discussed in Section 3.3.

Table 3: Traffic volumes utilised for intersection assessment.

Johnson Rd & Cherryfield Rd Intersection		Leg 1				Leg 2				Leg 3			
		Johnson Rd (To Town Centre)				Cherryfield Rd				Johnson Rd (To Kabra)			
		Left		Thru		Left		Right		Thru		Right	
		LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV
AM	2011	22	1	11	5	6	1	86	7	21	6	3	1
	2013	23	1	12	5	6	1	91	7	22	6	3	1
	2025 Pre-Development	33	2	17	8	9	2	130	11	32	9	5	2
	Additional From Development	74	0	0	0	9	0	172	0	0	0	4	0
	2025 Post-Development	107	2	17	8	18	2	302	11	32	9	8	2
PM	2011	92	4	38	0	1	0	35	1	21	1	4	0
	2013	98	4	40	0	1	0	37	1	22	1	4	0
	2025 Pre-Development	139	6	57	0	2	0	53	2	32	2	6	0
	Additional From Development	172	0	0	0	4	0	74	0	0	0	9	0
	2025 Post-Development	311	6	57	0	5	0	127	2	32	2	15	0

4.2.3. SIDRA Output

A SIDRA intersection analysis has been carried out for each for the four scenarios to be investigated, including pre and post traffic flows under AM and PM conditions. Several output parameters have been reviewed to determine the effect of the proposed developments upon the existing intersection infrastructure. These parameters include:

Scenario	Degree of Saturation	Min. Level of Service	Average Delay (sec)
2025 AM Pre-Development	0.211	B	8.3
2025 AM Post-Development	0.476	B	10.5
2025 PM Pre-Development	0.085	B	7.0
2025 PM Post-Development	0.233	B	8.8

From the above, it is evident that the existing intersection infrastructure is sufficiently capable of accommodating the 2025 traffic volumes in conjunction with the proposed developmental traffic.

4.2.4. Turn Warrants

Turn warrant checks have been performed to determine the adequacy of the existing turn warrants for this intersection. Checks accounted for AM/PM traffic peaks, and compared results between 2025 pre and post development traffic volumes. The current intersection geometry includes a 43 metre long CHR(S) and 37 metre long AUL(S).

AM Turn Warrants		PM Turn Warrants	
2025 Pre-Development	2025 Post-Development	2025 Pre-Development	2025 Post-Development
QR= 6	QR= 10	QR= 6	QR= 15
QM= 100	QM= 173	QM= 236	QM= 408
QL= 35	QL= 108	QL= 145	QL= 317
QM= 24	QM= 24	QM= 57	QM= 57

It should be noted that the turn volumes to and from Washpool Road are higher than the through volumes on Cherryfield Road. Typically in these situations the intersection would be realigned to accommodate the high traffic movements. However, long term it is expected that Cherryfield Road through movements will exceed Washpool Road as part of future urban development located south of the subject site.

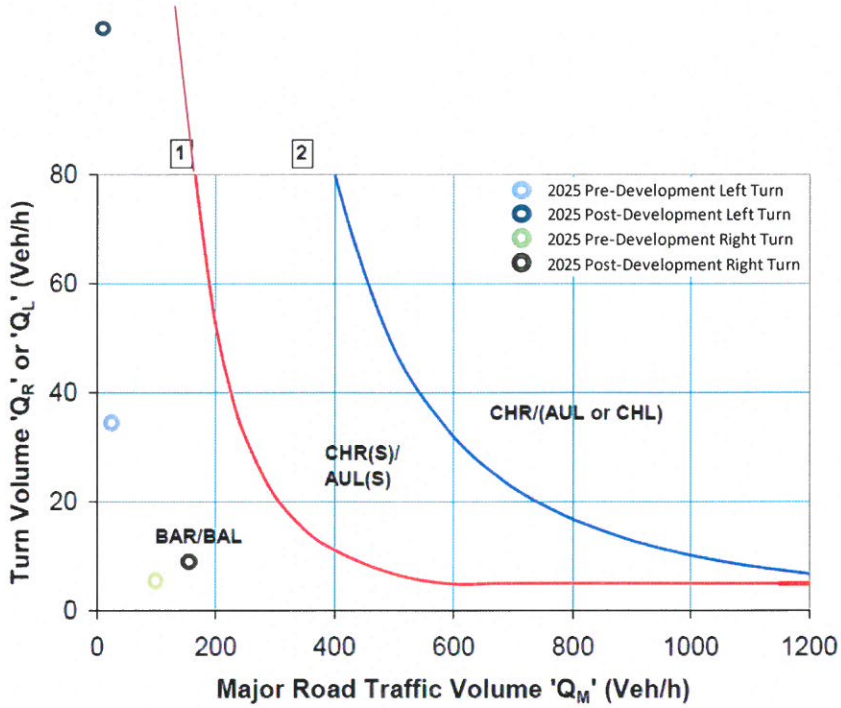


Figure 9: AM Turn Warrants for Cherryfield Road / Johnson Road Intersection.

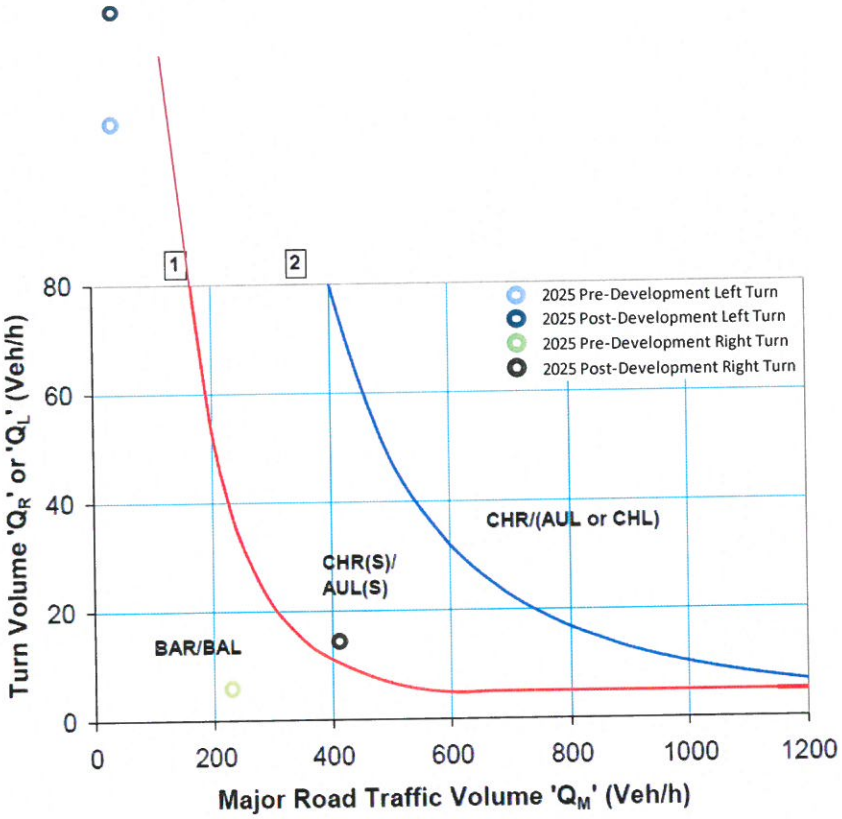


Figure 10: PM Turn Warrants for Cherryfield Road / Johnson Road Intersection.

The turn warrant checks shown above have concluded that under 2025 post-development conditions, a CHR(S) is required to satisfy turn warrant requirements. A recent upgrade of this intersection has included a CHR(S) lane and an AUL(S) into the intersection geometry. Therefore, no upgrades are required to take place.

4.3. Lucas Street / Johnson Road Intersection

4.3.1. Existing Intersection

The existing intersection has been recently upgraded in the past years to include several features including 2.5m wide parking lanes and 2.0m wide bicycle lanes. The major road on the intersection (Johnson Road) is signed 60km/h speed with Lucas Street being signed at 70km/h. Traffic medians within this intersection include painted chevron islands on Johnson Road and a 1.0m wide raised traffic island on the Lucas Street leg.

Figure 11: Aerial imagery of Lucas Street / Johnson Road Intersection.

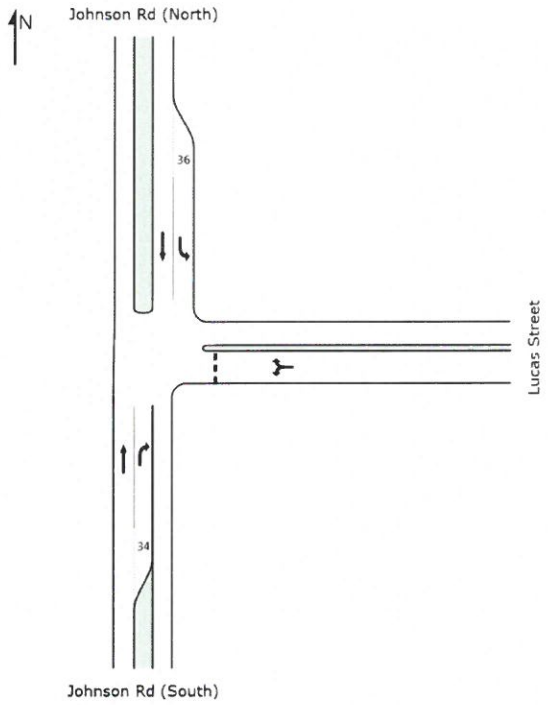


Figure 12: SIDRA representation of the existing Lucas Street / Johnson Road Intersection.

4.3.2. Traffic Volumes

Traffic volumes presented below have been calculated and grown at 3% (compounding) based upon intersection count data supplied by RRC. Development traffic has also been incorporated after being subjected to destination and directional splits.

Table 4: Traffic volumes utilised for intersection assessment.

Johnson Rd & Lucas St Intersection		Leg 1				Leg 2				Leg 3			
		Johnson Rd (To Town Centre)				Lucas St				Johnson Rd (To Kabra)			
		Left		Thru		Left		Right		Thru		Right	
		LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV
AM	2011	35	2	35	2	10	0	45	2	66	5	36	3
	2013	37	2	37	2	11	0	48	2	70	5	38	3
	2025 Pre-Development	53	3	53	3	15	0	68	3	100	8	54	5
	Additional From Development	0	0	74	0	0	0	0	0	172	0	0	0
	2025 Post-Development	53	3	127	3	15	0	68	3	272	8	54	5
PM	2011	63	1	92	5	21	3	36	5	34	4	18	1
	2013	67	1	98	5	22	3	38	5	36	4	19	1
	2025 Pre-Development	95	2	139	8	32	5	54	8	51	6	27	2
	Additional From Development	0	0	172	0	0	0	0	0	74	0	0	0
	2025 Post-Development	95	2	311	8	32	5	54	8	125	6	27	2

4.3.3. SIDRA Output

The analysis of the intersections performance at the year 2025 under ultimate conditions incorporating the proposed development was performed using SIDRA Intersection 5.1. This software produces as an output the estimated degree of saturation (DOS), delays and Level of Service (LOS).

The intersection analysis results are summarised below with full lane summaries published in Appendix B.

Scenario	Degree of Saturation	Min. Level of Service	Average Delay (sec)
2025 AM Pre-Development	0.138	B	5.8
2025 AM Post-Development	0.203	B	5.6
2025 PM Pre-Development	0.171	B	5.7
2025 PM Post-Development	0.256	B	4.3

The results show that without any upgrade to the existing intersection that it is more than capable of servicing future traffic background growth and development traffic without upgrade.

4.3.4. Turn Warrants

In order to assess the impact upon the existing intersection by the proposed traffic generation, turn warrant checks have be carried out. The checks have analysed AM/PM, pre and post development traffic volumes for both left and right turn movements. The current intersection geometry includes a 34 metre CHR(S) and a 36 metre long AUL(S).

AM Turn Warrants		PM Turn Warrants	
2025 Pre-Development QR= 59 QM= 219 QL= 56 QM= 56	2025 Post-Development QR= 59 QM= 465 QL= 56 QM= 130	2025 Pre-Development QR= 29 QM= 301 QL= 97 QM= 147	2025 Post-Development QR= 29 QM= 546 QL= 97 QM= 319

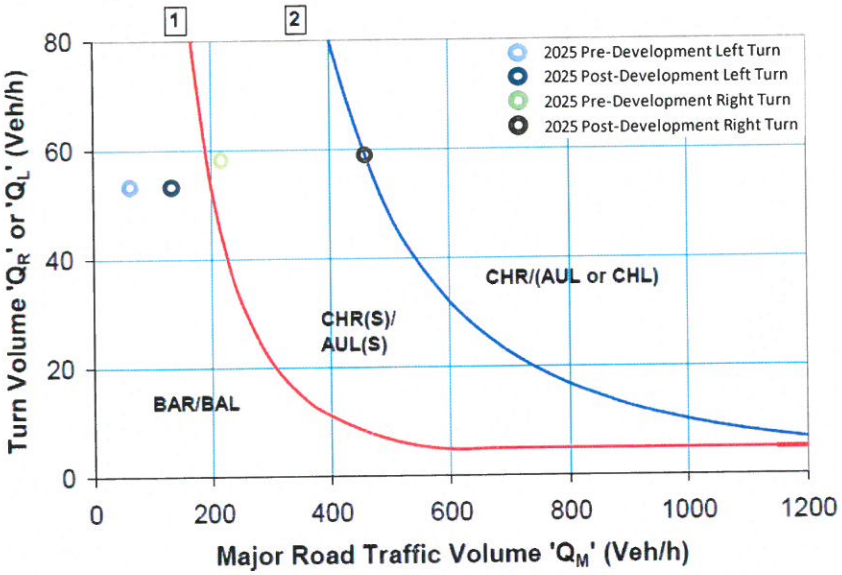


Figure 13: AM Turn Warrants for Lucas Street / Johnson Road Intersection.

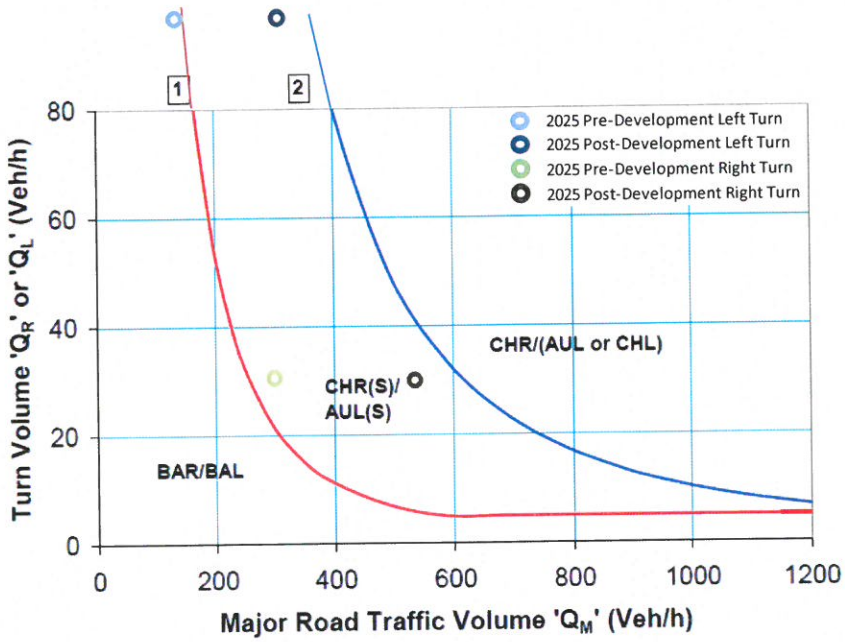


Figure 14: PM Turn Warrants for Lucas Street / Johnson Road Intersection.

The turn warrant checks have concluded that under PM peak conditions, both left and right turns have triggered an upgrade to the turn treatments. The Left turn is required to consist of a AUL(S) under 2025 post-development conditions. A recent upgrade to this intersection has included a 36m long AUL(S). For the Right turn, an upgrade from a CHR(S) to a CHR has been triggered. The current geometry of the intersection contains a painted chevron island prior to the CHR(S). In order to satisfy 2025 ultimate conditions, alterations in the line marking may be incorporated to lengthen the existing CHR(S) to satisfy this CHR requirement.

4.4. Breakspear Street / Johnson Road Intersection

4.4.1. Existing Intersection

The existing Johnson Road consists of a divided road with 6.5m road widths and a 4.8m wide raised traffic island. Breakspear Street features 3.5m lane widths with 2.5m parking lanes on each side. Whilst all intersection legs are signed at 60km/h speeds, the nearby school has a school zone encompassing the intersection which aligns within the peak hours of the intersection. Therefore, for both AM and PM peaks the approach and exiting speeds have been reduced to 40km/h for all legs.

Figure 15: Aerial imagery of the Breakspear Street / Johnson Road Intersection (Provided by RRC).

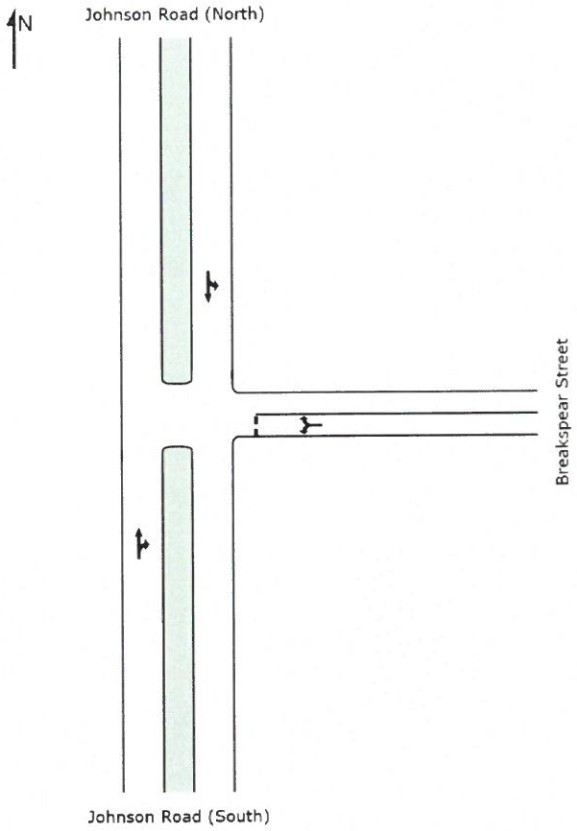


Figure 16: SIDRA representation of the existing Breakspear Street / Johnson Road Intersection.

4.4.2. Traffic Volumes

Traffic volumes shown below, as previously performed with other intersections, has been extrapolated from 2011 intersection count data supplied by RRC. Traffic development from the proposed sites have been included within the 2025 post-development traffic volumes incorporating destination and directional traffic splits.

Table 5: Traffic volumes utilised for intersection assessment.

Johnson Rd & Breakspear St Intersection		Leg 1				Leg 2				Leg 3			
		Johnson Rd (To Town Centre)				Breakspear St				Johnson Rd (To Kabra)			
		Left		Thru		Left		Right		Thru		Right	
		LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV
AM	2011	49	2	101	8	56	1	49	1	167	9	53	3
	2013	52	2	107	8	59	1	52	1	177	10	56	3
	2025 Pre-Development	74	3	153	12	85	2	74	2	253	14	80	5
	Additional From Development	0	0	70	0	4	0	0	0	163	0	9	0
	2025 Post-Development	74	3	223	12	88	2	74	2	416	14	89	5
PM	2011	73	1	165	12	47	0	48	1	168	11	62	2
	2013	77	1	175	13	50	0	51	1	178	12	66	2
	2025 Pre-Development	110	2	250	18	71	0	73	2	254	17	94	3
	Additional From Development	0	0	163	0	9	0	0	0	70	0	4	0
	2025 Post-Development	110	2	413	18	80	0	73	2	324	17	97	3

4.4.3. SIDRA Output

In order to establish the full extent of any future traffic impacts upon existing council intersection infrastructure several SIDRA intersection analysis' were carried out. Analysis' were carried out under 2025 conditions in order to allow for one year's construction and then an additional further 10 years of growth. Four scenarios were analysed and summarised below. The full SIDRA output can be found in Appendix B.

Scenario	Degree of Saturation	Min. Level of Service	Average Delay (sec)
2025 AM Pre-Development	0.330	B	5.8
2025 AM Post-Development	0.508	B	6.8
2025 PM Pre-Development	0.405	B	6.7
2025 PM Post-Development	0.676	B	9.4

The results show that without any upgrade to the existing council intersection that it is more than capable of servicing future traffic background growth and development traffic.

4.4.4. Turn Warrants

A complete turn warrant assessment has been carried out in order to establish the effects upon current intersection infrastructure through the development of the proposed site.

AM Turn Warrants		PM Turn Warrants	
2025 Pre-Development QR= 85 QM= 508 QL= 77 QM= 165	2025 Post-Development QR= 93 QM= 741 QL= 77 QM= 235	2025 Pre-Development QR= 97 QM= 650 QL= 112 QM= 635	2025 Post-Development QR= 100 QM= 884 QL= 112 QM= 872

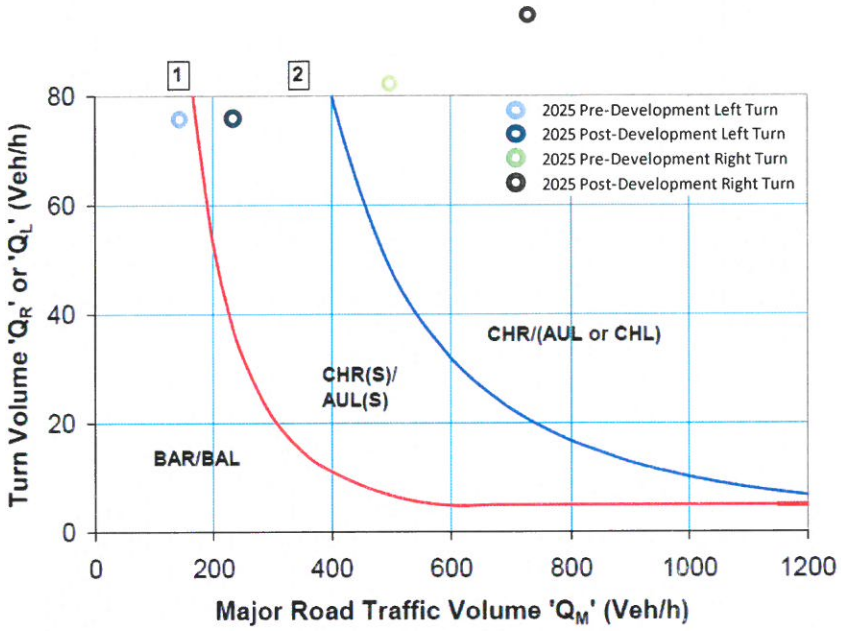


Figure 17: AM Turn Warrants for Breakspear Street / Johnson Road Intersection.

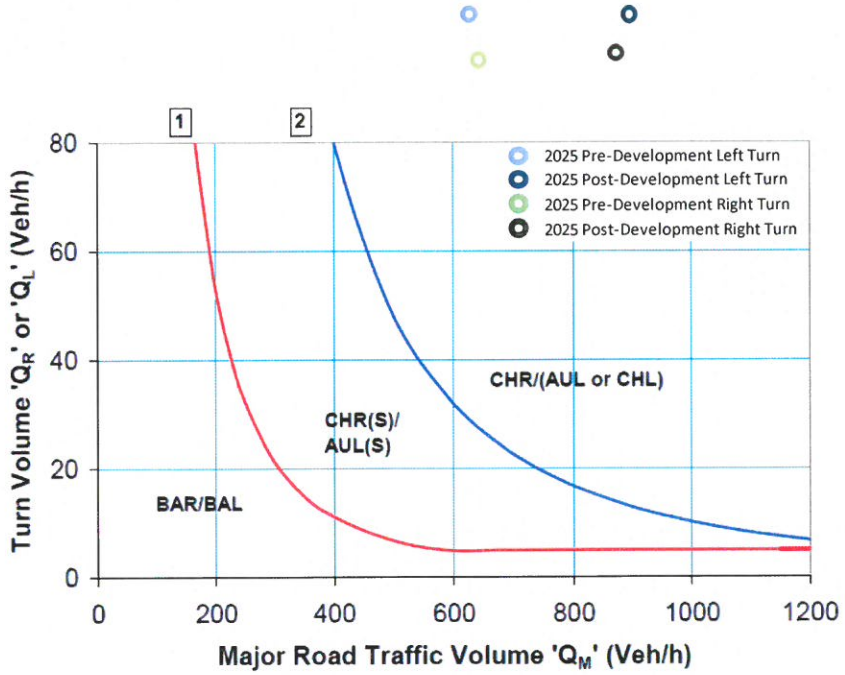


Figure 18: PM Turn Warrants for Breakspear Street / Johnson Road Intersection.

Turn warrant checks carried out for the above intersection has found that under PM peak conditions no turn warrant upgrades have been triggered by the proposed development. The current 2013 geometry does not include any turn treatments and would under normal background traffic growth be required to be upgraded to a CHR arrangement to suit 2025 traffic volumes. The traffic generated through the proposed development therefore does not trigger any upgrades from what would otherwise be required to be created to satisfy 2025 background traffic growth. Due to the current pavement width of 6.5m, these turn treatment could easily be incorporated with minimal cost.

4.5. Middle Road / Johnson Road Intersection

4.5.1. Existing Intersection

Currently, the Middle Road / Johnson Road intersection consists of a divided Johnson Road with lane widths between 6.5 and 10m. The existing traffic median between the divided lanes is 15m wide with a channel running down the middle acting as the primary drainage for the road. The signed speed limits for the intersection on all legs is 60km/h, however during school zone hours, Johnsons Road (South) and Middle Road and reduced to 40km/h.

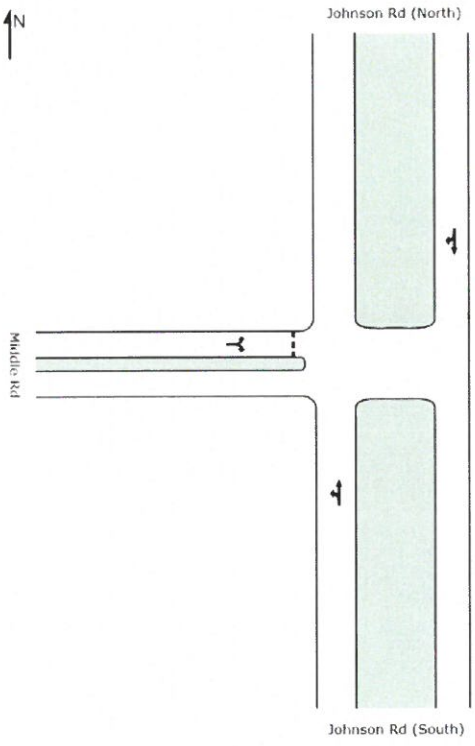


Figure 19: SIDRA representation of the existing Middle Road / Johnson Road Intersection.

4.5.2. Traffic Volumes

The below traffic volumes have been developed for use in both turn warrant and SIDRA analysis. The volumes have been heavily based around traffic counts recorded in June 2011, provided by RRC. As discussed previously, the 2011 data has been grown using a 3% annual growth rate (compounding), developing both 2013 and 2025 pre-development traffic volumes. Development traffic, once subjected to destination and directional splits, was added to the 2025 data in order to estimate 2025 post-development traffic volumes.

Table 6: Traffic volumes utilised for intersection analysis.

Johnson Rd & Middle Rd Intersection		Leg 1 Johnson Rd (To Town Centre)				Leg 3 Johnson Rd (To Kabra)				Leg 4 Middle Rd			
		Thru		Right		Left		Thru		Left		Right	
		LV	HV	LV	HV	LV	HV	LV	HV	LV	HV	LV	HV
AM	2011	144	12	48	1	28	1	206	15	45	4	33	0
	2013	153	13	51	1	30	1	219	16	48	4	35	0
	2025 Pre-Development	218	18	73	2	42	2	312	23	68	6	50	0
	Additional From Development	66	0	0	0	8	0	155	0	0	0	3	0
	2025 Post-Development	284	18	73	2	51	2	467	23	68	6	53	0
PM	2011	282	7	60	1	17	1	165	7	40	1	19	1
	2013	299	7	64	1	18	1	175	7	42	1	20	1
	2025 Pre-Development	427	11	91	2	26	2	250	11	61	2	29	2
	Additional From Development	155	0	0	0	3	0	66	0	0	0	8	0
	2025 Post-Development	582	11	91	2	29	2	316	11	61	2	37	2

4.5.3. SIDRA Output

Standard SIDRA intersection analysis has been utilised to evaluate an intersection's degree of saturation, Level of Service, queues and average delay. Under a standard sign controlled intersection, the desired ultimate practical degree of saturation is 0.8 with a minimum level of service of D.

A SIDRA intersection analysis has been conducted under four alternative scenarios for each intersection in the year 2025. They include 2025 pre-development and 2025 post-development conditions in both AM and PM peaks. The intersection analysis results are summarised below with full lane summaries published in Appendix B.

Scenario	Degree of Saturation	Min. Level of Service	Average Delay (sec)
2025 AM Pre-Development	0.306	B	4.6
2025 AM Post-Development	0.505	D	6.8
2025 PM Pre-Development	0.329	B	4.7
2025 PM Post-Development	0.474	D	6.8

From the above output, the existing intersection is sufficiently capable to service the 2025 background and developmental traffic, maintaining a LOS at or above a D and Degree of Saturation of less than 0.8.

Under 2025 conditions post-development, there is an increase in delay for vehicles turning out of Middle Road in the morning peak. Whilst easily at acceptable levels, minor line marking would allow for further a second lane on Middle Road, allowing for separate left and right turn lanes. This would reduce the delay of vehicles turning left out of Middle Road in the morning and also have a noticeable advantage for vehicles turning right.

4.5.4. Turn Warrants

Turn warrant checks have been performed in order to determine in the existing intersection is capable of maintaining dafe turn warrants throughout its ultimate scenario. The checks accounted for AM/PM traffic peaks, and compared results between 2025 pre and post development traffic volumes. There is currently no existing turning infrastructure at this intersection.

AM Turn Warrants		PM Turn Warrants	
2025 Pre-Development	2025 Post-Development	2025 Pre-Development	2025 Post-Development
QR= 73	QR= 74	QR= 92	QR= 92
QM= 614	QM= 844	QM= 725	QM= 950
QL= 44	QL= 52	QL= 27	QL= 31
QM= 334	QM= 489	QM= 260	QM= 327

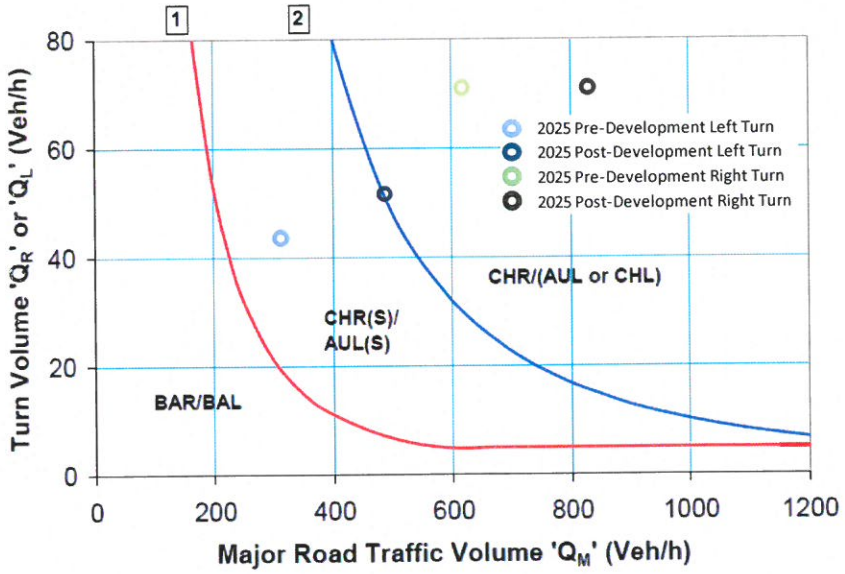


Figure 20: AM Turn Warrants for Middle Road / Johnson Road Intersection.

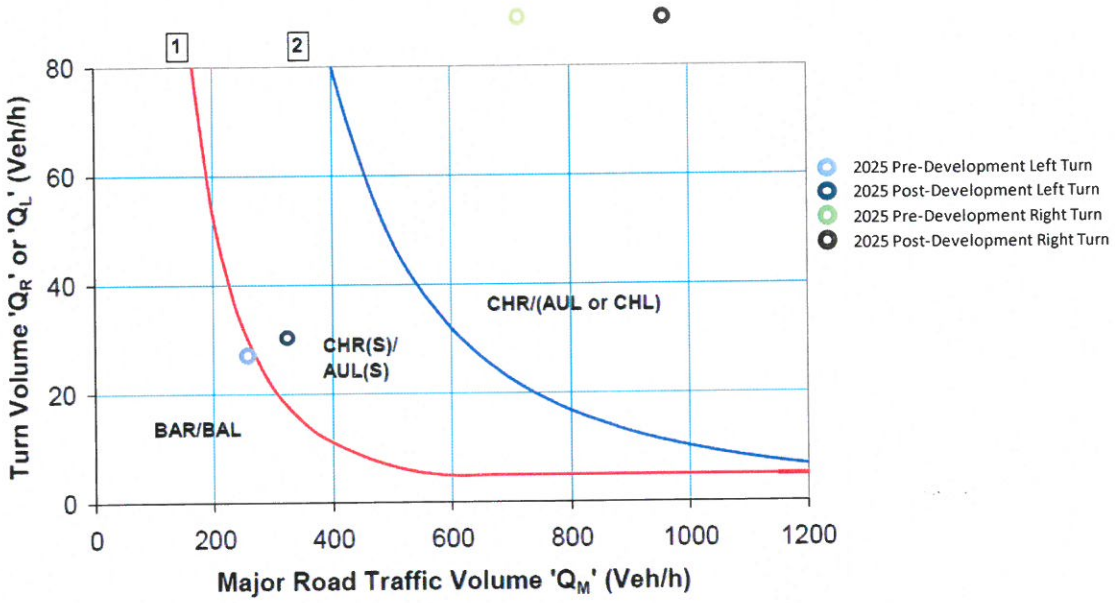


Figure 21: PM Turn Warrants for Middle Road / Johnson Road Intersection.

Analysis of the turn warrant results has shown that under 2025 pre-development traffic volumes that a CHR would be required to satisfy background traffic growth, therefore not requiring an upgrade to include development traffic. For the left turn treatment however, an upgrade from an AUL(S) to an AUL will be required. As an AUL(S) will be required under normal background traffic growth, the upgrade from a AUL(S) to a AUL will be covered through infrastructure contributions.

4.6. Impact Upon Cherryfield Road

In accordance with the December 2012 RRC Transport Network Infrastructure Map (39-3) for future trunk infrastructure (attached in Appendix C), Cherryfield Road has been identified to be upgraded to a major urban collector. Under the Capricorn Municipal District Guidelines (CMDG), a major collector is able to convey a maximum of 6000 vehicle movements per day, or to service 600 allotments.

In order to assess the 2025 ultimate traffic scenario (2011 Intersection Count + Background Growth + Development Traffic), traffic volumes discussed in Section 4.1.2 have been adopted. The critical section of Cherryfield Road is identified as being between the intersections of Johnson Road and Washpool Road. From the traffic volumes, 464 vehicle movements are calculated to travel along Cherryfield Road during peak hour.

If adopting standard traffic generation that peak hour traffic volume is approximately 15% of AADT, Cherryfield Road would be calculated at 3894 vpd, well below the 6000vpd allowance. Alternatively, the use of RTA's guide to traffic engineering of 0.85 movements per dwelling during peak hour and 9 movements per dwelling per day can be utilised. Using this method, the 464 movements will equate to 546 dwellings or 4913 vpd, well below a major collectors capacity.

4.7. Impact upon Road A of Gracemere Springs 1

In accordance with the CMDG, Road A of Gracemere Springs 1 has been designed to satisfy two different road hierarchy conditions. As previously mentioned in the original traffic impact assessment, a small portion of Road A closest to allotments 1 and 16 will be a major urban collector with the remainder of Road A being a minor urban collector.

Under the CMDG, a minor collector should not exceed 3000 vehicle movements per day. Using CMDGs recommended ten (10) daily movements per dwelling, a minor collector is sufficient for 300 allotments. The Gracemere Springs 2 Traffic Catchment Plan, attached in Appendix D, outlines how the development of Gracemere Springs 2 will be managed to ensure no more than 300 allotments are being serviced by the minor collector at any one time.

As shown in Appendix D, there are 88 allotments whose traffic will be conveyed down Road D, connect onto Road A and onto Washpool Road. This small section of Road A between the Washpool Road intersection and intersection with Road D will be a major urban collector, the allotments being serviced by this section is 385 (297+88).

Downstream on Road A from the intersection with Road D, the maximum number of allotments to be serviced is 297. As a minor urban collector is able to convey traffic from 300 allotments Road A will not be run over capacity.

As Road A is restricted to service below 300 allotments, there are 63 allotments which cannot be developed until the surrounding road network and secondary access onto Washpool Road is established.

On connection of the future access, Road A in Gracemere Springs 1 will have a reduction in traffic as the majority of Gracemere Springs 2 will use the future access to Washpool Road.

Its intersection with Road A prior to the construction of Gracemere Springs 2 future access will be built as a T-Intersection of two major urban collectors but will essentially act as a bend in the road. Once the Gracemere Springs 2 access to Washpool Road is constructed, the intersection can be reassessed using turn warrants/SIDRA and if required be upgraded to include right turn lanes if necessary. Washpool Road Reserve is approximately 40m in width which will allow for these modifications without affecting property boundaries.

5. CONCLUSION

In conclusion, the entirety of proposed developments of both Gracemere Springs 1 and Gracemere Springs 2 can be effectively incorporated into Gracemere's existing transport infrastructure without the requirement for any significant upgrades, when analysed under 2025 ultimate traffic.

In order to satisfy turn warrant requirements, the following upgrades from existing are required:

Washpool Road / Cherryfield Road Intersection – As the existing intersection does not currently exhibit any turn treatments this intersection will be required to be upgraded to incorporate both BAL and BAR treatments in order to service future traffic with background growth. Additional upgrades to AUL(S) turn treatment is required in order to allow for a safe turning environment post development.

Cherryfield Road / Johnson Road Intersection – Currently, this intersection includes both AUL(S) and CHR(S) turn treatments. After a full intersection analysis it is not required that these treatments be upgraded in order to incorporate the proposed developments.

Lucas Street / Johnson Road Intersection – The current Lucas Street intersection contains both AUL(S) and CHR(S) turn movements. In order to safely incorporate the proposed developments into this intersection, it is required that the CHR(S) be upgraded to a CHR.

Breakspear Street / Johnson Road Intersection – After analysis of 2025 traffic volumes it was found that under background growth conditions that the upgrade to both a CHR and AUL was required without any influence from the proposed developments traffic volumes. Therefore, under an ultimate scenario where development traffic is influencing the turn treatments, no upgrade is required.

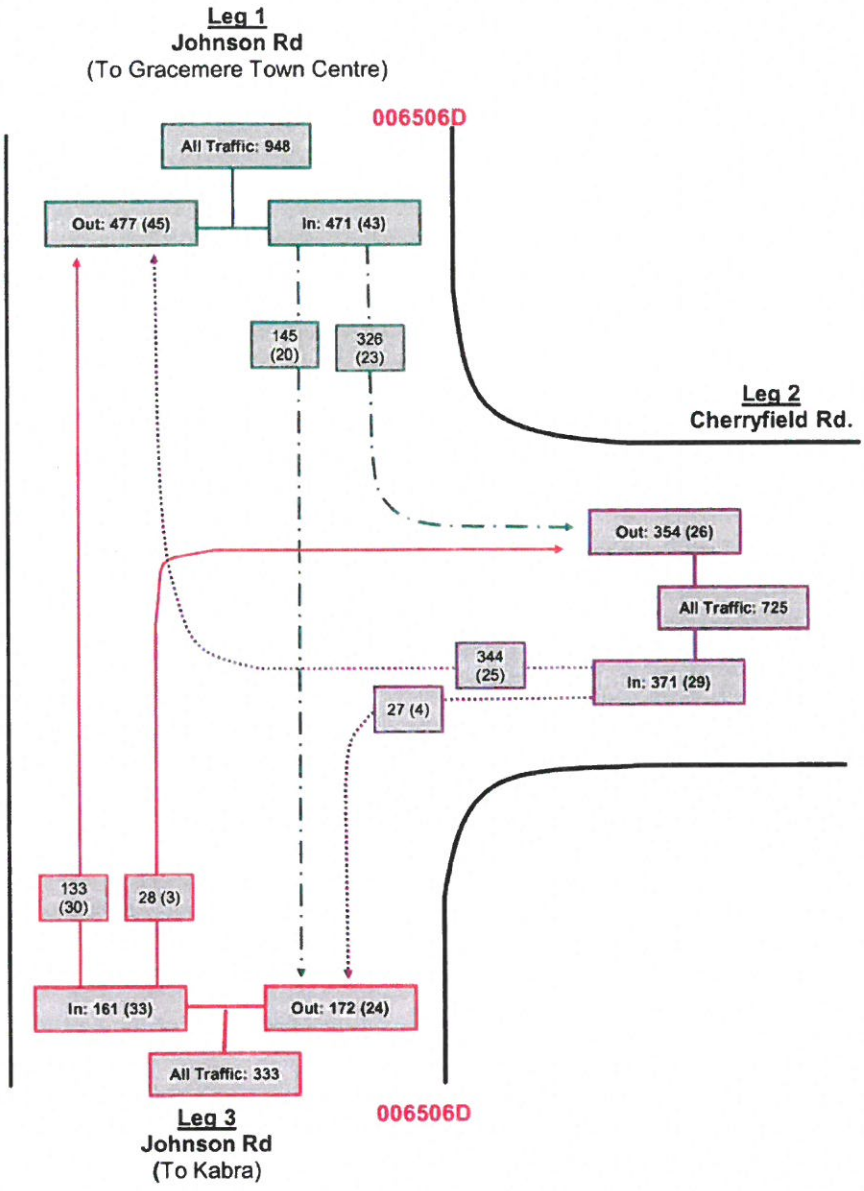
Middle Road / Johnson Road Intersection – The existing intersection is currently consisting of no turn treatments. Under 2025 background growth is was established that an AUL(S) and CHR will have to be incorporated into this intersection. Once development traffic was factored into movement volumes it was established that the AUL(S) would be required to be further upgraded to an AUL turn treatment.

It should be noted that some of the intersections and roads assessed as part of this study have been identified in Council's Future Infrastructures Plans as detailed below and in included in the MAP 39-3 located in Appendix C.

Map 39-3	Transport	T-66	Johnson Road/ Middle Road intersection	Intersection upgrade and associated works.	$ 850,000	2021
Map 39-3	Transport	T-67	Johnson Road/ Breakspear Street intersection	Intersection upgrade and associated works.	$ 850,000	2021
Map 39-3	Transport	T-68	Johnson Road/ Lucas Street intersection.	Construct intersection improvements to increase capacity and operation.	$ 1,500,000	2021
Map 86-3	Transport	T-81	McMillan Avenue	Construct extension of McMillan Avenue (from mid L1- RP603508 to Olive Street extended). Build at Urban Arterial	$ 550,000	2031
Map 39-3	Transport	T-83	Cherryfield Road (Washpool Road to Regal Drive).	Upgrade to Major Urban Collector (from Washpool Road to Regal Drive)	$ 2,150,000	2026

APPENDIX A – Intersection Count Data

LOCATION: Johnson Rd - Cherryfield Road Int (R.H.S)
ROAD No: 006056D
DATE: Thu, 21/07/11
TIME: 06:00 - 18:00



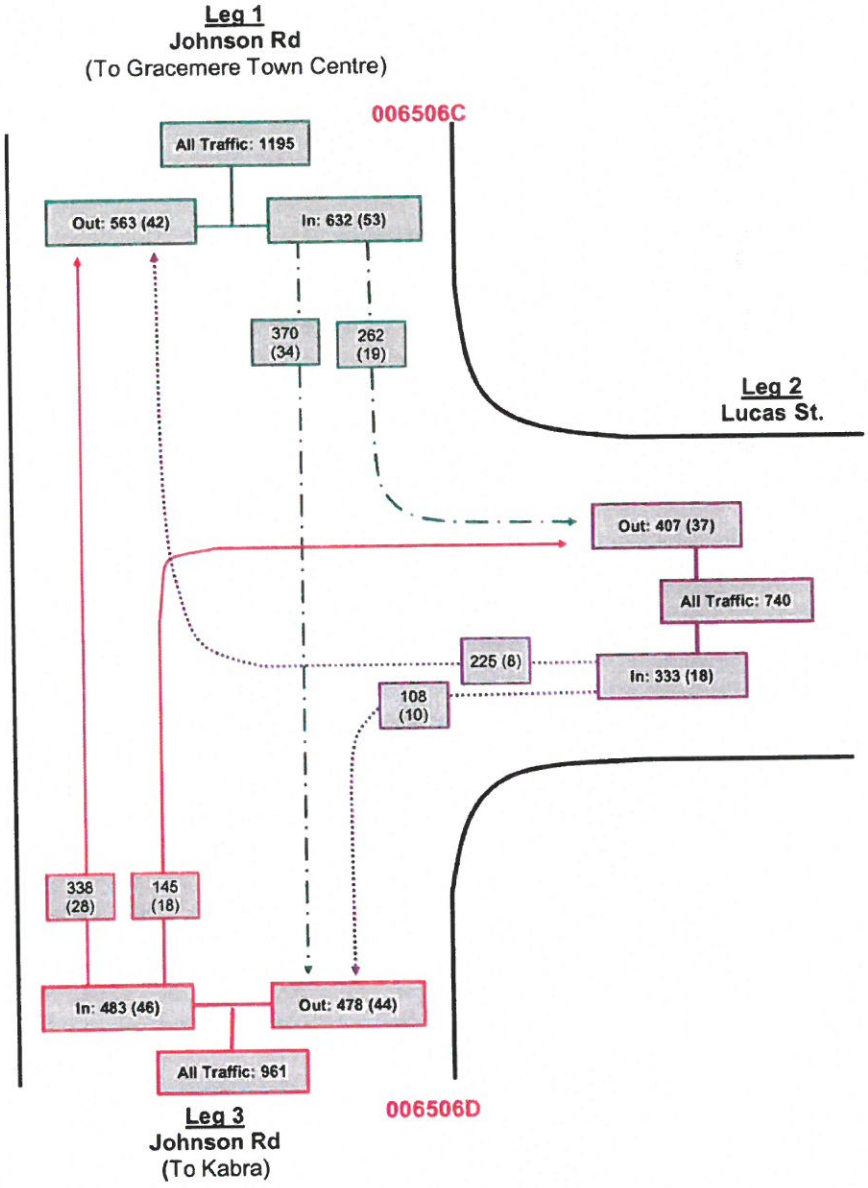
Count Tally Sheet With Totals and Peak Flows.

LOCATION: Johnson Rd - Cherryfield Road Int (R.H.S)
ROAD No: 006056D
DATE: Thu, 21/07/11
TIME: 06:00 - 18:00

	Leg 1					Leg 2					Leg 3				
	Left		Thru		Leg	Left		Right		Leg	Thru		Right		Leg
Time	*Light*	*Heavy*	*Light*	*Heavy*	Total	*Light*	*Heavy*	*Light*	*Heavy*	Total	*Light*	*Heavy*	*Light*	*Heavy*	Total
6:00 - 6:15					0					0					0
6:15 - 6:30					0					0					0
6:30 - 6:45	1	0	6	1	8	4	0	10	2	16	3	1	0	0	4
6:45 - 7:00	2	0	3	3	8	1	0	12	1	14	1	0	0	0	1
7:00 - 7:15	4	0	2	2	8	1	0	12	1	14	3	0	1	0	4
7:15 - 7:30	5	2	4	1	12	1	1	16	2	20	3	0	0	0	3
7:30 - 7:45	4	0	5	0	9	1	0	21	4	26	3	3	1	0	7
7:45 - 8:00	6	0	3	4	13	4	1	22	0	27	5	1	1	0	7
8:00 - 8:15	3	1	0	0	4	0	0	19	1	20	11	1	1	1	14
8:15 - 8:30	9	0	3	1	13	1	0	24	2	27	2	1	0	0	3
8:30 - 8:45	11	0	3	0	14	2	0	16	1	19	6	1	0	0	7
8:45 - 9:00	9	0	3	2	14	0	0	14	2	16	4	4	0	0	8
9:00 - 9:15	7	2	3	4	16	0	0	6	0	6	1	1	1	0	3
9:15 - 9:30	5	0	5	0	10	2	0	5	0	7	1	3	1	0	5
9:30 - 9:45					0					0					0
14:15 - 14:30					0					0					0
14:30 - 14:45	6	1	4	1	12	0	0	15	0	15	2	2	2	0	6
14:45 - 15:00	10	1	1	1	13	2	1	12	3	18	1	3	0	0	4
15:00 - 15:15	13	0	3	0	16	0	0	13	1	14	4	1	1	1	7
15:15 - 15:30	21	2	5	0	28	0	0	8	0	8	3	1	1	0	5
15:30 - 15:45	17	2	3	0	22	0	0	10	1	11	7	2	1	0	10
15:45 - 16:00	12	2	6	0	20	1	1	8	1	11	8	2	3	1	14
16:00 - 16:15	13	3	7	0	23	1	0	7	0	8	2	2	0	0	4
16:15 - 16:30	18	2	10	0	30	0	0	13	1	14	3	0	3	0	6
16:30 - 16:45	14	1	3	0	18	1	0	13	1	15	7	0	2	0	9
16:45 - 17:00	16	0	9	0	25	0	0	7	0	7	4	1	1	0	6
17:00 - 17:15	28	1	10	0	39	0	0	9	0	9	7	0	1	0	8
17:15 - 17:30	24	2	12	0	38	0	0	9	0	9	5	0	2	0	7
17:30 - 17:45	24	1	7	0	32	1	0	10	1	12	5	0	0	0	5
17:45 - 18:00	21	0	5	0	26	0	0	8	0	8	2	0	2	0	4
Total:	303	23	125	20	471	23	4	319	25	371	103	30	25	3	161
Peak Count:	7	9	11	7	135	6	2	34	8	100	7	9	1	2	36
Peak Hour:	06:15 to 07:15	15:15 to 16:15	06:15 to 07:15	06:30 to 07:30	17:00 to 18:00	06:15 to 07:15	07:00 to 08:00	06:15 to 07:15	06:45 to 07:45	07:30 to 08:30	06:15 to 07:15	08:30 to 09:30	06:15 to 07:15	15:00 to 16:00	15:00 to 16:00

Data Collection Date:
Compiled by:

LOCATION: Johnson Rd - Lucas St Int (R.H.S)
ROAD No: 006056C
DATE: Wed, 20/07/11
TIME: 06:00 - 18:00



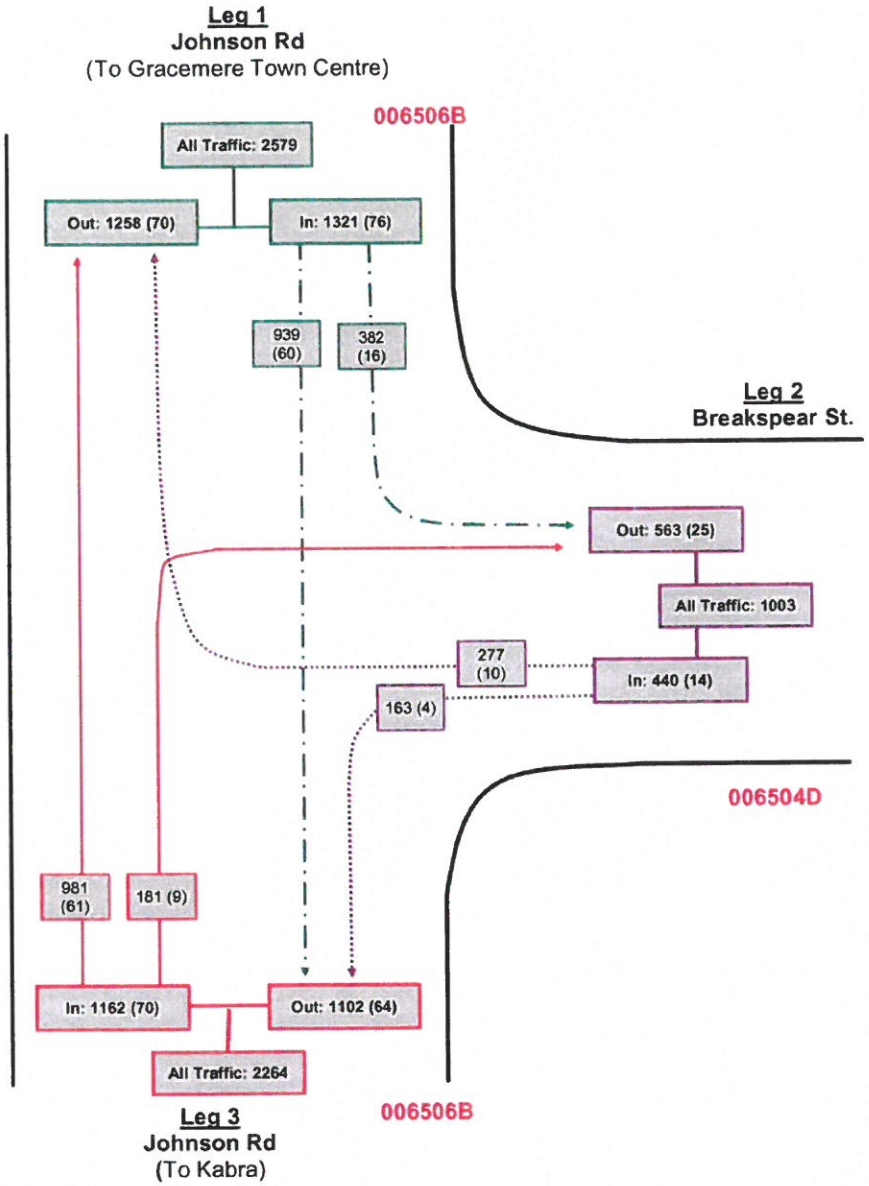
Count Tally Sheet With Totals and Peak Flows.

LOCATION: Johnson Rd - Lucas St Int (R.H.S)
ROAD No: 006056C
DATE: Wed, 20/07/11
TIME: 06:00 - 18:00

	Leg 1					Leg 2					Leg 3				
	Left		Thru		Leg	Left		Right		Leg	Thru		Right		Leg
Time	*Light*	*Heavy*	*Light*	*Heavy*	Total	*Light*	*Heavy*	*Light*	*Heavy*	Total	*Light*	*Heavy*	*Light*	*Heavy*	Total
6:00 - 6:15					0					0					0
6:15 - 6:30					0					0					0
6:30 - 6:45	5	0	4	1	10	3	0	10	0	13	11	1	0	1	13
6:45 - 7:00	6	1	7	1	15	4	0	6	0	10	13	0	2	0	15
7:00 - 7:15	3	2	3	2	10	4	0	7	0	11	18	1	1	2	22
7:15 - 7:30	7	3	3	2	15	3	1	17	1	22	21	3	4	1	29
7:30 - 7:45	7	1	5	2	15	5	1	8	0	14	17	0	9	0	26
7:45 - 8:00	5	1	4	1	11	7	1	4	0	12	18	2	11	2	33
8:00 - 8:15	9	2	6	0	17	1	0	9	1	11	15	1	14	1	31
8:15 - 8:30	7	0	12	1	20	2	0	7	1	10	16	1	12	1	30
8:30 - 8:45	5	0	9	0	14	5	0	19	0	24	19	2	7	0	28
8:45 - 9:00	14	0	8	1	23	2	0	10	0	12	16	1	3	1	21
9:00 - 9:15	8	1	13	5	27	0	0	14	0	14	13	1	2	1	17
9:15 - 9:30	3	1	12	4	20	2	0	11	0	13	10	0	1	0	11
9:30 - 9:45					0					0					0
14:15 - 14:30					0					0					0
14:30 - 14:45	6	1	9	1	10	5	0	13	0	18	11	2	6	1	20
14:45 - 15:00	5	1	9	1	10	5	0	8	0	13	14	1	5	0	20
15:00 - 15:15	11	1	12	1	13	4	0	3	0	7	11	0	6	0	17
15:15 - 15:30	9	0	12	1	13	8	1	5	0	14	10	2	5	1	18
15:30 - 15:45	8	0	16	2	18	4	0	2	0	6	11	3	4	0	18
15:45 - 16:00	11	0	19	1	20	3	1	7	0	11	8	2	4	1	15
16:00 - 16:15	11	1	19	0	19	4	0	4	0	8	7	0	1	1	9
16:15 - 16:30	12	1	18	1	19	2	2	7	0	11	3	0	1	3	7
16:30 - 16:45	12	0	20	1	21	5	1	12	1	19	7	1	5	0	13
16:45 - 17:00	11	0	21	1	22	2	2	9	3	16	9	1	5	1	16
17:00 - 17:15	17	1	24	1	25	7	0	8	1	16	9	2	4	0	15
17:15 - 17:30	23	0	27	2	29	7	0	7	0	14	9	0	4	0	13
17:30 - 17:45	14	0	26	0	26	3	0	7	0	10	9	0	8	0	17
17:45 - 18:00	14	1	18	1	19	1	0	3	0	4	5	1	3	0	9
Total:	243	19	336	34	632	98	10	217	8	333	310	28	127	18	483
Peak Count:	35	7	98	10	102	11	5	23	5	65	42	7	3	5	122
Peak Hour:	08:00 to 09:00	06:45 to 07:45	16:45 to 17:45	08:30 to 09:30	16:45 to 17:45	06:15 to 07:15	16:00 to 17:00	06:15 to 07:15	16:15 to 17:15	16:30 to 17:30	06:15 to 07:15	15:00 to 16:00	06:15 to 07:15	07:00 to 08:00	07:45 to 08:45

Data Collection Date:
Compiled by:

LOCATION: Johnson Rd - Breakspear St Int (R.H.S)
ROAD No: 006056B
DATE: Thu, 09/06/11
TIME: 06:00 - 18:00



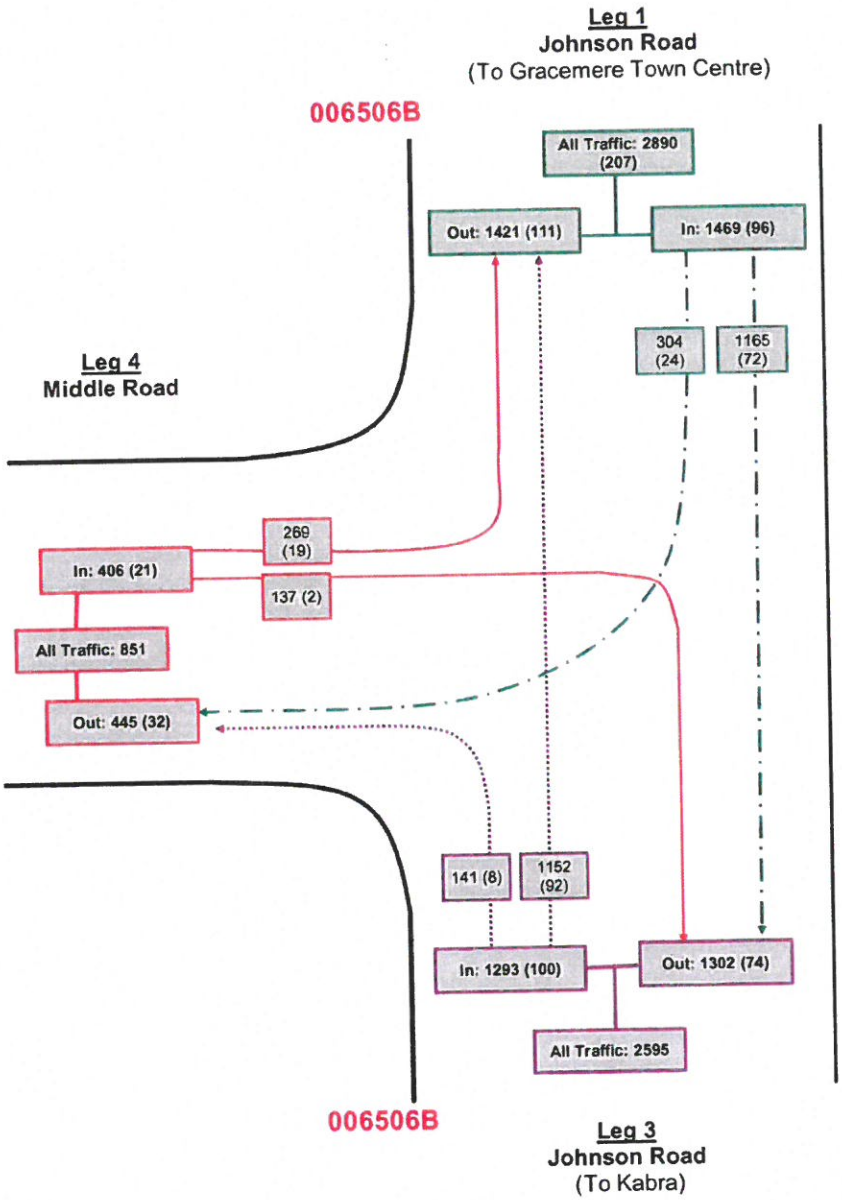
Count Tally Sheet With Totals and Peak Flows.

LOCATION: Johnson Rd - Breakspear St Int (R.H.S)
ROAD No: 006056B
DATE: Thu, 09/06/11
TIME: 06:00 - 18:00

	Leg 1					Leg 2					Leg 3				
	Left		Thru		Leg	Left		Right		Leg	Thru		Right		Leg
Time	*Light*	*Heavy*	*Light*	*Heavy*	Total	*Light*	*Heavy*	*Light*	*Heavy*	Total	*Light*	*Heavy*	*Light*	*Heavy*	Total
6:00 - 6:15					0					0					0
6:15 - 6:30					0					0					0
6:30 - 6:45	4	1	10	2	17	1	1	6	0	8	29	4	2	0	35
6:45 - 7:00	2	0	17	6	25	3	0	3	0	6	30	1	2	0	33
7:00 - 7:15	7	1	12	3	23	1	0	7	0	8	28	2	3	0	33
7:15 - 7:30	3	0	18	4	25	0	0	9	1	10	38	2	0	0	40
7:30 - 7:45	5	0	17	0	22	2	0	8	1	11	51	0	3	0	54
7:45 - 8:00	13	1	14	4	32	3	1	12	2	18	40	5	4	1	50
8:00 - 8:15	13	0	19	2	34	3	0	12	0	15	34	1	7	0	42
8:15 - 8:30	17	0	22	4	43	5	0	19	0	24	39	2	11	3	55
8:30 - 8:45	10	0	30	2	42	28	1	12	1	42	43	3	17	0	63
8:45 - 9:00	9	2	30	0	41	20	0	6	0	26	51	3	18	0	72
9:00 - 9:15	10	1	16	2	29	2	0	11	0	13	38	3	4	0	45
9:15 - 9:30	15	0	24	3	42	1	0	9	0	10	28	1	1	0	30
9:30 - 9:45					0					0					0
14:15 - 14:30					0					0					0
14:30 - 14:45	19	0	42	1	62	12	0	10	0	22	33	2	1	0	36
14:45 - 15:00	14	0	41	4	59	16	0	11	0	27	44	2	4	0	50
15:00 - 15:15	22	1	46	2	71	14	0	17	1	32	56	4	40	0	100
15:15 - 15:30	18	0	36	5	59	5	0	10	0	15	35	3	17	2	57
15:30 - 15:45	16	3	35	5	59	1	0	10	0	11	26	4	0	0	30
15:45 - 16:00	18	0	51	3	72	5	1	11	0	17	20	5	4	1	30
16:00 - 16:15	22	0	42	1	65	6	0	4	0	10	39	3	5	0	47
16:15 - 16:30	18	2	66	3	89	3	0	7	0	10	36	3	3	0	42
16:30 - 16:45	22	0	48	0	70	7	0	13	2	22	30	1	4	0	35
16:45 - 17:00	22	0	44	1	67	7	0	19	0	26	25	3	0	1	29
17:00 - 17:15	18	2	60	0	80	1	0	8	0	9	29	2	4	0	35
17:15 - 17:30	18	0	55	1	74	4	0	11	0	15	38	1	9	0	48
17:30 - 17:45	15	2	51	2	70	5	0	11	0	16	26	1	5	1	33
17:45 - 18:00	16	0	33	0	49	4	0	11	2	17	34	0	4	0	38
Total:	366	16	879	60	1321	159	4	267	10	440	920	61	172	9	1162
Peak Count:	84	5	218	16	306	56	2	55	4	107	171	16	62	4	243
Peak Hour:	16:00 to 17:00	15:30 to 16:30	16:15 to 17:15	14:45 to 15:45	16:15 to 17:15	08:00 to 09:00	07:45 to 08:45	07:45 to 08:45	07:00 to 08:00	08:00 to 09:00	08:15 to 09:15	15:00 to 16:00	14:30 to 15:30	07:30 to 08:30	14:30 to 15:30

Data Collection Date:
Compiled by:

LOCATION: Int Johnson Road & Middle Road(L.H.S)
ROAD No: 006506B
DATE: Tue, 07/06/11
TIME: 06:00 - 18:00



Count Tally Sheet With Totals and Peak Flows.

LOCATION: Int Johnson Road & Middle Road(L.H.S)
ROAD No: 006506B
DATE: Tue, 07/06/11
TIME: 06:00 - 18:00

Time	Leg 1					Leg 3					Leg 4				
	Thru		Right		Leg	Left		Thru		Leg	Left		Right		Leg
	Light	*Heavy*	*Light*	*Heavy*	Total	*Light*	*Heavy*	*Light*	*Heavy*	Total	*Light*	*Heavy*	*Light*	*Heavy*	Total
6:00 - 6:15					0					0					0
6:15 - 6:30					0					0					0
6:30 - 6:45	17	7	3	1	28	2	0	23	1	26	9	1	0	0	10
6:45 - 7:00	17	5	1	1	24	9	0	36	4	49	6	0	1	0	7
7:00 - 7:15	21	2	6	0	29	2	1	36	2	41	8	0	1	0	9
7:15 - 7:30	18	2	4	0	24	3	0	57	5	65	11	0	2	1	14
7:30 - 7:45	19	5	9	1	34	9	0	50	6	65	15	3	7	0	25
7:45 - 8:00	35	1	12	1	49	9	0	55	8	72	20	2	6	0	28
8:00 - 8:15	23	4	8	0	35	8	1	46	3	58	6	0	11	0	17
8:15 - 8:30	41	7	10	0	58	9	0	46	1	56	11	0	12	0	23
8:30 - 8:45	45	0	18	0	63	2	0	59	3	64	8	2	4	0	14
8:45 - 9:00	26	2	9	2	39	5	0	51	1	57	5	1	2	0	8
9:00 - 9:15	29	3	5	1	38	3	0	51	4	58	8	2	2	0	12
9:15 - 9:30	26	2	8	1	37	2	0	43	3	48	4	0	2	0	6
9:30 - 9:45					0					0					0
9:45 - 10:00					0					0					0
14:15 - 14:30					0					0					0
14:30 - 14:45	35	2	10	2	49	5	0	30	1	36	15	1	11	0	27
14:45 - 15:00	44	4	12	1	61	4	0	32	3	39	12	2	8	0	22
15:00 - 15:15	45	3	11	2	61	14	2	46	4	66	8	1	10	0	19
15:15 - 15:30	43	1	7	1	52	5	0	34	3	42	8	0	8	0	16
15:30 - 15:45	51	7	16	2	76	5	1	23	4	33	13	0	3	0	16
15:45 - 16:00	46	4	17	1	68	5	2	28	7	42	9	1	7	0	17
16:00 - 16:15	41	2	15	0	58	1	0	33	9	43	7	0	5	0	12
16:15 - 16:30	78	1	14	2	95	5	0	44	6	55	9	1	6	0	16
16:30 - 16:45	57	0	13	1	71	4	0	41	4	49	8	1	6	0	15
16:45 - 17:00	61	2	15	0	78	2	0	29	3	34	9	0	4	0	13
17:00 - 17:15	76	3	15	0	94	4	0	43	2	49	16	0	7	0	23
17:15 - 17:30	77	0	17	1	95	5	0	35	1	41	6	0	3	1	10
17:30 - 17:45	68	2	13	0	83	6	1	58	1	66	9	1	5	0	15
17:45 - 18:00	54	1	12	3	70	5	0	31	3	39	10	0	2	0	12
Total:	1093	72	280	24	1469	133	8	1060	92	1293	250	19	135	2	406
Peak Count:	124	17	33	6	350	23	5	108	26	260	35	5	29	1	93
Peak Hour:	14:15 to 15:15	07:30 to 08:30	14:15 to 15:15	14:30 to 15:30	16:45 to 17:45	14:15 to 15:15	15:00 to 16:00	14:15 to 15:15	15:30 to 16:30	07:15 to 08:15	14:15 to 15:15	07:00 to 08:00	14:15 to 15:15	06:30 to 07:30	07:30 to 08:30

Data Collection Date:
Compiled by:

APPENDIX B – SIDRA Output

LANE SUMMARY

Cherryfield Rd - Washpool Rd Intersection, Gracemere
2025 AM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Cherryfield Road (South)																
Lane 1	0	159	2	161	7.8	1826	0.088	100	3.2	LOS A	0.8	5.8	500	–	0.0	0.0
Approach	0	159	2	161	7.8		0.088		3.2	NA	0.8	5.8				
North East: Washpool Road																
Lane 1	2	0	13	15	0.0	702	0.021	100	10.9	LOS B	0.1	0.5	500	–	0.0	0.0
Approach	2	0	13	15	0.0		0.021		10.9	LOS B	0.1	0.5				
North West: Cherryfield Road (North)																
Lane 1	2	43	0	45	7.0	1861	0.024	100	0.5	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	2	43	0	45	7.0		0.024		0.5	NA	0.0	0.0				
Intersection				221	7.1		0.088		3.1	NA	0.8	5.8				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

LANE SUMMARY

Site: 2025 AM Post-Development

Cherryfield Rd - Washpool Rd Intersection, Gracemere
2025 AM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap Adj %	Prob Block. %
South East: Cherryfield Road (South)																
Lane 1	0	159	6	165	7.6	1754	0.094	100	1.7	LOS A	0.9	6.7	500	–	0.0	0.0
Approach	0	159	6	165	7.6		0.094		1.7	NA	0.9	6.7				
North East: Washpool Road																
Lane 1	12	0	203	215	0.0	631	0.341	100	12.7	LOS B	1.7	12.1	500	–	0.0	0.0
Approach	12	0	203	215	0.0		0.341		12.7	LOS B	1.7	12.1				
North West: Cherryfield Road (North)																
Lane 1	83	43	0	126	2.5	1859	0.068	100	6.6	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	83	43	0	126	2.5		0.068		6.6	NA	0.0	0.0				
Intersection				506	3.1		0.341		7.6	NA	1.7	12.1				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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LANE SUMMARY

Cherryfield Rd - Washpool Rd Intersection, Gracemere
2025 PM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Cherryfield Road (South)																
Lane 1	0	43	2	45	7.0	1727	0.026	100	2.1	LOS A	0.2	1.8	500	–	0.0	0.0
Approach	0	43	2	45	7.0		0.026		2.1	NA	0.2	1.8				
North East: Washpool Road																
Lane 1	2	0	2	4	0.0	792	0.005	100	10.5	LOS B	0.0	0.1	500	–	0.0	0.0
Approach	2	0	2	4	0.0		0.005		10.5	LOS B	0.0	0.1				
North West: Cherryfield Road (North)																
Lane 1	13	159	0	172	7.4	1854	0.093	100	0.7	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	13	159	0	172	7.4		0.093		0.7	NA	0.0	0.0				
Intersection				221	7.1		0.093		1.2	NA	0.2	1.8				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

LANE SUMMARY

Cherryfield Rd - Washpool Rd Intersection, Gracemere
2025 PM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Cherryfield Road (South)																
Lane 1	0	43	12	55	5.8	1194	0.046	100	6.4	LOS A	0.4	3.0	500	–	0.0	0.0
Approach	0	43	12	55	5.8		0.046		6.4	NA	0.4	3.0				
North East: Washpool Road																
Lane 1	6	0	83	89	0.0	571	0.157	100	12.8	LOS B	0.6	4.4	500	–	0.0	0.0
Approach	6	0	83	89	0.0		0.157		12.8	LOS B	0.6	4.4				
North West: Cherryfield Road (North)																
Lane 1	203	159	0	362	3.5	1856	0.195	100	5.6	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	203	159	0	362	3.5		0.195		5.6	NA	0.0	0.0				
Intersection				506	3.1		0.195		7.0	NA	0.6	4.4				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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LANE SUMMARY

Johnson Rd - Cherryfield Rd Intersection, Gracemere
2025 AM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	Sl. Type	Cap. Adj. %	Prob Block. %
South East: Cherryfield Rd																
Lane 1	12	0	148	160	8.6	758	0.211	100	11.6	LOS B	0.9	7.0	500	–	0.0	0.0
Approach	12	0	148	160	8.6		0.211		11.6	LOS B	0.9	7.0				
North East: Johnson Rd (To Gracemere Town Centre)																
Lane 1	36	0	0	36	2.9	1819	0.020	100	9.3	LOS A	0.0	0.0	37	Turn Bay	0.0	0.0
Lane 2	0	26	0	26	32.0	1614	0.016	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	36	26	0	62	15.3		0.020		5.4	NA	0.0	0.0				
South West: Johnson Road (To Kabra)																
Lane 1	0	43	0	43	22.0	1707	0.025	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 2	0	0	7	7	28.6	870[1]	0.008	100	10.9	LOS B	0.0	0.2	43	Turn Bay	0.0	0.0
Approach	0	43	7	51	22.9		0.025		1.6	NA	0.0	0.2				
Intersection				273	12.7		0.211		8.3	NA	0.9	7.0				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

1 Reduced capacity due to a short lane effect

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LANE SUMMARY

Johnson Rd - Cherryfield Rd Intersection, Gracemere
2025 AM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap Adj %	Prob Block %
South East: Cherryfield Rd																
Lane 1	21	0	329	351	3.9	737	0.476	100	13.0	LOS B	3.4	24.6	500	–	0.0	0.0
Approach	21	0	329	351	3.9		0.476		13.0	LOS B	3.4	24.6				
North East: Johnson Rd (To Gracemere Town Centre)																
Lane 1	115	0	0	115	1.8	1833	0.063	100	9.2	LOS A	0.0	0.0	37	Turn Bay	0.0	0.0
Lane 2	0	26	0	26	32.0	1614	0.016	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	115	26	0	141	7.5		0.063		7.5	NA	0.0	0.0				
South West: Johnson Road (To Kabra)																
Lane 1	0	43	0	43	22.0	1707	0.025	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 2	0	0	11	11	20.0	932[1]	0.011	100	10.8	LOS B	0.0	0.3	43	Turn Bay	0.0	0.0
Approach	0	43	11	54	21.6		0.025		2.1	NA	0.0	0.3				
Intersection				545	6.6		0.476		10.5	NA	3.4	24.6				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
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LANE SUMMARY

Site: 2025 PM Pre-Development

Johnson Rd - Cherryfield Rd Intersection, Gracemere
2025 PM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap Adj %	Prob Block %
South East: Cherryfield Rd																
Lane 1	2	0	58	60	3.5	703	0.085	100	11.9	LOS B	0.3	2.4	500	–	0.0	0.0
Approach	2	0	58	60	3.5		0.085		11.9	LOS B	0.3	2.4				
North East: Johnson Rd (To Gracemere Town Centre)																
Lane 1	153	0	0	153	4.1	1804	0.085	100	9.4	LOS A	0.0	0.0	37	Turn Bay	0.0	0.0
Lane 2	0	60	0	60	0.0	1950	0.031	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	153	60	0	213	3.0		0.085		6.7	NA	0.0	0.0				
South West: Johnson Road (To Kabra)																
Lane 1	0	36	0	36	5.9	1878	0.019	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 2	0	0	6	6	0.0	1103[1]	0.006	100	9.9	LOS A	0.0	0.1	43	Turn Bay	0.0	0.0
Approach	0	36	6	42	5.0		0.019		1.5	NA	0.0	0.1				
Intersection				315	3.3		0.085		7.0	NA	0.3	2.4				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
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LANE SUMMARY

Johnson Rd - Cherryfield Rd Intersection, Gracemere
2025 PM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South East: Cherryfield Rd																
Lane 1	5	0	136	141	1.5	605	0.233	100	13.4	LOS B	1.0	7.0	500	–	0.0	0.0
Approach	5	0	136	141	1.5		0.233		13.4	LOS B	1.0	7.0				
North East: Johnson Rd (To Gracemere Town Centre)																
Lane 1	334	0	0	334	1.9	1832	0.182	100	9.2	LOS A	0.0	0.0	37	Turn Bay	0.0	0.0
Lane 2	0	60	0	60	0.0	1950	0.031	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	334	60	0	394	1.6		0.182		7.8	NA	0.0	0.0				
South West: Johnson Road (To Kabra)																
Lane 1	0	36	0	36	5.9	1878	0.019	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 2	0	0	16	16	0.0	972	0.016	100	10.8	LOS B	0.1	0.4	43	Turn Bay	0.0	0.0
Approach	0	36	16	52	4.1		0.019		3.3	NA	0.1	0.4				
Intersection				586	1.8		0.233		8.8	NA	1.0	7.0				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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LANE SUMMARY

Site: 2025 AM Pre-Development

Johnson Road - Lucas Street Intersection, Gracemere
2025 AM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap Adj %	Prob. Block. %
South: Johnson Rd (South)																
Lane 1	0	114	0	114	7.4	1860	0.061	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 2	0	0	62	62	8.5	1007[1]	0.062	100	9.8	LOS A	0.2	1.5	34	Turn Bay	0.0	0.0
Approach	0	114	62	176	7.8		0.062		3.5	NA	0.2	1.5				
East: Lucas Street																
Lane 1	16	0	75	91	3.5	655	0.138	100	11.7	LOS B	0.6	4.0	500	–	0.0	0.0
Approach	16	0	75	91	3.5		0.138		11.7	LOS B	0.6	4.0				
North: Johnson Rd (North)																
Lane 1	59	0	0	59	5.4	1789	0.033	100	9.2	LOS A	0.0	0.0	36	Turn Bay	0.0	0.0
Lane 2	0	59	0	59	5.4	1884	0.031	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	59	59	0	118	5.4		0.033		4.6	NA	0.0	0.0				
Intersection				384	6.0		0.138		5.8	NA	0.6	4.0				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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LANE SUMMARY

Johnson Road - Lucas Street Intersection, Gracemere
2025 AM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob Block %
South: Johnson Rd (South)																
Lane 1	0	295	0	295	2.9	1914	0.154	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 2	0	0	62	62	8.5	987[1]	0.063	100	10.2	LOS B	0.2	1.6	34	Turn Bay	0.0	0.0
Approach	0	295	62	357	3.8		0.154		1.8	NA	0.2	1.6				
East: Lucas Street																
Lane 1	16	0	75	91	3.5	446	0.203	100	15.4	LOS C	0.8	5.6	500	–	0.0	0.0
Approach	16	0	75	91	3.5		0.203		15.4	LOS C	0.8	5.6				
North: Johnson Rd (North)																
Lane 1	59	0	0	59	5.4	1789	0.033	100	9.2	LOS A	0.0	0.0	36	Turn Bay	0.0	0.0
Lane 2	0	137	0	137	2.3	1921	0.071	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	59	137	0	196	3.2		0.071		2.8	NA	0.0	0.0				
Intersection				643	3.6		0.203		4.0	NA	0.8	5.6				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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LANE SUMMARY

Johnson Road - Lucas Street Intersection, Gracemere
2025 PM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob Block. %
South: Johnson Rd (South)																
Lane 1	0	60	0	60	10.5	1825	0.033	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 2	0	0	31	31	6.9	989[1]	0.031	100	10.3	LOS B	0.1	0.8	34	Turn Bay	0.0	0.0
Approach	0	60	31	91	9.3		0.033		3.5	NA	0.1	0.8				
East: Lucas Street																
Lane 1	39	0	65	104	13.1	610	0.171	100	12.6	LOS B	0.7	5.3	500	–	0.0	0.0
Approach	39	0	65	104	13.1		0.171		12.6	LOS B	0.7	5.3				
North: Johnson Rd (North)																
Lane 1	102	0	0	102	2.1	1830	0.056	100	9.0	LOS A	0.0	0.0	36	Turn Bay	0.0	0.0
Lane 2	0	155	0	155	5.4	1883	0.082	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	102	155	0	257	4.1		0.082		3.6	NA	0.0	0.0				
Intersection				452	7.2		0.171		5.7	NA	0.7	5.3				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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LANE SUMMARY

Johnson Road - Lucas Street Intersection, Gracemere
2025 PM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Johnson Rd (South)																
Lane 1	0	138	0	138	4.6	1894	0.073	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Lane 2	0	0	31	31	6.9	899	0.034	100	11.3	LOS B	0.1	1.0	34	Turn Bay	0.0	0.0
Approach	0	138	31	168	5.0		0.073		2.0	NA	0.1	1.0				
East: Lucas Street																
Lane 1	39	0	65	104	13.1	407	0.256	100	17.2	LOS C	1.0	8.1	500	–	0.0	0.0
Approach	39	0	65	104	13.1		0.256		17.2	LOS C	1.0	8.1				
North: Johnson Rd (North)																
Lane 1	102	0	0	102	2.1	1830	0.056	100	9.0	LOS A	0.0	0.0	36	Turn Bay	0.0	0.0
Lane 2	0	336	0	336	2.5	1919	0.175	100	0.0	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	102	336	0	438	2.4		0.175		2.1	NA	0.0	0.0				
Intersection				711	4.6		0.256		4.3	NA	1.0	8.1				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
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SIDRA INTERSECTION

LANE SUMMARY

Johnson Road - Breakspear Street Intersection, Gracemere
2025 AM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap Adj %	Prob Block %
South: Johnson Road (South)																
Lane 1	0	281	89	371	5.4	1607	0.231	100	2.8	LOS A	1.6	11.7	500	–	0.0	0.0
Approach	0	281	89	371	5.4		0.231		2.8	NA	1.6	11.7				
East: Breakspear Street																
Lane 1	88	0	80	168	2.5	511	0.330	100	14.0	LOS B	1.5	11.0	500	–	0.0	0.0
Approach	88	0	80	168	2.5		0.330		14.0	LOS B	1.5	11.0				
North: Johnson Road (North)																
Lane 1	81	174	0	255	6.2	1844	0.138	100	4.7	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	81	174	0	255	6.2		0.138		4.7	NA	0.0	0.0				
Intersection				794	5.0		0.330		5.8	NA	1.6	11.7				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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Project: H:\R13\0\1\R13018\Admin\Traffic Report - June 2013\Johnson Rd - Breakspear St Int.sip
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SIDRA INTERSECTION

LANE SUMMARY

Site: 2025 AM Post-Development

Johnson Road - Breakspear Street Intersection, Gracemere
2025 AM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap Adj %	Prob Block %
South: Johnson Road (South)																
Lane 1	0	453	99	552	3.6	1650	0.334	100	3.3	LOS A	2.9	21.0	500	–	0.0	0.0
Approach	0	453	99	552	3.6		0.334		3.3	NA	2.9	21.0				
East: Breakspear Street																
Lane 1	95	0	80	175	2.4	344	0.508	100	22.6	LOS C	2.8	20.0	500	–	0.0	0.0
Approach	95	0	80	175	2.4		0.508		22.6	LOS C	2.8	20.0				
North: Johnson Road (North)																
Lane 1	81	247	0	328	4.8	1867	0.176	100	4.3	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	81	247	0	328	4.8		0.176		4.3	NA	0.0	0.0				
Intersection				1055	3.8		0.508		6.8	NA	2.9	21.0				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

LANE SUMMARY

Johnson Road - Breakspear Street Intersection, Gracemere
2025 PM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Johnson Road (South)																
Lane 1	0	285	102	387	5.4	1482	0.261	100	4.1	LOS A	2.0	14.5	500	–	0.0	0.0
Approach	0	285	102	387	5.4		0.261		4.1	NA	2.0	14.5				
East: Breakspear Street																
Lane 1	75	0	79	154	1.4	380	0.405	100	18.8	LOS C	2.0	13.9	500	–	0.0	0.0
Approach	75	0	79	154	1.4		0.405		18.8	LOS C	2.0	13.9				
North: Johnson Road (North)																
Lane 1	118	282	0	400	5.3	1858	0.215	100	4.6	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	118	282	0	400	5.3		0.215		4.6	NA	0.0	0.0				
Intersection				941	4.7		0.405		6.7	NA	2.0	14.5				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

LANE SUMMARY

Johnson Road - Breakspear Street Intersection, Gracemere
2025 PM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Johnson Road (South)																
Lane 1	0	359	105	464	4.5	1398	0.332	100	6.5	LOS A	3.6	26.5	500	–	0.0	0.0
Approach	0	359	105	464	4.5		0.332		6.5	NA	3.6	26.5				
East: Breakspear Street																
Lane 1	84	0	79	163	1.3	241	0.676	100	36.1	LOS E	3.9	27.5	500	–	0.0	0.0
Approach	84	0	79	163	1.3		0.676		36.1	LOS E	3.9	27.5				
North: Johnson Road (North)																
Lane 1	118	454	0	572	3.7	1885	0.303	100	4.1	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	118	454	0	572	3.7		0.303		4.1	NA	0.0	0.0				
Intersection				1199	3.7		0.676		9.4	NA	3.9	27.5				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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SIDRA INTERSECTION

LANE SUMMARY

Site: 2025 AM Pre-Development

Johnson Road - Middle Road Intersection, Gracemere
2025 AM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block. %
South: Johnson Rd (South)																
Lane 1	46	353	0	399	6.6	1859	0.215	100	0.5	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	46	353	0	399	6.6		0.215		0.5	NA	0.0	0.0				
North: Johnson Rd (North)																
Lane 1	0	248	79	327	6.4	1499	0.218	100	6.2	LOS A	1.6	11.8	500	–	0.0	0.0
Approach	0	248	79	327	6.4		0.218		6.2	NA	1.6	11.8				
West: Middle Rd																
Lane 1	78	0	53	131	4.8	427	0.306	100	13.0	LOS B	1.3	9.5	500	–	0.0	0.0
Approach	78	0	53	131	4.8		0.306		13.0	LOS B	1.3	9.5				
Intersection				857	6.3		0.306		4.6	NA	1.6	11.8				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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LANE SUMMARY

Johnson Road - Middle Road Intersection, Gracemere
2025 AM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap Adj %	Prob Block %
South: Johnson Rd (South)																
Lane 1	56	516	0	572	4.6	1884	0.303	100	0.4	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	56	516	0	572	4.6		0.303		0.4	NA	0.0	0.0				
North: Johnson Rd (North)																
Lane 1	0	318	89	407	7.8	1313	0.310	100	10.0	LOS A	3.6	26.7	500	–	0.0	0.0
Approach	0	318	89	407	7.8		0.310		10.0	NA	3.6	26.7				
West: Middle Rd																
Lane 1	78	0	56	134	4.7	265	0.505	100	24.2	LOS C	2.4	17.3	500	–	0.0	0.0
Approach	78	0	56	134	4.7		0.505		24.2	LOS C	2.4	17.3				
Intersection				1113	5.8		0.505		6.8	NA	3.6	26.7				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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LANE SUMMARY

Site: 2025 PM Pre-Development

Johnson Road - Middle Road Intersection, Gracemere
2025 PM Pre-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap veh/h	Deg Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap Adj %	Prob Block %
South: Johnson Rd (South)																
Lane 1	29	275	0	304	4.5	1884	0.161	100	0.4	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	29	275	0	304	4.5		0.161		0.4	NA	0.0	0.0				
North: Johnson Rd (North)																
Lane 1	0	461	94	555	2.3	1685	0.329	100	5.5	LOS A	2.8	19.9	500	–	0.0	0.0
Approach	0	461	94	555	2.3		0.329		5.5	NA	2.8	19.9				
West: Middle Rd																
Lane 1	66	0	33	99	4.3	400	0.247	100	12.9	LOS B	0.9	6.6	500	–	0.0	0.0
Approach	66	0	33	99	4.3		0.247		12.9	LOS B	0.9	6.6				
Intersection				958	3.2		0.329		4.7	NA	2.8	19.9				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
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LANE SUMMARY

Johnson Road - Middle Road Intersection, Gracemere
2025 PM Post-Development
Giveway / Yield (Two-Way)

Lane Use and Performance

	Demand Flows L veh/h	T veh/h	R veh/h	Total veh/h	HV %	Cap. veh/h	Deg. Satn v/c	Lane Util. %	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Lane Length m	SL Type	Cap. Adj. %	Prob. Block %
South: Johnson Rd (South)																
Lane 1	33	344	0	377	3.6	1896	0.199	100	0.4	LOS A	0.0	0.0	500	–	0.0	0.0
Approach	33	344	0	377	3.6		0.199		0.4	NA	0.0	0.0				
North: Johnson Rd (North)																
Lane 1	0	624	98	722	1.9	1698	0.425	100	7.0	LOS A	5.6	39.8	500	–	0.0	0.0
Approach	0	624	98	722	1.9		0.425		7.0	NA	5.6	39.8				
West: Middle Rd																
Lane 1	66	0	43	109	3.8	231	0.474	100	27.2	LOS D	2.1	15.5	500	–	0.0	0.0
Approach	66	0	43	109	3.8		0.474		27.2	LOS D	2.1	15.5				
Intersection				1208	2.6		0.474		6.8	NA	5.6	39.8				

Level of Service (LOS) Method: Delay (HCM 2000).
Lane LOS values are based on average delay per lane.
Minor Road Approach LOS values are based on average delay for all lanes.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road lanes.
SIDRA Standard Delay Model used.

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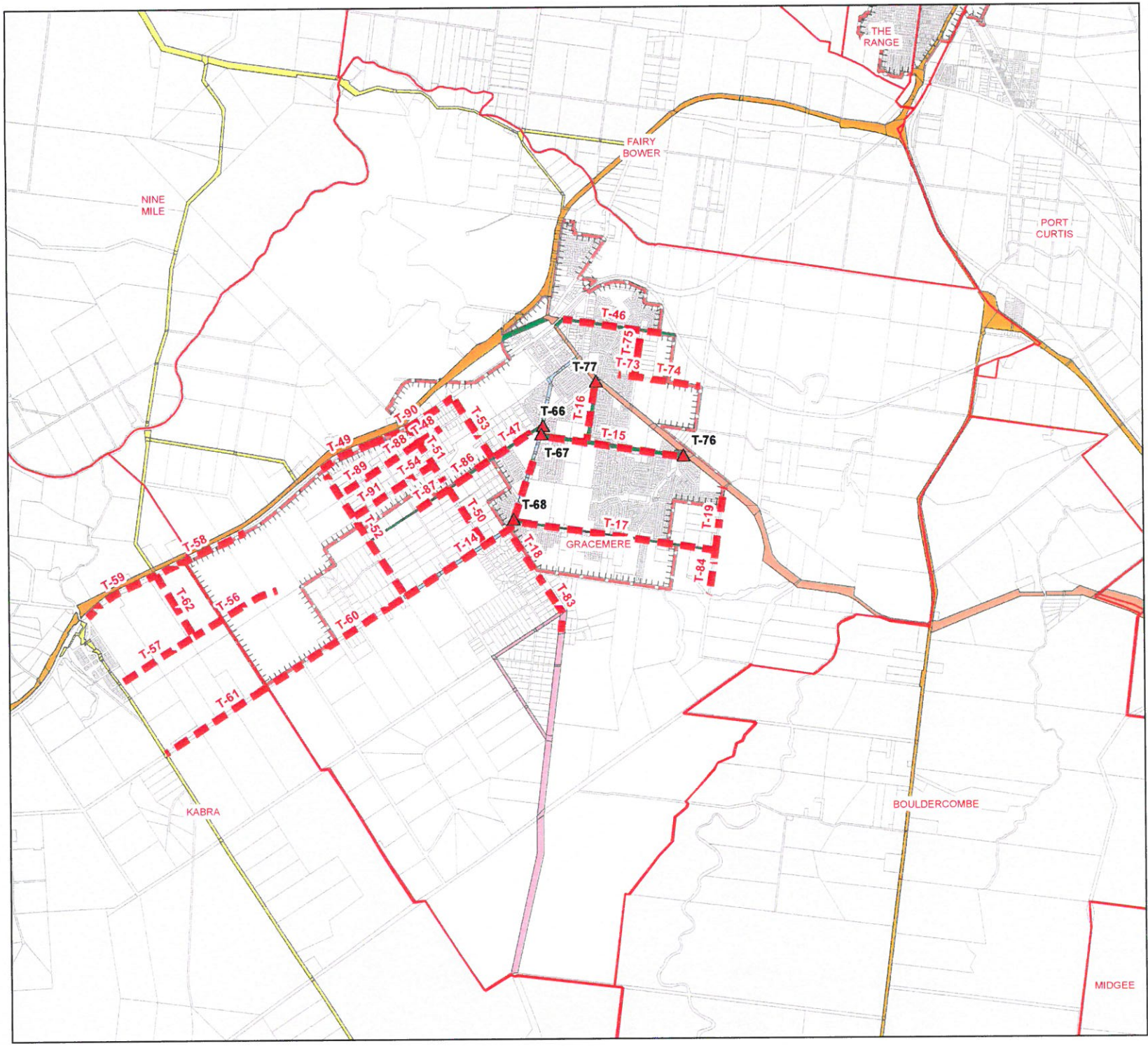
SIDRA INTERSECTION

APPENDIX C – Ultimate Road Hierarchy



Trunk Infrastructure - Transport

- Locality Boundaries

Future Trunk Infrastracture

- Bridge
- Intersection
- Road Works

Existing Trunk Infrastructure

- 1 - Highway
- 2 - Main Road
- 3 - Rural Arterial
- 4A - Major Rural Collector
- 6A - Major Urban Arterial
- 6B - Urban Arterial
- 6C - Urban Sub-Arterial
- 7 - Major Urban Collector
- Cadastral Parcels
- Priority Infrastructure Area

Note: Priority Infrastructure Area located inside hashed boundary.

Approx Scale @A3 1:45,000

0 650 1,300 2,600 Metres

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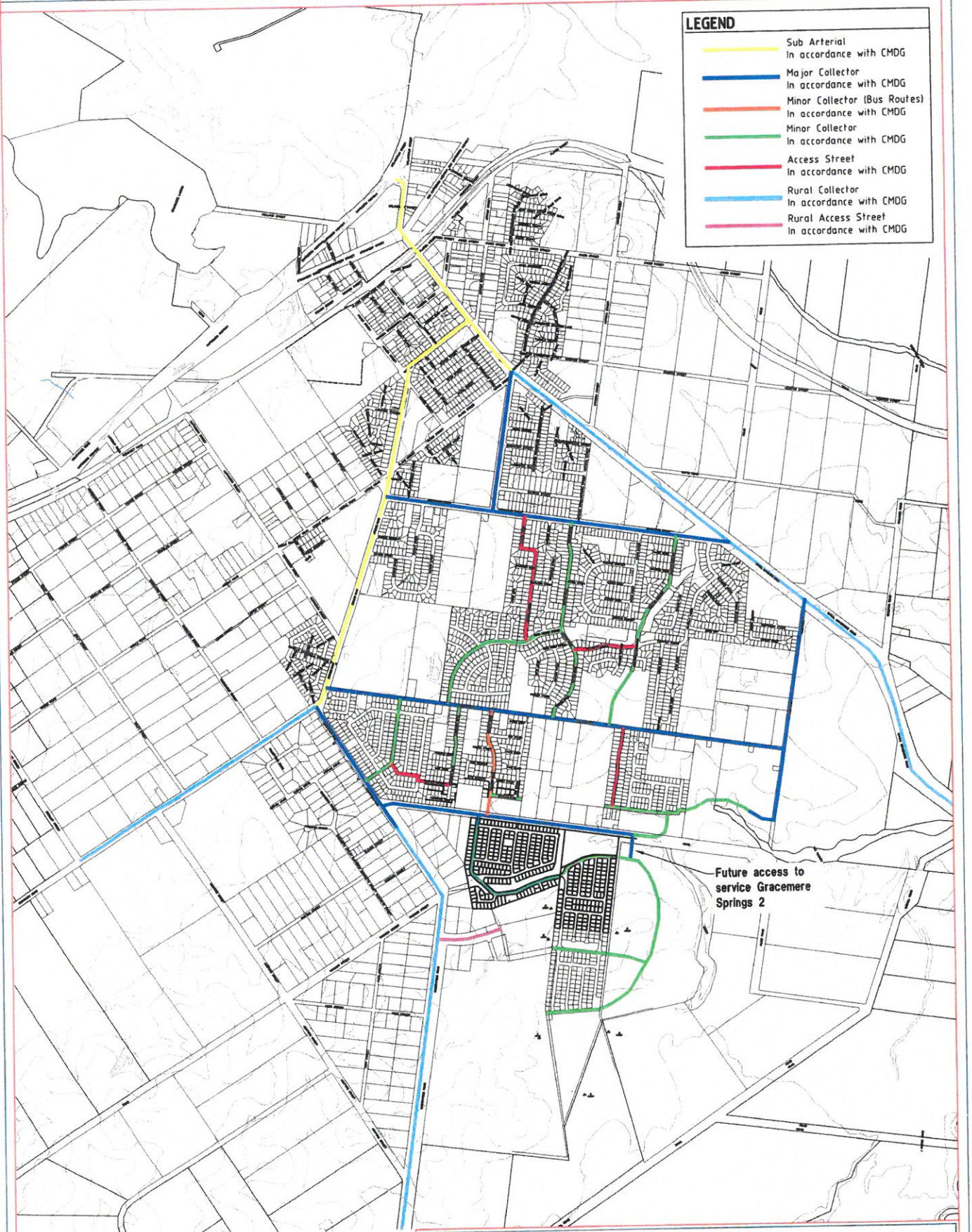
Map 39-3
GRACEMERE
Transport Network Infrastructure Map

December 2012

Rockhampton Regional Council



GRACEMERE SPRINGS 2
ULTIMATE ROAD
HIERARCHY PLAN - R13018

0 50.0 200.0m 1:10,000 (A1)
0 100.0 400.0m 1:20,000 (A3)

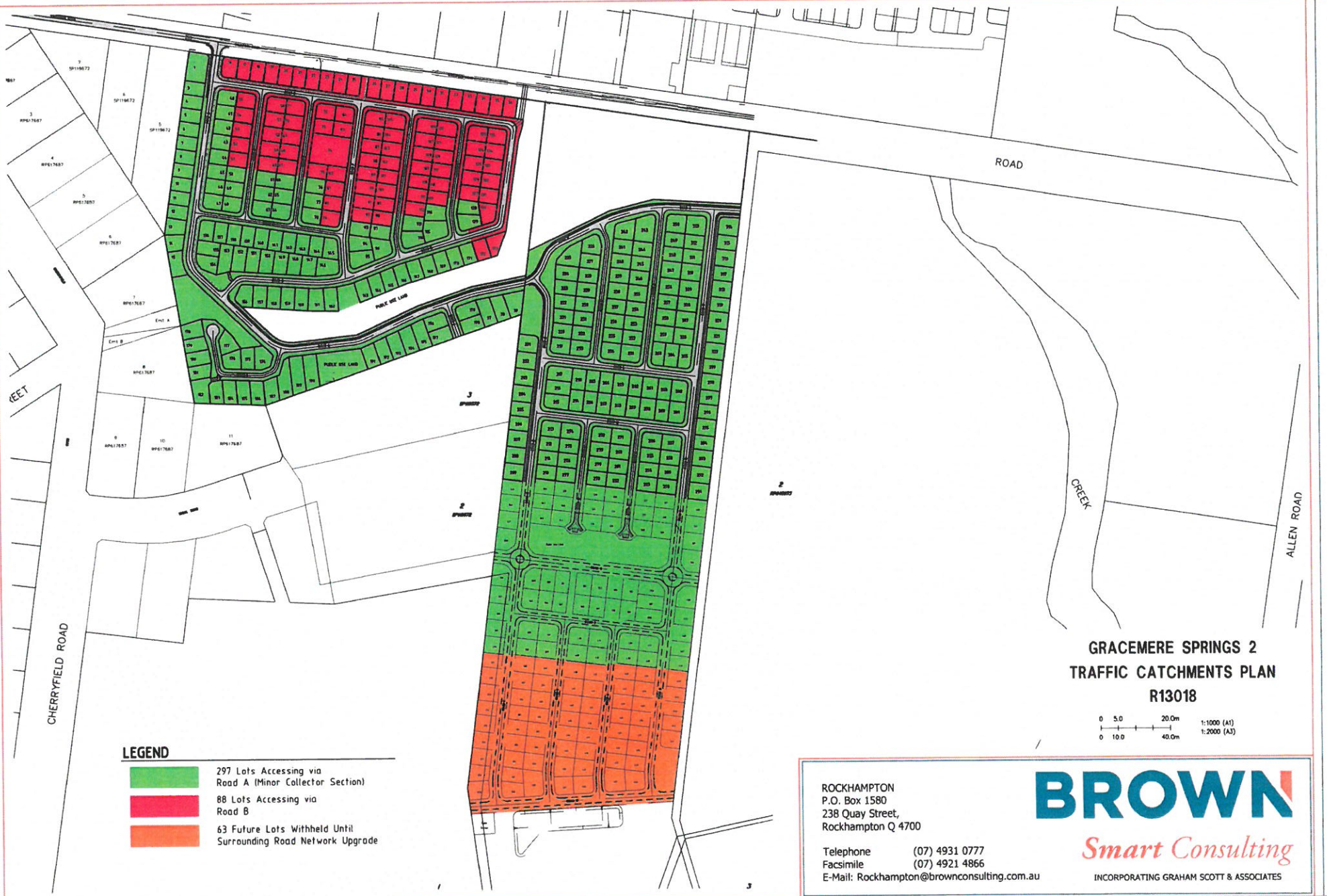
ROCKHAMPTON
P.O. Box 1580
238 Quay Street,
Rockhampton Q 4700

Telephone (07) 4931 0777
Facsimile (07) 4921 4866
E-Mail: Rockhampton@brownconsulting.com.au

BROWN
Smart Consulting
INCORPORATING GRAHAM SCOTT & ASSOCIATES

BROWN
Smart Urban

APPENDIX D – Gracemere Springs 2 Traffic Catchment Plan



GRACEMERE SPRINGS 2
TRAFFIC CATCHMENTS PLAN
R13018

0 5.0 20.0m
0 10.0 40.0m
1:1000 (A1)
1:2000 (A3)

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Smart Consulting
INCORPORATING GRAHAM SCOTT & ASSOCIATES

ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with Development Permit No. D588-2012
Dated 05/04/2016

LEGEND

- Sub Arterial In accordance with CMDG
- Major Collector In accordance with CMDG
- Minor Collector (Bus Routes) In accordance with CMDG
- Minor Collector In accordance with CMDG
- Access Street In accordance with CMDG
- Rural Collector In accordance with CMDG
- Rural Access Street In accordance with CMDG

Future access to service Gracemere Springs 2

Existing Major Drainage Flow Path

GRACEMERE SPRINGS 2
ULTIMATE ROAD
HIERARCHY PLAN - R13018

0 50.0 200.0m
0 100.0 400.0m
1:10,000 (A1)
1:20,000 (A3)

ROCKHAMPTON
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FITZROY
RIVER WATER
Business Unit of RRC

ROCKHAMPTON REGIONAL COUNCIL
These plans are approved subject to the current conditions of approval associated with Development Permit No. D588-2012
Dated 05/04/2016

31 May 2013

Our Ref: 1335/1358
Enquiries: Peter Wheelhouse
Telephone: 4932 9000 or 1300 22 55 77
Fax: 4936 8862 or 1300 22 55 79
Enquiries: enquiries@rrc.qld.gov.au

Gracemere Springs 1 Pty Ltd
C/- Brown Consulting Pty Ltd
PO BOX 1580
ROCKHAMPTON QLD 4700

ATTENTION: PETER MORLEY

Dear Peter

WATER NETWORK ANALYSIS – 70 WASHPOOL ROAD, GRACEMERE

I refer to your request for the above work; please find enclosed the water network analysis as requested.

An invoice in the amount of $1,380.00 (6 hrs water) will be forwarded to you in the near future.

Should you require any further information in relation to this matter please do not hesitate to contact me on either of the contact details listed above.

Yours faithfully

Peter Wheelhouse
Manager Network Systems
Fitzroy River Water
Regional Services

Enc Water Network Analysis

Water Network Analysis

Client:	Gracemere Springs 1 Pty Ltd	
Address:	C/-	Brown Consulting Pty Ltd PO Box 1580 ROCKHAMPTON QLD 4700
Site Address:	70 Washpool Rd, GRACEMERE	

Description of Analysis:

Investigate the capacity of the water reticulation network to accommodate the proposed 199 lot residential subdivision located at 70 Washpool Rd, Gracemere on Lot 4 SP119674 as detailed in the plan received by Council on 4 April 2013.

- Refer Attachment A Allotment layout

Network Analysis

Existing Reticulation

The subject site is located outside the current water supply area. It is proposed to bring the site into the Lucas St reservoir supply zone. The zone is primarily supplied via the Lucas St Pump Station located adjacent to the Lucas St reservoir. The current set point for the Lucas Street pump station is 540kPa.

The existing reticulation terminates at the intersection of Cherryfield Road and Washpool Road with dual interconnected 200mm and 150mm mains.

Future Reticulation

It is recommend that a connection is taken off the existing 200mm main and a new 200mm main be extended along the southern side of Washpool Road a distance of approximately 800m to the entrance of the subject development.

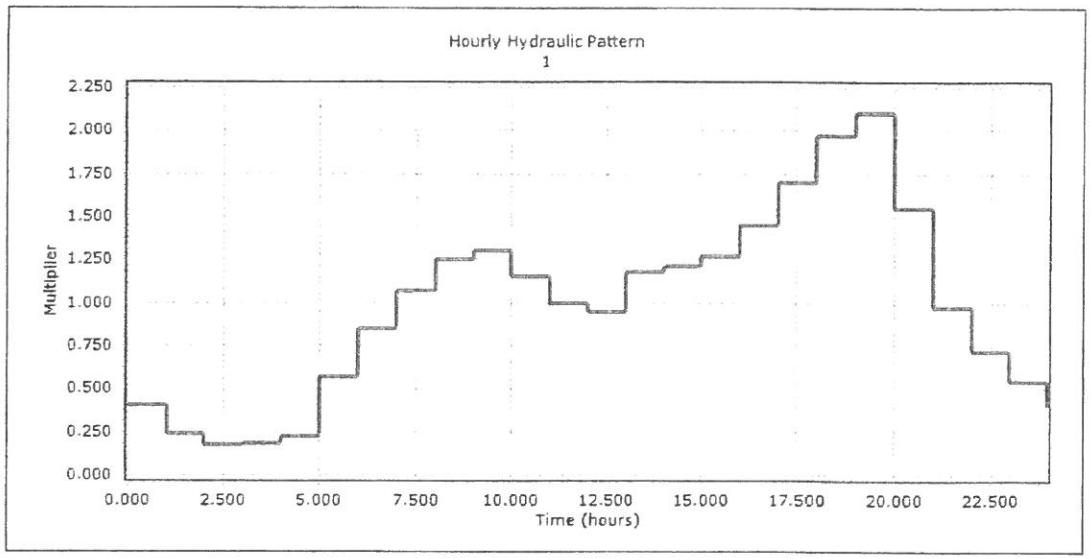
- Refer Attachment B Future External Reticulation

Estimated Demands

The demands for the proposed development have been calculated based on the following assumption.

- Maximum Day (MD) Base Demand per ET = 0.03 L/s

These demands have been apportioned throughout the assumed reticulation network layout and have been applied to the model using a residential diurnal pattern identified as Curve 1.



Fire Fighting

For a residential development the following fire fighting requirement is applicable.

- Design criteria of 15L/s @ 120kPa residual pressure

Results:

These results are theoretical and based on the use of the water model (WaterGEMs V8i), which has been developed by Council based on the best information available. Errors in the model may occur due to a range of factors. The results should not be taken to represent measured values in the pipe network, as the condition at the time of measuring may be different to those modeled.

- Refer Attachment C - Optimised Internal Pipe Sizing and Residual Pressure Results

Scenario	Residual Pressure (kPa)		
	Residential Demand		Fire Flow @ 15 L/s
	Min	Max	
1	625	771	500

Summary of Residual Pressure Results

Discussion:

The residual residential pressures are considered high although still within the adopted service standard range of 220kPa and 800kPa.

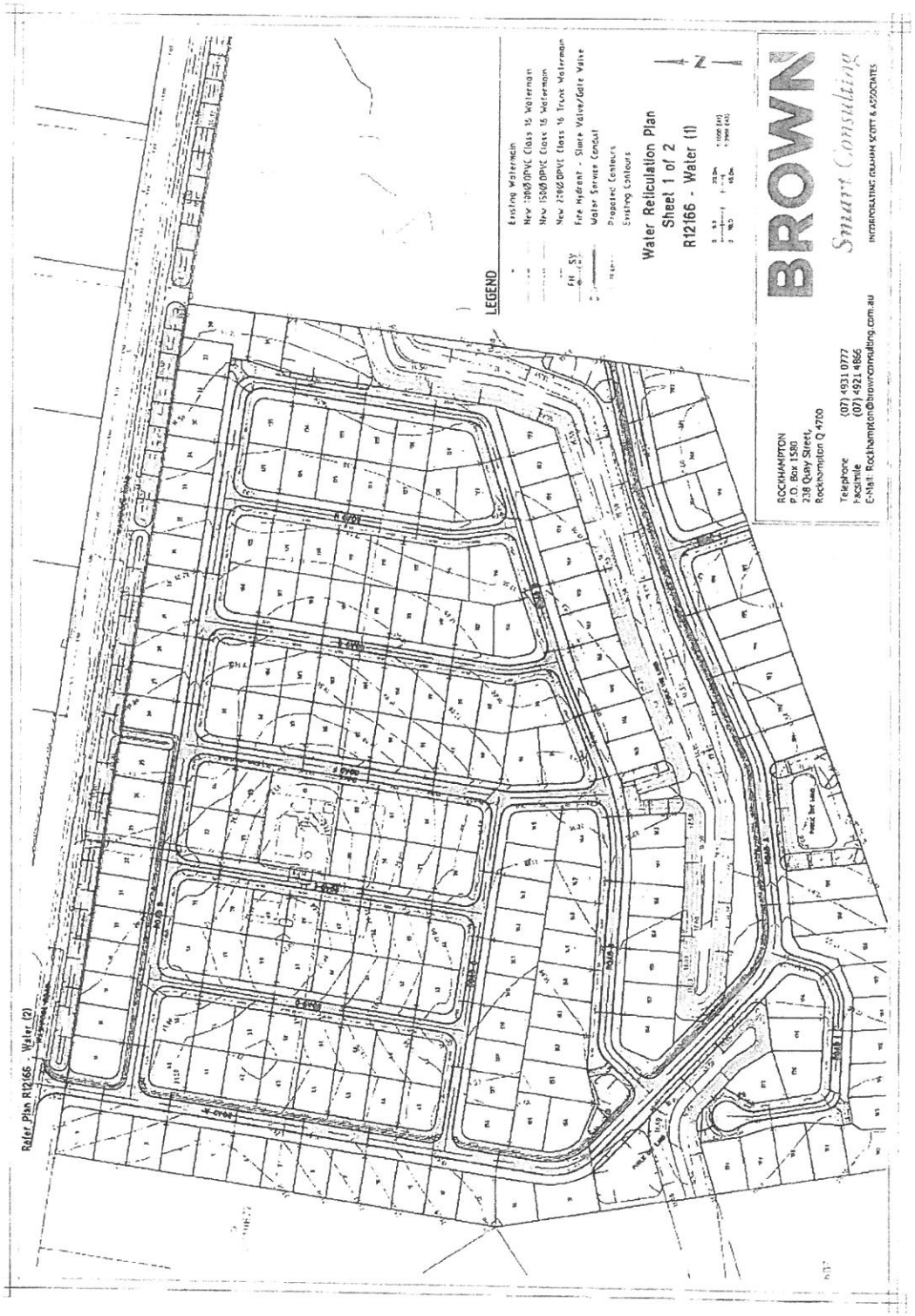
There is no requirement for pressure management at this time as it is anticipated that the set point for the Lucas St pump station will be reduced as future reticulation augmentation works are progressively implemented.

Recommendations:

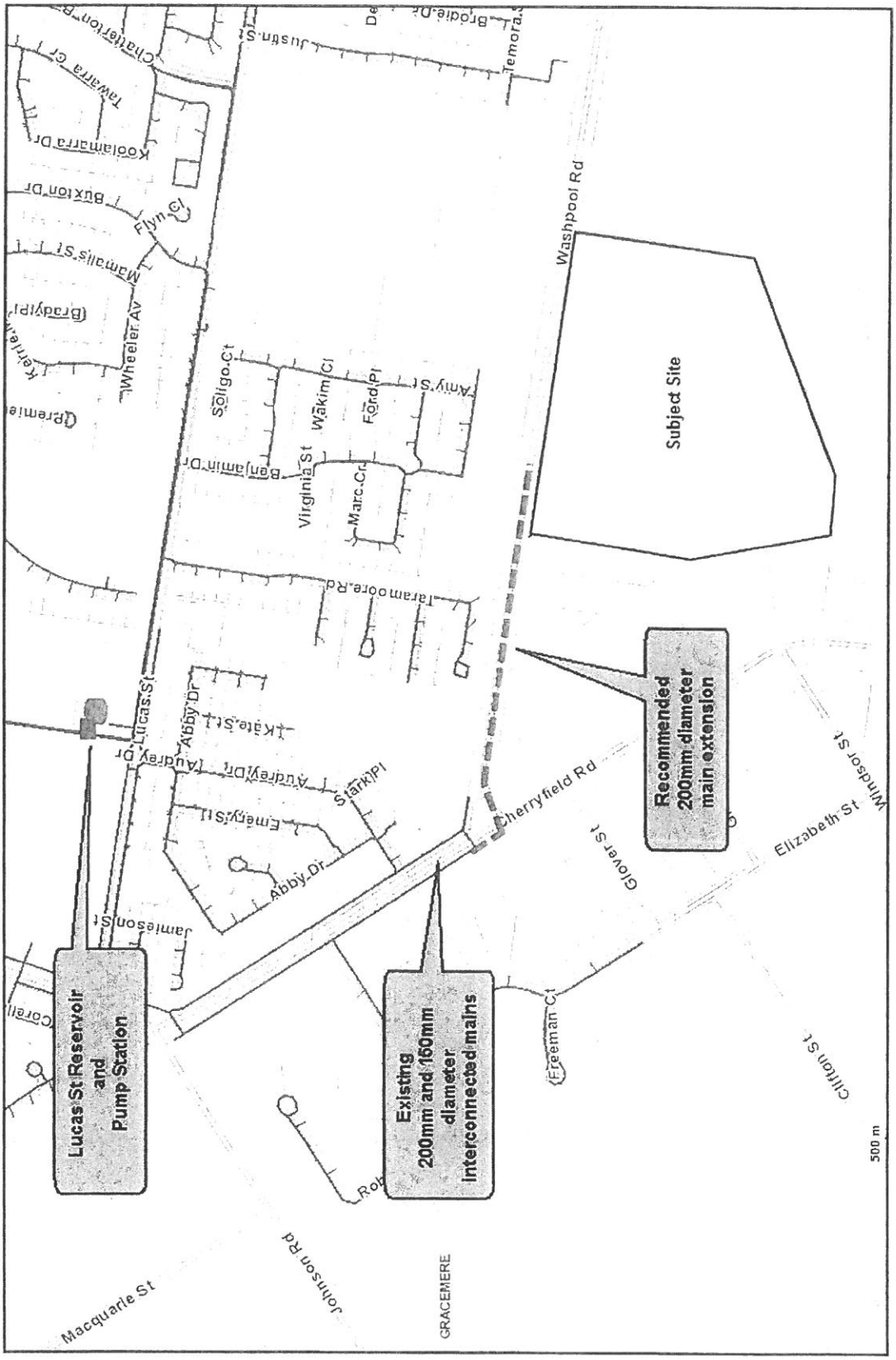
It is recommended the proposed 199 lot residential subdivision should be serviced via a 200mm diameter connection to the existing 200mm diameter main in Cherryfield Rd. The proposed main should extend approximately 800m to the entrance of the subject site following the southern side of Washpool Road.

End of Report
Date 30 May 2013

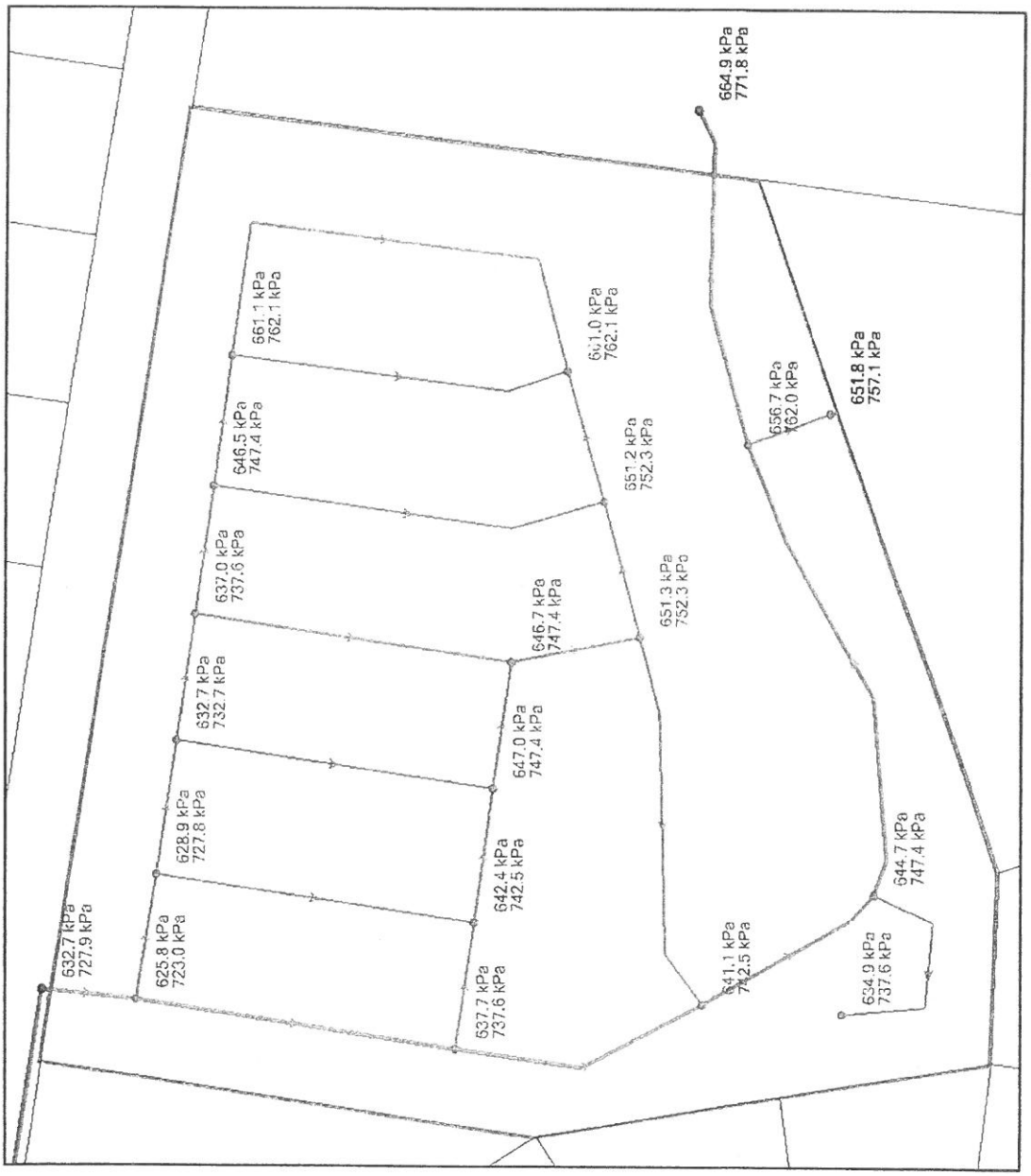
Attachment A
Allotment layout sketch



Attachment B
Future External Reticulation



Attachment C
Optimised Internal Pipe Sizing and Residual Pressure Results



The colour coding for optimised pipe sizing diameters

Green 100mm
Blue 150mm
Red 200mm