

SITE BASED STORMWATER MANAGEMENT AND CIVIL ENGINEERING REPORT

**FOR THE PROPOSED
MIXED-USE DEVELOPMENT**

PLANS AND DOCUMENTS
referred to in the **ULDA**
APPROVAL dated 21 / 6 / 12

**LOCATED AT
REMORA ROAD
HAMILTON**

**PREPARED FOR
SHAYHER DEVELOPMENTS PTY LTD**

**BY
BORNHORST & WARD PTY LTD**

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Bornhorst & Ward Project No. **12008**

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1. INTRODUCTION

Bornhorst and Ward has been commissioned to investigate and report on the Civil Engineering and Servicing requirements pertaining to the proposed Mixed-Use development located at Remora Road, Hamilton. The site is located on cancelled Lot 1160 on SP108456, which has recently been subdivided into Lots 402-407 on SP187479. Included in this subdivision, was the allocation of 2436m² in the southwest corner of the cancelled lot for new road to allow for the realignment of Macarthur Avenue. Refer to the Plan of Lots 402-407 in Appendix A for details. The development site is located across Lots 402, 403 and 406. The proposed development is shown on the attached Woods Bagot Architectural Design Plans in Appendix B. The proposal consists of residential, commercial and retail spaces, underground basement car parking, road construction on Lot 406 and all associated services and infrastructure.

It should be noted that Lots 404, 405 and 407 on SP187479 have no bearing on the proposed development, nor does the realignment of Macarthur Avenue, and as such, these items have not been included in the proposal. Lot 407 will become a future road, to be constructed by others, prior to the completion of the proposed development. This future road will provide access into the proposed development's basement car park. Refer to the Woods Bagot Architectural Design Plans in Appendix B.

The following document reports on the engineering investigation relating to the proposed development on Lots 402, 403 and 406 only, and considers the effects that this development may cause on neighbouring properties, and the services and works required for the proposal. All Engineering requirements shall be in accordance with the Brisbane City Council (BCC) Guidelines, State Planning Policy 4/10 - Healthy Waters and the Queensland Urban Drainage Manual (QUDM). This report outlines the preliminary design methodology and calculations in support of a Development Application and should be read in conjunction with other documents issued by the consultant team.

2. SITE CHARACTERISTICS

2.1 LOCATION

The subject site is within the declared Northshore Hamilton Urban Development Area (UDA) located approximately six kilometres from the Brisbane CBD in a major renewal area adjacent to the Brisbane River. The Northshore Hamilton UDA includes land between Kingsford Smith Drive and the Brisbane River extending from Brett's Wharf to the west and the Gateway Motorway to the east, incorporating the Royal Queensland Golf Club at the eastern extent. The subject site is located on Remora Road in the western extent of the UDA, and is indicated in the figure on the following page.

The development site has a western frontage to Remora Road and is opposite the Hamilton Recreation Reserve which is a public park. The site is bound by the Macarthur Avenue realignment dedication to the south, a commercial development to the north and a future road reserve to the east which will connect the development site directly to Curtin Avenue West and Macarthur Avenue. Further east of the site are industrial/commercial developments, as indicated in the figure on the following page.

Street Address: Remora Road, Hamilton
RP Description: Lots 402, 403 and 406 on SP187479



Figure 1: NearMap Aerial Image - Remora Road, Hamilton (accessed 08/02/2012)

2.2 LANDUSE

2.2.1 EXISTING

The south portion of the site is currently occupied by a bitumen car park and areas of compacted bare earth. The north portion is currently vacant and is comprised primarily of compacted bare earth and gravel, with isolated patches of short grasses around the boundaries. Two vehicle crossovers exist into the site from Remora Road. Refer to Figure 1 above and the LandPartners Detail Survey plan in Appendix C for details.

2.2.2 PROPOSED

The development proposal consists of the construction of eight multi-storey, multi-use buildings (four on Lot 402 and four on Lot 403) which includes residential, commercial and retail spaces, underground basement car parking across the entire site (accessed from the future road to the east of the site) and landscaping. A road will be constructed on Lot 406 to provide access to the site from Remora Road and will connect with the future public road to be constructed on Lot 407. The proposed scheme contains a diverse mix of building heights, uses and apartment types.

The site masterplan provides for eight buildings across the two Lots, 402 and 403:

- Lot 402 (Site D):
 - o Building 1: 12 levels, 71 apartments and 407m² Retail GFA
 - o Building 2: 5 levels, 3630m² Commercial GFA
 - o Building 3: 12 levels, 88 apartments and 223m² Retail GFA
 - o Building 4: 5 levels, 18 apartments
 - o Total Site D Commercial Area: 3630m² GFA
 - o Total Site D Retail Area: 630m² GFA
- Lot 403 (Site C):
 - o Building 5A: 8 levels, 28 apartments and 342m² Retail GFA
 - o Building 5B: 8 levels, 29 apartments and 193m² Retail GFA
 - o Building 6A: 8 levels, 24 apartments
 - o Building 6B: 7 levels, 27 apartments
 - o Total Site C Retail Area: 535m² GFA

Car parking is provided in a one level basement with 321 car spaces for retail users and residents. Visitor car parking will be provided on the podium level within Lot 403.

The future public road on Lot 407, which does not form part of this proposal, will be constructed by others prior to the completion of the development. This road will connect Curtin Avenue West, Macarthur Avenue and the east-west road on Lot 406, as well as providing access into development site basement car parking. This forms part of the Northshore Hamilton UDA Trunk Roads Upgrade. Refer to the Parsons Brinckerhoff Northshore Hamilton UDA Precincts 2 & 3 – Trunk Roads Concept Layout attached in Appendix H. The realignment and upgrade of Macarthur Avenue and the upgrade of Remora Road are also included in the Northshore Hamilton UDA Trunk Roads Upgrade.

However, these roads have not been designed yet, and as such, the levels at the perimeter of the site have been estimated based on existing levels and the proposed road corridor layouts, and may be subject to change. Refer to the Bornhorst & Ward Preliminary Site Levels drawing SK-C010 attached in Appendix D.

2.3 TOPOGRAPHY & SITE DRAINAGE

The development site has an area of approximately 1.25ha and ranges in level from RL4.06m AHD at the northeast corner, to RL3.08m AHD at the north boundary approximately 52m from the Remora Road road reserve. The site has an average grade of approximately 1.0%, falling from the east boundary to the west boundary.

Stormwater runoff drains from the site into the adjacent road reserves of Remora Road to the west and Macarthur Avenue to the south, primarily as overland flow. An existing drainage pit is located within the site adjacent to the west boundary approximately 35m north of the Remora Road and Hercules Street roundabout. This drainage pit likely drains to an existing gully pit in Remora Road, however; no survey information confirms this. Refer to the LandPartners Detail Survey Plan in Appendix C for further details.

3. SITE FLOODING

To establish minimum floor levels for the proposed building structures on Lots 402 and 403, separate Brisbane City Council FloodWise Property Reports were obtained for the respective allotments.

The report for Lot 402 indicated the highest source of flooding was from storm tide and the 100 year ARI yielded an expected flood level of 2.5m AHD. As was the case for Lot 402, the report for Lot 403 indicated the highest source of flooding was from storm tide with the same 100 year ARI flood level of 2.5m AHD.

However, previous studies completed in the vicinity of the development site, a SKM Site Based Management Plan (August 2003) and Bornhorst & Ward Engineering Report (November 2010), indicate that the area surrounding the development site is not only affected by storm tide flooding, but also local flooding from stormwater ponding. Review of these investigations; indicate local flooding is experienced during a 100 year ARI storm event within a sag in Hercules Street (west of the site) to RL3.4m AHD. As a conservative measure, this 100 year ARI flood level has been adopted.

Under Brisbane City Council Subdivision and Development Guidelines, no freeboard is required to commercial or basement areas. However, it is recommended that 100mm freeboard is provided to these areas as a conservative measure, and hence these levels shall be set at or above RL3.5m AHD. Freeboard to the basement will be provided at the basement entrance to prevent inundation.

The residential premises within the proposed development will have a minimum finished floor level of RL3.9m AHD, providing 500mm freeboard to the expected 100 year ARI flood level in the local area.

4. EXISTING AND PROPOSED CIVIL INFRASTRUCTURE

4.1 STORMWATER

4.1.1 EXISTING INFRASTRUCTURE

There is existing stormwater infrastructure located within the development site and the road reserves fronting the site. These are summarised as follows, and illustrated in the Brisbane City Council eBIMAP Infrastructure Plans and the LandPartners Detail Survey Plan in Appendix C;

- Previously discussed in Section 2.3 of this report, there is an existing stormwater pit at the west boundary of the site approximately 35m north of the Remora Road and Hercules Street roundabout.
- There is an existing drainage line at the west end of Curtin Avenue West, which directs stormwater west to Remora Road. This drainage line continues south discharging stormwater to the Brisbane River via a 2100 by 2700 box culvert.
- Numerous gully pits are located along Remora Road adjacent to the west boundary of the development site. These gully pits connect with the stormwater line in the Remora Road road reserve.

- Another drainage line is located at the west end of Macarthur Avenue, south of the development site, which discharges to the Brisbane River via a 900mm diameter pipe.

4.1.2 PROPOSED INFRASTRUCTURE

Due to the extent of the basement car park beneath the development site, an internal podium drainage system will be provided (to be designed by the hydraulic engineer) to direct runoff towards the existing stormwater infrastructure located in Remora Road west of the site and to future infrastructure to be constructed within the re-alignment of Macarthur Avenue south of the site.

Stormwater connection stubs will be provided from the stormwater infrastructure (both existing and future) in Remora Road and the re-alignment of Macarthur Avenue. The number of connections into the existing and future infrastructure required to service the internal drainage system is to be advised by the hydraulic engineer.

The east-west road to be constructed on Lot 406 is proposed to have a crest near the middle of the site to ensure runoff is directed to the external road reserves. Refer to the Bornhorst & Ward Preliminary Site Levels drawing SK-C010 in Appendix D. Runoff from this road will be captured and conveyed by existing and future stormwater infrastructure within the external road reserves of Remora Road and the future public road to be constructed on Lot 407. For further details of the road to be constructed on Lot 406, refer to the East-West Road drawings attached in Appendix J.

As part of the development, two rainwater tanks will be provided, one in the southeast corner of Lot 402 (Site D), the other along the east boundary. Refer to the Woods Bagot Architectural drawings in Appendix B for further details. The rainwater tank storage volumes have been estimated based on the proposed tank site areas in the architectural drawings and an assumed depth of 2m. The actual storage volumes are to be advised by the hydraulic engineer. Overflow from these rainwater tanks will be directed to the existing and future stormwater infrastructure adjacent to the site in the road reserves of Remora Road and the re-alignment of Macarthur Avenue.

Refer to the Bornhorst & Ward Preliminary Siteworks and Drainage Plan drawing SK-C100 in Appendix D for further details of the proposed stormwater infrastructure.

4.2 SEWERAGE

4.2.1 EXISTING INFRASTRUCTURE

There is no existing sewerage infrastructure located within the development site, however; there are existing sewer lines in the road reserves surrounding the development. These are summarised as follows, and illustrated in the Brisbane City Council eBIMAP Infrastructure Plans, the LandPartners Detail Survey Plan and the Northshore Hamilton Branch Sewer drawings attached in Appendix C.

- There is an existing 225mm diameter gravity sewer line located in the southern side of Macarthur Avenue draining west towards Remora Road.
- At the southern end of Remora Road, the sewer line from Macarthur Avenue connects with a 300mm diameter gravity sewer line which drains north towards and past Kingsford Smith Drive.
- A 225mm diameter sewer line drains west along Curtin Avenue West, connecting with the 300mm diameter sewer line in Remora Road.

- Adjacent to the southeast corner of the development site, there is a sewer manhole (structure 13/4) and a 400mm diameter PE sewer in the north side of Macarthur Avenue, recently constructed as part of the Northshore Hamilton Stage 1 works. This follows Macarthur Avenue and discharges into the existing pump station at the end of Barcham Street (approximately 650m east of the development site).
- The Northshore Hamilton Branch Sewer Plans in Appendix C indicate three sewer connection stubs are located on sewer manhole 13/4.

4.2.2 SEWER LOADING

A preliminary calculation of sewer loading for the development has been calculated at 7.61L/s (under Peak Wet Weather Flow) in Table 1 below. Calculations have been undertaken based on the Equivalent Person (EP) Loadings, and Queensland Urban Utilities (QUU) Sewerage Code Part 1 (Planning and Design).

Table 1: Development Site Sewer Flow Calculations

Area Classification	Units / GFA	EP Loading	Total EP
1 bedroom unit	133	1.75 EP / unit	232.75
2 bedroom unit	134	2.0 EP / unit	268.00
3 bedroom unit	18	2.5 EP / unit	45.00
Retail	1165m ² GFA	1.25 EP / 100m ² GFA ^A	14.56
Commercial	3630m ² GFA	4.0 EP / 100m ² GFA ^A	145.20
Total EP			705.51
Design Flow (EP x ("d" x SF + GWI + RDF))			7.61 L/s

^A EP Loadings for the Retail and Commercial GFA were sourced from the Ipswich City Council Planning Scheme Policy 5 as the QUU Sewerage Code Part 1 (Planning and Design) only provides EP Loadings based on site area (ha). This method is believed to be more accurate given the known building details.

The values for SF, GWI, RDF and "d" were adopted or calculated from the QUU Sewerage Code Part 1 (Planning and Design) and are indicated in the table below.

Table 2: Adopted QUU Sewer Flow Calculation Parameters

Parameter	Value
SF (sanitary flow)	150L/EP/day
GWI (ground water in-flow)	30L/EP/day
RDF (rainfall dependent in-flow)	360L/EP/day
"d" (sanitary flow peaking factor)	3.612

4.2.3 SEWER CONNECTION

To provide sewerage services to the development site, it is proposed to construct a new sewer line parallel to the east site boundary, within Lot 407 designated as future public road. This new sewer line will connect with the existing sewer manhole (structure 13/4) via one of the 250mm diameter sewer connection stubs. Refer to the Bornhorst & Ward Preliminary Concept Siteworks and Drainage Plan SK-C100 in Appendix D.

As the proposed sewer line is to be constructed in the future public road on Lot 407, it is likely that this infrastructure will be required to service other allotments in the vicinity of the site, namely; Lot 614 on SL9157 (7 Remora Road) directly north of the proposed development, and Lot 879 on SL9157 (7 Curtin Avenue) east of

the future public road. The other property to the east of the future public road, Lot 916 on SL5057 (32 Macarthur Avenue), has not been included as a sewer manhole with stub connections is located within the Macarthur Avenue road reserve which fronts this allotment. Refer to Figure 1 on page 2 for the allotment locations, and the Northshore Hamilton Branch Sewer drawings attached in Appendix C for details of the existing sewer in Macarthur Avenue.

Further preliminary sewer loading calculations were completed to estimate the total sewage flows expected from the development site and the additional allotments, Lot 614 on SL9157 and Lot 916 on SL5057. Calculations were undertaken based on the Equivalent Person (EP) Loadings, and Queensland Urban Utilities (QUU) Sewerage Code Part 1 (Planning and Design).

Table 3: Total Sewer Flow Calculations

Development/Allotment	Site Area	EP Loading	Total EP
Proposed Development	-	-	705.5
Lot 614 on SL9157	0.3660 ha	150 EP / ha ^A	54.9
Lot 916 on SL5057	0.4105 ha	150 EP / ha ^A	61.6
Total EP			822.0
Design Flow (EP x ("d" x SF + GWI + RDF))^B			8.73 L/s

^A The EP Loadings for the additional allotments have been assumed to be of a commercial nature to be conservative.

^B The values for SF, GWI, RDF used were equal to those indicated in Table 2 on the previous page. The "d" value was re-calculated to be 3.515 in accordance with the QUU Guidelines.

A 150mm diameter sewer line, graded at the QUU minimum of 0.5%, has a capacity of 10.77L/s. Therefore, a 150mm diameter sewer line will have sufficient capacity to cater for the calculated sewer flow of 8.73L/s indicated in Table 3 above.

Queensland Urban Utilities has confirmed that sufficient capacity will exist in the sewer reticulation network when the pump station at the end of Barcham Street is replaced by a 500mm diameter trunk sewer. This sewer infrastructure is currently under construction and is anticipated to be completed in October 2012. Therefore, the sewer infrastructure will have sufficient capacity to cater for the proposed development upon its completion in 2013.

4.3 WATER

There are existing water mains in all the road reserves surrounding the development site (Macarthur Avenue, Remora Road and Curtin Avenue West), the largest being the 300mm diameter line located in the eastern side of Remora Road. Refer to the Brisbane City Council eBIMAP Infrastructure Plans in Appendix B.

As part of the development, new water connections and meters will be required for both Lots 402 and 403 to service the development. Connections can be made into the existing 300mm diameter main in Remora Road, or alternatively, into the future water main to be constructed within the road reserve of Lot 407 (the future public road).

Queensland Urban Utilities have completed an assessment of the existing water reticulation network and have indicated that the existing infrastructure has adequate capacity to service the proposed development.

4.4 ROADS

Due to the basement car park extents beneath the development, the east-west road constructed on Lot 406 will be suspended. It is the developer's intention to transfer the ownership of this asset to Brisbane City Council post development. This will require a volumetric subdivision to create a volumetric lot to contain the road pavement. In addition, volumetric easements will be provided for pedestrian access and services on either side of the road pavement. The developer will retain ownership of the paving, landscaping and parking areas provided within the volumetric easement. Any maintenance works required on the pavements and landscaping areas within the volumetric easement will be the responsibility of the developer. For further details of the road to be constructed on Lot 406, refer to the East-West Road drawings attached in Appendix J.

As discussed above, preliminary site levels have been completed for the proposed development based on existing levels in the road reserves surrounding the site. Indicated in the Bornhorst & Ward Preliminary Site Levels drawing SK-C010 attached in Appendix D, is a high point near the centre of the east-west road. This crest will allow runoff to drain from the east-west road into the existing and future stormwater infrastructure in Remora Road and the future public road on Lot 407, respectively.

The future road construction on Lot 407, which will be undertaken by others prior to the completion of the proposed development, provides access to the basement car parking within the development site. The two concrete vehicle crossings from the future road into the basement car park will be designed and constructed in accordance with Brisbane City Council Subdivision and Development Guidelines and Standard Drawings.

4.5 EARTHWORKS

Significant excavation works are required across the site for the basement construction with an approximate cut level of 4.0m. Further earthworks will be required for grading of the site for stormwater runoff, and trenching for services. All earthworks will be carried out in accordance with Brisbane City Council specifications and Subdivision and Development Guidelines.

Brisbane City Council eBIMAP information has identified the development site to contain high acid sulphate soils. Further geotechnical investigation will be required to determine the extent of acid sulphate soils within the site. The acid sulphate soils within the site will be treated and managed in accordance with the Queensland Acid Sulfate Soil Technical Manual.

4.6 ELECTRICITY

Overhead power lines exist on the western side of the Remora Road road reserve. Also, Energex Asset Plans obtained from the online 'Dial Before You Dig' service, indicate underground electricity cables exist within the Remora Road and Macarthur Avenue road reserves. Refer to the Energex Asset Plan in Appendix C for details. Connection into this infrastructure and all the electrical requirements of the development will be assessed by the electrical engineer.

4.7 TELECOMMUNICATIONS

Telstra Asset Plans indicate communications infrastructure exists within the Remora Road, Macarthur Avenue and Curtin Avenue West road reserves. Also shown is an existing Telstra connection into Lot 402 from the infrastructure in Remora Road. Additional telecommunication cables, owned and operated by Optus, are located north of the site in the Curtin Avenue West road reserve. Refer to the Telstra and Optus Asset Plans in

Appendix C for details. All works required to provide telecommunication services to the proposed development will be undertaken with Telstra's approval and coordination.

4.8 NATURAL GAS

APA Group plans obtained from the online 'Dial Before You Dig' service, indicate a medium pressure natural gas line exists within the western side of the Remora Road road reserve. Also indicated is a dormant main located within the Curtin Avenue West road reserve. Refer to the APA Group Asset Plan in Appendix C for details. If gas services are required, APA Group's confirmation of sufficient capacity within the infrastructure to service the proposed development will be required. Furthermore, all connection works to this infrastructure will be undertaken with APA Group's approval and supervision.

5. STORMWATER MANAGEMENT PLAN

5.1 STORMWATER OBJECTIVES

Under the Queensland Urban Drainage Manual, several design elements were identified in relation to stormwater management issues:

- The proposed development can be drained;
- The stormwater management system can follow the features and functions of the natural drainage system;
- The volume, timing velocity and pollutant load of stormwater has no adverse effect on any surrounding properties or receiving waters; and
- Suitable provision is made in the design layout to accommodate for major drainage.

5.2 LEGAL POINT OF DISCHARGE

The existing point of discharge from the site is along the west and south boundaries into the existing stormwater infrastructure located within the Remora Road and Macarthur Avenue road reserves, respectively. Post development, stormwater will discharge to the existing and future stormwater infrastructure in the external road reserves of Remora Road and the realignment of Macarthur Avenue via piped drainage.

6. STORMWATER QUANTITY

6.1 STORMWATER DRAINAGE METHODOLOGY

Modelling of stormwater runoff quantity has been considered for the existing case and operational phase of the development. In order to assess the existing and predicted future (operational phase) discharge rates from the development site, calculations have been conducted based on the Rational Method, according to the methods specified in the Queensland Urban Drainage Manual and the Brisbane City Council Subdivision and Development Guidelines.

6.2 PEAK FLOW CALCULATIONS

The Rational Method as outlined in the Queensland Urban Drainage Manual was used to determine the peak flow rate corresponding to the minor and major storm events for this development. The fraction impervious for the existing and developed conditions has been estimated based on a review of aerial photography and the proposed development layout, respectively.

The following design storms for the site have been identified in accordance with the Queensland Urban Drainage Manual:

Minor (piped flow) - 1 in 10 year ARI
Major (overland flow) - 1 in 100 year ARI

Review of historical satellite imagery has shown the site was previously used for an industrial purpose with a high percentage of the site used for storage. Refer to Figure 2 below.



Figure 2: Google Earth Image dated 21/08/2005 - Remora Road, Hamilton (accessed 06/02/2012)

Shown in Figure 2 above is a previous use of the site which has a high fraction of impervious area. The central area occupied by bare earth would be compacted to cater for the plant machinery operating in the site and can be considered to be almost impervious. Based on this information, the fraction impervious value for the existing conditions was estimated at 90%. The developed site fraction impervious was estimated at 95% based on the proposed architectural site layout plan and the extents of the underlying basement.

In order to find the coefficients of runoff for the existing conditions and the proposed development, the 60 minute, 10 year ARI rainfall intensity is required. Table B2.3: Rainfall Intensity for Brisbane, of the Brisbane City

Council Subdivision and Development Guidelines, indicates this rainfall intensity is 70mm/hr. In accordance with the Queensland Urban Drainage Manual, the coefficients of runoff for the existing and developed conditions were found to be 0.88 and 0.89, respectively.

The time of concentration for both cases was determined in accordance with the Queensland Urban Drainage Manual. The existing time of concentration was calculated at 11.1 minutes based on a 40m sheet flow at approximately 1% across a bare soil surface, and 40m of channel flow over a fall of 0.5m. The developed time of concentration was calculated at 11.5 minutes based on a 22m sheet flow at approximately 1% across a poorly grassed surface, and 65m of pipe flow over a fall of 0.9m.

The following table is a summary of the stormwater discharge from the site for both scenarios. Detailed calculations can be reviewed in Appendix F.

Table 4: Pre & Post Development Peak Flow Calculations

Catchment Details	Parameter	Existing	Proposed	Difference
	Area (ha)	1.2464	1.2464	-
	Fraction Impervious	90%	95%	+5.0%
	Coefficient of Runoff	0.88	0.89	+0.01
	Time of Concentration (min)	11.1	11.5	+0.4
	10 year Rainfall Intensity (mm/hr)	161	161	-
	50 year Rainfall Intensity (mm/hr)	221	221	-
	100 year Rainfall Intensity (mm/hr)	247	247	-
Discharge	1 in 10 year ARI (m³/s)	0.491	0.497	+0.006
	1 in 50 year ARI (m³/s)	0.765	0.765	-
	1 in 100 year ARI (m³/s)	0.857	0.857	-

As indicated in the table above, the discharge rates from the proposed development are either only marginally greater than or equal to the flows discharged under existing conditions. Therefore, no stormwater quantity control measures are deemed necessary.

Furthermore, due to the close proximity of the site to the Brisbane River, we recommend the discharge of stormwater from the site without any form of detention to ensure the peak flow from the development site does not coincide with the peak flow of the Brisbane River during a storm event.

7. STORMWATER QUALITY

All references to water quality designs and requirements have been made to Queensland Water Quality Guidelines, Department of Environment and Resource Management's Healthy Waters Guidelines – State Planning Policy 4/10 and the reference material - Water by Design: MUSIC modelling guidelines. The State Planning Policy 4/10 Development Assessment Code has been completed for this proposed development and is attached in Appendix I.

7.1 POLLUTANTS OF CONCERN

Key pollutants to be targeted, and the minimum pollutant concentration removal objectives outlined in Queensland Water Quality Guidelines – Table 8.2.2 are indicated in the table on the following page:

Table 5: Water Quality Objectives

Pollutant	Concentration Removal
Total Suspended Solids (TSS)	80%
Total Phosphorus (TP)	60%
Total Nitrogen (TN)	45%
Gross Pollutants (GP)	90%

7.2 MODELLING/ASSESSMENT APPROACH

A quantitative assessment of stormwater runoff quality was considered for the operational phase of the development.

The predicted future (operational phase) discharge concentrations of key pollutants have been identified using the “*Model for Urban Stormwater Improvement Conceptualisation (MUSIC)*”. MUSIC is a stormwater quality modelling program that provides estimates of stormwater pollution generation and the performance of stormwater management measures used in series or parallel to form a ‘treatment train’.

Input parameters and desired Water Quality Objectives (WQOs) specific to southeast Queensland were adopted in accordance with Healthy Waters Planning Policies.

7.2.1 METEOROLOGICAL DATA

The first step in creating the MUSIC model was to select the appropriate meteorological data set (period and time step) to be used as the basis for the runoff algorithms. Section 3.1 – Meteorological Data and Section 3.2 – Modelling Period and time-step, of the reference material details the Rainfall Data and Time Step process requirements of the model, respectively.

The time step used for the MUSIC modelling process was: Brisbane 6 Minutes.

7.2.2 SOURCE NODES

The second step taken in creating the MUSIC models was to define ‘Source Nodes’ or Sub-Catchments. Source nodes for modelling these catchments were based on the Water by Design reference material: Music Modelling Guidelines.

Based on the Architectural Plans attached in Appendix B, the development site has an intended mixed-use with a significant residential emphasis. Therefore, the site can be considered to be of a residential nature for the modelling of stormwater quality. Stormwater quality treatment measures will be implemented to mitigate pollutant discharge from Lot 402 and 403. The MUSIC model consisted of two source nodes; residential roof areas and residential ground areas. Source node input parameters for each node type were adopted from the

reference material – Water by Design: MUSIC Modelling Guidelines. The parameters used are listed in Appendix G for reference.

7.2.3 TREATMENT NODES

A range of SQBMPs were considered for inclusion in the development site layout, with information on available SQBMPs sourced from Water by Design and Brisbane City Council: Guidelines for Pollutant Export Modelling in Brisbane. Each has been reviewed for its suitability for this location. For this particular development, the following treatment options have been chosen for incorporation into the development design:

Table 6: SQBMP Selection Matrix

SQBMP Description	Discussion
Bio-retention Area	A bio-retention system is a combination of vegetation and filter substrate that provides treatment of stormwater through filtration, extended detention and some biological uptake. The option to implement bio-retention systems will reduce overland flow, improve pollutant concentrations and provide aesthetic amenity for the site. Three bio-retention areas are proposed for the development; two in Site C, located to the east and west of the visitor car parking, and the other in Site D, adjacent to Building 1 in the landscaped area north of the vehicle turnaround area. Proposed Systems (as modelled): Bio-retention Site C1 - Filter Area = 15.1m² - Filter Depth = 0.35m - Extended Detention Depth = 0.15m Bio-retention Site C2 - Filter Area = 12.6m² - Filter Depth = 0.35m - Extended Detention Depth = 0.15m Bio-retention Site D - Filter Area = 54.5m² - Filter Depth = 0.35m - Extended Detention Depth = 0.15m
Gross Pollutant Trap	A gross pollutant trap is a treatment device designed to capture coarse sediment, trash and vegetation matter in stormwater. Two Ecosol RSF4000 gross pollutant traps have been proposed and modelled in the MUSIC analysis (one for Site D and one for Site C), though an equivalent product will suffice.
Rainwater Tanks	Legislation mandates the inclusion of rainwater tanks in new developments. Two rainwater tanks have been proposed for the development (one in each lot). The rainwater tanks are to be constructed in the basement. Rainwater reuse for toilet flushing, laundry usage,

pool/pond re-filling and irrigation purposes have been included in the MUSIC model. Refer to Appendix G for details of adopted guidelines and reuse volumes.

Proposed System (as modelled):

Site C Rainwater Tank

- Storage Volume = 315m³
- Surface Area = 157.5m²
- Reuse = 8.230kL/day

Site D Rainwater Tank

- Storage Volume = 304m³
- Surface Area = 152m²
- Reuse = 16.638kL/day

Please note the adopted storage volumes have been estimated based on the rainwater tank site areas indicated in the architectural drawings and an assumed depth of 2m. The actual storage volumes of the respective tanks are to be advised by the hydraulic engineer.

Refer to the Bornhorst & Ward Preliminary Concept Siteworks and Drainage Plan drawing SK-C100 in Appendix D and the MUSIC information and MUSIC Catchment Plan in Appendix G for further details.

7.3 PROPOSED TREATMENT TRAIN

From the available SQBMPs, a Best Management Practice 'Treatment Train' was developed to target each of the pollutants of concern and was subsequently incorporated into the development site layout. This treatment train is illustrated in Figure 3 below:

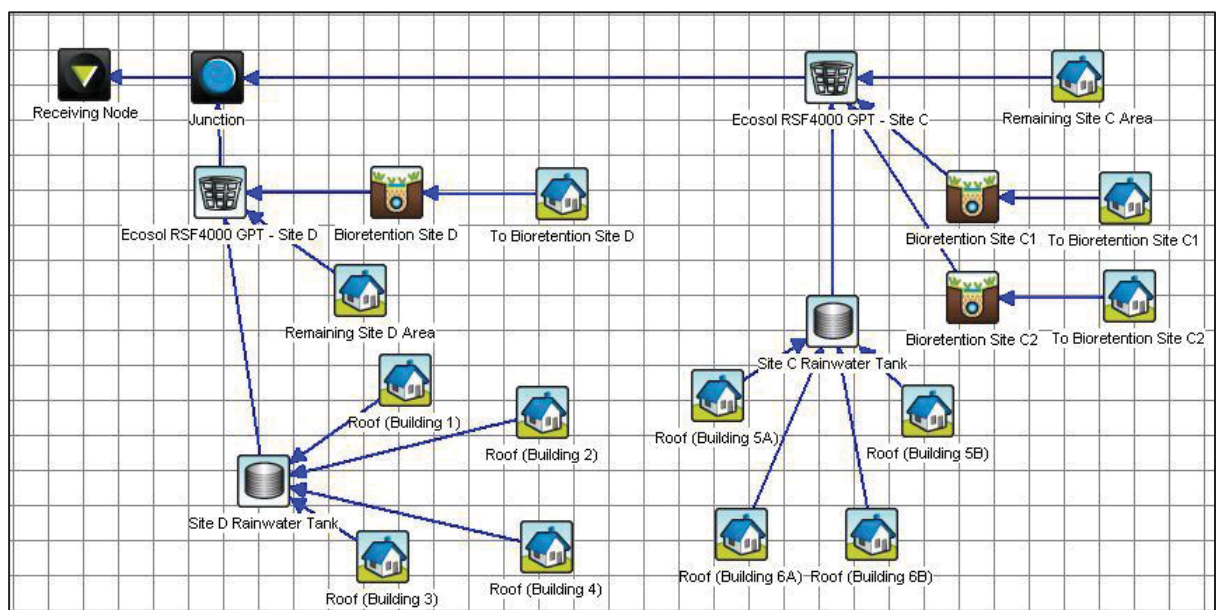


Figure 3: Proposed Treatment Train

7.4 RESULTS

The pollutant export removal rates for the developed phase obtained from the MUSIC model and analysis are tabulated below.

Table 7: Pollutant Removal Rates Discharge

Pollutant	TSS (%)	TP (%)	TN (%)	GP (%)
Treatment Train	95.1	62.6	54.6	99.4
QWQG WQOs	80.0	60.0	45.0	90.0

Indicated in the table above, the removal rates for the target pollutants; total suspended solids (TSS), total phosphorus (TP), total nitrogen (TN) and gross pollutants, are all above the nominated Queensland Water Quality Guidelines Objectives. On this basis we believe the proposed treatment train provided for the development will yield satisfactory pollutant removal.

7.5 WATER QUALITY MONITORING PROGRAM

As this development discharges stormwater into the existing Brisbane City Council Infrastructure using stormwater quality Best Management Practices, no proposal for water quality monitoring has been made. The measures proposed for water quality treatment are reasonably well understood and demonstrated in Brisbane, and as such, it is anticipated that they are acceptable.

7.6 EROSION AND SEDIMENT CONTROL PLAN (ESCP)

A comprehensive Erosion and Sediment Control Plan including a construction process will be prepared for this development. The ESCP designs will be in accordance with the International Erosion Control Association Australasia – Best Practice Erosion and Sediment Control reference material and Brisbane City Council Subdivision and Development Guidelines.

8. SUMMARY

The investigations and reporting relating to the proposed development at Remora Road, Hamilton have shown the following:

- The area surrounding the development site is affected by flooding during a 100 year ARI storm event to RL3.4m AHD. Therefore, the minimum habitable floor level within the development site will be set at RL3.9m AHD, providing 500mm freeboard to the 100 year ARI flood level. For the basement entries and the commercial areas, we recommend a minimum floor level of RL3.5m AHD, providing a 100mm freeboard to the expected 100 year ARI flood level.
- A future public road will be constructed by others on Lot 407, connecting Curtin Avenue West and Macarthur Avenue, as well as providing access into the development's basement car park. Included in this road construction will be appropriate stormwater drainage and water reticulation infrastructure.
- The road to be constructed on Lot 406 will be suspended above the basement car park and ownership of this road will be handed over to Brisbane City Council. A volumetric subdivision will be required to create a volumetric lot to contain the road pavement. Volumetric easements will be provided for

pedestrian access and services on either side of the road pavement with the developer to maintain ownership of the paving, landscaping and parking areas provided within the volumetric easement.

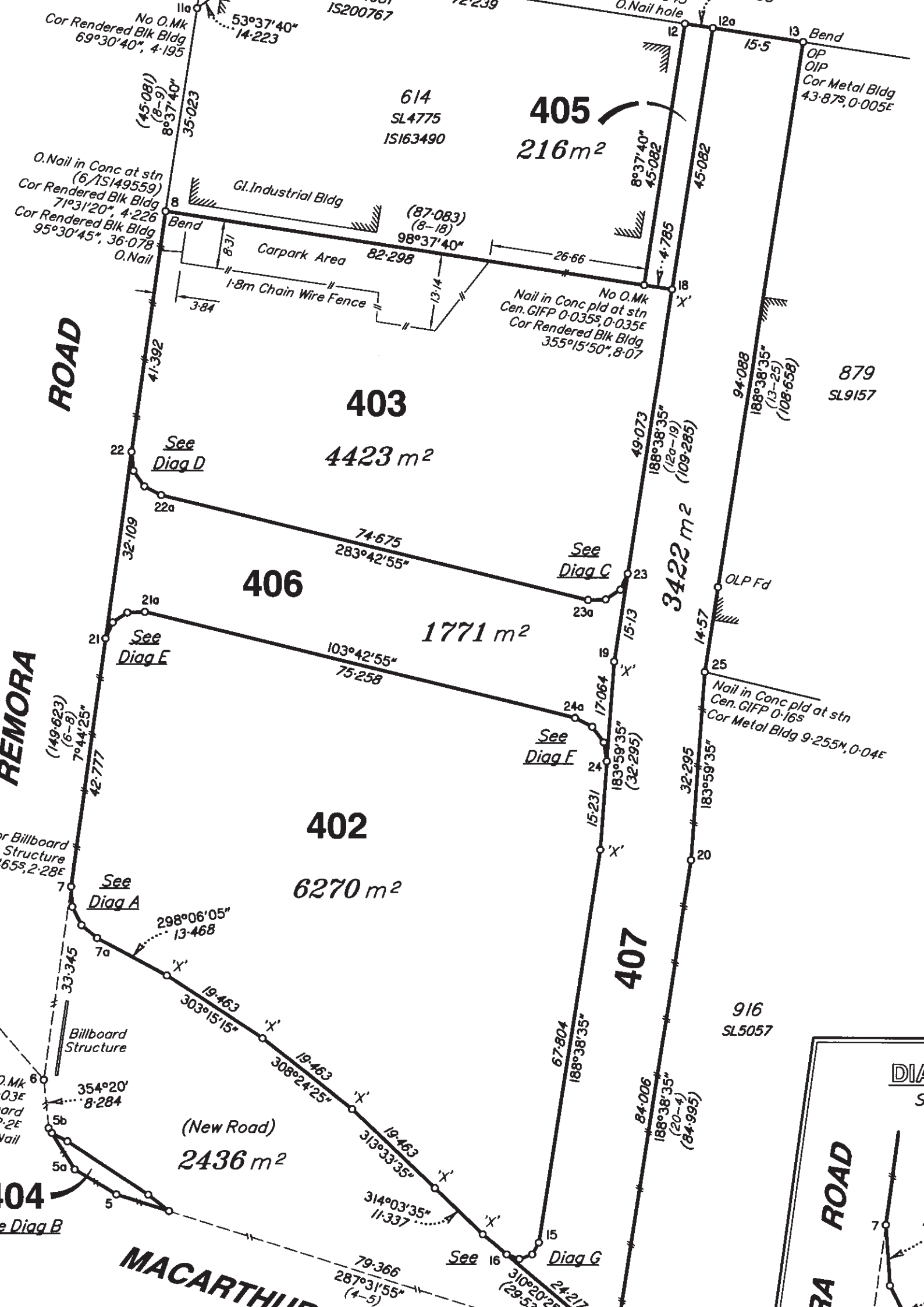
- The proposed development will be drained via an internal podium drainage system (to be designed by the hydraulic engineer). Stormwater from the site will discharge to the existing and future stormwater infrastructure in the external road reserves via piped drainage.
- The water quality requirements for the site have been identified in accordance with the State Planning Policy 4/10 – Healthy Waters and the Queensland Water Quality Objectives. A treatment train for on-site stormwater quality treatment has been proposed, and found to meet the required water quality objectives through MUSIC modelling. The stormwater treatment measures include; two rainwater tanks, two gross pollutant traps and three bio-retention systems.
- To provide sewerage services to the development, it is proposed to construct a new 150mm diameter sewer line within Lot 407 (the future public road) to connect with the existing 400mm diameter main located southeast of the development within the Macarthur Avenue road reserve. This proposed line has been sized to cater for the calculated sewage flow generated from the development and two additional upstream allotments; Lot 614 on SL4775 (7 Remora Road) and Lot 879 on SL9157 (7 Curtin Avenue West).
- Queensland Urban Utilities has confirmed that upon completion of the sewer upgrade at the end of Barcham Street (anticipated completion date is October 2012), sufficient capacity will exist within the sewer reticulation system to cater for the proposed development.
- Two water meters and connections (one for each allotment) will be required to service the proposed development. These connections will be made into either the existing 300mm water main in Remora Road or the water main to be constructed within the future road on Lot 407. Queensland Urban Utilities has confirmed that the existing water reticulation system has sufficient capacity to cater for the proposed development.
- There is existing electricity, communications and gas infrastructure in the vicinity of the site to service the proposed development.

From the investigations conducted, it has been shown that the proposed development can be constructed and serviced in accordance with the Brisbane City Council Subdivision and Development Guidelines, and the Queensland Urban Drainage Manual.

The Stormwater Management Plan has demonstrated that adequate treatment of stormwater quantity and quality is possible under the proposed plan. Sufficient consideration of stormwater controls has been made to demonstrate the viability of the proposed development.

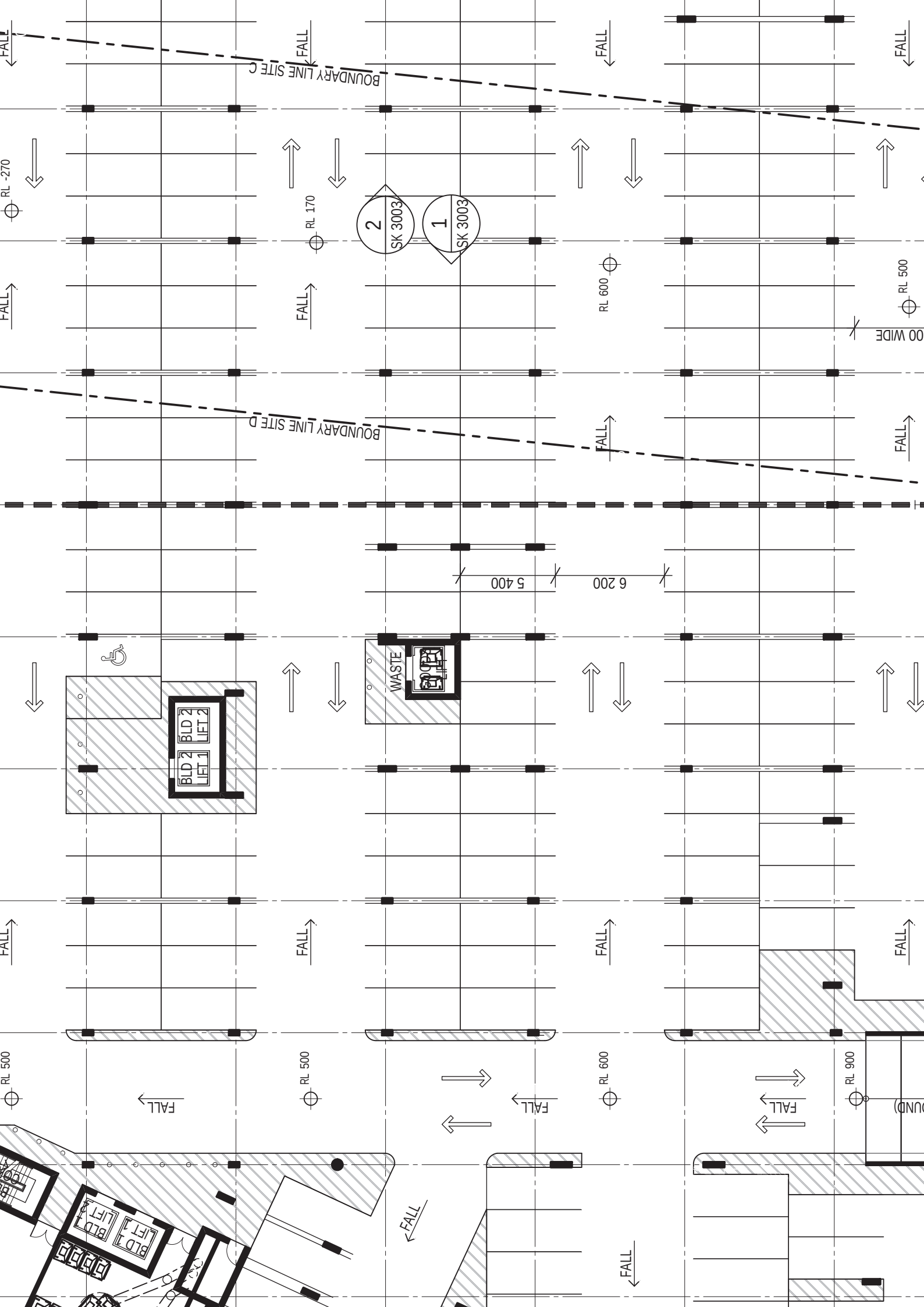
APPENDIX A

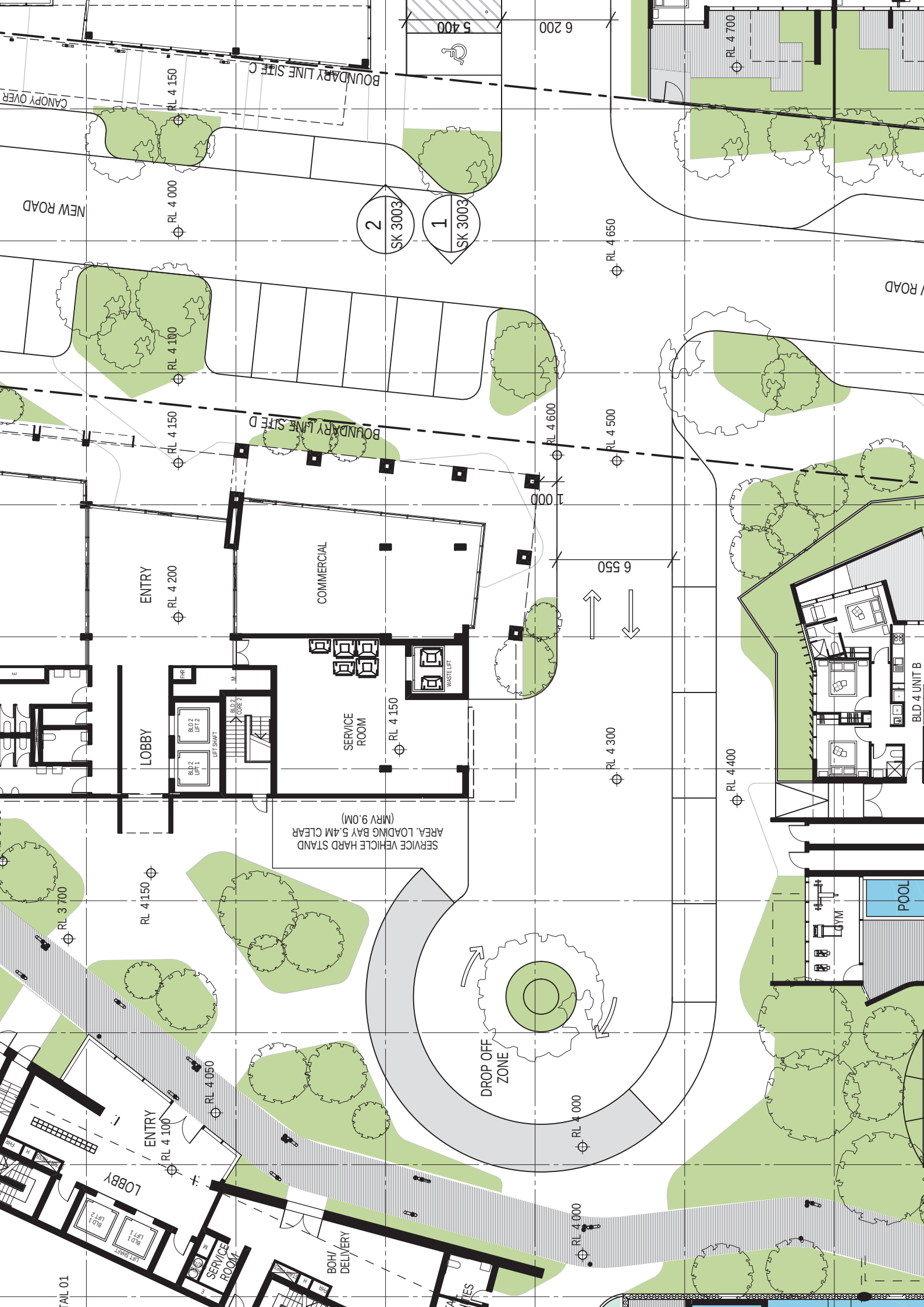
SURVEY PLAN OF LOTS 402-407



APPENDIX B

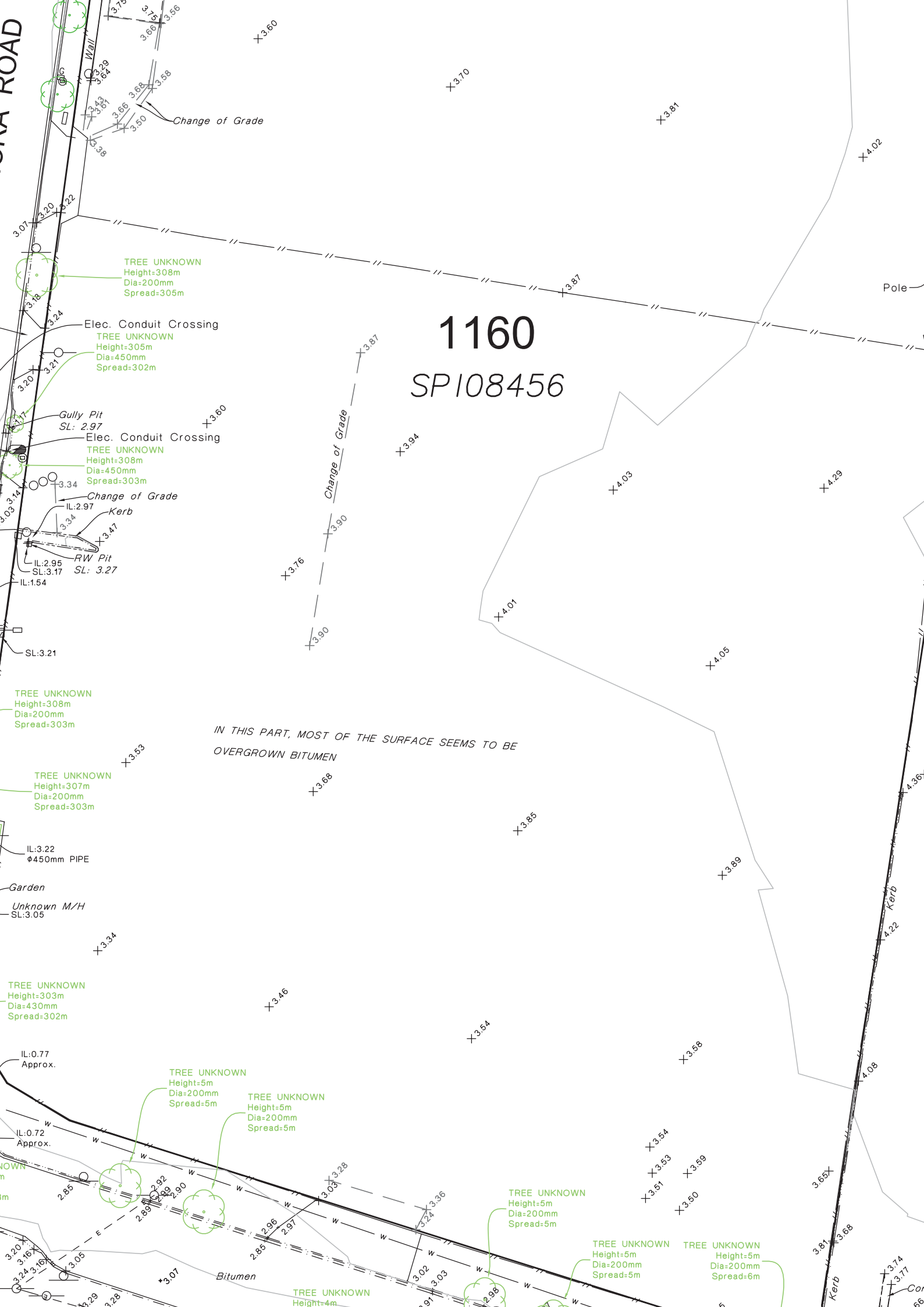
ARCHITECTURAL DRAWINGS





APPENDIX C

EXISTING INFRASTRUCTURE AND SURVEY INFORMATION





LOCALITY PLAN
MAP 141 GRD No: D19

ENVIRONMENTAL NOTES

1 VEGETATION PROTECTION

- 1.1 TREES LOCATED ALONG THE FOOTPATH SHOULD BE, WHERE POSSIBLE, TRANSPLANTED PRIOR TO CONSTRUCTION, OR REPLACED IF DESTROYED.
- 1.2 WHEN WORKING WITHIN 4m OF TREES, RUBBER OR HARDWOOD GROULES SHOULD BE CONSTRUCTION WITH 1.8m BATTENS CLOSELY SPACED AND ARRANGED VERTICALLY FROM GROUND LEVEL. GROULES MUST BE STRAPPED TO TREES PRIOR TO CONSTRUCTIONS AND REMAIN UNTIL COMPLETION.
- 1.2 WHERE POSSIBLE, TREE ROOTS SHOULD BE TUNNELLED UNDER, RATHER THAN SEVERED. IF ROOTS ARE SEVERED THE DAMAGED AREA SHOULD BE TREATED WITH A SUITABLE FUNGICIDE. CONTACT COUNCIL ARBORIST FOR FURTHER ADVICE. PH. 3403 8888.
- 1.3 ANY TREE LOPPING REQUIRED SHOULD BE UNDERTAKEN BY COUNCIL'S METROPOLITAN TREE SERVICES. PH. 3403 8888.

2 SOIL

- 2.1 TOPSOIL AND SUBSOIL SHOULD BE STOCKPILED SEPARATELY.
- 2.2 CARE SHOULD BE TAKEN TO PREVENT SEDIMENT FROM ENTERING THE STORMWATER SYSTEM. THIS MAY INVOLVE PLACING APPROPRIATE SEDIMENT CONTROLS AROUND STOCKPILES.

3 CREEK CROSSINGS

- 3.1 SILTATION CONTROL MEASURES SHOULD BE PLACED DOWNSTREAM OF ANY EXCAVATION WORK.
- 3.2 APPROPRIATE SEDIMENT CONTROLS SHOULD BE USED TO PREVENT SEDIMENT FROM ENTERING THE CREEK.
- 3.3 NO SOIL SHOULD BE STOCKPILED WITHIN 5m OF THE CREEK.

4 REHABILITATION

- 4.1 PREDISTURBANCE SOIL PROFILES AND COMPACTION LEVELS ARE TO BE REINSTITUTED.
- 4.2 PREDISTURBANCE VEGETATION PATTERNS SHOULD BE RESTORED. FOR FURTHER INFORMATION CONTACT BILL MANNERS PH. 3403 8888.

NOTE
ALL ENVIRONMENT PROTECTION MEASURES SHOULD BE IMPLEMENTED PRIOR TO ANY CONSTRUCTION WORK, INCLUDING CLEARING, COMMENCING.

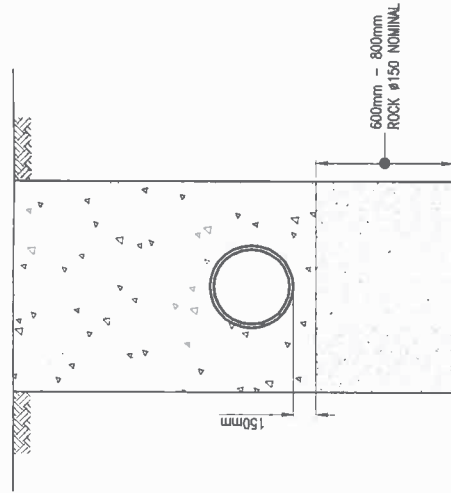
* SEWER CONNECTION IS PRELIMINARY ONLY AND SUBJECT TO BRISBANE WATER APPROVAL

- 1b CONTRACTOR TO REMOVE END CAP AND LAY 1 SHORT PIPE (WITH AN I.O.), THEN LAY SEWER LINES. AFTER CLEANING AND TESTING, I.O. PIPE TO BE SURROUNDED WITH 150mm OF CONCRETE.
 - 1c COUNCIL TO REMOVE TEMPORARY PLUG AFTER SUCCESSFUL "ON MAINTENANCE" INSPECTION.
- NOTE: TRANSFER OF EXISTING SERVICES NOT TO OCCUR. EXISTING SEWER IS TO REMAIN OPERATIONAL UNTIL FUTURE WORKS WITHIN THE CATCHMENT. AN ABANDONMENT PLAN WILL BE COMPLETED AT THIS STAGE

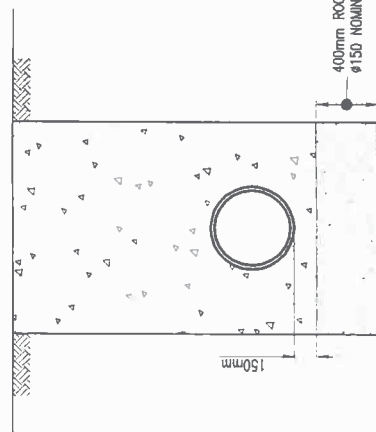
B.C.C. AND C
CONSULTING ENGINEER
UTILITY SERVICES 24
CONSTRUCTION ON
TO BE CARRIED OUT
WORK BY CONTRACT
CONTRACTORS AT DE
'SAFE WORK PLAN'
LEGISLATION TO COL
WORKS. IT IS THE E
SEWER WORKS ARE
TO BE CONNECTED.

LEGEND

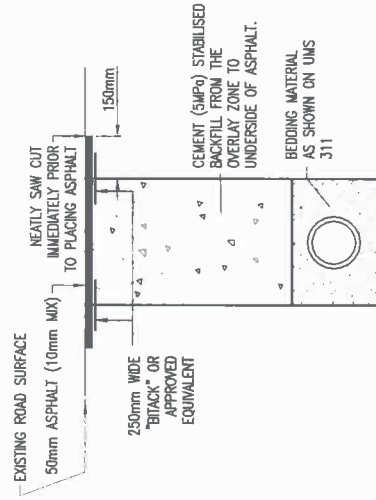
- EXISTING
- S ---
 - -4- ---
 - SW ---
 - W ---
 - T ---
 - E ---



TYPICAL TRENCH DETAIL
>6m DEPTH



TYPICAL TRENCH DETAIL
<6m DEPTH



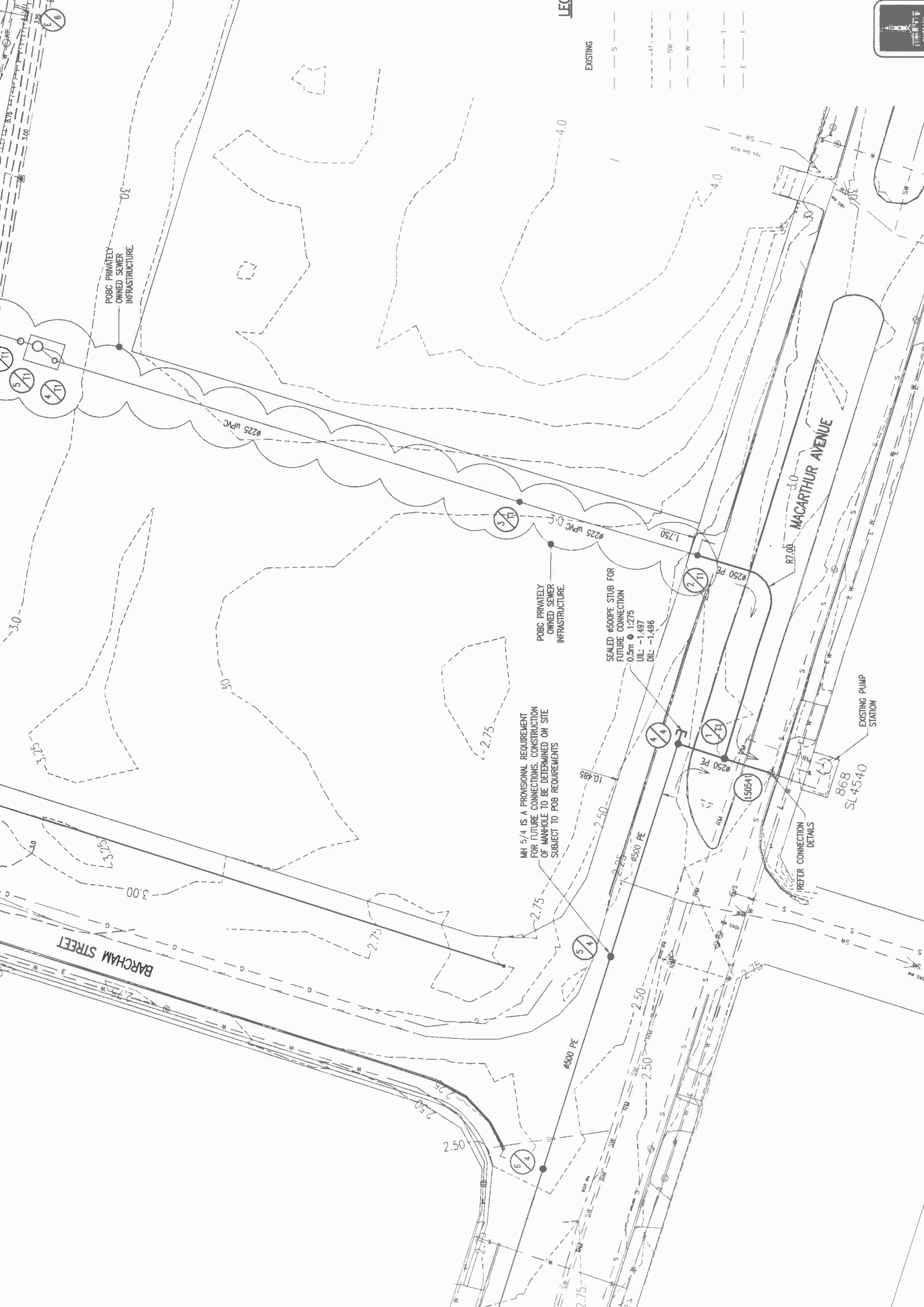
TRENCH DETAIL THROUGH
EXISTING ROAD



NOTE: TRENCH DETAILS TO BE CONFIRMED

LEVEL DATUM

CONSULTANT : BORNHÖRST + WARD PTY LTD
CONTRACT : MURRAY'S POYTS



LEG

EXISTING	— S —
	— SW —
	— W —
	— T —
	— E —

MH 5/4 IS A PROVISIONAL REQUIREMENT FOR FUTURE CONNECTIONS. CONSTRUCTION OF MANHOLE TO BE DETERMINED ON SITE SUBJECT TO POB REQUIREMENTS

SEALED 4500PE STUB FOR FUTURE CONNECTION
0.3m @ 1:275
U/L: -1.497
D/L: -1.496

MACARTHUR AVENUE

BARCHAM STREET

EXISTING PUMP STATION
868
SL 4540

REFER CONNECTION DETAILS

— T —
— E —

FUTURE CONNECTION STUB
250PE SDR21
0.5m @ 1:275
DIL: -0.740
UIL: -0.738

FUTURE CONNECTION STUB
250PE SDR21
0.5m @ 1:275
DIL: -0.740
UIL: -0.738

FUTURE CONNECTION STUB
250PE SDR21
0.5m @ 1:275
DIL: -0.947
UIL: -0.945

MCCARTHRU AVENUE

711
SL4546

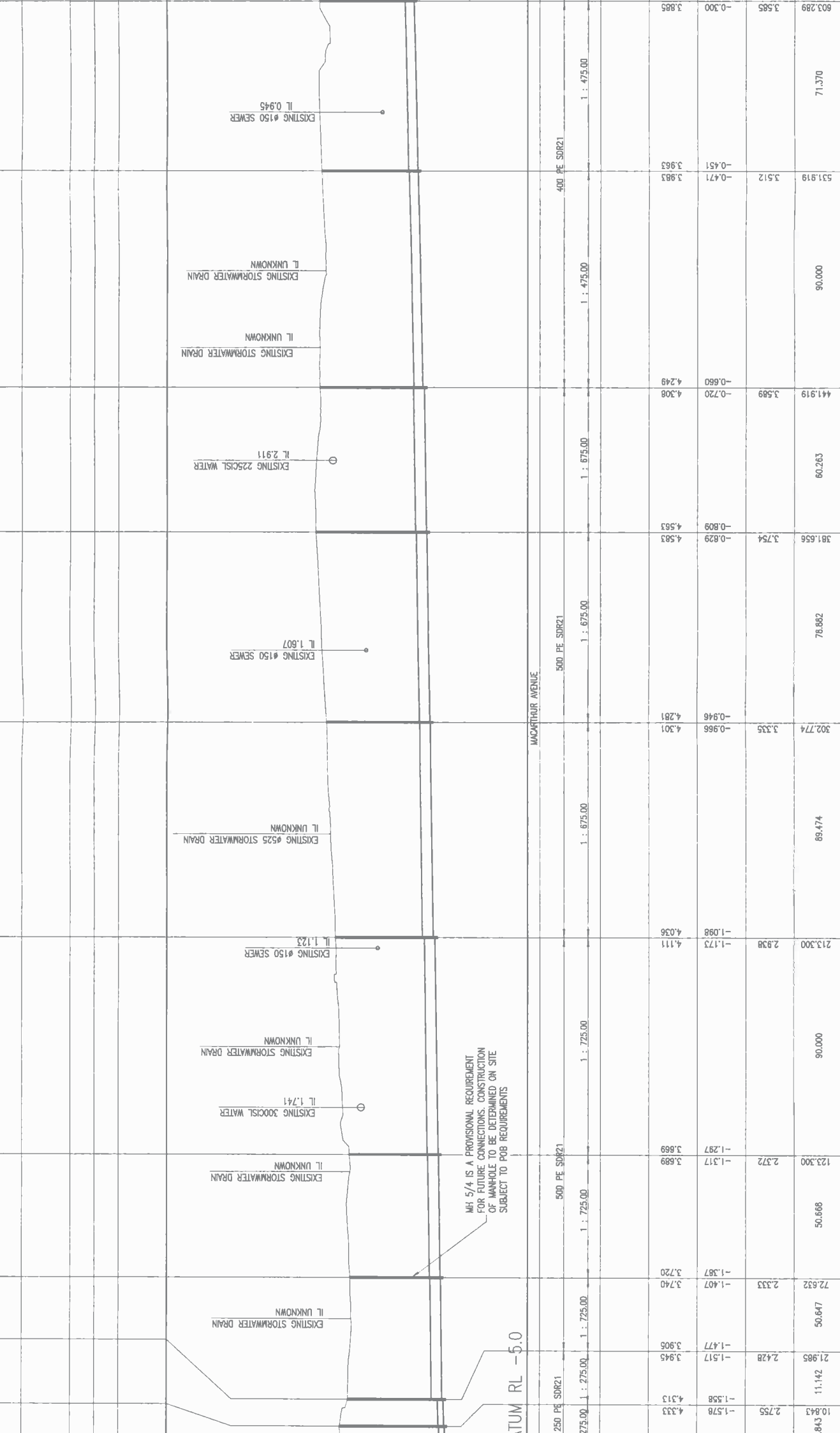
1165
SP108460

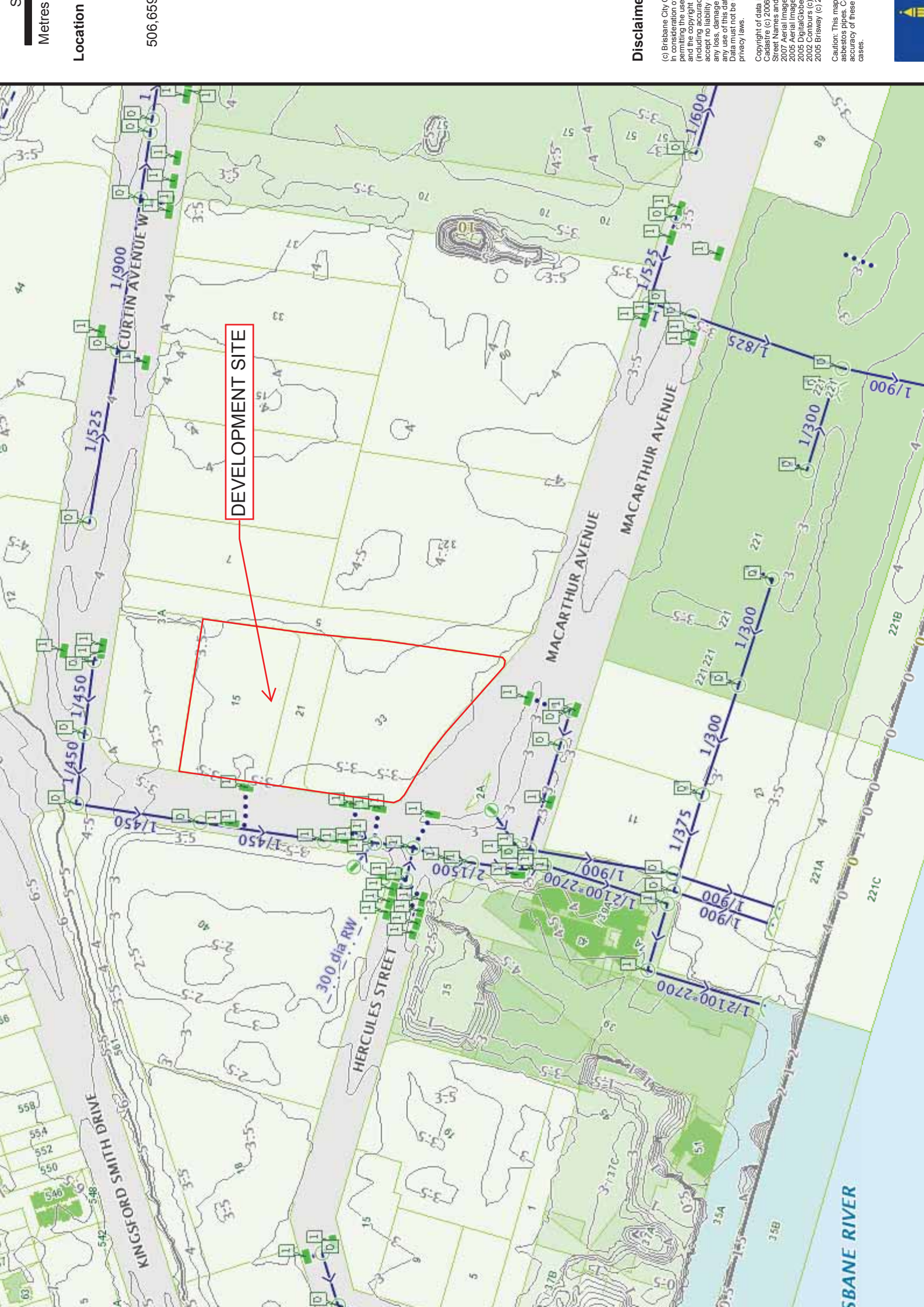
916
SL5057





4





DEVELOPMENT SITE

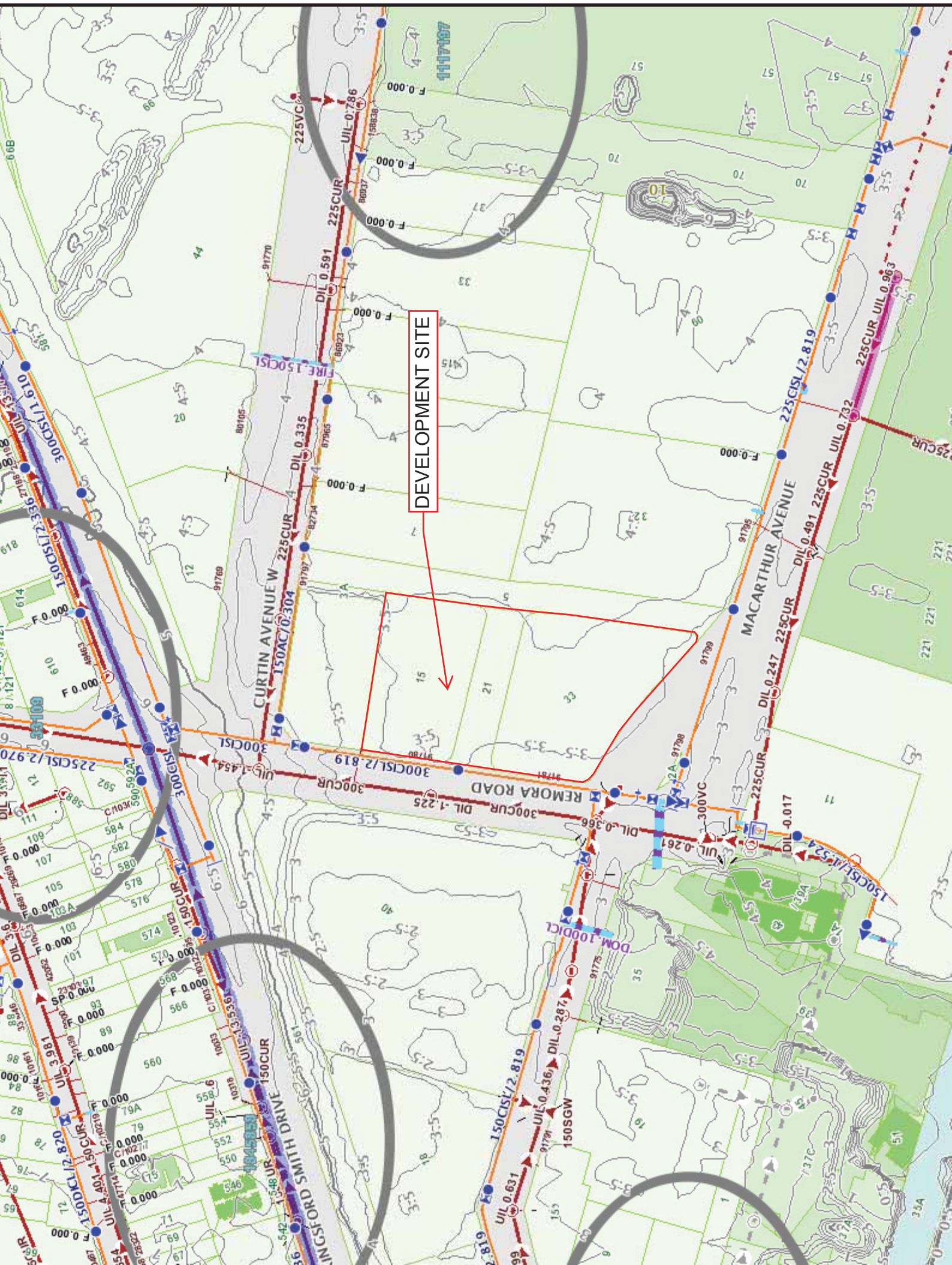
Metres

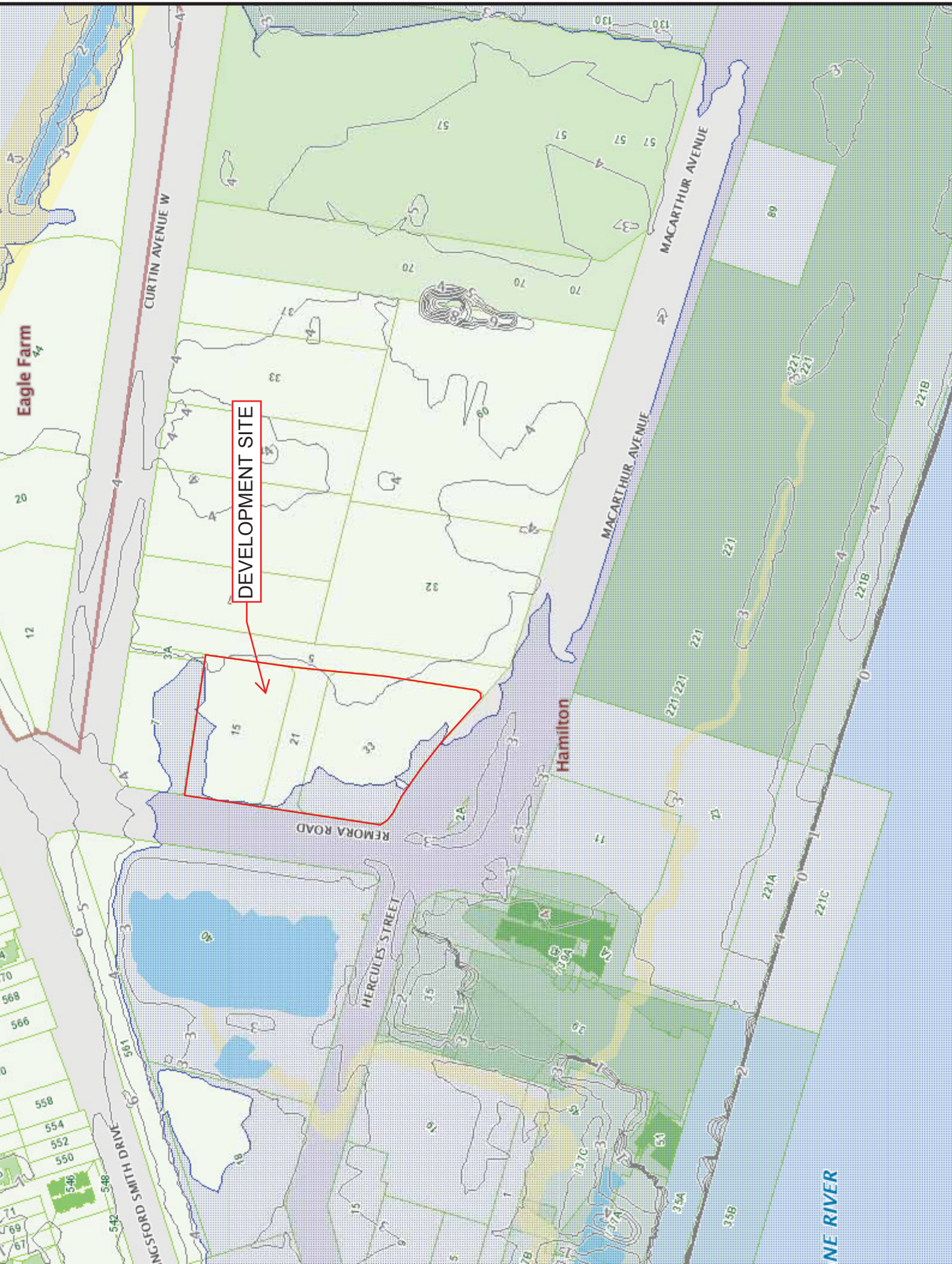
Location

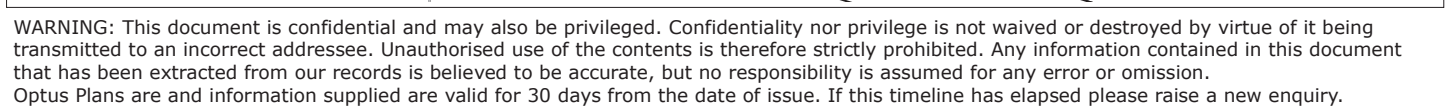
506,655

Disclaimer

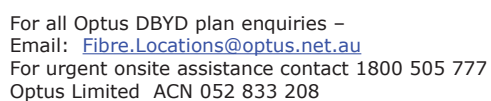
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Copyright (c) 2006
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2005 Aerial Image
2005 DigitalGlobe
2002 Contours (c)
2005 Brisbane (c)
Caution: This map
asbestos pipes. C
accuracy of these
cases.







Date Generated: 06/02/2012

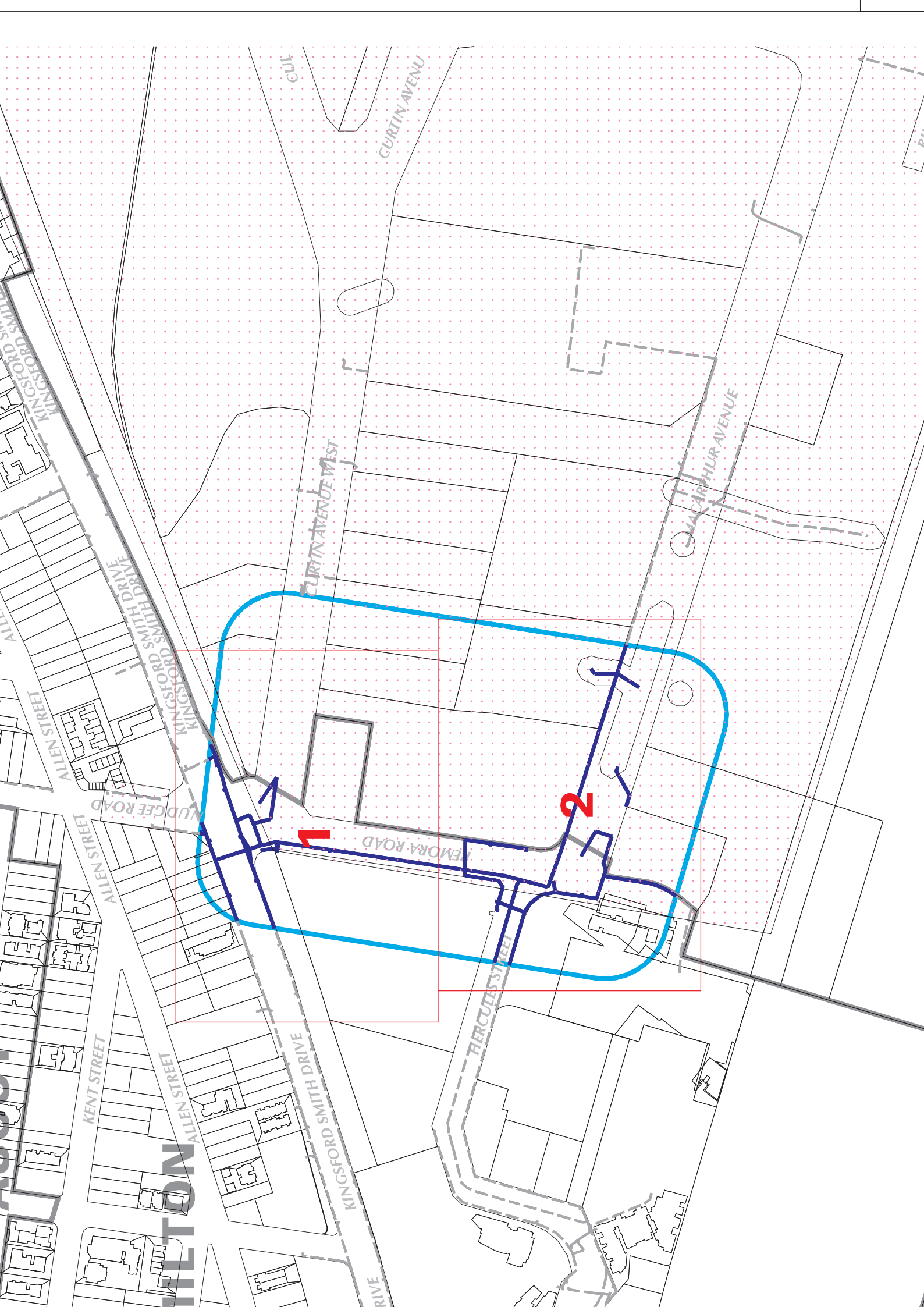




Top Sheet: 1

Scale: 1: 1000

Legend				
	Transmission Pressure Natural Gas		Sleeve	
	High Pressure Natural Gas		Valve	
	Medium Pressure Natural Gas		Syphon	
	Low Pressure Natural Gas		Endcap	
	LPG Reticulation		Regulator	
	Dormant Main		Pipe Connector	
	Proposed Main		Insulated Connection	
			Cathodic Test Point	



APPENDIX D

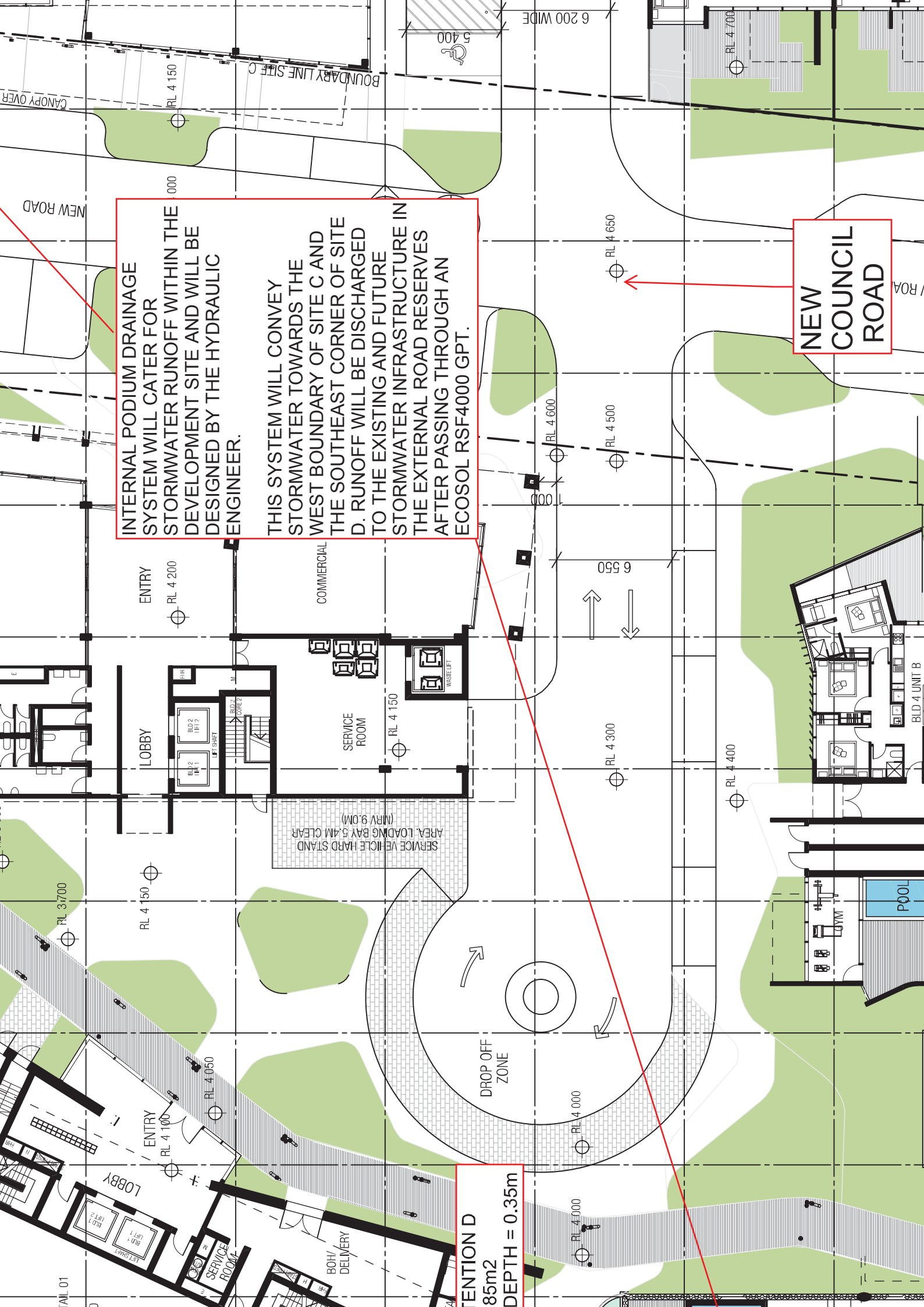
BORNHORST & WARD DEVELOPMENT DRAWINGS

INTERNAL PODIUM DRAINAGE SYSTEM WILL CATER FOR STORMWATER RUNOFF WITHIN THE DEVELOPMENT SITE AND WILL BE DESIGNED BY THE HYDRAULIC ENGINEER.

THIS SYSTEM WILL CONVEY STORMWATER TOWARDS THE WEST BOUNDARY OF SITE C AND THE SOUTHEAST CORNER OF SITE D. RUNOFF WILL BE DISCHARGED TO THE EXISTING AND FUTURE STORMWATER INFRASTRUCTURE IN THE EXTERNAL ROAD RESERVES AFTER PASSING THROUGH AN ECOSOL RSF4000 GPT.

NEW COUNCIL ROAD

ATTENTION D
85m2
DEPTH = 0.35m



APPENDIX E

BRISBANE CITY COUNCIL FLOODWISE PROPERTY REPORT



Brisbane City Council FloodWise Property Report

R 1842890

1842890

07/02/2012 08:44:14

Dedicated to a better Brisbane

The FloodWise Property Report is a free report to inform Brisbane residents and professionals about flood risks for a specified lot or property so they may better prepare for flooding and to plan and build in accordance with Council requirements. A flood level higher than those shown below can occur in any year, although such events are rare.

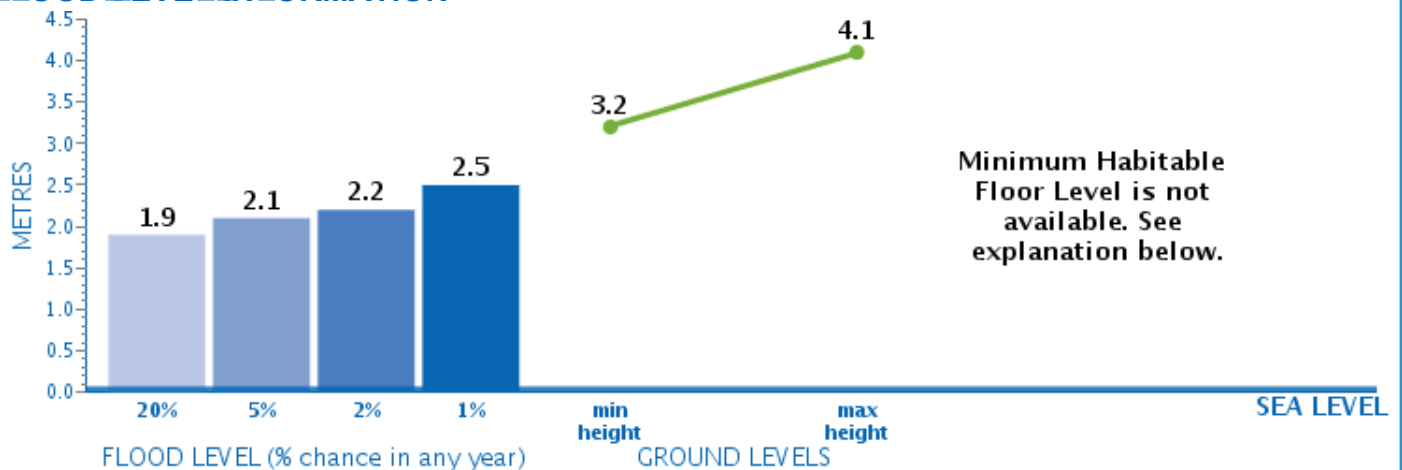
To find out more about how the contents of this report may affect your ability to build or renovate, as well as Council advice on how to protect your property and family by being FloodWise, visit www.brisbane.qld.gov.au, a Customer Service Centre or call (07) 3403 8888.

PROPERTY DETAILS

ADDRESS 33 REMORA RD HAMMILLTON QLD 4007

LOT/SP 402 SP.187479

FLOOD LEVEL INFORMATION



THE BARS

The bars in the graph above show the percentage chance of that level being reached or exceeded in any year at this address or lot.

THE LINE

The line above shows this property's lowest and highest ground levels. Confirm with a surveyor.

MINIMUM HABITABLE FLOOR LEVEL

If a property is in an overland flow path or a large allotment a minimum habitable floor level cannot be provided. See flood and property flag information over page.

HIGHEST SOURCE OF FLOODING

STORM TIDE The highest source of flooding affecting this property originates from storm tide. Storm tide results from the combined effects of wind and atmospheric pressure such as tropical cyclones or storms creating tides higher than normal levels. Such rises may lead to flooding in coastal and bayside areas of the city.

FLOOD AND PROPERTY DEVELOPMENT FLAGS

Current records indicate this property may be affected by one or more flood or property development flags. Please review the technical summary over page for more detail.

Technical Summary

Use this summary to supply information about this property to surveyors, builders, certifiers, architects and engineers who may request this Flood Risk Property Report. This summary has been designed to be easily read if scanned or faxed.

Property Details

Address: 33 REMORA RD HAMILTON QLD 4007

Lot Details: L.402/SP.187479

Property Information

Minimum Ground Level (m)	3.2 m
Maximum Ground Level (m)	4.1 m
Defined Flood Level (mF)	2.0 m
Defined Flood Level Source	T1000 T1000
Minimum Habitable Floor Level (m)	0/0

Estimated Peak Flooding Levels

Return Period (Years)	Chance	Level (m)	Source
10	20%	1.0 m	T1000 T1000
20	10%	2.1 m	T1000 T1000
50	2%	2.2 m	T1000 T1000
100	1%	2.0 m	T1000 T1000

Flood and Property Development Flags

Large Allotment

This property is a large allotment of over 1000 square metres. Flood levels may vary significantly across allotments of this size. Further investigations may be warranted in determining the variation in flood levels and the minimum habitable floor level across this site. For more information or advice it is recommended you engage a registered Professional Engineer of Queensland.

Disclaimer

- Defined Flood Levels and Interim Residential Flood Levels and the Minimum Habitable Floor Levels based on them are determined from the information available to Council at the date of issue. These flood levels for a particular property may change if more detailed information becomes available or changes are made in the method of calculating flood levels.
- Council makes no warranty or representation regarding the accuracy or completeness of a Flood Risk Property Report. Council disclaims any responsibility or liability in relation to the use or reliance by any person on a Flood Risk Property Report.



Brisbane City Council FloodWise Property Report

Report Reference

1844323

07/02/2012 09:42:47

Dedicated to a better Brisbane

The FloodWise Property Report is a free report to inform Brisbane residents and professionals about flood risks for a specified lot or property so they may better prepare for flooding and to plan and build in accordance with Council requirements. A flood level higher than those shown below can occur in any year although such events are rare.

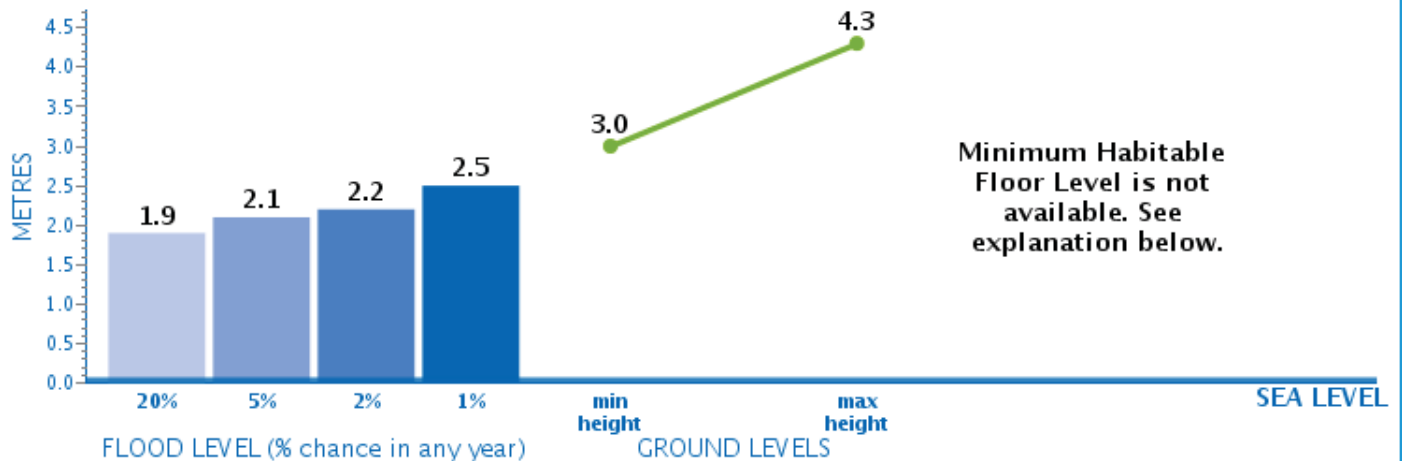
To find out more about how the contents of this report may affect your ability to build or renovate as well as Council advice on how to protect your property and family by being FloodWise visit www.brisbane.qld.gov.au a Customer Service Centre or call (07) 3403 0000.

PROPERTY DETAILS:

Address: 1 REMORA RD HAMILTON QLD 4007

Lot Details: L.403/SP.187479

FLOOD LEVEL INFORMATION



Flood Levels

The bars in the graph above show the percentage chance of that level being reached or exceeded in any year at this address or lot.

Ground Levels (Min/Max)

The line above shows this property's lowest and highest ground levels. Confirm with a surveyor.

Minimum Habitable Floor Level

If a property is in an overland flow path or a large allotment a minimum habitable floor level cannot be provided. See flood and property flag information over page.

For a detailed summary and associated flood levels and data see technical summary over page.

HIGHEST SOURCE OF FLOODING

Storm Tide The highest source of flooding affecting this property originates from storm tide. Storm tide results from the combined effects of wind and atmospheric pressure such as tropical cyclones or storms creating tides higher than normal levels. Such rises may lead to flooding in coastal and bayside areas of the city.

FLOOD AND PROPERTY DEVELOPMENT FLAGS

Current records indicate this property may be affected by one or more flood or property development flags. Please review the technical summary over page for more detail.

Technical Summary

Use this summary to supply information about this property to surveyors, builders, certifiers, architects and engineers who may request this Flood Risk Property Report. This summary has been designed to be easily read if scanned or faxed.

Property Details

Address: 33 REMORA RD HAMILTON QLD 4007

Lot Details: L.402/SP.187479

Property Information

Minimum Ground Level (m)	3.2 m
Maximum Ground Level (m)	4.1 m
Defined Flood Level (mF)	2.0 m
Defined Flood Level Source	T1000 T1000
Minimum Habitable Floor Level (m)	0/0

Estimated Peak Flooding Levels

Return Period (Years)	Chance	Level (m)	Source
10	20%	1.0 m	T1000 T1000
20	10%	2.1 m	T1000 T1000
50	2%	2.2 m	T1000 T1000
100	1%	2.0 m	T1000 T1000

Flood and Property Development Flags

Large Allotment

This property is a large allotment of over 1000 square metres. Flood levels may vary significantly across allotments of this size. Further investigations may be warranted in determining the variation in flood levels and the minimum habitable floor level across this site. For more information or advice it is recommended you engage a registered Professional Engineer of Queensland.

Disclaimer

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- Council makes no warranty or representation regarding the accuracy or completeness of a Flood Risk Property Report. Council disclaims any responsibility or liability in relation to the use or reliance by any person on a Flood Risk Property Report.

APPENDIX F

HYDRAULIC CALCULATIONS

C
T

Existing runoff coefficient calculated based on estimated fraction impervious from review of historical imagery.

Proposed runoff coefficient calculated based on fraction impervious from architectural drawings

. R. NO. OE.					
S at Area Ha		Roof coefficients		Calculated 10	
Esti	Proposed	Esti	Proposed	Esti	Proposed
1.244	1.244	0.00	0.00		
1.244	1.244			0.88	0.89

Please note
User data to be placed in the
Green Cells only

E. ISTIN		TIME OF CONCENTRATION	
SHEET LO HANNEL/PIPE		Time of Inlet	
		Time of Slope ()	1
		Flow Length (m)	40
		Portion of In	0.027
		Travel Time (min)	10.0
		Travel Length (m)	40
		Fall (m)	0.00
		Travel Time (min)	1
		Multiplier	1
		Travel Time (min)	1
Total Time			11.1

DEVELOPED TIME OF CONCENTRATION	
SHEET LO HANNEL/PIPE	Time of Inlet
	Time of Slope ()
	Flow Length (m)
	Portion of In
	Travel Time (min)
	Travel Length (m)
	Fall (m)
	Travel Time (min)
	Multiplier
	Travel Time (min)
Total Time	

PEAK FLOOD SCENARIO REQUIREMENTS			
ARI Event	Flood Q1	Peak discharge m/s	
		Esti	Proposed
1mth	2	0.02	0.03
2mth	40	0.083	0.084
3mth	0	0.104	0.10
4mth	0	0.12	0.12
5mth	7	0.1	0.18
6mth	0	0.188	0.190
12mth	100	0.208	0.211

PEAK RUNOFF CALCULATIONS					
Rainfall Intensity mm/hr		Coefficient of runoff		Peak Runoff Rates m/s	
Esti	Proposed	Esti	Proposed	Esti	Proposed
110	110	0.70	0.71	0.208	0.211
142	142	0.7	0.7	0.28	0.289
171	171	0.4	0	0.411	0.41
221	221	0	0	0.491	0.497
247	247	0.02	0.03	0.97	0.04
		1.00	1.00	0.7	0.7
		1.00	1.00	0.87	0.87

APPENDIX G

MUSIC INFORMATION

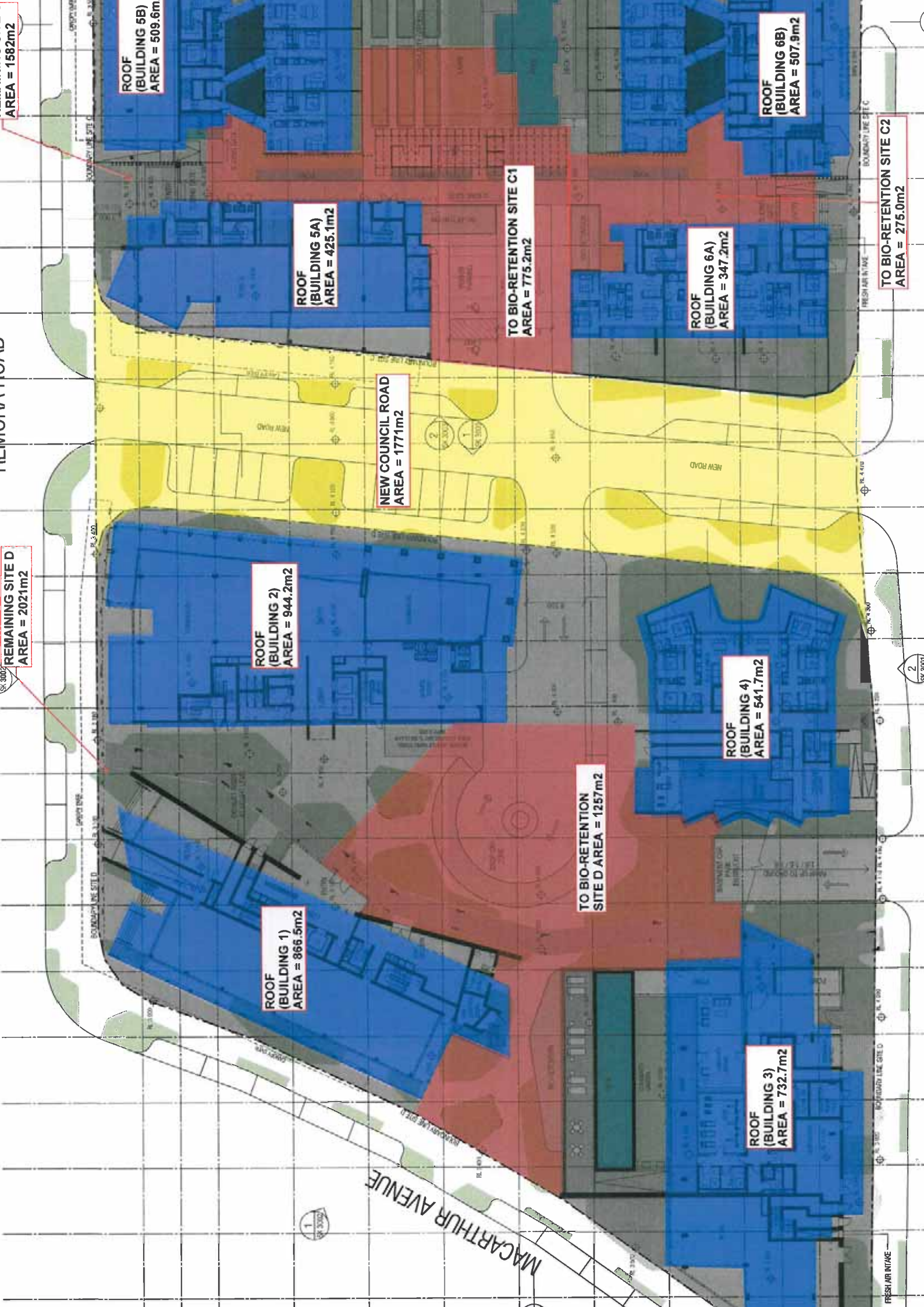


Figure 1: MUSIC Stormwater Quality Treatment Train

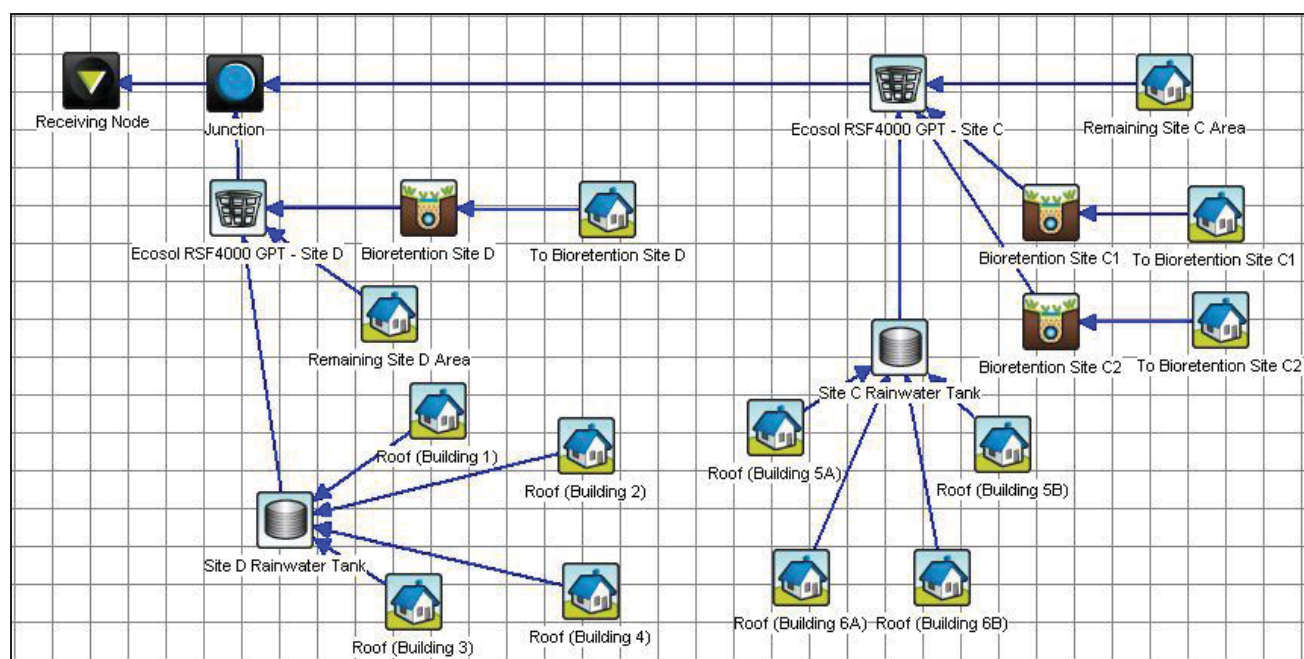


Table 1: Source Node Catchment Inputs

Catchment	Node Type	Area (m ²)	Area (ha)	Fraction Impervious
Roof (Building 1)	Urban Roofwater	866.5	0.087	100%
Roof (Building 2)	Urban Roofwater	944.2	0.094	100%
Roof (Building 3)	Urban Roofwater	732.7	0.073	100%
Roof (Building 4)	Urban Roofwater	541.7	0.054	100%
Roof (Building 5A)	Urban Roofwater	425.1	0.043	100%
Roof (Building 5B)	Urban Roofwater	509.6	0.051	100%
Roof (Building 6A)	Urban Roofwater	347.2	0.035	100%
Roof (Building 6B)	Urban Roofwater	507.9	0.051	100%
To Bio-retention Site C1	Urban Residential	775.2	0.078	79%
To Bio-retention Site C2	Urban Residential	275.0	0.028	70%
To Bio-retention Site D	Urban Residential	1256.8	0.126	64%
Remaining Site C	Urban Residential	1582.8	0.158	59%
Remaining Site D	Urban Residential	1928.2	0.193	58%
Total Site	-	10693	1.071	80%

Table 2: Pollutants Typically Generated During the Construction Phase

Pollutant	Source
Litter	Paper, construction packaging, food packaging, cement bags, off-cuts
Sediment	Unprotected exposed soils and stockpiles during earthworks and building
Hydrocarbons	Fuel and oil spills, leaks from construction equipment
Toxic materials	Cement slurry, asphalt prime, solvents, cleaning agents, washwaters (e.g. from tile works)
pH altering substances	Acid sulphate soils, cement slurry and washwaters

Table 3: Recommended MUSIC Rainfall-Runoff Generation Parameters

Parameter	Urban Residential
Rainfall Threshold (mm)	1
Soil Storage Capacity (mm)	500
Initial Storage (% capacity)	10
Field Capacity (mm)	200
Infiltration Capacity Coefficient a	211
Infiltration Capacity Exponent b	5.0
Initial Depth (mm)	50
Daily Recharge Rate (%)	28
Daily Baseflow Rate (%)	27
Daily Deep Seepage Rate (%)	0

Table 4: Music Base and Storm flow Concentration Parameters for Brisbane Catchments

Land Use Type	Parameter	TSS (Log ₁₀ mg/L)		P (Log ₁₀ mg/L)		N (Log ₁₀ mg/L)	
		Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow
Urban Residential	Roof						
	Mean	N/A	1.30	N/A	-0.89	N/A	0.26
	Std Dev	N/A	0.39	N/A	0.31	N/A	0.23
Roads	Mean	1.00	2.43	-0.97	-0.30	0.20	0.26
	Std Dev	0.34	0.39	0.31	0.31	0.20	0.23
Ground Level	Mean	1.00	2.18	-0.97	-0.47	0.20	0.26
	Std Dev	0.34	0.39	0.31	0.31	0.20	0.23

Table 5: Bio-retention Site C1 as modelled

Properties	Bio-retention C1
Low flow by-pass (m ³ /s)	0.000
High flow by-pass (m ³ /s)	100.000
Extended Detention Depth (m)	0.15
Surface Area (m ²)	21.50
Filter Area (m ²)	15.05
Unlined Filter Media Perimeter (m)	19.00
Saturated Hydraulic Conductivity (mm/hr)	200.00
Filter Depth (m)	0.35
TN Content of Filter Media (mg/kg)	800
Proportion of Organic Material in Filter (%)	< 5
Orthophosphate Content of Filter Media (mg/kg)	< 55
Is Base Lined?	No
Vegetated with Effective Nutrient Removal Plants	Yes
Overflow Weir Width (m)	2.15
Underdrain Present	Yes
Submerged Zone with Carbon Present	No
Exfiltration Rate (mm/hr)	0.00

Table 6: Bio-retention Site C2 as modelled

Properties	Bio-retention C2
Low flow by-pass (m ³ /s)	0.000
High flow by-pass (m ³ /s)	100.000
Extended Detention Depth (m)	0.15
Surface Area (m ²)	17.75
Filter Area (m ²)	12.60
Unlined Filter Media Perimeter (m)	14.90
Saturated Hydraulic Conductivity (mm/hr)	200.00
Filter Depth (m)	0.35
TN Content of Filter Media (mg/kg)	800
Proportion of Organic Material in Filter (%)	< 5
Orthophosphate Content of Filter Media (mg/kg)	< 55
Is Base Lined?	No
Vegetated with Effective Nutrient Removal Plants	Yes

Overflow Weir Width (m)	1.78
Underdrain Present	Yes
Submerged Zone with Carbon Present	No
Exfiltration Rate (mm/hr)	0.00

Table 7: Bio-retention Site D as modelled

Properties	Bio-retention D
Low flow by-pass (m ³ /s)	0.000
High flow by-pass (m ³ /s)	100.000
Extended Detention Depth (m)	0.15
Surface Area (m ²)	69.90
Filter Area (m ²)	54.50
Unlined Filter Media Perimeter (m)	48.20
Saturated Hydraulic Conductivity (mm/hr)	200.00
Filter Depth (m)	0.35
TN Content of Filter Media (mg/kg)	800
Proportion of Organic Material in Filter (%)	< 5
Orthophosphate Content of Filter Media (mg/kg)	< 55
Is Base Lined?	No
Vegetated with Effective Nutrient Removal Plants	Yes
Overflow Weir Width (m)	6.99
Underdrain Present	Yes
Submerged Zone with Carbon Present	No
Exfiltration Rate (mm/hr)	0.00

Table 8: Site D Rainwater Tank as modelled

Properties	Site D Rainwater Tank
Low flow by-pass (m ³ /s)	0.00
High flow by-pass (m ³ /s)	100.00
Volume below overflow pipe (kL)	304.00
Depth above overflow (metres)	0.20
Surface Area (square metres)	152.0
Overflow Pipe Diameter (mm)	90
Annual Demand (kL/yr) scaled by daily PET - Rain	2.358
Daily Demand (kL/day)	14.280

Monthly distribution of Annual Demand (kL/yr)	0.000
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Table 9: Site C Rainwater Tank as modelled

Properties	Site C Rainwater Tank
Low flow by-pass (m ³ /s)	0.00
High flow by-pass (m ³ /s)	100.00
Volume below overflow pipe (kL)	315.00
Depth above overflow (metres)	0.20
Surface Area (square metres)	157.5
Overflow Pipe Diameter (mm)	90
Annual Demand (kL/yr) scaled by daily PET - Rain	1.763
Daily Demand (kL/day)	6.467
Monthly distribution of Annual Demand (kL/yr)	0.000

Table 10: GPT (Ecosol RSF4000) as modelled

Properties	Ecosol RSF4000 GPT
Low flow by-pass (m ³ /s)	0.000
High flow by-pass (m ³ /s)	100.000
TSS removal rate	91%
TP removal rate	30%
TN removal rate	13%
GP removal rate	98%

APPENDIX H

PARSONS BRINCKERHOFF NORTSHORE HAMILTON UDA PRECINCTS 2 & 3 – TRUNK ROADS CONCEPT LAYOUT



APPENDIX I

STATE PLANNING POLICY 4/10 DEVELOPMENT ASSESSMENT CODE

TABLE – RESPONSE TO PART A - URBAN STORMWATER MANAGEMENT

PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	RESPONSE
Protecting Water Quality Performance outcome PO1 The development is compatible with the land use constraints of the site for achieving stormwater design objectives.	Acceptable outcome AO1.1 The nature, design and stormwater management of the development is in accordance with design objectives stated in Chapter 4 (section 4.9) of the State Planning Policy Guideline for Healthy Waters (the guideline) and Prepare a site stormwater quality management plan (SQMP) that: a. Is consistent with any local area stormwater water management planning; and b. Provides for achievable stormwater quality treatment measures reflecting land use constraints, such as soil type, landscape features (including landform), nutrient hazardous areas, acid sulfate soil and rainfall erosivity.	A Site Based Stormwater Management Plan (SBSMP) has been prepared for the development in accordance with QUDM, Brisbane City Councils Subdivision and Development Guidelines, Best Management Practices and the Healthy Waters Policy. The preliminary proposed treatment train has been included in the SBSMP.
Performance outcome PO2 The entry of contaminants into, and transport of contaminants, in stormwater is avoided or minimised.	Acceptable outcome AO2.1 Any development application incorporates: ▪ stormwater management measures to achieve relevant design objectives outlined in Chapter 4 of the guideline ▪ management of nutrients of concern and acid sulfate soils. and Prepare a site stormwater quality management plan	The development application includes a SBSMP which covers: • Target pollutants for the construction and developed phases of the project based on the proposal and site conditions. • Proposed stormwater management measures and a treatment train to achieve acceptable pollutant outputs.

TABLE – RESPONSE TO PART A - URBAN STORMWATER MANAGEMENT

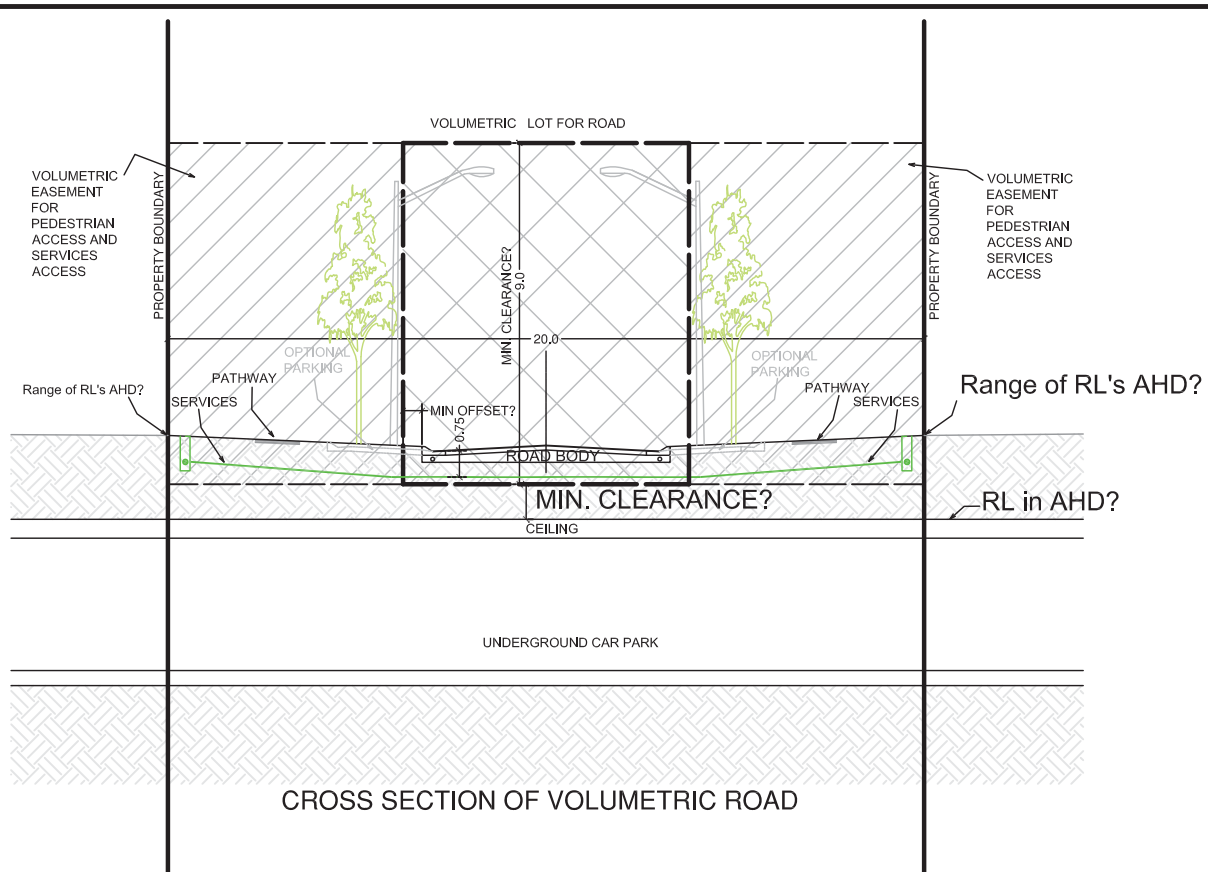
PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	RESPONSE
	(SQMP) that: ▪ a. accounts for development type, construction phase, local landscape, climatic conditions and design objectives in accordance with the guideline; and ▪ b. is consistent with the Queensland Acid Sulfate Soil Technical Manual.	The site is subject to high acid sulfate soils according to Brisbane City Council eBIMAP information. After a geotechnical investigation is completed and the extent of the acid sulfate soils is determined, the management and treatment of the soils will be in accordance with the Queensland Acid Sulfate Soil Technical Manual.
Performance outcome PO3 Construction activities for the development avoid or minimise adverse impacts on stormwater quality.	Acceptable outcome AO3.1 Any development application for the development is accompanied by an erosion and sediment control plan (ESCP) prepared in accordance with the guideline that demonstrates release of sediment laden stormwater is avoided for the nominated design storm, and minimised when the nominated design storm is exceeded by addressing design objectives in the guideline, Chapter 4, for: ▪ drainage control; ▪ erosion control; ▪ sediment control; and ▪ water quality outcomes. Addressing the design objectives may include enhancing the achievement of some objectives if achievement of other objectives is impractical. and Acceptable outcome AO3.2 Erosion and sediment control practices including any	A detailed Erosion and Sediment Control Plan (ESCP) is to be provided during the detailed design phase of the project once earthworks designs have been completed. The plan will include: • Any drainage redirection around exposed soils, • Erosion prevention measures, • Sediment capture and removal, • Maintain water quality objectives throughout the construction process.

TABLE – RESPONSE TO PART A - URBAN STORMWATER MANAGEMENT

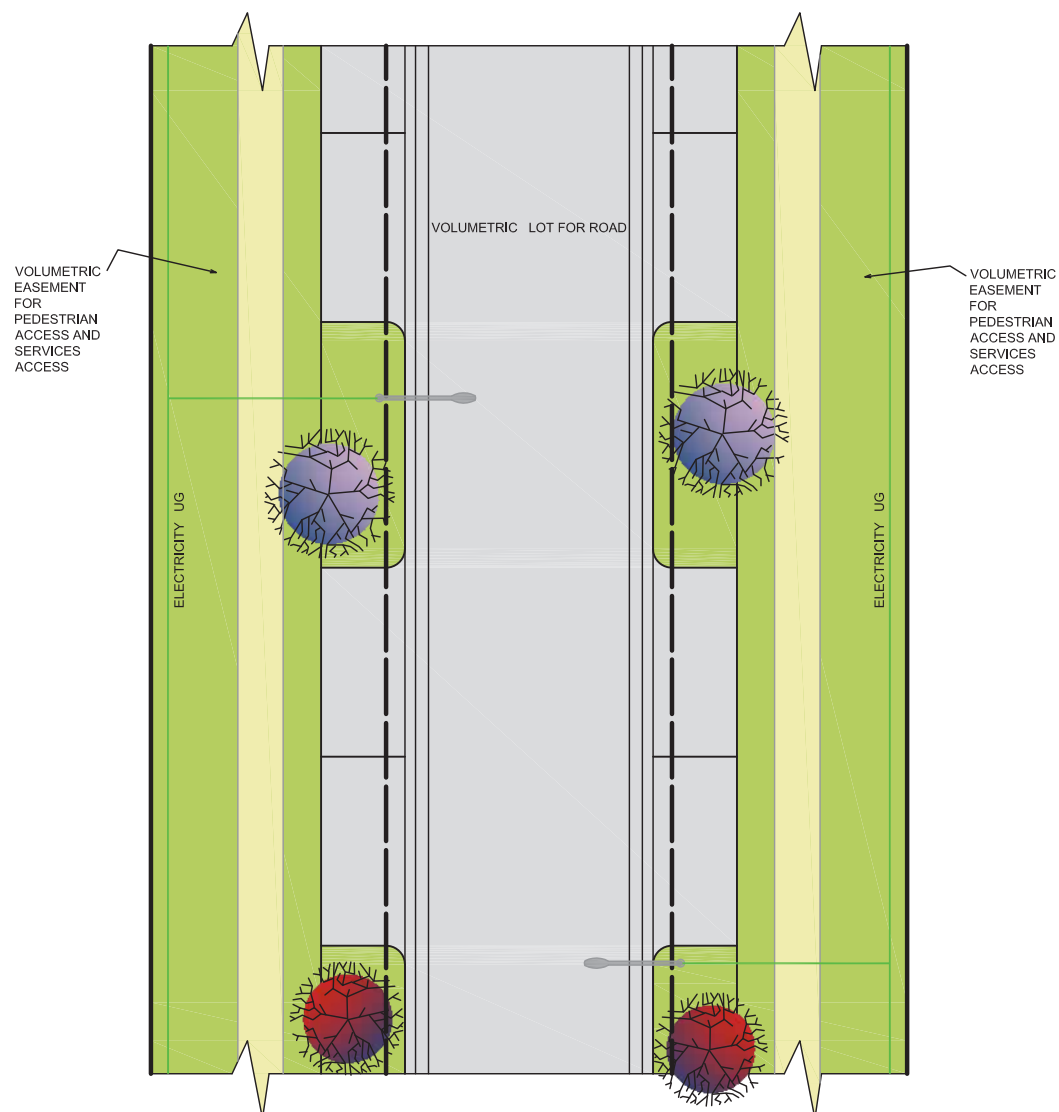
PERFORMANCE OUTCOMES	ACCEPTABLE OUTCOMES	RESPONSE
	proprietary erosion and sediment control products³⁰ are designed, installed, constructed, operated, monitored and maintained, and any other erosion and sediment control practices are carried out, in accordance with local conditions and appropriate recommendations from a suitably qualified person³¹. or The ESCP demonstrates how stormwater quality will be managed in accordance with an acceptable regional or local guideline so that target contaminants are treated to a design objective at least equivalent to Acceptable Outcome AO3.1.	
Protection of Natural Flows Performance outcome PO4 Construction and operation activities for the development avoid or minimise changes to waterway hydrology from adverse impacts of altered stormwater quality and flow.	Acceptable outcome AO4.1 Development incorporates stormwater flow control measures to achieve at least the design objectives set out in Chapter 4 of the guideline. Both the construction and operational phases for the development comply with advice and the design objectives in Chapter 4 of the guideline including management of frequent flows, peak flows, and construction phase hydrological impacts.	The development will not impact on the hydrology of the local area as the site is not located in an overland flow path and site runoff will not significantly increase as a result of the proposal.

APPENDIX J

EAST-WEST ROAD INFORMATION



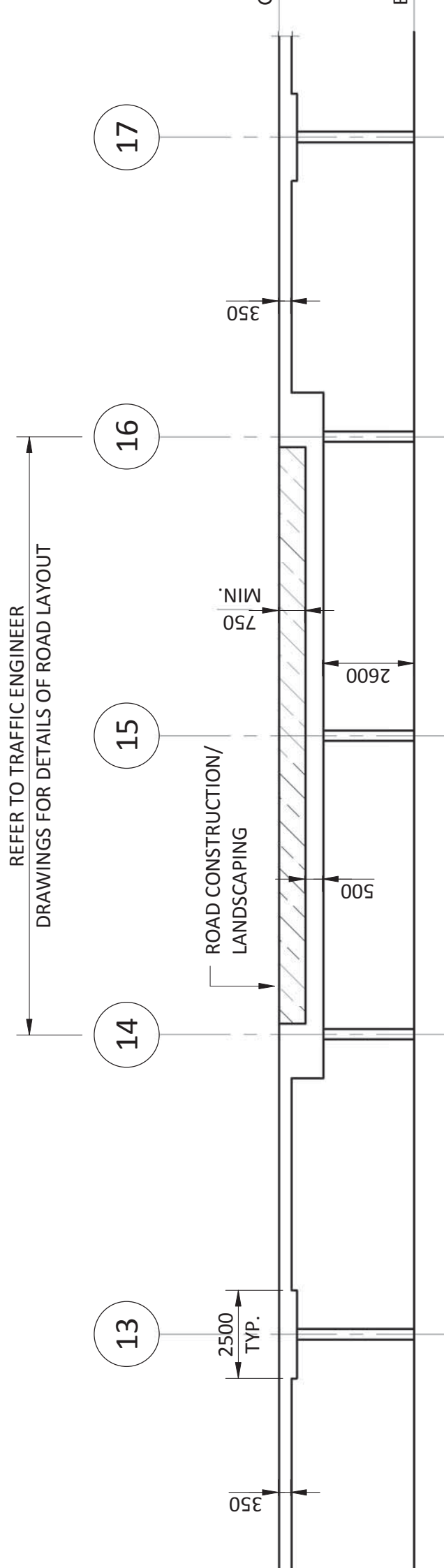
LOT 406 on SP187479



NOT TO SCALE

INDICATIVE PLAN VIEW OF VOLUMETRIC ROAD

22/02/2012
BRRM4250.REM



TYPICAL SECTION