

PLANS AND DOCUMENTS

referred to in the ULDA

APPROVAL dated 6 / 5 /11

ENGINEERING REPORT

FOR THE PROPOSED
MIRVAC HAMILTON DEVELOPMENT

LOCATED AT
19 HERCULES STREET
HAMILTON

PREPARED FOR
MIRVAC LIMITED
BY BORNHORST & WARD PTY LTD

Bornhorst & Ward Project No. **10363**

If you have any queries regarding this report please contact Kris Rensch.

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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 Mirvac Hamilton Development, located at 19 Hercules Street, Hamilton. The location of the proposed site is indicated in Figure 1 below and Figure 9, Appendix A.

The development site is located within the Northshore Hamilton UDA, however all Engineering requirements for this proposal, including Stormwater Quality Requirements, shall be in accordance with Brisbane City Council Subdivision and Development Guidelines and the Brisbane City Council City Plan. This is consistent with developments within and surrounding the UDA.

Waterways retain significant natural value and provide important environmental, commercial and recreational benefits. It is important that these uses are protected from the threat of stormwater pollution, which the proposed development at 19 Hercules St Hamilton aims to deliver through an integrated water cycle management strategy. The Engineering requirements noted above have been considered in conjunction with an integrated watercycle, whereby capture and reuse options for stormwater runoff from the development site have been investigated. Due to the spatial restraints associated with the proposed development site, larger scale options for capture of stormwater runoff are limited. Nonetheless allowances have been made for incorporation of stormwater harvesting and treatment into the development site for various internal uses including irrigation, commercial toilet flushing and fire sprinkler protection.

This report outlines the proposed 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 6 kilometres northeast 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 Gold Club at the eastern extent. The subject site is located on Hercules Street in the western extent of the UDA, and is indicated in the figure below.

The subject site has a northern frontage to Hercules Street and is opposite the Hamilton Recreation Reserve which is a public park. Adjoining the site to the east is land currently utilised as a temporary car park which is covered by a current development approval for a 15 storey mixed use building comprising residential units with ground floor retail tenancies. To the south of the subject site is the Portside Wharf development incorporating the Brisbane Cruise Ship Terminal, residential, retail and commercial activities in a range of multistorey buildings ranging in heights. Approved and proposed future residential apartment buildings up to 15 storeys in height are intended to form part of this site. Development west of the site includes existing two storey brick commercial buildings including the "Samies Girl" seafood market.

Street Address: 19 Hercules Street, Hamilton

RP Description: Lot 3 SP 172658



Figure 1: Orientation Plan (www.nearmap.com)

2.2 LANDUSE

2.2.1 EXISTING

The site is currently occupied by a number of older low rise buildings consisting of predominantly masonry construction. A newer two storey office/administration building is located at the Hercules Street frontage with former laboratories and testing facilities located behind this building surrounding a central hardstand servicing area.

A sealed single aisle car parking area occupies the length of the site adjacent to the eastern side boundary with a single crossover to Hercules Street. The majority of the site is occupied by hardstand areas and buildings with limited landscaped areas located adjacent to the car parking area and adjacent to some of the buildings.

The site is generally flat with site levels ranging between approximately RL 3 – 3.5m.

2.2.2 PROPOSED

The development proposal comprises of four buildings that address Hercules Street, Main Street and the proposed pedestrian spine, which is a public landscape feature that links Main Street to Hamilton Park through the site. The proposed scheme contains a diverse mix of building heights, apartment types and uses that activate the frontages.

The site masterplan provides for four buildings:

Building 1: 23 levels, 263 apartments, maximum height RL 74.40

Building 2: 18 levels, 200 apartments, maximum height RL 60.40

Building 3: 8 levels, 119 apartments, maximum height RL 31.40

Building 4: 2 levels, maximum height RL 4.5

Retail and services uses (approximately 1,600m²) are planned for the ground podium, which will marry with the existing podium level of adjoining Portside Wharf. The overall gross floor area of the proposed development is approximately 42,755m² (excluding lifts and services).

Car parking is provided in a three-level basement with 600 car spaces for retail users, residents and visitors. There is also potential for an additional 16 car spaces on podium for retail tenants. Provision for this is conditional on the adjoining developer, Brookfield Multiplex, completing construction of Main Street and negotiations permitting Mirvac an access easement to use the private road. The main vehicular and servicing access points are separate and are both off Hercules Street. The proposed site layout is shown on the Mirvac Design architectural drawings, attached in Appendix A.

2.3 TOPOGRAPHY & SITE DRAINAGE

In existing conditions, the site is relatively flat with levels around RL 3.0m. The existing carpark and roof areas are serviced by an internal drainage system, directing stormwater to the rear of the site, to an existing stormwater connection provided within the Portside Wharf development.

It is understood through discussions with Brookfield Multiplex that the existing stormwater line servicing the site will be terminated as part of the planned development works within the adjoining allotment. A new stormwater line connecting to the existing infrastructure within Hercules Street, close to Remora Road is required. This is discussed further in Section 4.1.2 below.

3. SITE DATA

3.1 SOURCES OF INFORMATION

In order to collate existing information for the site and the immediate environment, the relevant Council and governing authorities were contacted to determine whether any of the following documents, relevant to the area immediately adjacent to the development, exist:

Waterway Management Plans	- NIL
Catchment Management Plans	- NIL
Stormwater Management Plans	- SKM Site Based Stormwater Management Plan (August 2003) - Bornhorst and Ward Master Plan 2 (December 2006)
Flood Studies	- NIL
Infrastructure Charges Plans	- NIL

4. EXISTING AND PROPOSED CIVIL WORKS AND INFRASTRUCTURE

4.1 STORMWATER

4.1.1 EXISTING INFRASTRUCTURE

There is existing stormwater infrastructure within the road reserves fronting the development site, and within the site itself. These are summarised as follows, and illustrated in the figure below:

- There are eight stormwater gully pits with 4.8m lintels, constructed in a sag arrangement within Hercules Street, at the intersection of Hercules Street and Remora Road. These direct stormwater to five pipes of 525 and 600mm diameters which then discharge to twin 1200 x 900mm box culverts within Hercules Street and Remora Road. Stormwater is then discharged to the Brisbane River via a 2100 x 2700mm box culvert.
- There are a number of field inlets and stormwater lines within the existing carpark on the site. These drain to the south into an 825mm diameter stormwater line within the existing Portside development, where stormwater is then directed through to the outlet into the Brisbane River. This infrastructure is to be removed during construction works in the Portside and Mirvac development sites.



Figure 2: BCC Bimap Stormwater Records.

4.1.2 PROPOSED CONNECTION LOCATION

As discussed above, drainage from the site is currently directed to the existing 825mm diameter line within the Portside Wharf development. To allow the site to be independent of surrounding properties, a new stormwater connection is required to the existing stormwater system fronting the development site. An analysis of the existing and proposed system has been undertaken and is described in the following sections.

- **BACKGROUND**

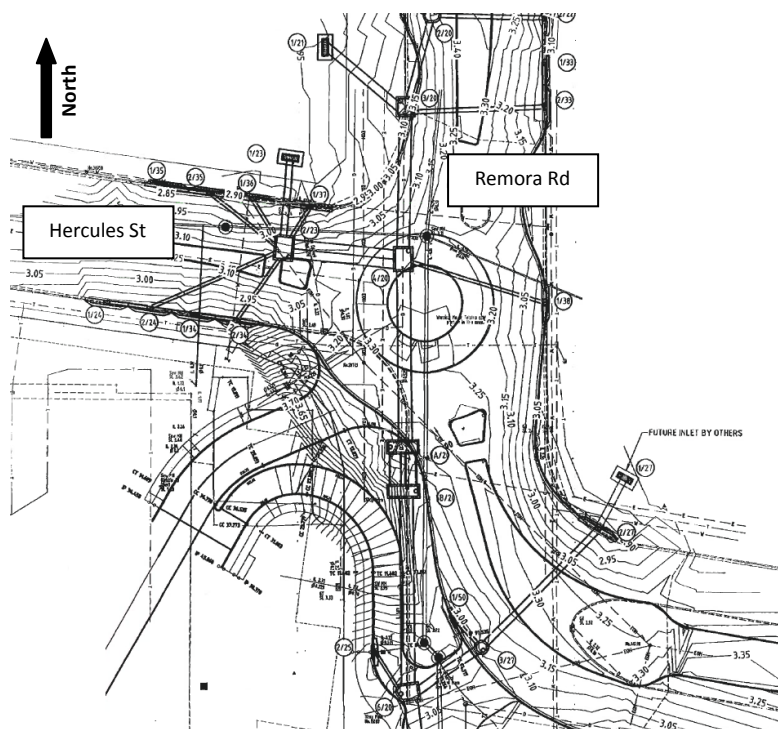
During the original master subdivision of the adjoining Portside development, SKM undertook drainage investigations and design of the stormwater system. As part of the works undertaken, stormwater drainage with Q_{100} capacity was constructed at the corner of Hercules Street and Remora Road, and Hercules Street and Harbour Road. This was required to alleviate minor flooding of the area, as the terrain is very flat and sufficient overland flow capacities through to the Brisbane River did not exist.

Allowances have been made in the original design for the development site to connect Q_{100} flows to the existing 825mm diameter stormwater line in the adjoining allotment, and discharge to the system at the intersection of Hercules Street and Harbour Road. The original designs undertaken were based on development of the area by a single developer, with all new drainage being a hydraulics system connecting to a single connection point, close to the Brisbane River outlet, with the existing 825mm diameter stormwater line and property connection being removed.

The development site has since changed ownership, as such there are no current agreements between Mirvac and Brookfield Multiplex to maintain the existing stormwater connection to the site. To allow the site to function as an independent system, a new connection to the existing drainage in Hercules Street is required.

• EXISTING SYSTEM

The existing drainage system in the area has been analysed in terms of drainage capacity and overland flow. The SKM design drawings, originally approved by BCC, for the existing system have been obtained. Based on the design drawings it is understood that detailed hydraulic modelling has been completed in addition to PC Drain modelling, to determine bypass flows within the area. The original SKM design drawings are attached in Appendix C. The existing drainage within Hercules Street and Remora Road is indicated in Figure 3 below.



When the capacity of the underground pipework is reached, stormwater will pond in this sag location, until such time that it overtops the road crests noted above, and flows south and east via Hercules Street. The original SKM drawings indicate that ponding to a level of RL 3.225m AHD will occur, while discharging $1.6\text{m}^3/\text{s}$ east towards Remora Road, $0.5\text{m}^3/\text{s}$ south towards Harbour Road, and $0.3\text{m}^3/\text{s}$ south into the development site via the existing crossover.

To model the existing scenario, a PC Drain model of the existing system has been set up. This has been completed by using data from the calculation tables and long sections supplied in the original design drawings by SKM, which are assumed to be generally correct. Pipe levels, sizes and locations from the existing long sections have been utilised. On completion of the existing model, minor discrepancies in hydraulic grade levels in the structures were noticed. This can be attributed to minor discrepancies between the modelling data.

A number of assumptions within the original model have also been reviewed. It was noted that these allowed for a very conservative design, and may not reflect actual on site operating conditions. These assumptions have been updated as follows:

- The adjoining park area has been modelled by SKM, with a coefficient of runoff of 0.22 for the Q_{100} storm event, and a 5 minute time of concentration. This is to remain as park area as part of the ULDA's UDA masterplan, and if redeveloped in the future, existing runoff rates will need to be maintained. Based on methods outlined by QUDM, the time of concentration for the park catchments has been recalculated at 20 and 30 minutes using both sheet and channel flow components. The PC Drain model has been updated using a 20 minute time of concentration, and a Q_{100} coefficient of runoff of 0.88. This is consistent with QUDM and BCC Guidelines.
- There is an existing field inlet located in the south western corner of the park, which is not indicated on BCC Bimap Records or as constructed information for the drainage system being analysed. This connects to the Hercules Street drainage infrastructure and is shown in the figure below.

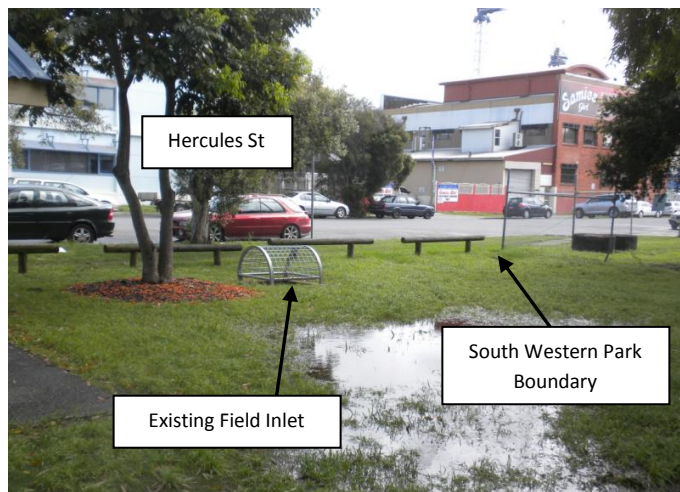


Figure 4: Existing Stormwater Inlet

From a site inspection it is evident that the entire park area does not grade towards the stormwater inlets provided at the corner of Hercules Street and Remora Road. The western section of the park has been raised and banded around the existing amenities and play equipment. This 0.25Ha area generally grades towards the new field inlet indicated in the figure above. As this catchment does not

effect the existing stormwater system being analysed, it has been excluded from the model. An amended catchment plan is provided on the Bornhorst & Ward Drawing C090 attached in Appendix A.

- The Hydraulic Grade Level at the Brisbane River outlet has been modelled as RL 1.63m AHD, being Highest Astronomical Tide (HAT). We believe that this level, combined with the design storm provides for an extremely conservative design. The outlet level for the existing case has hence been amended to the Mean High Water Springs (MHWS) level of RL 1.06m AHD. This outlet hydraulic grade level is consistent with the Queensland Urban Drainage Manual requirements, which stipulate the outlet HGL under tidal operating conditions to be between MHWS and HAT.
- From assessment of the existing calculations for the stormwater system, it has been found that the portion of land to the east of the site, specifically the Citimark property identified by Catchment 130 in the figure below and on the SKM Stormwater Drainage Catchment Plan GC520 has not been included in the PC Drain model. This area has been added back into the model of the existing conditions.

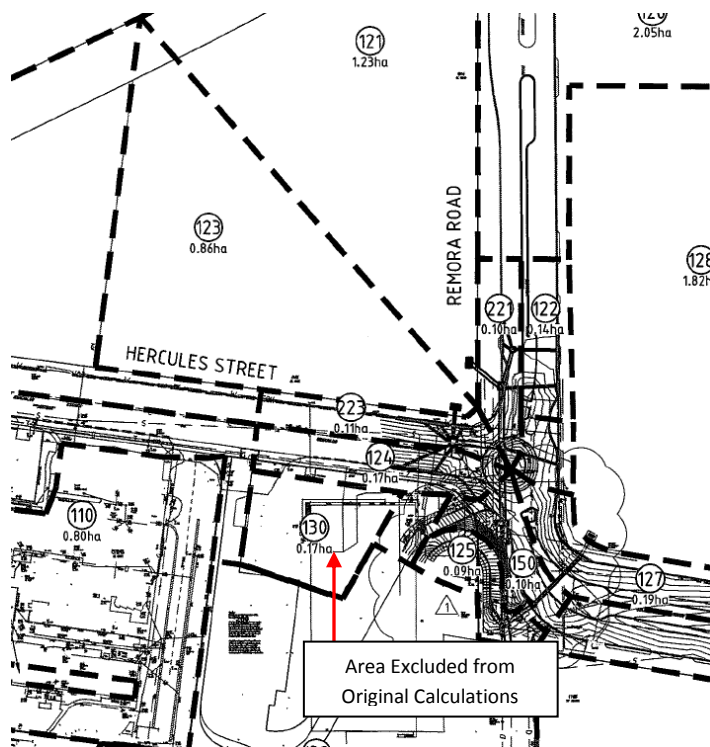


Figure 5: Existing Catchment Plan (SKM Drawing GC520)

A PC Drain model has therefore been recreated based on the changes discussed above. This has been adopted as the existing operating conditions for the site. We believe that this provides for a more accurate estimate of the actual operating conditions. Full calculations for the existing model can be provided on request.

• CONNECTION LOCATION

As discussed above, drainage from the site is directed to the existing 825mm diameter line within the Portside Wharf development. To allow the site to be independent of surrounding developments, a new stormwater connection is required to the existing stormwater system fronting the development site.

The existing stormwater system has been analysed in terms of an appropriate connection location. It is believed that the most feasible option is connection to the existing drainage system within Hercules Street, near Remora Road, at the existing structure 2/23 indicated in the figure below. It is therefore proposed that a new stormwater line is extended from the existing chamber within Hercules Street to the development site (Refer drawing C030 attached in Appendix A). As a result of the proposed development being raised above the existing surface level, both Q_{100} stormwater runoff and bypass flow currently entering the site will be directed back to Hercules Street.

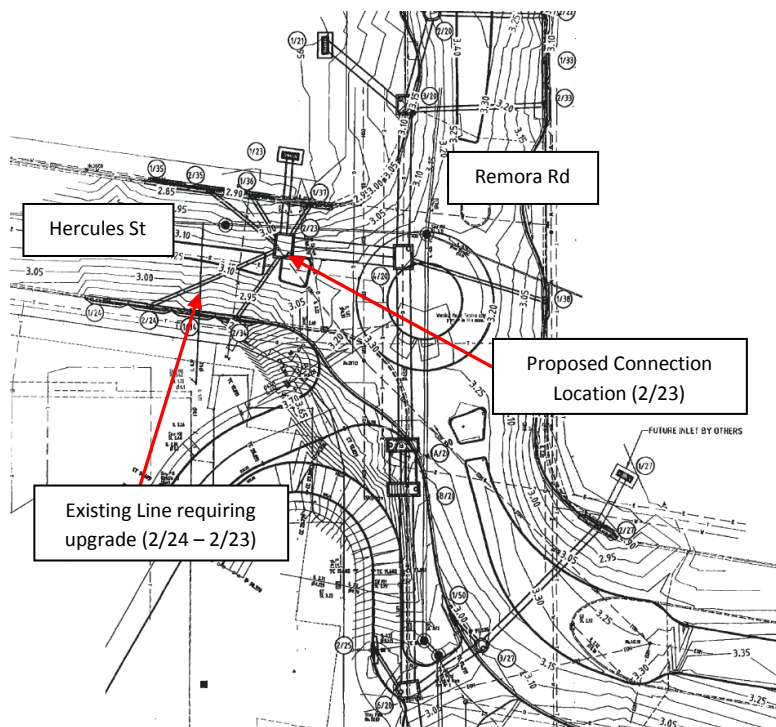


Figure 6: Stormwater Connection Location (SKM Design Drawing GC521)

The model as discussed above has been amended to include a new 825mm diameter drainage line from the site to the existing stormwater chamber in Hercules Street. Given the lack of sufficient overland flow paths within the area, the existing system is of Q_{100} capacity. The new line servicing the property therefore also requires Q_{100} capacity for the development site. This will form the legal point of discharge for the development site.

The PC Drain model has been calculated, with the results (long sections and calculations) being shown on the Bornhorst & Ward Drawings C040 – C046 attached in Appendix A. As a result of the additional flow, the Q_{100} hydraulic grade line within the system has risen slightly with minor surcharge occurring at an existing gully pit within Hercules Street structure 1/24. As such upgrade of the existing 600mm diameter line to a new 750mm diameter stormwater line between Structures 2/24 and 2/23 is required. This is indicated in the figure above.

The $0.3\text{m}^3/\text{s}$ currently flowing into the site has also been added to the existing stormwater system. This has negligible effect on the stormwater system. The existing gully pits consist of a Standard BCC Type A gully pits, with a 4.8m lintel, in a sag arrangement. The BCC inlet capacity chart on standard drawing UMS 388 has been checked for this additional flow. Based on 100mm of ponding over the eight existing gully pits, there is sufficient capacity for 100% capture of the existing catchment and existing bypass flows as well as the additional $0.3\text{m}^3/\text{s}$ now directed to Hercules Street.

4.2 SITE FLOODING

A BCC Floodwise Report has been obtained for the site. The highest defined flood level is RL2.5m AHD as a result of a Storm Tide. As the Ground Level for the development will be constructed at RL4.46m AHD, with residential areas being above this, the development will not be affected by flooding, and have freeboard, to the highest defined flood level, exceeding 1.9m. Existing levels within Hercules Street, surrounding the site access range around RL3.0m, therefore sufficient freeboard is provided to the basement access from this storm event.

From review of the original SKM drawings for the drainage system for Hercules Street, it is believed that minor local flooding also occurs during a Q_{100} rainfall event. As discussed in previous sections, ponding occurs within a sag in Hercules Street, to the west of the development site. The original SKM drawings indicate that stormwater will pond to a level of approximately RL 3.225m while bypassing stormwater back east within Hercules Street.

A weir flow calculation has been undertaken at the crest locations within Hercules Street, and across the existing site crossover. Based on the bypass flow information from the SKM drawings, it is believed that stormwater will pond to approximately RL 3.4m AHD. This discrepancy in levels can possibly be attributed to more detailed level information being used for these updated calculations. Under BCC Subdivision and Development Guidelines, no freeboard is required to commercial areas and basement accesses. It is however recommended that 100mm freeboard is provided to the lower areas of the development site. The basement access and lower commercial areas floor levels shall therefore be set at RL3.5m AHD. All basement ventilation is also required to be above this level.

4.3 EXTERNAL SEWER

The existing sewer infrastructure and options for sewer connection are discussed in the following sections. Detailed advice from both QUU and the ULDA, in terms of their servicing agreement, as well as their preferred connection location is still required.

4.3.1 EXISTING INFRASTRUCTURE

The existing sewer infrastructure surrounding the site is described as follows:

- There is an existing 225mm diameter sewer directly fronting the development site. There is also an existing 100mm diameter property connection servicing the site. This is indicated in the figure below.
- There is an existing 225mm diameter sewer connection and private drain within an easement in the adjoining property on the east of the development site.
- There is a 400mm diameter PE sewer in 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. The sewer has been designed to cater for an external catchment, consisting of the Hamilton Harbour and Portside Developments.

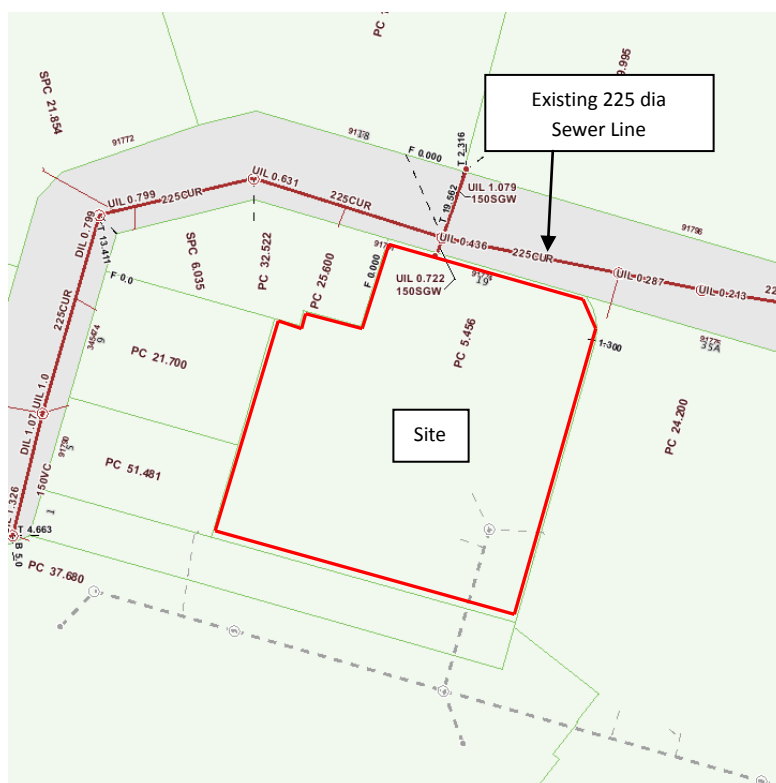


Figure 7: BCC Bimap Sewer Records

4.3.2 SEWER LOADING

A preliminary calculation of sewer loading for the development has been calculated at 15.3L/s (under Peak Wet Weather Flow) in Table 1 below. Calculations have been based on the Brisbane City Council Sewerage Standards and the Water Services Australia Sewerage Code.

Table 1: Sewer Flow Calculations

Area Classification	Units	EP Loading / unit	Total EP
1 Bedroom	344	1.75 EP / unit	602
2 Bedroom	238	2.0 EP / unit	476
Retail / Commercial	1600m ² NLA	152 EP/Ha	25
Total EP			1103
PWWF (1200L/EP/day)			15.3 L/s

4.3.3 SEWER CONNECTION OPTIONS

Options for the development's sewer connection have been identified as follows. The preliminary location of sewer options is shown on the Sewer Connection Options drawing SKC001 attached in Appendix A.

- Option 1

The first and preferred option is to connect to the existing 225mm diameter sewer within Hercules Street fronting the development site.

Previous applications in the area, including the 5 – 9 Hercules Street, and the adjacent Citimark Portside Building 6 have obtained permission by Queensland Urban Utilities (Formerly Brisbane Water), to connect

to the existing 225mm diameter line. Given the previous applications and approvals issued by QUU for sewer connections, it is expected that the existing 225mm diameter sewer line is however nearing capacity. QUU have also confirmed that there are capacity issues in the area.

- Option 2

The second option is for extension of a new 250mm diameter PE sewer line within Hercules Street to the existing 300mm diameter sewer in Remora Road. This would involve construction of approximately 155m of sewer. A preliminary alignment for this, located in the verge and park area to avoid services clashes is shown on SKC001 attached in Appendix A.

- Option 3

The third option is to connect to the existing 400mm diameter Macarthur Avenue sewer by extending a new 250mm diameter PE sewer through Hercules Street and Remora Road. The total length of new sewer is approximately 380m. A preliminary alignment for this, with sections of sewer located in the verge and park area to avoid services clashes is shown on SKC001 attached in Appendix A. This is preliminary only and is subject to further investigation of existing services and detailed survey information.

The existing Northshore line has been designed with sufficient capacity for this catchment. This line is however limited by the capacity of the exiting pump station near Barcham Street. Queensland Urban Utilities has advised that there is spare capacity of approximately 1000 EP within the pump station. Preliminary designs have been completed for construction of a trunk sewer from the Macarthur Avenue line, connecting directly to the Violet Street Sewer Pump Station, however the construction timing of this is currently unknown. A servicing agreement between the ULDA and QUU is currently being arranged. This will detail connection locations and a delivery timeline.

Discussions with Queensland Urban Utilities regarding these options have commenced. Advice from QUU and the ULDA is still required to determine their preferred connection location, as this is dependent on the servicing agreement between the ULDA and QUU, which is currently being prepared.

4.4 INTERNAL SEWER

Design of the sewer internal to the site will be completed by the Hydraulic Engineer. Any internal pumps required to service basement areas will be assessed under Plumbing and Drainage requirements will remain the property of the development and not be handed over to Council.

4.5 WATER

There is an existing 150mm diameter potable water main within Hercules Street, along the full frontage of the site. There is also an existing 150mm diameter water connection to the site from the existing water main. This connection was constructed by Brookfield Multiplex as part of the master subdivision for the area. Flow and pressure tests will be required to determine suitability of this existing connections and main. A new water meter is also required for this connection (refer drawing C070 attached in Appendix A). Although this is not shown on the BCC Bimap records, this is located approximately 18.5m from the eastern property boundary. It is the developer's intention to utilise this existing water connection for the development site. Connection details internal to the site are to be confirmed by the Building Services / Hydraulic Consultant.



Figure 8: BCC Bimap Water Records

Informal discussions with QUU have occurred, whereby it was advised that the existing water system has sufficient capacity to service the development site. Permission from QUU will be required for any additional water connections required for the development site. This permission is also pending on the servicing agreement between the ULDA and QUU.

4.6 NON CIVIL SERVICES

A Dial Before You Dig enquiry has been lodged for this development. The existing services fronting the development site are described as follows. A copy of the Dial Before You Dig records are available on request.

4.6.1 GAS

There is an existing 100mm diameter dormant gas main following the full frontage of the development site, which is operated by APA Group. Dial Before You Dig records indicate that this line is approximately located on a 1.3m alignment within the verge, from the property boundary. APA Group should be contacted if gas services are required for this development. This service is required to be located prior to any services crossings.

4.6.2 ELECTRICITY

There are existing Energex assets within the verge and the Hercules Street roadway fronting the development site. Within the verge there are 9 conduits, containing cables of voltage less than 33kV. Within the roadway there are 2 direct lay cables, also less than 33kV. The electrical consultant for the project shall advise on any additional requirements for the development site.

It is expected that these range in depth between 600 – 750mm however actual location of these cables are required prior to construction of any services crossings.

4.6.3 TELECOMMUNICATIONS

There are existing Telstra assets within the verge fronting the development site. There is a Telstra Pit close to the existing crossover into the site. There is a single 100mm diameter conduit, as well as two PVC conduits between the western site boundary and the pit. To the eastern side of the pit, there is a single 100mm diameter Conduit, as well as four PVC conduits. These contain both local and mains cables, as well as fibre optics.

The serviceability of the site would be considered by Telstra in conjunction with projects electrical consultant during the application for the development.

4.7 EARTHWORKS

Earthworks will be required for excavation of the basement level. All earthworks will be undertaken in accordance with Brisbane City Council Subdivision and Development Guidelines. A preliminary earthworks drawing and sections have been completed. Refer drawings C010 and C015 attached in Appendix A.

A number of assumptions have been made for basement levels and earthworks levels, based on known ground conditions in the area. These are preliminary only and are subject to further review during further design and are also subject to specific construction requirements. The geotechnical engineer shall also confirm the safe batter angle for earthworks within the site.

4.8 EROSION AND SEDIMENT CONTROL PLAN (ESCP)

A comprehensive Erosion and Sediment Control Plan including a construction process has been prepared for this development. This is preliminary at this stage, however will be updated as required during further detailed design. It is proposed at this stage, that all areas are directed to the lift overruns for settlement and pump out.

The ESCP designs are in accordance with the Institution of Engineers reference material and Brisbane City Council's Guidelines. Refer drawings C020 and C021 attached in Appendix A.

4.9 ASSET HANDOVER

It is the intention of the applicant that the stormwater quantity and quality controls located within the site will be owned and maintained by the development as part of the sites stormwater infrastructure. External works including stormwater connection and any external sewer upgrades will be dedicated to BCC and Queensland Urban Utilities via the ULDA.

5. STORMWATER MANAGEMENT PLAN

5.1 STORMWATER OBJECTIVES

Under the Brisbane City Council Land Use Development Guidelines, several design elements were identified in relation to stormwater management issues. Brisbane City Council must be satisfied that:

- 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 CATCHMENT DESCRIPTION

5.2.1 EXISTING AND PROPOSED

In existing conditions, the site is relatively flat with levels being approximately RL3.0m. Surface water discharged into the adjoining property at the rear of the site. The majority of the site in existing conditions, is covered with impervious areas.

As a result of the development proposal the site will consist mainly of roof and podium areas. Under developed conditions, the site will have a high fraction impervious, similar to existing conditions.

5.3 LEGAL POINT OF DISCHARGE

The existing point of discharge from the site is the existing connection into the Portside Drainage system at the rear of the property. The legal point of discharge for the development is the proposed pipework within Hercules Street, connecting to the existing chamber at the intersection of Remora Road. This is discussed further in Section 4.1.2 above.

5.4 OPPORTUNITIES AND CONSTRAINTS

5.4.1 SITE OPPORTUNITIES

The major opportunities identified for the site with respect to the application of stormwater quality and quantity controls are:

- The use of rainwater tanks to capture roofwater runoff for re-use within the internal plumbing of the buildings.

5.4.2 SITE CONSTRAINTS

The major constraints identified for the site with respect to the application of stormwater quality and quantity controls are:

- High density developments change the runoff characteristics of the development. An increase in impervious area can result in an increased amount of runoff.
- The size of the development site restricts the space available for use in stormwater management.

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 Brisbane City Council's Subdivision and Development Guidelines.

Calculations have been undertaken to determine the undeveloped and developed peak run-off rates with the Best Management Practices (BMPs) incorporated into the site layout for stormwater quantity control.

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 have been estimated based on a review of aerial photography and the proposed development layout.

Brisbane City Council Subdivision and Development Guidelines, Table B2.1, "Design Standards for Major/Minor Drainage Systems" was used to identify the design storm events for this development as:

Minor -	1 in 10 year ARI
Major -	1 in 50 year ARI
Major (overland flow) -	1 in 100 year ARI

Flow rates were calculated at the point of discharge from the site for the existing and developed phases of the development. Detailed calculations can be reviewed in Appendix B.

Table 2: Pre & Post Development Peak Flow Calculations

	Parameter	Existing	Proposed
Catchment Details	Area (Ha)	0.7637	0.7637
	Fraction Impervious	90%	100%
	Coefficient of Runoff (C10)	0.88	0.90
	Time of Concentration (min)	5.0	5.0
	10 year Rainfall Intensity (mm/hr)	215	215
	50 year Rainfall Intensity (mm/hr)	291	291
	100 year Rainfall Intensity (mm/hr)	325	325
Discharge	1 in 10 year ARI (m³/s)	0.401	0.410
	1 in 50 year ARI (m³/s)	0.617	0.617
	1 in 100 year ARI (m³/s)	0.689	0.689

As indicated within the table above, the discharge rates from the proposed development are similar to the existing conditions, hence no stormwater quantity controls are proposed. This can be attributed to the existing site being completely developed. Due to the close proximity of the site to the Brisbane River, stormwater will

be discharged as quickly as possible. This will prevent the peak runoff from the local catchment from coinciding with the peak of the upstream catchments, ultimately increasing the peak runoff. The development will however incorporate a rainwater tank which will provide some mitigation to the minor storm runoff. This has been assumed full for the above calculations.

7. STORMWATER QUALITY

7.1 WATER QUALITY

All references to water quality objectives and design requirements within this report have been based on Brisbane City Council Standards and in particular Brisbane City Council Subdivision and Development Guidelines Part C – Water Quality Management Guidelines. The ULDA Development Assessment Certification Procedures Manual makes reference to the South East Queensland Regional Plan – Implementation Guideline No. 7 Draft – Water Sensitive Urban Design Objectives for Urban Stormwater Management. Given the nature of the proposed development and previous developments and approvals in the area, we believe that the Brisbane City Council guidelines are acceptable.

The Brisbane City Council Subdivision and Development Guidelines, Part C – Water Quality Management Guidelines, specifies that the level of stormwater treatment is determined by the development falling into either the ‘high’ or ‘low’ risk categories. For a development to be classified as ‘high risk’ it must fall within one of the following categories as specified in Section 3.1.1 of the above guidelines:

- Development located in a waterway corridor, Brisbane River corridor, or wetland area;
- Multi-unit dwellings or commercial uses with an impermeable surface area (not including roof area) in excess of 2500m²;
- Subdivision where greater than 6 lots are involved
- Industrial activities that are not impact assessable (under Council’s City Plan) and have at least 1000m² in uncovered storage / working space;
- Industrial activities that are impact assessable (under Council’s City Plan);
- Uncovered car parks with at least 100 spaces;
- Developments which discharge stormwater or wastewater to an area deemed by Council to have significant environmental value.

Based on the current architectural drawings, the 7637m² site will consist of approximately 4700m² of roof areas, and 2937m² of podium area. The majority of podium area will be for pedestrian use only, and will not be subject to vehicular traffic; as such the pollutant discharges from this area will generally be low.

From a review of the above categories, we believe that the development can be classified as ‘low risk’ for Water Quality as the site is not located in a waterway corridor, Brisbane River corridor or wetland area. Although the impermeable surface area for the site exceeds the 2500m² trigger for high risk developments, much of the impermeable surface area will consist of podium area, not subjected to vehicular traffic. The pollutant discharges for this area will therefore be low. The uses of this area are also consistent with surrounding site uses, with the proposed stormwater quality treatment methods being consistent with recent development in the area. As the development has been classified as ‘low risk’ Best Management Practices will be applied.

7.2 SITE CHARACTERISTICS AND IMPACTS

The proposed development is such that the majority of the site is covered with roof area. It is hence expected that the generation of pollutants would be low. Best management practices will be applied to mitigate the pollutant discharge from the site.

7.3 PROPOSED TREATMENT TRAIN

It is proposed to install a GPT in the basement area for treatment of stormwater prior to discharge. We expect that this would be of the Ecosol RSF4000 range which allows trapping of oils and grease. This would also provide treatment to the stormwater runoff from the podium areas. The location of this is to be determined by the Hydraulic Engineer during the detailed design phase.

7.4 INTEGRATED WATER CYCLE

The development will include an integrated water cycle system, including elements such as a rainwater collection tank and reuse system. A rainwater tank, located within the basement level will be provided as part of the development. This will capture runoff from roof areas, and provide water for reuse in the fire sprinkler system, landscaping irrigation and toilet flushing for the retail toilets. The tank sizing and final location is to be confirmed by the Hydraulic Engineer during the detailed design phase of the development.

7.5 WATER QUALITY MONITORING PROGRAM

As this development discharges stormwater into the existing drainage system using stormwater quality Best Management Practices, no proposal for water quality monitoring has been made. The measures proposed for water quality and water quantity treatment are reasonably well understood and demonstrated in Brisbane. It is hence anticipated that they are acceptable here.

8. SUMMARY

From the investigations conducted, it has been shown that the proposed development can be constructed and serviced in accordance with Brisbane City Council requirements, the Queensland Urban Drainage Manual and widely accepted engineering principles.

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

FIGURES AND DRAWINGS

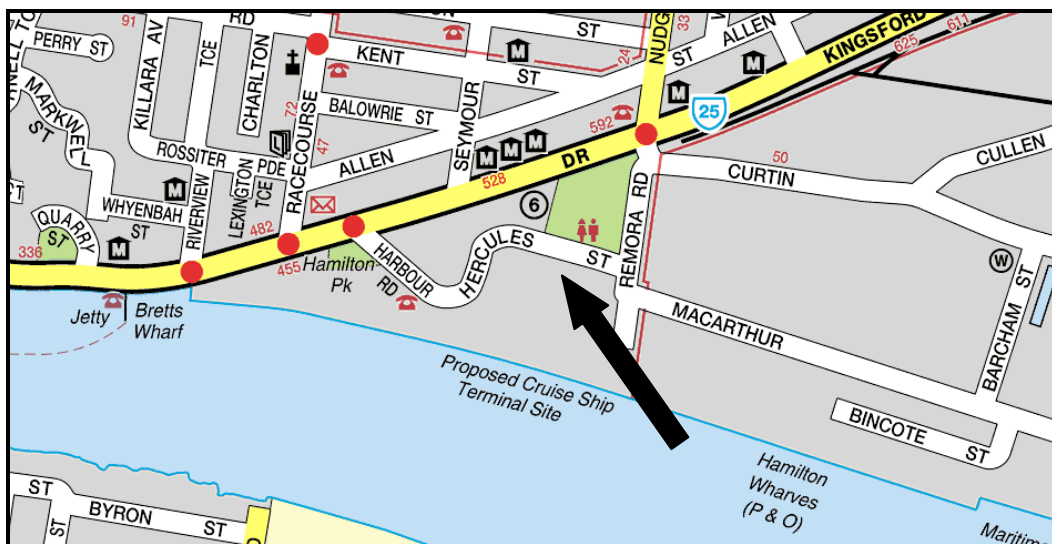
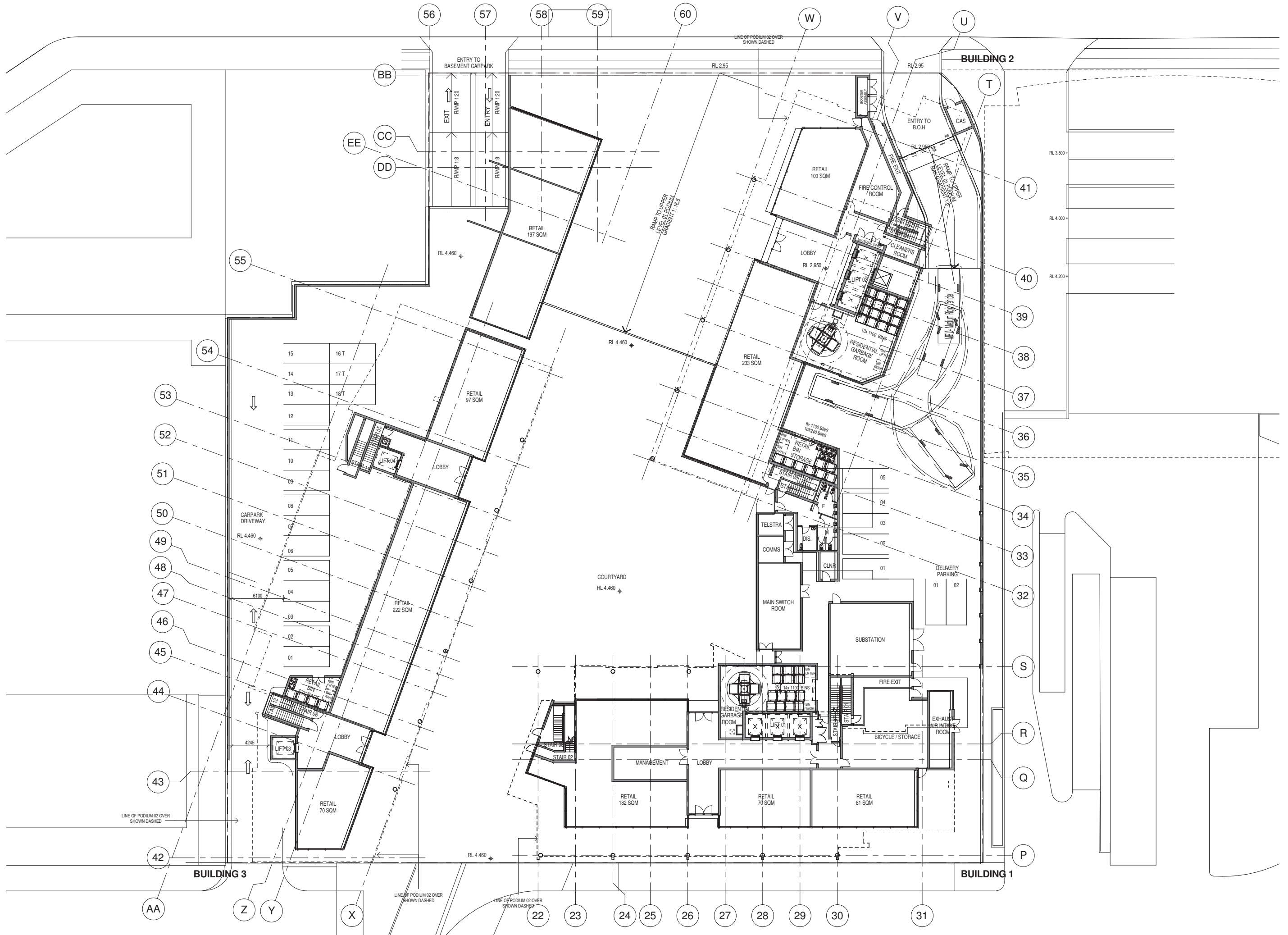
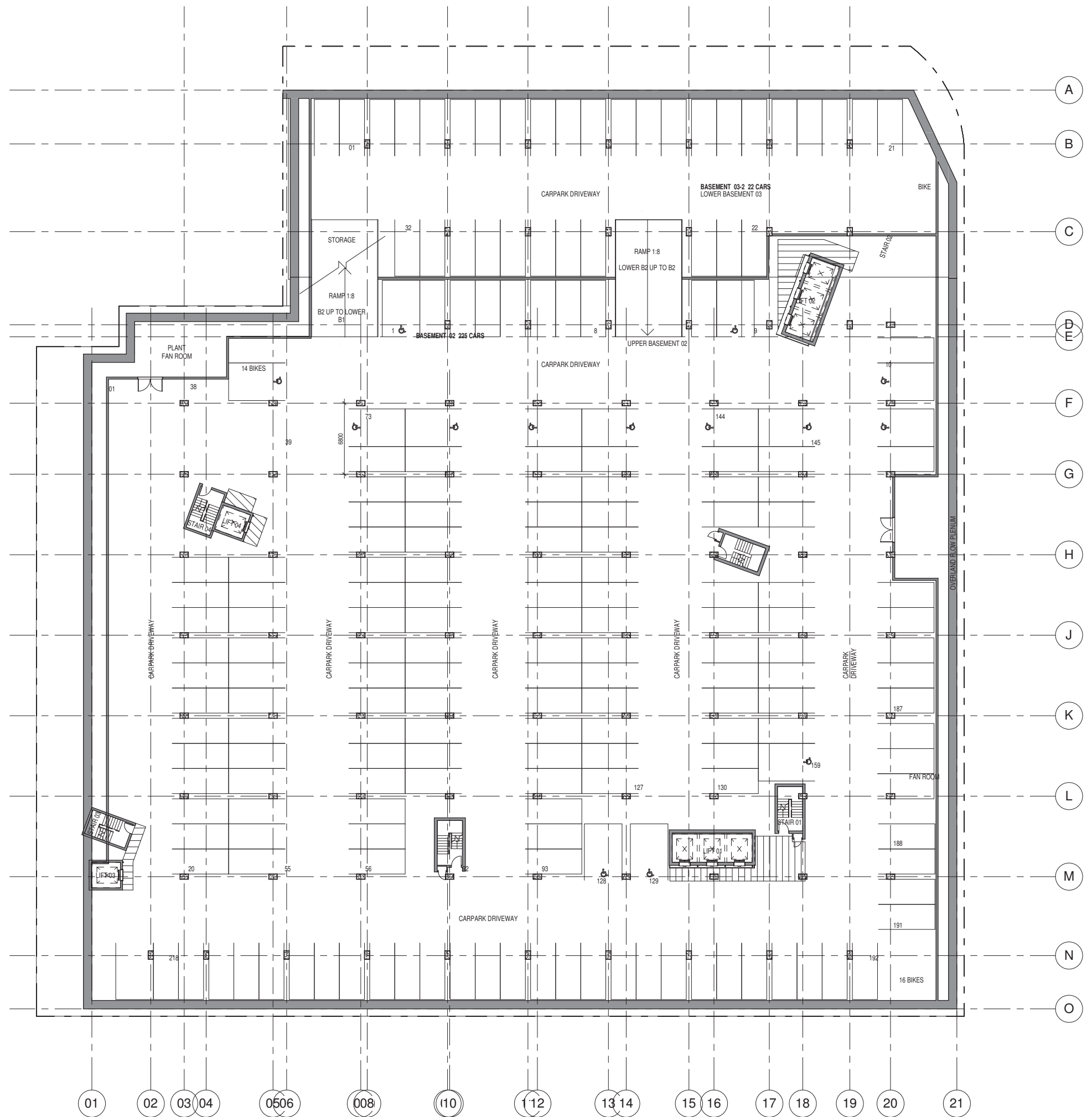


Figure 9: Locality Map

UBD Map: Brisbane UBD, Map 240 – C1

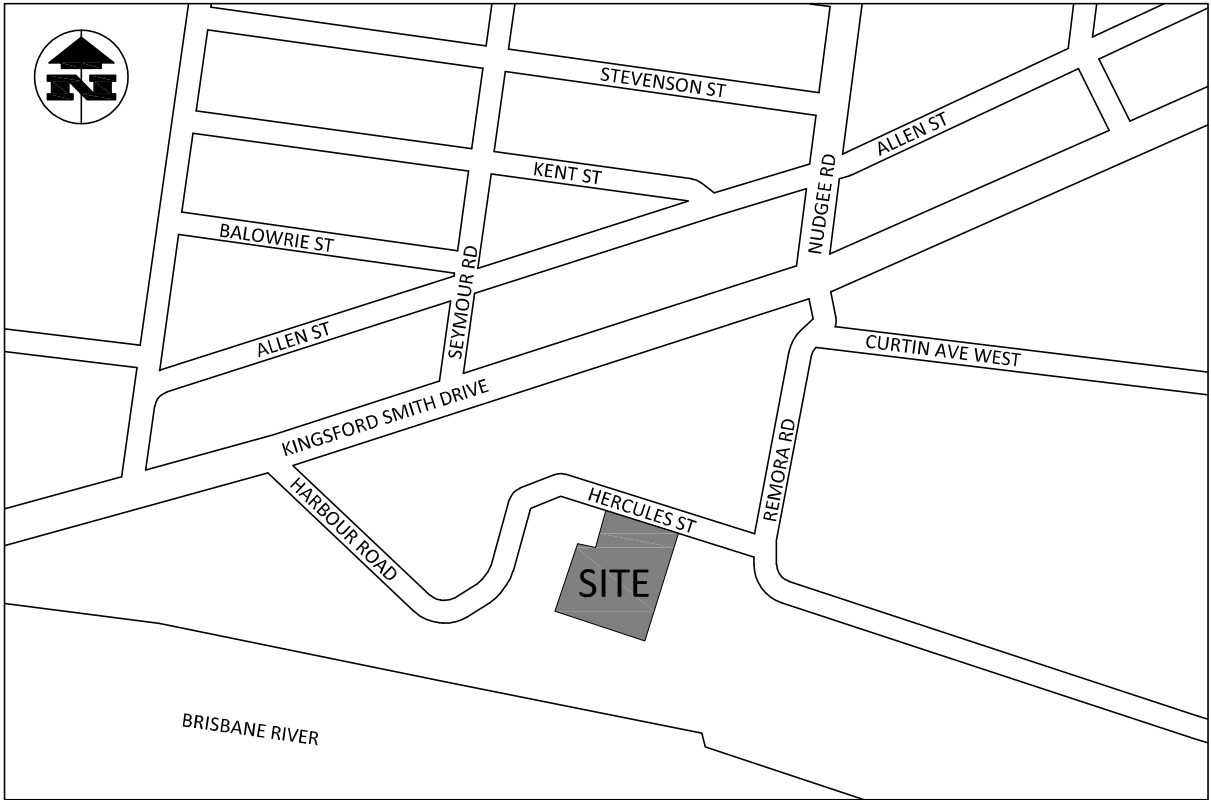




MIRVAC HAMILTON

MULTI UNIT DEVELOPMENT

CIVIL WORKS



SITE LOCALITY PLAN
BRISBANE UBD MAP 140, GRID REFERENCE Q18
NTS

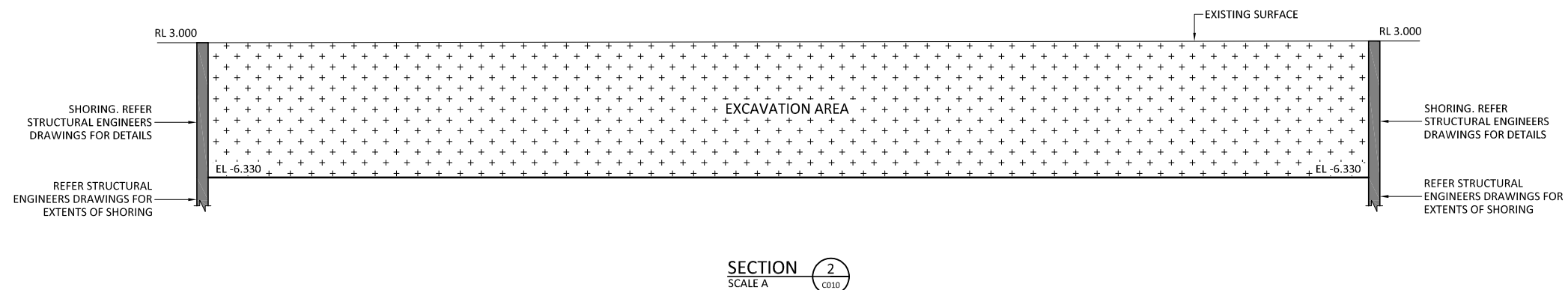
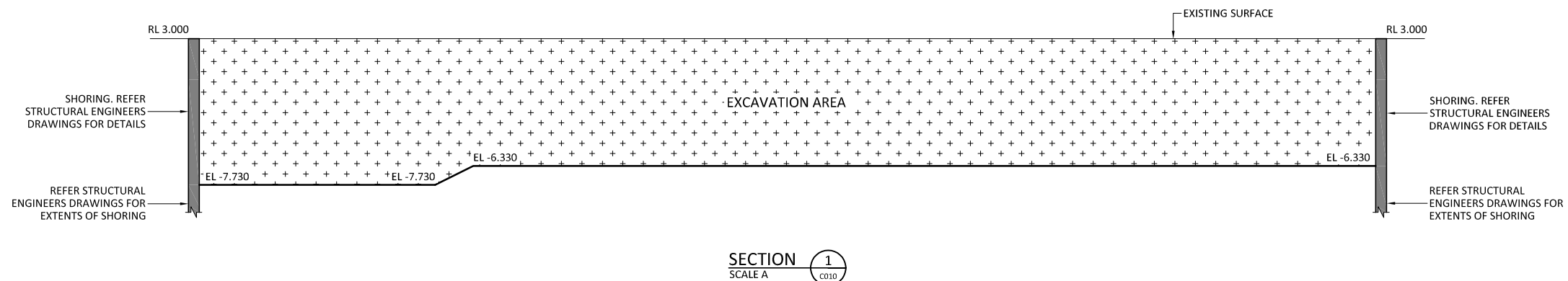
DRAWING INDEX	
DRAWING No.	DESCRIPTION
C001	DRAWING LIST AND LOCALITY PLAN
C005	STANDARD NOTES AND DETAILS PLAN
C010	BULK EARTHWORKS PLAN
C015	BULK EARTHWORKS SECTIONS AND DETAILS PLAN
C020	SEDIMENT AND EROSION CONTROL NOTES AND DETAILS PLAN
C021	SEDIMENT AND EROSION CONTROL LAYOUT PLAN
C030	ROADWORKS AND DRAINAGE PLAN
C040	STORMWATER LONGITUDINAL SECTIONS SHEET 1
C041	STORMWATER LONGITUDINAL SECTIONS SHEET 2
C042	STORMWATER LONGITUDINAL SECTIONS SHEET 3
C043	STORMWATER STRUCTURE DETAILS PLAN
C045	STORMWATER DRAINAGE CALCULATION TABLES SHEET 1
C046	STORMWATER DRAINAGE CALCULATION TABLES SHEET 2
C047	STORMWATER DRAINAGE CALCULATION TABLES SHEET 3
C060	SEWER RETICULATION NOTES AND DETAILS
C061	SEWER RETICULATION LAYOUT PLAN
C065	SEWER LONGITUDINAL SECTIONS
C070	HERCULES STREET WATER CONNECTION
C090	STORMWATER DRAINAGE CATCHMENT PLAN

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ADVICE FROM SERVICING AUTHORITIES.

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STATUS
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NOTE: PRELIMINARY EARTHWORKS LEVELS SHOWN ONLY AND ARE SUBJECT TO FURTHER COORDINATION

NOTE: DRAWINGS ARE PRELIMINARY ONLY AND ARE
SUBJECT TO SURVEY, FURTHER COORDINATION AND
ADVICE FROM SERVICING AUTHORITIES.

DIMENSIONS IN METRES EXCEPT WHERE SHOWN OTHERWISE. CULVERT AND PIPE SIZES IN MILLIMETRES		A1 UNREDUCED
		A3 REDUCED
SCALES		UNREDUCED / REDUCED
A		1 : 200 / 1 : 400

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Member Firm

CLIENT MIRVAC LIMITED	PROJECT MIRVAC HAMILTON	SUBJECT BULK EARTHWORKS SECTIONS AND DETAILS PLAN
		PROJECT No. 10363
		DRAWING No. REVISION
		C015 A

- EROSION AND SEDIMENT CONTROL PROGRAM**
1. THIS PROGRAM AND ASSOCIATED PLANS SHALL BE READ IN CONJUNCTION WITH THE SITE MANAGEMENT SPECIFICATION INCORPORATED IN THE CONTRACT DOCUMENTS. THE PROVISIONS OF THE SPECIFICATION ARE TO BE STRICTLY ADHERED TO.
2. PRIOR TO THE COMMENCEMENT OF CONSTRUCTION, THE CONTRACTOR IS TO PROVIDE A DETAILED PROGRAM TO THE SUPERINTENDENT SHOWING THE TIMING FOR ALL WORKS ASSOCIATED WITH THE PROJECT, NOMINATING, IN PARTICULAR, THE PROGRAM FOR INSTALLATION OF SOIL AND EROSION CONTROL SYSTEMS.
3. EARTHWORKS SHALL BE CARRIED OUT IN SUCH A MANNER THAT THE SITE IS MAINTAINED IN A WELL DRAINED CONDITION, AREAS OF LOOSE SOIL ARE MINIMISED AND CONCENTRATIONS OF STORM WATER ARE MINIMISED.
4. THE BASIC OBJECTIVES OF THE EROSION AND SEDIMENT CONTROL ARE :
i. IDENTIFY CRITICAL AREAS AND PROVIDE SPECIAL ATTENTION TO THOSE AREAS.
ii. PLAN SITE LAYOUTS SO THAT ACCESS TO ALL REQUIRED DRAINAGE EROSION AND SEDIMENT CONTROL MEASURES IS MAINTAINED.
iii. LIMIT EXPOSURE TIME BY PROGRAMMING TO MINIMISE THE AREA OF LAND EXPOSED TO POTENTIALLY ADVERSE WEATHER CONDITIONS AT ANY ONE TIME.
iv. PROVIDE CONTROL MEASURES INCLUDING TEMPORARY AND PERMANENT DRAINAGE, EROSION AND SEDIMENT CONTROLS.
5. THE EROSION AND SEDIMENT CONTROL SHALL COMPLY WITH BCC EROSION AND SEDIMENT CONTROL STANDARDS, THE SOIL EROSION AND SEDIMENTATION CONTROL - ENGINEERING GUIDELINES FOR QUEENSLAND (CURRENT EDITIONS), AND ALL OTHER BCC EROSION AND SEDIMENT CONTROL GUIDELINES.
6. ALL ESC MEASURES SHALL BE INSPECTED:
- AT LEAST DAILY (WHEN WORK IS OCCURRING ON SITE);
- WITHIN 24 HOURS OF EXPECTED RAIN; AND
- WITHIN 18 HOURS OF A RAINFALL EVENT (i.e. AN EVENT OF SUFFICIENT INTENSITY AND DURATION TO MOBILISE SEDIMENT ON SITE). MAINTENANCE OF ESC MEASURES SHALL OCCUR IN ACCORDANCE WITH THE FOLLOWING TABLE:
- | ESC MEASURES | MAINTENANCE TRIGGER | TIME FRAME FOR COMPLETION OF MAINTENANCE |
|--------------------|---|--|
| SEDIMENT BASINS | WHEN SETTLED SEDIMENT EXCEEDS THE VOLUME OF THE SEDIMENT STORAGE ZONE (SEE COUNCIL'S SEDIMENT BASIN DESIGN GUIDELINES). | WITHIN 7 DAYS OF THE INSPECTION |
| OTHER ESC MEASURES | THE CAPACITY OF ESC MEASURES FALLS BELOW 75%. | BY THE END OF THE DAY. |
7. WATER QUALITY SAMPLES MUST BE TAKEN AND ANALYSED PRIOR TO THE RELEASE OF ANY WATER FROM THE SITE. WATER QUALITY MUST SATISFY THE FOLLOWING CRITERIA: TSS<50 mg/L pH BETWEEN 6.5 AND 8.5. IF WATER QUALITY FAILS THE CRITERIA THEN USE OF A GYPSUM FLOCCULENT IS TO BE APPLIED AS DIRECTED BY THE SUPERINTENDENT.
8. ALL WATER QUALITY DATA INCLUDING DATES OF RAINFALL, TESTING AND WATER RELEASE MUST BE MAINTAINED IN AN ON-SITE REGISTER. THIS REGISTER IS TO BE MAINTAINED FOR THE DURATION OF THE APPROVED WORKS AND BE AVAILABLE ON SITE FOR INSPECTION BY COUNCIL OFFICERS ON REQUEST.
9. CONSTRUCTION ACCESS SHALL BE AT ONLY ONE NOMINATED POINT ON HERCULES ST. A TRUCK WASH HARD STAND AS DETAILED ON THE PLAN COMPRISING FREE DRAINING GRAVEL SHALL BE LOCATED ADJACENT TO THE POINT OF ACCESS WHERE VEHICLES CAN BE WASHED DOWN PRIOR TO EXIT TO THE STREET SYSTEM IF REQUIRED. THE WASH DOWN AREA SHALL BE KEPT FREE OF MUD.
10. FOR DETAILS OF SHAKE DOWN AREA REFER TO IEAUST STANDARD DRAWING A5-C3.
11. SUPPLEMENTARY EROSION AND SEDIMENT CONTROL DEVICES MAY BE REQUIRED AT THE DISCRETION OF THE SUPERINTENDENT AND/OR COUNCIL.
12. SEDIMENT CONTROL DEVICES SHALL BE PROVIDED WHERE SHOWN ON THE DRAWINGS. SEDIMENT TRAPS SHALL REMAIN IN PLACE UNTIL AT LEAST 70% SOIL COVERAGE UPSTREAM AND DOWNSTREAM OF THE DEVICE IS ACHIEVED AND/OR AS DIRECTED BY COUNCIL.
13. EXCAVATED MATERIAL WILL BE PLACED DIRECTLY INTO FILL AREAS IN ACCORDANCE WITH THE APPROVED SPECIFICATION.
14. ANY IMPORTED FILL MATERIAL SHALL COMPLY WITH THE REQUIREMENTS OF THE SPECIFICATION.
15. ALL TEMPORARY EROSION AND SEDIMENT CONTROL (ESC) MEASURES TO BE MAINTAINED AND FULLY OPERATIONAL DURING THE MAINTENANCE PERIOD AND ARE TO BE REMOVED AFTER THE SATISFACTORY COMPLETION OF AN OFF-MAINTENANCE INSPECTION BY COUNCIL AND PRIOR TO FORMAL ACCEPTANCE "OFF MAINTENANCE" BY COUNCIL.

- EROSION AND SEDIMENTATION CONTROL NOTES:**
- TOPSOIL
1. SEDIMENT FENCES TO BE PLACED AS SHOWN. FOR DETAILS OF SEDIMENT FENCE REFER TO IEAUST STANDARD DRAWING A5-C10.
2. STRIP AND STOCKPILE AVAILABLE TOPSOIL (ASSUMED AVERAGE DEPTH 100mm) FROM ALL DISTURBED AREAS PRIOR TO BULK EARTHWORKS.
3. GRADE EVENLY BETWEEN ALLOTMENT FINISHED SURFACE LEVELS AND ENSURE LOTS ARE FREE DRAINING.
4. MINIMUM SLOPE ACROSS ALLOTMENTS TO BE 1%.
5. ALL FOOTPATHS, BATTERS, AND EARTHWORK AFFECTED ALLOTMENTS ARE TO BE TOPSOILED TO A MINIMUM DEPTH OF 100mm (LIGHTLY COMPACTED) AND TURFED WHERE SPECIFIED.
6. SEDIMENT FENCES TO BE REPAIRED AND EXCESSIVE SEDIMENT DEPOSITS SHALL BE REMOVED ONCE CAPACITY FALLS BELOW 75 %.
- SEDIMENT FENCES
1. FOR DETAILS OF SEDIMENT FENCE REFER TO IMEAQ STANDARD DRAWING D-0040.
2. SEDIMENT FENCES TO BE REPAIRED AS REQUIRED AND EXCESSIVE SEDIMENT DEPOSITS SHOULD BE REMOVED.
3. IN THE EVENT OF WET WEATHER, INSTALL KERB INLETS FILTER WITH GRAVEL RANGING FROM 50mm TO 75mm IN SIZE. REFER IPWEAQ STANDARD DRAWING D-0041. WHEREVER PRACTICABLE SEDIMENT RUNOFF SHOULD BE COLLECTED AND RETAINED WHOLLY WITHIN THE WORKSITE OR PRIOR TO ENTRY ON A ROAD SURFACE(WHETHER INSIDE OR OUTSIDE THE SITE).

IF THE GRAVEL FILTER BECOMES CLOGGED WITH SEDIMENT DURING ITS USE, THE GRAVEL MUST BE PULLED AWAY FROM THE MESH AND CLEANED OR REPLACED.

4. DAILY CHECKS OF SILT FENCES IS TO BE MADE ALONG WITH A CHECK AFTER ANY SIGNIFICANT STORM EVENT TO ENSURE INTEGRITY AND PERFORMANCE.

- TURFING
1. PROVIDE TURFING TO ENTIRE WIDTH OF ALL SWALES, FOOTPATHS, AND 1 IN 4 CUT AND FILL BATTERS.
2. FOOTPATH BATTERS ARE TO BE STABILISED WITH TOPSOIL (AND TURFED) AS SOON AS PRACTICAL AFTER THE BATTERS HAVE BEEN COMPLETED. REMAINING EXPOSED AREAS ON LOTS ARE TO BE SEEDED AND MULCHED (E.G HYDROMULCHED).

- A. DURING CONSTRUCTION
1. TOPSOIL STOCKPILE TO HAVE A SEDIMENT FENCE DOWN SLOPE AND A DIVERSION DRAIN UPSLOPE.
2. SEDIMENTATION FENCES TO BE PLACED AS SHOWN.
3. INSPECT BANKS DAILY AND REPAIR ANY SLUMPS, WHEEL TRACK DAMAGE OR LOSS OF FREEBOARD.
4. REMOVE SEDIMENT TO AVOID PONDING FROM CATCH DRAINS.
5. REMOVE EXCESSIVE SEDIMENT FROM UPSTREAM OF CHECK DAM.
6. ROAD RESERVE TO BE USED AS HAUL ROAD.
7. A CATCH DRAIN/CATCH BANK IS TO BE PROVIDED ON THE TOP SIDE OF ALL CUTS AND DISCHARGE EITHER TO UNDISTURBED GRASS LANDS OR TO THE CROSS ROAD DRAINAGE
8. SUPPLEMENTARY EROSION AND SEDIMENT CONTROL DEVICES MAY BE REQUIRED AT THE DISCRETION OF THE ENGINEER.
9. GRASS SEEDING IS TO ACHIEVE 70% COVER WITHIN 30 DAYS OF COMPLETION OF EARTHWORKS.

- B. FOLLOWING CONSTRUCTION
1. SEDIMENTATION AND EROSION CONTROLS TO BE MAINTAINED UNTIL SITE IS 80% STABILISED WITH ESTABLISHED GRASS/TURF THEN CONTROLS CAN BE REMOVED.

HOLD POINT

1. WORK TO ROADS, DRAINAGE, SEWER, WATER OR EARTHWORKS MUST NOT PROCEED UNTIL ADEQUATE SEDIMENT CONTROL IS IN PLACE TO THE SATISFACTION OF THE SUPERINTENDENT.

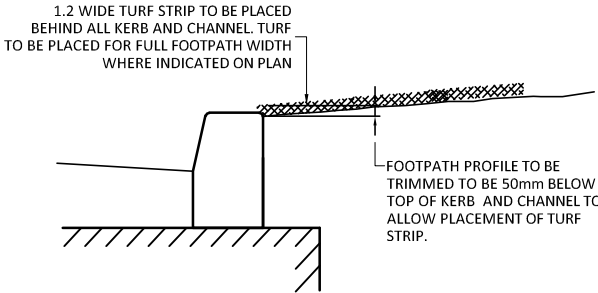
SITE WORKS PLAN

1. SITE WORKS WILL BE CARRIED OUT AS DETAILED ON THE ENGINEERING PLAN.
2. WHERE DEWATERING OF DRAINS AND TRENCHES IS NECESSARY, THE EFFLUENT SHALL BE RETURNED TO THE DRAIN VIA A GEOFABRIC SEDIMENT FILTER. SEDIMENT COLLECTED SHALL BE BURIED ON SITE CLEAR OF POTENTIAL EROSION.
3. OPEN CHANNELS ARE TO BE TURFED WITHIN 3 DAYS.
4. DISTURBED AREAS TO BE SEEDED WITHIN 3 DAYS.

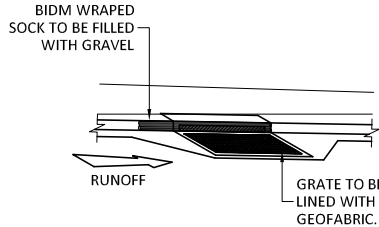
NOTE: REFER LANDSCAPE ARCHITECT FOR FINISHED RE-VEGETATION PROGRAM AND MAINTENANCE REQUIREMENTS.

NOTE: INITIAL SOIL DISTURBANCE IS STRICTLY LIMITED TO THE CONSTRUCTION OF SEDIMENT CONTROL DEVICES. THESE STRUCTURES ARE TO BE INSPECTED BY THE SUPERINTENDENT PRIOR TO EARTHWORKS COMMENCING.

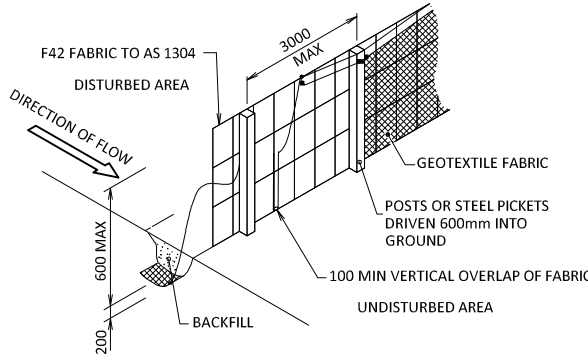
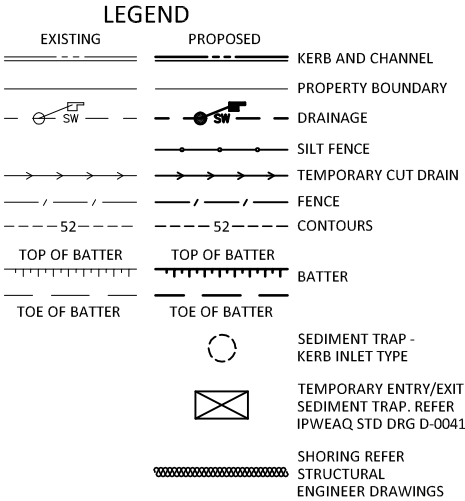
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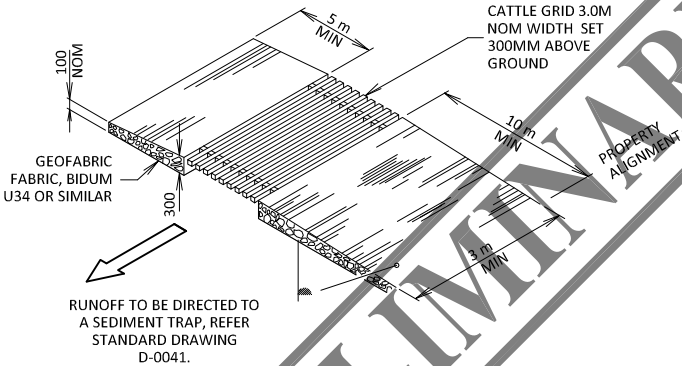
EROSION CONTROL AT KERB
N.T.S.



TYPICAL KERB INLET SEDIMENT TRAP
N.T.S.



SILT FENCE ELEVATION
N.T.S.



TEMPORARY CONSTRUCTION ENTRY / EXIT
SEDIMENT TRAP
N.T.S.

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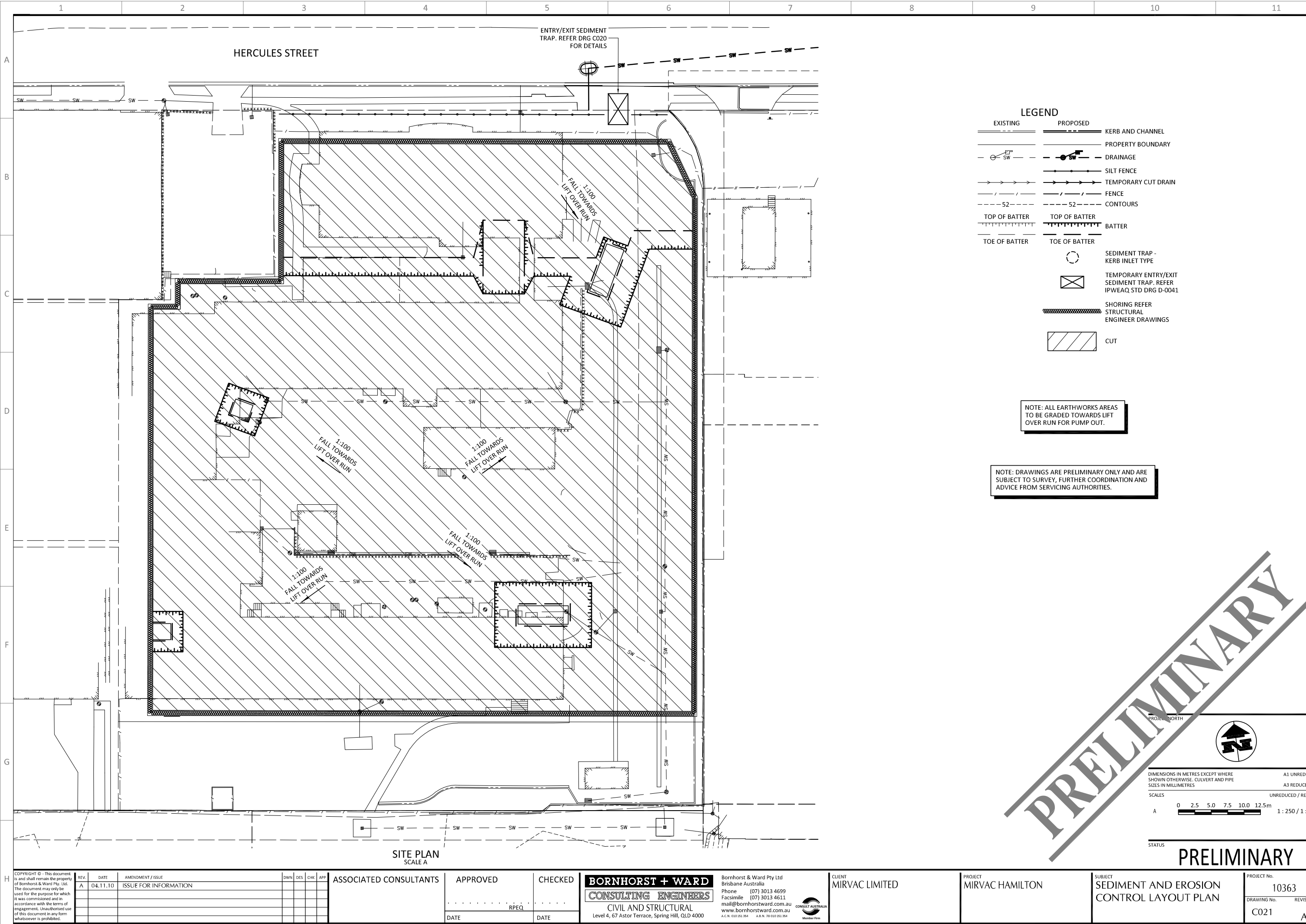
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CLIENT
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PROJECT
MIRVAC HAMILTON

SUBJECT
SEDIMENT AND EROSION
CONTROL NOTES AND
DETAILS PLAN

PROJECT No.
10363
DRAWING No. REVISION
C020 A



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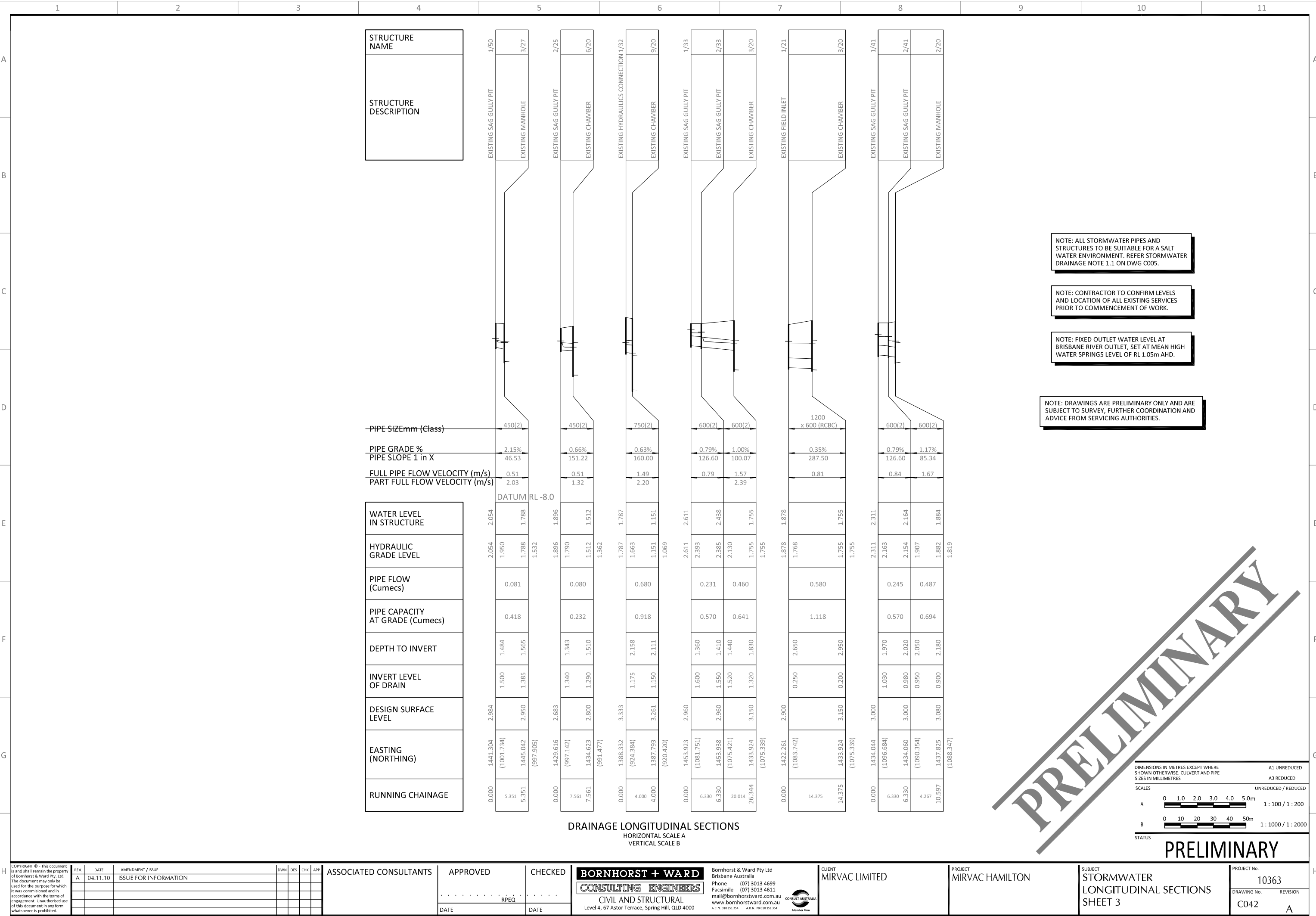
PROJECT
MIRVAC HAMILTON

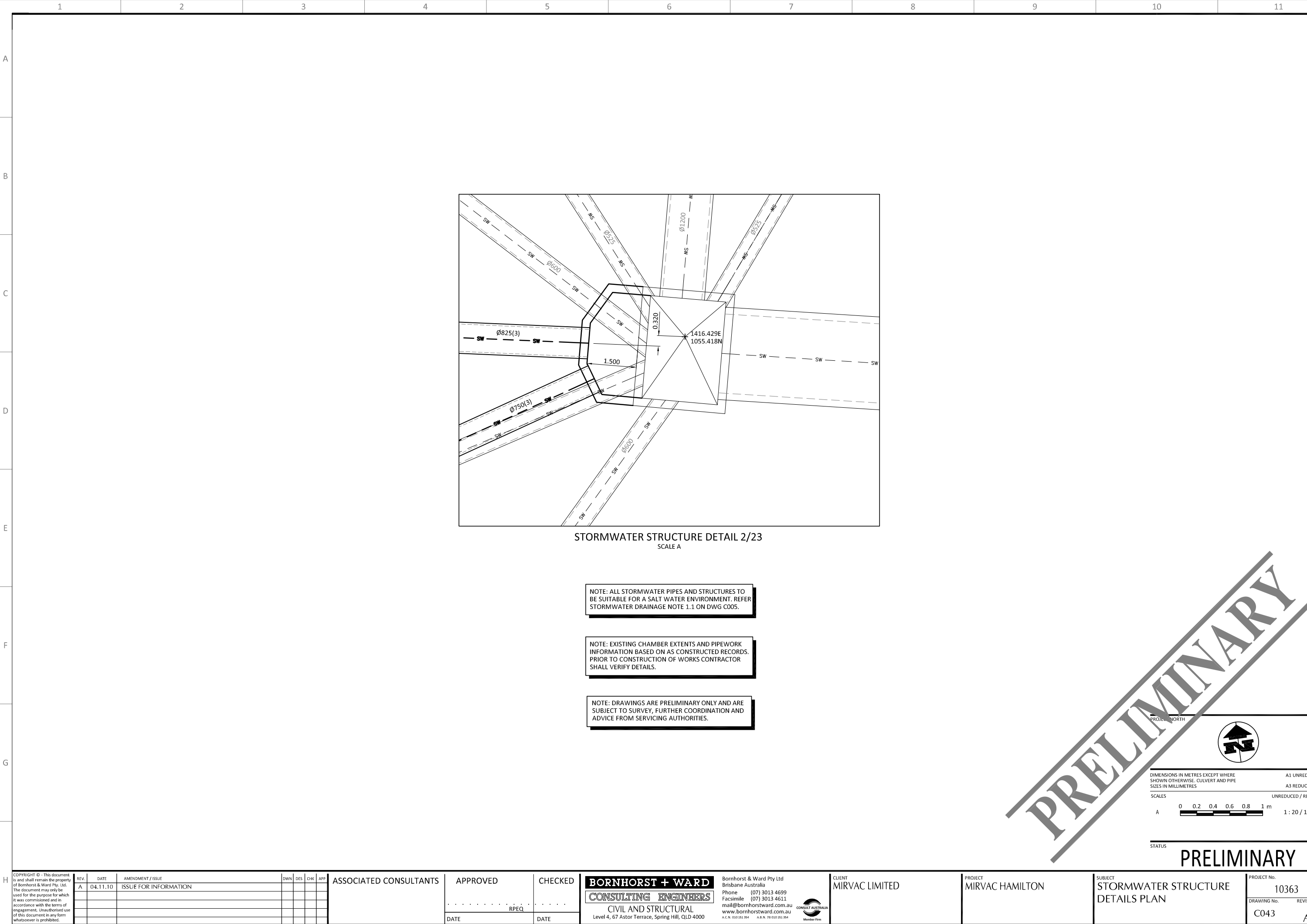
SUBJECT
SEDIMENT AND EROSION
CONTROL LAYOUT PLAN

PROJECT No.
10363
DRAWING No.
C021
REVISION
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STORMWATER STRUCTURE DETAIL 2/23
SCALE A

NOTE: ALL STORMWATER PIPES AND STRUCTURES TO BE SUITABLE FOR A SALT WATER ENVIRONMENT. REFER STORMWATER DRAINAGE NOTE 1.1 ON DWG C005.

NOTE: EXISTING CHAMBER EXTENTS AND PIPEWORK INFORMATION BASED ON AS CONSTRUCTED RECORDS. PRIOR TO CONSTRUCTION OF WORKS CONTRACTOR SHALL VERIFY DETAILS.

NOTE: DRAWINGS ARE PRELIMINARY ONLY AND ARE SUBJECT TO SURVEY, FURTHER COORDINATION AND ADVICE FROM SERVICING AUTHORITIES.

PRELIMINARY

PROJECT NORTH

DIMENSIONS IN METRES EXCEPT WHERE SHOWN OTHERWISE. CULVERT AND PIPE SIZES IN MILLIMETRES

A1 UNREDUCED
A3 REDUCED

UNREDUCED / REDUCED

0 0.2 0.4 0.6 0.8 1 m

1 : 20 / 1 : 40

STATUS

PRELIMINARY

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