

Robert **Bird** Group

Site Based Stormwater
Management Plan (SBSMP)

For

**Proposed Mixed Use Development
at 58-66 Abbotsford Road,
Bowen Hills**

Prepared For: Seymour Group

Revision: A

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Job No.: 15402C



[illegible]

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Signing for and on behalf of
Robert Bird Group Pty Ltd
Date: 7th October 2015

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Appendices

Appendix A – Architectural Layout Plan of Proposed Development by Nettleton Tribe

Appendix B – BCC Erosion Hazard Assessment Form

Appendix C – MUSIC Modelling Results Summary

Appendix D – Concept Erosion and Sediment Control Plan by Robert Bird Group

Appendix E – Concept Stormwater Management Plan by Robert Bird Group

Appendix F – Brisbane City Council's Flood Information

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Appendix H – BCC's Codes

Appendix I – State Planning Policy July 2014 SPP Code: Water Quality

Appendix J – Stormwater 360 Enviropod and Stormfilter Manuals

1.0 Purpose of Document

This document has been prepared by Robert Bird Group (RBG) as part of the responses to the further issues (Reference number: DEV2015/703) dated 18th September 2015 that issued by Economic Development Queensland (EDQ) for the proposed mixed use development located at 58-66 Abbotsford Road, Bowen Hills Qld.

The purpose of this report is to address the stormwater quantity and quality issues at a conceptual level for the proposed development.

This report was prepared using information obtained from the following sources:

- Architectural Plans of the proposed development prepared by Nettleton Tribe.
- Detail survey of 58-66 Abbotsford Road Bowen Hills (Project no: 208243-005, drawing no: 005-SU1) revision 01 dated 12/10/2010 prepared by Aurecon.
- Brisbane City Council EBIMAP information.
- Dial-Before-You-Dig (DBYD) services.
- Approved Flood Constraints Assessment (Report Number B07195.W.01.AMcP.azh dated 28th February 2011) prepared by Brown Consulting for the proposed mixed use development at 58-66 Abbotsford Road, Bowen Hills.
- Drawings of the existing stormwater from Brisbane City Council's (BCC's) Plan Custodian.

2.0 Introduction

2.1 Project Description

The proposed development is situated on land described as Lot 1 on RP155441, Lot 1 on RP127538 and Lot 2 on RP133342.

The site is bound by Abbotsford Road to the east, existing railway to the west, existing workshop to the north and Queensland Rail (QR) building to the south.

The site is located approximately 3km to the north of the Brisbane CBD. Under the City Plan Area Classification, the site is classified as Emerging Community (EC).

The subject site is currently fully developed and occupied by car repair workshop.

The total area of the existing site is 3,199m².

Proposal Details

The proposed mixed use development comprises:

- Two residential towers
- 7 levels of car parking: 4 levels of basement car parking and 3 levels of podium car parking
- Retail
- Recreational areas on Level 3

Vehicle Access and Parking

Currently vehicles can access the site from Abbotsford Road.

The proposed development will have vehicle access to the site from Abbotsford Road via a proposed driveway crossover.

Car parking for the proposed development will be provided in the basement and podium levels.

Refer to architect's drawings for details.

2.2 Risk Assessment

According to BCC's Erosion Hazard Assessment - June 2014 form, the proposed development is located in a "medium" risk site for erosion potential. Refer Appendix B for a copy of the completed form.

3.0 Site Characteristics

3.1 Location

The street address for the site is 58-66 Abbotsford Road, Bowen Hills Qld.

Figure 3.1 – Site Location



Image by Google Maps © 2015

3.2 Topography and Site Drainage

The site is currently occupied by Accident Repair Centre. The detail survey drawing 005-SU1 prepared by Aurecon shows that the site has been fully developed which consists of large roofed area and a small area of carpark/ driveway at the frontage.

According to the survey drawing, there are an existing stormwater inlet located at the north-east of the site and an existing stormwater manhole located at the south-east of the site. It is believed that the stormwater runoff from the site have been picked up by internal drainage system and discharged into existing council stormwater system in Abbotsford Road.

3.3 Soils

There was no Acid Sulphate Soil's investigation available at the time that this report was prepared.

In the event that future testing for Acid Sulphate Soil's (ASS's) indicate that ASS's do exist on the site, a suitable Acid Sulphate Soils Management Plan will be developed by an appropriately qualified consultant and implemented to minimise any potential impacts due to the disturbances of ASS's.

3.4 Waterway Corridor

The site is around 400m from the nearest point to the Breakfast Creek and is therefore considered to be outside any Brisbane City Council designated waterway corridor (30m from high-water mark in built up areas). According to the Brisbane City Council EBIMAP and Brisbane City Plan 2014 interactive mapping information, the site is not affected by any other waterway corridors. Therefore, no further consideration of waterway corridor issues has been documented in this SBSMP.

3.5 Existing Stormwater Infrastructure

According to information available from BCC EBIMAP service, the following stormwater infrastructure is located in the vicinity of the site:

- Existing stormwater manhole K16000312 is located at the middle of the northern boundary of QR site (Lot 1 on RP215078). From this manhole, stormwater is discharging into the following two stormwater pipes:
 - i. A 900mm diameter stormwater pipe runs in a easterly direction along the northern boundary of the QR site and connects into stormwater manhole K16000313 which located in the middle of Abbotsford Road.
 - ii. A 450 mm diameter stormwater pipe runs in a north-easterly direction into the subject site and connects to stormwater manhole K16000318 which located adjacent to the north-east corner of Lot 2 on RP133342. From manhole K16000318, the stormwater is discharging to another two stormwater pipes: a 600mm diameter stormwater pipe exits the site at the middle of the site's eastern boundary and connects to manhole K16000042 which located at the north-east of Abbotsford Rd/ Folkestone St intersection, a 100mm diameter stormwater pipe exits the site at north-east corner of Lot 2 on RP133342 and connects to another manhole (K16000324) which located at the Folkestone St where intersects with Abbotsford Rd.
- Two existing stormwater gullies are located in Abbotsford Road adjacent to the north-east corner of QR site. No outlet information are available for these gullies.
- Another two existing stormwater gullies are located in Abbotsford Road adjacent to the middle of Lot 20 on RP226975. Ebimap information has indicated that these stormwater gullies are discharging to manhole K16000042 via a 100mm diameter pipe.

4.0 Stormwater Quantity Assessment

4.1 Flood

The FloodWise Property Report indicates that BCC has not assigned flood level information to the site. However, BCC flood awareness map shows that the site is affected by flooding sources from Brisbane River and overland flow. Meanwhile BCC interactive mapping shows the site is located within Brisbane River flood planning area 5 but outside of overland flow flood planning area. Refer to Appendix F. All sources indicate that the site is not affected by flooding from the Breakfast Creek.

Considering there was an open ditch running through the site according to BCC's records (Refer to Appendix G), the existing site has since been fully developed which currently occupied by buildings to the extent of the site. Therefore overland flow path as shown in the BCC flood awareness map is believed to have reflected to the old record hence the flood information as shown in the BCC interactive mapping is adopted.

The approved Flood Constraints Assessment (Report Number B07195.W.01.AMcP.azh dated 28th February 2011) prepared by Brown Consulting for the proposed mixed use development at 58-66 Abbotsford Road, Bowen Hills has identified the flood levels in the vicinity of the site. Table 4.1 below has shown the flood levels extracted from the report.

Table 4.1 – Flood Levels for the Site

Average Recurrence Interval - ARI (years)	Flood Levels		
	With Pipe	Pipe 50% Blocked	Without Pipe
5	4.12	4.14	4.16
20	4.18	4.2	4.21
50	4.22	4.24	4.25
100	4.24	4.26	4.27

As a conservative measure, the flood levels calculated from the "without pipe" scenario have been selected to determine the minimum finished floor levels for the proposed development.

Notwithstanding there is no River flood level information available for the site, Residential Flood Level (RFL) are available in the FloodWise Property Reports of the surrounding lots. The RFL in this area is 2.7m AHD. This level is sitting well below the overland flood levels as identified in Brown Consulting's report, therefore the overland flood levels have been adopted to determine the minimum design floor levels for the proposed development.

The minimum finished floor levels as summarised in the table below have been determined based on the flood immunity requirements as documented in Brisbane City Plan 2014 – Flood overlay code:

Development Type	Minimum Design Floor Level (mAHD)			
	Habitable room	Non-habitable room	Basement entry *	Essential services
Residential (BCA Class 2)	4.75	4.55	4.55	4.75
Retail (BCA Class 6)	N/A	4.25	4.25	4.75

**Unless essential electrical services are proposed in the basement*

The architect's drawings show that the floor levels and basement entry level for the proposed development are complying with the flood immunity requirements as documented in Brisbane City Plan 2014.

4.2 Stormwater Quantity Modelling Approach

The site is currently fully developed as a car repair workshop. Therefore the proposed development will not generate additional stormwater runoff compared to the existing site and detention will not be required for the proposed development.

4.3 Proposed Stormwater System

The existing council stormwater infrastructure that traversing the site has been proposed to be realigned. The existing 450mm diameter stormwater pipe will be diverted before it entering the site in Lot 32 on SP122214 and to be aligned within the existing lane to Abbotsford Road. This stormwater pipe is proposed to be aligned along Abbotsford Road and connected into the existing 600mm diameter stormwater pipe at where adjacent to the center of the site's eastern boundary via a proposed manhole. The stormwater connection for the proposed development is proposed to be connected into a proposed stormwater gully which connects into the proposed manhole.

In the absence of the size and level information of the existing services, the proposed stormwater pipe will have at least 1.5m cover when crossing the Abbotsford Road reserve. This will ensure clearance to any standard services. However, additional survey to the existing services can be carried out during detailed design phase to determine if any relocations are required to the existing services.

4.4 Legal Point of Discharge

The legal point of discharge for the minor and major storm events for the proposed development is as follows:

- Minor storm is proposed to be discharged into the existing stormwater system in Abbotsford Road.
- Major storm is proposed to be discharged onto the Abbotsford Road and into the Breakfast Creek eventually.

5.0 Stormwater Management Design Objectives

5.1 Construction Phase

During the construction phase of a development, the stormwater management design objectives in Queensland Government State Planning Policy (SPP) July 2014 Appendix 3 Table A are to be met. The stormwater management design objectives are reproduced in the Table 5.1 below:

Table 5.1 - Stormwater Management Design Objectives During the Construction Phase

Issue		Design objectives
Drainage control	Temporary drainage works	1. Design life and design storm for temporary drainage works: • Disturbed area open for <12 months—1 in 2-year ARI event • Disturbed area open for 12–24 months—1 in 5-year ARI event • Disturbed area open for > 24 months—1 in 10-year ARI event 2. Design capacity excludes minimum 150 mm freeboard 3. Temporary culvert crossing—minimum 1 in 1-year ARI hydraulic capacity
Erosion control	Erosion control measures	1. Minimise exposure of disturbed soils at any time 2. Divert water run-off from undisturbed areas around disturbed areas 3. Determine the erosion risk rating using local rainfall erosivity, rainfall depth, soil-loss rate or other acceptable methods 4. Implement erosion control methods corresponding to identified erosion risk rating
Sediment	Sediment	1. Determine appropriate sediment control measures using:

control	control measures Design storm for sediment control basins Sump pit dewatering	- potential soil loss rate, or - monthly erosivity, or - average monthly rainfall 2. Collect and drain stormwater from disturbed soils to sump pit for design storm event: - design storm for sump pit sizing is 80th% five-day event or similar 3. Site discharge during sump pit dewatering: - TSS < 50 mg/L TSS, and - Turbidity not >10% receiving waters turbidity, and - pH 6.5–8.5
Water quality	Litter and other waste, hydrocarbons and other contaminants	1. Avoid wind-blown litter; remove gross pollutants 2. Ensure there is no visible oil or grease sheen on released waters 3. Dispose of waste containing contaminants at authorised facilities
Waterway stability and flood flow management	Changes to the natural waterway hydraulics and hydrology	1. For peak flow for the 1-year and 100-year ARI event, use constructed sump pit to attenuate the discharge rate of stormwater from the site

5.2 Post Construction Phase

Based on the nature of the development proposed as described above we have assessed this site to be “high-risk” development according to Brisbane City Plan 2014 - Stormwater code. Therefore the proposed development is required to comply with the requirements as set out in BCC’s planning scheme policies for stormwater and the Queensland Government SPP for Water Quality. The minimum WQO’s as specified by SPP and BCC are identical and are summarised in Table 5.2 below:

Table 5.2- SPP and BCC Water Quality Objectives

Pollutants	WQO's
Total Suspended Solids	80%
Total Phosphorous	60%
Total Nitrogen	45%
Gross Pollutants	90%

Refer SPP July 2014 Appendix 3 Table B and DERM Urban Stormwater Quality Planning Guidelines 2010 Table 2.2.

6.0 Proposed Stormwater Quality Management

6.1 Stormwater Quality Treatment Train

As the proposed development will consist of mainly roof areas and no uncovered car park, the pollutants generated from the proposed development will be minimal. The following stormwater quality improvement devices (SQID's) which will suit the characteristic of the proposed development have been proposed:

SQID	Discussion
Stormwater360 Enviropod	Enviropod (gully pit basket) is designed to remove gross pollutants, coarse sediment and associated pollutants (Hydrocarbons, metals & nutrients) at high flows. Refer to Appendix J for details.
Stormwater360 Stormfilter	Stormfilter improves the quality of stormwater runoff by removing non-point source pollutants, including sediment, oil and grease, soluble metals, nutrients, organics, and trash and debris. Refer to Appendix J for details.

Although landscape areas have been proposed on the podium level, these areas are considered unsuitable to be used as bio-retention as these areas are located on the third floor, the head height, stormwater connection, overflow provision, and maintenance issues will prevent implementation.

All stormwater runoff from the site will be collected internally and discharged into a stormwater treatment tank. The stormwater treatment tank consists of 2 Enviropods and 10 Stormfilters. This tank will be located on Ground Level and the access to the tank will be provided at Level 1 for maintenance purposes. Proposed ground floor level is located at RL 4.80m AHD and the stormwater connection to Abbotsford Road will be approximately IL 3.0m AHD. Therefore the tank can be gravity fed to the proposed stormwater connection via internal drainage that runs within basement. Refer to Appendix E for the Concept Stormwater Management Plan, further detail will be provided by the services consultant during the building application submission.

6.2 MUSIC Model Parameters

The input parameters used in the MUSIC modelling for each proposed SQID are as listed below:

Stormwater360 Enviropod and Stormfilter

- Stormfilter and Enviropod nodes (SFEP USE 2011B) supplied by Stormwater360. Refer to Appendix J for details.

6.3 MUSIC Results

The MUSIC modelling results for the post-development scenario can be found in Appendix C and are summarised in Table 6.3 below.

Table 6.3 - MUSIC Modelling Results – Post Development Scenario (Residential Development with Stormwater Treatment)

Pollutant	Min WQO's (%)	Objectives Achieved (%)
Total Suspended Solids	80	88.8
Total Phosphorous	60	66.4
Total Nitrogen	45	45
Gross Pollutants	90	100

The results in Table 6.3 have demonstrated that the proposed development will achieve all WQO's required by both SPP and BCC.

7.0 Construction Phase Stormwater Quality Management Options

7.1 Pre-Construction

Before construction activities begin, the following measures need to be implemented to ensure minimal disturbance and adverse water quality impacts. These measures may be adopted in a staged approach, and may be implemented prior to commencement of construction in any one section of the project.

- Sediment fences constructed to the perimeter of the construction area as required.
- Designation of areas for plant and construction material storage.
- Diversion of upstream stormwater runoff around disturbed areas of the development if required.
- Immediate stabilisation of disturbed areas as required.
- Monitoring of stormwater quality discharging from the development and the implementation of additional measures / modification of existing measures if the quality of stormwater discharging from the site will have a negative impact.
- Designation and marking of transport routes across the site to minimise dust disturbance.
- Drainage structure protection devices installed to existing stormwater inlet structures within the site, and within the road ways adjacent to the site.
- Education of site personnel to the sediment and erosion control measures implemented on site.

7.2 During Construction

Runoff is proposed to be directed to a sump pit before discharging into stormwater utilities. The sump pit is to be located to suit the construction program as required. Measures to mitigate water quality impacts during construction will include:

- Provision of pump out facilities to the satisfaction of Brisbane City Council for the sump pit.
- Construction activities to be confined within the necessary construction area(s).
- Regular inspection and maintenance of the erosion control measures. Following rainfall events greater than 20 mm, inspection of erosion control measures and removal of collected material shall be undertaken. Replacement of any damaged equipment shall be performed immediately.
- Monitoring of water quality impacts from construction activities as appropriate.

8.0 Stormwater Quality Monitoring Program

Stormwater runoff from this development will discharge to the Breakfast Creek. Stormwater quality best management practices are proposed and therefore no stormwater quality monitoring is required.

The proposed measures for stormwater quality are reasonably well understood and their effectiveness has been demonstrated at numerous sites throughout Queensland.

9.0 Maintenance Plans

Maintenance for the SQID's proposed for the development is to be consistent with the requirements of this report and the manufacturer's recommendations. The general requirement of maintenance during the operational phase will be:

Stormwater360 Enviropod and Stormfilter

- In accordance with the manufacturer's recommendations / owner's manual.
- Refer to Appendix J for details.

10.0 Asset Hand Over

It is intended that the stormwater quantity and quality controls detailed in this document will remain under private ownership and will not become a council asset. Therefore, no further assessment of asset handover is relevant to this site.

11.0 Conclusion

This Site Based Stormwater Management Plan demonstrates that under the proposed concept plan, stormwater runoff from the proposed mixed use development will be able to be treated to acceptable levels.

The consideration of the proposed stormwater runoff and drainage demonstrates the viability of the proposed development, with regards to stormwater quantity and quality.

Further details of the proposed stormwater drainage system will be provided to EDQ / Council in future applications (i.e. Operational Works submission).

12.0 References

Brisbane City Council City Plan 2014

Brisbane City Council EBIMAP information.

Brisbane City Council FloodWise Property Report.

Brisbane City Council Website.

DERM's Urban Stormwater Quality Planning Guidelines 2010.

DSDIP's State Planning Policy Code: Water Quality.

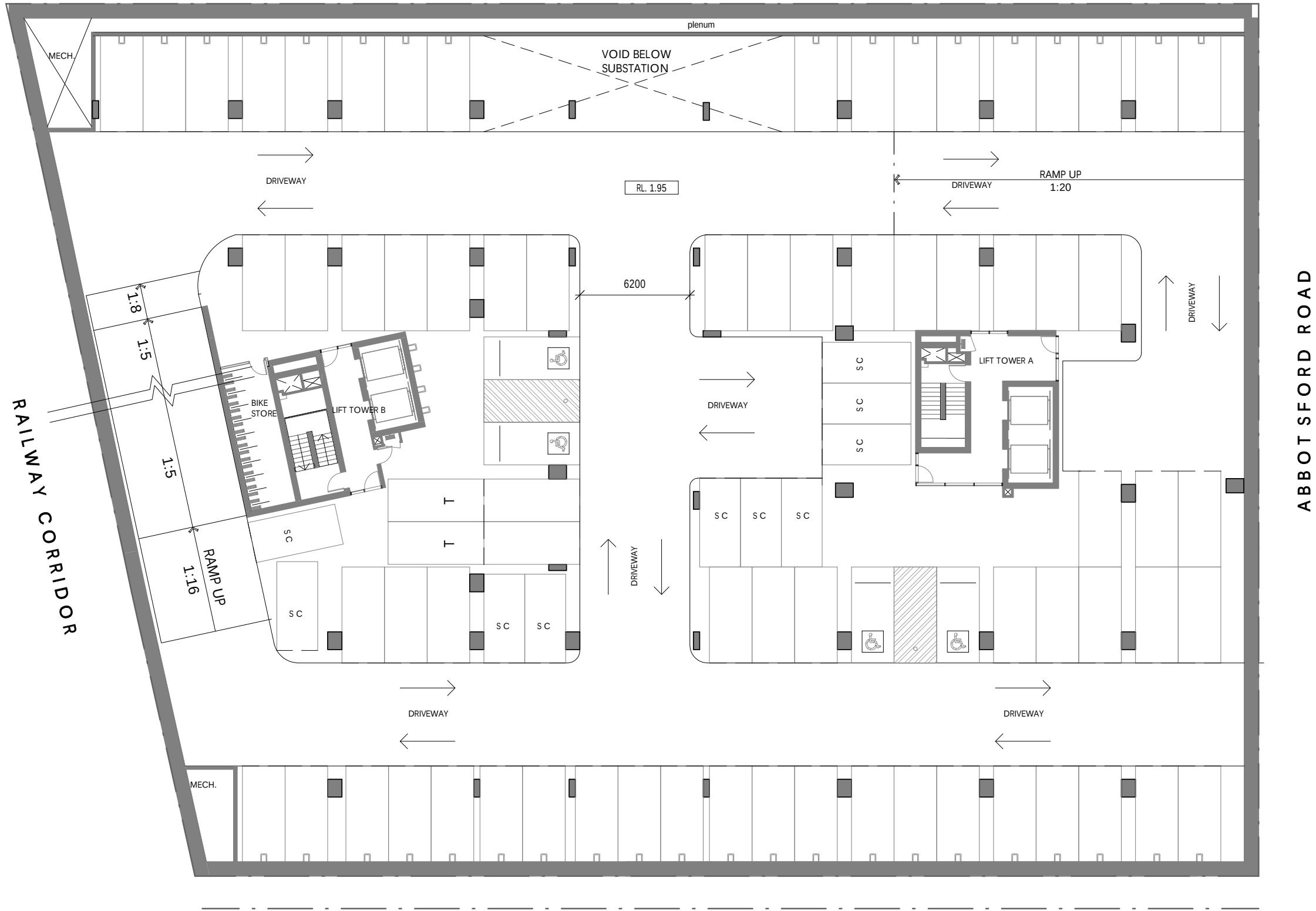
Queensland Urban Drainage Manual (2007).

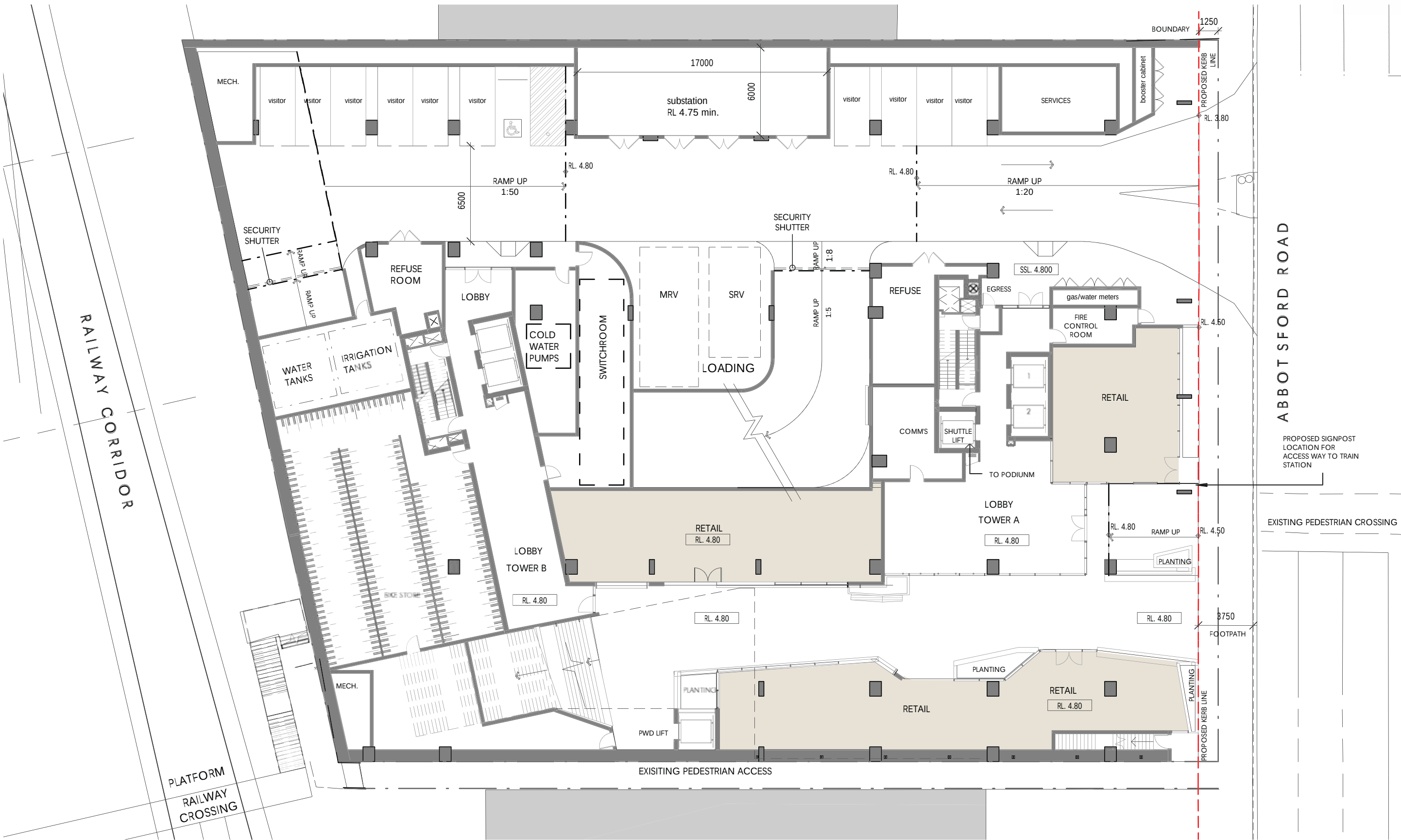
Healthy Waterways Water by Design MUSIC Modelling Guidelines Version 1.0 - 2010.

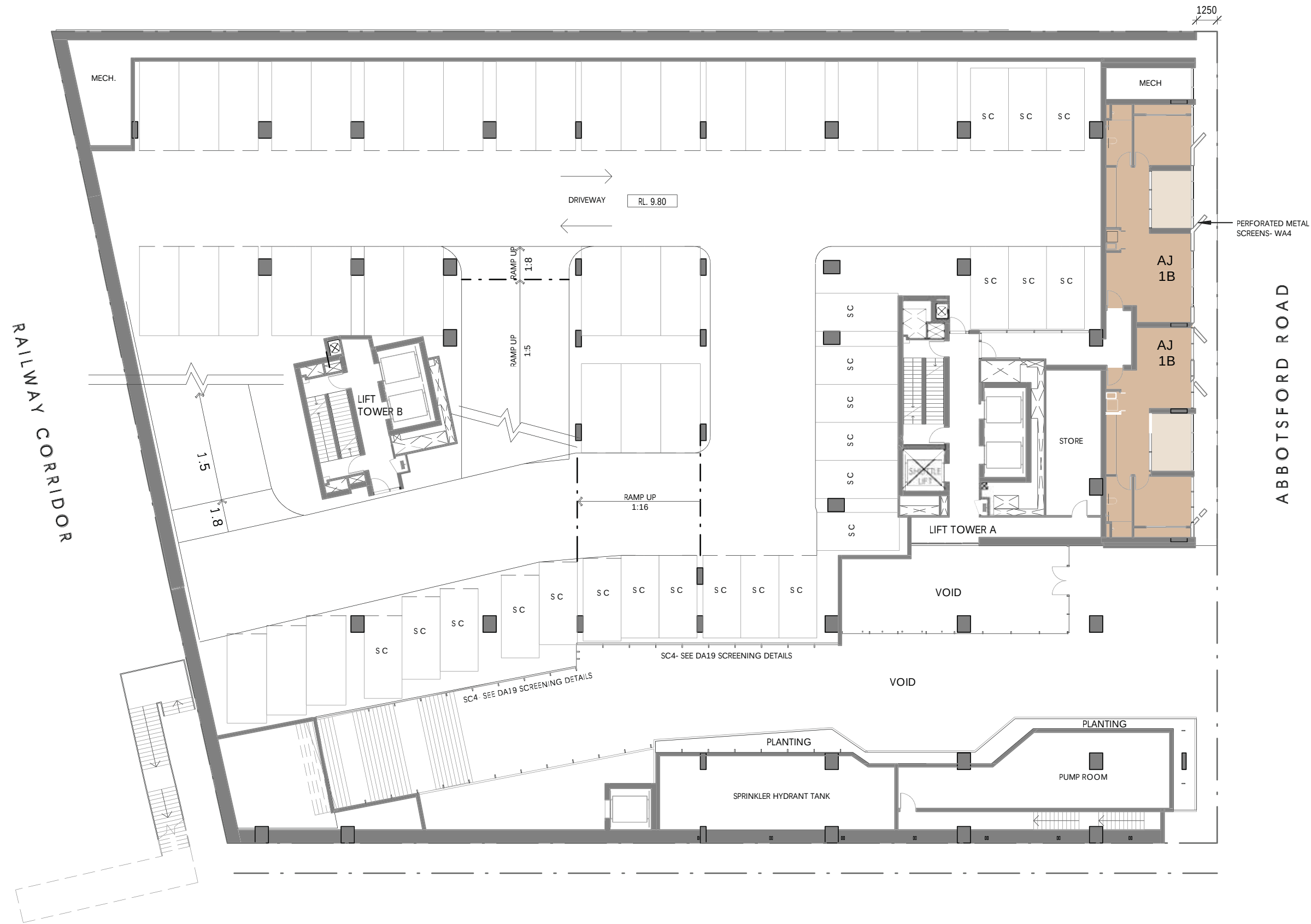
Satellite imagery from Google Map.

Appendix A

Architectural Layout Plan of Proposed Development by Nettleton Tribe







Appendix B

BCC Erosion Hazard Assessment Form



Erosion Hazard Assessment - June 2014

Brisbane City Council (BCC), *Erosion Hazard Assessment* form must be read in conjunction with the *Erosion Hazard Assessment- Supporting Technical Notes* (June 2014 or later version) for explanatory terms and Certification information.

What is an Erosion Hazard Assessment?

Soil erosion and sediment from urban development, particularly during construction activities, is a significant source of sediment pollution in Brisbane's waterways. The Erosion Hazard Assessment determines whether the risk of soil erosion and sediment pollution to the environment is 'low', 'medium' or 'high'.

When is the EHA required?

An *Erosion Hazard Assessment* form must be completed and lodged with BCC for any Development Application (ie MCU or ROL) that will result in soil disturbance OR Operational Works or Compliance Assessment Application for 'Filling' or Excavation.

Failure to submit this form during lodgement of an application may result in assessment delays or refusal of the application.

Privacy Statement

The personal information collected on this form will be used by Brisbane City Council for the purposes of fulfilling your request and undertaking associated Council functions and services. Your personal information will not be disclosed to any third party without your consent, unless this is required or permitted by law.

Assessment Details

1 Please turn over and complete the erosion hazard assessment.

2 Based on the erosion hazard assessment overleaf, is the site:

☐ A 'low' risk site

Best practice erosion and sediment control (ESC) must be implemented but no erosion and sediment control plans need to be submitted with the development application. Factsheets outlining best practice ESC can be found at <http://www.waterbydesign.com.au/factsheets>

☒ A 'medium' risk site

If the development is approved, the applicant will need to engage a Registered Professional Engineer (RPEQ) or Certified Professional in Erosion and Sediment Control (CPESC) to prepare an ESC Program and Plan and supporting documentation — in accordance with the requirements of the Infrastructure Design Planning Scheme Policy.

☐ A 'high' risk site

If the development is approved, the applicant will need to engage a RPEQ and CPESC to prepare an ESC Program and Plan and supporting documentation — in accordance with the requirements of the Infrastructure Design Planning Scheme Policy. The plans and program will need to be certified by a CPESC.

3 Site Information and Certification

Application number (if known)

Site address

58-66 ABBOTSFORD ROAD,
BOWEN HILLS.

Postcode 4006

I certify that:

- ☒ I have made all relevant enquiries and am satisfied no matters of significance have been withheld from the assessment manager.
- ☒ I am a person with suitable qualifications and/or experience in erosion and sediment control.
- ☒ The Erosion Hazard Assessment was completed in accordance with the Erosion Hazard Assessment Supporting Technical Notes and the BCC Infrastructure Design Planning Scheme Policy.
- ☒ The Erosion Hazard Assessment accurately reflects the site's overall risk of soil erosion and sediment pollution to the environment.
- ☒ I acknowledge and accept that the BCC, as assessment manager, relies, in good faith, on this certification as part of its development assessment process and the provision of false or misleading information to the BCC constitutes an offence for which BCC may take punitive steps/ action against me/ enforcement action against me.

Certified by Print name

LUCAS THEN

Certifier's signature

Date

18 / 9 / 2015

Assessment Table

Table 1: Low Risk Test

		Yes	No
1.1	is the area of land disturbance > 1000 m ²	☒	☐
1.2	does any land disturbance occur in a BCC mapped waterway corridor	☐	☒
1.3	is there any slope on site (longer than three metres in length) before, during or after construction that is steeper than 5%	☒	☐
1.4	does any land disturbance occur below 5 m AHD	☒	☐
1.5	does development involve endorsement of a staging plan	☐	☒
1.6	is there an upstream catchment passing through the site > 1 hectare	☐	☒

Have you answered 'yes' to any of the questions in Table 1?

Yes	No
☒	☐

If 'No' then site is low risk with respect to erosion and sediment control

If 'Yes' then proceed to Table 2

Table 2: Medium Risk Test

		Yes	No
2.1	is the area of land disturbance > 1 hectare	☐	☒

If 'No' then site is medium risk with respect to erosion and sediment control

If 'Yes' then proceed to Table 3

Table 3: High Risk Test

3.1	is there an upstream catchment passing through the site > 1 hectare	☐	☐
3.2	does any land disturbance occurs in a BCC mapped waterway corridor	☐	☐
3.3	is there any slope on site (longer than three metres in length) before, during or after construction that is steeper than 15%	☐	☐

Have you answered 'yes' to any of the questions in Table 3?

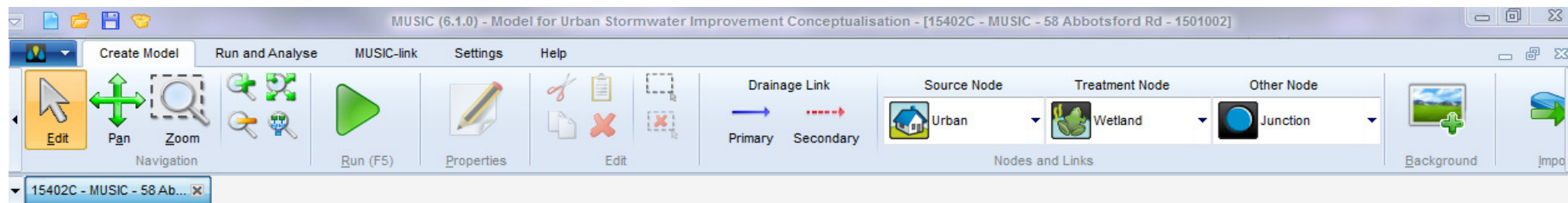
Yes	No
☐	☐

If 'No' then site is medium risk with respect to erosion and sediment control

If 'Yes' then site is high risk with respect to erosion and sediment control

Appendix C

MUSIC Modelling Results Summary

MUSIC Version 6.1.0 Results (Post Development with Treatment) for 58 Abbotsford Road


	Sources	Residual Load	Pollutant Reduction Achieved (%)	Min WQO's (%)	Performance
Flow (ML/yr)	3.11	3.11	0	-	-
Total Suspended Solids (kg/yr)	709	79.1	88.8	80	Pass
Total Phosphorus (kg/yr)	1.37	0.461	66.4	60	Pass
Total Nitrogen (kg/yr)	6.48	3.56	45	45	Pass
Gross Pollutants (kg/yr)	75.1	0	100	90	Pass

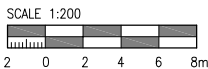
Appendix D

Concept Erosion and Sediment Control Plan by Robert Bird Group

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Rev.	Revision Description	By	App.	Date	Rev.	Revision Description	By	App.	Date
A	ISSUE FOR APPROVAL	MN	LT	07.10.15					

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Client

SEYMOUR GROUP

Title

**CONCEPT EROSION AND
SEDIMENT CONTROL PLAN**

Project

**58-66 ABBOTSFORD ROAD
BOWEN HILLS**

NOT FOR CONSTRUCTION

Date
SEPTEMBER 2015

Scale at A1
1:200

Job Number
15402C

Designer
L.THEN

Drawn
M.NG

Drawing Number

SKC-001

Design Checker
L.McCUBBIN

Principal/Project Leader
L.McCUBBIN

Revision

A

LEGEND

- EXISTING PROPERTY BOUNDARY
- EXISTING EASEMENT BOUNDARY
- EXISTING BUILDING OUTLINE
- EXISTING ROOF OUTLINE
- EXISTING FENCE
- EXISTING KERB
- EXISTING MAJOR CONTOURS
- EXISTING MINOR CONTOURS
- EXISTING WATER MAIN (FROM DBYD)
- EXISTING GAS MAIN (FROM DBYD)
- EXISTING STORMWATER MAIN
- EXISTING SEWER MAIN (FROM DBYD)
- EXISTING TELSTRA CABLE (FROM DBYD)
- EXISTING ELECTRICAL CABLE (FROM DBYD)
- POTENTIAL TRAFFIC SIGNAL CABLE TBC
(THESE SERVICES HAVE BEEN IDENTIFIED AS
DRAINAGE IN THE SURVEY 005-SU1)
- PROPOSED SITE BOUNDARY
- PROPOSED BASEMENT OUTLINE
- PROPOSED SEDIMENT FENCE
- PROPOSED PUMP LINE
- PROPOSED INLET PROTECTION ON GRADE
- PROPOSED ROCK PAD
CONSTRUCTION EXIT
- DIRECTION OF FALL FROM LOTS
- PROPOSED SUMP PIT

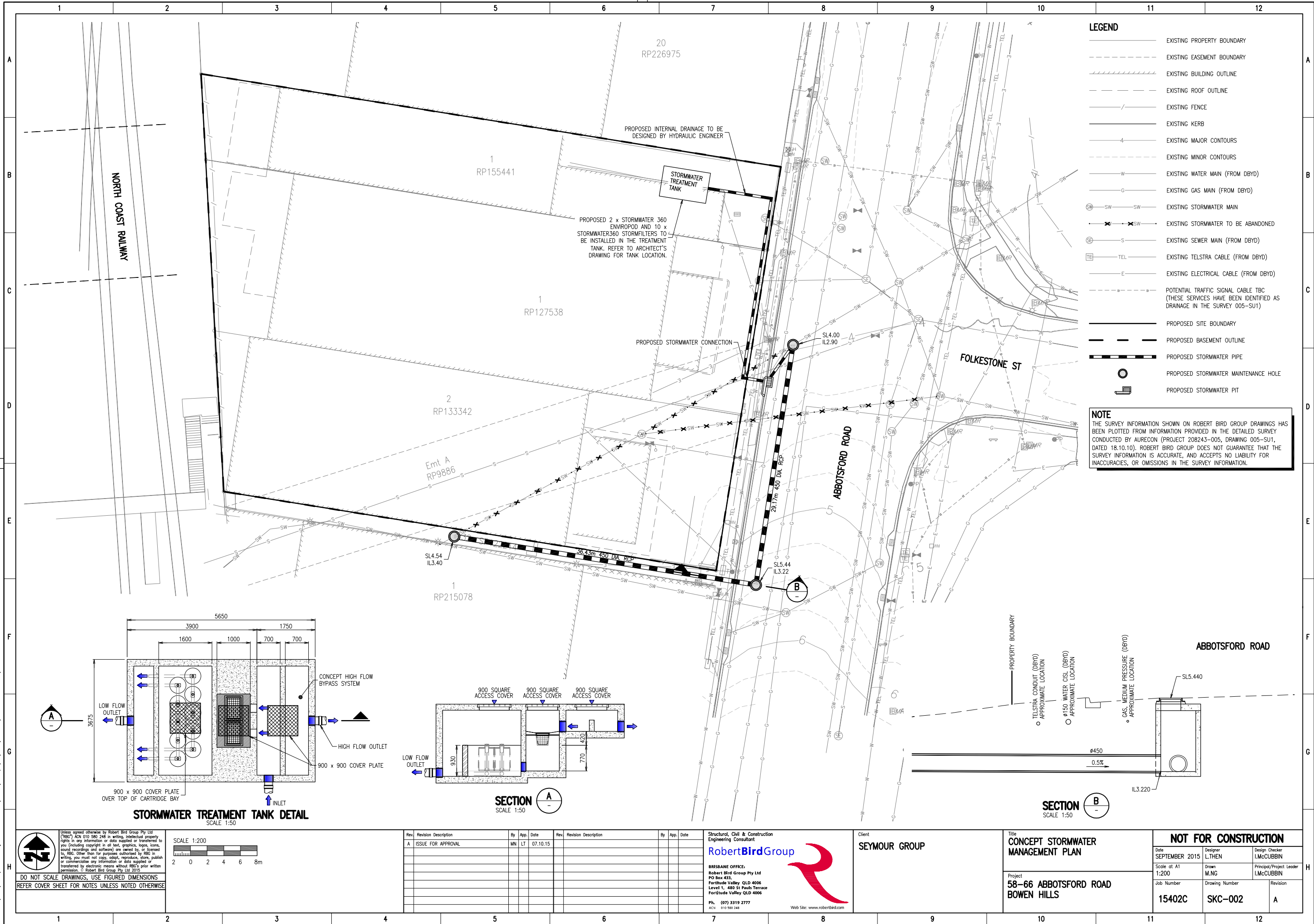
NOTE

THE SURVEY INFORMATION SHOWN ON ROBERT BIRD GROUP DRAWINGS HAS BEEN PLOTTED FROM INFORMATION PROVIDED IN THE DETAILED SURVEY CONDUCTED BY AURECON (PROJECT 208243-005, DRAWING 005-SU1, DATED 18.10.10). ROBERT BIRD GROUP DOES NOT GUARANTEE THAT THE SURVEY INFORMATION IS ACCURATE, AND ACCEPTS NO LIABILITY FOR INACCURACIES, OR OMISSIONS IN THE SURVEY INFORMATION.

Appendix E

Concept Stormwater Management Plan by Robert Bird Group

Disclaimer: Robert Bird Group Pty Ltd ACN 010 580 248 and its related entities (RBG) do not warrant the accuracy, currency or completeness of any information or data they supply or transfer by electronic means. You are responsible for verifying that any information or data supplied or transferred by electronic means matches the information or data on the corresponding PDF or BMR version issued by RBG. RBG is not liable for any loss or damage however caused which you or any other party may directly or indirectly suffer in connection with your access to or use of that information or data.

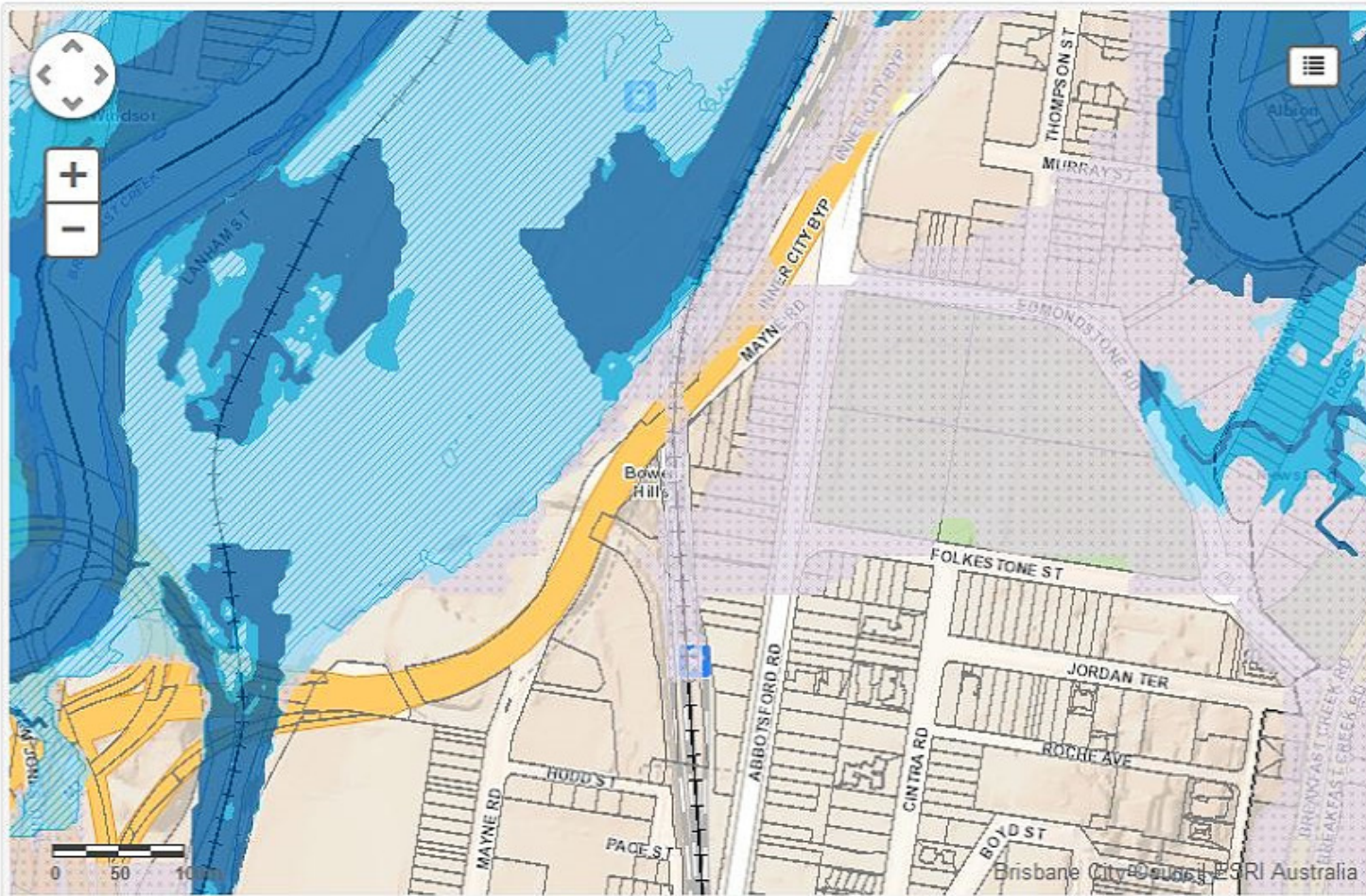


Appendix F

Brisbane City Council's Flood Information

☒ Flood Awareness ☐ Flood Sources ☐ Historic Floods

☐ River ☒ Creek ☐ Storm Tide ☐ Overland Flow



Click a Flood Source

Select a flood source by clicking the different flood source buttons to the left. Then click the map legend buttons below to explore the flood risk areas for that source.

The high risk button will always be turned on. You can also choose to turn on the medium, low and very low flood risk buttons.

Information about the flood risk area will appear in this box when you click on each button. [Click here](#) for an explanation of flood risk.

Map legend

☒ High flood risk

☒ Medium flood risk

☒ Low flood risk

☒ Very low flood risk

Estimated area subject to
flooding

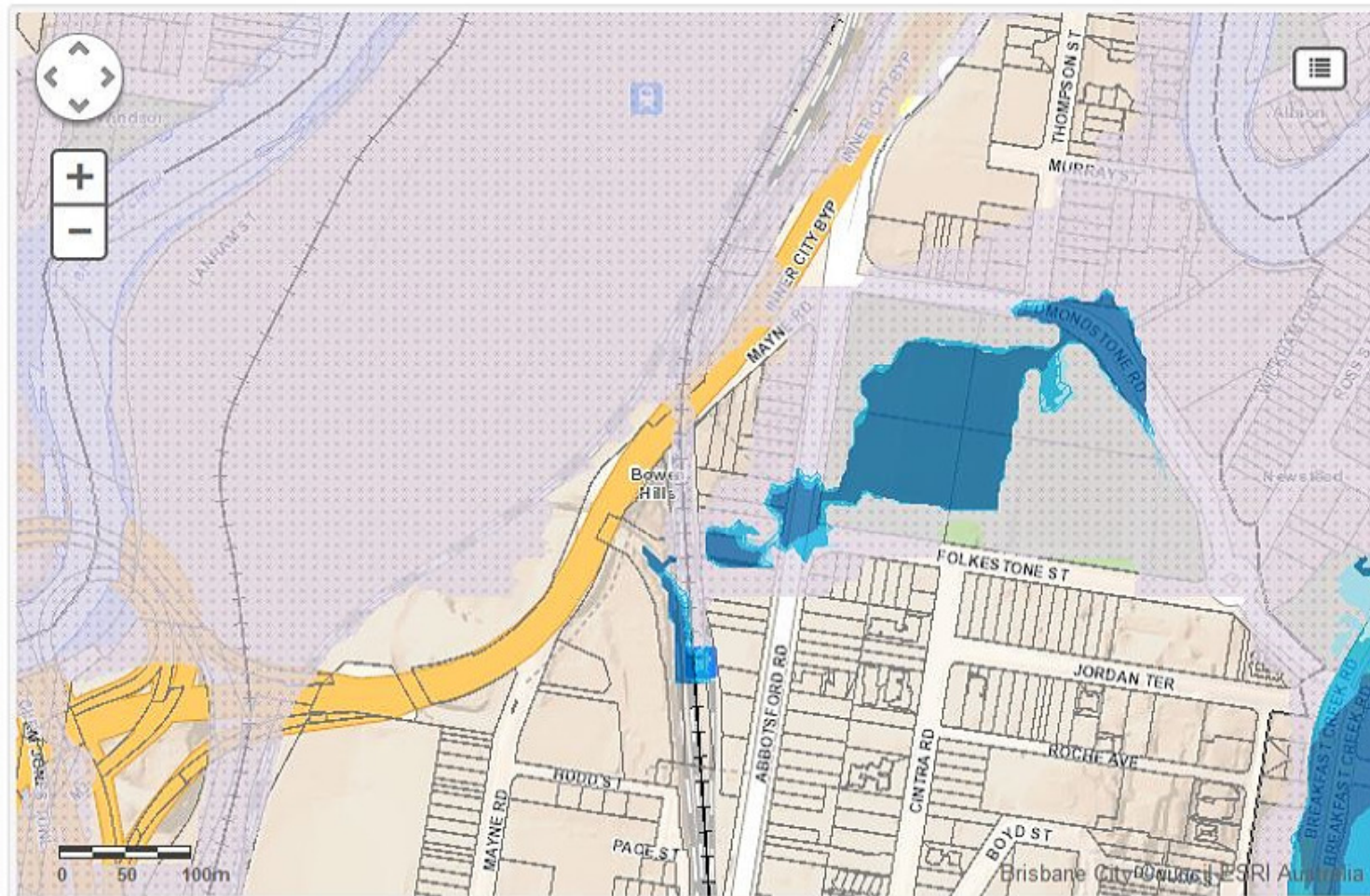
Creek flood

Creek flooding happens when intense rain falls over a creek catchment. Run-off from houses and streets also contributes to creek flooding. The combination of heavy rainfall, run-off and the existing water in the creek causes creek levels to rise.

Brisbane has 32 creeks with thousands of properties located near creeks. Floodwaters in creeks are fast flowing and will generally rise and recede quickly.

☒ Flood Awareness ☐ Flood Sources ☐ Historic Floods

☐ River ☐ Creek ☐ Storm Tide ☒ Overland Flow



Click a Flood Source

Select a flood source by clicking the different flood source buttons to the left. Then click the map legend buttons below to explore the flood risk areas for that source.

The high risk button will always be turned on. You can also choose to turn on the medium, low and very low flood risk buttons.

Information about the flood risk area will appear in this box when you click on each button. [Click here](#) for an explanation of flood risk.

Map legend

☒ High flood risk

☒ Medium flood risk

☒ Low flood risk

☒ Very low flood risk

Estimated area subject to
flooding

Scheduled for review

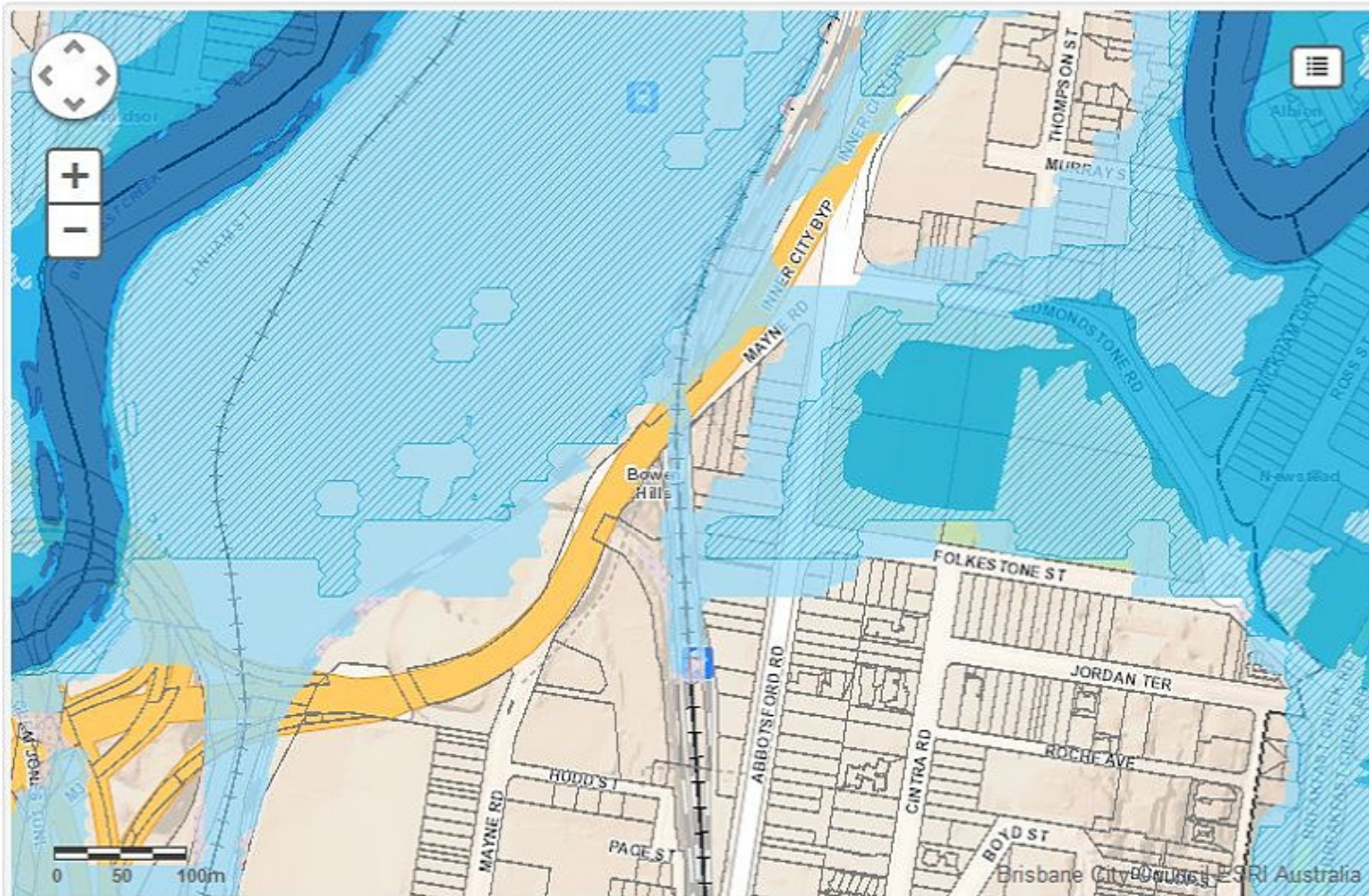
Overland flow

Overland flow is run-off that travels over the land during heavy rainfall events. Overland flow can be unpredictable because it is affected by localised rainfall and urban features such as stormwater infrastructure, roads, fences, walls and other structures. The actual depth and impact of overland flow varies depending on local conditions and manmade alterations e.g. retaining walls and drainage improvement, but generally occurs quickly. Overland flow flooding can range from very shallow to deep.



☒ Flood Awareness ☐ Flood Sources ☐ Historic Floods

☒ River ☐ Creek ☐ Storm Tide ☐ Overland Flow



Click a Flood Source

Select a flood source by clicking the different flood source buttons to the left. Then click the map legend buttons below to explore the flood risk areas for that source.

The high risk button will always be turned on. You can also choose to turn on the medium, low and very low flood risk buttons.

Information about the flood risk area will appear in this box when you click on each button. [Click here](#) for an explanation of flood risk.

Map legend

☒ High flood risk

☒ Medium flood risk

☒ Low flood risk

☒ Very low flood risk

Estimated area subject to flooding

River flood

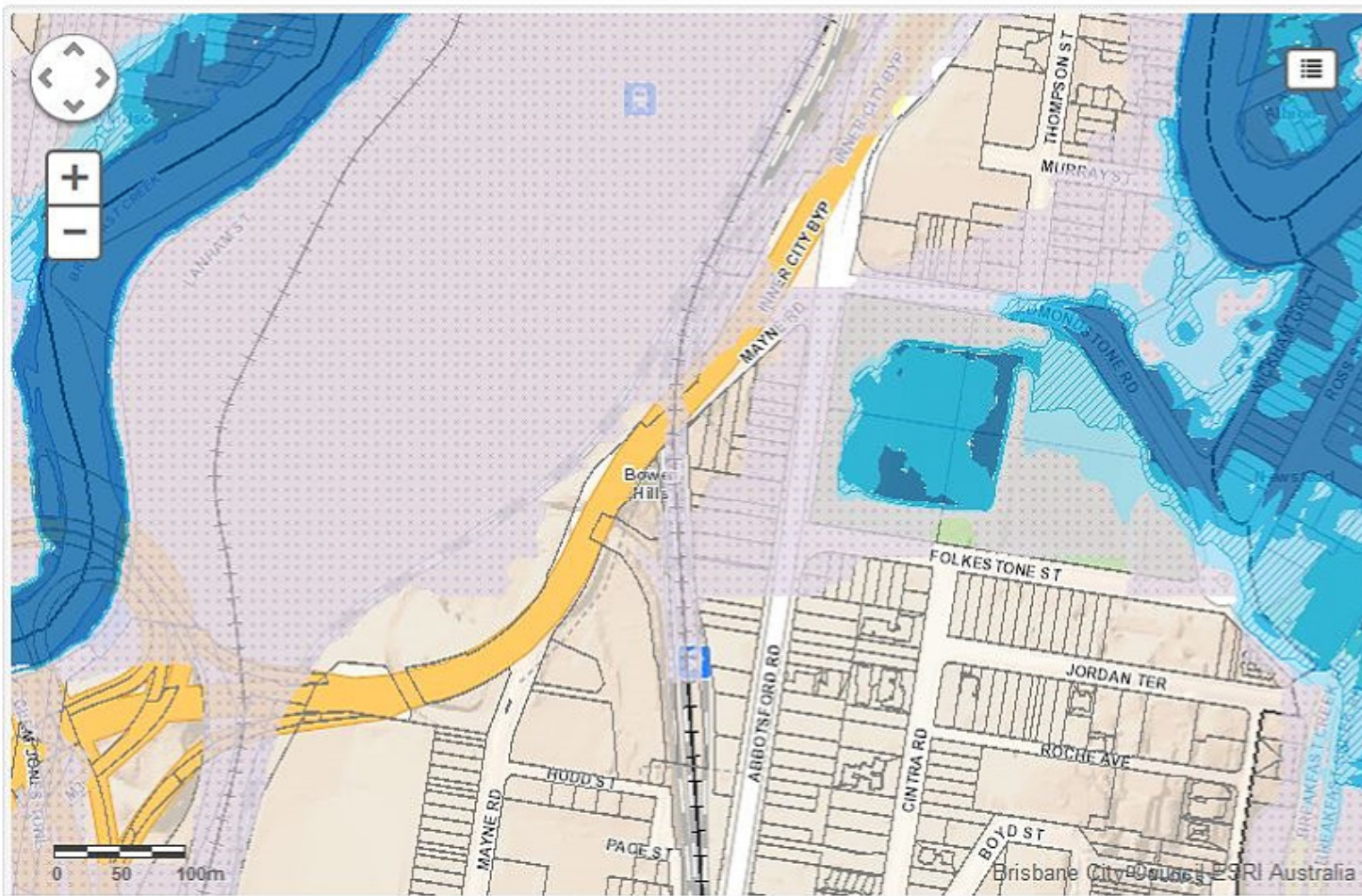
River flooding happens when widespread, prolonged rain falls over the catchment of a river.

As the river reaches capacity, excess water flows over its banks causing flooding. River flooding downstream can occur hours after the rain has finished. River floodwaters rise and recede slowly but can be large and fast moving, and be filled with debris washed into the water.

the Flooding in Brisbane Guide for Residents PDF, HTML or Business PDF, HTML

☒ Flood Awareness ☐ Flood Sources ☐ Historic Floods

☐ River ☐ Creek ☒ Storm Tide ☐ Overland Flow



Click a Flood Source

Select a flood source by clicking the different flood source buttons to the left. Then click the map legend buttons below to explore the flood risk areas for that source.

The high risk button will always be turned on. You can also choose to turn on the medium, low and very low flood risk buttons.

Information about the flood risk area will appear in this box when you click on each button. [Click here](#) for an explanation of flood risk.

Map legend

☒ High flood risk

☒ Medium flood risk

☒ Low flood risk

☒ Very low flood risk

Estimated area subject to
flooding

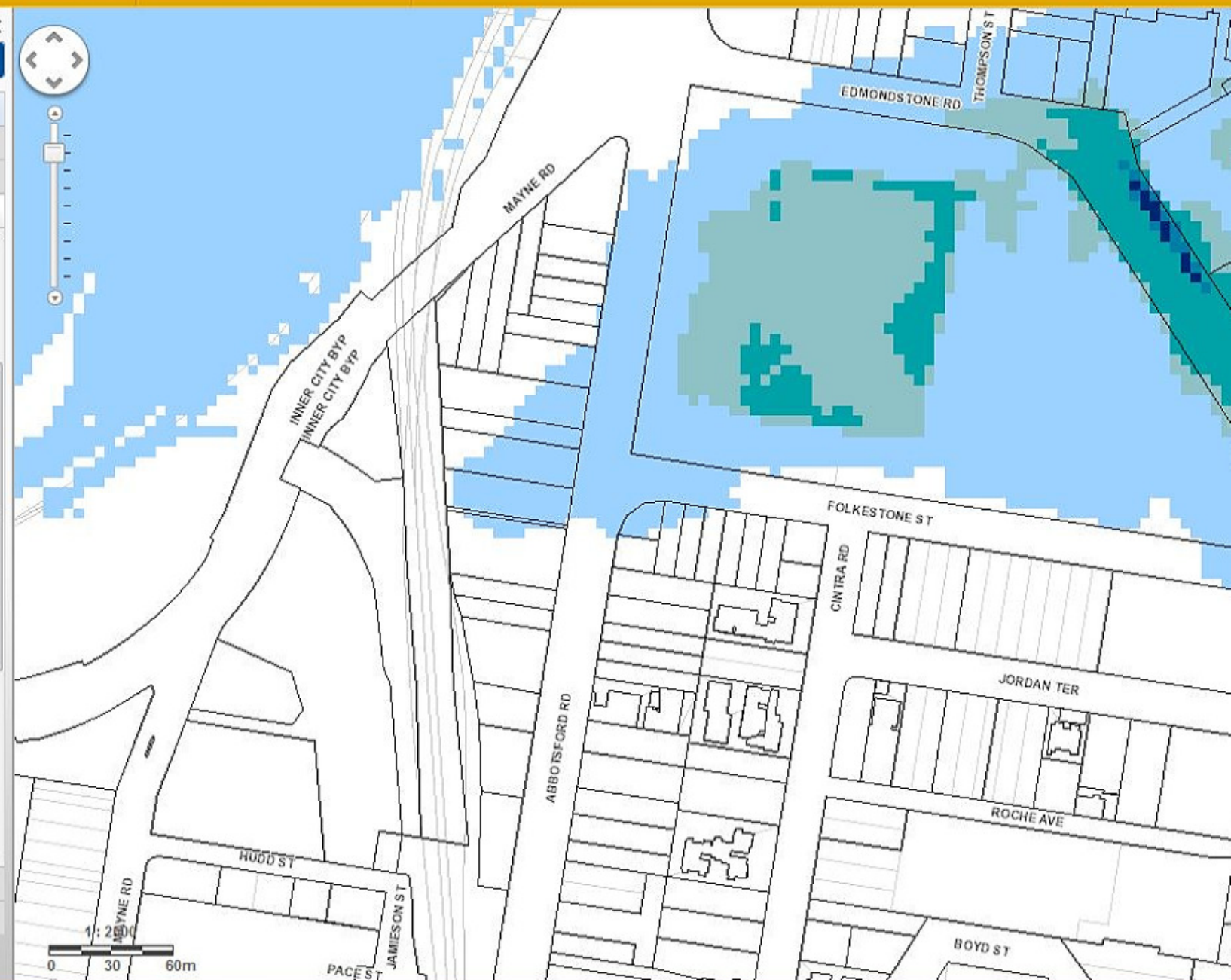
Storm Tide

Storm tide flooding happens when a storm surge creates higher than normal sea levels. A storm surge is caused when a low pressure system or strong on-shore winds force sea levels to rise above normal levels. The impact from storm tide or storm surge is increased during high tides and king tides and can affect low-lying areas close to tidal waterways and foreshores.



Map Contents

- Boundaries and Labels
- Aerial
- Zoning Map
- Overlays
 - Critical infrastructure and movement network
 - Dwelling house character
 - Extractive resources
 - Flood
 - ☐ None
 - ☒ Brisbane River flood planning area
 - Brisbane River flood planning area 1
 - Brisbane River flood planning area 2a
 - Brisbane River flood planning area 2b
 - Brisbane River flood planning area 3
 - Brisbane River flood planning area 4
 - Brisbane River flood planning area 5
 - ☐ Creek/waterway
 - Creek/waterway flood planning area 1
 - Creek/waterway flood planning area 2
 - Creek/waterway flood planning area 3
 - Creek/waterway flood planning area 4
 - Creek/waterway flood planning area 5
 - ☐ Overland flow flood planning area
 - Heritage
 - Industrial amenity
 - Landslide
 - Neighbourhood Plans
 - Priority Infrastructure Plan





Map Contents

Boundaries and Labels

Aerial

Zoning Map

Overlays

Critical infrastructure and movement network

Dwelling house character

Extractive resources

Flood

None

Brisbane River flood planning area

Brisbane River flood planning area 1

Brisbane River flood planning area 2a

Brisbane River flood planning area 2b

Brisbane River flood planning area 3

Brisbane River flood planning area 4

Brisbane River flood planning area 5

Creek/waterway

Creek/waterway flood planning area 1

Creek/waterway flood planning area 2

Creek/waterway flood planning area 3

Creek/waterway flood planning area 4

Creek/waterway flood planning area 5

Overland flow flood planning area

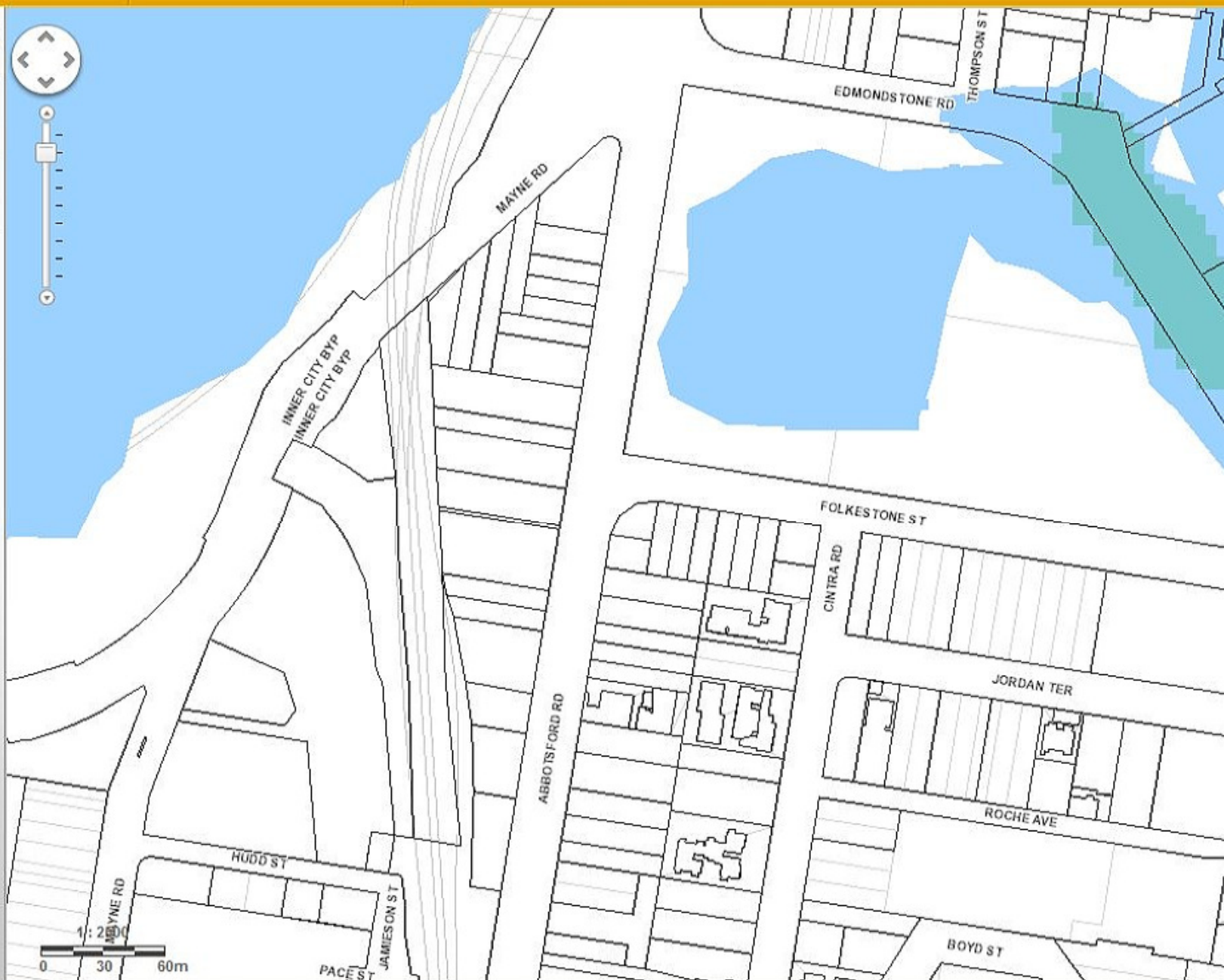
Heritage

Industrial amenity

Landslide

Neighbourhood Plans

Priority Infrastructure Plan





Map Contents

Boundaries and Labels

Aerial

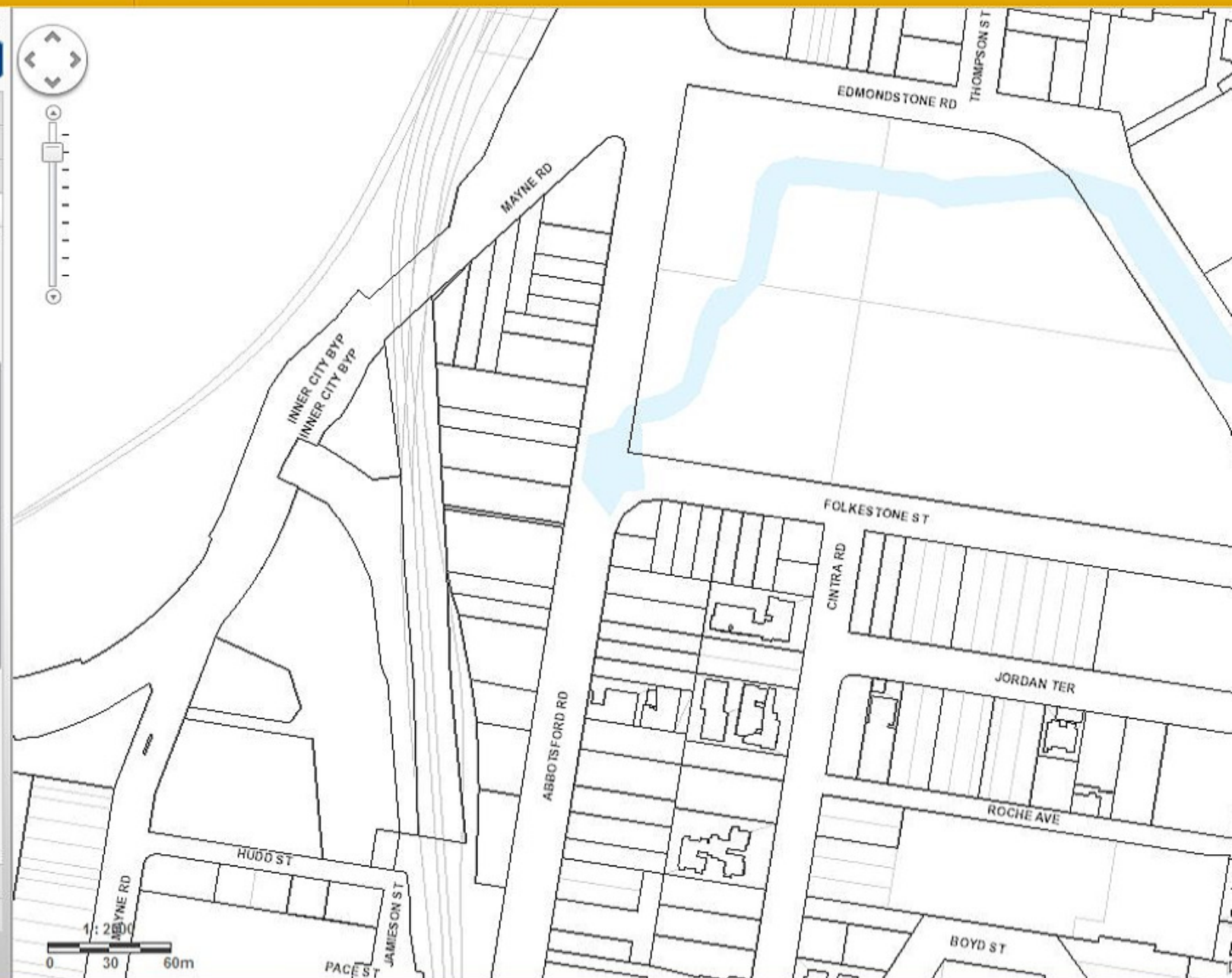
Zoning Map

Overlays

- ▶ Critical infrastructure and movement network
- ▶ Dwelling house character
- ▶ Extractive resources
- ▼ Flood
 - ☐ None
 - ☐ Brisbane River flood planning area
 - Brisbane River flood planning area 1
 - Brisbane River flood planning area 2a
 - Brisbane River flood planning area 2b
 - Brisbane River flood planning area 3
 - Brisbane River flood planning area 4
 - Brisbane River flood planning area 5
 - ☐ Creek/waterway
 - Creek/waterway flood planning area 1
 - Creek/waterway flood planning area 2
 - Creek/waterway flood planning area 3
 - Creek/waterway flood planning area 4
 - Creek/waterway flood planning area 5
 - ☒ Overland flow flood planning area
- ▶ Heritage
- ▶ Industrial amenity
- ▶ Landslide

Neighbourhood Plans

Priority Infrastructure Plan



Appendix G

Brisbane City Council's Existing Stormwater Drawings

LEGEND

SEWERAGE LINES..

P.M.O. CONDUIT.

GAS MAINS.

WATER MAINS.

ELECTRICITY CABLES.

PARISH OF NORTH BRISBANE
ABBOTSFORD RD. MAYNE.
Lot 25 R.P. 127644
Mr. James J. REDDIEK and
Mrs. Valma E. REDDIEK.
52 ABBOTSFORD RD. MAYNE.

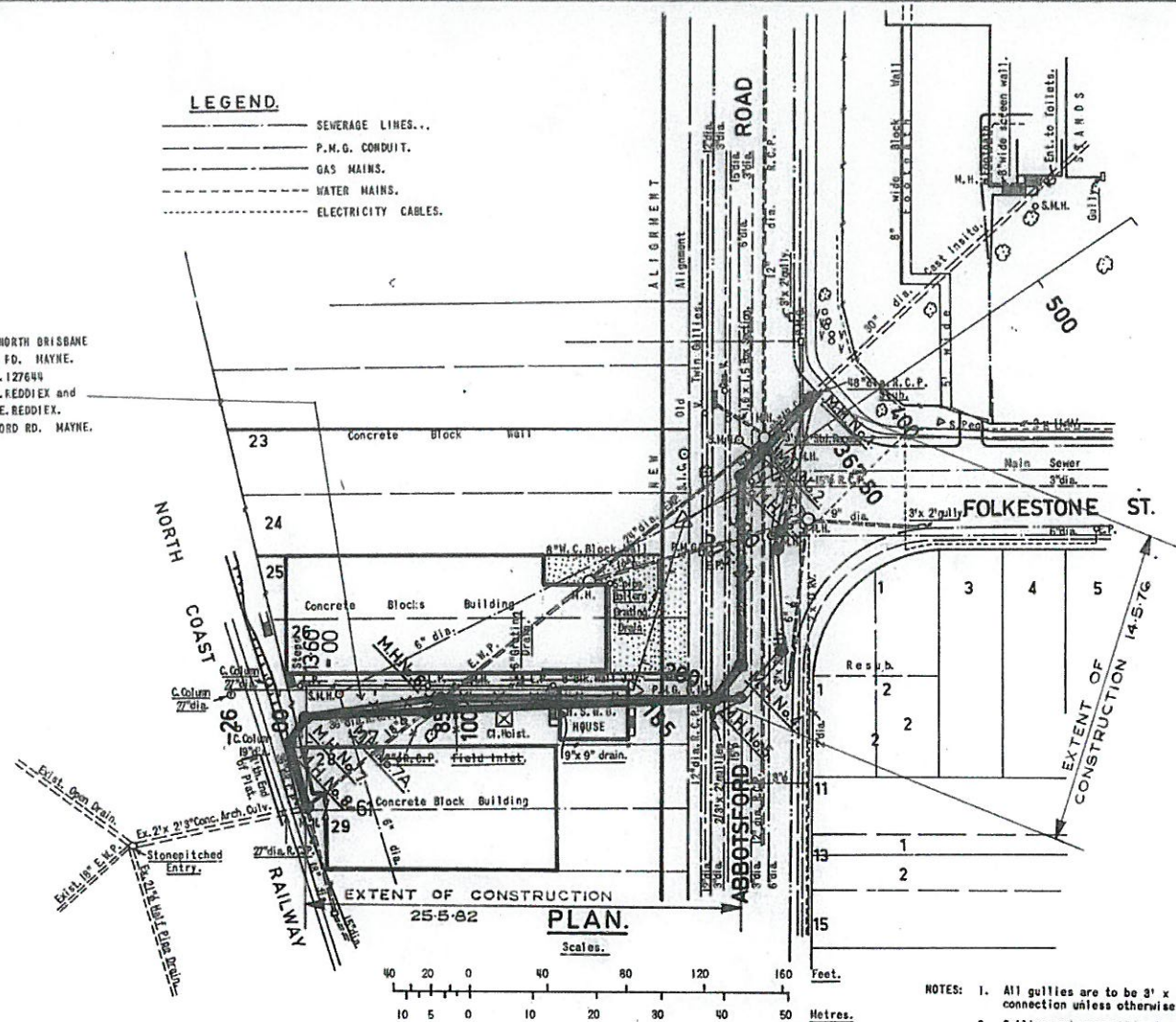
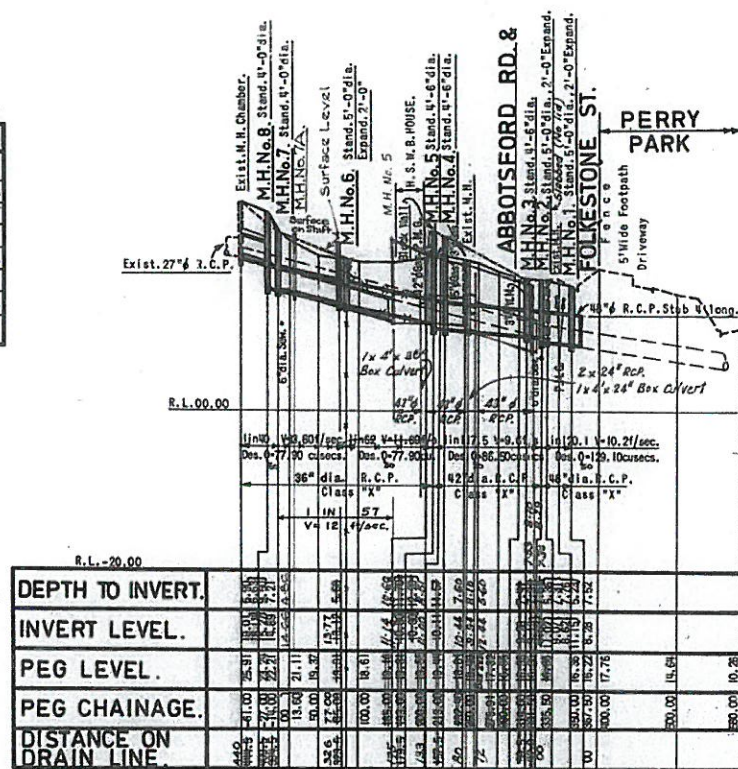


TABLE OF OFFSETS.

M.H. No.	CHAINAGE	OFFSET
1	367.5'	15' L.
2	381.5'	8.5' L.
3	314.0'	3' L.
4	213.0'	50' R.
5	193.0'	42.25' R.
6	86.0'	12' W.
7	14.0'	0.75' L.
8	27.0'	9' L.

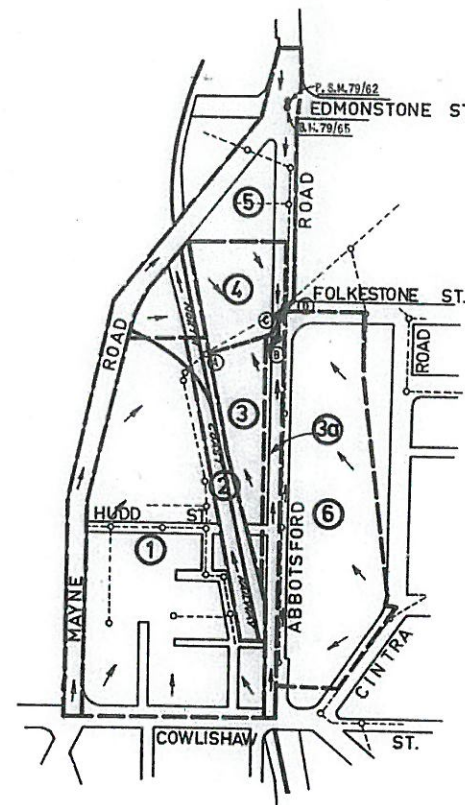


- NOTES:**
- All gullies are to be 3' x 2' with 12" dia. pipe connection unless otherwise shown.
 - Gullies and connections have been allowed for in the schedule as shown on the plans, but the actual number of gullies and extent of connections will be determined by the Engineer on site.
 - Notwithstanding that the present and/or proposed positions of Public Utilities, Fittings, Pipes, Poles, Manholes etc. may be indicated in the drawings, no responsibility will be accepted by the Brisbane City Council for the accuracy of the representation or the omission thereof.
 - Attention of tenderers is particularly drawn to the following clauses in the documents of contract:
 - Clauses 18.04 - 18.06 of General Specification concerning demolition of existing bridges, culverts, drains etc.
 - Clause 9.01 of Specification for Excavation for Drainage Works, concerning connection to existing drains.
 - Widths of trenches for 12" dia. to 21" dia. R.C. pipes to be equal to external diameter of pipe + 9". For widths of trenches for other pipes, see Standard Drawing W.495/18.
 - Bench Marks must be checked by Contractor. (See Clause 31.00 of General Specification.)

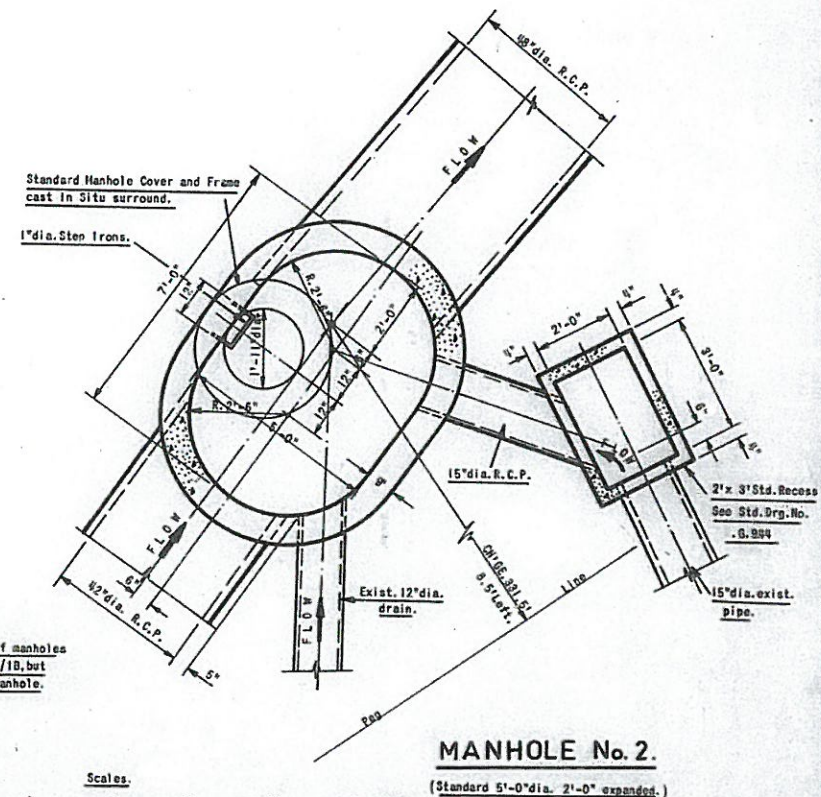
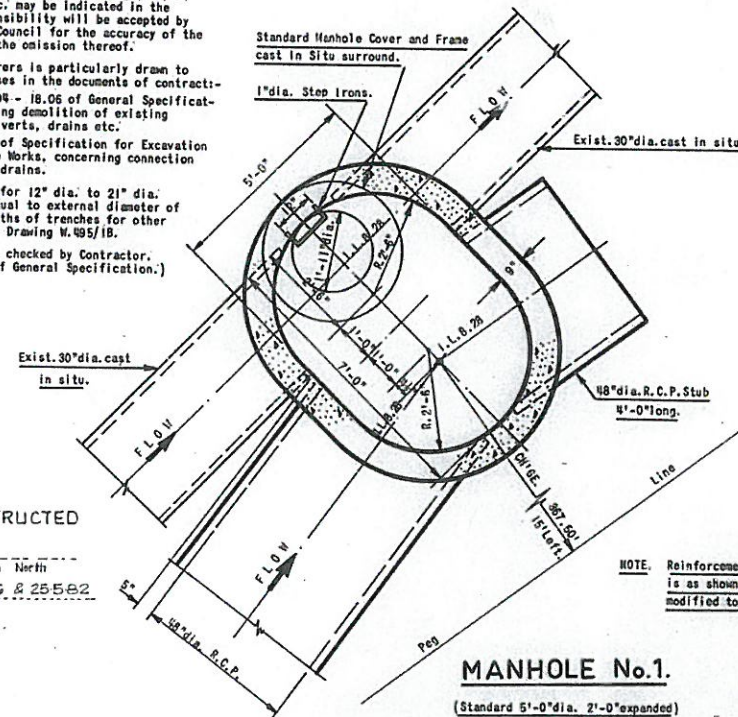
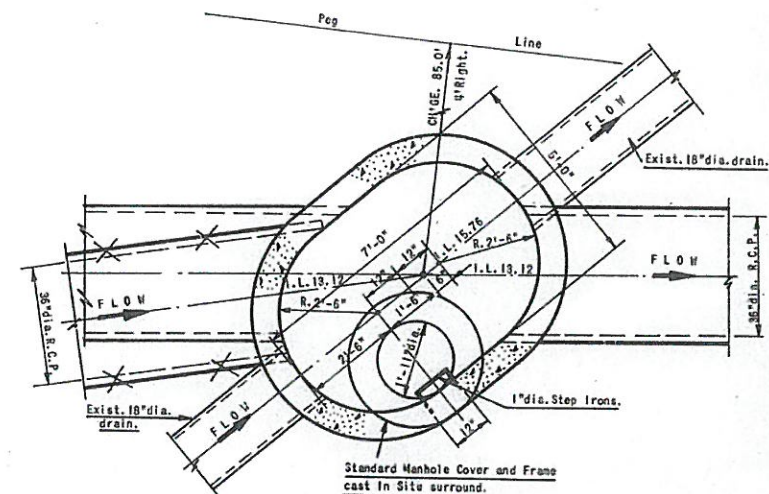
WORKS AS CONSTRUCTED

L. KING

Senior Engineer Construction North
Date: 14.5.76 & 25.5.82



LINE	CATCH. CONTRID.	AREA IN ACRES.
A-D	1,2,3	16.24 acres
B-C	1,2,3,3a	12.66 "
C-D	1,2,3,3a,6	26.20 "



NOT TO SCALE

A	LINE FROM M.H. No. 5 TO M.H. No. 7 STRAIGHTENED.	30-5-80	14-5-76	25-5-82
B	WORKS AS CONSTRUCTED			
Suffix.	Amendment.	Date.	E. for D.	D. C. E. & M. F. C. N. S. E. Issued.

Chief Engineer and Manager.	Engineer for Design.
Date: 14.5.76	Date: 2.4.74

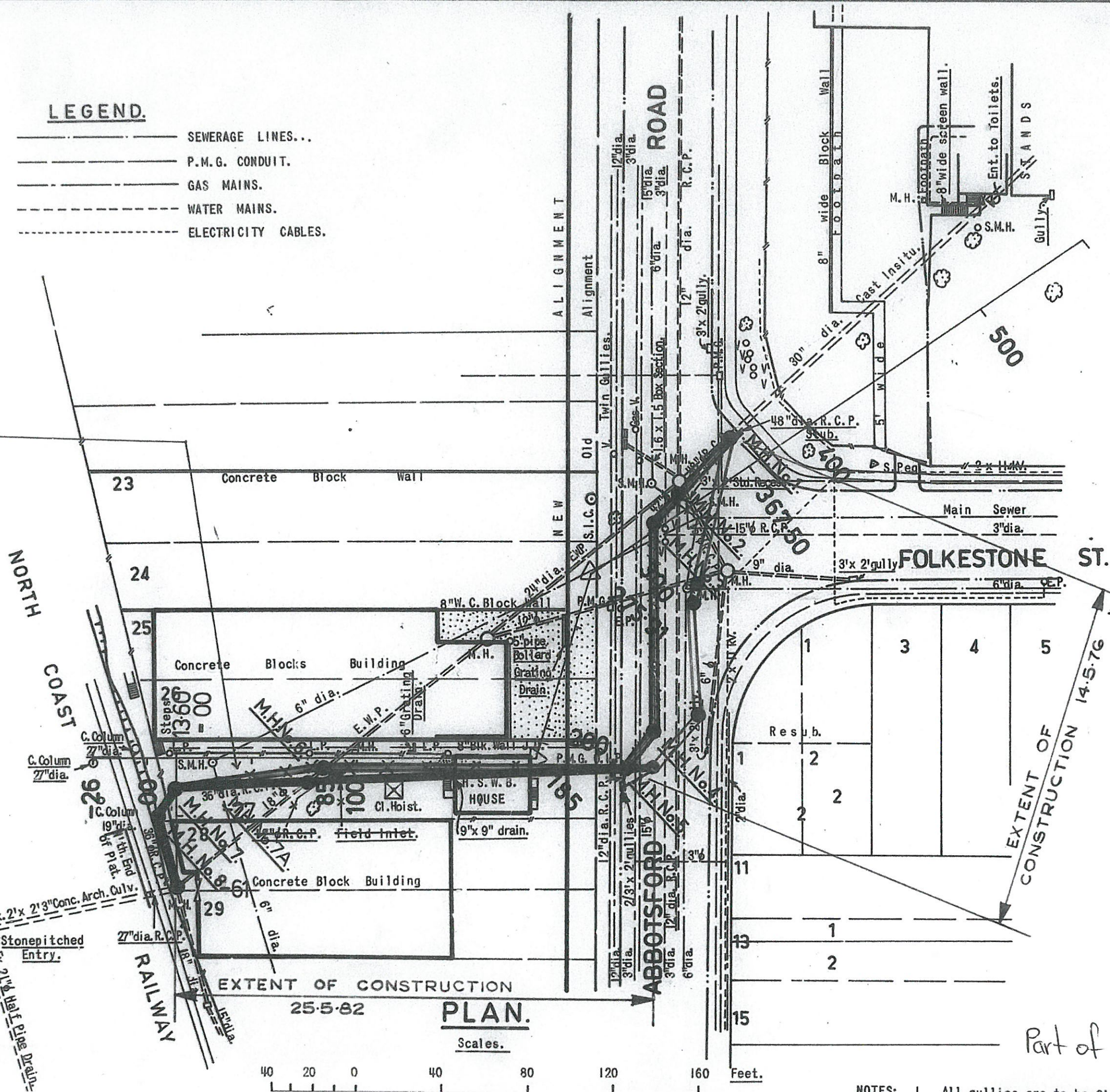
Plotted.	Field Bl.	ACQUISITIONS.
1. J. Oct. 73	6070/1	Proposed or Nil. PROP.
2. J. Dec. 73	5070/23	Proposed or Nil. PROP.
3. K. E. C. Dec. 73	Register.	Proposed or Nil. PROP.
4. G. T. Jul. 74	D.O.O. No.	Proposed or Nil. PROP.
5. J. J. 1/76	1670/2602	Proposed or Nil. PROP.

BRISBANE CITY COUNCIL - DEPARTMENT OF WORKS.
DRAINAGE
NEW BOWEN HILLS RAILWAY STATION TO PERRY PARK.
W5368 1XB

LEGEND.

- SEWERAGE LINES...
- P.M.G. CONDUIT.
- GAS MAINS.
- WATER MAINS.
- ELECTRICITY CABLES.

ISM OF NORTH BRISBANE
OTSFORD RD. MAYNE.
25 R.P. 127644
James J. REDDIE and
.Valma E. REDDIE.
ABBOTSFORD RD. MAYNE.



NOT
TO SCALE

THIS INFORMATION SHOULD BE USED ONLY AS A
GENERAL GUIDE TO STORMWATER DRAINAGE PLANS
The information shown on this sheet has been obtained from
plans available in the Works Design Office at the date of
completion.
It cannot be inferred that the drainage shown is constructed or
if constructed, agrees with the information shown.
No warranty is given as to the accuracy or complete-
ness of the information shown.

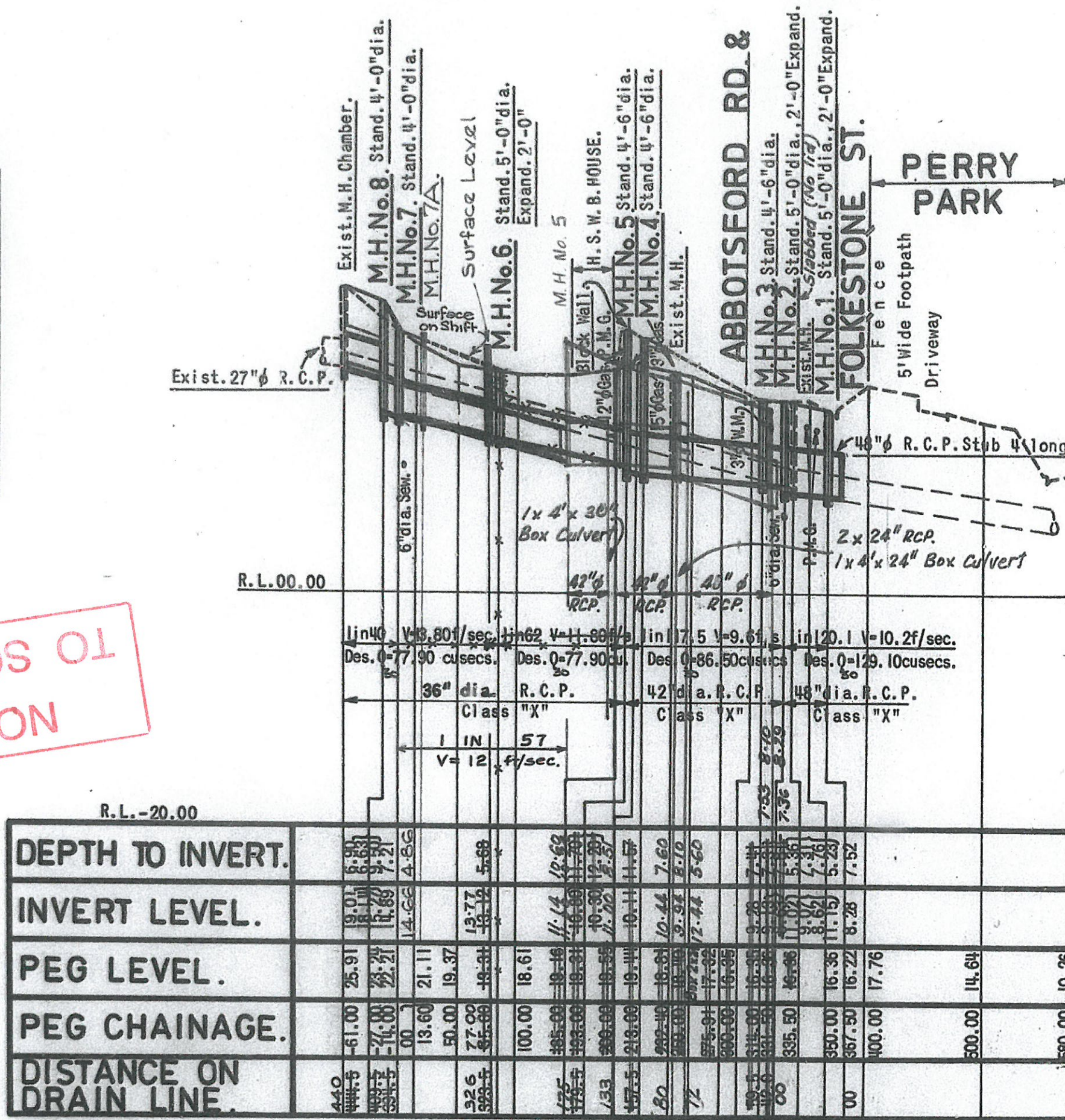
Part of W5388

NOTES: 1. All gullies are to be 24" dia. for 15' and 30'.

F OFFSETS.

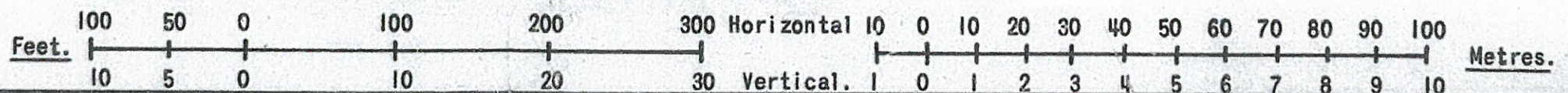
AGE	OFFSET
.5'	15' L.
.5'	8.5' L.
.0'	3' L.
.0'	50' R.
.0'	42.25' R.
.0'	12' R.
.0'	0.75' L.
.0'	9' L.

NOT TO SCALE



LONGITUDINAL SECTION.

B.C.C. DATUM.
P.S.M. 79/62 R.L. 30.09
On Traffic Is. junction of
ABBOTSFORD RD. and EDMONSTONE ST.
B.M. 79/65 R.L. 29.15
On Traffic Is. junction of
ABBOTSFORD RD. and EDMONSTONE ST.



number of gullies and extent of connections will be determined by the Engineer on site.

- Notwithstanding that the present and/or proposed positions of Public Utilities, Fittings, Pipes, Poles, Manholes etc. may be indicated in the drawings, no responsibility will be accepted by the Brisbane City Council for the accuracy of the representation or the omission thereof.
- Attention of tenderers is particularly drawn to the following clauses in the documents of contract:
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- Widths of trenches for 12" dia. to 21" dia. R.C. pipes to be equal to external diameter of pipe + 9". For widths of trenches for other pipes, see Standard Drawing W.495/1B.
- Bench Marks must be checked by Contractor. (See Clause 31.00 of General Specification.)

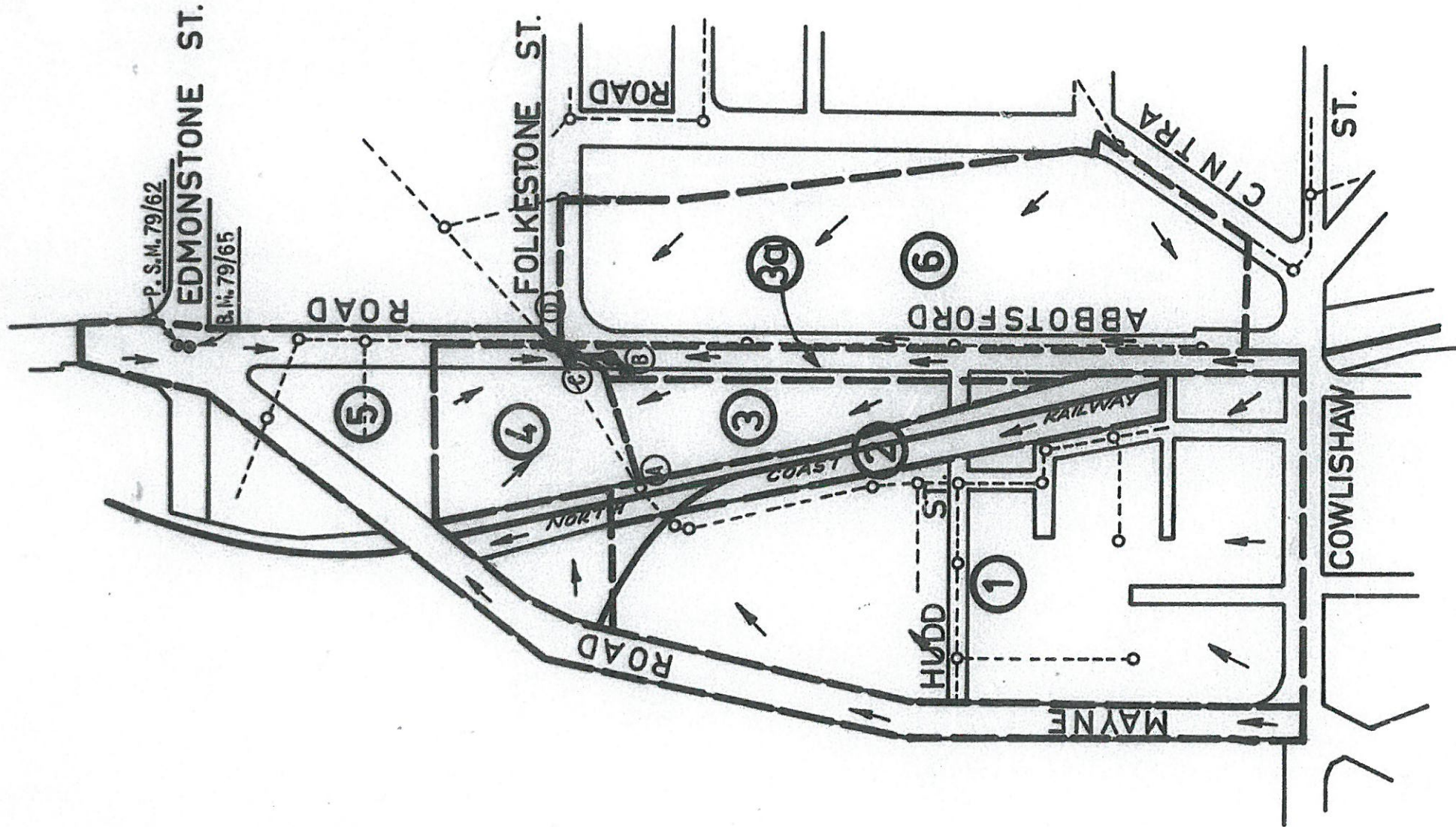
WORKS AS CONSTRUCTED

L. KING

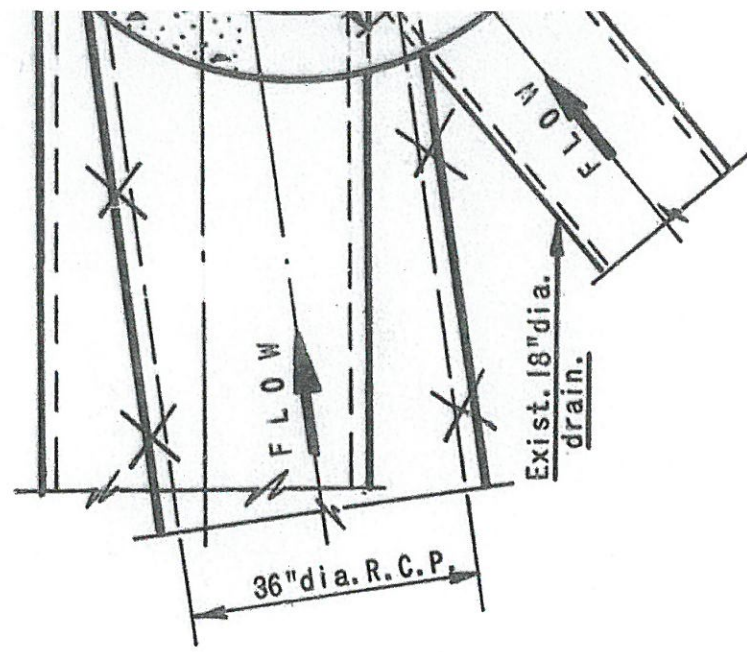
Senior Engineer Construction North

Date: 14.5.76 & 25.5.82

Part of W 5388



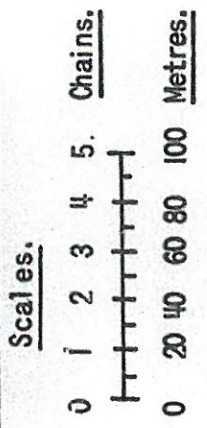
LINE	CATCH. CONTRIB.	AREA IN ACRES.
A-B	1, 2, 3	16.34 acres
B-C	1, 2, 3, 3a	12.66 "
C-D	1, 2, 3, 3a, 6	26.20 "



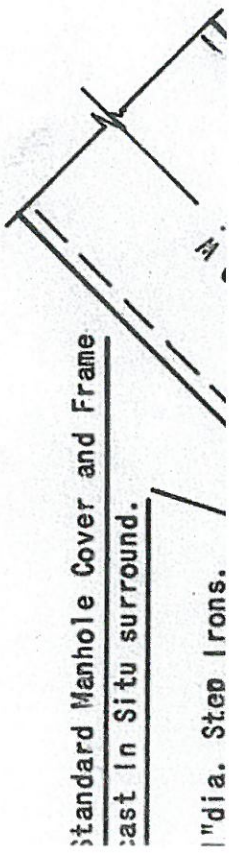
WARNING
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 GENERAL GUIDE TO STORMWATER DRAINAGE PLANS.
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 plans available in the Works Design Office at the date of
 compilation.
 It cannot be inferred that the drainage shown is constructed or
 that, if constructed, agrees with the information shown.
 Therefore no warranty is given as to the accuracy or com-
 pleteness of the information shown.

**NOT
TO SCALE**

WATERSHED.



Part of
W 5380.



Standard Manhole Cover and Frame
 Cast in Situ surround.

1"dia. Step Irons.

Standard Manhole Cover and Frame

228

30

20

12" DIA
IL 8.69

2'-0" DIA
IL 8.64

D=4'-4"
IL 11.16
SL 15.56

9" DIA
IL 9.00

18" DIA

D=5'-0"
IL 24.78
18" DIA

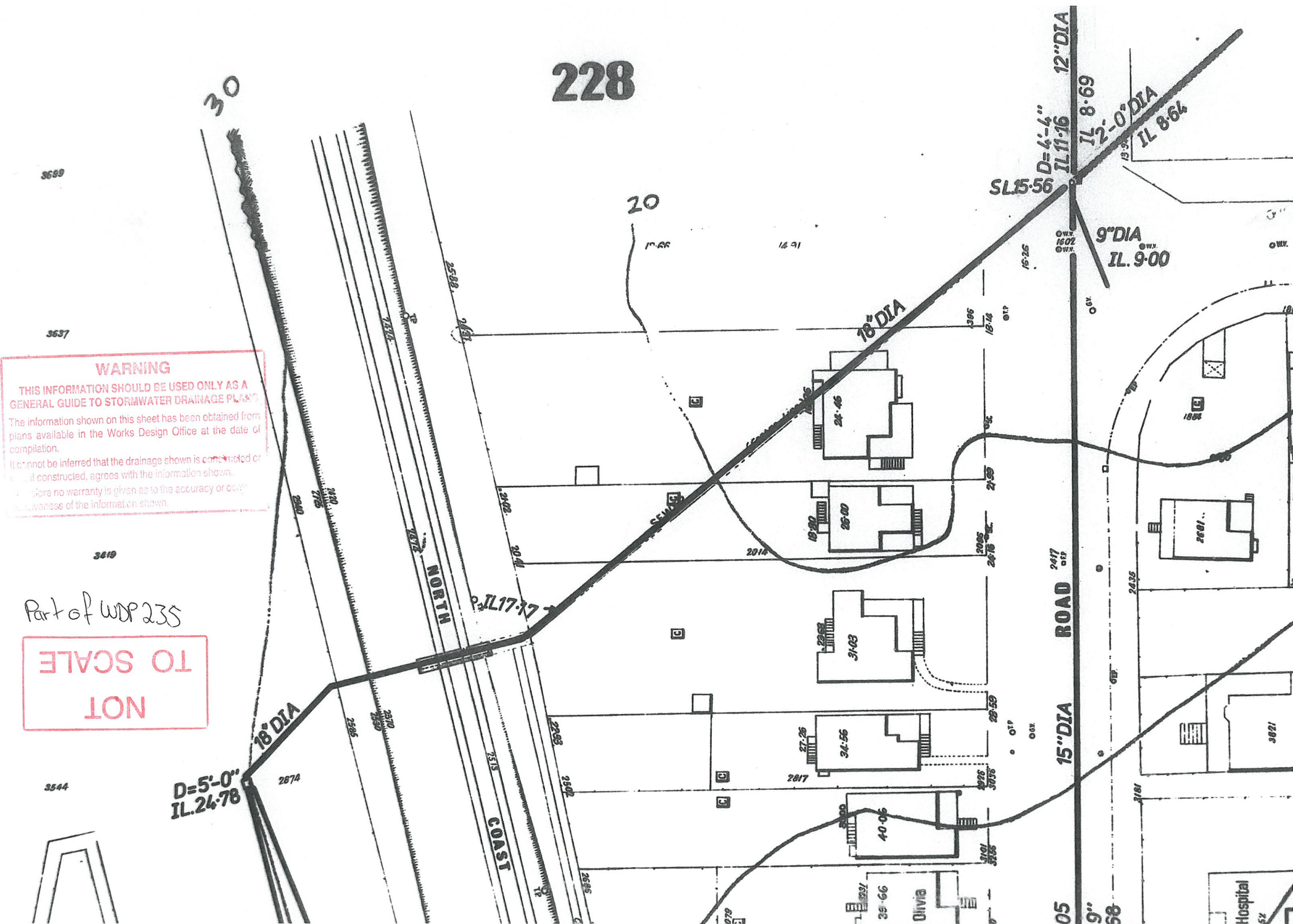
15" DIA
ROAD 2417
05

NORTH

COAST

WARNING
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of the information shown.

Part of WDP 235
NOT TO SCALE



WARNING

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compilation.

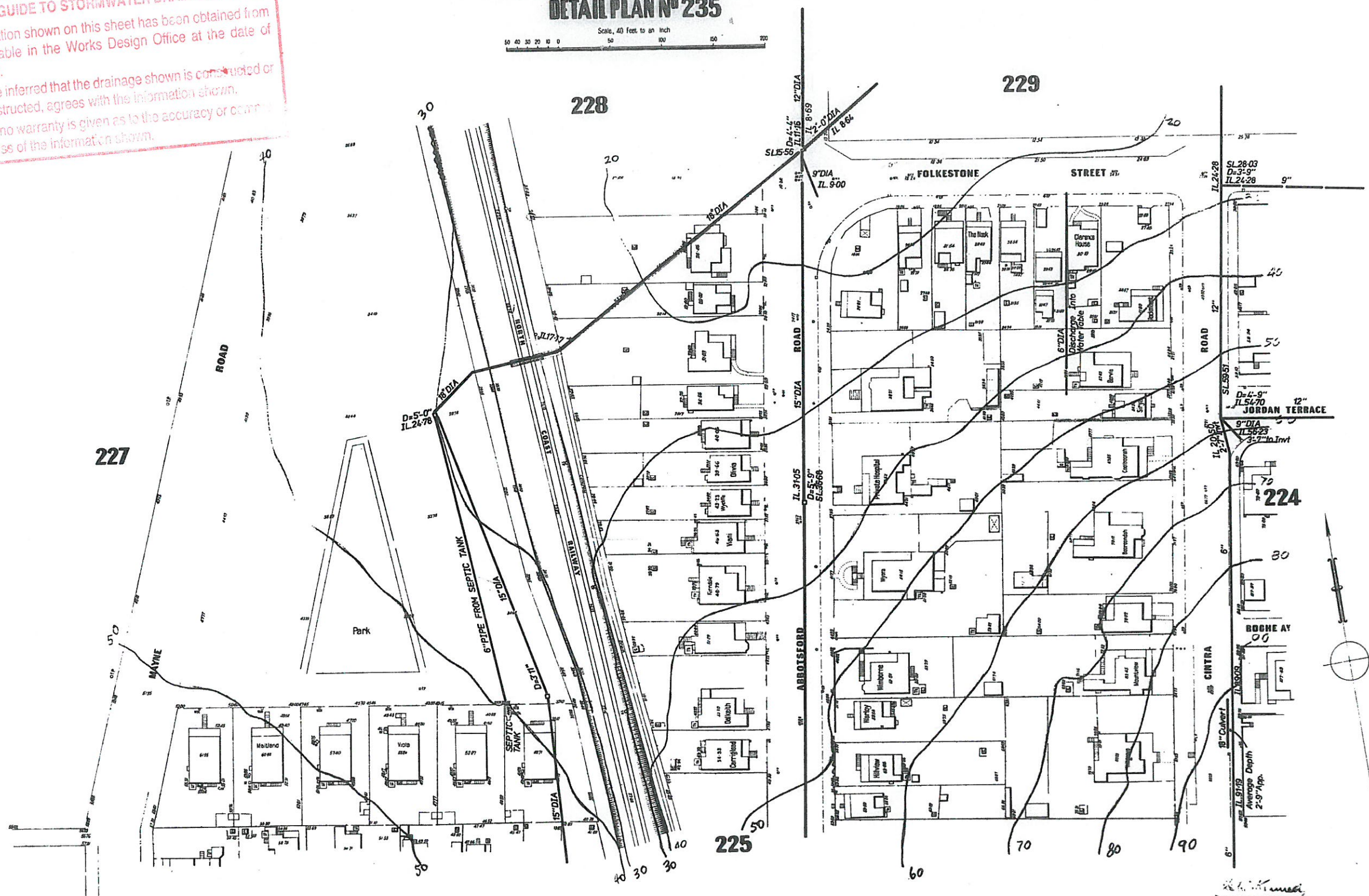
It cannot be inferred that the drainage shown is constructed or
that, if constructed, agrees with the information shown.

Therefore no warranty is given as to the accuracy or com-
pleteness of the information shown.

METROPOLITAN WATER AND SEWERAGE BOARD CITY OF BRISBANE DISTRICT No. 4

DETAIL PLAN No. 235

Scale, 40 feet to an inch



STORMWATER DRAINS AS SURVEYED IN 1923
REDRAWN from Sewerage Contract No. 27, 29 & 30
4 Chain Map No. 79

BRISBANE CITY COUNCIL DEPARTMENT OF WORKS

WORKS DETAIL PLAN - WDP - 235

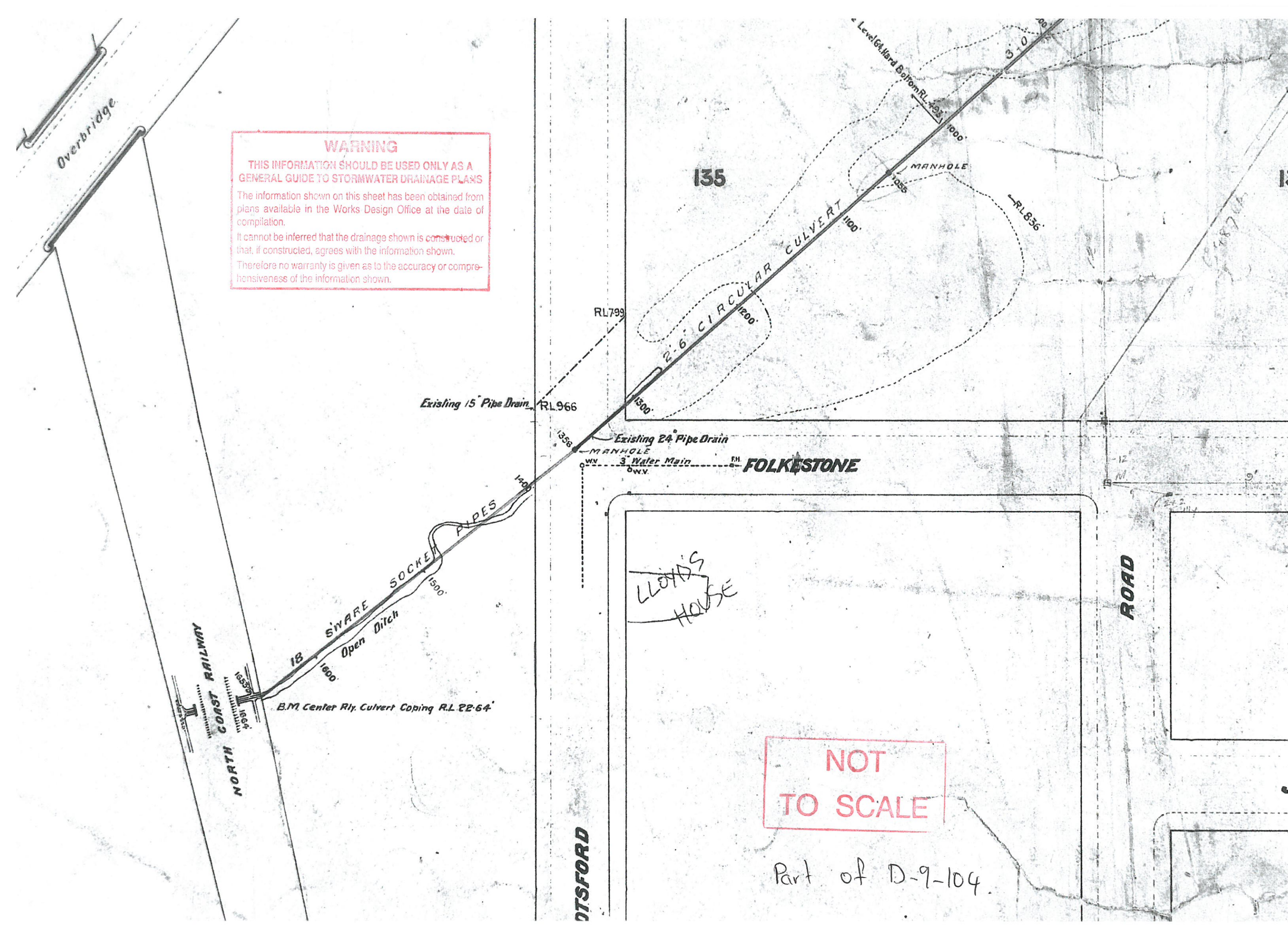
AUTHORISED SURVEYOR

NOT
TO SCALE

THIS INFORMATION SHOULD BE USED ONLY AS A
GENERAL GUIDE TO STORMWATER DRAINAGE PLANS

It cannot be inferred that the drainage shown is constructed or that, if constructed, agrees with the information shown.

Therefore no warranty is given as to the accuracy or comprehensiveness of the information shown.



CITY OF BRISBANE

Drainage of Perrys Paddock

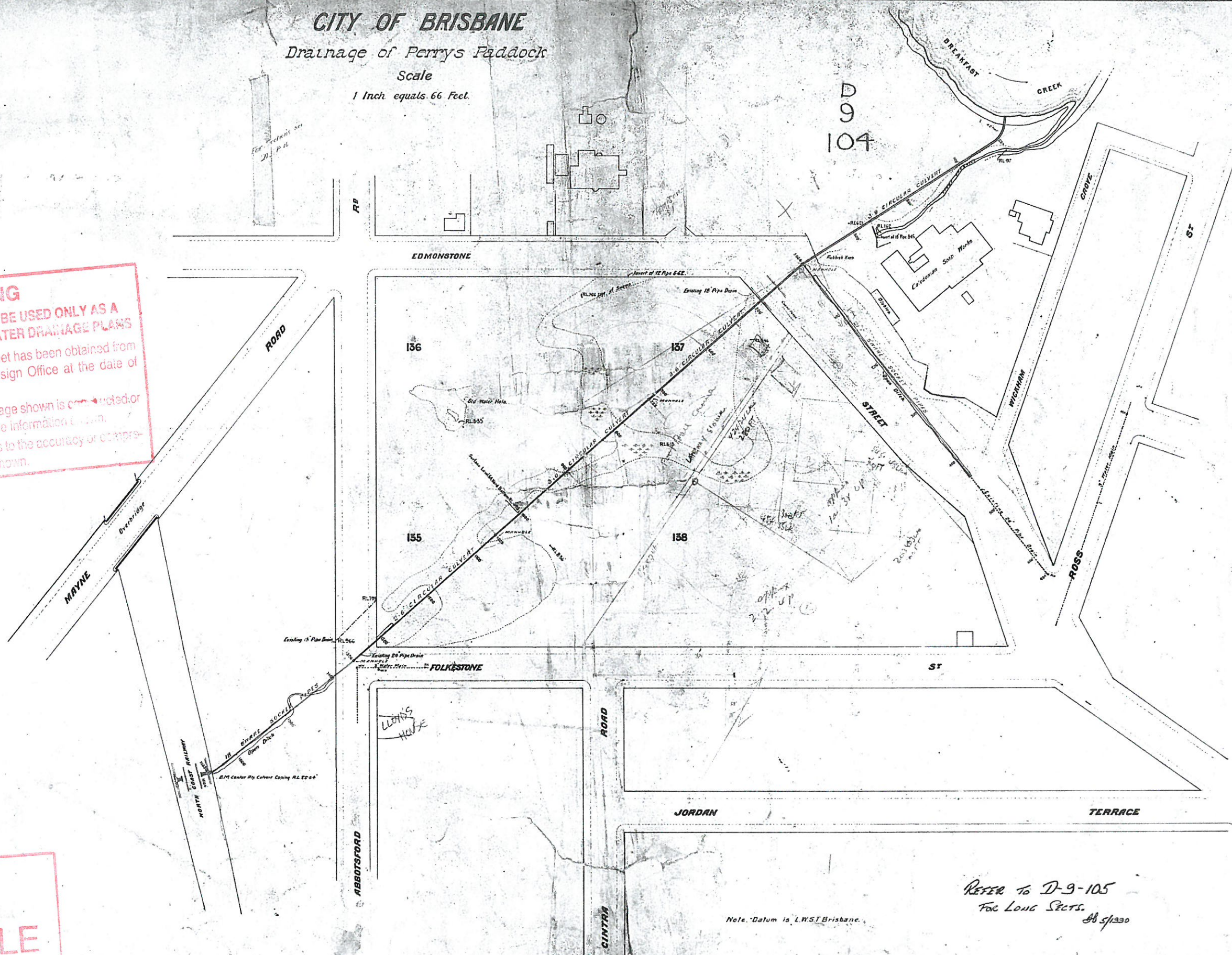
Scale
1 Inch equals 66 Feet.

D
9
104

WARNING

THIS INFORMATION SHOULD BE USED ONLY AS A
GENERAL GUIDE TO STORMWATER DRAINAGE PLANS
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plans available in the Works Design Office at the date of
revision.
It is not to be inferred that the drainage shown is constructed or
to be constructed, agrees with the information shown.
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of the information shown.

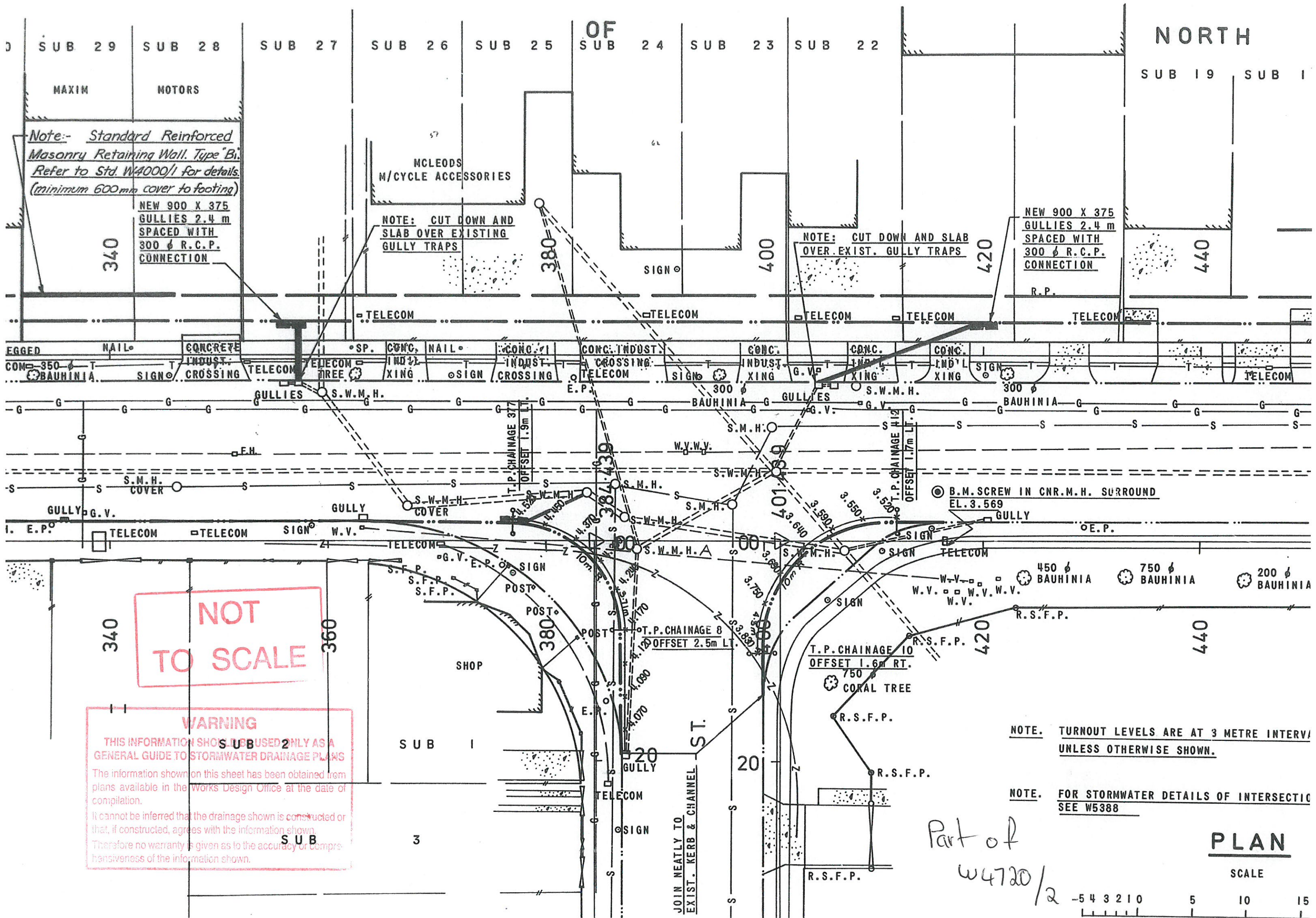
NOT
TO SCALE



Note: Datum is L.W.S.T. Brisbane.

Refer to D-9-105
For Long Sects.
AS 5/1330

A-BCC- D. 9. 104.



NOT
TO SCALE

WARNING
THIS INFORMATION SHOULD BE USED ONLY AS A GENERAL GUIDE TO STORMWATER DRAINAGE PLANS. The information shown on this sheet has been obtained from plans available in the Works Design Office at the date of compilation. It cannot be inferred that the drainage shown is constructed or that, if constructed, agrees with the information shown. Therefore no warranty is given as to the accuracy or comprehensiveness of the information shown.

NOTE. TURNOUT LEVELS ARE AT 3 METRE INTERVALS UNLESS OTHERWISE SHOWN.
NOTE. FOR STORMWATER DETAILS OF INTERSECTION SEE W5388

Part of
W4720/2

PLAN
SCALE
0 5 10 15

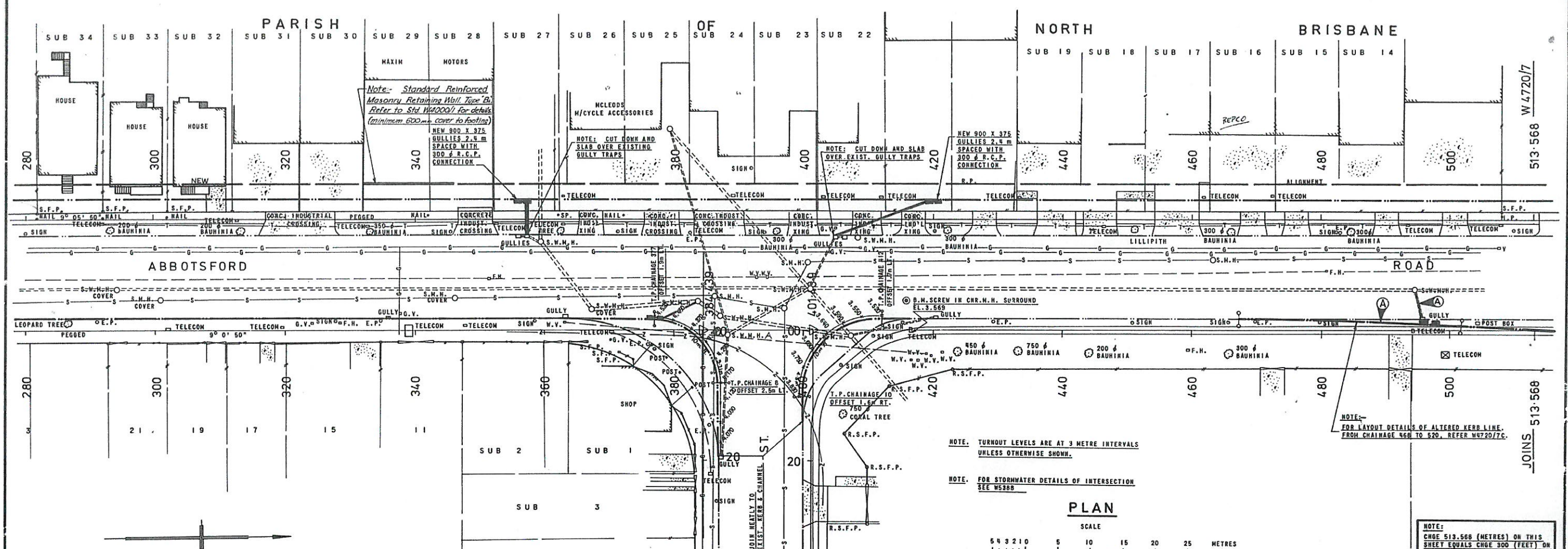


TABLE OF LIP LEVELS

CHAINAGE	LIP LINE L.H.S. OFFSET	ELEVATION	LIP LINE R.H.S. OFFSET	ELEVATION
60	2.747 LT.	19.270	1.500 LT.	19.086
65	"	19.090	1.505	18.921
70	"	18.920	1.510	18.758
75	"	18.750	1.515	18.591
80	"	18.590	1.520	18.419
85	"	18.410	1.525	18.261
90	"	18.260	1.530	18.118
95	"	18.110	1.535	17.961
100	"	17.980	1.540	17.815
105	"	17.820	1.545	17.665
110	"	17.680	1.550	17.521
115	"	17.530	1.555	17.378
120	"	17.390	1.560	17.230
125	"	17.260	1.565	17.095
130	"	17.130	1.570	16.950
135	"	17.000	1.575	16.810
140	"	16.840	1.580	16.675
145	"	16.640	1.585	16.540
150	"	16.430	1.590	16.419
155	"	16.270	1.595	16.299
160	"	16.130	1.600 LT.	16.181
165	"	16.010	"	16.080
170	"	15.900	"	15.963
175	"	15.780	"	15.829
180	"	15.610	"	15.665
185	"	15.590	"	
190	"	15.475	"	15.472
195	"	15.360	"	
200	"	15.239	"	15.270
205	"	15.105	"	
210	"	15.062	"	15.062
215	"	14.961	"	
220	"	14.810	"	14.860
225	"	14.762	"	
230	"	14.662	"	14.651
235	"	14.518	1.625 LT.	
240	"	14.365	"	

CHAINAGE	LIP LINE L.H.S. OFFSET	ELEVATION	LIP LINE R.H.S. OFFSET	ELEVATION
210	2.747 LT.	14.220	1.650 LT.	14.440
215	"	14.143	"	
220	"	14.070	"	
225	"	13.920	1.675 LT.	14.220
230	"	13.758	1.700	13.995
235	"	13.590	1.713	13.760
240	"	13.488	1.725	13.520
245	"	13.221	1.738	13.278
250	"	12.878	1.750	13.020
255	"	12.678	1.763	12.760
260	"	12.580	1.775	12.481
265	"	12.280	1.788	12.196
270	"	11.885	1.800	11.890
275	"	11.781	1.800	11.599
280	"	11.615	1.800	11.320
285	"	11.350	"	

CHAINAGE	LIP LINE L.H.S. OFFSET	ELEVATION	LIP LINE R.H.S. OFFSET	ELEVATION
275	2.747 LT.	11.090	1.800 LT.	11.065
280	"	10.960	"	
285	"	10.820	1.800 LT.	10.810
290	"	10.640	1.813 LT.	10.520
295	"	10.218	1.825 LT.	10.233
300	"	10.178	1.838 LT.	9.940
305	"	9.868	1.850	9.650
310	"	9.478	1.863	9.321
315	"	9.170	1.875	8.957
320	"	8.843	1.888	8.600
325	"	8.348	1.900	8.248
330	"	8.155	"	
335	"	8.027	"	
340	"	7.910	"	

CHAINAGE	LIP LINE L.H.S. OFFSET	ELEVATION	LIP LINE R.H.S. OFFSET	ELEVATION
324.70	2.747 LT.	7.859	1.900 LT.	7.920
325	"	7.678	"	7.600
330	"	7.400	"	7.282
335	"	6.921	"	6.921
340	"	6.879	"	6.519
345	"	6.440	"	6.100
350	"	6.265	"	5.682
355	"	6.059	"	5.270
360	"	5.770	"	4.860
365	"	5.480	"	4.450
370	"	5.302	"	4.038
375	"	5.280	"	3.620
380	"	5.100	"	3.210
385	"	4.990	"	2.800
390	"	4.980	"	2.385
395	"	4.860	"	1.970
400	"	4.722	"	1.555
405	"	4.656	"	1.142
410	"	4.485	"	0.728
415	"	4.358	"	0.315
420	"	4.350	"	
425	"	4.280	"	
430	"	4.252	"	
435	"	4.182	"	
440	"	4.138	"	
445	"	4.060	"	
450	"	3.941	"	
455	"	3.828	"	
460	"	3.758	"	
465	"	3.700	"	

CHAINAGE	LIP LINE L.H.S. OFFSET	ELEVATION	LIP LINE R.H.S. OFFSET	ELEVATION
402.10	2.747 LT	3.649	2.747 LT.	4.500
405	"	3.601	"	4.508
410	"	3.573	"	4.538
415	"	3.524	"	4.558
420	"	3.521	"	4.588
425	"	3.492	"	4.640
430	"	3.455	"	4.720
435	"	3.440	"	4.738
440	"	3.432	"	4.740
445	"	3.432	"	4.763
450	"	3.430	"	4.790
455	"	3.439	"	4.798
460	"	3.450	"	4.800
465	"	3.480	"	4.811
470	"	3.500	"	4.821
475	"	3.520	"	4.829
480	"	3.558	"	
485	"	3.610	"	
490	"	3.685	"	
495	"	3.710	"	
500	"	3.762	"	
505	"	3.800	"	
510	"	3.835	"	
515	"	3.853	"	
520	"	3.891	"	
525	"	3.950	"	
530	"	4.035	"	
535	"	4.112	"	
540	"	4.122	"	
545	"	4.103	"	
550	"	4.258	"	
555	"	4.280	"	
560	"	4.308	"	
565	"	4.350	"	
570	"	4.390	"	
575	"	4.421	"	
580	"	4.435	"	
585	"	4.451	"	
590	"	4.477	"	

NOT TO SCALE

WORKS AS CONSTRUCTED
R. JONES
Senior Engineer Construction North
Date 3-4-82

Suffix	Amendment	Date	E. for D.	C.E. & M.	M.P. & C.	Microfiled
G						
F						
E						
D						
C						
B	AS CONSTRUCTED INFO ADDED	MAY 84				
A	ALTERATION TO KERB LINE 460-575	SEPT 80				

DATE MAINT.	Reference B.M.	P.S.M. 79/151 ON EAST CHR. OF CAMPBELL ST. AND ABBOTSFORD RD. EL. 19.554
	P.S.M. 1.35 ON LEFT CHGE. 158.15	EL. 16.028
	B.M. SCREW IN E. CHR. OF TELECOM N.H. SURROUND	EL. 3.569

CHIEF ENGINEER & MANAGER	MANAGER PLANNING & COORD.	Plotted	J.E.C.	MAR. 77	Field Bk.	5777
Date 8-12-78	Date 23-10-80		J.E.C.	APR. 77	Level Bk.	5777
ENGINEER FOR DESIGN	WORKS ORDER No.		J.E.C.	JUN 78	Registered	202/11/PO 020
Date 8-12-78			T.B.J.	AUG. 78		202/11/PO 020
			R.S.H.			Services File No. 436/12/PO 020

General File No.	436/09/PO 020	BRISBANE CITY COUNCIL DEPARTMENT OF WORKS
Acquisition File No.	202/11/PO 020	ROADWORKS & DRAINAGE
Services File No.	436/12/PO 020	ABBOTSFORD ROAD, MAYNE
		CAMPBELL STREET TO MAYNE RD.
		CH'GE. 280 - 513-568

Appendix H

BCC's Codes

POTENTIAL AND ACTUAL ACID SULPHATE SOILS OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
PO1	Development protects the environmental values and ecological health of receiving waters and does not subject assets to accelerated corrosion.	AO1	Development ensures that: (a) no potential or actual acid sulphate soils are disturbed; or Note—This can be demonstrated through the submission of an acid sulphate soil investigation report with reference to the Potential and actual acid sulphate soils planning scheme policy. (b) the disturbance impacts in an area that hosts potential acid sulphate soils are appropriately managed, if less than 500m³ of soil is disturbed and the watertable is not affected; or Note—This can be demonstrated through the submission of an acid sulphate soil investigation report and a preliminary acid sulphate soil management plan, with reference to the Potential and actual acid sulphate soils planning scheme policy. (c) impacts are appropriately managed if 500m³ or more of soil is disturbed or the watertable in an area that hosts potential or actual acid sulphate soils is affected. Note—This can be demonstrated through the submission of an acid sulphate soil investigation report and a full acid sulphate soil management plan, with reference to the Potential and actual acid sulphate soils planning scheme policy. Using levels of testing commensurate with the level of risk. If the investigation demonstrates that an acid sulphate soil management plan is not required, only an investigation report is required.	An acid sulphate soil investigation report will be prepared by a suitably qualified Geotechnical Engineer in accordance with the Potential and actual acid sulphate soils planning scheme policy. An acid sulphate management plan will also be prepared by a suitably qualified Geotechnical Engineer if required as a result of the outcome of the acid sulphate soil investigation report. These reports will be lodged with the Operational Works Submission.

FLOOD OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes	Performance outcome
Section A—If for self-assessable or assessable development for a <u>dwelling house</u> including a secondary dwelling Note – Development for a <u>dwelling house</u> does not require assessment against any other section of this code.			
PO1	Development involving any habitable or non-habitable part of a <u>dwelling house</u> , including any <u>secondary dwelling</u> , is located and designed to: (a) minimise the risk to people from flood hazard; (b) achieve acceptable flood immunity; (c) minimise property impacts from a flood event up to and including the defined flood event; (d) minimise disruption to residents, recovery time and rebuilding or restoration costs after a flood event up to and including the defined flood event.	AO1.1	Development for a <u>dwelling house</u> including any <u>secondary dwelling</u> : (a) is not located in the Brisbane River flood planning area 1, 2a or 2b sub-categories or the Creek/waterway flood planning area 1 or 2 subcategories; or (b) is only located in these sub-categories, if a <u>Registered Professional Engineer Queensland</u> certifies that the <u>dwelling house</u> and any <u>secondary dwelling</u> are structurally designed to be able to resist hydrostatic and hydrodynamic loads associated with flooding up to and including the defined flood event.
		AO1.2	Development for a <u>dwelling house</u> and any <u>secondary dwelling</u> complies with the minimum flood planning levels in <u>Table 8.2.11.3.B</u> . Note—If located in an area that has no flood level information available from the Council such as an overland flow path, a <u>Registered Professional Engineer of Queensland</u> with expertise in undertaking flood studies is to certify that the flood level and development levels for the dwelling house and any secondary dwelling achieve the required flood planning levels in <u>Table 8.2.11.3.B</u> .
AO1.1, AO1.2, AO1.3 & AO2 are not applicable to this development.			

FLOOD OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
		AO1.3	Development involving a building undercroft complies with the minimum clearance requirements in Table 8.2.11.3.E. Editor's note—For creek/waterway, storm-tide and river flooding, applicable flood planning information is available from Council's FloodWise Property Report. Note—The Flood planning scheme policy provides guidance on undercroft design.	
PO2	Development within the Creek/waterway flood planning area sub-categories or Overland flow flood planning area sub-category: (a) maintains the conveyance of flood waters to allow them to pass predominantly unimpeded through the site; (b) does not concentrate, intensify or divert floodwater onto upstream, downstream or adjacent properties; (c) will not result in a material increase in flood levels or flood hazard on upstream, downstream or adjacent properties	AO2	Development: (a) is not located within the Creek/waterway flood planning area 1, 2 or 3 sub-categories or the Overland flow flood planning area sub-category; or (b) provides an open undercroft area from natural ground level to habitable floor level for any area inundated by the defined flood event; or Note—This undercroft area is not suitable for providing non-habitable rooms, secure storage of valuables, or future enclosing for storage or car parking. The clear area may include structural elements such as columns and floor substructure. The Flood planning scheme policy provides guidance on undercroft design. Editor's note—An open undercroft design may be achieved through a 'valance' treatment around the perimeter of an otherwise internally clear undercroft. Editor's note—For Creek/waterway, storm-tide and river flooding, applicable flood planning information is available from Council's FloodWise Property Report. (c) a report from a Registered Professional Engineer Queensland certifies that the development in the	

FLOOD OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
			Creek/waterway flood planning area or Overland flow flood planning area sub-categories will not result in a material increase in flood level or flood hazard on upstream, downstream or adjacent properties. Note—Flood studies demonstrate that the development and engineering design methods conform to the principles within the <u>Flood planning scheme policy</u> and the <u>Infrastructure design planning scheme policy</u>.	
Section B—If for self-assessable or assessable development other than for a dwelling house or reconfiguring a lot. Note – If self-assessable development complies with the acceptable outcomes of this part, no further assessment against this code is required.				
PO3	Development: (a) is compatible with flood hazard in a <u>defined flood event</u>; (b) minimises the risk to people from flood hazard; (c) does not reduce the ability of evacuation resources including <u>emergency services</u> to access and evacuate the site in a flood emergency, with consideration to the scale of the development; (d) minimises impacts on property from flooding; (e) minimises disruption to residents, business or site operations and recovery time due to flooding; (f) minimises the need to rebuild structures after a flood event greater than the defined flood event. Note—Where <u>Table 8.2.11.3.C</u> identifies that a flood risk assessment is required, compliance with this performance outcome can be achieved by submitting a flood risk assessment, which may be included within a flood study, addressing the criteria within this performance solution.	AO3	Development for a material change of use complies with <u>Table 8.2.11.3.C</u>.	Complies with AO3.

FLOOD OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
	Preparing flood risk assessments and flood studies is required to be in accordance with the <u>Flood planning scheme policy</u> . Note—An emergency management plan prepared in accordance with the <u>Flood planning scheme policy</u> , which sets out procedures for evacuation due to flooding may be used to demonstrate compliance with this performance outcome.			
PO4	Development for a <u>park</u> ensures that the design of a park and location of structures and facilities responds to the flood hazard and balances the safety of intended users with: (a) maintaining continuity of operations; (b) impacts of flooding on asset life and ongoing maintenance costs; (c) efficient recovery after flood events; (d) recreational benefits to the city; (e) availability of suitable land within the <u>park</u> .	AO4.1	Development involving a building or structure in a <u>park</u> complies with the flood planning levels specified in <u>Table 8.2.11.3.D</u> .	Not applicable to this development.
		AO4.2	Development involving a building or structure where <u>Table 8.2.11.3.D</u> does not apply: (a) is not located within the 20% <u>AEP</u> flood extent of any creek/waterway or overland flow path; or (b) is located above the 20% AEP flood level of any creek/waterway or overland flow path.	Not applicable to this development.
Section C—If assessable development other than for a <u>dwelling house</u>				
PO5	Development is located and designed to: (a) minimise the risk to people from flood hazard on the site; (b) minimise flood damage to the development and contents of buildings up to the <u>defined flood event</u> ; (c) provide suitable amenity; (d) minimise disruption to residents, recovery time and the need to rebuild structures after a flood event up to and including the defined flood event.	AO5.1	Development complies with the flood planning levels specified in <u>Table 8.2.11.3.D</u> . Note—If located in an area with no Council-derived flood levels such as an overland flow path, a <u>Registered Professional Engineer Queensland</u> with expertise in undertaking flood studies is to derive the applicable flood level and certify that the development meets the required flood planning levels in <u>Table 8.2.11.3.D</u> . The study is to demonstrate that the development and engineering design methods conform to the principles within the <u>Flood planning scheme</u>	Complies with AO5.1. Refer to the SBSMP. Further details will be lodged with the Operational Works Submission.

FLOOD OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
			policy and the <u>Infrastructure design planning scheme policy</u> .	
		A05.2	Development is: (a) not located in the: (i) Brisbane River flood planning area 1, 2a, or 2b sub-categories; (ii) Creek/waterway flood planning area 1 or 2 sub-categories; (iii) Overland flow flood planning area sub-category; or (b) only located in these sub-categories if a <u>Registered Professional Engineer Queensland</u> with expertise in undertaking flood studies certifies that: (i) the development design, siting and any mitigation measures will ensure the development is structurally adequate to resist hydrostatic, hydrodynamic and debris impact loads associated with flooding up to the defined flood event; and (ii) the risk to people is managed to an acceptable level.	Complies with AO5.2.
PO6	Development involving essential electrical services or a <u>basement</u> storage area is suitably located and designed to ensure public safety and minimise flood recovery and economic consequences of damage during a flood.	AO6.1	Development ensures that: (a) all areas containing essential electrical services comply with the flood planning levels in <u>Table 8.2.11.3.D</u>; or (b) if a <u>basement</u> contains essential electrical services or a private basement storage area, the basement is a waterproof structure with walls and floors impermeable to the passage of water with all entry points and	Complies with AO6.1. Further details will be provided in the electrical consultant's documentation to be lodged with the Building Application Submission.

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Performance outcomes		Acceptable outcomes		Performance outcome
			services located at or above the relevant flood planning level in <u>Table 8.2.11.3.D</u> . Note—A <u>basement</u> storage area does not include a bike storage room, change room, building maintenance storage and non-critical electrical services.	
		AO6.2	Development involving a <u>basement</u> that relies on a pumping solution to manage floodwater ingress or for dewatering after a flood provides a redundant pump system with a backup power source for those pumps.	Complies with AO6.2. The access to the basement will be designed such that the access point is above the required flood level.
PO7	Development does not directly or indirectly create a material adverse impact on flood behaviour or drainage on properties that are upstream, downstream or adjacent to the development.	AO7.1	Development: (a) does not block, or divert floodwaters for any area affected by creek/waterway or overland flow flooding, excluding storm-tide flooding and Brisbane River flooding sources; or (b) does not result in a material increase in flood level or hydraulic hazard on upstream, downstream or adjacent properties. Note—Compliance with this acceptable solution can be demonstrated by the submission of a flood study by a <u>Registered Professional Engineer of Queensland</u> with expertise in undertaking flood studies demonstrating that the development and engineering design methods conform to the principles within the <u>Flood planning scheme policy</u> and the <u>Infrastructure design planning scheme policy</u> .	Complies with AO7.1. Refer to the SBSMP.

FLOOD OVERLAY CODE

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Performance outcomes		Acceptable outcomes		Performance outcome
		AO7.2	Development retains existing overland flow paths and does not rely wholly on piped solutions to manage major flows.	Acceptable solution provided. There is no existing overland flow path has been identified for the site. The proposed building will cover the full extent of the site therefore minor and major stormwater flows from the site will be collected by piped system.
		AO7.3	Development which creates a new overland flow path or significantly modifies an existing overland flow path via earthworks does not materially worsen hydraulic hazard on the site from existing conditions. Note—Compliance with this acceptable solution can be demonstrated by the submission of a flood study by a <u>Registered Professional Engineer of Queensland</u> with expertise in undertaking flood studies demonstrating that the development and engineering design methods conform to the principles within the <u>Flood planning scheme policy</u> and the <u>Infrastructure design planning scheme policy</u> .	Not applicable to this development. Existing site has been fully developed with buildings occupying the entire site.

FLOOD OVERLAY CODE

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Performance outcomes		Acceptable outcomes		Performance outcome
PO8	Development for <u>filling or excavation</u> in an area affected by creek/waterway flooding does not directly, indirectly or cumulatively cause any material increase in flooding or hydraulic hazard or involve significant redistribution of flood storage from high to lower areas in the floodplain. Note—This can be demonstrated by undertaking earthworks in compliance with the <u>Compensatory earthworks planning scheme policy</u>. Note—This part of the code applies to all development other than a <u>dwelling house</u> and any <u>secondary dwelling</u> which involves <u>filling or excavation</u>, whether or not the development application comprises a separate development application for operational work involving filling or excavation.	AO8	Development ensures that no <u>filling or excavation</u> greater than 100mm is located in the Creek/waterway flood planning area 1, 2 or 3 subcategories if contained in the 5% <u>AEP</u> flood extent of any Creek/waterway flood planning area subcategory for which no waterway corridor has been mapped in the <u>Waterway corridors overlay</u>.	Not applicable to this development. The development is not affected by any creek/waterway other than the Brisbane River. The development site does not fall within creek/waterway flood planning area.
PO9	Development ensures that the building and site design: (a) maintains the conveyance capacity of existing overland flow paths and creek/waterways; (b) ensures floodwaters and flood debris can pass predominantly unimpeded under a structure or building to minimise property or building damage, including for a flood larger than the <u>defined flood event</u>; (c) mitigates flood impacts by ensuring that filling, excavation and location of services are designed to allow for the conveyance of floodwater across the site. Note—The <u>Flood planning scheme policy</u> provides guidance on relevant considerations in determining minimum undercroft clearances and treatment of ground level in undercroft areas where floodwater conveyance is required underneath development.	AO9.1	Development involving a building undercroft in the Creek/waterway flood planning area sub-categories or the Overland flow flood planning area subcategory: (a) complies with the minimum building undercroft clearance requirements in <u>Table 8.2.11.3.E</u>; (b) not located directly above any part of a waterway corridor as mapped in the <u>Waterway corridors overlay</u>.	Not applicable to this development.
		AO9.2	Development involving a building undercroft in the Creek/waterway flood planning area sub-categories or the Overland flow flood planning area sub category: (a) has a ground level within the undercroft area is free draining; (b) does not involve excavation below ground level of more than 300mm within the undercroft area.	Not applicable to this development.

FLOOD OVERLAY CODE

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Performance outcomes		Acceptable outcomes	Performance outcome
PO10	Development for <u>vulnerable uses</u>, <u>difficult to evacuate uses</u> or <u>assembly uses</u> optimises vehicular access and efficient evacuation from the development to parts of the road network unaffected by flood hazard, in order to: (a) protect safety of users and <u>emergency services</u> personnel; (b) support efficient emergency services access and site evacuation with consideration to the scale of development. Note—A flood risk assessment may be required to address the performance outcomes or acceptable solutions which deal with evacuation and isolation arrangements, and the ability to take refuge. The <u>Flood planning scheme policy</u> provides information for undertaking flood risk assessments.	AO10 Development for <u>vulnerable uses</u>, <u>difficult to evacuate uses</u> or <u>assembly uses</u>: (a) is not isolated in any event up to the relevant flood planning level specified in <u>Table 8.2.11.3.L</u>; or (b) has direct vehicle access to a critical route or interim critical route in the <u>Critical infrastructure and movement network overlay</u> for evacuation in a flood; or (c) can achieve vehicular evacuation to a suitable flood-free location. Note—A suitable flood-free <u>location</u> is of a size and nature sufficient to provide for the size and characteristics of the population likely to need evacuation to that area..	Not applicable to this development.
PO11	Development has access which, having regard to hydraulic hazard provides for safe vehicular and pedestrian movement and emergency services access to adjoining roads.	AO11.1 Development provides an access or driveway into the site which is: (a) trafficable during the defined flood event; (b) not located in the Creek/waterway flood planning area 1 sub-category; (c) not located in the Overland flow flood planning area sub-category if the hydraulic hazard is unsafe in the <u>defined flood event</u>; (d) the access or driveway is not inundated by a 10% <u>AEP</u> flood.	Complies with AO11.1.
		AO11.2 Development located in the Creek/waterway flood planning area 1, 2, 3 or 4 sub-categories locates any disabled access in the highest part of the site. Note—explanation of hydraulic hazard provided in the <u>Flood planning scheme policy</u>.	Not applicable to this development. The development is not affected by any creek/waterway other

FLOOD OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
				than the Brisbane River.
PO12	Development involving a new road, a bridge or culvert is designed to minimise impacts to flood behaviour, minimise disruption to traffic during a flood and allow for emergency access.	AO12	Development involving a new road complies with the flood planning levels in Table 8.2.11.3.F .	Not applicable to this development.
PO13	Development for pedestrian and cyclist paths: (a) provides a suitable level of trafficability; (b) manages the impacts of flooding on asset life and ongoing maintenance costs; (c) balances route availability with recreational and transport connectivity benefits to the city.	AO13.1	Development for cyclist and pedestrian facilities other than on public roads, including those traversing through a park and adjacent to a watercourse and overland flow path, are located above the 39% AEP (2 year ARI) flood immunity from all flooding sources. Note—If the site is subject to more than one type of flooding, the requirement that affords the greatest level of protection will apply.	Complies with AO13.2.
		AO13.2	All new on-road cyclist and pedestrian facilities comply with the flood planning levels and trafficability standards for the applicable category of road in Table 8.2.11.3.F or Table 8.2.11.3.K .	Not applicable to this development.
PO14	Development which increases the residential population within the Brisbane River flood planning area sub-categories minimises the risk to people in all flood events with consideration to flood hazard, including warning time.	AO14	Development in the Brisbane River flood planning area sub-categories in areas where the residential flood level is greater than 12.8m AHD involving: (a) an increase in the number of residential dwellings; or (b) additional residential lots; or (c) is not subject to an unsafe hydraulic hazard in the 0.2% AEP flood event. Note—Explanation of a hydraulic hazard is provided in the Flood planning scheme policy .	Not applicable to this development.

FLOOD OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
Additional criteria for <u>essential community infrastructure</u>				
P015	Development involving <u>essential community infrastructure</u> : (a) remains functional to serve community need during and immediately after a flood event, or is part of a network that is able to maintain the function of the essential community infrastructure when parts of the development are unable to function during or after a flood; (b) is designed, sited and operated to avoid adverse impacts on the community or the environment due to the impacts of flooding on infrastructure, facilities or access and egress routes; (c) is able to remain functional or is part of a network which is able to remain functional even when other infrastructure or services (such as electricity supply) may be compromised in a flood event; (d) contains mitigation measures which are not entirely dependent on human activation to respond to a flood event. Note—Protection of function is required up to and including the flood event in <u>Table 8.2.11.3.G</u> .	A015	Development involving <u>essential community infrastructure</u> : (a) is ancillary to and not relied upon for the provision of the essential service during a flood; or (b) is located above the flood planning levels in <u>Table 8.2.11.3.G</u> ; (c) has access to or provides the necessary backup emergency electricity and communications supply in times of flood; (d) is designed and constructed to resist hydrostatic and hydrodynamic forces as a result of inundation by the flood event listed for the development type in <u>Table 8.2.11.3.G</u> ; (e) that services a local area: (i) is able to be accessed in times of flood to service local community needs up to the event listed for that development type in <u>Table 8.2.11.3.G</u> ; or (ii) has a service continuity plan that demonstrates the continued provision of service during the relevant flood event.	Not applicable to this development.
P016	Development involving the storage and handling of <u>hazardous materials</u> avoids or minimises risks to public health and safety and the environment, by: (a) protecting underground tanks for hazardous materials against the forces of buoyancy, velocity flow and debris impacts; (b) securing above-ground tanks for hazardous materials against flotation and lateral movement; (c) preventing damage to hazardous materials pipework or	A016	(a) Development does not include the storage or handling of hazardous chemicals that are equivalent to or exceed the threshold quantities in <u>Table 8.2.11.3.M</u> . (b) Development involving the processes listed in <u>Table 8.2.11.3.H</u> : (i) where located in the Flood overlay area, occurs only in the Creek/waterway flood planning area 5 sub-category or the Brisbane River flood	Not applicable to this development.

FLOOD OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
	entry of floodwater into hazardous materials pipework; (d) preventing damage to or off-site release of packages, drums or containers storing hazardous materials. Note—A chemical hazards flood risk report prepared in accordance with the <u>Management of hazardous chemicals in flood prone areas planning scheme policy</u> can assist in demonstrating achievement of this performance outcome.		planning area 5 subcategory; or (ii) is consistent with the standards contained in the <u>Management of hazardous chemicals in flood prone areas planning scheme policy</u> and can operate without risk of environmental harm during a flood event. Note—The <u>Management of hazardous chemicals in flood prone areas planning scheme policy</u> sets out further information and processes including risk assessment for the management of hazardous chemicals in flood planning areas.	
P017	Development locates and designs all lots resulting from reconfiguring a lot to: (a) minimise the risk to people from flood hazard; (b) minimise damage to property from flood hazard; (c) facilitate safe and efficient evacuation. Note— • Consideration of all floods up to the probably maximum flood is relevant to minimising the risk to people. • Flood warning time is not considered sufficient in the Creek/waterway planning area sub-categories or the Overland flow flood planning area subcategory. • Filling above the flood planning level for a flood event greater than the defined flood event cannot be assumed to mitigate the flood hazard.	A017.1	Development creating new lots is to comply with <u>Table 8.2.11.3.I.</u>	Not applicable to this development.
		A017.2	Development provides for reconfiguring a lot design that achieves a road and lot layout which: (a) provides trafficable vehicular egress for evacuation during a <u>defined flood event</u>; (b) optimises hazard-free movement away from sources of flood hazard within the development. Note—Further advice on road and lot layout is contained in the <u>Flood planning scheme policy</u>.	Not applicable to this development.
		A017.3	Development which creates a new residential lot in an area subject to Brisbane River flooding, if the residential flood level is greater than 12.8m AHD is not subject to a hydraulic hazard greater than 0.6m²/s DV or 0.6m deep in a 0.2% AEP flood. Note—Refer to the <u>Flood planning scheme policy</u> for further explanation on the 0.2% AEP flood.	Not applicable to this development.

FLOOD OVERLAY CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
P018	Development involving reconfiguring a lot: (a) minimises the risk to people from flood hazard; (b) creates safe evacuation routes or avoids isolation of the development during a flood greater than the defined flood event; (c) minimises damage to property and services; (d) provides lots and roads that are not frequently flooded or subject to nuisance ponding or seepage; (e) ensures lots created for park or private open space minimise the risk to people from flood hazard and are fit for purpose; (f) provides a lot that is not substantially burdened by flood mitigation infrastructure.	A018.1	Development involving reconfiguring a lot ensures: (a) all lots comply with the flood planning levels in Table 8.2.11.3.J; (b) a new road complies with the flood planning levels in Table 8.2.11.3.F.	Not applicable to this development.
		A018.2	Development involving reconfiguring a lot creating more than 6 residential lots or a lot for industry ensures the flood planning levels of a dedicated road fronting the development or providing primary access within 200m of the development: (a) complies with Table 8.2.11.3.K; or (b) has acceptable trafficability in accordance with the requirements in the Flood planning scheme policy and the Queensland Urban Drainage Manual. Note—The Flood planning scheme policy contains supporting information about trafficability on existing roads and serviceability during floods.	Not applicable to this development.
		A018.3	Development protects the conveyance of flood hazard area by providing an easement over the: (a) 2% AEP flood extent for overland flow flooding; (b) 1% AEP flood extent for creek/waterway flooding.	Not applicable to this development.

FILLING AND EXCAVATING CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
PO1	Development for filling or excavation minimises visual impacts from retaining walls and earthworks.	AO1	Development ensures that the total height of any cut and fill, whether or not retained, does not exceed: (a) 2.5m in a zone in the Industry zones category; (b) 1m in all other zones, or if adjoining a sensitive zone.	Acceptable solution provided: The proposed development will have more than 1m of cut. The excavation is to create a basement that will not have any visual impacts. The design of basement retaining walls will be lodged with the building application.
PO2	Development of a retaining wall proposed as a result of filling or excavation : (a) is designed and constructed to be fit for purpose; (b) does not impact adversely on significant vegetation; (c) is capable of easy maintenance. Editor's note—A retaining wall also needs to comply with the Building Regulation and embankment gradients will need to comply with the Building Regulation .	AO2.1	Development of a retaining structure, including footings, surface drainage and subsoil drainage: (a) is wholly contained within the site; (b) if the total height to be retained is greater than 1m, then: (i) the retaining wall at the property boundary is no greater than 1m above the ground level; (ii) all further terracing from the 1m high boundary retaining wall is 1 vertical unit:1 horizontal unit; (iii) the distance between each successive retaining wall (back of lower wall to face of higher wall) is no less than 1m horizontally to incorporate planting areas.	Complies with AO2.1: Any retaining walls will be designed and constructed in accordance with Council requirements and the code.
	Note—Guidance on the protection of native vegetation is included in the Biodiversity areas planning scheme policy .	AO2.2	Development of a retaining wall over 1m in height protects significant vegetation on the site and on adjoining land and is designed and constructed in accordance with the structures standards in the Infrastructure design planning scheme policy and certified by a Registered Professional Engineer Queensland .	Complies with AO2.2: Refer AO2.1

FILLING AND EXCAVATING CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
		AO2.3	Development provides a retaining wall finish that presents to adjoining land that is maintenance free if the setback is less than 750mm from the boundary.	Complies with AO2.3: Refer AO2.1
		AO2.4	Development for filling only uses clean fill that does not include any construction rubble or debris.	Complies with AO2.4.
PO3	Development ensures that a rock anchor is designed and constructed to be fit for purpose.	AO3	Development ensures that a rock anchor: (a) is constructed in accordance with the standards in the Infrastructure design planning scheme policy; (b) where it extends beyond the property boundary, is supported by a letter of consent from the adjoining land and building owners.	Complies with AO3: If any rock anchors are proposed, they will be designed and constructed in accordance with Council requirements and the code. The design of basement retaining walls including any rock anchors will be lodged with the operational works application.
PO4	Development protects all services and public utilities.	AO4	Development protects services and public utilities and ensures that any alteration or relocation of services or public utilities meets the standard design specifications of the responsible service authorities.	Complies with AO4: Proposed relocation to the existing council's stormwater infrastructure will be done in accordance with the relevant BCC standard specifications. Should any other relocation works associated with proposed services and/or public utilities be required, the works will be done in accordance with the relevant BCC standard specifications and the requirements of the responsible service authorities.

FILLING AND EXCAVATING CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
PO5	Development provides surface and sub-surface drainage to prevent water seepage, concentration of run-off or ponding of stormwater on adjacent land.	AO5	Development ensures all flows and subsoil drainage are directed to a lawful point of discharge of a surface water diversion drain, including to the top or toe of a retaining wall in accordance with the stormwater drainage section of the Infrastructure design planning scheme policy	Complies with AO5: Refer to SBSMP. The proposed development will have building extended to the site boundary. Stormwater runoff from the proposed development will be collected internal via piped drainage system which will be designed by hydraulic consultants and further details will be lodged with the building approval application.
PO6	Development ensures that the design and construction of all open drainage works is undertaken in accordance with natural channel design principles, being the development of a stormwater conveyance system for major flows, by using a vegetated open channel or drain that approximates the features and functions of a natural waterway to enhance or improve riparian values of those stormwater conveyance systems. Editor's note—Guidance on natural channel design principles can be found in the Council's publication Natural channel design guidelines .	AO6	No acceptable outcome is prescribed.	Not applicable to this project.
PO7	Development for filling or excavation : (a) does not degrade water quality or adversely affect environmental values in receiving waters;	AO7.1	Development for filling or excavation provides water quality treatment that complies with the stormwater drainage section of the Infrastructure design planning scheme policy .	Complies with AO7.1: An erosion and sediment control program and sketch have been prepared as part of the SBSMP which

FILLING AND EXCAVATING CODE

BRISBANE CITY COUNCIL 2014

Performance outcomes		Acceptable outcomes		Performance outcome
	(b) ensures site sediment and erosion control standards are best practice.			comply with the Infrastructure design planning scheme policy. Further details will be lodged with the operational works submission.
		AO7.2	Development provides erosion and sediment control standards that are in accordance with the stormwater drainage section of the Infrastructure design planning scheme policy .	Complies with AO7.2: Refer AO7.1. Further details will be lodged with the operational works submission.
PO8	Development for filling or excavation is conducted such that adverse impacts at a sensitive use due to noise and dust are prevented or minimised. Note—A noise and dust impact management plan prepared in accordance with the Management plans planning scheme policy can assist in demonstrating achievement of this performance outcome.	AO8.1	Development ensures that no dust emissions extend beyond the boundary of the site, including dust from construction vehicles entering and leaving the site.	Complies with AO8.1: A dust impact management plan will be prepared as part of the construction management plan to be lodged by contractor prior to the commencement of works.
		AO8.2	Development for filling or excavation activity only occurs between the hours of 6:30am and 6:30pm Monday to Saturday, excluding public holidays.	Complies with AO8.2: Times of operation will be limited to the hours of 6:30am and 6:30pm Monday to Saturday, excluding public holidays.

FILLING AND EXCAVATING CODE

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Performance outcomes		Acceptable outcomes		Performance outcome
PO9	Development ensures that vibration generated by the filling or excavation operation does not exceed the vibration criteria in Table 9.4.3.3.D , Table 9.4.3.3.E , Table 9.4.3.3.F and Table 9.4.3.3.G . Note—A noise management report prepared in accordance with the Noise impact assessment planning scheme policy can assist in demonstrating achievement of this performance outcome.	AO9	Development involving filling or excavation does not cause a ground-borne vibration beyond the boundary of the site.	AO9 can be complied: A vibration management report will be provided as part of the construction management plan to be lodged by the contractor prior to the commencement of works.
PO10	Development ensures that heavy trucks hauling material to and from the site do not affect the amenity of established areas and limits environmental nuisance impact on adjacent land.	AO10	Development ensures that heavy trucks hauling material to and from the site: (a) occur for a maximum of 3 weeks; (b) use a major road to access the site; (c) only use a minor road for the shortest-most-direct route that has the least amount of environmental nuisance if there is no major road alternative.	AO10 can be complied with: Excavation works may take longer than 3 weeks to complete. A construction management plan will be developed and lodged by the contractor prior to the commencement of works.
PO11	Development for filling or excavation protects the environment and community health and wellbeing from exposure to contaminated land and contaminated material.	AO11	Development does not involve: (a) excavation on land previously occupied by a notifiable activity or on land listed on the Environmental Management Register or the Contaminated Land Register ; (b) filling with material containing a contaminant.	Acceptable solution provided: The proposed development involves excavation on land which may be listed on the Environmental Management or Contaminated Land Registers. This will be confirmed prior to lodgement of the operational works submission. If the land is on these registers, the works will be done in accordance with DSDIP's requirements.

FILLING AND EXCAVATING CODE

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Performance outcomes		Acceptable outcomes		Performance outcome
PO12	Development provides for: (a) landscaping for water conservation purposes; (b) water sensitive urban design measures which are employed within the landscape design to maximise stormwater use and to reduce any adverse impacts on the landscape; (c) stormwater harvesting to be maximised and any adverse impacts of stormwater minimised.	AO12.1	Development provides landscaping which is designed using the standards in the Landscape design guidelines for water conservation planning scheme policy .	Acceptable solution provided: Landscaping is to be designed in accordance with the landscape design guidelines for water conservation planning scheme policy where applicable. Refer to landscape architect's documentation for details.
		AO12.2	Development ensures that the design and requirements for irrigation are in compliance with the standards in the Landscape design guidelines for water conservation planning scheme policy .	Acceptable solution provided: Design and requirements for irrigation will be done in accordance with the landscape design guidelines for water conservation planning scheme policy. Refer to landscape architect's documentation for details.
		AO12.3	Development provides areas of pavement, turf and mulched garden beds which are drained. Note—This may be achieved through the provision and/or treatment of swales, spoon drains, field gullies, sub-surface drainage and stormwater connections.	Complies with AO12.3: Refer to SBSMP for the surface stormwater management. Further details will be lodged with the building approval submission.

STORMWATER CODE

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Performance outcomes		Acceptable outcomes		Performance outcome
Section A—If for a material change of use, reconfiguring a lot, operational work or building work				
Note—Compliance with the performance outcomes and acceptable outcomes in this section should be demonstrated by the submission of a site-based stormwater management plan for high risk development only.				
PO1	Development provides a stormwater management system which achieves the integrated management of stormwater to: (a) minimise flooding; (b) protect environmental values of receiving waters; (c) maximise the use of water sensitive urban design; (d) minimise safety risk to all persons; (e) maximise the use of natural waterway corridors and natural channel design principles. Editor's note—The stormwater management system to be developed to address PO1 is not intended to require management of stormwater quality.	AO1	Development provides a stormwater management system designed in compliance with the <u>Infrastructure design planning scheme policy</u>	Complies with AO1: Refer to SBSMP. The detailed design of the stormwater management system will be lodged with the operational works submission in compliance with the Infrastructure design planning scheme policy.
PO2	Development ensures that the stormwater management system and site work does not adversely impact flooding or drainage characteristics of premises which are up slope, down slope or adjacent to the site.	AO2.1	Development does not result in an increase in flood level or flood hazard on up slope, down slope or adjacent premises.	Complies with AO2.1: Refer to SBSMP.
		AO2.2	Development provides a stormwater management system which is designed in compliance with the standards in the <u>Infrastructure design planning scheme policy</u> .	Complies with AO2.2: Refer AO1.
PO3	Development ensures that the stormwater management system does not direct stormwater run-off through existing or proposed lots and property where it is likely to adversely affect the safety of, or cause	AO3.1	Development ensures that the location of the stormwater drainage system is contained within a road reserve, drainage reserve, public pathway, park or waterway corridor.	Complies with AO3.1: Refer to SBSMP.

STORMWATER CODE

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Performance outcomes		Acceptable outcomes		Performance outcome
	nuisance to properties.	AO3.2	Development provides a stormwater management system which is designed in compliance with the standards in the <u>Infrastructure design planning scheme policy</u> .	Complies with AO3.2: Refer AO1.
		AO3.3	Development obtains a lawful point of discharge in compliance with the standards in the <u>Infrastructure design planning scheme policy</u>	Complies with AO3.3: Refer AO1.
		AO3.4	Where on private land, all underground stormwater infrastructure is secured by a drainage easement.	Not applicable to this development.
P04	Development provides a stormwater management system which has sufficient capacity to safely convey run-off taking into account increased run-off from impervious surfaces and flooding in local catchments.	AO4.1	Development provides a stormwater conveyance system which is designed to safely convey flows in compliance with the standards in the <u>Infrastructure design planning scheme policy</u> .	Complies with AO4.1: Refer to SBSMP.
		AO4.2	Development provides sufficient area to convey run-off which will comply with the standards in the <u>Infrastructure design planning scheme policy</u> .	Complies with AO4.2: Refer to SBSMP.
P05	Development designs stormwater channels, creek modification works, bridges, culverts and major drains to protect and enhance the value of the waterway corridor or drainage path for fauna movement.	AO5	Development ensures the design of stormwater channels, creek modifications or other infrastructure, permits terrestrial and aquatic fauna movement.	Not applicable to this development.
P06	Development ensures that location and design of stormwater detention and water quality treatment: (a) minimises risk to people and property; (b) provides for safe access and	AO6.1	Development locates stormwater detention and water quality treatment: (a) outside of a waterway corridor; (b) offline to any catchment not contained within the development.	Complies with AO6.1: Refer to SBSMP.

STORMWATER CODE

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Performance outcomes		Acceptable outcomes		Performance outcome
	maintenance; (c) minimises ecological impacts to creeks and waterways.	AO6.2	Development providing for stormwater detention and water quality treatment devices are designed in compliance with the standards in the Infrastructure design planning scheme policy	Complies with AO6.2: Refer to SBSMP.
PO7	Development is designed, including any car parking areas and channel works to: (a) reduce property damage; (b) provide safe access to the site during the defined flood event .	AO7.1	Development (including any ancillary structures and car parking areas) is located above minimum flood immunity levels in Table 9.4.9.3.B , Table 9.4.9.3.C , Table 9.4.9.3.D , Table 9.4.9.3.E and Table 9.4.9.3.F . Note—Compliance with this acceptable outcome can be demonstrated by the submission of a hydraulic and hydrology report identifying flood levels and development design levels (as part of a site-based stormwater management plan).	Complies with AO7.1: Refer to SBSMP.
		AO7.2	Development including the road network provides a stormwater management system that provides safe pedestrian and vehicle access in accordance with the standards in the Infrastructure design planning scheme policy .	Complies with AO7.2: Refer to SBSMP.
PO8	Development designs stormwater channels, creek modification works and the drainage network to protect and enhance the environmental values of the waterway corridor or drainage path.	AO8.1	Development ensures natural waterway corridors and drainage paths are retained.	Not applicable to this development.
		AO8.2	Development provides the required hydraulic conveyance of the drainage channel and floodway, while maximising its potential to maximise environmental benefits and minimise scour. Editor's note—Guidance on natural channel design principles can be found in the Council's publication Natural channel design guidelines	Not applicable to this development.
		AO8.3	Development provides stormwater outlets into waterways, creeks, wetlands and overland flow paths with energy dissipation to minimise scour in compliance with the standards in the Infrastructure design planning scheme policy	Not applicable to this development.

STORMWATER CODE

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Performance outcomes		Acceptable outcomes		Performance outcome
		AO8.4	Development ensures that the design of modifications to the existing design of new stormwater channels, creeks and major drains is in compliance with the standards in the <u>Infrastructure design planning scheme policy</u>	Not applicable to this development.
PO9	Development is designed to manage run-off and peak flows by minimising large areas of impervious material and maximising opportunities for capture and re-use.	AO9	No acceptable outcome is prescribed.	Complies with AO9: The proposed development will not increase peak flows of the site.
PO10	Development ensures that there is sufficient site area to accommodate an effective stormwater management system. Note—Compliance with the performance outcome should be demonstrated by the submission of a site-based stormwater management plan for high-risk development only.	AO10	No acceptable outcome is prescribed.	Complies with AO10: Refer to SBSMP.
PO11	Development provides for the orderly development of stormwater infrastructure within a catchment, having regard to the: (a) existing capacity of stormwater infrastructure within and external to the site, and any planned stormwater infrastructure upgrades; (b) safe management of stormwater discharge from existing and future up-slope development; (c) implication for adjacent and down-slope development.	AO11.1	Development with up-slope external catchment areas provides a drainage connection sized for ultimate catchment conditions that is directed to a lawful point of discharge.	Not applicable to this development.
		AO11.2	Development ensures that existing stormwater infrastructure that is undersized is upgraded in compliance with the <u>Priority infrastructure plan</u> and the standards in the <u>Infrastructure design planning scheme policy</u>	Complies with AO11.2. The proposed development will not increase the peak flows of the site.

STORMWATER CODE

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Performance outcomes		Acceptable outcomes		Performance outcome
PO12	Development provides stormwater infrastructure which: (a) remains fit for purpose for the life of the development and maintains full functionality in the design flood event; (b) can be safely accessed and maintained cost effectively; (c) ensures no structural damage to existing stormwater infrastructure.	AO12.1	The stormwater management system is designed in compliance with the <u>Infrastructure design planning scheme policy</u>	Complies with AO12.1: Refer to SBSMP.
		AO12.2	Development provides a clear area with a minimum of 2m radius from the centre of an existing manhole cover and with a minimum height clearance of 2.5m.	Not applicable to this development.
PO13	Development ensures that all reasonable and practicable measures are taken to manage the impacts of erosion, turbidity and sedimentation, both within and external to the development site from construction activities, including vegetation clearing, earthworks, civil construction, installation of services, rehabilitation, revegetation and landscaping to protect: (a) the environmental values and water quality objectives of waters; (b) waterway hydrology; (c) the maintenance and serviceability of stormwater infrastructure. Note—The <u>Infrastructure design planning scheme policy</u> outlines the appropriate measures to be taken into account to achieve the performance outcome.	AO13	No acceptable outcome is prescribed.	Complies with AO13: The SBSMP provides details of the ESC strategy. A program and sketch have been provided as part of the SBSMP and more detailed plans can be lodged with the operational works submission.
PO14	Development ensures that: (a) unnecessary disturbance to soil, waterways or drainage channels is avoided; (b) all soil surfaces remain effectively	AO14	No acceptable outcome is prescribed.	Complies with AO14: Refer AO13.

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Performance outcomes		Acceptable outcomes		Performance outcome
	stabilised against erosion in the short and long term.			
PO15	Development does not increase: (a) the concentration of total suspended solids or other contaminants in stormwater flows during site construction; (b) run-off which causes erosion either on site or off site.	AO15	No acceptable outcome is prescribed.	Complies with AO15: Refer AO13.

STORMWATER CODE

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Section B—Additional criteria which apply to high-risk development, being one or more of the following:

- (a) a material change of use for an urban purpose which involves greater than 2,500m² of land that:
 - (i) will result in an impervious area greater than 25% of the net developable area; or
 - (ii) will result in 6 or more dwellings.
- (b) reconfiguring a lot for an urban purpose that involves greater than 2,500m² of land and will result in 6 or more lots;
- (c) operational work for an urban purpose which involves disturbing greater than 2,500m² of land.

PO16	Development ensures that the entry and transport of contaminants into stormwater is avoided or minimised to protect receiving water environmental values. Note—Prescribed water contaminants are defined in the Environmental Protection Act 1994. Note—Compliance with the performance outcome should be demonstrated by the submission of a site-based stormwater management plan for high-risk development only.	AO16	Development provides a stormwater management system which is designed in compliance with the standards in the Infrastructure design planning scheme policy.	Complies with AO16: Refer to SBSMP.
PO17	Development ensures that: (a) the discharge of wastewater to a waterway or external to the site is avoided; or (b) if the discharge cannot practicably be avoided, the development minimises wastewater discharge through re-use, recycling, recovery and treatment. Note—The preparation of a wastewater management plan can assist in demonstrating achievement of this performance outcome. Editor's note—This code does not deal with sewerage which is the subject of the Wastewater code.	AO17	No acceptable outcome is prescribed.	Complies with AO17: No wastewater will be discharged into stormwater system.

Appendix I

State Planning Policy July 2014 SPP

Code: Water Quality

State Planning Policy July 2014

SPP Code: Water Quality

Performance Outcomes and Acceptable Solutions
Plan to avoid/ minimise new impacts

Performance Outcomes		Acceptable Outcomes	Proposal Compliance Response
PO1	The development is planned and designed considering the land use constraints of the site for achieving stormwater design objectives.	AO1.1 A site stormwater quality management plan (SQMP) is prepared, and: a) is consistent with any local area stormwater management planning, and b) provides for achievable stormwater quality treatment measures meeting design objectives listed below in Table A (construction phase) and Table B (post construction phase), or current best practice environmental managements, reflecting land use constraints, such as: • erosive, dispersive, sodic and/or saline soil types • landscape features (including landform) • acid sulfate soil and management of nutrients of concern • rainfall erosivity. <i>Editor's note: Local area stormwater management planning may include Urban Stormwater Quality Management Plans, or Catchment or waterway management plans, Healthy Waters Management Plans, Water Quality Improvement Plans, Natural Resource Management Plans.</i>	Complies with AO1.1: The development will be carried out to comply with the design objectives stated in State Planning Policy: Water Quality. Refer to SBSMP for proposed design and implementation of best management practices. A SQMP has been prepared by RBG as part of the SBSMP prepared in accordance with BCC guidelines to support the development application. Design objectives listed in Table A (construction phase) and Table B (post construction phase) can be achieved. Best management practices (BMP's) are incorporated into the stormwater quality treatment train.
PO2	Development does not discharge wastewater to a waterway or off site unless demonstrated to be best	AO2.1 A wastewater management plan (WWMP) is prepared by a suitably qualified person and addresses:	Complies with AO2.1: All waste water generated from the site will be managed in accordance with the Hydraulic Consultants waste water design.

Performance Outcomes	Acceptable Outcomes	Proposal Compliance Response
PO4 Any non-tidal artificial waterway is located in a way that is compatible with existing tidal waterways.	AO4.1 Where a non-tidal artificial waterway is located adjacent to, or is connected to, a tidal waterway by means of a weir, lock, pumping system or similar: a) there is sufficient flushing or a tidal range of >0.3m, or b) any tidal flow alteration does not adversely impact on the tidal waterway, or c) there is no introduction of salt water into freshwater environments.	Complies with AO4.1: Not applicable to this development.

Design to avoid / minimise new impacts

Performance Outcome	Acceptable Outcome	Proposal Compliance Response
PO5 Stormwater does not discharge directly to a non-tidal artificial waterway without treatment to manage stormwater quality management.	AO5.1 Any non-tidal artificial waterway is designed and managed for any of the following end-use purposes: a) amenity including aesthetics, landscaping and recreation, or b) flood management, or c) stormwater harvesting as part of an integrated water cycle management plan, or d) aquatic habitat, and AO5.2 The end-use purpose of any non-tidal artificial waterway is designed and operated in a way that protects water environmental values.	Complies with AO5.1 and AO5.2: Not applicable to this development.

Construct to avoid / minimise new impacts

Performance Outcome		Acceptable Outcome	Proposal Compliance Response
PO6	Construction activities for the development avoid or minimise adverse impacts on stormwater quality.	AO6.1 An erosion and sediment control plan (ESCP) demonstrates that 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 listed below in Table A (construction phase) or local equivalent, for: a) drainage control, and b) erosion control, and c) sediment control, and d) water quality outcomes, and	Complies with AO6.1: An ESC program and sketch have been prepared as part of the SBSMP. Further details will be lodged with the Operational Works Submission.
		AO6.2 Erosion and sediment control practices (including any proprietary erosion and sediment control products) 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 person, or	Complies with AO6.2: Refer AO6.1.
		AO6.2 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 AO6.1.	Complies with AO6.2: Refer AO6.1.

Operate to avoid / minimise new impacts

Performance Outcome		Acceptable Outcome	Proposal Compliance Response
PO7	Operational activities for the development avoid or minimises changes to waterway hydrology from adverse impacts of altered stormwater quality and flow.	AO7.1 Development incorporate stormwater flow control measure to achieve the design objectives set out below in and Table B (post construction phase). The operational phases for the development comply with design objectives in Table B (post construction phase), or current best practice environmental management, including management of frequent flows, and peak flows.	Complies with AO7.1: Stormwater detention is not required for the proposed development. Refer SBSMP for details of stormwater quality management.
PO8	Any treatment and disposal of waste water to a waterway accounts for: - the applicable water quality objectives for the receiving waters, and - adverse impact on ecosystem health or receiving waters, and - in waters mapped as being of high ecological value, the adverse impacts of such releases and their offset.	AO8.1 Implement the WWMP prepared in accordance with AO2.1.	Complies with AO8.1: Refer AO2.1.
PO9	Wastewater discharge to a waterway is managed in a way that maintains ecological processes, riparian vegetation, waterway integrity, and downstream ecosystem health.	AO9.1 Wastewater discharge waterways is managed to avoid or minimize the release of nutrients of concern so as to minimize the occurrence, frequency and intensity of coastal algal blooms, and AO9.2 Development in coastal catchments avoids or minimises and appropriately manages soil disturbance or altering natural hydrology, and	Complies with AO9.1 and AO9.2: Not applicable to this development.

Performance Outcome	Acceptable Outcome	Proposal Compliance Response
PO10 Any non-tidal artificial waterway is managed and operated by suitably qualified persons to achieve water quality objectives in natural waterways.	AO9.3 Development in coastal catchments: a) avoids lowering groundwater levels where potential or actual acid sulphate soils are present, and b) manages wastewaters so that: (i) the pH of any wastewater discharged is maintained between 6.5 and 8.5 to avoid mobilisation of acid, iron, aluminium, and metals, and (ii) holding times of neutralised wastewaters ensures the flocculation and removal of any dissolved iron prior to release, and (iii) visible iron floc is not present in any discharge, and (iv) precipitated iron floc is contained and disposed of, and (v) wastewater and precipitates that cannot be contained and treated for discharge on site are removed and disposed of through trade waste or another lawful method.	Complies with AO9.3: Not applicable to this development.
	AO10.1 Any non-tidal artificial waterway is designed, constructed and managed under the responsibility of a suitably qualified registered professional engineer, Queensland (RPEQ) with specific experience in establishing and managing artificial waterways, and	Complies with AO10.1, AO10.2, AO10.3, AO10.4: Not applicable to this development.
	AO10.2 Monitoring and maintenance programs adaptively manage water quality in any non-tidal artificial waterway to achieve relevant water-quality objectives downstream of the waterway, and	
	AO10.3 Aquatic weeds are managed in any non-tidal artificial waterway to achieve a low percentage of coverage of the water surface area (less than 10%). Pests and vectors (such as mosquitoes) are managed through avoiding stagnant water areas, providing for native fish	

Performance Outcome	Acceptable Outcome	Proposal Compliance Response
	predators, and any other best practices for monitoring and treating pests, and AO10.4 Any non-tidal artificial waterway is managed and operated by a responsible entity under agreement for the life of the waterway. The responsible entity is to implement a deed of agreement for the management and operation of the waterway that: a) identifies the waterway, and b) states a period of responsibility for the entity, and c) states a process for any transfer of responsibility for the waterway, and d) states required actions under the agreement for monitoring the water quality of the waterway and receiving waters, and e) states required actions under the agreement for maintaining the waterway to achieve the outcomes of this code and any relevant conditions of a development approval, and f) identifies funding sources for the above, including bonds, infrastructure charges or levies.	

Appendix J

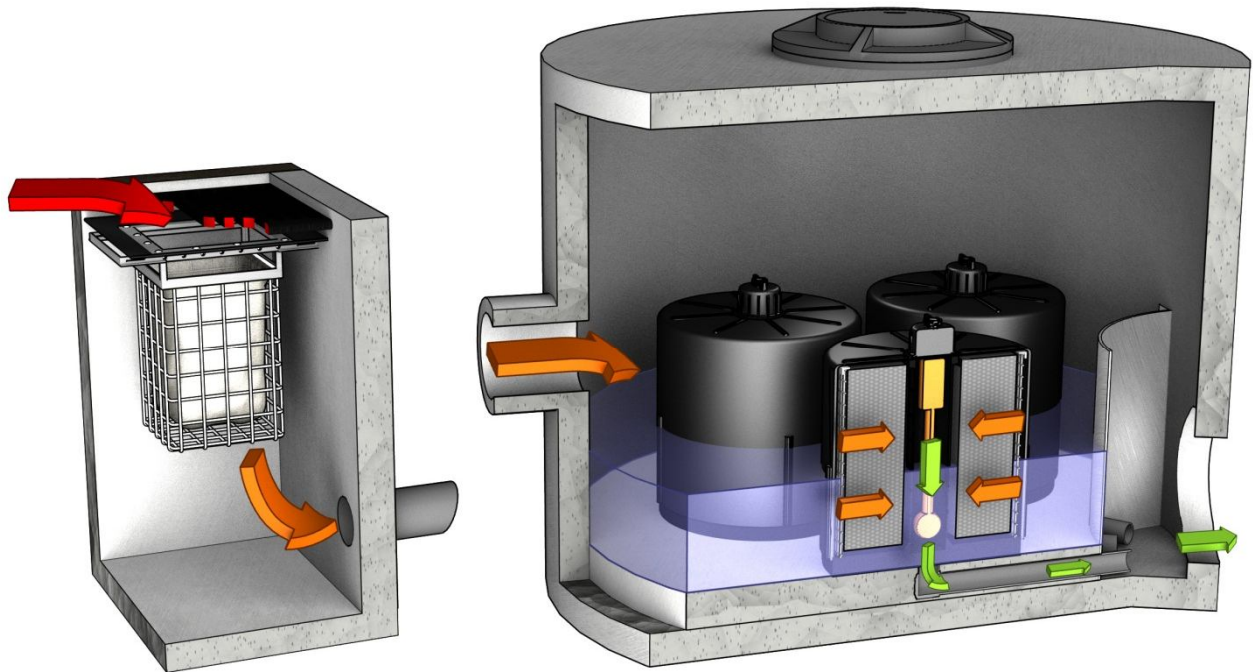
Stormwater 360 Enviropod and Stormfilter Manuals

StormFilter / EnviroPod

SFEP Treatment Train

Operations and Maintenance

For: _____



Note: This guideline should be used as a part of the site stormwater management plan and is to be read in conjunction with the site specific Maintenance Schedule.



Client: _____

Contact: _____ Phone: _____

Engineer: _____

Contact: _____ Phone: _____

Address of Device: _____

Items: SFEP Treatment Train

1		
1		
2		

Frequency of Inspections and Maintenance:

	<i>Inspections (time/year)</i>	<i>Major Maintenance</i>
<i>EnviroPods</i>	2 (and after major storm)	3-4 months
<i>StormFilters</i>	1 (after 25mm rain event)	12 months

Maintenance Estimate Annual Cost:

<i>StormFilters:</i>		
<i>EnviroPods:</i>		

Treatment Train Specifications

Performance Specification

The stormwater filtration treatment train shall consist of ____ x 200 micron gully pit basket/s and ____ x 460/690mm passive, siphon-actuated, radial flow, self cleaning media filtration cartridge system/s operating at a specific flow rate of not more than 1.5L/s/m².

The gully pit basket system shall consist of the following components;

- Removable 200 micron Nylon monofilament Precision woven Filtration Bag;
- Fixed Galvanised Mesh Cage (no greater than 80mm x 80mm) around the Filtration Bag;
- Recycled modified ABS plastic to seal the unit into the pit; and
- By-pass mechanism above the Filter with no moving parts.
- System rigidly fixed to the walls of the pit.

The media filtration system shall be located within the following structure.

- Manhole;
- DownPipe;
- Linear;
- Vault;
- Large Box; and
- Detention.

Regardless of the system type, the media filtration system shall consist of the following components;

- Inlet energy dissipation;
- Cartridge section;
- Outlet section to bypass storm flows and convey treated stormwater;
- Access Lids in roof slab for access to Cartridges;
- Siphon actuated cartridges filled with proprietary ZPG™ filter media;
- Specific flow rate of each individual cartridge limited not to exceed 1.5L/s/m²;
- Air Lock Cap complete with one way Air Valve Flap;
- Outer Hood complete with Scrubbing Regulators;
- Automated high-energy turbulence on the screen face (only) at the end of storm flows to flush pollutants from the cartridge;
- Centre Drainage Tube complete with Buoyancy Float;
- Individual Cartridge Flow Restrictor Disc; and
- ¼ Turn Bayonet Fittings; and
- Under drain manifold to convey treated stormwater to the receiving environment.

The components of any proposed the treatment train or technology, including a gully pit basket upstream of a radial flow cartridge filtration system, must be evaluated for a range of pollutants and these performance expectations must comply with current best practice guidelines, ie Water by Design “MUSIC Modeling Guidelines version 1.0 2010” for South East Queensland. In short, the performance evaluation of any system must show;

- 1. Any reduction efficiencies are justified by rigorous scientific testing as determined by an independent peer reviewer and the results further peer reviewed and published in a credible scientific journal. Any potential or perceived conflicts of interest should be disclosed within the published article.**
- 2. Published article providing insight into the pollutant composition (eg. soluble vs particulate for nitrogen) and the mean concentration of inflow and outflow to compare to local and or regional conditions.**
- 3. Performance evaluation undertaken in dry weather conditions OR a method to take into account any potential leaching of nutrients that may occur in the system(s).**

4. **Evaluation is conducted using full-scale systems with details of treatable flow rates sampled and how they correlate to discrete removal efficiencies and comparisons to the designed treatable flow rates of the device. A comparison should also be made to the climatic conditions especially where un-restricted filters are used.**

Maintenance Overview

The primary purpose of the Stormwater Treatment Train is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the system to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance must be performed in accordance with the Treatment Trains Operation & Maintenance Guidelines.

1. INTRODUCTION

The following report details the recommended methods for cleaning and maintaining the Enviropod Stormwater Gully Pit Insert. The aspects associated with cleaning included in this manual are methods for grate removal, filter bag cleaning, unit inspection, filter bag rejuvenation and the re-installation of the filter bags. This plan should be used in conjunction with the appropriate traffic management plans and site safety plans produced for each project. Other Stormwater360 (IES) documents which IES staff should use in conjunction with this report include the IES Employee Health and Safety Manual. It is recommended that contractors develop their own health and safety plans for activities to ensure that the workers are placed in a safe work environment.



Enviropod filter in service.

Each stormwater treatment device must be inspected and maintained regularly to ensure it is working properly throughout the estimated design life. During each inspection and clean, details of the mass, volume and type of material observed should be recorded to provide ongoing data for future management plan revisions and the optimisation of the maintenance frequency. It is essential that maintenance (including inspections, recording and reporting) be carried out in a systematic manner and is carried out by qualified and experienced personnel. It is also advisable that the treatment device owner has a nominated person responsible for overseeing the management process.

Maintenance is an essential component of stormwater management enabling ongoing at source control of stormwater pollution. Maintenance will also prevent failures such as structural failure (e.g. prevents blocked outlets) or aesthetic failure (e.g. debris accumulation). All stormwater treatment devices require maintenance to ensure the ongoing performance of the system.

This document consists primarily of the processes and tasks associated with the hand maintenance and inductor maintenance procedures. It does not include detail of the traffic management requirements or occupational health and safety requirements. Contractors or IES staff should utilise their own Employee Health and Safety Manual, which details the policies and procedures for safe work.

2. Health and Safety

Cleaning of Enviropod filters and Stormfilters is a specialist activity. Material collected can be harmful if not handled correctly. Sediments may contain heavy metals and carcinogenic substances as well as harmful objects such as broken glass and syringes. It is essential that Occupational Safety and Health guidelines are followed at all times, and that the following steps are carried out to ensure safe and successful maintenance operations.

In addition to the hazards associated with the cleaning handling of material in the filter bags, there also hazards associated with traffic at the work site, the removal of the grate, pedestrians and other non-worker personnel, and general work place hazards associated with working outdoors.

The procedures indicated in the Operations section of this manual are recommend as the safest and most efficient manner in conducting the maintenance of Enviropod Units (Section 3), however contractors and cleaning staff may vary the procedure in response to the site conditions, varying work practices or general preferences in the cleaning techniques. Please note that procedures outlined in this manual are not exhaustive, and that any changes should still comply with general safe work practices.

2.1 Personnel Health and Safety

All contractors and staff shall comply with all current Health and Safety Legislation and take all practicable steps to:

- Comply with all applicable laws, regulations and standards.
- Ensure that all employees, contractors and visitors are informed of and understand their obligations in respect of current Health and Safety Legislation.
- Ensure that employees understand and accept their responsibility to practice and promote a safe and healthy work environment.

All relevant precautions must be taken to prevent contact with sediment and litter when maintaining filters. The following personal protective equipment (PPE) safety equipment should be worn:

- Puncture resistant gloves.
- Steel capped safety boots.
- Fluorescent safety vest.
- Overalls or similar skin protection.
- Safety apron. (if necessary)*
- Eye protection. (if necessary)*

*Higher personal safety conditions may be required when maintaining units that may contain more hazardous material, for example pits where syringes have be observed or pits located in areas associated with such activities.

2.2 Traffic Control

All stormwater collection pits are typically situated either in/on roads and car parks or adjacent to roads in the footpath or swales. Traffic control requirements at each of these locations is typically the same, with most of the state and local road authorities requiring the same controls implemented whether the work is to be conducted on the road or on the road reserve.

As traffic requirements vary based on the road usage and the specific road configuration, traffic control plans should be prepared for each site. Given that maintenance is typically a quick process, the contractor should liaise with the relevant road authority to determine the specific road safety requirements for each location to ensure that on site workers can conduct the cleaning operations safely and efficiently, while complying with all laws and regulations.

NSW RTA working on roads safety manual indicates the signage requirements, placement of barricades or witches hats and the positioning of traffic control personnel. In addition to standard safety requirements IES

recommends that the maintenance vehicle be used to increase safety, through shielding the work area from oncoming traffic.

Plate 1 indicates the vehicle placed to shield the work area with cones placed around the vehicle. Plate 2 indicates at head on view, note the vehicle is positioned to allow access to the drive, whilst still blocking the pit from on-coming traffic. The vehicle has a flashing light on the roof and the hazard lights switched on.



Plate 1 Vehicle positioned near pit, preventing traffic from passing close to the pit.



Plate 1 Head-on view, indicating the placement of the vehicle near the pit.

2.3 Confined Spaces

Confined spaces poses a serious safety hazard for all personnel, however during the normal maintenance procedures there should be no reason to enter a confined space. All maintenance procedures are able to be conducted from the surface. Confined space entry procedures are not included as part of this manual, for IES employees confined space entry procedures are included as part of the IES Safety Manual. It is recommend

that all contractors evaluate their own needs for confined space entry and compliance with Occupation Health and Safety regulations.

When repairs or maintenance activities cannot be conducted from the surface, the contractor/cleaner should evaluate the need to enter the confined space, considering all alternative options. Where there is a need to proceed in a confined space, only staff with current confined space training shall operate in a confined space. Appropriate measures and controls shall be put in place to meet confined space entry requirements. Safety equipment must be worn where deemed necessary and where gas or oxygen hazard occurs, staff trained in its use will only use BA gear. **Non-trained staff must not go into confined spaces.**

3. Operations

This section details the specific activities required to clean the Enviropod units. Please note it has been written for use by someone who has never encountered a stormwater pit or an Enviropod unit, providing a step by step process for each of the cleaning stages.

3.1 Maintenance & Monitoring of Enviropod filters

To ensure that the unit performs optimally, the material collected by the filter bag should be emptied when the level of material is no more than approximately **half to two thirds** of the total bag depth or when there is evidence of material overflow. Although the bag has greater storage area, it is recommended that it is not left to fill completely prior to emptying, for the following reasons; the bags are capable of retaining a heavy mass of material (in excess of 50kg); material near the top of the bag can be resuspended during high to extreme rainfall events; and blockage of the overflow sections can occur, when material is allowed to build up above the filter bag.

It is also recommended that additional monitoring should be conducted following moderate to extreme rainfall events, in particular, when preceding months have had little to no rainfall. This monitoring is considered necessary to accommodate for higher volumes of runoff generated during major rainfall events, an anticipated greater accumulation of surface contamination during low rainfall periods and to ensure that the units have not been damaged due to high pipe velocities.

3.2 Stormwater Pit Cover Removal

3.2.1 Hinged Pit Grates

To open a hinged pit grate follow the following steps:

1. Insert the lifting hooks beneath the grate. (Position indicated in Plate 2)
2. Check hinge point is not damaged and debris is not caught in the hinge area.
3. Note many cast iron hinges are not hinged securely (to enable the removal of the grate). This may result in the pit grate not being able to sit in an open position. Additionally the hinge pins may also be damaged or corroded, which may allow for the pit grate to fall into pit. Such pit grates can be removed using the method indicated below for non-hinged grates.
4. Fully open pit grate, ensuring that the grate will stay in the open position without any external forces applied. Grates which do not remain open without being held should be removed or secured during cleaning or maintenance activities. Plate 3 and Plate 4 indicate the grate being opened and grate resting freely in the open position, respectively.



Plate 2 Lifting the grate



Plate 3 Opening Grate



Plate 4 Fully open grate



Plate 5 Lowering grate

3.2.2 Non-Hinged Pit Grates

To remove a non-hinged pit grate:

1. Place lifting hooks beneath grate, where possible in the four corners of the grate (Plate 6). Concrete lids may have Gatic lifting points, a key arrangement or holes in the lid, as such special equipment, such as Gatic lifters may be required.
2. Position each person either side of the grate. (Plate 7)
3. Lift the grate, ensuring that good heavy lifting posture is used at all times.
4. Place the grate on an angle on the gutter, to allow for the lifting hooks to be removed. (Plate 8)
5. For extremely heavy one piece grates and concrete Gatic covers, insert the lifters in place and slide the lids back. Note some lids may still require two people. (Picture required)



Plate 6 Insert hook near edge of grate



Plate 7 Position each lifter either side of the grate



Plate 8 Lift grate and move grate to one side



Plate 9 Lift grate above the support frame



Plate 10 Reinstated non hinged grate

3.3 Cleaning Methods

One of the following methods of maintenance should be used for the servicing of these Enviropod Filters:

- Hand Maintenance.

3.3.1 Cleaning using Inductor Truck

The following steps indicate a safe and efficient method to clean the Enviropod using an Inductor:

1. Open gully pit. (See Section **Error! Reference source not found.**)
2. Place the inductor hose over the material collected in the filter bag and switch on the inductor.
3. Using the inductor hose suck all of the sediment, organic leaf material, litter etc., collected in the filter bag
4. Allow the filter bag to be sucked up into the inductor hose for a few seconds to allow for the filter mesh pores to be cleaned. Care is to be taken by the operator not to damage the filter, i.e. ensure that there are no sharp edges on the inductor hose.

5. If material has built up around the overflows, use the inductor hose to clear the accumulated material.
6. Remove filter bag from the pit.
7. Sediment retained in the gully pit grate is to be removed.
8. Back opening channels are to be cleared of any debris to ensure flow is not hindered. Debris can be collected using the inductor truck.
9. All gully pit waste is to be removed from the pit.
10. Check the Enviropod unit. (See Section 0)
11. Check filter bag. (See Section 0)
12. Reinstall filter bag and gully pit lids.



Plate 11 Cleaning an Enviropod using the inductor method

Gully pit sediments under no circumstances are to be backwashed into the gully pit.

3.3.2 Hand Maintenance

The following steps indicate a safe and efficient method to clean the Enviropod manually by hand:

1. Open gully pit. (See Section **Error! Reference source not found.**)
2. Place the lifting hooks in the lifting loops of the filter bag. (See Plate 12)
3. For extremely heavy and overfilled bags either use a hydraulic lifting arm to lift the bag, or remove excess material using a shovel or similar piece of equipment. IES prefers the use of a post hole shovel, due to the reduced strain on the back when digging and the ability of the shovel to grab material vertically. (Insert Picture)
4. Lift the bag vertically off the supporting frame, ensuring that no undue pressure is placed on the filter bag. (See Plate 13)
5. Lift the bag clear of the stormwater pit. (See Plate 14)
6. Position the bag over the truck or other collection vehicle, taking hold of the loops at the base of the bag. (See Plate 15 and Plate 16)
7. Lift and empty the filter bag by holding the bottom lifting loops only. (See Plate 17)
8. Completely empty the filter bag. (See Plate 18)
9. Brush the filter bag with a stiff brush to remove bound sediment from the filter pores. (See Plate 19)
10. Check the filter bag. (See Section 0)
11. Check the Enviropod unit. (See Section 0)
12. Reinstall filter bag, ensuring bag is installed the correct way. (See Plate 20 and Plate 21)

13. Reinstate gully pit lids. (See Plate 22 and Plate 23)



Plate 12 Place the lifting hooks through the bag loops



Plate 13 Lift the bag from the cage and support frame



Plate 14 Lift the bag from the stormwater pit



Plate 15 Lift the bag onto the collection vehicle



Plate 16 Grab the bottom lifting loops



Plate 17 Lifting the bottom bag loops empty the filter bag



Plate 18 Completely empty the contents of



Plate 19 Brush the pores filter bag with a

the filter bag



Plate 20 Reinstall filter bag

stiff brush



Plate 21 Ensure that the unit is positioned correctly, with the lifting loops on the inside



Plate 22 Correctly installed filter bag



Plate 23 Installed filter bag and sealed pit

3.4 Unit Inspection

After the Enviropod filter bag is removed, emptied and cleaned, the following should be checked to ensure that the unit has not been damaged:

- All connections and joints should be checked and broken rivets replaced (See Plate 24);
- The plastic pit seals should be inspected for unit movement or damage (See Plate 30); and
- The cage should be inspected for damage or movement (See Plate 31).

The overflow diversion channels, and the area between the Enviropod cage and pit wall should also be inspected for the accumulation of debris. Any observed debris should be removed and disposed of off-site. Accumulated material within the outlet pipe may need to be flushed.

Note: If the units are not cleaned regularly the mobilisation of material collected in the Enviropod unit may occur, as such cleaning of the units in accordance with this management plan is required. As this plan is based on observations and data collected during the monitoring period, ongoing adjustment of the cleaning frequency is generally required to improve the overall efficiency in the removal of collected material and prevent material overflow.



Plate 24 Check seals are pushed against the pit walls

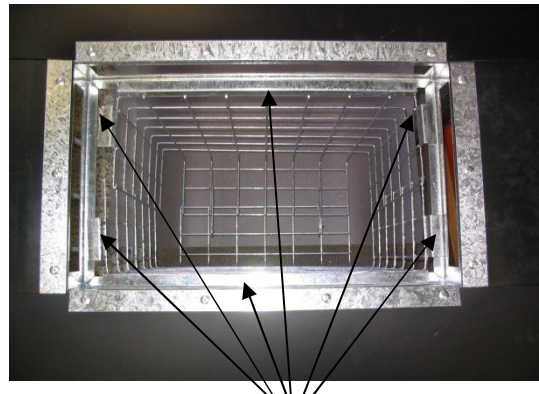


Plate 25 Check joining rivets (two piece unit shown above)

3.5 Filter Bag Inspection and Rejuvenation

Following the emptying and cleaning of the filter bags, the filter bag should be inspected to evaluate the bag condition. Given the nature of stormwater the filter bag from some Enviropod units can become considerably clogged with fine sediment. Filters can also be damaged by various objects in stormwater as well as fauna. Sharp objects such as sticks combined with high velocity water and a large mass in the filter bag can cause small tears in the filter material. Animals such as rats have also been known to chew through fine mesh filter bags located in gully pits near takeaway food outlets.

3.5.1 Clogged Filters

Clogged filter bags can be clean using several different methods. If the bag cleaning techniques described in the general maintenance sections above are not able to clean the filter bags the following options should be considered:

- Using a stiff brush and a bucket of soapy water scrub the filter bag surface.
- Remove filter bags from the pit and wash the bags using a high pressure water spray. Care has to be taken to not transfer the contamination elsewhere. Waste water from the process should be collected of and disposed of correctly.
- Remove the filter bags from the pits and the support rings and wash the bags in an industrial washing machine.

The final option presented above typically results in the bags appearing like new, with no visible stain or pore clogging within the filter mesh.



Plate 26 Slightly clogged filter bag, indicated by the brown stain on in the centre of the bag



Plate 27 A clean used filter bag

3.5.2 Damaged Filters

Damaged filters can often be repaired, provided the damage is small. Small tears in the fabric may occur do to several reasons, however the overall strength & structure of the nylon fabric typically prevents small tears becoming much larger. Although the bag is unlikely to tear further care must be used when clean torn bags as not to spill the collected material into the pit.

Small tears maybe repaired by either sewing the tear back together, with additional fabric to increase the strength of the stitching, or by sewing a patch of the filter material onto the filter bag. The filter bags may need to be replaced if large tears are present, as the filter bag is no longer able to function as intended.

3.6 Disposal of Material

All gully pit wastes from the site are to be taken off site and disposed of at a transfer station or similar approved disposal site. Stormwater Sediments can contain Lead, Copper, Zinc, Mercury, hydrocarbons and PCBs, which are harmful to both humans and the receiving environment. Appropriate sampling and laboratory analysis may be required to classify the material as suitable for reuse, or disposal under appropriate local guidelines.

4. Emergency Procedures

4.1 Spill Procedures

In the event of a spill discharging into any gully pit all sediment is to be extracted and the filter bags are to be removed and replaced with rejuvenated filter bags. Normal operation procedures apply to additional cleaning as a result of spills.

4.2 Blockages

In the unlikely event of surface flooding around a gully pit fitted with an Enviropod the following steps should be carried out:

Check Enviropod over flow bypass. The Enviropod filter has been designed with an overflow mechanism built into the filter box. If surface flooding still exists check the overflow slots underneath the rubber seal. If debris is lodged in the overflow slots these can be easily cleared by hand or steel rod.

If overflow is clear and surface flooding still exists remove Enviropod and check outlet pipe for blockages.

Removal of the Enviropod may be difficult if the filter is clogged and the Enviropod is holding water. If the filter is clogged, brush the side walls of the filter with a yard broom or similar. This will dislodge particles trapped at the interface allowing contained water to flow through the filter.

If the outlet pipe is blocked, it is likely that a gully sucker truck will be required to unblock it. Debris should be removed from the Enviropod with the gully sucker truck before removal of the Enviropod filter.

If a gully sucker truck is not available and the Enviropod needs to be removed by hand, follow the steps below:

- Remove excess debris by hand or brush the side of the filter.
- Lift and place filter ring through the filter box and into cage.
- Remove Filter box.
- Lift cage containing filter bag and ring out of the pit.
- Unblock outlet pipe.

SECTION 1

1.1 DESCRIPTION

StormFilter is a passive, flow-through stormwater filtration system. It consists of vaults that house rechargeable cartridges filled with a variety of filter media. The filter systems are installed in-line with storm drains. The StormFilter works by passing stormwater through media-filled cartridges, which trap particulates and adsorb materials such as dissolved metals and hydrocarbons. After being filtered through the media, the treated stormwater flows into a collection pipe or discharges into an open channel drainage way. StormFilter is offered in three different configurations: cast-in-place, precast and linear. The precast and linear models utilize pre-manufactured vaults. The cast-in-place units are customized for larger flows and may be either covered or uncovered underground units.

1.2 OPERATION

1.2.1 Purpose

The StormFilter is a passive stormwater filtration system designed to improve the quality of stormwater runoff from the urban environment before it enters receiving waterways.

Through independent third party studies, it has been demonstrated that the StormFilter is highly effective for treatment of first flush flows and flow-paced flows during the latter part of a storm. In general, StormFilter's efficiency is highest when pollutant concentrations are highest. The primary target pollutants for removal are: sediments (TSS), soluble metals, soluble phosphorus, nitrates, and oil and grease.

1.2.2 Sizing

The StormFilter® is typically sized to treat the peak flow of a water quality design storm as it passes through the filter. The peak flow is determined by calculations based on the contributing watershed hydrology and using a design storm magnitude. The design storm is usually based on the regulatory requirements set by the local stormwater management agency. The particular size of a StormFilter is determined by the number of filter cartridges (see Figure 4) required to treat the peak stormwater flow. Each cartridge is designed to treat a peak flow of 1 Litre/second. For example: a peak design stormwater flow rate of 10L/s would require that 10 cartridges be used in the treatment vault.

Because of the highly porous nature of the granular filter media, the flow through a newly installed cartridge is restricted to 1L/s, using a restrictor disc, to ensure adequate pollutant-media contact time.

1.2.3 Basic Function

The StormFilter is designed to siphon stormwater runoff through a filter cartridge containing media. The variety of media available can be designed to act as a mechanical filter to remove sediments, as an ion exchanger to remove dissolved heavy metals, and as an absorber to remove oils and greases.

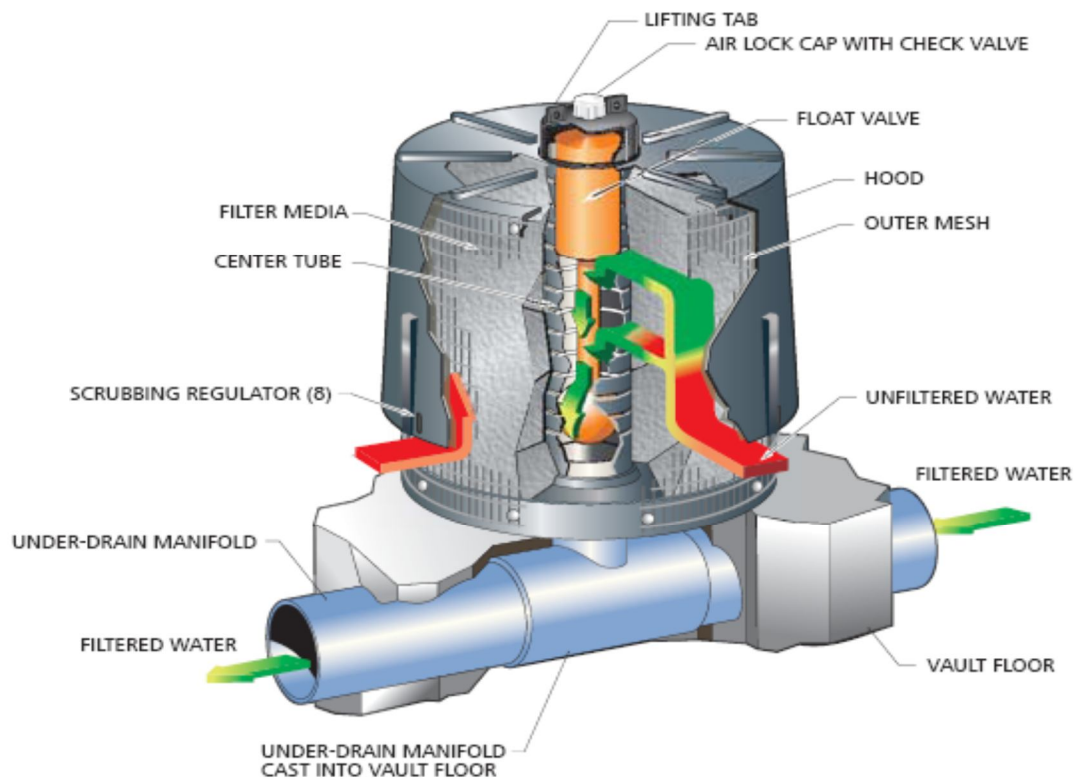


Figure 4. Filter Cartridge

1.2.4 Priming System Function

The treated stormwater collects in the centre tube of the cartridge, which is equipped with a self-priming siphon system. Figure 1 illustrates this system. The key component of the system is the plastic float. The float consists of a ball located at the base leading up to a larger portion, which provides increased buoyancy. Initially the ball rests in a seat effectively closing off the port to the drainage manifold.

As a result, the filter fills the centre drainage tube until the water level has risen high enough to purge the air from the filter cartridges and displaces the float. At a water depth of 22 inches the float pulls loose and allows the filtered water to drain out through the manifold. This effectively "primes" a siphon within the drainage tube and greatly increases the potential across the filter. The priming system increases StormFilter's ability to be loaded with sediment. A related feature is the cartridge "hood". This hood maintains the siphon effect by preventing air from being drawn into the cartridge until the external water level drops below the bottom of the hood.

Cartridges are connected to the manifold with a plastic connector. Since some media used is potentially buoyant, a threaded connector affixed to the manifold with compression bolts is necessary to ensure the cartridge isn't lifted out of place. For the heavier leaf media, a slip connector is used.

StormFilter is also equipped with flow spreaders that trap floating debris and surface films, even during overflow conditions. Depending on individual site characteristics, some systems are equipped with high and/or low flow bypasses. High flow bypasses are installed when the calculated peak storm event generates a flow that overcomes the overflow capacity of the system. This is especially important for precast systems. Low flow bypasses are sometimes installed to bypass continuous inflows caused by ground water seepage, which usually do not require treatment. All StormFilter units are designed with an overflow. The overflow operates when the inflow rate is greater than the infiltration capacity of the filter media.

1.2.5 Maintenance Overview

The primary purpose of the StormFilter is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. To assist the owner with maintenance issues, Stormwater360 provides detailed Operation & Maintenance Guidelines with each unit.

Stormwater360 can provide maintenance services completely, or in part. Available services include tracking of installed systems, advising the system's owner of maintenance needs, and notification of the regulatory agency once the system has been maintained.

Maintenance is usually performed in the dryer periods to rejuvenate the filter media and prepare the system for the next rainy period. Maintenance activities can also be required in the event of a chemical spill or excessive sediment loading due to site erosion or extreme storms. It is good practice to inspect the system after severe storm events.

END OF SECTION 1

SECTION 2

RECOMMENDED MAINTENANCE AND EXPECTED PERFORMANCE

2.1 TYPES OF MAINTENANCE

Presently, procedures have been developed for two levels of maintenance: Inspection/minor maintenance and major maintenance. Inspection/minor maintenance activities are combined since the minor maintenance does not require special equipment and typically little or no materials are in need of disposal. Inspection/minor maintenance typically involves opening the flow restricting valves (to pre-set levels) and cleanup of vegetation and debris. Major maintenance typically includes cartridge recharging. Major maintenance may involve disposal of materials that require consideration of regulatory guidelines. Depending on the particular unit configuration and equipment used, major maintenance may require an understanding of OSHA rules. Table 1 summarizes the primary activities associated with StormFilter maintenance.

Table 1: StormFilter

Facility Component Requiring Maintenance	Maintenance Activity	When Maintenance Activity Is Required	Expected Facility Performance After Maintaining
StormFilter® Cartridges and Containment Structure	Trash and Debris Removal	Floatable objects or other trash is present in the filter. Remove to avoid hindrance of filtration and eliminate unsightly debris and trash.	Permanent removal from storm system.
	Cartridge Replacement and Sediment Removal	1. Media has been contaminated by high levels of pollutants, such as after a spill.	1. New media is able to effectively treat stormwater.
Drainage System Piping	Flushing With Water	Drainage system is obstructed by debris or sediment.	Outflow is not restricted.

2.2 MAINTENANCE ACTIVITIES

2.2.1 Maintenance Activity Timing

Two scheduled inspections/maintenance activities should take place during the year. During the minor maintenance activities (routine inspection, debris removal), the type of major maintenance required is determined and, if required for disposal, samples of the sediments and media are obtained. The next scheduled date is to perform major maintenance activities (replacement of the filter cartridges and associated sediment removal). In addition to the scheduled activities, it is important to check the condition of the filter after major storms to check for damage caused by high flows and to check for high sediment accumulation, which may be caused by localised erosion in the drainage area. It may be necessary to adjust maintenance activity scheduling depending on the actual operating conditions encountered by the system.

2.2.2 Maintenance Activity Frequency

The primary factor controlling timing of maintenance for the StormFilter is sedimentation. A properly functioning system will remove solids from water by trapping these particulates within the porous structure of the media. The flow through the system will naturally decrease as more and more solids are trapped. Eventually the flow through a system will be low enough to require replacement of the cartridges. Sediment should be removed from upstream trapping devices on an as needed basis to prevent material from being re-suspended and discharged to the system.

Site conditions greatly influence maintenance requirements. StormFilter units located in areas with erosion or active construction should be inspected and maintained more often than those in fully established areas. The maintenance frequency may be adjusted as additional monitoring information becomes available during the inspection program. Areas that develop known problems should be inspected more frequently than areas that demonstrate no problems, particularly after large storms. Ultimately, inspection and maintenance activities should be scheduled based on the historic records and characteristics of an individual filter.

2.3 MAINTENANCE CREW REQUIREMENTS

Table 4 lists the anticipated crew requirements for maintenance operations. Removal of water and sediments during major maintenance activities can be accomplished using either a pump and water truck or a vacuum truck. All applicable safety (OH & S) and disposal regulations should be followed. A general description of the maintenance activities follows.

Table 4: ANTICIPATED CREW REQUIREMENTS

	Inspection/Minor Maintenance	Major Maintenance: Sediment Removal	Major Maintenance: Cartridge Replacement
Labourer	1		1
Skilled Worker	1	1	1
Vacuum/Water Truck Operator		1	0/1
Total	2*	2*	2/3*
Special Requirements	Knowledge of Proper StormFilter Function	Knowledge of Disposal Requirements	Knowledge of Cartridge Removal and Installation Procedures

* May require OH & S trained person if/when vault entry occurs.

2.4 MAINTENANCE METHODS

2.4.1 Minor Maintenance/Inspection (Twice A Year)

Minor maintenance typically will involve the steps below, however if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

Steps for Minor Maintenance

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the doors to the vault and allow the system to air out for 5-10 minutes.
5. **Without entering the vault**, inspect the inside of the unit, including components.
6. Take notes about the external and internal condition. This includes inspecting pit penetrations, walls, lids, ladders & grates etc.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault in the forebay (or pre-treatment bay), and on top of the internal components. If flow is occurring, note the level of water and estimate the flow rate per drainage pipe. Record all observations.
8. Remove large loose debris and trash using a pole with a grapple or net on the end.
9. Close and fasten the door, and remove safety equipment.

10. Finally, make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.

2.4.2 Major Maintenance Inspection (Once a Year)

The primary goal of the major maintenance inspection is to assess the condition of the cartridges relative to the level of sediment loading. It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present and very little flow will be discharging from the drainage pipes. It is likely that the cartridges need to be replaced. Major maintenance inspection will typically involve the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.**

Steps for Pre-Major Maintenance Inspection

1. Maintenance to be performed by a skilled worker familiar with StormFilter units.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the doors to the vault and allow the vault to air out for 5-10 minutes.
5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
6. Take notes about the external and internal condition.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
8. Remove large loose debris and trash using a pole with a grapple or net on the end.
9. If the visit is during a storm, make the flow observations discussed above.
10. Close and fasten the door, and remove safety equipment.
11. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loading of other materials to the system.
12. Review the condition reports from the previous minor and major maintenance visits and schedule for cartridge replacement if needed.

2.4.3 Major Maintenance: Sediment Removal & Cartridge Replacement (& Emergency)

Major maintenance/filter cartridge replacement typically involves the steps below. However, if it appears that a spill of some type has occurred, the local hazard control agency and Stormwater360 should be notified immediately. **In the case of a spill, the worker should abort maintenance activities until the proper guidance has been obtained.** Depending on the configuration of the particular system, a worker may be required to enter the vault to perform some tasks. If vault entry is required, OH & S rules for general confined space entry must be strictly adhered to. Filter cartridge replacement should occur during dry weather and it may be necessary to plug the filter inlet pipe if base flows exist. Standing water present in the vault should be regarded as polluted and contained during this operation by temporarily capping the manifold connectors.

Steps For Cartridge Replacement Maintenance

1. Depending on the particular unit, one or two utility workers and a hauling truck operator will deliver the replacement cartridges to the site. Information concerning how to obtain the replacement cartridges is available from Stormwater360.
2. If applicable, set up safety equipment to protect pedestrians from fall hazards presented by open doors. Also, set up appropriate safety equipment for work near roadways.
3. Inspect the external condition of the unit and take notes concerning defects/problems.
4. Open the doors to the vault and allow the system to air out for 5-10 minutes.
5. Without entering the vault, give the inside of the unit, including components, a general condition inspection.
6. Make notes about the external and internal condition.
7. Give particular attention to recording the level of sediment build-up on the floor of the vault, in the forebay, and on top of the internal components.
8. Remove large loose debris and trash using a pole with a grapple or net on the end.
9. Ensuring safe working procedures are met, off load the replacement cartridges (16-39kgs each) and set aside.
10. Remove the top cap (threaded), upper seal and float from the cartridge. Repeat procedure for every cartridge within StormFilter vault. Place items in a large plastic container to be lifted from the vault.
Note: * Confined space entry may be required on StormFilter systems. In this case, please ensure that appropriate Confined Space entry training and subsequent certification has been undertaken and valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 immediately.
11. Using a cordless drill and 8mm hex head, remove the three screws located around the top perimeter of the cartridge hood. Place screws in the large plastic container and, once full or completed, remove plastic container from vault.
12. Move the Vacuum truck near the StormFilter vault on the down wide side. Be sure that the Vacuum truck is not too close to the vault so as the fumes will not enter the vault. Make sure that the last 500mm of the nozzle is approx. 100-125mm in outside diameter.

13. Feed vacuum nozzle into cartridge bay and start vacuum truck. Remove cartridge hood and place nozzle directly onto filter media. Completely remove media from each cartridge and repeat process for every cartridge in vault.
14. Once completed unthread cartridges from vault floor and place hood back on cartridges
15. Using the appropriate lifting cap, attach the cable and remove the cartridge (up to 10kgs. each) from the vault. Personnel standing under suspended cartridges is strictly prohibited. Care must be used to avoid damaging the cartridges during removal and installation. The cost of repairing components damaged during maintenance will be the responsibility of the owner unless maintenance activities are being performed by Stormwater360 and damage is not related to discharges to the system.
16. Set the used cartridge aside or load onto the hauling truck.
17. Repeat steps 14 to 15 once all cartridges have been removed.
18. Remove deposited sediment from the floor of the vault and, if large amounts are present, from the forebay. This can be accomplished by using the Vacuum truck
15. Once the sediments are removed, it is necessary to assess the condition of the vault, particularly the manifold and the connectors. These are short sections of 2-inch schedule 50 PVC, or threaded schedule 80 PVC that should protrude above the floor of the vault. If required, apply a light coating of FDA approved silicon grease to the outside of the exposed portion of the connectors. This ensures a watertight connection between the cartridge and the drainage pipe. Replace any damaged connectors.
16. Using the boom, crane, or tripod, lower and install the new cartridges (typically 16-17kgs. for perlite cartridges). Once again, take care not to damage connections.
17. Close and fasten the door, and remove safety equipment.
18. Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.
19. Finally, dispose of the residual materials in accordance with applicable regulations. Make arrangements to return the used cartridges to Stormwater360.

2.4.4 Related Maintenance Activities (Performed on an as-needed basis)

StormFilter units are often just one of many components in a more comprehensive stormwater drainage and treatment system. The entire system may include catch basins, detention vaults, sedimentation vaults and manholes, detention/retention ponds, swales, artificial wetlands, and other miscellaneous components. In order for maintenance of the StormFilter to be successful, it is imperative that all other components be

properly maintained. The maintenance/repair of upstream facilities should be carried out prior to StormFilter maintenance activities. In addition to considering upstream facilities, it is also important to correct any problems identified in the drainage area. Drainage area concerns may include: erosion problems, heavy oil and grease loading, and discharges of inappropriate materials.

2.5 TYPICAL EQUIPMENT REQUIRED FOR MAINTENANCE ACTIVITIES

Typical equipment required for conducting maintenance is shown in Table 5. Some of the materials listed are suggestions rather than requirements. It should be noted that there is more than one way to accomplish some tasks. Owners with available labour and equipment resources may desire to use alternative methods. However, it is advisable that guidance from Stormwater360 be obtained prior to using alternative techniques.

Table 5: MAINTENANCE EQUIPMENT REQUIREMENTS

Maintenance Equipment Required		
Minor Maintenance	Pre-Major Maintenance Inspection	Major Maintenance Cartridge Replacement
Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.	Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.	Safety Equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats.
Work Clothes: Rubber boots, overalls, and gloves.	Work Clothes: Rubber boots, overalls, and gloves.	Work Clothes: Rubber boots, overalls, and gloves.
Door Bolt, Wrench, proprietary lifters (e.g. Gatic) and Miscellaneous Tools.	Door Bolt, Wrench, proprietary lifters (e.g. Gatic) and Miscellaneous Tools.	Door Bolt, Wrench, Pentasocket and Miscellaneous Tools.
Tape Measure	Tape Measure	Tape Measure
Flashlight	Flashlight	Flashlight
Grapple or Net Pole	Grapple or Net Pole	Grapple or Net Pole
Record Keeping Forms	Record Keeping Forms	Record Keeping Forms
Trash/Debris Container	Trash/Debris Container	Vacuum Truck
		Replacement Cartridges
		Cartridge Hauling Truck
		Crane, Tripod and Hoist, or Other Lifting Device (150kg minimum capacity)
		Shovels
		Extra 50mm PVC cartridge connectors
		Spare Flow Restrictor disks
		Trash/Debris Container
		Vault Inlet Pipe Plug
		Dolly
		PVC Pipe Cutter
		Ladder
		Cartridge Installation and Removal Sling

* Confined space equipment may be required for vault entry. This equipment must be used by personnel with the appropriate OH & S training. This equipment typically includes: Atmospheric testing devices, atmospheric purging and ventilating devices, and entry, exit, and rescue assisting devices.

2.6 MATERIAL DISPOSAL

The accumulated sediment found in stormwater treatment and conveyance systems must be handled and disposed of in a manner that will not allow the material to affect surface or ground water. It is possible for sediments to contain measurable concentrations of heavy metals and organic chemicals (such as pesticides and petroleum products). Areas with the greatest potential for high pollutant loading include industrial areas and heavily traveled roads. Sediments and water must be disposed of in accordance with all applicable waste disposal regulations. It is not appropriate to discharge these materials back to the stormwater drainage system. Part of arranging for maintenance to occur should include coordination of disposal of solids (landfill coordination) and liquids (municipal vacuum truck decant facility, local wastewater treatment plant, on-site treatment and discharge). Owners should contact the local public works department and inquire about how the department disposes of their street waste residuals. Disposal methods or reuse of the media contained in the cartridges will be determined by Stormwater360. If the material has been contaminated with any unusual substance, the cost of special handling and disposal will be the responsibility of the owner.

Enviropod Service Receipt

Site:
Contractor:
Location:
Year:

Job Number:
Receipt Number:
Week Serviced:

Service Frequency:
Enviropods on Site:

Enviropods Cleaned:
Bags Checked:
Frames and Seals Checked:
Overflows Checked
Tonnage:

If Damaged, Action:
If Damaged, Action:
If Blocked, Cleaned:

Comments

This service has been performed in accordance with Enviropod Management Plan (EMP) for above site. Please file this receipt with EMP and keep on site for compliance inspections.

Signature:

Position:

EnviroPod Maintenance Form

Client:		Project:		Bag:		NOTE:					See maps for detailed location.								
ENVIROPOD Sites		Date:		Bag Size		Date		% Organics		% Litter		% Sediment		Fullness - F, 1/2, 1/4 or 0		Notes		Grate	
Pit No.	Map No.	Location																	
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
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Sample StormFilter Minor Maintenance Inspection Data Sheet

Date: _____ **Location:** _____

System Size: _____ **TYPE:** **Cast-In-Place** **Precast** **Linear**

Personnel: _____

System Observations

Media Months in Service: _____

Oil and Grease in Forebay: _____

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged? (Yes _____ No _____) How Deep? _____

StormFilter Minor Maintenance Activities (check off if done and give description)

Remove Trash and Debris: _____

Minor Structural Repairs: _____

Drainage Area Report

Excessive Oil and Grease Loading (Yes _____ No _____) Source: _____

Sediment Accumulation on Pavement (Yes _____ No _____) Source: _____

Erosion of Landscaped Areas (Yes _____ No _____) Source: _____

Items Needing Further Work: _____

Comments: _____

Sample StormFilter Major Maintenance Inspection Data Sheet

It may be desirable to conduct this inspection during a storm to observe the relative flow through the filter cartridges. If the submerged cartridges are severely plugged, large amounts of sediments should be present, very little flow will be discharging from the drainage pipes, and it is likely that the cartridges need to be replaced during major maintenance.

Date: _____ **Location:** _____

System Size: _____ **TYPE:** **Cast-In-Place** **Precast** **Linear**

Personnel: _____

System Observations

Media Months in Service: _____

Oil and Grease in Forebay: _____

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Estimated Flow from Drainage Pipes (if available): _____

Cartridges Submerged? (Yes _____ No _____) How Deep? _____

Drainage Area Report

Excessive Oil and Grease Loading (Yes _____ No _____) Source: _____

Sediment Accumulation on Pavement (Yes _____ No _____) Source: _____

Erosion of Landscaped Areas (Yes _____ No _____) Source: _____

Comments: _____

Review the condition reports from the previous minor and major maintenance visits.

Sample StormFilter Major Maintenance/Cartridge Replacement Data Sheet

Date: _____ Location: _____

System Size: _____ TYPE: Cast-In-Place Precast Linear

Personnel: _____

List Safety Procedures and Equipment Used: _____

System Observations

Media Months in Service: _____

Oil and Grease in Forebay: _____

Sediment Depth in Forebay: _____

Sediment Depth on Vault Floor: _____

Structural Damage: _____

Drainage Area Report

Excessive Oil and Grease Loading (Yes _____ No _____) Source: _____

Sediment Accumulation on Pavement (Yes _____ No _____) Source: _____

Erosion of Landscaped Areas (Yes _____ No _____) Source: _____

StormFilter Cartridge Replacement Maintenance Activities (check off it done and give description)

Remove Trash and Debris (Yes _____ No _____) Details: _____

Replace Cartridges (Yes _____ No _____) Details: _____

Sediment Removed (Yes _____ No _____) Details: _____

Quantity of Sediment Removed (estimate?): _____

Minor Structural Repairs (Yes _____ No _____) Details: _____

Residuals (debris, sediment) Disposal Methods: _____

Notes/Problems: _____

Stormwater Management StormFilter
and EnviroPod Filter (SFEP) Technical Design Guide



INTRODUCTION

Stormwater360 has adopted a comprehensive research and design program which is unparalleled by any manufacturer in Australasia, to strategically provide our clients, both consulting engineers and regulators alike, the reassurance of our products in-field performance, validity and longevity. This document has been produced as a guideline to assist engineers and designers with development application process when utilizing Stormwater360's Stormwater Management StormFilter and EnviroPod treatment train (SFEP) of products in meeting the current best practice load based water quality objectives.

Stormwater360 utilises the StormFilter & EnviroPod (SFEP) as a series of products within a treatment train. The EnviroPod (gully pit basket) is designed to remove gross pollutants, coarse sediment and associated pollutants (Hydrocarbons, metals & nutrients) at high flows and is typically located within each gully inlet pit. The StormFilter technology is designed to remove both particulate bound and soluble pollutants, including some soluble forms of nitrogen and is located near the outlet of the catchment. The SFEP treatment train of devices is well suited to highly urbanized (developed) catchments where space is at a premium and pollutant loads are high.

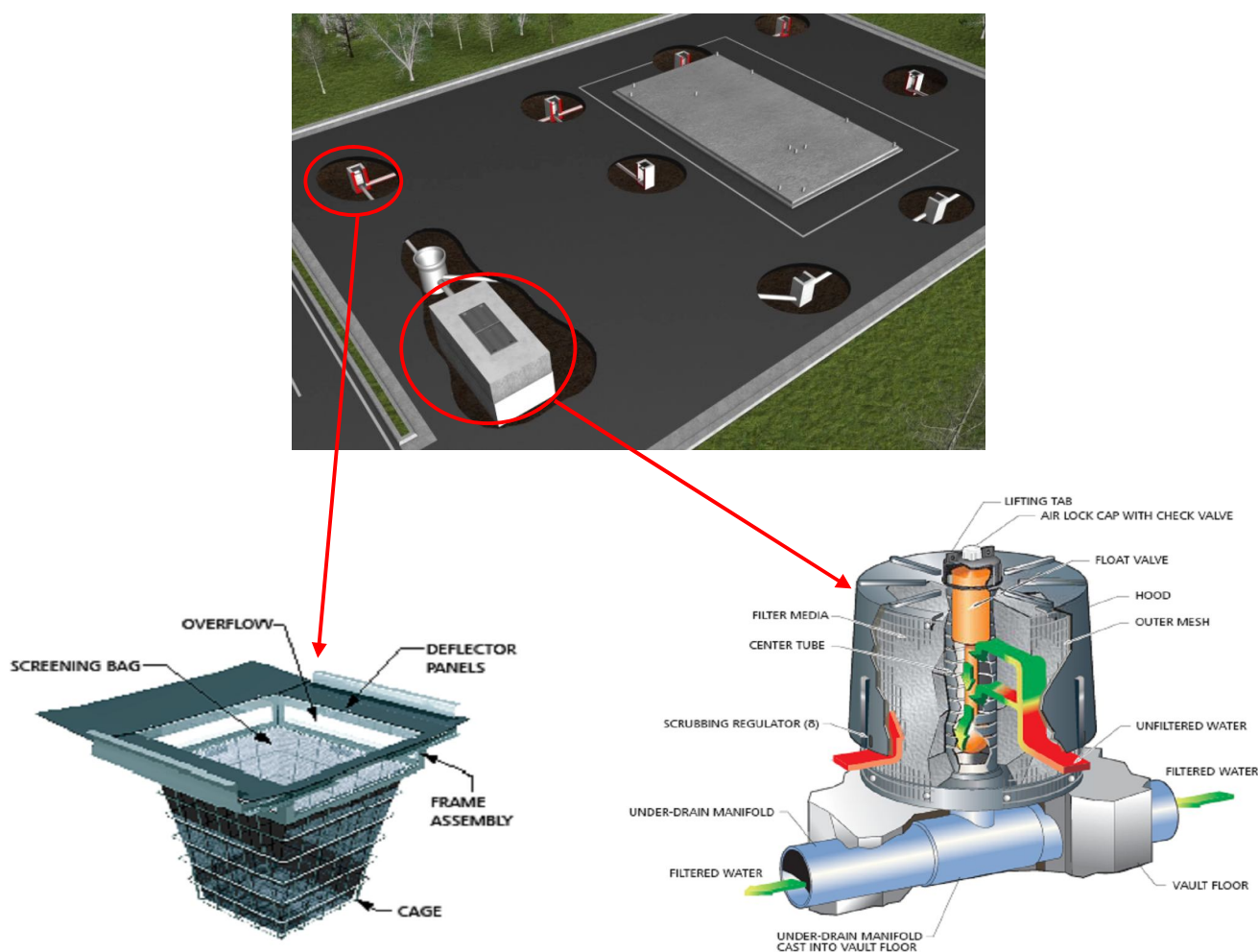


Figure 1. The EnviroPod pit filter and StormFilter media cartridge.

METHODOLOGY

There are several methods for determining the size of Stormwater treatment systems, however, the most common is by using software packages. The Model for Conceptual MUSIC is the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) is available from eWater Limited. MUSIC is now the industry standard aiding the design of various Water Sensitive Urban Design treatment measures in demonstrating compliance with regulator's water quality objectives. In this section you will find step-by-step instructions on how to determine the number of filter cartridges required for your StormFilter.

Modelling the treatment systems within MUSIC should be undertaken by individuals who are familiar with MUSIC's functions and limitations. Should you require further information, or to make use of Stormwater360's design services, please contact Stormwater360's Engineering Services & Support. MUSIC modeling SFEP treatment nodes and corresponding documentation are available from Stormwater 360 upon request. The derivation of parameters for modeling reductions of sediment and nutrients are not discussed within this document.

Completing a MUSIC model will determine the treatable flow rate of the specified StormFilter system required to treat the runoff from your site. The next step when designing a system is to select the StormFilter cartridge and configuration that will best suit the constraints of a particular site. The StormFilter technology has three (3) cartridges height options providing varying magnitude of hydraulic head loss. The StormFilter is also offered in several system configurations: manhole, detention, vault, cast in place or panel.

Using the cartridge height, quantity and the system configuration determined in the design, the final step in the design process is to integrate the StormFilter into your site plans. In this section you will find information on factors that you must consider when integrating the StormFilter into your site plans. Factors include: selecting a site location, evaluating system depth and maintenance access requirements and determining bypassing needs.

Determining the treatable flow rate of your SFEP system - MUSIC Modeling

Typically when designing the SFEP treatment train, the first step is to determine that number of EnviroPod filters required from the engineering plans. The EnviroPod filter is a gully pit insert and works effectively on small sub-catchments. The typical maximum impervious sub-catchment treated by each EnviroPod filter is 500 - 1,000m². Any sub-catchments in excess of this impervious area significantly reduces the effectiveness of the filter. For this reason the EnviroPod must only be design to pick up flow from a grated inlet and not an inlet pipe draining larger catchment areas.

When designing the EnviroPod filter as part of the SFEP treatment train, the grade of filter must be the 200µm ("EnviroPod series 200 Filter"). Although several grades exist this is the most suitable as pre-treatment upstream of the StormFilter. The EnviroPod can fit any pit from 450mm x 450mm to 1200mm x 1200mm as a standard at a minimum 300mm deep or more.

The StormFilter technology is usually place downstream of any pre-treatment devices such as gully pit inserts, gross pollutant traps, porous paving, rainwater tanks etc, and consequently the node is simply placed in-line or end-of-pipe near the outlet of the catchment model. The treatable flow rate of the StormFilter is determined by an iterative process of increasing the number of cartridges until the water quality objectives have been achieved. The estimated maintenance frequency will also have to be checked as part of this process.

Given below is a simplified procedure for modeling the Stormwater360 SFEP treatment train.

1. Research the available the regulators policies and documents to determine the appropriate MUSIC modeling guideline for the project. Utilise the desired meteorological data and evapotranspiration for the region. Create, copy and edit ALL source nodes after perusing all known information from the site plans etc.

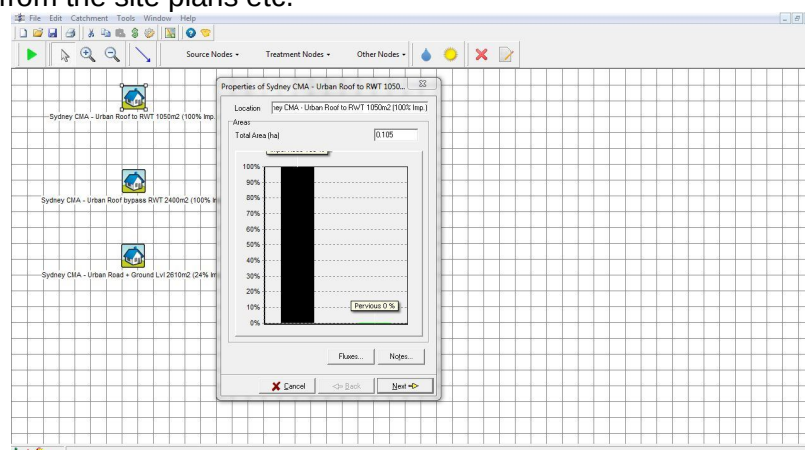


Figure 2. Rainfall & Source Node setup

2. Copy and create all treatment nodes. The treatment nodes to successfully model the SFEP system are;
 - i. EnviroPod
 - ii. Detention with StormFilter
 - iii. StormFilter

EnviroPod Filter

The treatable flow rate for each EnviroPod filter is 20L/s and there when modeled as a series of EnviroPod filters is simply the quantity of EnviroPod's multiplied by this number. This number is then entered into the high-flow bypass details. For example 3 x EnviroPod's yield 0.06m³/s within the high flow by-pass below.

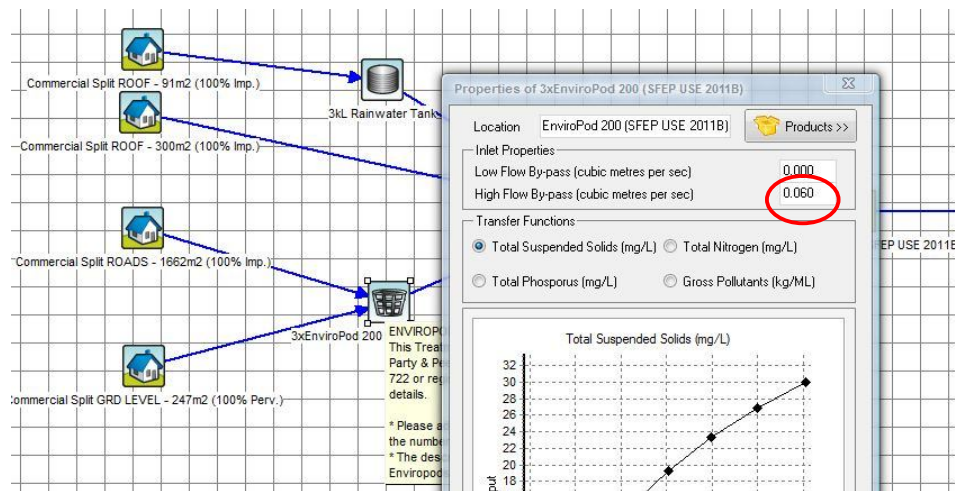


Figure 3. High flow bypass details in MUSIC for EnviroPod.

Detention within StormFilter Chamber

Due to the nature of the StormFilter operation, stormwater attenuation occurs before and during siphonic filtration mechanism is activated within the StormFilter cartridge. Whilst the detention component can be minimal in StormFilter systems it helps to buffer the flows coming into the device. The StormFilter cartridge has a siphon mechanism that requires a driving head (head loss) be achieved prior to the design flow occurring across the filter. There is an imperfect seal on the bottom of the float inside the cartridge and this allows a trickle flow through the cartridge during the rising limb of the hydrograph. PRIOR to the siphon mechanism only a trickle flow through each cartridge is generated, hence creating the detention within the chamber. Once the siphon is initiated the cartridge immediately operates at the design flow rate. The head outside of the cartridge will change and the relationship between cartridge throughput, head and flow attenuation, albeit small, continues throughout the storm.

In regard to the calculations the parameters requiring changing are given below;

- Surface Area – We have only taken into account the surface area between the filters,
- Extended Detention Depth – height of detention in chamber.
- Permanent Pool Volume – Always set at 0.0
- Exfiltration Rate - Always set at 0.0
- Evaporative Loss - Always set at 0.0
- Equivalent Pipe Diameter – For the given Extended Detention Depth the orifice diameter is determined to equal the flow rate of all the cartridges.
- Overflow Weir Width – Always set at 2.0m (unrestricted bypass flow)

Stormwater360 produce a spread sheet to assist in determine these parameters.

StormFilter

Modify the StormFilter node by changing the high flow bypass only. As a starting point for StormFilter, modify the high-flow bypass and initially estimate 1L/s of treatment per 250m² of upstream catchment area.

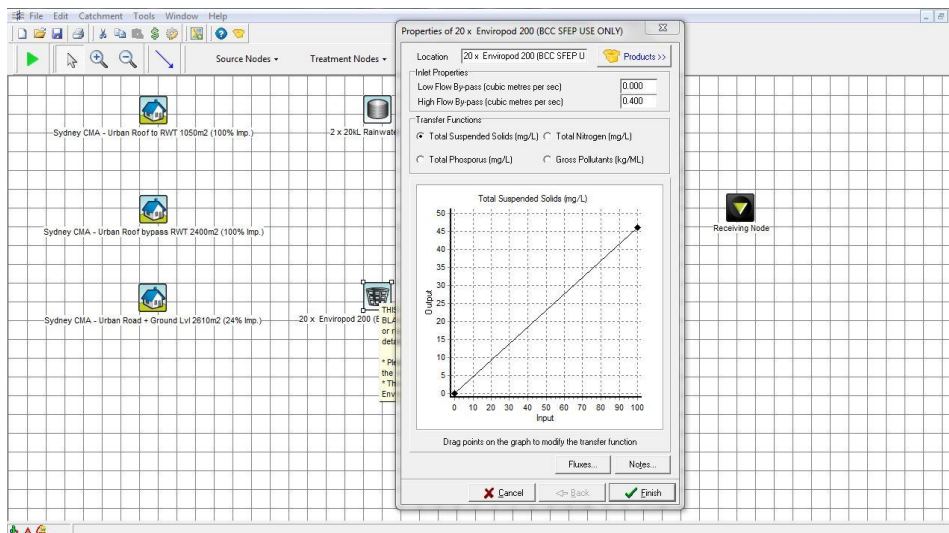


Figure 4. Create, Copy and Edit Treatment Nodes

3. Link all nodes and then run the model. After the model has finished, check the results obtained and compare them to the water quality targets. Adjust the high-flow bypass of the StormFilter to refine the design and re-run the model.

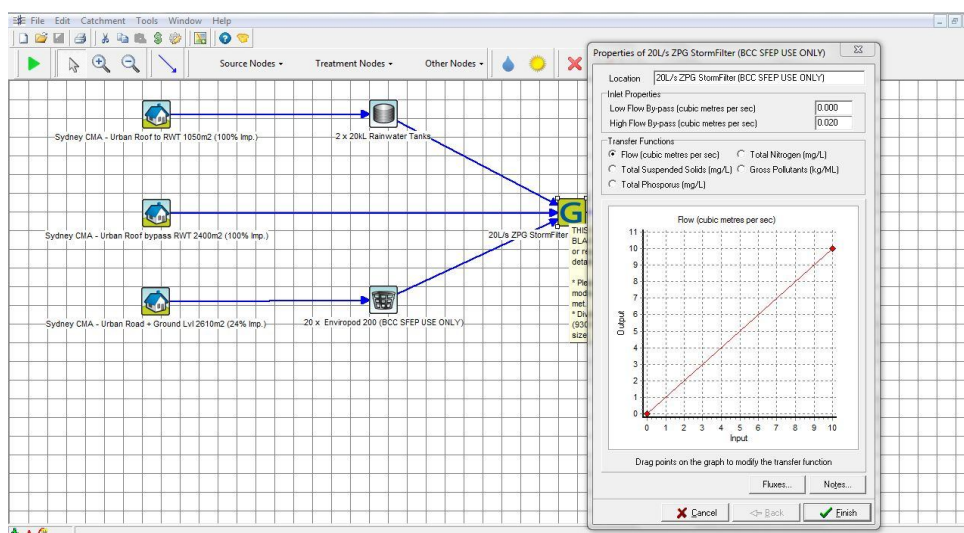


Figure 5. First Model Simulation

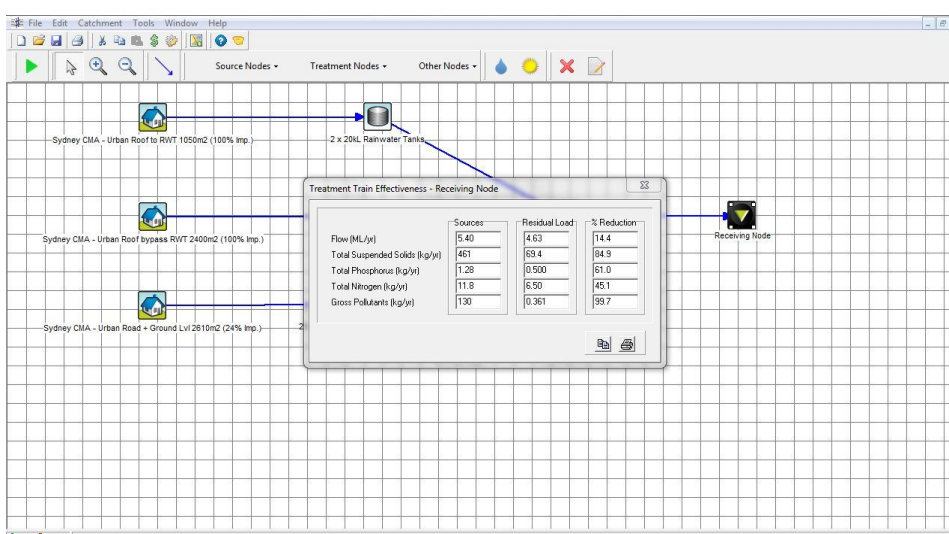


Figure 6. Results

4. Once the water quality objectives have been achieved the system hydraulics need to be considered and the maintenance frequency needs to be checked.

Selecting your StormFilter cartridge height

Peruse your site plans or detail survey to determine the amount of fall or hydraulic loss that is available for your site. Once determined, select the most appropriate StormFilter cartridge that best suits your needs from the table below.

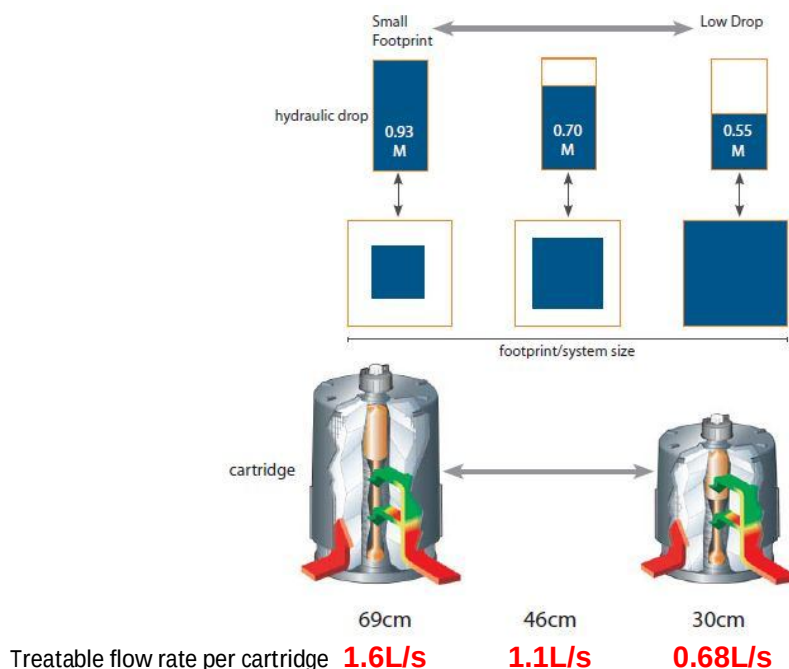


Figure 7. Filter Cartridge height options

The peak flow rates for each cartridge are shown above in red. Simply divide the high flow bypass from your MUSIC modelling results to determine the number of cartridges required. You will need to record the cartridge height used in the design.

Please note that Stormwater360 prefers to drop the hydraulic loss across the unit (head drop). If this cannot be achieved, the StormFilter CAN be configured for a zero drop system. Please contact Stormwater360 for more details.

Determining the Maintenance frequency of the StormFilter from the MUSIC model

The primary purpose of the StormFilter is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, periodically these pollutants must be removed to restore the StormFilter to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. To assist the owner with maintenance issues, Stormwater360 provides detailed Operation & Maintenance Guidelines with each unit.

Stormwater360 can provide maintenance services completely, or in part. Available services include tracking of installed systems, advising the system's owner of maintenance needs, and notification of the regulatory agency once the system has been maintained.

Types of Maintenance

Presently, procedures have been developed for two levels of maintenance: Inspection/minor maintenance and major maintenance. Inspection/minor maintenance activities are combined since the minor maintenance does not require special equipment and typically little or no materials are in need of disposal. Inspection/minor maintenance typically involves a visual inspection and cleanup of vegetation and debris should it be required. Major maintenance typically includes cartridge recharging. Major maintenance may involve disposal of materials that require consideration of regulatory guidelines.

Maintenance Frequency

The primary factor controlling timing of maintenance for the StormFilter is sedimentation. A properly functioning system will remove solids from water by trapping these particulates within the porous structure of the media. The flow through the system will naturally decrease as more and more solids are trapped. Eventually the flow through a system will be low enough to require replacement of the cartridges. Sediment should be removed from upstream trapping devices on an as needed basis to prevent material from being re-suspended and discharged to the system.

Maintenance frequencies shown in Table 2 should be followed as a minimum. Any maintenance frequencies less than 12 months for the StormFilter designs are to be avoided.

	INSPECTION/MINOR MAINTENANCE (TIMES/YEAR)	MAJOR MAINTENANCE (TIMES/YEAR)
StormFilter	2 (and after major storms)	1 (except in case of a spill)

Table 1. Frequency of Maintenance (typ.)

Determining Maintenance Frequency from Modeling Design

The procedure below however provides a method to estimate the cartridge replacement frequency.

- Using the results obtained from the modeling in figure 7 above, determine the mass of TSS removed by the StormFilter technology itself. This involves determining the difference between the residual load of suspended solids between the StormFilter node and node located immediately upstream of the StormFilter.

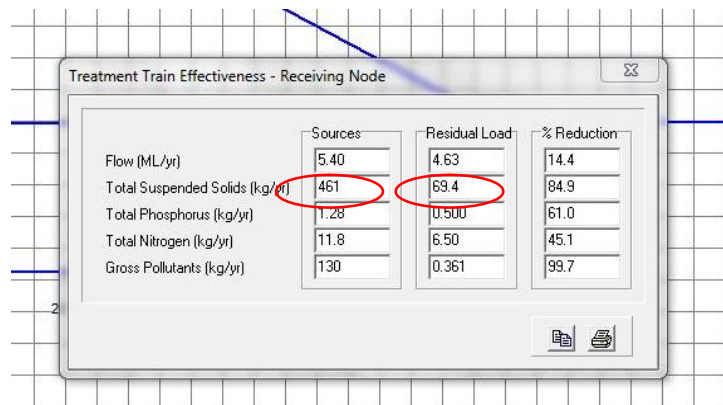


Figure 5. Results

- Open the StormFilter Maintenance Frequency Calculator spreadsheet (shown below) and enter the load removed by the filter into cell C8. Also enter the number of cartridges from the previous design section into cell C13.

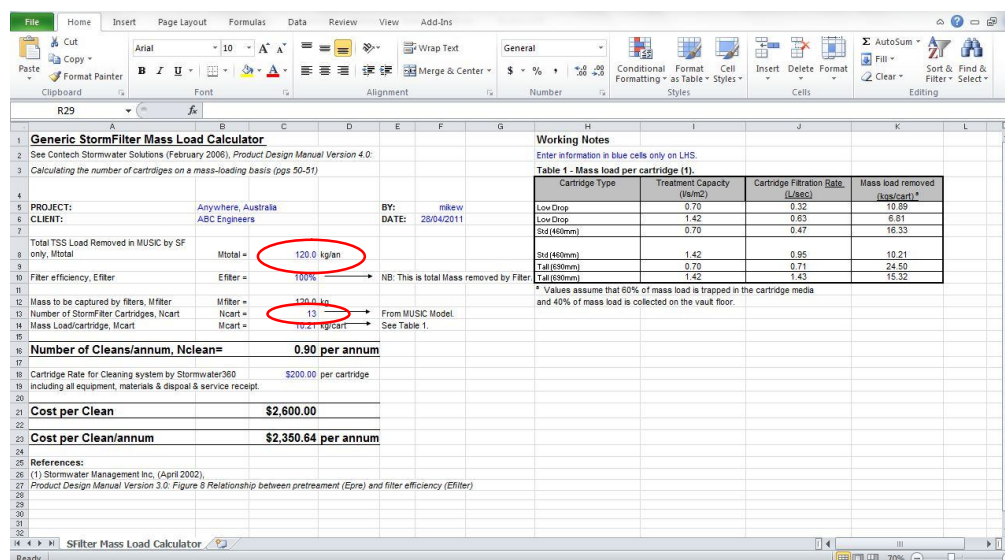


Figure 8. StormFilter Maintenance Frequency Spreadsheet

3. Lookup the table on the spreadsheet. For each given cartridge height (column H) find the corresponding mass load per cartridge (column k) removed by the filter and enter into cell into cell C8. Also enter the number of cartridges from the previous design section into cell C13.

Calculating the number of cartridges on a mass-loading basis (pgs 50-51)				Table 1 - Mass load per cartridge (1).			
PROJECT:	Anywhere, Australia	BY:	mikew	Cartridge Type	Treatment Capacity (l/s/m ²)	Cartridge Filtration Rate (L/sec)	Mass load removed (kg/cart) ^a
CLIENT:	ABC Engineers	DATE:	28/04/2011	Low Drop	0.70	0.32	10.89
Total TSS Load Removed in MUSIC by SF only, Mtotal	Mtotal =	120.0 kg/an		Low Drop	1.42	0.63	6.81
Filter efficiency, Efilter	Efilter =	100%	NB: This is total Mass removed by Filter	Std (460mm)	0.70	0.47	16.33
Mass to be captured by filters, Mfilter	Mfilter =	120.0 kg		Std (460mm)	1.42	0.95	10.21
Number of StormFilter Cartridges, Ncart	Ncart =	13	From MUSIC Model.	Tall (690mm)	0.70	0.71	24.50
Mass Load/cartridge, Mcart	Mcart =	10.21 kg/cart	See Table 1.	Tall (690mm)	1.42	1.43	15.32
Number of Cleans/annum, Nclean=		0.90 per annum		^a Values assume that 60% of mass load is trapped in the cartridge media and 40% of mass load is collected on the vault floor.			

Figure 9. StormFilter Maintenance Frequency Spreadsheet

Once complete read off cell C16 to determine the maintenance frequency of the cartridge replacement. Always check that the cartridge replacement period is no less than 12months. Sizing the StormFilter technology is now complete.

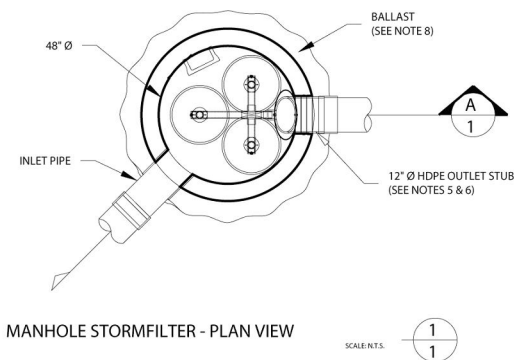
Determining the StormFilter configuration

After the number of cartridge has been selected, determine the system size from the table below and contact Stormwater360, or go online and register at www.stormwater360.com.au to download the applicable drawing for your site. For more configurations contact Stormwater360.

Configuration	System Cartridge Capacity	System Footprint
Manhole	1 – 2 3 – 4 5 – 7 8 - 22	1200mm dia 1500mm dia 1800mm dia 3100mm dia
Vault	23 - 44	5.4 x2.4m
Large Vault	45 – 70 71 - 140	10.8m x 2.4m 10.8m x 4.9m
Cast In-Place or Panel	140 +	Contact Stormwater360

Table 2. System Configurations

Manhole StormFilter



The Manhole StormFilter™ consists of a 1200mm dia to 3100mm concrete manhole that can contain up to twenty-two StormFilter cartridges. The Manhole StormFilter can be installed flush with the finished grade. The top of the unit has an either 600mm sq or 900mm sq, Class D rated, traffic-bearing access cover (or grates) that allows the filter to be installed in paved areas and, for all practical purposes, takes up no land area.

The Manhole StormFilter unit treats peak water quality design flows up to 35L/s and has an internal bypass capability of 50L/s.

Design Operation

The Manhole StormFilter is installed online with the storm system, typically downstream of an existing catch basin or of a detention system. Runoff enters the Manhole StormFilter through an inlet pipe discharging directly to the unit and, therefore, may require an additional upstream pretreatment system depending on local agency requirements.

An inherent benefit of the manhole design is the flexibility in piping orientation. The inlet pipe may be placed in the manhole at any angle relative to the outlet pipe. Access to the cartridges is provided by manhole opening. Installation of the Manhole StormFilter is identical to that of a typical manhole.

Applications

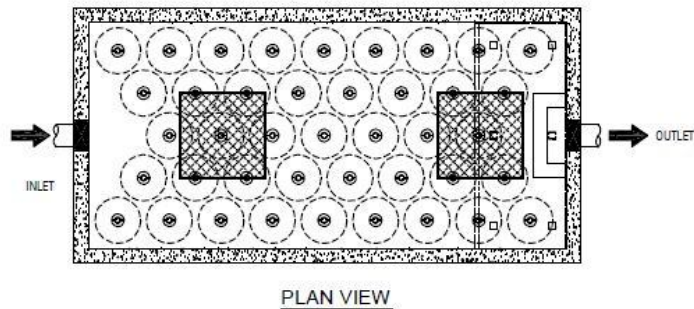
The Manhole StormFilter is particularly useful where small flows are being treated.

Special Considerations

When designing the Manhole StormFilter into your system, you should consider the following:

- " The unit should maintain sufficient drop from the invert of the inlet to the invert of the outlet.
- " For depths greater than 2.5m, contact Stormwater360 for information on additional requirements.

Vault StormFilter



Overview

The Vault (and large vault) StormFilter can consist of one or more precast concrete structures 5.4 x 2.4m (ID). These units treat peak water quality design flows up to 70L/s. StormFilter vaults can be placed in series or in parallel to treat higher flows if needed (Large Vault type). A Vault StormFilter can be installed online or offline with the storm system. It is installed with 900mm sq Class D traffic-bearing lids for parking lot applications, and it takes up no land area.

Design Operation

The typical Vault StormFilter is composed of a filtration bay, with inlet energy dissipation and an outlet baffled overflow riser. Stormwater first enters the StormFilter vault through the inlet pipe. The stormwater is then directed over an energy dissipater into the filtration bay for full treatment. The outlet overflow riser acts as a baffle, trapping some floatables, oils, and surface scum as the stormwater is filtered through towards the filtration bay.

Once in the filtration bay, the stormwater begins to pond and percolate horizontally through the media contained in the filter cartridges. After passing through the media, treated water that has collected in the cartridge center tube is directed into the outlet bay by an under-drain manifold. The treated water in the outlet bay is then discharged through the single outlet pipe. The Vault StormFilter has an internal bypass capability of 50L/s. If peak flows to the system exceed 50L/s, a high flow bypass is needed. See Stormwater360 for more information.

Applications

The Vault StormFilter can be used for the following applications:

- " Parking lots
- " Roadways
- " Residential developments
- " Retail/commercial developments
- " Business/industrial sites
- " Maintenance facilities

Special Considerations

When designing the Vault StormFilter into your system, you should consider the following:

- " Stormwater360 recommends a minimum of 1500mm of head room inside the vault for maintenance access.
- " For depths greater than 3.6m, contact Stormwater360 for information on additional requirements.



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