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ORIGINAL

WATER & ENVIRONMENT

Herston Quarter (SRACC)
Stormwater Management Plan

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1 INTRODUCTION

This technical report provides details of the stormwater quality and quantity analysis undertaken to support the proposed development for the Herston Quarter *Specialist Rehabilitation and Ambulatory Care Centre* (SRACC) and the adjoining Spanish Steps. The development, located on Herston Road, consists of an 8 storey building, raised courtyard and connecting Spanish Steps. The proposed development is located within the Brisbane City Council (BCC) local government area.

Although this development application is for the SRACC, courtyard and Spanish Steps only, the stormwater management strategy proposed (which utilises the void below the Spanish Steps to place treatment systems) has made allowance for the future buildings to the west of the SRACC as these buildings fall to the same discharge point of the Spanish Steps. The stormwater quantity and quality management strategies proposed for the development are outlined below:

- *Stormwater Quality* – Proprietary devices are proposed to treat runoff from the SRACC, surrounding courtyard and Spanish steps with allowance for the future development to the west of the steps also incorporated. MUSIC modelling undertaken for the site has determined two Stormwater360's (StormFilter and Enviropods) systems will treat the runoff to meet water quality objectives (WQOs) outlined in the State Planning Policy (SPP, 2016). The proprietary devices have been integrated into the developments layout such that no development area has been lost. **Section 3** of this report provides further details and analysis of the stormwater quality strategy.
- *Stormwater Quantity* – Analysis has been completed for the stormwater catchments discharging to the two lawful points of discharge on Herston Road. A stormwater detention tank located in the void under the Spanish steps is proposed to mitigate the increase in peak flows discharging from the south western corner of the site, while reducing the catchment discharging south east to Herston Road results in no increase in peak flows from this location.

The analysis provided in this technical report, demonstrates that the required stormwater quality and quantity objectives will be achieved with the proposed integrated stormwater management strategies.

For clarity and consistency, the abovementioned development area as presented in **Appendix A** will herein be referred to as "the site".

1.1 SCOPE OF THIS DOCUMENT

In order to demonstrate that objectives for stormwater quality and downstream discharge are achieved, the following investigations will be undertaken:

- Determine Lawful Points of Discharge;
- Develop a stormwater quality management strategy incorporating Stormwater Quality Improvement Devices (SQIDs) and model using Model for Urban Stormwater Improvement Conceptualisation (MUSIC) to demonstrate the proposed strategy will achieve the Water Quality Objectives (WQOs) required under the *State Planning Policy* (SPP, 2016);
- Determine existing and developed peak flows to the Lawful Points of Discharge using the Watershed Bounded Network Model (WBNM);
- Design a stormwater quantity device to mitigate the increased peak flows to the discharge locations; and
- Design a stormwater drainage network to collect and convey runoff through the site.

2 SITE CHARACTERISTICS

The site is located in the southern portion of Herston Quarter, fronting Herston Road, Herston. The proposed development makes up the first stage in the overall development of the Herston Quarter Masterplan area. The site is bound by Herston Road to the south, Bramston Terrace to the east, the QIMR Berghofer Medical Research Institute to the west and the existing Lady Lamington Building to the north. The development site is shown in **Figure 2-1** below.

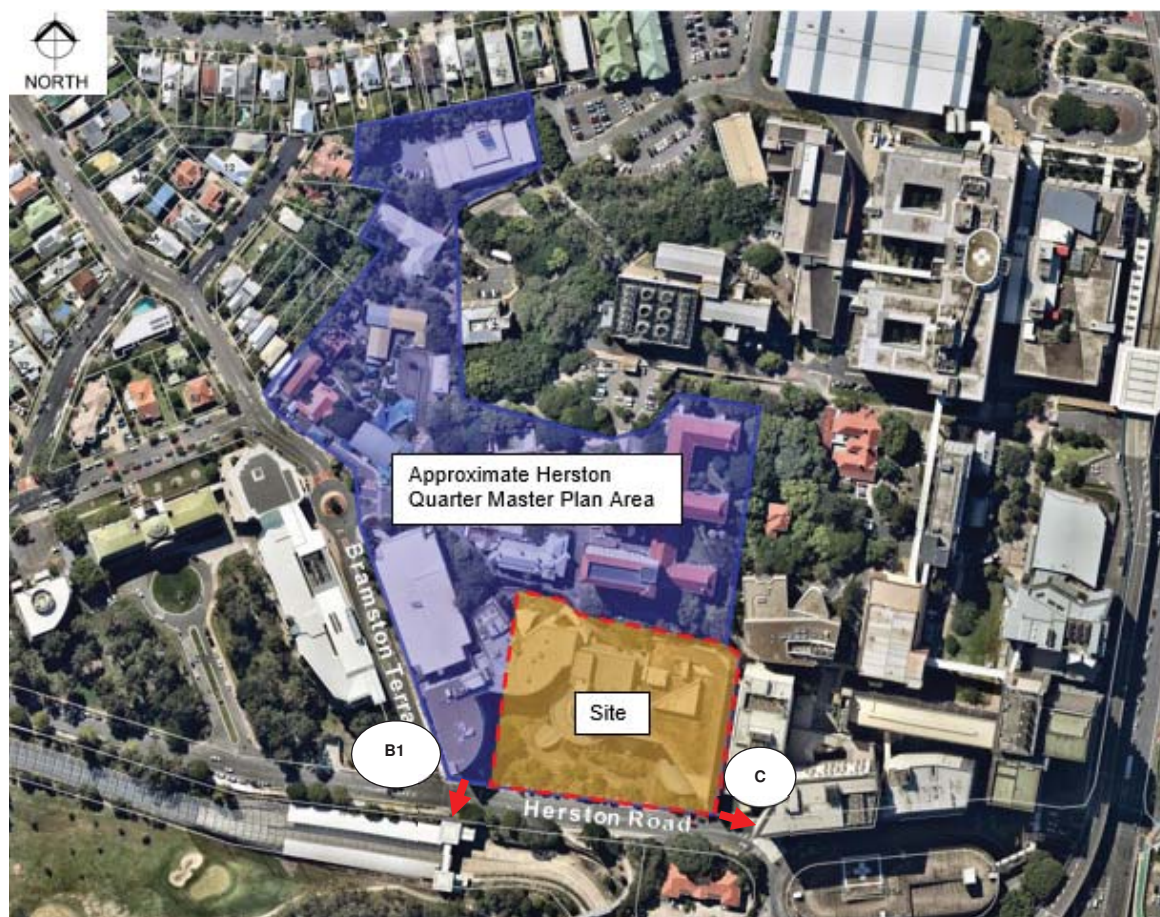


Figure 2-1: Site Location (Source: Nearmap)

2.1 LAWFUL POINTS OF DISCHARGE

Under existing conditions, the site discharges runoff to two points on Herston Road being locations B1 and C as indicated in **Figure 2-1** above. Drawing No. 16-002928-SK201 in **Appendix E** shows the existing discharge locations and the contributing site catchment delineation. The site will maintain the existing Lawful Points of Discharge under developed conditions with the peak flow analysis presented in **Section 4** undertaken to these locations.

3 STORMWATER QUALITY

This section demonstrates that the proposed stormwater quality management strategy for the site is adequate to meet the required WQO's as per *SPP* (2016) requirements. WQO's have been adopted from *Appendix 3* of the *SPP* (2016) as per **Table 3-1** below.

Table 3-1: Water Quality Objective for South East Queensland

Pollutant	Total Suspended Solids	Total Phosphorus	Total Nitrogen	Gross Pollutants
Load Reduction Target	80%	60%	45%	90%

To improve the quality of stormwater leaving the site, two treatment trains comprising of proprietary stormwater quality treatment devices are proposed. The modelled proprietary devices are Stormwater360's PSorb StormFilter and EnviroPod (SFEP) systems.

A system is proposed for each Discharge Location (B1 and C). The PSorb StormFilter systems (or approved equivalent) will be located upstream of the Discharge Locations while the EnviroPods (or approved equivalent) will be installed within field inlets and gully pits located throughout the Site.

- Catchment B1 - The StormFilter system treating Catchment B1 has been sized with consideration of the development of the future buildings to the west as the filter system is proposed to be located in the void under the Spanish Steps. Construction of the StormFilter system is to take place concurrently with the Spanish Steps as post construction access to the void will be limited. The EnviroPods required to treat the catchment will be integrated into the upstream stormwater drainage network.
- Catchment C - The StormFilter system treating Catchment C runoff is proposed to be located in the traffic island of the SRACC car park entrance with the maintenance access manhole located within the traffic island. Flows will discharge the system east to the existing stormwater drainage network in Herston Road. Refer to Drawing No. **16-002928-SK203** in **Appendix E** for further details.

EnviroPod units (or approved equivalent) will be provided within field inlets and gully pits within the Site to remove gross pollutants, coarse sediments and associated pollutants (e.g. hydrocarbons, metals and some nutrients) before runoff enters the PSorb StormFilter systems. Refer to the Stormwater360 Drawing No. **EP_TYP_01D** for the typical EnviroPod cross-section located within the garden and Drawing No. **TG_Into_EPOD** for the EnviroPod located within the slab found in **Appendix E**.

Both end of line PSorb StormFilter systems (or approved equivalent) will be located below ground level. PSorb StormFilter systems are passive filtration systems that use filter cartridges to remove both particulate bound and soluble pollutants. They will remove sediments, oils, grease and nutrients from stormwater runoff. Refer to Stormwater360 Drawing No. **24C690_3150SFMH** and **34C-DET-TANK-STD-690** for the configuration of the StormFilter systems proposed for the SRACC and Spanish Steps respectively. Refer to **Figure 3-1** for a typical section of Stormwater360's StormFilter system.

It should be noted that the proprietary treatment devices have been adopted for this stormwater management at this phase of the project. It is acknowledged that alternate proprietary treatment systems may be considered at a later phase so long as the alternate system meets the required performance criteria.

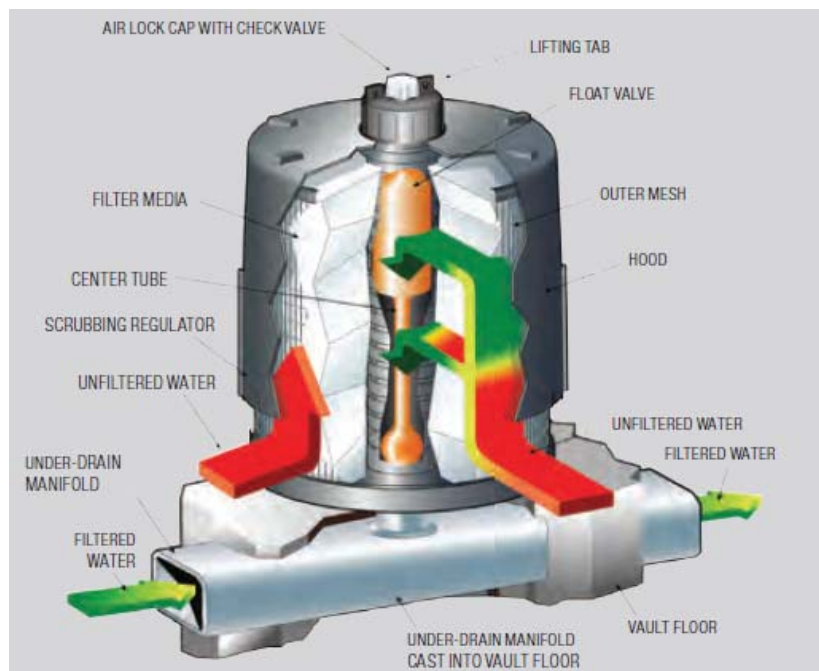


Figure 3-1: SW360 Filter Cartridge (Source: SW360)

3.1 MUSIC MODELLING SETUP

Water quality modelling has been undertaken using MUSIC Version 6.2.0, developed by the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC enables the user to conceptualise the transfer of pollutants through a stormwater drainage system and provides an aid in quantifying the effectiveness of the proposed stormwater quality treatment train. MUSIC only provides quantitative modelling for Total Suspended Solids (TSS), Total Phosphorous (TP), Total Nitrogen (TN) and Gross Pollutants (GP). The MUSIC model was setup generally in accordance with Water by Design *MUSIC Modelling Guidelines* (2010).

3.1.1 METEOROLOGICAL DATA

Six minute pluviographic data was sourced from the Bureau of Meteorology (BOM) for Brisbane Aero (Station No. 040223). In accordance with *Table 3.1* from *Music Modelling Guidelines* (2010), the 10 year period from 1st January 1980 to 31st December 1989 has been adopted for the rainfall duration. The mean annual rainfall for this period based on six minute pluviograph data from the Brisbane Aero station is 1,155mm.

3.1.2 SOURCE NODES

A split catchment approach has been adopted in accordance with the MUSIC Modelling Guidelines (2010). The split catchment approach separates the catchment areas into surface areas representing roof, road, ground and open space. The Site has been divided into two catchment as shown on Drawing No. **16-002928-SK202** in **Appendix E**. See **Table 3-2** for the adopted source node areas and fraction impervious values. For further details of the MUSIC model setup, refer to **Appendix B**.

Table 3-2: MUSIC Source Node Areas

Catchment	Surface	Area (ha)	Fraction Impervious (%)
B1	Roof	0.556	100
	Road	0.061	75
	Ground	0.374	80
	Open Space	0.086	50
B1a	Bypass	0.095	50
C	Roof	0.605	100
	Road	0.082	75
	Ground	0.075	80
	Open Space	0.058	50

3.1.3 TREATMENT NODES

3.1.3.1 ENVIROPODS

Stormwater360 EnviroPods (with a high-flow bypass rate of 20L/s each) were modelled in MUSIC using a GPT Treatment Node. The treatment node was provided by Stormwater360 and included the configuration of pollutant removal efficiencies. **Table 3-3** below outlines the minimum number of EnviroPods required to meet the WQOs for each Site catchment. All areas within the corresponding catchment, including roofs, require EnviroPod treatment.

Table 3-3: EnviroPods

Catchment	Min. number of EnviroPods
B1	4
C	3

3.1.3.2 STORMFILTERS

Stormwater360's PSorb StormFilter cartridges were modelled in MUSIC using the Generic Treatment Node. The treatment nodes were configured in accordance with Stormwater360 specifications. Detention storage available within the Stormfilter vault was modelled using the Detention Basin Treatment Node and configured in accordance with Stormwater360 specifications. **Table 3-4** below outlines the minimum number of PSorb StormFilter cartridges (690mm high) required. All areas within the corresponding catchment require StormFilter treatment.

Table 3-4: PSorb StormFilter Cartridges (690mm High)

Catchment	Min. number of StormFilter Cartridges
B1	34
C	24

3.1.4 MUSIC MODELLING RESULTS

Table 3-5 presents the MUSIC modelling results for the overall Site.

Table 3-5: MUSIC Model Results

Pollutant	WQO	Site Load Reduction	WQO Achieved?
Total Suspended Solids (kg/yr)	80%	82%	Yes
Total Phosphorus (kg/yr)	60%	67%	Yes
Total Nitrogen (kg/yr)	45%	45%	Yes
Gross Pollutants (kg/yr)	90%	94%	Yes

The results demonstrate that the overall stormwater quality management strategy achieves the WQOs required under the *SPP* (2016).

4 PEAK FLOW INVESTIGATION

Analysis has been undertaken to determine the change peak flows from the site between existing and post development conditions. A peak flow mitigation strategy has been designed to ensure the site will not result in adverse impacts to the existing downstream drainage network within Herston Road. The peak flow investigation was undertaken using the hydrological Watershed Bounded Network Model (WBNM) which was calibrated to the Rational Method calculation in accordance with BCC requirements.

4.1 EXISTING SCENARIO

The existing scenario analysis was undertaken utilising both WBNM and Rational Method calculations. The results determined from the Rational Method calculations were used to verify loss and lag parameter configuration adopted in the WBNM. Peak flows determined in the existing scenario have been used for comparison with developed scenario to determine the impact of developing the Site.

4.1.1 CATCHMENT DATA

Site catchment areas and fraction impervious values indicated in **Table 4-1** were delineated as per Drawing No. **16-002928-SK201** in **Appendix E**. Catchment areas have been determined using site survey data, aerial imagery and BCC eBimap contour and drainage data. Fraction impervious values were measured from aerial imagery obtained from Nearmap and survey information.

Table 4-1: Existing Scenario Catchment Details

Catchment	Area (ha)	Fraction Impervious (%)
A1	0.289	30
A2	1.266	57
A4	0.210	57
A5	0.184	42
B1	1.219	80
B2	0.734	90
C	0.902	87
D	0.508	58
EXT-A3	0.435	70
EXT-A6	0.587	30
EXT-A8	0.649	60
EXT-A9	0.429	70
EXT-A10	0.401	80

Note: **Table 4-1** presents the Catchments of the overall Herston Quarter Master Plan, the Site specific Catchment are indicated in **BOLD** above.

4.1.2 RATIONAL METHOD CALCULATIONS

The Rational Method calculation was undertaken under existing conditions to verify the WBNM peak flows at Discharge Location A1. This catchment has been used to verify the WBNM model as this Discharge point has the largest contributing catchment, furthermore the analysis to be undertaken for the overall master plan analysis will adopt the following WBNM configuration. Refer to **Appendix C** for the detailed Rational Method calculation.

4.1.2.1 CATCHMENT DETAILS

The overall catchment to Discharge Location A1 (discharge to the existing stormwater drainage network within Butterfield Street to the north of the site) includes Catchments A1 to A5 as presented in **Table 4-1** and Drawing No. **16-002928-SK201**. A fraction impervious (Fi) value of 0.56 has been determined based on aerial imagery and the survey information provided. A Coefficient of Runoff (C_{10}) value of 0.81 was determined based on the Fi value in accordance with the *Queensland Urban Drainage Manual (QUDM, 2013)*.

4.1.2.2 TIME OF CONCENTRATION

The time of concentration (T_c) is an input parameter used to derive relevant rainfall intensities for the QRM calculation. The following travel time components were adopted to estimate the time of concentration:

- Roof to Main System: A standard inlet time of 5 minutes in accordance with *Table 4.6.3* of the *QUDM (2013)*.
- Kerb and Channel Flow: A kerb and channel flow time of 1 minute was determined in accordance with *Section 4.6.8* of *QUDM (2013)*.
- Assumed Pipe Flow Velocity: An assumed channel velocity time of 3 minutes was determined in accordance with *Section 4.6.3(a)* of *QUDM (2013)*.

Based on the above travel time components a T_c of 9 minutes was determined.

4.1.2.3 RAINFALL DATA

Rainfall intensity data was obtained from BCC's guidelines.

4.1.2.4 RATIONAL METHOD PEAK FLOW RESULTS

Peak flows at Discharge Location A1 were determined for the verification of the WBNM analysis. Refer to **Table 4-2** below for the calculated peak flows and **Appendix C** for the detailed calculations.

Table 4-2: Existing Rational Method Peak Flow Results at Discharge Location A1

AEP (%)	Peak Flows (m ³ /s)
63	0.75
39	1.03
18	1.47
10	1.74
5	2.11
2	2.72
1	3.17

4.1.3 EXISTING WBNM ANALYSIS

WBNM was used to determine the peak flows for the 63% to 1% AEP storms under existing conditions at each of the sites discharge location. The existing WBNM was verified at Discharge Location A1 against the Rational Method calculation peak flows presented in **Section 4.1.2**.

4.1.3.1 CATCHMENT DETAILS

Catchments areas and fraction impervious values were adopted as per **Table 4-1** in **Section 4.1.1**.

4.1.3.2 RAINFALL DATA

Design storm rainfall data in WBNM was generated using log normal intensities and geographical factors adopted from the WBNM rainfall database.

4.1.3.3 INFILTRATION LOSSES & LAG PARAMETER VALUE

Various Infiltration Loss and Lag Parameter values were trialled to determine WBNM results that correlated best with the Rational Method peak flows. To ensure an accurate calibration for all AEP storm events, Loss and Lag values were determined for minor and major storm events separately. Refer to **Table 4-3** below for the adopted Loss and Lag values.

Table 4-3: WBNM Loss Parameters Existing Verification Scenario

Parameter	Minor Storm (63% - 5% AEP) Value	Major Storm (2% - 1% AEP) Value
Pervious Initial Loss (mm)	20	0
Pervious Continuing Loss (mm/hr)	2.5	2.5
Impervious Initial Loss (mm)	1	1
Lag Parameter (C) Value	1.3	1.3

4.1.3.4 MODEL VERIFICATION

Table 4-4 below indicates the comparison between the Rational Method and the WBNM peak flows under existing conditions at Discharge Location A1 with the loss and lag values presented in **Table 4-3**.

Table 4-4: Existing Rational Method Peak Flow Results at Discharge Location A1

AEP (%)	RM Peak Flows (m ³ /s)	WBNM Peak Flows (m ³ /s)	Percentage Difference (%)
63	0.75	0.69	-9
39	1.03	1.06	3
18	1.47	1.59	8
10	1.74	1.90	9
5	2.11	2.30	9
2	2.72	2.66	-2
1	3.17	3.05	-4

*Negative values represent a lower WBNM peak flow.

As indicated in **Table 4-4** above, there is good correlation between the WBNM and Rational Method results, with an average difference of -4% between the Rational Method calculation and the WBNM peak flows. This is considered to be an acceptable verification of the WBNM.

Therefore, the loss and lag parameter values provided in **Table 4-3** were adopted for all remaining analysis.

4.1.4 EXISTING WBNM PEAK FLOW RESULTS

Using the verified WBNM, existing peak flows were determined for the site's discharge locations as outlined in **Table 4-5** below. Existing results were used for comparison to the developed peak flows to determine the validity of the proposed mitigation strategy.

Table 4-5: Existing WBNM Peak Flows at Site Discharge Locations

AEP (%)	Discharge Location B1 (m ³ /s)	Discharge Location C (m ³ /s)
63	0.28	0.22
39	0.39	0.30
18	0.53	0.41
10	0.62	0.47
5	0.73	0.55
2	0.82	0.62
1	0.93	0.70

4.2 DEVELOPED SCENARIO

The WBNM model was updated to incorporate the developed site conditions and peak flow mitigation strategies to demonstrate no adverse impacts downstream. The following mitigation strategies were implemented to manage the increase in peak flows from Catchment B1 and C:

- Discharge Location B1– A detention tank is proposed to mitigate the increase peak flows from Catchment B1. Located in the void under the Spanish Steps, the detention tank has been sized to mitigate the increase in peak flows from the upstream SRACC courtyard, Spanish Steps with consideration of the future buildings to the west of the SRACC before discharging flows to the existing network flowing west within Herston Road. Refer to **Section 4.2.4** for further details of the detention tank.
- Discharge Location C – A reduced catchment approach has been investigated to maintain existing peak flows from Discharge Location C. By limiting the catchment to the extent of the SRACC roof, a reduction in peak flows from the site has been achieved. Refer to **Section 4.2.1** for the amended catchment details.

4.2.1 CATCHMENT DETAILS

Catchment areas and fraction impervious values indicated in **Table 4-6** were delineated as per Drawing No. **16-002928-SK202** in **Appendix E**. Site specific catchments have been highlighted in **bold** below.

Table 4-6: Developed Scenario Catchment Details

Catchment	Area (ha)	Fraction Impervious (%)
A1	0.403	95
A2	0.555	50
A4	0.210	50
A5	0.375	74
A7	0.540	85
B1	1.076	87
B1a*	0.095	50
B2	0.740	75
C	0.819	95
D	0.508	58
EXT-A3	0.428	70
EXT-A6	0.585	30
EXT-A8	0.649	60
EXT-A9	0.429	70
EXT-A10	0.401	80

*Catchment B1a represents the portion of Catchment B1 bypassing quantity treatment.

4.2.2 RAINFALL DATA

The same rainfall data as per the existing scenario was adopted, refer to **Section 4.1.3.4** for further details.

4.2.3 INFILTRATION LOSSES & LAG PARAMETER VALUE

The existing scenario Infiltration Losses and Lag Parameter values as outlined in **Section 4.1.3.3** have been adopted for the developed scenario analysis to ensure consistency between peak flow comparisons.

4.2.4 MITIGATION STRATEGY – DETENTION TANK

An underground detention tank is proposed to reduce the peak flows back to or below existing values. The proposed detention tank will receive and detain all flows from Catchment B1 before discharging the site. Further details of the proposed detention tank are provided in **Table 4-7** below.

Table 4-7: Detention Tank Details

Proposed Detention Tank		Details
Surface Area		100m ²
Total Detention Volume		150m ³
Detention Volume to 1% AEP		96m ³
Detention Tank Invert Level (m AHD)		RL 28.0
Detention Tank Top Level (Bottom Level of Ceiling) (m AHD)		RL 29.5
1% AEP WSL (m AHD)		RL 28.96
Circular Orifice 1		2x 375mm RCP at IL 28m AHD
Circular Orifice 2		375mm RCP at IL 28.3m AHD
Overflow Weir		0.5m Wide at IL 28.9m AHD

Note: See the detailed calculations in **Appendix C**.

4.2.5 DEVELOPED PEAK FLOW RESULTS

Modelling was undertaken for all recurrence interval storm events up to and including the 1% AEP storm event. A comparison between peak flows for the existing and developed scenarios are provided in the following sections.

4.2.5.1 PEAK FLOW COMPARISON AT DISCHARGE LOCATION B1

Refer to **Table 4-8** below for the existing and developed peak flow comparison and the expected water surface levels (WSL) within the detention tank.

Table 4-8: Existing and Developed Peak Flow Comparison at Discharge Location B1

AEP (%)	Existing Peak Flows (m ³ /s)	Developed Peak Flows (m ³ /s)	Percentage Difference (%)	WSL in Tank (m AHD)
63	0.28	0.25	-8	28.37
39	0.39	0.36	-9	28.45
18	0.53	0.47	-11	28.57
10	0.62	0.54	-11	28.65
5	0.73	0.64	-12	28.74
2	0.82	0.78	-5	28.84
1	0.93	0.89	-4	28.96

*Negative values represent a decrease in peak flows.

As demonstrated in **Table 4-8**, modelling results for the proposed detention tank indicates peak flows from Discharge Location B1 are reduced below existing peak flows. It is also noted that, the difference in peak flows (from existing to develop) is significant which is expected to allow for the development of the future buildings to the west of the SRACC.

4.2.5.2 PEAK FLOW COMPARISON AT DISCHARGE LOCATION C

Refer to **Table 4-9** below for the existing and developed peak flow comparison at Discharge Location C

Table 4-9: Existing and Developed Peak Flow Comparison at Discharge Location C

AEP (%)	Existing Peak Flows (m ³ /s)	Developed Peak Flows (m ³ /s)	Percentage Difference (%)
63	0.22	0.21	-5
39	0.30	0.28	-7
18	0.41	0.37	-8
10	0.47	0.43	-9
5	0.55	0.50	-9
2	0.62	0.56	-9
1	0.70	0.64	-9

*Negative values represent a decrease in peak flows.

As demonstrated in **Table 4-9**, modelling results indicate that by reducing the developed catchment to Discharge Location C will reduce the site peak flows to below existing conditions.

5 DRAINAGE STRATEGY

The design of the stormwater drainage strategy for the SRACC, surrounding courtyard and Spanish Steps (upstream of the StormFilter system and detention tank) has been undertaken by MPR Hydraulic & Fire Services Consultants. Refer MPR's documentation for further details.

The following stormwater drainage strategy has been designed for the portions of the site outside of MRP Consulting's scope as outlined above;

- Detention Tank Outlet – A stormwater drainage network incorporating a series of Reinforced Concrete Pipes (RCP) and manholes allows flows discharging the detention tank to be conveyed to Discharge Location B1 whilst maintaining pipe grades of approximately 1%. Refer to Drawing No. **SCR-C-321** in **Appendix E** for the stormwater drainage long-section proposed under the Spanish Steps.
- Northern B1 Catchment – Runoff from the northern B1 catchment will be collected and conveyed by a pit and pipe network located within garden bed along the rock wall. The proposed pit and pipe will convey it the runoff to the stormwater drainage network designed by MRP (ultimately being conveyed to the Catchment B1 treatment devices). Refer to Drawing No. **16-002928-SK203** in **Appendix E** for the location of the drainage network and the point of connection to the courtyard network.
- Rock-face Runoff – Under existing conditions flows have been observed discharging through the rock face (to the north of the existing Children's Hospital). However due to limited access, geotechnical testing to quantify the magnitude of flows discharging from the rock face have not been possible. Under developed conditions a spoon drain is proposed to collect and convey these flows to Discharge Location C. Assumptions have been made to assist the sizing of the proposed spoon drain, further details of the magnitude flows from the rock face will be provided once geotechnical tests are undertaken (tests will be undertaken once access is available after the demolition of the existing Children's Hospital). Refer to Drawing No. **16-002928-SK204** in **Appendix E** for the location and configuration of the proposed drainage network.

6 CONCLUSION

This technical report provides an integrated stormwater quality and quantity strategy to support the development of a portion of Herston Quarter Master Plan Area. The development, located on Herston Road, consists of an 8 storey building, raised courtyard and connecting Spanish Steps with provisions for future development to the west of the site. The analysis provided in this technical report has demonstrated the following:

- **Stormwater Quality:** MUSIC modelling has demonstrated that the proposed stormwater quality management strategy incorporating two Enviropod and StormFilter systems provides adequate pollutant load reduction to meet the WQOs as outlined in the SPP (2016) for the overall site.
- **Stormwater Quantity:** Analysis using WBNM has determined the existing and developed peak flows discharging from the site. Modelling has demonstrated the proposed detention tank located in the void under the Spanish Steps will mitigate the increase in peak flows from the site at Discharge Location B1. Furthermore by reducing the development catchment to Discharge Location C, developed peak flows are reduced to below existing conditions at this location. Therefore modelling has appropriately demonstrated the development will not result in adverse impacts to the existing drainage network within Herston Road.

It is recommended that the proposed stormwater management strategy be accepted for the SRACC and Spanish Steps development.

7 REFERENCES

- Brisbane City Council, City Plan 2014.
- Department of Energy and Water Supply (31 October 2013), Queensland Urban Drainage Manual (Vol. 1 3rd Ed.);
- Department of State Development, Infrastructure and Planning (July 2016), State Planning Policy;
- Healthy Waterways (2010), MUSIC Modelling Guidelines Version 1.0;
- Healthy Waterways (2016), Stormwater Compliance: MUSIC Modelling;
- Institution of Engineers, Australia (1987), Australian Rainfall and Runoff;

8 DISCLAIMER

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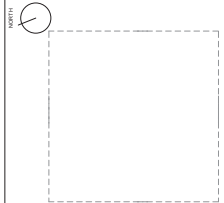
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APPENDIX B	MUSIC
APPENDIX C	DETAILED CALCULATIONS
APPENDIX D	MAINTENANCE GUIDELINES AND CHECKLISTS
APPENDIX E	DETAILED DESIGN DRAWINGS

APPENDIX A SITE LAYOUT



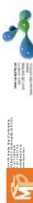
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SRACC

HERSTON ROAD,
HERSTON, QLD.

CONTRACT NO.

GENERAL ARRANGEMENTS PLAN

PROJECT NO.

012375

SRCC-0400

DATE

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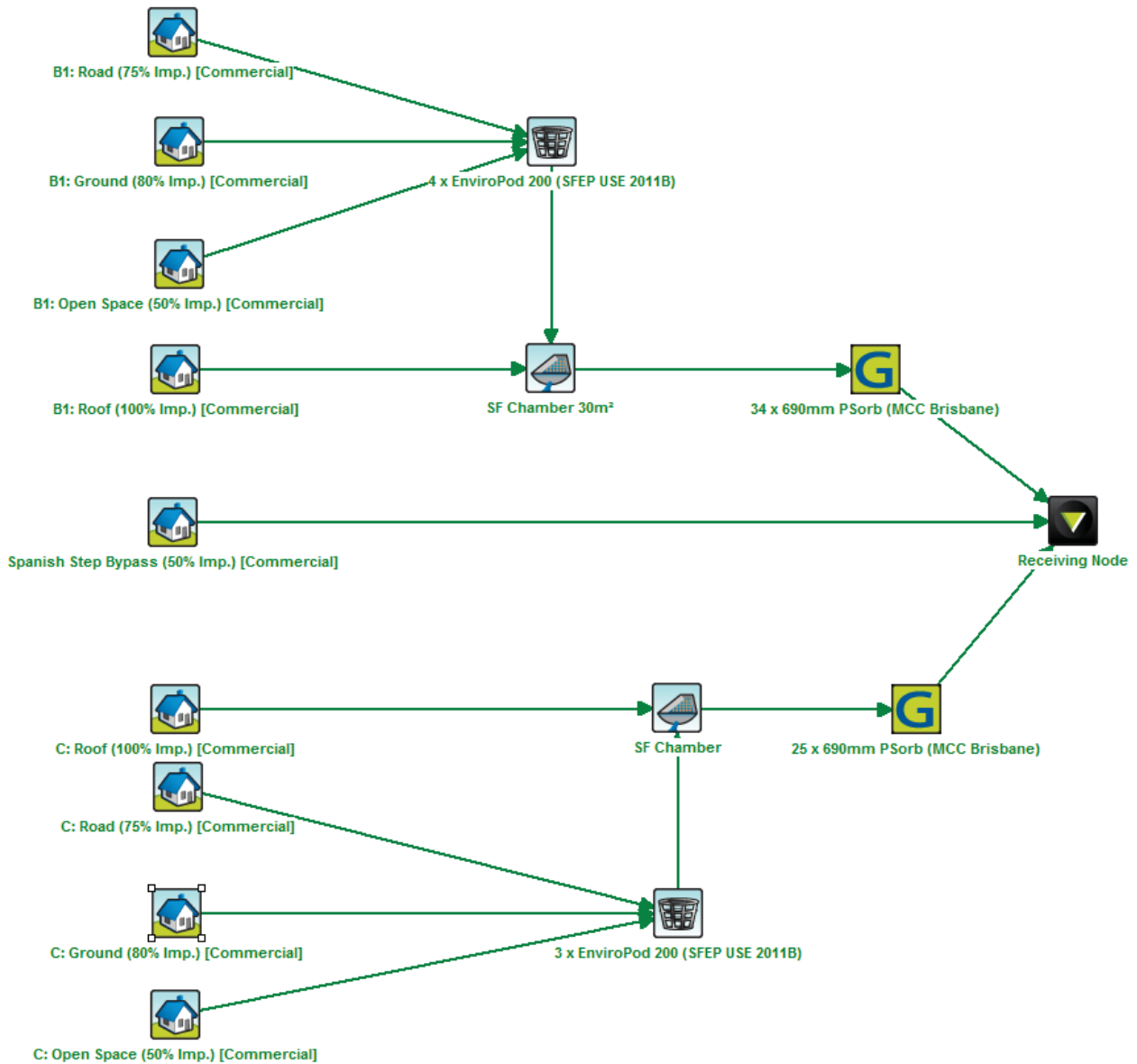
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APPENDIX B MUSIC

MUSIC Configuration



MUSIC Source Node Inputs

MUSIC Source Node Areas							
Discharge Location	Catchment	Area (ha)	Roof (100% Imp)	Road (75% Imp)	Ground (80% Imp)	Open Space (50% Imp)	Bypass (50% Imp)
B1	B1	1.077	0.556	0.061	0.374	0.086	-
	B1a	0.095	-	-	-	-	0.095
C	C	0.820	0.605	0.082	0.075	0.058	-

Results

Results			
Parameter	Source	Residual	Reduction
Flow (ML/yr)	19.80	19.80	0
Total Suspended Solids (kg/yr)	2200.00	398.00	82
Total Phosphorus (kg/yr)	6.47	2.13	67
Total Nitrogen (kg/yr)	63.40	34.90	45
Gross Pollutants (kg/yr)	459.00	29.20	94

APPENDIX C DETAILED CALCULATIONS

Discharge Location A1 - Rational Method Calculation

File:

H:\16\002928 - Herston Quarter_Watpac\9_Technical\Stormwater\Quantity\Rational Method Calculations.xlsx\Discharge A1

Date:

17/07/03

Job:

16-002928

By:

MP

Locality:

BCC

IFD Ref:

IFD_BCC

IFD Source:

Table 7.2.2.2.A of Chapter 7, Infrastructure Design Planning Scheme Policy, City Plan (2014)

Time of Concentration Calculations

Reference	Equation Type / Method	Area (ha)	Length (m)	Av. Slope (%)	Pipe Diameter (mm)	Velocity (m/s)	Wetted Area (m ²)	Wetted Perimeter (m)	Hydraulic Radius R	Roughness (Mannings/ Hortons)	Sub Total (mins)	tc (min)
Table 4.6.3 QUDM (2013)	Roof to Main System	4.45		1.0							5	5
4.6.8 QUDM (2013)	Kerb and Channel Flow		120	10.0							1	
4.6.3 (a) QUDM (2013)	Assumed Pipe Flow Velocity		240			1.5					3	
											Adopted tc	9

C10 VALUE

Select Development Category	Development Category	f _i	1I ₁₀ (mm/hr)	C10
Table 7.3.3.1.A of Chapter 7, Infrastructure Design Planning Scheme Policy, City Plan	Commerical and Indutsrrial	0.56	70	0.81
		Adopted C10		0.81

Flow Calculations (QUDM 4.03.1)

tc (min)					9
ARI	Cy	tc _{I_y}	A (ha)	Q (m ³ /s)	
1	0.65	94	4.450	0.755	
2	0.69	121	4.450	1.032	
5	0.77	154	4.450	1.468	
10	0.81	173	4.450	1.736	
20	0.85	200	4.450	2.108	
50	0.93	236	4.450	2.724	
100	0.97	263	4.450	3.168	

Detention Tank Calculations

Date: 17/07/03

User: MP

Note: Storage and outlet calcs for Detention Tank

STAGE - STORAGE RELATIONSHIP FOR WBNM

RL	Area. (m2)	Vol. (m ³)	Accumulated Vol. (m ³)
28	100	0	0
28.1	100	10	10
28.2	100	10	20
28.3	100	10	30
28.4	100	10	40
28.5	100	10	50
28.6	100	10	60
28.7	100	10	70
28.8	100	10	80
28.9	100	10	90
29	100	10	100
29.1	100	10	110
29.2	100	10	120
29.3	100	10	130
29.4	100	10	140
29.5	100	10	150

OUTLET CALCULATIONS

Type	Circular Orifice 1	Circular Orifice 2	Overflow Weir
Length	20	20	
Width			
No.	2	1	
Dia (m)	0.375	0.375	
Height (m)			
Area (m ²)	0.110	0.110	
Invert Level (R.L.)	28.0	28.3	28.9
Inflow Level (R.L.)	28.0	28.3	
D/S HGL (R.L.)	0.000	0.000	
f (Fig 1.6)	0.029	0.029	
Pit Loss (K)	1	1	
Hyd Cond. (k) (m/hr)			
Depth Media d (m)			
Perimeter (m)			0.5
% Opening Clear *			

STAGE - DISCHARGE RELATIONSHIP FOR WBNM

RL	Accum. Vol. (m ³)	Circular Orifice 1	Circular Orifice 2	Overflow Weir	Total Discharge (m ³ /s)
28	0	0.00	0.00	0.00	0.00
28.1	10	0.03	0.00	0.00	0.03
28.2	20	0.08	0.00	0.00	0.08
28.3	30	0.16	0.00	0.00	0.16
28.4	40	0.25	0.01	0.00	0.27
28.5	50	0.34	0.04	0.00	0.38
28.6	60	0.38	0.08	0.00	0.46
28.7	70	0.42	0.13	0.00	0.55
28.8	80	0.46	0.17	0.00	0.63
28.9	90	0.50	0.19	0.00	0.69
29	100	0.53	0.21	0.03	0.77
29.1	110	0.56	0.23	0.07	0.87
29.2	120	0.59	0.25	0.14	0.98
29.3	130	0.63	0.27	0.21	1.10
29.4	140	0.66	0.28	0.29	1.23
29.5	150	0.68	0.30	0.39	1.37

APPENDIX D MAINTENANCE GUIDELINES AND CHECKLISTS

Operations and maintenance

StormFilter® EnviroPod Treatment Train



Our waterways. Our future.

Stormwater360
AUSTRALIA

Device details			
Location of Device			
GPS Coord	N:	E:	D P Number:
Relevant Council			
Company			
Contact	Email		Ph
Engineer			
Contact	Email		Ph
SFEP Treatment			
1			
2			
Frequency of Inspection/Maintenance		Maintenance Estimated Annual Cost	
	Inspections (time/year)	Major Maintenance	StormFilter
StormFilter			EnviroPod
			TOTAL
EnviroPod			

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Maintaining the EnviroPod® Stormwater Gully Pit Insert

Maintenance is as integral to every stormwater management system as it is to any other item of machinery or equipment.

The primary purpose of the EnviroPod® Stormwater Gully Pit insert is to filter out and remove pollutants from entering our waterways. To ensure that the EnviroPod® continues to function effectively, it is important that the pollutants it captures are periodically removed, and the filtration components properly cleaned.

Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site, as well as the occurrence of events such as chemical spills or excessive sediment loading due to site erosion or extreme storms. Similarly, the system should be inspected after all major storm events.

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
- 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
- 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
- ¼ Turn Bayonet Fittings
- Under drain manifold to convey treated stormwater to the receiving environment.

Components of any proposed treatment train or technology



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, i.e. 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 (e.g. 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 and Maintenance Guidelines.

Introduction



This manual has been designed to assist you with cleaning and maintaining the EnviroPod Stormwater Gully Pit Insert, using the methods recommended by the manufacturer.

The cleaning process and methods described cover all aspects of the system, including:

- Removing the grate
- Cleaning the filter bag
- Inspecting the unit
- Rejuvenating the filter bag
- Re-installing the filter bags.

The manual should be used in conjunction with your site's traffic management and safety plans, as well as other appropriate Stormwater360 (IES) documents such as the IES Employee Health and Safety Manual. We also recommend that maintenance and cleaning contractors, or device owners, develop their own site-specific health and safety activity plans to ensure a safe work environment.

*** Please note:** This manual consists primarily of the processes and tasks associated with the hand maintenance and inductor maintenance procedures. It does not include details of the site's traffic management 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.

Why cleaning and maintenance are so vitally important

Adhering to the inspection and maintenance schedule of each stormwater treatment device is essential to ensuring that it works properly throughout its estimated design life.

During each inspection and clean, details of the mass, volume and type of material that has been collected by the device should be recorded. This data will assist with the revision of future management plans and help determine maintenance interval frequency. It's also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner. To ensure consistency, we recommend that one person be responsible for overseeing the management of the maintenance and cleaning process.

Maintenance of your stormwater management system is essential to ensuring ongoing at-source control of stormwater pollution. Maintenance also helps prevent structural failures (e.g. prevents blocked outlets) and aesthetic failures (e.g. debris build up).

Health and safety



The EnviroPod has been designed to trap and retain pollutants in stormwater runoff, helping to maintain the quality of water entering our aquatic ecosystems. Depending on the nature of your site, pollutants can range from organic material such as leaves and sticks through to debris such as broken glass, syringes or other potentially harmful materials.

Access to gully pits containing EnviroPods may require removing heavy protective grates, while cleaning such pits may entail working in confined spaces. For these reasons, all aspects of maintaining and cleaning your EnviroPod require careful adherence to Occupational Health and Safety (OH&S) guidelines. Doing so will ensure that all maintenance personnel are adequately protected and have been properly trained before taking part in any specialist activities. The same level of care needs to be taken to protect non-work personnel in and around the site, while appropriate traffic control measures must be put in place where collection pits are situated in, or adjacent to, roadways or car parks.

* The procedures indicated in the Operations section of this manual are recommended as the safest and most efficient manner of conducting the maintenance of EnviroPod units (Section 2), 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 made should always comply with general safe work practices.

Cleaning of EnviroPod filters and StormFilters is a specialist activity. The material collected by the devices can be harmful, and needs to be handled correctly. For example, 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 dangers associated with the cleaning and handling of material in the filter bags, precaution needs to be taken with activities such as removing the grate as well as with managing the traffic, pedestrians and other non-worker personnel at the site. The general workplace hazards associated with working outdoors also need to be taken into account.

2.1 Personnel health and safety

All contractors and staff must comply with all current workplace 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 workplace health and safety legislation
- Ensure that employees understand and accept their responsibility to practice and promote a safe and healthy work environment.

* Take proper care. Pollutants can range from organic materials such as leaves and sticks through to debris such as broken glass, syringes or other potentially harmful materials.

While cleaning and maintaining filters, all relevant precautions must be taken to prevent contact with sediment and litter.

This includes wearing the following personal protective and safety equipment:

- 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 been observed or pits located in areas associated with such activities.



2.2 Traffic control

Stormwater collection pits are typically situated either in or on roads and car parks, or adjacent to roads in a footpath or swale. Traffic control requirements across all such locations differ with most of the state and local road authorities requiring the same controls to be implemented whether the work is to be conducted on the road or on the road reserve.

As traffic requirements differ depending on road usage and the specific road configuration, separate 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.

State government publications such as the NSW RMS *Traffic Control at Work Sites* safety manual outline the signage requirements, placement of barricades or witches hats and the positioning of traffic control personnel that's required when working on public roads. For increased safety, IES recommends that the maintenance vehicle be used to shield the work area from oncoming traffic.

Photo 1 shows the maintenance vehicle with cones placed around and positioned to shield the work area. **Photo 2** shows the 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.

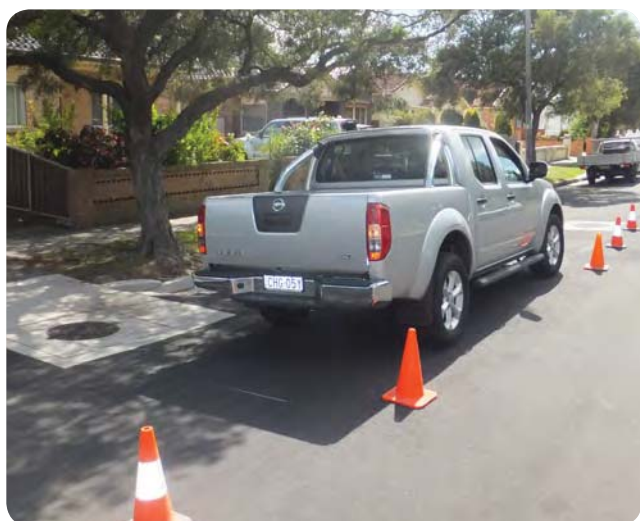


Photo 1 Vehicle positioned near pit, preventing traffic from passing close to the pit.

2.3 Confined spaces

Confined space entry procedures are not included as part of this manual. For IES employees these procedures are included as part of the IES Safety Manual. It is recommended that all contractors evaluate their own needs for confined space entry and compliance with Occupational Health and Safety regulations.

When repairs or maintenance activities cannot be conducted from the surface, and there is a need to enter and work in a confined space, only staff with current confined space training are permitted to operate in a confined space. Appropriate measures and controls must be put in place to meet confined space entry requirements. At all times the necessary safety equipment must be worn, and where gas or oxygen hazards occur, only staff trained in its use will use breathing apparatus gear. **Non-trained staff must not go into confined spaces.**

* Confined spaces pose a serious safety hazard for all personnel; however during the normal maintenance procedures there should be no reason to enter a confined space and all maintenance procedures are able to be conducted from the surface.



Photo 2 Head-on view, indicating the placement of the vehicle near the pit.

Operations



EnviroPod units need to be regularly inspected to determine whether they require maintenance or cleaning. This process involves several steps, and may require two or more maintenance personnel working together, as well the use of specialised equipment such as a hydraulic lifting arm or an inductor truck with a vacuum hose.

As gully pit grates are usually quite heavy, it is important that correct lifting procedures are adopted, and that the area surrounding the opened pit is shielded from access to non-work personnel.

If inspection reveals that the filter bag needs to be emptied and rejuvenated, the entire unit should also be examined to ensure that all connections and joints are sound. Any material that has accumulated in the overflow diversion channels or outlet pipes also needs to be removed, with those areas then being flushed. Where required, filter bags may need to be cleaned or repaired, and all waste material must be disposed of according to local guidelines at either an approved disposal site or transfer station.

This section outlines the procedures for cleaning the EnviroPod units. It has been written so that someone who has never previously encountered a stormwater pit or an EnviroPod unit can carry out such maintenance by simply following the outlined steps.

3.1 Maintenance and monitoring of EnviroPod filters

To ensure that each EnviroPod unit achieves optimal performance, 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. While the bag has a greater storage capacity, 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), which will make them more difficult to lift and empty
- material near the top of the bag can be re-suspended during high to extreme rainfall events
- 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 is conducted following moderate to extreme rainfall events, especially when preceding months have had little or no rainfall. This increased frequency of monitoring is necessary as there is a greater accumulation of surface contamination during low rainfall periods, which will then enter the unit with the higher volumes of runoff generated during a major rainfall event. It is also important 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

These are the steps for opening a hinged pit grate:

- 1 Insert the lifting hooks beneath the grate.
(Position indicated in **Photo 3**)
- 2 Check hinge point is not damaged and debris is not caught in the hinge area.
- 3 Fully open pit grate, ensuring that the grate will stay in the open position without any external forces applied. Grates that do not remain open without being held should be removed or secured during cleaning or maintenance activities. **Photo 4** indicates the grate being opened and grate resting freely in the open position, respectively.

*** Please 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 the grate to fall into the pit. Such pit grates can be removed using the method indicated below for non-hinged grates.



Photo 3 Lifting the grate



Photo 4 Fully open grate



Photo 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 (see **Photo 6**). Concrete lids may have Gatic lifting points, a key arrangement or holes in the lid, which may require special equipment such as Gatic lifters
- 2** Position each person either side of the grate (see **Photo 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 (see **Photo 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



Photo 6 Insert hook near edge of grate



Photo 7 Position each lifter either side of the grate



Photo 8 Lift grate and move grate to one side



Photo 9 Lift grate above the support frame



Photo 10 Reinstated non hinged grate

3.3 Cleaning methods

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

3.3.1 Cleaning using an inductor truck

Follow these steps to safely and efficiently clean the EnviroPod using an inductor truck:

- 1 Open gully pit (See Section 3.2)
- 2 Place the inductor hose over the material collected in the filter bag and switch on the inductor
- 3 Using the inductor hose, suck out 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 that there are no sharp edges on the inductor hose that can damage the filter bag
- 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. This debris can also be collected using the inductor truck
- 9 All gully pit waste is to be removed from the pit
- 10 Check the EnviroPod unit (Section 3.4)
- 11 Check filter bag (Section 3.4)
- 12 Reinstate filter bag and gully pit lids



Photo 11 Cleaning an EnviroPod using the inductor method

3.3.2 Hand maintenance

To clean the EnviroPod manually by hand, follow these steps:

- 1 Open gully pit (See Section 1)
- 2 Place the lifting hooks in the lifting loops of the filter bag (See **Photo 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
- 4 Lift the bag vertically off the supporting frame, ensuring that no undue pressure is placed on the filter bag. (See **Photo 13**)
- 5 Lift the bag clear of the stormwater pit (See **Photo 14**)
- 6 Position the bag over the truck or other collection vehicle, taking hold of the loops at the base of the bag (See **Photo 15** and **Photo 16**)
- 7 Lift and empty the filter bag by holding the bottom lifting loops only (See **Photo 17**)
- 8 Completely empty the filter bag (See **Photo 18**)
- 9 Brush the filter bag with a stiff brush to remove bound sediment from the filter pores
- 10 Check the EnviroPod unit (Section 3.4)
- 11 Check the filter bag (Section 3.5)
- 12 Reinstate filter bag, ensuring bag is installed the correct way (See **Photo 19** and **Photo 20**)
- 13 Reinstate gully pit lids (See **Photo 21** and **Photo 22**)



Photo 12 Place the lifting hooks through the bag loops



Photo 13 Lift the bag from the cage and support frame



Photo 14 Lift the bag from the stormwater pit



Photo 15 Lift the bag onto the collection vehicle



Photo 16 Grab the bottom lifting loops



Photo 17 Lifting the bottom bag loops empty the filter bag



Photo 18 Completely empty the contents of the filter bag



Photo 19 Reinstall filter bag



Photo 20 Ensure that the unit is positioned correctly, with the lifting loops on the inside



Photo 21 Correctly installed filter bag



Photo 22 Installed filter bag and sealed pit

* Please note: Under no circumstances are gully pit sediments to be backwashed into the gully pit.



Photo 23 Check seals are pushed against the pit walls



Photo 24 Check joining rivets (two piece unit shown above)

3.4 Unit inspection

After the EnviroPod filter bag has been 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 **Photo 23**)
- The plastic pit seals should be inspected for unit movement or damage (See **Photo 24**)
- The cage should be inspected for damage or movement.

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

If spare parts are required, Stormwater360 is able to provide these at a cost to the owner of the EnviroPod unit, although these parts may also be obtained from other suppliers.

*** Please 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.

3.5 Filter bag inspection and rejuvenation

After the filter bags have been emptied and cleaned, they should be inspected to evaluate their condition. Given the nature of stormwater, the filter bag may become considerably clogged with fine sediment or damaged by various objects in stormwater as well as fauna. Sharp material 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 cleaned using several different methods. If the techniques described in the general maintenance sections above do not adequately 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, taking care not to transfer the contamination elsewhere. Wastewater from the process should be collected and disposed of correctly.
- Remove the filter bags from the pits and the support rings and wash the bags in an industrial washing machine.

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



Photo 25 Slightly clogged filter bag, indicated by the brown stain on in the centre of the bag



Photo 26 A clean used filter bag

3.5.2 Damaged filters

Damaged filter bags can often be repaired, provided the damage is small. Small tears in the fabric may occur due to several reasons, however the overall strength and 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 cleaning torn bags so as not to spill the collected material into the pit.

Small tears may be 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. If large tears are present, the filter bag may need to be replaced as it is no longer able to function as intended.

3.6 Disposal of material

All gully pit wastes 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.

Emergency procedures



Spills and blockages can have an immediate impact on the performance of a stormwater management system, and can potentially result in serious damage to built infrastructure as well as the surrounding waterways and wetlands.

In these types of emergencies, it is important to act quickly to remediate the problem by removing affected sediment or clearing the cause of the blockage, so that the system can resume normal and effective functioning as soon as possible.

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:

- 1** Check EnviroPod overflow 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 it can be easily cleared by hand or a steel rod.
- 2** If overflow is clear and surface flooding still exists remove EnviroPod and check outlet pipe for blockages.
- 3** 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 sidewalls 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.
- 4** 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:
 - a** Remove excess debris by hand or brush the side of the filter.
 - b** Lift and place filter ring through the filter box and into cage.
 - c** Remove Filter box.
 - d** Lift cage containing filter bag and ring out of the pit.
 - e** Unblock outlet pipe.

The Stormwater Management StormFilter®

For almost two decades the Stormwater Management StormFilter® has helped meet the most stringent stormwater quality requirements.

The system has been continually tested and refined, to ensure it achieves maximum reliability and performance.

As a best management practice (BMP) system, it removes the most challenging target pollutants – including fine solids, soluble heavy metals, oils and total nutrients (including soluble) – by using a variety of media to achieve site-specific pollutant removal objectives.

StormFilter® overview



1.1 Description

StormFilter is a passive, flow-through stormwater filtration system consisting of vaults that house rechargeable cartridges filled with a variety of filter media, and is 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 utilise pre-manufactured vaults. The cast-in-place units are customised 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 fast-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 meet design water quality objectives, which are subject to legislation regulated by local government authorities and other relevant environmental bodies. MUSIC modelling software is used to determine pollutant loads from a site, influenced by a number of factors such as site area, imperviousness and land use. Pollutant load reduction capabilities, based on third party testing, allows the number of StormFilter cartridges required to achieve the relevant objectives to be established. Cartridges are designed to treat a peak flow between 0.7 and 1.6 litres/second, depending on the cartridge size used. For example, 10 standard sized cartridges (460mm) are able to treat 11 L/s, as each filter can treat 1.1 L/s.

Because of the highly porous nature of the granular filter media, the flow through a newly installed cartridge is restricted to 1 L/s (average 460mm), using a restrictor disc, to ensure adequate pollutant-media contact time.



Photo 27 Filter cartridge

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.

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, consisting 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. These can be either quarter turn connectors or in the older systems, threaded connectors.

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, these pollutants must be removed periodically 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 and 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.

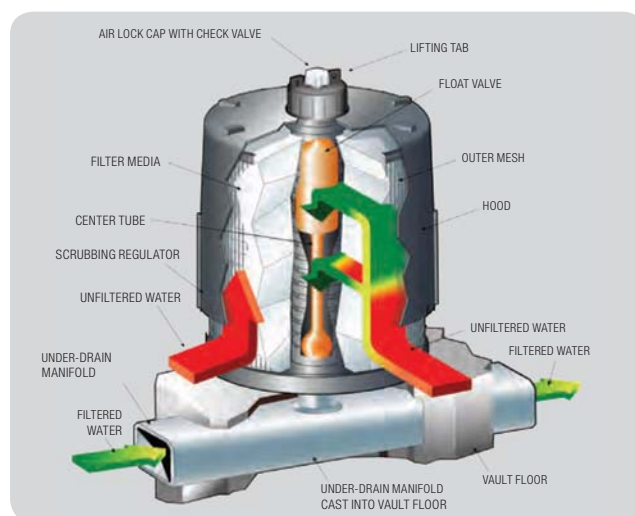


Figure 1 Filter cartridge

StormFilter[®] maintenance and performance expectations



To ensure the optimal and ongoing performance of the StormFilter, the system requires systematic inspection, cleaning and maintenance. This maintenance regime falls into two categories – ongoing minor inspection and maintenance, and major cleaning and maintenance. The maintenance frequency is largely determined by the conditions of each site, and the amount of sedimentation in the stormwater runoff that flows through the system. Unexpected events such as chemical spills, erosion or extreme storm activity require immediate inspection of the system, together with removal of debris or contaminated sediment, and where appropriate, replacement of the media cartridges.

While some maintenance activities can be completed by hand, others require specialised equipment such as an inductor truck with a vacuum hose. In all cases, it is important that maintenance staff are properly trained in the functioning of the StormFilter system and have a good knowledge of the correct procedures for disposing contaminated sediment as well as the methods for removing and installing StormFilter media cartridges.

At all times, appropriate safety equipment must be used, and Occupational Health And Safety (OH&S) guidelines adhered to.

2.1 Types of maintenance

Presently, procedures have been developed for two levels of maintenance:

- Inspection and/or minor maintenance
- 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 cleaning up 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** summarises 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	Litter and debris removal	Floatable objects or other litter is present in the filter. Remove to avoid hindrance of filtration and eliminate unsightly debris and litter.	Permanent removal from storm system.
StormFilter cartridges and containment structure	Cartridge replacement and sediment removal	Media has been contaminated by high levels of pollutants, such as after a spill.	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 2 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 occupational health and safety (OH&S) and disposal regulations should be followed. A general description of the maintenance activities follows.

Table 2 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.

Steps for Minor 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 access covers. 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 access covers 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 and grates etc.
- 7 Give particular attention to recording the level of sediment build-up on the floor of the vault 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 litter using a pole with a grapple or net on the end.
- 9 Close and fasten the access cover, 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.

* In the case of a spill, workers should abort maintenance activities until the proper guidance has been obtained.

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 access covers 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, and on top of the internal components.
- 8 Remove large loose debris and litter 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 access cover, 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 and cartridge replacement (and 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.

*** Please 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 is valid, and work procedures are strictly adhered to. If you are unsure, do not enter the vault and contact Stormwater360 immediately.

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 and on top of the internal components.
- 8 Ensuring safe working procedures are met, off load the replacement cartridges (16-39kgs each) and set aside.
- 9 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.
- 10 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.
- 11 Move the vacuum truck near the StormFilter vault on the down-wind side. Be sure that the truck is not too close to the vault so that fumes will not enter the vault. Make sure that the last 500mm of the nozzle is approximately 100-125mm in outside diameter.
- 12 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.
- 13 Once completed disconnect cartridges from vault floor and place hood back on cartridges
- 14 Using the appropriate lifting cap, attach the cable and remove the cartridge (up to 10kgs. each) from the vault. It is strictly prohibited to have personnel standing under suspended cartridges. Care must also 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 Stormwater360 is performing maintenance activities and damage is not related to discharges to the system.
- 15 Set the used cartridge aside or load onto the hauling truck.
- 16 Repeat steps 14 to 15 until all cartridges have been removed.
- 17 Remove deposited sediment from the floor of the vault. This can be accomplished by using the vacuum truck
- 18 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.
- 19 Using the boom, crane, or tripod, lower and install the new cartridges (typically 30kg for standard 460 cartridges). Once again, take care not to damage connectors.
- 20 Close and fasten the access cover, and remove safety equipment.
- 21 Make notes about the local drainage area relative to ongoing construction, erosion problems, or high loadings of other materials to the system.
- 22 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 3. 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 3 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 - Work clothes: Rubber boots, overalls, and gloves - Door bolt, wrench, proprietary lifters (e.g. Gatic) and miscellaneous Tools - Tape measure - Flashlight - Grapple or net pole - Record keeping forms - Litter/debris container	- Safety equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats - Work clothes: Rubber boots, overalls, and gloves - Door bolt, wrench, proprietary lifters (e.g. Gatic) and miscellaneous Tools - Tape measure - Flashlight - Grapple or net pole - Record keeping forms - Litter/debris container	- Safety equipment*: First aid, cones, barricades, flagging, flares, tape, vests, hard hats - Work clothes: Rubber boots, overalls, and gloves - Door bolt, wrench, Pentasocket and miscellaneous Tools - Tape measure - Flashlight - Grapple or net pole - Record keeping forms - 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 discs - Litter/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 travelled 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. Stormwater360 will determine disposal methods or reuse of the media contained in the cartridges. If the material has been contaminated with any unusual substance, the cost of special handling and disposal will be the responsibility of the owner.



SFEP StormFilter & EnviroPod Maintenance Data Sheet



Date:	Location:	GPS COORD:
System size:	Type: ☐ Cast-in-place ☐ Precast ☐ Linear	
Number of Cartridges:	Type of Cartridge: ☒ 460mm ☐ 690mm ☐ 310mm	
Filter Media: ☐ ZPG ☐ Perlite		
Type of EnviroPods:		Number of EnviroPods:
Personnel:		

STORMFILTER SYSTEM OBSERVATIONS

Last service:	
Sediment Depth on Vault Floor:	
Structural Damage:	
Cartridges submerged: ☐ Yes ☐ No	How deep:
Comments:	

ENVIROPOD SYSTEM OBSERVATIONS

Last service:
Amount of Sediment in Basket:
Structural Damage:
Comments:

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:		

STORMFILTER CARTRIDGE MAINTENANCE ACTIVITIES

Remove Litter and Debris	☐ Yes ☐ No	Details:
Sediment Removed from Vault Floor	☐ Yes ☐ No	Details:
Quantity of Sediment Removed (estimate?):		
Replace Cartridges	☐ Yes ☐ No	Details:
Minor Structural Repairs	☐ Yes ☐ No	Details:
Residuals (debris, sediment) Disposal Methods:		
Notes/Problems:		

ENVIROPOD MAINTENANCE ACTIVITIES

Number of Bags Replaced:	Clogged EnviroPods/Bags: ☐ Yes ☐ No
Comments:	

SFEP Treatment Train 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:	GPS COORD:
System size:	Type: ☐ Cast-in-place ☐ Precast ☐ Linear	
Number of Cartridges:	Type of Cartridge: ☐ 460mm ☐ 690mm ☐ 310mm	
Filter Media: ☐ ZPG ☐ Perlite		
Type of EnviroPods:		Number of EnviroPods:
Personnel Attending Inspection:		

STORMFILTER SYSTEM OBSERVATIONS

Last service:	
Sediment Depth on Vault Floor:	
Structural Damage:	
Cartridges submerged:	☐ Yes ☐ No How deep:
Comments:	

ENVIROPOD SYSTEM OBSERVATIONS

Last service:	
Amount of Sediment in Basket:	
Structural Damage:	
Comments:	

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:		

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See the Stormwater360 Australia standard quotation or acknowledgement for applicable warranties and other terms and conditions of sale.

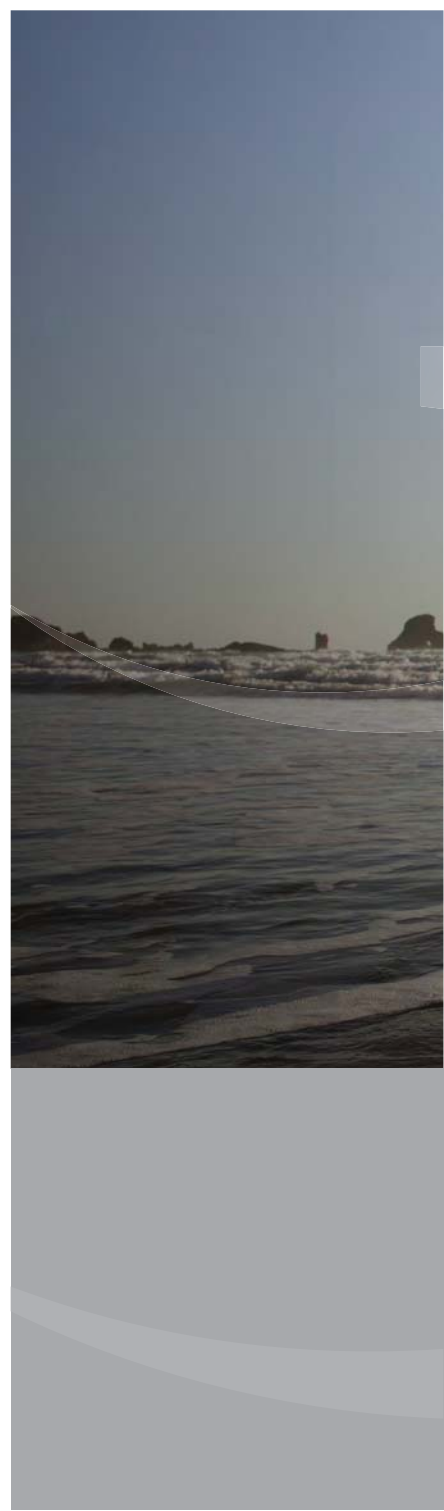
The product(s) described may be protected by one or more of the following US, Australian and New Zealand patents: 5,322,629; 5,624,576; 5,707,527; 5,759,415; 5,788,848; 5,985,157; 6,027,639; 6,350,374; 6,406,218; 6,641,720; 6,511,595; 6,649,048; 6,991,114; 6,998,038; 7,186,058; 705,778; 711,957; 326,257; 332,517; 780,521; 336,761; 2,991,114 or other patents pending.

Stormwater Management StormFilter is a licensed trademark of Stormwater360 Australia.

Stormwater360 supplies and maintains
a complete range of filtration,
hydrodynamic separation, screening and
oil/water separation technologies.

Call 1300 354 722

www.stormwater360.com.au



Maintenance Agreement



Maintenance Agreement

Tax Invoice

Agreement No:

NATIONAL MAINTENANCE SOLUTIONS PTY LTD ABN: 42 156 044 834 (**we or us or our**) agrees to provide to the customer named in the Schedule below (**you**) the services described in the Schedule below (the **Maintenance Services**) in relation to the equipment described in the Schedule below (the **Equipment**) and, where applicable, any Additional Services (as later defined) and you agree to accept the provision of the Maintenance Services and, where applicable, the Additional Services (collectively the **Services**) on the terms and conditions set out in this document (including any Special Conditions set out in this document). This document will not bind us until it is signed by our authorised officer, at which time a contract for the provision of Services in relation to the Equipment (this **Agreement**) will arise without the need for us to give any further notice.

Schedule

FACILITIES MANAGEMENT PLAN			
Facilities Management Plan applies:		Yes	No
Facilities Management Plan No:		Date of Facilities Management Plan:	

CUSTOMER	
Name:	
Trading as:	ACN/ABN:
Address:	
Telephone number:	Facsimile number:
Contact person:	Email address:

EQUIPMENT		
Model	Description	Serial No(s) (if applicable)

EQUIPMENT LOCATION	

MAINTENANCE SERVICES			
Maintenance Services cover the cleaning and maintenance of the Equipment and the removal from the Equipment of Stormwater Waste (up to the Maximum Pollutant Load per Cartridge referred to below), on and subject to the Terms and Conditions set out in this document. Stormwater Waste means pollutants and concentrations generated in typical stormwater run-off defined as the pollutants (gross pollutants suspended solids, metals, nutrients and hydrocarbons only) that exist within stormwater run-off that are generated from fully developed and stabilised (once building and construction work ceases) residential, commercial and light industrial (non-manufacturing) catchments and exhibit “typical” pollutant concentrations only as prescribed in “Managing Urban Stormwater: Harvesting and Reuse” published by the Department of Environment and Conservation NSW, 2006.			
Estimated Maintenance Frequency:	Cartridge Type:	690mm	460mm
Maximum Pollutant Load per Cartridge (in kgs):			

MAINTENANCE SPECIFICATIONS	

Services Agreement Terms and Conditions

- Definitions and Interpretation** In this Agreement, unless the context otherwise requires: **Billing Period, Commencement Date, Equipment, Equipment Location, Facilities Management Plan, Maintenance Specifications, Maintenance Services, Maintenance Services Charge, Services, Stormwater Waste and Term** are as defined or referred to in the Schedule; **ACL** means The Australian Consumer Law as set out in Schedule 2 of the Competition and Consumer Act 2010 (Cth); **Additional Services** has the meaning provided in clause 3(2); **Additional Services Charges** has the meaning provided in clause 4(4); **Annual Recurrence Interval (ARI)** has the meaning provided by the Bureau of Meteorology's Australian Water Information Dictionary; **Business Day** means any day on which banks are open for business in Australia, other than a Saturday or Sunday; **GST** means goods and services tax levied under A New Tax System (Goods and Services Tax) Act 1999 (Cth) and related legislation; **Hazardous Waste** means any waste material classified as "Hazardous Waste" or otherwise identified as having specific handling and disposal requirements by the Department of Sustainability, Environment, Water, Population and Communities [**Schedule** means the Schedule to this Agreement; words importing the singular include the plural and vice versa; headings shall be ignored in construing this Agreement; if any party is comprised of more than one person, those persons' obligations are joint and several; references to a party include references to that party's legal personal representatives, successors and permitted assigns; references to persons include references to corporations and other bodies and entities; references to statutes include all statutes amending, consolidating or replacing such statutes; and a reference to "\$" or "dollars" is a reference to the lawful currency of the Commonwealth of Australia.
- Term** This Agreement commences on or with effect from the Commencement Date and, subject to clause 13, shall continue for the Term.
- Provision of Services** (1) We will provide the Maintenance Services at the Equipment Location at the times specified in clause 7. For the avoidance of doubt, Maintenance Services does not include any cleaning or maintenance of, removal from or other services in relation to the Equipment for or in respect of any Hazardous Waste, aggregates, concrete, debris, plastic, shingle, sediment or other waste contained on or within runoff derived from a 1 in 5 year Annual Recurrence Interval (ARI) or flood event, construction run-off or any other waste material other than Stormwater Waste. (2) We may, and you authorise us to, provide services in relation to the Equipment which are outside of and/or in addition to the Maintenance Services (**Additional Services**) (provided that where the cost of any Additional Services exceeds the Authorised Additional Services Amount specified in the Schedule, we will obtain your consent prior to undertaking those services). Such Additional Services may include, without limitation: (a) the cleaning or maintenance of the Equipment that does not fall under the scope of Maintenance Services (including, without limitation, the removal from the Equipment of any Stormwater Waste which is in excess of the Maximum Pollutant Load per Cartridge specified in the Schedule); (b) any additional time expended by us (including reasonable waiting time for any of our personnel at the Equipment Location) in performing the Maintenance Services as a result of any failure by you to comply with your obligations under clause 9 or any operation of the Equipment under abnormal conditions (including mains fluctuations or any contamination of the Equipment); (c) any additional time or costs expended by us arising from any delays or difficulties in accessing the Equipment Location or the Equipment (or any part of it) which are outside of our control; (d) the supply and installation of consumables specific to the Equipment, other than in accordance with the Maintenance Specifications or other than where such consumables can be supplied and installed as part of the Maintenance Services without significant additional expense or increase in the time required to perform the Maintenance Services; (e) the supply of any consumables used by us to perform the Maintenance Services, in particular, any substances used to clean and maintain the Equipment; (f) clearing any gas accumulated in the Equipment that cannot be cleared by natural means (for example, ventilation); (g) the cleaning, maintenance, removal, handling, uplifting, treatment or disposal of any Hazardous Waste or any other waste material other than Stormwater Waste; (h) undertaking any remedial work in respect of the Equipment in accordance with clause 8(3); (i) undertaking any instruction or training in respect of your safety procedures and other requirements for accessing the Equipment Location; (j) pedestrian or traffic control; (k) removing pit covers using hydraulic or other similar means.
- Charges** (1) If a Facilities Management Plan is referred to in the Schedule, then the charges for the Maintenance Services are included in the Rental Payments payable under the Facilities Management Plan. (2) If a Facilities Management Plan is not referred to in the Schedule, you must pay the Maintenance Services Charges at the times referred to in the Schedule. (3) If a Facilities Management Plan is not referred to in the Schedule, on each anniversary of the Commencement Date, we may increase the Maintenance Services Charges prevailing at the relevant time by the greater of: (a) any increases in the Index over the preceding 12 months; and (b) an amount (determined by us) of not more than the Specified Percentage Increase set out in the Schedule. "Index" means the Consumer Price Index (All Groups weighted average of eight capital cities) published by the Australian Bureau of Statistics (or an equivalent index, in the event that such index is discontinued or suspended). A certificate by us as to any increase in charges will be conclusive and binding on you. (4) Whether or not a Facilities Management Plan is referred to in the Schedule, we will invoice you separately at rates from time to time prevailing for the provision of any Additional Services (**Additional Services Charges**), which must be paid by you within 14 days of the date of each such invoice. Where current rates are specified in the Schedule, these will be subject to change in accordance with any changes in prevailing rates. (5) You must reimburse us on demand for the amount of any GST payable on any supply made by us under or in connection with this Agreement. (6) You must pay interest on any amount due but unpaid under this Agreement at 2% calculated from the due date for payment until the date on which the amount is paid. Such interest shall be calculated daily and is payable on demand. (7) You must pay all payments under this Agreement by way of direct debit or in such other manner as we may from time to time direct in writing. (8) All payments by you must be paid on demand or as provided for in the Schedule in funds that are immediately available to us. If a date for payment: (a) is not a Business Day, payment must be made on the preceding Business Day; or (b) falls on a day not contained in a month, the payment must be made on the last day of that month.
- Hazardous Waste** (1) You must promptly inform us of any spill or activity on or proximate to the Equipment Location or catchment which may result in Hazardous Waste entering the Equipment. (2) We will not be liable for removing, uplifting, treating or disposing of any Hazardous Waste unless specifically agreed between you and us, in which case such services will be provided by us as Additional Services pursuant to clause 3(2). You must provide an appropriate facility at the Equipment Location to enable us to store any Hazardous Waste and pay or reimburse us all costs and expenses incurred by us in handling any Hazardous Waste. (3) You acknowledge that we may be convicted or otherwise held liable under statute or regulation as a result of your actions, inaccuracies or omissions in the description of the Hazardous Waste and its collection, deposit or retention. You agree to indemnify us and keep us indemnified against all losses, liabilities, fines, costs, expenses and damages in respect of any prosecution, claim, action or conviction against us arising from or in connection with any such action, inaccuracy or omission by you.
- Maintenance Personnel** (1) We will perform the Services using appropriately trained and qualified personnel. (2) We may subcontract the provision of any of the Services to a third party, provided that we will remain primarily liable to you for the provision of such Services.
- Maintenance Times** (1) We will perform the Maintenance Services on the Equipment at the Estimated Maintenance Frequency specified in the Schedule and in accordance with the Maintenance Specifications. (2) The Maintenance Services and any Additional Services will be performed at a time agreed upon between you and us. If either party is unable to comply with the agreed time for the Services as a result of unforeseen events outside that party's control, it will notify the other party as soon as reasonably practicable, and you and us will agree another suitable time. (3) We will perform the Services between 9.00am and 5.00pm on Business Days agreed between you and us. If you require the Services to be performed outside these hours, an after-hours surcharge may be charged by us at our prevailing standard rates.
- Certification Services** (1) Where "Certification Services" is selected in the Schedule, we will at the Estimated Certification Frequency specified in the Schedule: (a) inspect the Equipment to ascertain whether it complies with our operations and maintenance procedures and requirements (the **Requirements**); (2) where the Equipment complies with the Requirements, issue a certificate to you confirming this (**Compliance Certificate**); and (3) where the Equipment does not comply with the Requirements, advise you and work with you to complete any remedial work required to enable a Compliance Certificate to be issued, provided that the cost of such remedial work will be borne by you and any services provided by us will be charged as Additional Services, unless they fall within the scope of the Maintenance Services.
- Consumables** If a Facilities Management Plan is referred to in the Schedule, we will replace any consumables supplied with the Equipment (including, without limitation, enviropod bags and broken filter cartridges) requiring replacement due to reasonable wear and tear or normal operating conditions (**Authorised Conditions**). For the avoidance of doubt, we will not be responsible for the replacement of any such consumables where the requirement for replacement arises other than due to Authorised Conditions, including, without limitation, a flood event or deliberate damage caused to the consumables.
- Co-operation** (1) You must: (a) operate the Equipment at all times in accordance with the Facilities Management Plan (if applicable) and any specifications for the Equipment; and (b) comply with our reasonable instructions and directions in respect of the maintenance and operation of the Equipment. (2) You must grant access to the Equipment Location and make the Equipment available to our personnel and subcontractors to allow the Services to be provided. (3) You must notify us of any special safety regulations or other requirements for accessing the Equipment Location that must be observed by us during the performance of the Services and you must, prior to the commencement of any such Services, explain such requirements to our personnel and provide such additional training in respect of such requirements as may be reasonably necessary to ensure that our personnel can provide the Services safely and effectively. If any such instruction or training results in a significant increase in the time required to perform the Services, we may charge Additional Services Charges in respect of such increase. (4) Where we attend the Equipment Location to perform any Services, you must inform our personnel of any problems or other variations from the normal operation of the Equipment and will provide such other information as our personnel may reasonably require in relation to the operation of the Equipment. (5) You must not, at any time without our prior written consent: (a) modify, repair or maintain the Equipment or permit any third party to do so; or (b) use any accessories or consumables as part of the operation of the Equipment other than in accordance with the specifications for the Equipment.
- Acknowledgements** (1) You acknowledge and agree that: (a) to the full extent permitted by the ACL and other applicable laws, all express and implied terms, conditions, representations, warranties and guarantees are excluded and we do not give any guarantee, representation, warranty or assurance as to the care and skill, fitness for purpose or time for supply in relation to the provision of the Services. Nothing in this Agreement, however, will exclude, restrict or modify any rights or remedies which you may have for failure to comply with a guarantee under the ACL or any other applicable law; (b) to the full extent permitted by the ACL and other applicable laws, we are not liable for any indirect, consequential or economic loss or damage (including, without limitation, loss of profit) arising under or in connection with this Agreement; and (c) in any event, to the full extent permitted by the ACL and other applicable laws, our liability under or in relation to this Agreement or the provision of the Services (to the extent that the ACL does not apply) or for failure to comply with a guarantee under the ACL (subject to section 64A(3) of the ACL) (to the extent that the ACL applies), is limited to, at our option, one or more of the following: (i) in the case of goods supplied, to one or more of the following (as we may determine): replacing the goods or supplying equivalent goods, repairing the goods, paying the cost of replacing the goods or of acquiring equivalent goods, or paying the cost of having the goods repaired; (ii) in the case of services supplied, to one or more of the following (as we may determine): supplying the services again or paying the cost of having the services supplied again. (2) You acknowledge that the Services and any replacement parts or consumables supplied in connection with the Services will be supplied to you for business purposes. (3) You must: (a) immediately notify us where you become aware of any problem with or damage to the Equipment; and (b) take all reasonable steps to mitigate the effect of any problem or damage. (4) Where appropriate, reconditioned parts may be used instead of new spare parts. We will own any parts removed from the Equipment.
- Insurance** You must, at your own cost, effect and keep current throughout the Term with a reputable and solvent insurer: (a) insurance for such amount of cover as is reasonably required by us against any loss, damage or injury of any kind whatever and however caused to any person or property arising out of the Equipment or its use, under a policy covering all such risks, including claims by third parties; and (b) insurance against any other loss, damage, injury or risk which we may reasonably require from time to time.
- Termination** (1) We may terminate this Agreement if: (a) you breach any provision of this Agreement and fail to rectify that breach within ten (10) Business Days of written notice from us; or (b) you enter into, or any steps are taken to have you enter into, liquidation, provisional liquidation, receivership, receivership and management, administration, bankruptcy or any arrangement, reconstruction or composition with your creditors or any of them, or a controller is appointed with respect to any of your assets, you become unable to pay your debts to any person as they become due or you otherwise become insolvent; or (c) if a Facilities Management Plan is referred to in the Schedule, the Facilities Management Plan is terminated. (2) Termination of this Agreement is without prejudice to any remedies available to us and any rights or obligations of the parties that accrued prior to the time of termination.
- Representations and Warranties** (1) You represent and warrant to us that: (a) you have full authority and all necessary consents to enter into and perform your obligations under this Agreement; and (b) the execution and performance by you of this Agreement will not result in a breach of, or constitute a default under, any instrument to which you are a party or by which you are bound or violate any laws. (2) If you enter into this Agreement as a trustee of a trust (the Trust), then, you represent and warrants to us that: (a) you enter into this Agreement for a proper purpose of the trust; (b) you have power and authority under the Trust to enter into this Agreement; and (c) you have the right to be indemnified fully out of the trust property before the Trust's beneficiaries for all liabilities you incur under this Agreement.
- General** (1) We will not be responsible for any delay or failure to perform our obligations under this Agreement to the extent that such delay or failure is due to any cause beyond our reasonable control. (2) You must not assign, transfer or otherwise deal with any of your rights under this Agreement without our prior written consent. We may assign, transfer or subcontract any of our rights and obligations under this Agreement without your consent. (3) No waiver of any breach of this Agreement will be effective unless such waiver is in writing and signed by the party against whom such waiver is claimed. No waiver of any breach will be deemed to be a waiver of any other or subsequent breach. (4) You irrevocably authorise us to set off without notice any money held by us on any account of yours against any money owing by you to us or any of our related bodies corporate. You must not exercise any right of set-off on any account. (5) This Agreement will be governed by and construed in accordance with the laws of New South Wales. (6) If any provision of this Agreement is found to be invalid or unenforceable in any jurisdiction, it will have no force or effect in that jurisdiction and will be severed from this Agreement in that jurisdiction without affecting the remaining provisions and without affecting the operation of this Agreement in any other jurisdiction. (7) You authorise us to insert the Commencement Date in the Schedule once the date of delivery of the Equipment is known (if a Facilities Management Plan is not referred to in the Schedule) and to complete and amend any other blank, incomplete or inaccurate particular appearing in the Schedule and to otherwise complete all necessary formalities to render this Plan complete and enforceable. (8) Any notice to or by a party to this Agreement: (a) must be in writing addressed to the other party or parties to this Agreement; (b) may be delivered in person, by pre-paid post or by facsimile transmission; and (c) is regarded as given by the sender and received by the addressee: (i) if by delivery in person, when delivered to the addressee; (ii) if by pre-paid post, on the third day after posting; and (iii) if by facsimile transmission, when transmitted to the addressee (provided that a report from the sending machine confirms successful transmission).

OTHER	
Certification Services	Estimated Certification Frequency:
Authorised Additional Services Amount: \$	

TERM	
	If a Facilities Management Plan is referred to in this Schedule: the Term is the "Term" referred to in the Facilities Management Plan and the Commencement Date is the "Commencement Date" referred to in the Facilities Management Plan.
	If a Facilities Management Plan is not referred to in this Schedule:
	Commencement Date - the date of delivery of the Equipment:
	Term: months from the Commencement Date

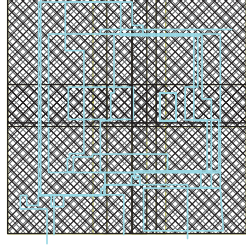
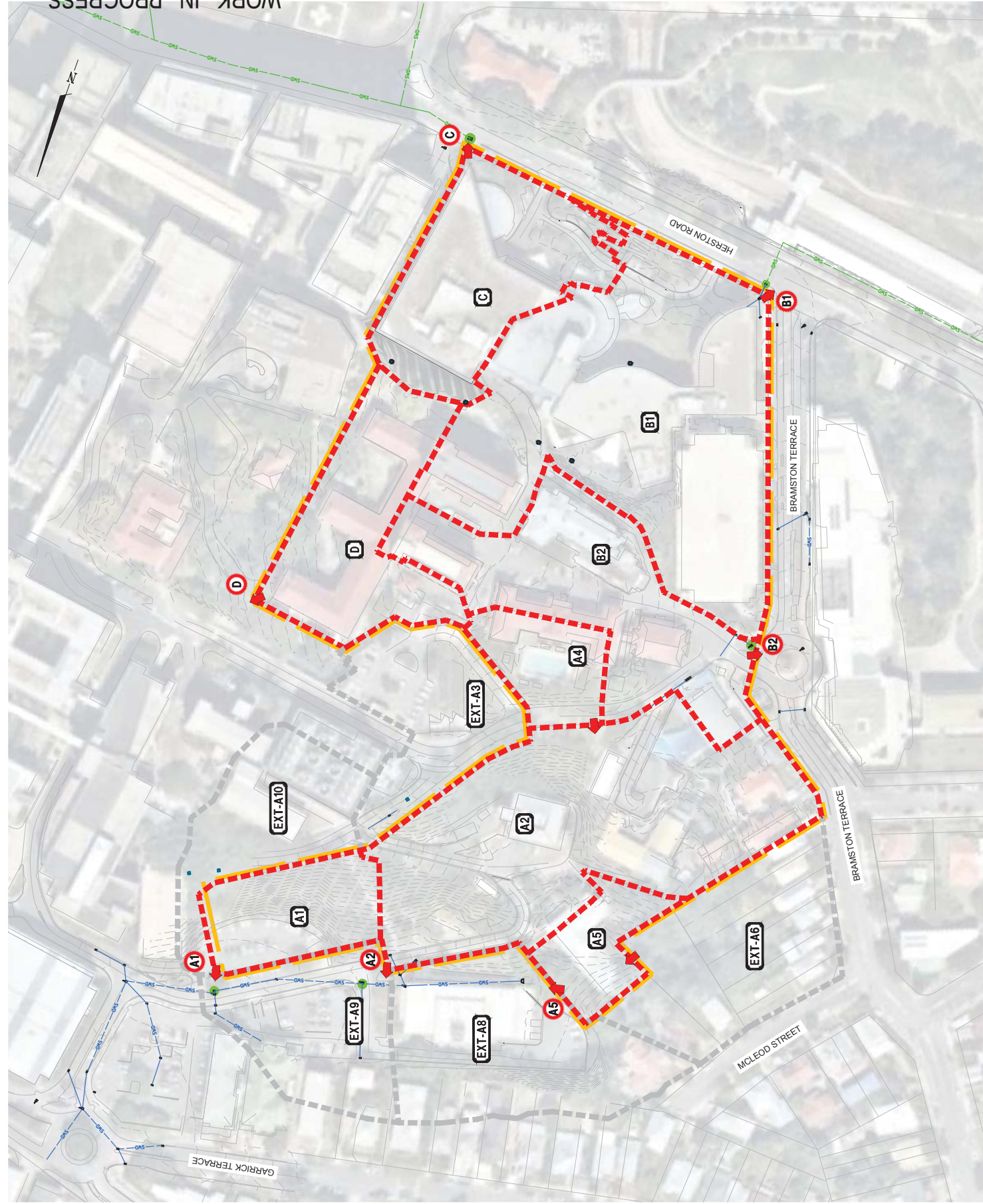
SERVICE CHARGES	
	If a Facilities Management Plan is referred to in this Schedule: the charges for the Maintenance Services are included in the Rental Payments payable under the Facilities Management Plan. Any Additional Services will be charged at our prevailing rates and invoiced separately.
Billing Periods:	Monthly Quarterly Half-Yearly Yearly
Maintenance Services Charge:	\$ plus \$ GST = \$ per billing period
Maintenance Services Charges are due and payable in advance on the _____ day of each Billing Period throughout the Term and are subject to adjustment in accordance with the terms and conditions set out in this document. Any Additional Services will be charged at our prevailing rates and invoiced separately.	
Specified Percentage Increase (for Maintenance Services Charges): _____ %	
Current rate for removal of Stormwater Waste in excess of Maximum Pollutant Load per Cartridge: \$ _____ per tonne	

SPECIAL CONDITIONS	

SIGNATURE OF CUSTOMER	
You acknowledge and confirm that: (1) you have read and understood and agree to be bound by the Terms and Conditions set out in this document; and (2) all information provided by you is true and correct.	
Executed by you/for and on your behalf:	
Executed by you:	Executed on your behalf:
Signed: ☒	Signed: ☒
Name:	Name:
Title/Position:	Title/Position:
Signed: ☒	Witness Signature: ☒
Name:	Name of Witness:
Title/Position:	Address of Witness

SIGNATURE OF	
Entity Name:	
Authorised Officer: ☒	Date:

APPENDIX E DETAILED DESIGN DRAWINGS



SCALE



NOTES

1. DO NOT SCALE DRAWINGS. WRITTEN DIMENSIONS GOVERN.
2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
3. PROCEEDING WITH THIS WORK, CALBRE SHALL BE NOTIFIED IN WRITING BY THE CLIENT.
4. THE DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.

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C	LAYOUT AMENDMENTS	03.07.17
B	STORMWATER UPDATE	25.05.17
A	ORIGINAL ISSUE	01.11.16

CONVEYANCE
MORRIS & CO PTY LTD
30 WARRY STREET FORTITUDE VALLEY
WEST AUSTRALIA 6015
BRISBANE BRISBANE
T 08 7394 4000 F 08 7394 4100

HASSELL



CLIENT



PROJECT

HERSTON QUATER - SRACC
HERSTON ROAD, HERSTON QLD

DRAWING TITLE

HERSTON QUATER MASTERPLAN
EXISTING CATCHMENT PLAN

PROJECT STAGE

SUB STAGE B

SHEET STATUS

FOR INFORMATION

SCALE @ A1 (B/A3)

As Indicated

PROJECT NUMBER

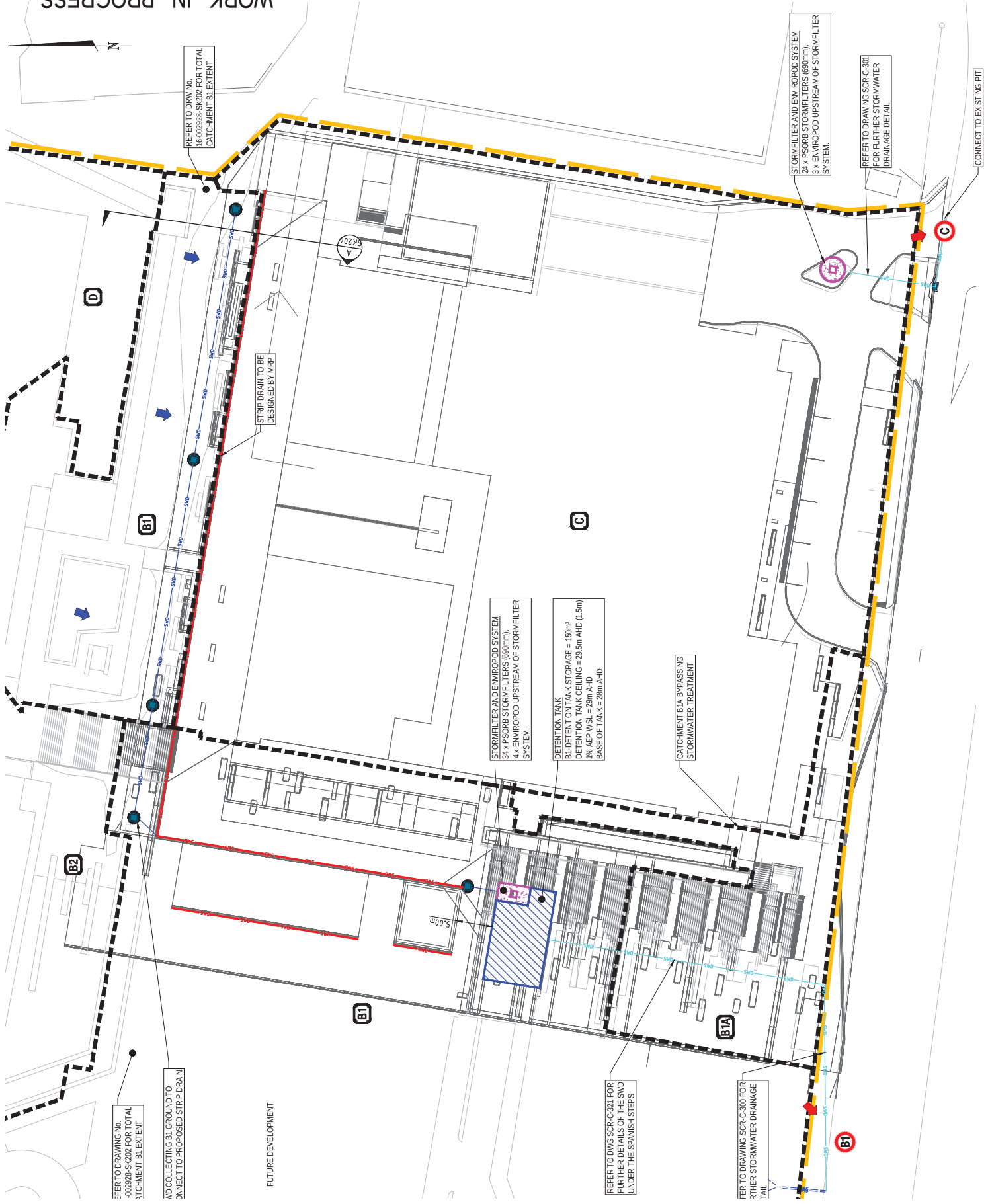
DRAWING NUMBER

REV

C

16-002928 | SK201

Original Sheet Size A1 - 841 x 594mm



WORK IN PROGRESS

REFER TO DRAWING No.
-002928-SK202 FOR TOTAL
ATTACHMENT B1 EXTENT

WD COLLECTING B1 GROUND TO
CONNECT TO PROPOSED STRIP DRAIN

FUTURE DEVELOPMENT

REFER TO DRW NO.
16-002928-SK202 FOR TOTAL
CATCHMENT B1 EXTENT

NOTES

1. DO NOT SCALE DRAWINGS. WRITTEN DIMENSIONS GOVERN.
2. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
3. ALL DIMENSIONS SHALL BE VERIFIED ON SITE BEFORE PROCEEDING WITH THE WORK. CALIBRE SHALL BE NOTIFIED IN WRITING OF ANY DISCREPANCIES.
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			03.07
A	ORIGINAL ISSUE		

CONSULTANT
HA SSELL Limited ABN 007 711 435
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+61 / 3 914 4000 F +61 / 3 914 4000
HASSELL



000150

HERSTON QUATER - SRACC
HERSTON ROAD, HERSTON QLD

DRAWING TITLE

STORMWATER MANAGEMENT PLAN

PROJECT STAGE

SUB STAGE B

SHEET STATUS

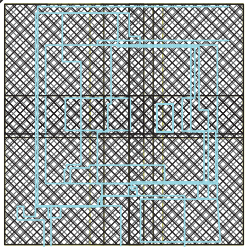
FOR INFORMATION

SCALE ⑩ A1 (⑩ A3)

As Indicated

PROJECT NUMBER	DRAWING NUMBER
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16-002928	SK203	A
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SCALE



Original Sheet Size A1-841 x 594mm

PROPOSED BARRIER KERB & CHANNEL TYPE E	
PROPOSED CONCRETE INVERT	
EXISTING BARRIER KERB AND CHANNEL	
EXISTING SEWERAGE RETICULATION	
EXISTING WATER RETICULATION	
PROPOSED STORMWATER DRAINAGE	
EXISTING STORMWATER DRAINAGE	

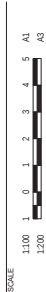
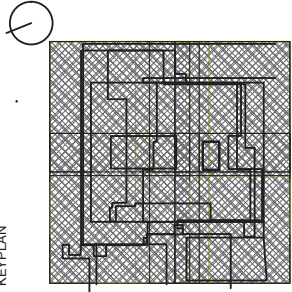
KERB SETOUT		
POINT	EASTING	NORTHING
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2	52588.6088	160995.3460
3	52586.9542	161004.3438
4	52626.7361	160995.3536
5	52630.2823	160995.9515
6	52633.0746	161003.9008
7	52633.6104	161007.2170
8	52633.9855	161012.7309
9	52634.2546	161016.5222
10	52635.5766	161024.4122
11	52650.6663	161021.8838
12	52649.9145	161017.3965
13	52649.4089	161012.4138
14	52649.7661	161008.1065
15	52649.4668	161000.7882

FOR CONTINUATION REFER RIGHT

ISLAND SETOUT		
POINT	EASTING	NORTHING
A	52639.8007	161001.8645
B	52640.7205	161002.0126
C	52643.7850	160996.8076
D	52641.8640	160994.7960
E	52639.4685	160996.0882
F	52638.4079	160998.1298
G	52638.6321	160998.8170
H	52636.7439	160991.7032
I	52638.1747	160992.2420
J	52643.2349	160988.2125
K	52643.4916	160987.6046

FOR CONTINUATION REFER LEFT

16	52648.8762	160997.2304
17	52648.5279	160990.3497
18	52649.1335	160985.5437
19	52627.8388	160988.3185
20	52630.7751	160991.7246
21	52630.4420	160994.9858
22	52624.5189	160994.7113
23	52617.4873	160994.6169
24	52600.4394	160997.4734
25	52593.4110	160993.2202



- NOTES
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 - PROCEEDING WITH THE WORK, CALIBRE SHALL BE NOTIFIED IN WRITING.
 - THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACT SPECIFICATIONS AND DRAWINGS.

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FOR INFORMATION	
1	04.07.17

CONSULTANT
HASSELL
11 HAWTHORN AVENUE, 7TH FLOOR
38 VARRY STREET, FORTITUDE VALLEY
BRISBANE, QUEENSLAND 4007
T +61 7 3914 4000 F +61 7 3914 4100

HASSELL



PROJECT
HERSTON QUATER - SRACC
HERSTON ROAD, HERSTON QLD

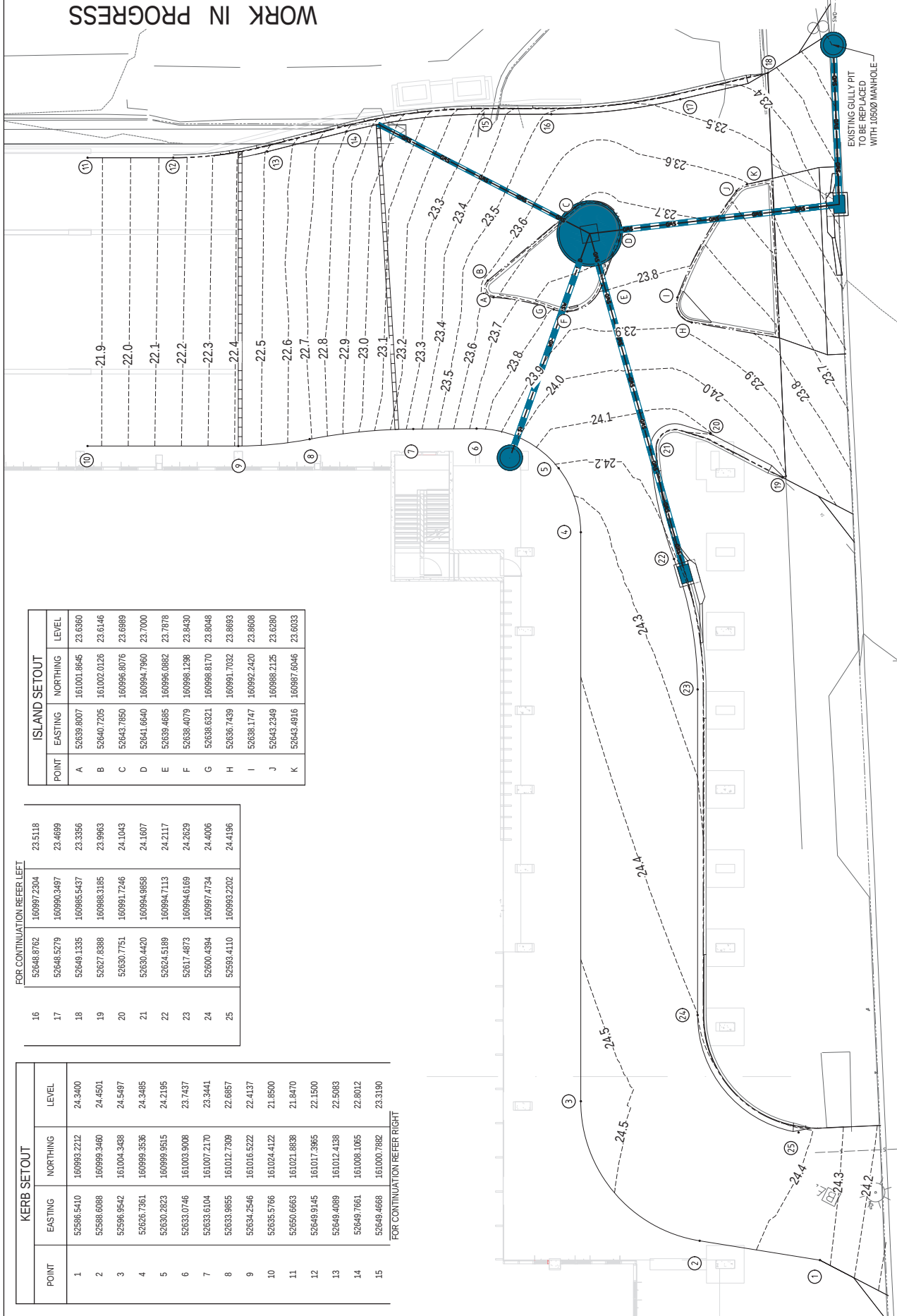
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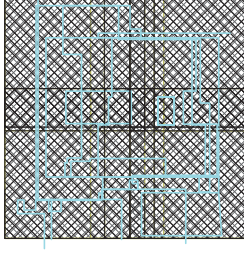
INTERSECTION DETAILS

PROJECT STAGE	SUB STAGE B
SHEET STATUS	FOR INFORMATION
SCALE @ A1 (800)	As Indicated
DRAWING NUMBER	16-002928
PROJECT NUMBER	SRC-C-301
REV	1

Original Sheet Size A1 841 x 594mm

WORK IN PROGRESS





NOTES	1100		VERTICAL	A3
1.	DO NOT SCALE DRAWINGS. WRITTEN DIMENSIONS GOVERN.			
2.	ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.			
3.	ALL DIMENSIONS SHALL BE VERIFIED ON SITE BEFORE PROCEEDING WITH THE WORK. CALIBRE SHALL BE NOTIFIED IN WRITING OF ANY DISCREPANCIES.			
4.	THIS DRAWING MUST BE READ IN CONJUNCTION WITH ALL RELEVANT CONTRACTS, SPECIFICATIONS AND DRAWINGS.			

THIS DRAWING IS AN UNCONTROLLED COPY, UNLESS NOTED OTHERWISE.

ENSURE THIS DRAWING IS PRINTED IN COLOUR.

1	FOR INFORMATION	04.07.17

CONSULTANT

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HASELL



PROJECT

HERSTON QUATER - SRACC
HERSTON ROAD, HERSTON QLD

DRAWING TITLE

STORMWATER LONGITUDINAL SECTION

PROJECT STAGE

SIR STAGE B

COUDRIAL D

SHEET STAINING

FOR INFORMATION

FOR INFORMATION	DRAWN
SCALE @ A1 (@A3)	

As Indicated
NA

PROJECT NUMBER	STANDARD ALLIANCE	TEAM
As indicated		

16-002028
SBC-C-321
DRAWING NUMBER
REV 1

1	176-0-010	1076700-01
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WORK IN PROGRESS

[illegible]

NOTES:
1. NOTW STORR LEVEE GRAT FINIS THE F DESIG ONLY ASSE AND U CLASS ACCC 3725- NOTE WORR DRAW

Line D

Line C

Line B

Line A

LINE

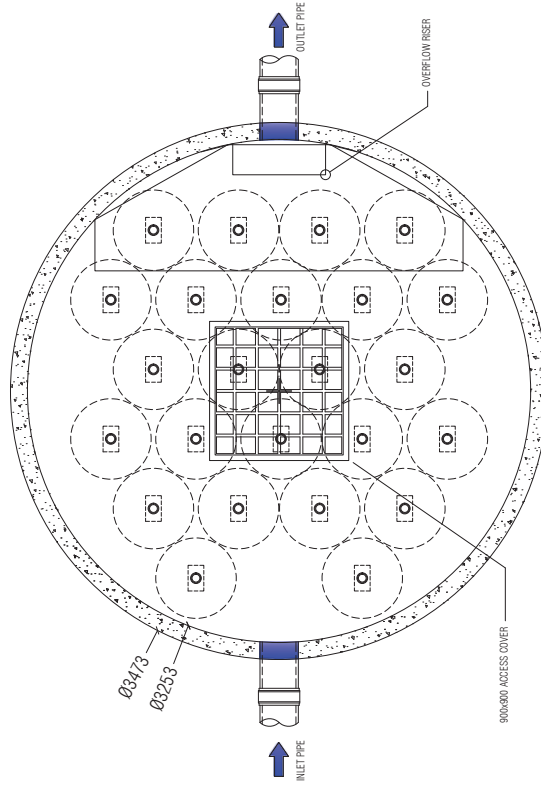
STORMFILTER DESIGN TABLE

- STORMWATER TREATMENT CAPACITY VARIES BY NUMBER OF FILTER CARTRIDGES INSTALLED AND BY REGION SPECIFIC INTERNAL FLOW CONTROLS. CONVEYANCE CAPACITY IS RATED AT 80US.
- THE STANDARD CONFIGURATION IS SHOWN. ACTUAL CONFIGURATION OF THE SPECIFIED STRUCTURE(S) PER CIVIL ENGINEER WILL BE SHOWN ON SUBMITTAL DRAWING(S).
- ALL PARTS PROVIDED AND INTERNAL ASSEMBLY BY STORMWATER360 AUSTRALIA UNLESS OTHERWISE NOTED.

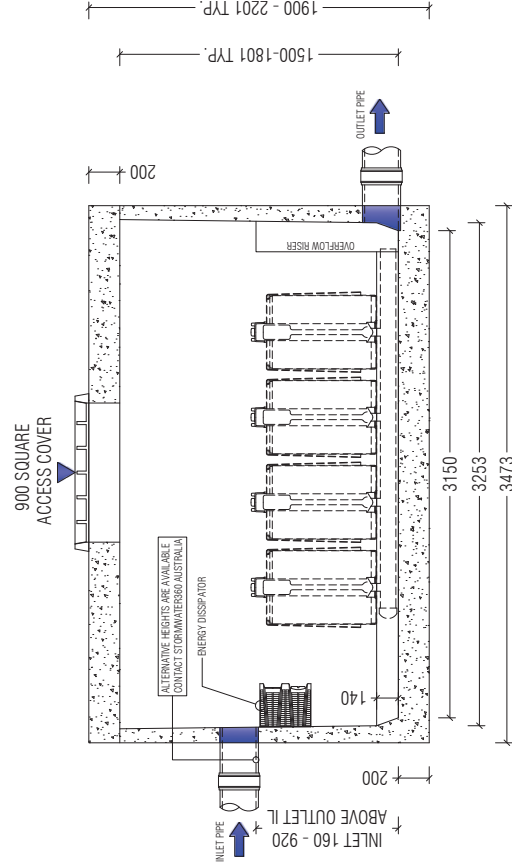
CARTRIDGE HEIGHT	690	460	310
SYSTEM HYDRAULIC DROP (H - REQ'D. MIN.)	930	700	550
TREATMENT BY MEDIA SURFACE AREA L/S/m2	1.4	1.4	0.7
CARTRIDGE FLOW RATE (Us)	1.42	0.71	0.63
			0.32

GENERAL NOTES

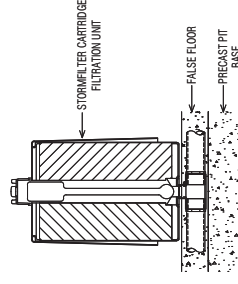
1. INLET AND OUTLET PIPING SHALL BE SPECIFIED BY SITE CIVIL ENGINEER (SEE PLANS) AND PROVIDED BY CONTRACTOR.
2. STORMWATER IS PROVIDED WITH OPENINGS AT INLET AND OUTLET LOCATIONS.
3. IF THE PEAK FLOW RATE, AS DETERMINED BY THE SITE CIVIL ENGINEER, EXCEEDS THE PEAK HYDRAULIC CAPACITY OF THE PRODUCT, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED. PLEASE CONTACT STORMWATER360 AUSTRALIA FOR OPTIONS.
4. THE FILTER CARTRIDGE(S) ARE SPHON-ACTUATED AND SELF-CLEANING. THE ACTUAL NUMBER SHALL BE SPECIFIED BY THE SITE CIVIL ENGINEER ON SITE PLANS OR IN DATA TABLE BELOW. PRECAST STRUCTURE TO BE CONSTRUCTED BY STORMWATER360 AUSTRALIA IN ACCORDANCE WITH AS3600.
5. SEE STORMFILTER™ DESIGN TABLE FOR REQUIRED HYDRAULIC DROP. FOR SHALLOW, LOW DROP OR SPECIAL DESIGN CONSTRAINTS, CONTACT STORMWATER360 AUSTRALIA FOR DESIGN OPTIONS.
6. ALL WATER QUALITY PRODUCTS REQUIRE PERIODIC MAINTENANCE AS OUTLINED IN THE O&M GUIDELINES. PROVIDE MINIMUM CLEARANCE FOR MAINTENANCE ACCESS.
7. STRUCTURE AND ACCESS COVERS DESIGNED TO MEET AUSTRASDAS T44 LOAD RATING WITH 0.0m TO 2.0m FILL MAXIMUM (CLASS 4).
8. ANY BACKFILL DEPTH, SUB-BASE AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY SITE CIVIL ENGINEER.
9. CARTRIDGE HEIGHT IS 690mm (SHOWN). CARTRIDGE HEIGHT AND ASSOCIATED DESIGN PARAMETERS PER STORMFILTER™ DESIGN TABLE.
10. STORMFILTER™ BY STORMWATER360 AUSTRALIA. PHONE: 1300 354 722 OR www.stormwater360.com.au



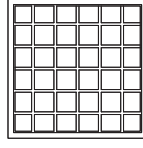
MANHOLE STORMFILTER PLAN



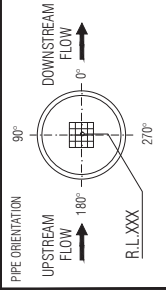
MANHOLE STORMFILTER SECTION



STORMFILTER CARTRIDGE DETAIL



900 x 900 ACCESS COVER



LADDER		YES/NO
ANTI-FLOTATION BALLAST	N/A	N/A
	N/A	N/A

NOTES/SPECIAL REQUIREMENTS:

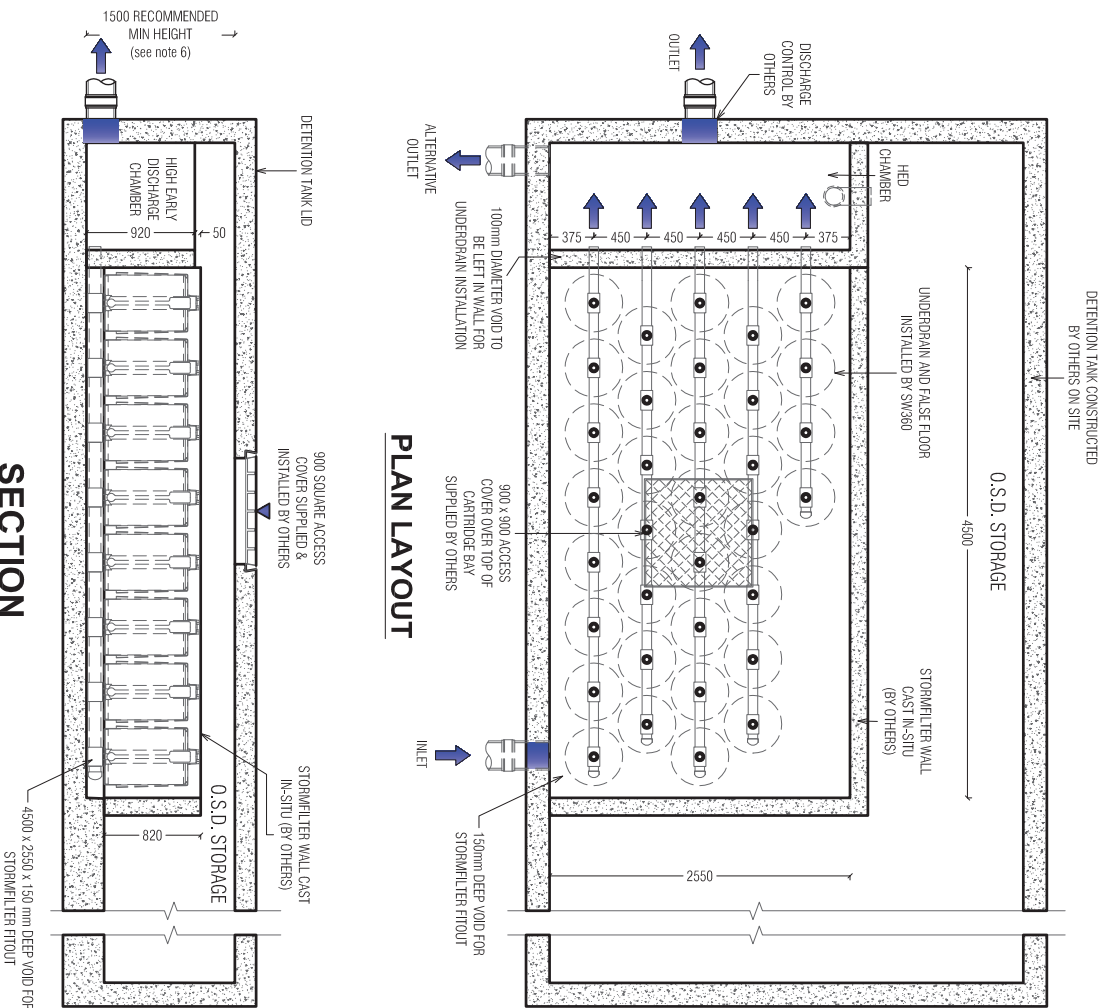
SITE SPECIFIC DATA REQUIREMENTS		XXX
STRUCTURE ID	WATER QUALITY FLOW RATE (L/S)	XXX
	PEAK FLOW RATE (U/S)	XXX
	RETURN PERIOD OF PEAK FLOW (yrs)	XXX
	# OF CARTRIDGES REQUIRED (T - 25)	XXX
	CARTRIDGE HEIGHT (310, 460 or 690mm)	690
	MEDIA TYPE (PERLITE, PERLITE/ZEOLITE OR ZrP6)	
	PRECAST VAULT WEIGHT	13000 kg
	PRECAST LID WEIGHT	4500 kg
	PIPE DATA:	
	IL MATERIAL	DIMETER
	INLET PIPE #1	XXX
	INLET PIPE #2	N/A
	OUTLET PIPE	XXX

	STORMWATER360 AUSTRALIA 24 CARTIDGE STORMFILTER SYSTEM Ø 3150 STORMFILTER TANK GENERAL ARRANGEMENT		DRAWING
			1
			A
DATE: 15.04.16		FILE NAME: 24C690 3150SFMH	DRN: W.J. CHK: M.W.

STORMFILTER DESIGN TABLE

- THE STORMFILTER TREATMENT CAPACITY VARIES BY NUMBER OF FILTER CARTRIDGES INSTALLED AND BY REGION SPECIFIC INTERNAL FLOW CONTROLS.
- THE STANDARD CONFIGURATION IS SHOWN, ACTUAL CONFIGURATION OF THE SPECIFIED STRUCTURE(S) PER CIVIL ENGINEER WILL BE SHOWN ON SUBMITTAL DRAWING(S).
- ALL PARTS PROVIDED AND INTERNAL ASSEMBLY BY STORMWATER360 UNLESS OTHERWISE NOTED.

CARTRIDGE TYPE	690	460	310
SYSTEM HYDRAULIC DROP (H - REQ'D. MIN.)	930	700	550



GENERAL NOTES

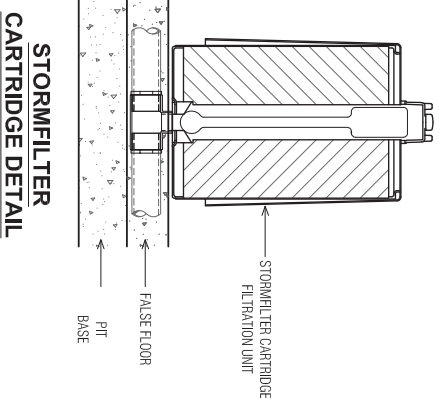
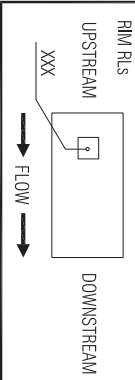
1. THIS IS A GENERAL ARRANGEMENT DRAWING. IT IS NOT A FOR CONSTRUCTION DRAWING.
2. INLET AND OUTLET PIPING SHALL BE SPECIFIED BY SITE CIVIL ENGINEER (SEE PLANS) AND PROVIDED BY CONTRACTOR. STORMFILTER IS PROVIDED WITH OPENINGS AT INLET AND OUTLET LOCATIONS.
3. IF THE PEAK FLOW RATE, AS DETERMINED BY THE SITE CIVIL ENGINEER, EXCEEDS THE PEAK HYDRAULIC CAPACITY OF THE PRODUCT, AN UPSTREAM BYPASS STRUCTURE IS REQUIRED. PLEASE CONTACT STORMWATER360 FOR OPTIONS.
4. THE FILTER CARTRIDGE(S) ARE SIPHON-ACTUATED AND SELF-CLEANING. THE STANDARD DETAIL DRAWING SHOWS THE MAXIMUM NUMBER OF CARTRIDGES. THE ACTUAL NUMBER SHALL BE SPECIFIED BY THE SITE CIVIL ENGINEER ON SITE PLANS OR IN DATA TABLE BELOW. CONCRETE STRUCTURE TO BE PROVIDED BY OTHERS.
5. SEE STORMFILTER DESIGN TABLE FOR REQUIRED HYDRAULIC DROP. FOR SHALLOW, LOW DROP OR SPECIAL DESIGN CONSTRAINTS, CONTACT STORMWATER360 FOR DESIGN OPTIONS.
6. ALL WATER QUALITY PRODUCTS REQUIRE PERIODIC MAINTENANCE AS OUTLINED IN THE O&M GUIDELINES. PROVIDE THE MINIMUM RECOMMENDED INTERNAL CLEARANCE FOR MAINTENANCE ACCESS, AS NOTED ON DRAWING. WHERE THIS INTERNAL CLEARANCE CANNOT BE ACHIEVED, PLEASE SPEAK TO SW360.
7. STRUCTURE AND ACCESS COVERS DESIGNED BY OTHERS. ACCESS COVERS TO BE A MINIMUM 900X900 ABOVE CARTRIDGES. O.H.S REGARDING ACCESS COVERS AND TANK ACCESS TO BE ASSESSED BY OTHERS ON SITE.
8. THE STRUCTURE THICKNESSES SHOWN ARE FOR REPRESENTATIONAL PURPOSES AND VARY REGIONALLY.
9. ANY BACKFILL DEPTH, SUB-BASE, AND OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY SITE CIVIL ENGINEER.
10. CARTRIDGE HEIGHT AND ASSOCIATED DESIGN PARAMETERS PER STORMFILTER DESIGN TABLE.
11. STORMFILTER BY STORMWATER360 AUSTRALIA. PHONE: 1300 354 1722 www.stormwater360.com.au

SITE SPECIFIC DATA REQUIREMENTS

STRUCTURE ID	XXX
WATER QUALITY FLOW RATE (L/S)	XXX
PEAK FLOW RATE (L/S)	XXX
RETURN PERIOD OF PEAK FLOW (yrs)	XXX
# OF CARTRIDGES REQUIRED	34
CARTRIDGE HEIGHT (310, 460 or 690mm)	690
MEDIA TYPE (PSORB OR ZPO)	XXX

PRECAST VAULT WEIGHT	- kg
PRECAST LID WEIGHT	- kg

PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE #1	XXX	MATERIAL	XXX
INLET PIPE #2	XXX	MATERIAL	XXX
OUTLET PIPE	XXX	MATERIAL	XXX



ANTI-FLOTATION BALLAST	XXX	XXX
NOTES/SPECIAL REQUIREMENTS:	XXX	XXX

Stormwater360

STORMWATER360 AUSTRALIA

STORMFILTER DETENTION TANK

34 CARTRIDGE STORMFILTER SYSTEM

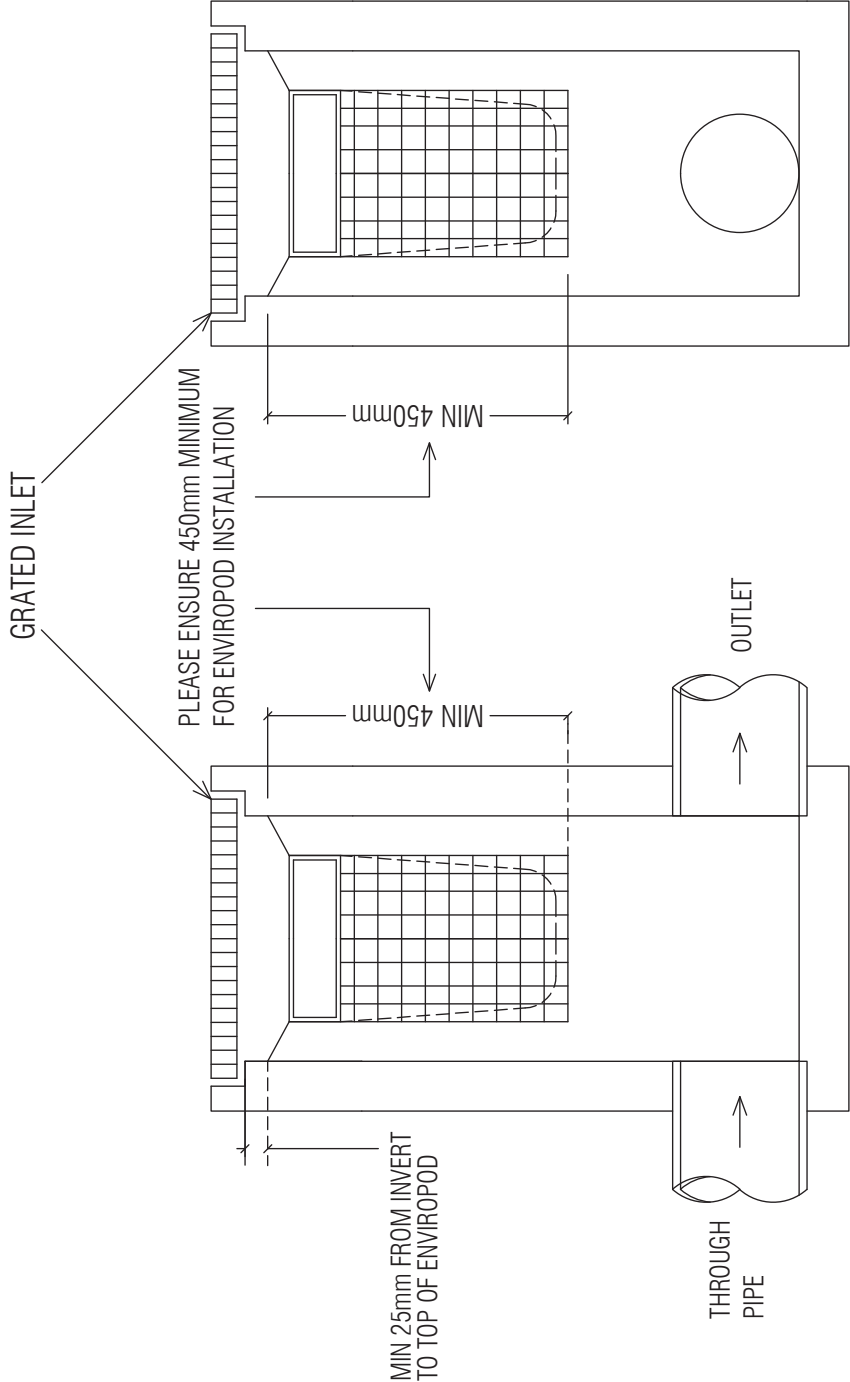
HED GENERAL ARRANGEMENT

DATE: 03-11-16 FILE NAME: 34C-DET-TANK-STD-690

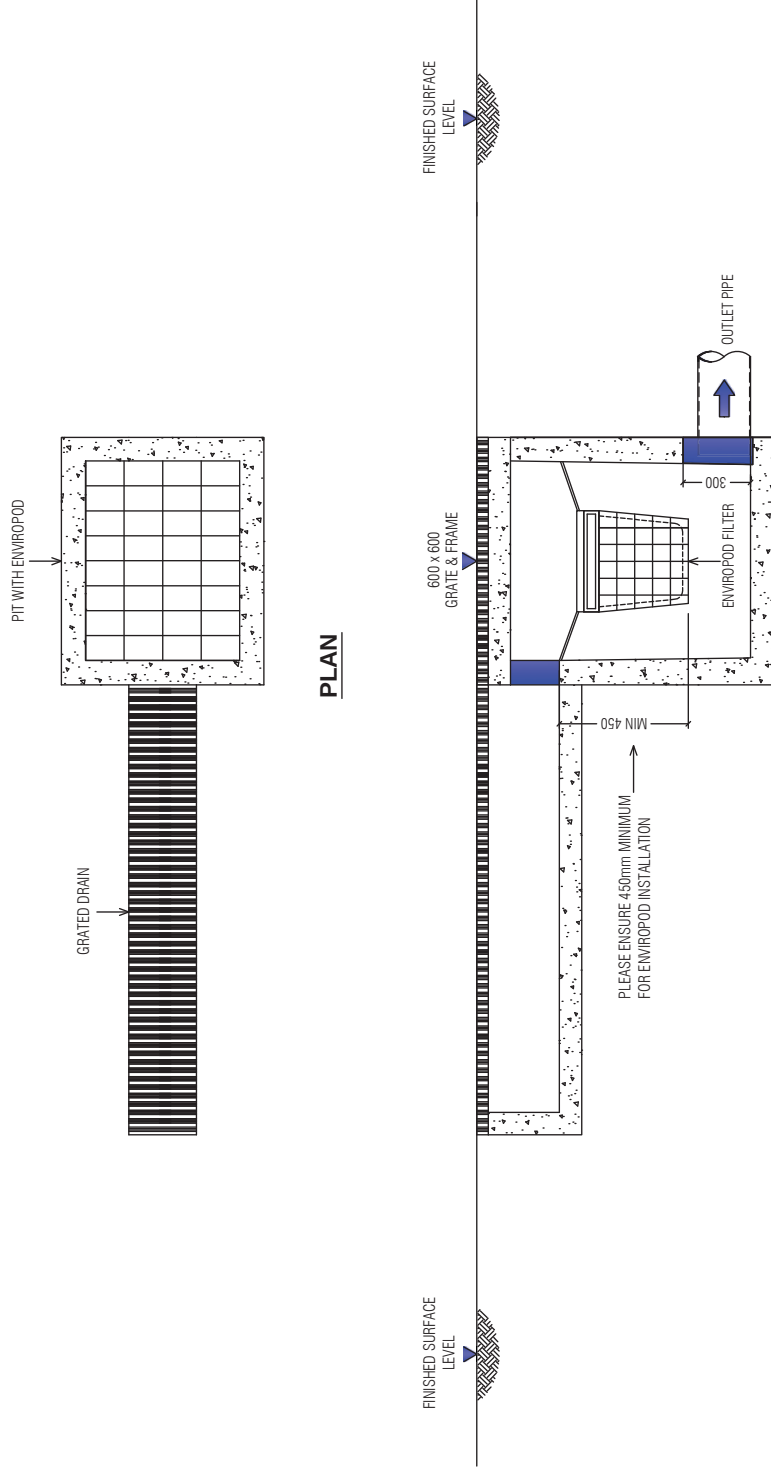
DRAWING

1

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Stormwater360		STORMWATER360		DRAWING
1		STANDARD ENVIPOD FILTER FOR STANDARD GULLY PIT		1
D		GENERAL ARRANGEMENT		D
DATE: 25.09.12	SCALE: N.T.S.	FILE NAME: EP_TYP_01D	DRN: R.P.	CHK: M.W.



PLAN

SECTION

TRENCH GRATE WITH ENVIROPOD IN GULLY PIT CONFIGURATION



DRAWING	1	Stormwater360	CHK: M.W.
TRENCH GRATE FLOW INTO GULLY PIT WITH ENVIROPOD FILTER TYPICAL CONFIGURATION			
DATE: 01.03.13	SCALE: 1:1	FILE NAME: TG-INTO-EP0D	DRN: F.M.