REDLAND CITY COUNCIL

Stormwater Infrastructure Plan for Weinam Creek PDA

Report




December 2013

M8000_023

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M8000_024 Stormwater Infrastructure Plan for Weinam Creek PDA					
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Rev 1	Issue to Client	Michael Howe	Mark Page	Mark Page	December 2013
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1. INTRODUCTION

Redland City Council (RCC) has commissioned Engeny to develop a stormwater infrastructure plan for the Weinam Creek Priority Development Area (PDA). Weinam Creek was declared a PDA by the Queensland Government and therefore this stormwater infrastructure plan has been prepared in support of the proposed development.

The purpose of this study is to determine the integrated stormwater quantity and quality trunk infrastructure requirements and associated preliminary costs estimates for the proposed infrastructure. The stormwater infrastructure plan will assist Council in applying appropriate planning and acquisition principles for servicing forecasting demands. The study area is located at the outlet of Weinam Creek to Moreton Bay within Redland Bay. Figure 1.1 presents the extent of the study area and the proposed development plan.

This investigation has adopted a design approach consistent with the Statutory Guideline 01/09 (DIP, 2009), Queensland Urban Drainage Manual (QUDM, 2007) and the Redland City Council Planning Scheme (RCC, 2013).

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Map Projection: Transverse Mercator
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Weinam Creek Priority Development Area
Stormwater Infrastructure Plan

Study Area

Figure 1.1

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2. FLOOD AND STORMWATER MANAGEMENT POLICY

The intent of this policy is to develop a policy direction for the PDA that is based on best practice and suitability for this growth area in terms of the physical characteristics, type of future developments, and Council planning requirements and vision. The objective of this policy is to set the stormwater and flood management principles for managing future development in the PDA.

This policy has been established based on Redlands Planning Scheme as well as other relevant guidelines such as the Queensland Urban Drainage Manual (QUDM) and State Planning Policy 4/10.

The objectives of stormwater management as per Redlands Planning Scheme 2013 and State Planning Policy (SPP) 4/10 include the following:

- Desired Standard of Service (DSS) for the stormwater network is based on the major and minor storm concept whereby the major storm is made up of roadways and open drains and the minor storm is typically conveyed by an underground pipe drainage system. The DSS for the PDA is defined as follows:
  - Minor Storm – 1:2 AEP; and
  - Major Storm – 1:100 AEP (all land uses).
- Water Quality Objectives for the PDA are pollutant load based reduction targets and are as follows:
  - Total Suspended Solids (TSS) – 80 % removal;
  - Total Phosphorous (TP) – 60 % removal;
  - Total Nitrogen (TN) – 45 % removal; and
  - Gross Pollutants (GP) – 90 % removal.

Given that the stormwater from the development will discharge directly into Moreton Bay, there is no need to mitigate ultimate catchment flows and maintain existing catchment flows. As such, the stormwater drainage system will be designed to convey flows to outlets without causing nuisance flooding.

The flood management objectives are to ensure the proposed development is not subject to flooding (river or coastal) and does not adversely affect properties external to the development. It is understood that the Weinam Creek PDA may be subject to inland flooding and therefore a flood impact assessment is warranted, however potential impacts from coastal flooding (i.e. storm tide) will also need to be considered along with the setting of development levels.

3. PROJECT DATA AND ASSUMPTIONS

This study was based on development information and assumptions as supplied by RCC and the following data was used as part of the study:

- Proposed land use plan provided by RCC (refer Figure 1.1);
- 0.25 m contours provided by RCC; and
- Rainfall estimates calculated from the procedures outlined within Book 2 of Australian Rainfall & Runoff (AR&R).

The following assumptions were adopted for the study:

- In the absence of a proposed earthworks plan for the proposed development, existing topography was used to determine sub catchments and ground levels for stormwater design purposes;
- Overall stormwater infrastructure strategy is based upon the provided development layout;
- Location and sizing of infrastructure (stormwater & water quality) has been undertaken at a high level and further design will be required once additional information becomes available (i.e. earthworks plan);
- Consideration for only the main drainage lines has been undertaken (i.e. not kerb inlets, connectors, etc.); and
- The outlet level for stormwater infrastructure has been set above the Mean High Water Springs (MHWS) of 0.96 m AHD.

4. STORMWATER DRAINAGE ASSESSMENT

4.1 Hydrological Analysis & Assumptions

A hydrological analysis was undertaken using the Rational Method to determine the peak flow from each sub catchment as per QUDM.

Sub catchments have been delineated based on the proposed property boundaries and the existing topography. The impervious fractions for each sub catchment were calculated based on the proposed development layout provided by RCC (refer Figure 1.1).

Design rainfall Intensity-Frequency Duration (IFD) data was derived based upon the procedures outlined in Book 2 of Australian Rainfall and Runoff (AR&R) (Engineers Australia, 2001).

The time of concentration was determined using the following:

- Standard inlet time of 5 minutes; and
- Kerb and Channel equation (refer Figure 4.10 within QUDM).

Figure 4.1 presents the hydrology sub-catchment layout.

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Weinam Creek Priority Development Area Stormwater Infrastructure Plan

Subcatchment Layout

Figure 4.1

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4.2 Stormwater Infrastructure Analysis

The proposed stormwater infrastructure has been designed for the ultimate development scenario to cater for the minor storm (typically 1:2 AEP) within the underground piped system and major storm (1:100 AEP) within the road reserve (where possible).

4.2.1 Proposed Minor Stormwater Infrastructure

Sizing of the proposed stormwater drainage pipes to accommodate the minor storm has been undertaken using the Manning's equation with the results of this analysis summarised in Table 4.1. Figure 4.2 presents the locations of proposed stormwater infrastructure.

Table 4.1 Proposed Stormwater Drainage Network

Stormwater Pipe ID	Proposed Pipe Diameter (mm)	Pipe Capacity (m^3/s)	Contributing Catchment Areas (ha)
WC1	375	0.17	0.42
WC2	375	0.24	0.73
WC3	375	0.39	1.24
WC4	600	0.61	1.84
WC5	525	0.57	1.50
WC6	450	0.24	0.69
WC7	450	0.43	1.58
WC8a	600	0.44	2.00
WC8b	600	0.39	2.00
WC9	450	0.35	0.32
WC10	525	0.36	0.89
WC11	375	0.12	0.32
WC12	525	0.30	1.08
WC14a	525	0.32	1.44
WC14b	525	0.32	1.44

Stormwater Pipe ID	Proposed Pipe Diameter (mm)	Pipe Capacity (m^3/s)	Contributing Catchment Areas (ha)
*WC15	675	2.53	4.49
WC16	375	0.13	0.40
WC18a	600	0.47	1.50
*WC18b	750	0.99	1.50
WC19	525	0.28	0.65
*WC20	600	1.44	2.03
WC21	300	0.24	0.71
WC22	375	0.38	0.79
WC23	600	1.10	3.93
WC24	300	0.17	0.51
WC25	300	0.17	0.54
WC26	450	0.26	1.09
WC27	300	0.06	0.23
WC28	375	0.15	0.44
WC29	600	1.31	4.29
WC30	450	0.33	0.84

*Denotes location of 1:100 AEP capacity pipe

4.2.2 Major Stormwater Infrastructure

The major stormwater system capacity has been assessed using the road flow capacity charts within QUDM Volume 2, Edition 1 (1992). These road flow capacity charts have been developed using the Izzard Equation. In the absence of an earthworks plan it has been assumed that roads in the PDA will have longitudinal slopes of 0.5 %, minimum road widths of 6 m and kerb heights of 250 mm.

The capacity of the major storm to be accommodated within the roads is the 1:100 AEP catchment flow less the capacity of the underground pipe network. The roads have also been assessed to determine whether roads are likely to be trafficable for vehicles and pedestrians (i.e. depth velocity product less than 0.4) in the 1:100 AEP. The maximum overland flow estimate within the PDA is approximately 1.64 m^3/s. The estimated road capacity is 1.76 m^3/s; therefore the roads have capacity to convey the major storm overland flows.

The total road capacities at 250 mm depth within the PDA have a depth velocity product of less than 0.4; therefore the roads within the PDA are considered trafficable in the 1:100 AEP.

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Weinam Creek Priority Development Area Stormwater Infrastructure Plan

Figure 4.2

Proposed Trunk Stormwater Infrastructure

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5. STORMWATER QUALITY ASSESSMENT

A quantitative assessment of stormwater runoff quality has been undertaken for the ultimate land use scenario for the Weinam Creek PDA. This assessment was undertaken in order to develop a required footprint for water quality treatment devices within the Weinam Creek PDA.

The State Planning Policy (SSP) provides the development criteria intended to ensure development is carried out in a way that will achieve the relevant water quality objectives of the EP Water Policy 2009. The policy outlines best practice stormwater quality management to protect environmental values of receiving water.

The SPP guidelines provide details of the required stormwater management for the study area. These guidelines identify pollutant load reductions for urban stormwater. Load based objectives compare loads produced by an unmitigated developed catchment to the loads coming from the developed catchment where Water Sensitive Urban Design has been implemented. It is recommended that these objectives for urbanised areas within the Weinam Creek catchment are adopted to ensure "Best Practice" Stormwater Management Standards are achieved. The percentage removal efficiency or the "treatment train effectiveness" requirements are outlined in Table 5.1.

Table 5.1 Water Quality Objectives

Pollutant Type	Objective	Urban Stormwater Quality Planning Guidelines 2010
Total Suspended Solid	Reduction in average annual load of pollutants leaving the developed unmitigated scenario compared to the developed mitigated scenario	80 %
Total Phosphorous	Reduction in average annual load of pollutants leaving the developed unmitigated scenario compared to the developed mitigated scenario	60%
Total Nitrogen	Reduction in average annual load of pollutants leaving the developed unmitigated scenario compared to the developed mitigated scenario	45%
Gross Pollutant	Reduction in average annual load of pollutants leaving the developed unmitigated scenario compared to the developed mitigated scenario	90%

A quantitative assessment of stormwater runoff quality has been considered for the ultimate land use scenario of the Weinam Creek catchment. The pollutant export loads from the catchment were assessed using the Cooperative Research Centre for Catchment Hydrology's (CRCCH) Model for Urban Stormwater Improvement Conceptualisation

(MUSIC). MUSIC is a decision support tool, used to plan and design appropriate urban stormwater management systems at the conceptual level. MUSIC Version 5.1, released in August 2011, was used in this assessment.

In accordance with State Planning Policy, MUSIC modelling has been undertaken in accordance with the Water by Design (2009) MUSIC modelling Guidelines for South East Queensland", in conjunction with the Healthy Waterways "Water Sensitive Urban Design Technical Design Guidelines for South East Queensland".

It is noted that the location and sizing of water quality infrastructure has been undertaken at a high planning level and further design will be required once additional data becomes available (i.e. earthworks plan, etc.) that is more representative of the proposed development. It is also noted that the treatment train proposed in this study provides an option for the development to achieve the objectives; however alternative WSUD treatment methods could be adopted including point source treatment such as raingardens, green roofs and walls, road design retrofits, street trees, etc. The selection will be based on site opportunities and constraints.

The MUSIC model was established for the post development scenarios. This involved the following steps:

1. Climate data for the catchment was sourced from the Bureau of Meteorology (BOM). Rainfall data is from the Redlands BOM station (40265), and uses the 1997-2006 rainfall events with six (6) minute time step.

2. Land uses for the ultimate catchment were derived from GIS information supplied by Redland City Council. Commercial, Industrial, Park and Urban land use were adopted for the MUSIC model with an impervious percentage of 90 % adopted for the industrial and commercial, 20 % for parks while 65 % had been used for the residential land use areas. This represents the effective impervious area which differs from the impervious area adopted as part of the hydrological assessment.

3. A treatment train was developed based on available space, proposed drainage infrastructure, tide levels, feasibility and target pollutants reductions.

It should be noted that:

- In accordance with the Water by Design MUSIC modelling guidelines, the natural assimilative capacity of any waterway was not represented within the MUSIC model;

- The finished surface of the bioretention filter media must be horizontal (i.e. flat) to ensure full engagement of the filter media by stormwater flows and to prevent concentration of stormwater flows within depressions and ruts resulting in potential scour and damage to the filter media; and

- Hydraulic analysis has not been undertaken to assess the effects the treatment systems may have on the drainage system as well as flood levels.

5.1 Typical Treatment Train

Best management practices in Water Sensitive Urban Design (WSUD) techniques are proposed to be implemented throughout the Weinam Creek PDA. Stormwater runoff will be treated by a range of treatment devices prior to discharge to Moreton Bay. Different WSUD treatment measures are used in different situations to target a variety of pollutants. Examples of typical WSUD treatment measures include:

5.1.1 Bioretention Basins

Bioretention systems act to treat stormwater by accepting stormwater flows into a shallow planted depression where water ponds above a sandy-loam filter planted filter media. This maximises the volume of runoff that passes through the filtration media. Water then percolates through the filter media at an infiltration rate of approximately 200 mm an hour and out through an underdrainage system where it exits into the receiving drainage system or waterway.

The treatment system operates by firstly filtering surface flows through surface vegetation and then percolating runoff through prescribed filtration media that provides treatment through fine filtration, extended detention and some biological uptake. They also provide flow retardation for smaller events and are particularly efficient in removing nutrients. There are a limited number of locations within the study area that could be retrofitted with end of pipe bioretention basins. Due to the constraints associated with the study area, street scale bioretention basins are recommended to be utilised and considered as part of streetscape planning. An example of a streetscape system is provided in Figure 5.1.

(Source:http://www.sfbetterstreets.org/find-project-types/greening-and-stormwater-management/stormwater-overview/bioretention-rain-gardens/)

Figure 5.1 Example of Streetscape Bioretention

5.1.2 Jellyfish Filter

The Jellyfish filter is a tertiary stormwater treatment system featuring membrane filtration to provide exceptional pollutant removal at high treatment flow rates with minimal head loss and low maintenance costs (Humes, Jellyfish Filter Technical Manual, Issue 2). It should be noted that the stormwater outlets downstream of the Jellyfish units will be required to have one way flood gates installed to ensure sea water does not enter the

Jellyfish units. Sea water may deteriorate the filters and compromise the effectiveness of the unit's water quality treatment; however it is anticipated that backflow protection could avoid this issue. A review of treatment measures should be undertaken once a detailed development plan has been developed for the site.

Further information on the Jellyfish system (provided by Humes) including maintenance and tidal considerations is provided below whilst **Appendix A** provides examples of potential backflow protection devices offered by Humes.

Maintenance

The Jellyfish filter will only require annual maintenance via a vacuum truck. At the same time, the filter "tentacles" are backwashed by placing a tube that holds 60 litres of water over the tentacle bundle and allowing it to drain back into the previously cleaned sump. After all of the filter bundles have been backwashed the sump can again be drained. The cost of this is typically in the order of $1800 to $2500 depending on the model of the Jellyfish filter.

Replacement of the cartridge bundle will only be necessary when the time for the 60 litres of water to drain down back through the tentacle bundle exceeds 12.5 seconds. The device in Australia is only 12 months old and while maintenance has been conducted as per the above, we have not yet needed to replace any cartridges. In the US where the product is mature and been in operation for the past 5 years, there still has not been a need to replace any cartridge bundles either. This is partly due to the fact that between every storm event the Jellyfish filter has a self-backwashing function that keeps the tentacle pores clear. This is explained in the technical manual. That said however, there will come a time where a cartridge bundle will need to be replaced. If we assume that it will be necessary to replace all of the cartridges at the same time (unlikely) after 5 years, then it will be necessary to budget a replacement cost of $200/cartridge bundle/year, which is based on a supply cost of $1000 per cartridge bundle.

Tidal locations and sea water exposure

The Jellyfish filter is set-up as an off-line device but we would still recommend the use of some form of backflow protection, which could be either a local application or end of line. The components that the Jellyfish filter is manufactured from are designed for a minimum 50 year design life, which includes saltwater conditions. The tentacle bundles themselves have a resin coating so are not prone to damage in this environment, so we expect the same longevity out of the filter elements as noted above. All of the metal components within the unit are 316 stainless steel. If required, the design life could be increased with the use of galvanised, or even stainless steel, reinforcement.

Field testing and localised statistical verification of performance has been undertaken for the Jellyfish as outlined in the report titled: 'Compatibility of the Field Testing of the Jellyfish Filter in Florida with South East Queensland Climatic and Environmental Conditions' (Queensland University of Technology, 2013).

5.2 Stormwater Quality Management Strategy

The stormwater quality management strategy for the catchment has considered site specific constraints for each of the sub catchments in conjunction with the development plan to integrate a range of water sensitive urban design features. The vast majority of the study area is already fully developed to some degree (i.e. brownfield) and as such, retrofitting of water treatment devices is constrained by available public open space areas.

The proposed stormwater quality treatment infrastructure for each sub catchment is presented in Table 5.2. MUSIC catchments and infrastructure layout is presented in Figure 5.2.

Table 5.2 Proposed Water Quality Infrastructure

Water Quality Location	Proposed Treatment
WQ1	2 x Jellyfish Filters (JF2400-9-2)
WQ2	Bioretention basin (140 m^2) & 2 x Jellyfish Filters (JF2400-10-2)
WQ3	Bioretention basin (200 m^2)
WQ4	2 x Jellyfish Filters (JF2400-6-2)
WQ5	Bioretention basin (120 m^2)
WQ6	3 x Jellyfish Filters (JF2400-10-2)
WQ7	2 x Jellyfish Filters (JF2400-8-2)
WQ8	Bioretention basin (350 m^2)
WQ9	Bioretention basin (800 m^2)
WQ10	4 x Jellyfish Filters (JF3000-18-4)
WQ11	2 x Jellyfish Filters (JF2400-8-2)
WQ12	1 x Jellyfish Filter (JF3000-11-3)
WQ13	Bioretention basin (100 m^2)
WQ14	Bioretention basin (100 m^2)
WQ15	Bioretention basin (130 m^2)
WQ16	Bioretention basin (170 m^2)

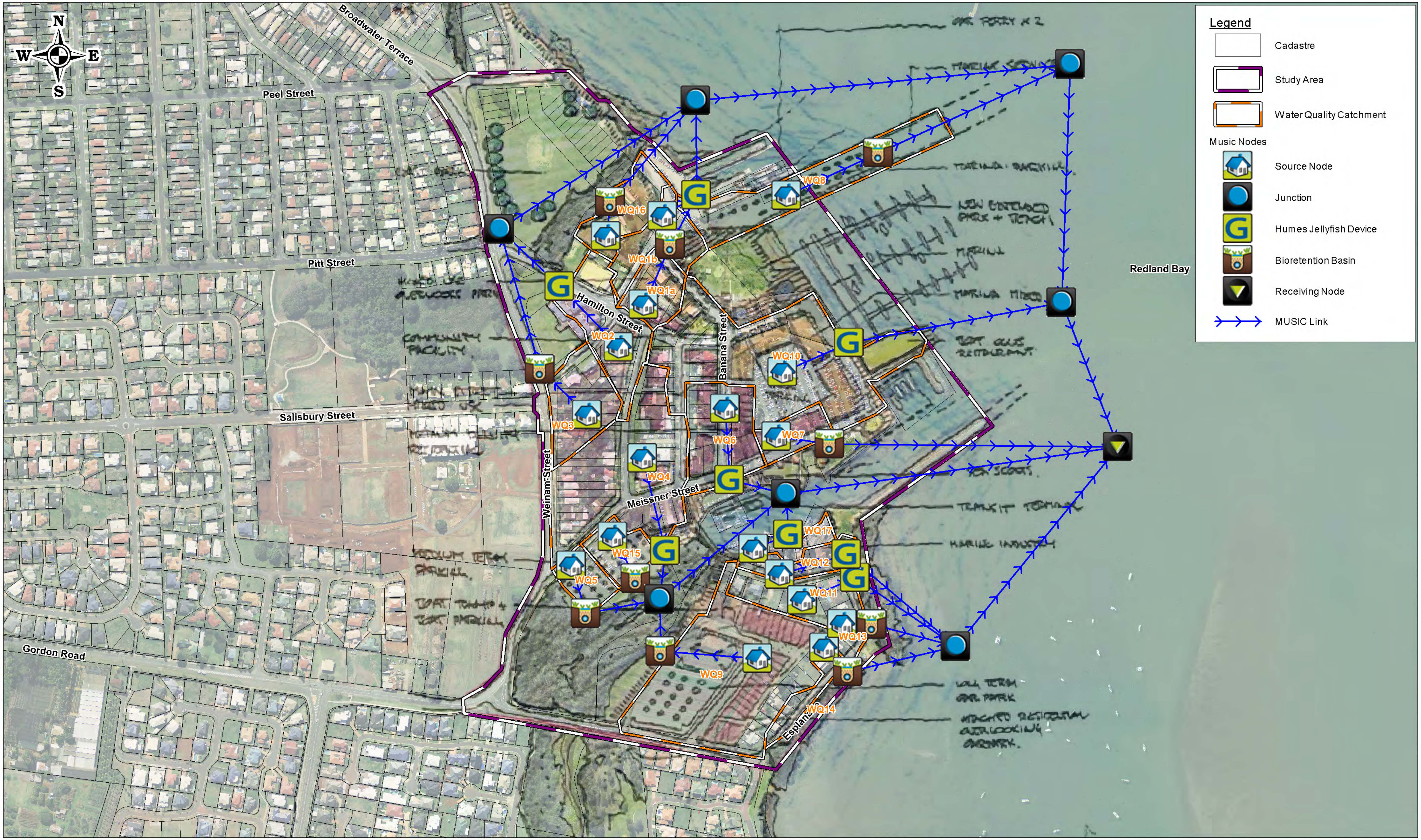
Water Quality Location	Proposed Treatment
WQ17	1 x Jellyfish Filter (JF3000-11-3)

5.3 Stormwater Quality Results

Results of the water quality assessment are presented in Table 5.3. The proposed treatment train for the overall Weinam Creek PDA demonstrates that water quality objectives are achieved overall.

Table 5.3 Water Quality Objective Results

Location	Pollutants	Reduction (%)	Target	Target Achieved
Receiving Node (Total catchment)	TSS (kg/yr)	83.30	80	✓
	TP (kg/yr)	60.00	60	✓
	TN (kg/yr)	45.80	45	✓
	GP (kg/yr)	95.50	90	✓



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Weinam Creek Priority Development Area
Stormwater Infrastructure Plan

Figure 5.2

Water Quality Catchments and MUSIC Model Layout

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6. PRELIMINARY COST ASSESSMENT

The preliminary cost estimates of the proposed stormwater quantity infrastructure have been prepared based on preliminary design arrangements including diameters and lengths of proposed trunk pipes. The estimated total stormwater trunk infrastructure cost is **$1,772,319**. This cost includes additional oncost such as contingency, design and surveys. The cost summary of the proposed stormwater trunk infrastructure network is shown in Table 6.2 .

Costing for the bioretention basins was obtained from the costing module within MUSIC using the upper acquisition cost. The unit prices for the Jellyfish devices were provided by Humes and are not inclusive of GST and are supply costs only. A summary of the stormwater quality infrastructure costs is outlined in Table 6.1. It is noted that this is an upper acquisition cost and does not include land acquisition, annual maintenance, annual renewal, annual establishment or decommissioning costs. It is also noted that these cost estimates should be revised when more detailed infrastructure planning is undertaken.

Table 6.1 Water Quality Infrastructure Cost Estimate

Treatment Device	Cost Estimate ($)
2x Jellyfish JF2400-9-2 (WQ1)	117,818
2x Jellyfish JF2400-10-2 (WQ2)	121,268
140 m² Bioretention Basin (WQ2)	59,959
200 m² Bioretention Basin (WQ3)	73,728
2x Jellyfish JF2400-6-2 (WQ4)	107,468
120 m² Bioretention Basin (WQ5)	54,990
3x Jellyfish JF2400-10-2 (WQ6)	121,268
2x Jellyfish JF2400-8-2 (WQ7)	114,368
350 m² Bioretention Basin (WQ8)	104,286
800 m² Bioretention Basin (WQ9)	185,565
4x Jellyfish JF3000-18-4 (WQ10)	369,152
2x Jellyfish JF2400-8-2 (WQ11)	114,368
1x Jellyfish JF3000-11-3 (WQ12)	78,488

Treatment Device	Cost Estimate ($)
100 m² Bioretention Basin (WQ13)	49,739
100 m² Bioretention Basin (WQ14)	49,739
130 m² Bioretention Basin (WQ15)	57,505
170 m² Bioretention Basin (WQ16)	67,019
1x Jellyfish JF3000-11-3 (WQ17)	78,488
Total Cost	**1,925,216**

Table 6.2

Weinam Creek PDA Costing Sheet

Location	**Description**
Weinam	Stormwater Pipe network

Item	Description	Unit	Quantity	Rate	Amount
			Preliminary Items		
1	Site establishment / Disestablishment	Item	1	$ 40,000.00	$ 20,000.00
2	Traffic control	Item	1	$ 32,763.96	$ 32,763.96
			Stormwater Network		
3	Supply 750mm RCP	m	44	$ 458.27	$ 20,307.50
4	Excavate/lay/backfill 750mm RCP	m	44	$ 448.82	$ 19,888.74
5	Supply 675mm RCP	m	22	$ 388.66	$ 8,550.52
6	Excavate/lay/backfill 675mm RCP	m	22	$ 458.47	$ 10,086.34
7	Supply 600mm RCP	m	569	$ 275.50	$ 156,876.97
8	Excavate/lay/backfill 600mm RCP	m	569	$ 447.85	$ 255,017.61
9	Supply 525mm RCP	m	530	$ 222.91	$ 118,141.03
10	Excavate/lay/backfill 525mm RCP	m	530	$ 446.41	$ 236,594.76
11	Supply 450mm RCP	m	249	$ 147.00	$ 36,635.82
12	Excavate/lay/backfill 450mm RCP	m	249	$ 428.31	$ 106,744.82
13	Supply 375mm RCP	m	352	$ 105.53	$ 832.65
14	Excavate/lay/backfill 375mm RCP	m	352	$ 289.56	$ 3,764.28
15	Supply 300mm RCP	m	166	$ 64.05	$ 10,626.54
16	Excavate/lay/backfill 300mm RCP	m	166	$ 289.56	$ 48,040.90
17	Install Side entry pit Type 1C3T	Item	48	$ 4,500.00	$ 217,490.34
18	Manholes 1200mm 0-2 metre deep	Item	21	$ 2,902.84	$ 60,959.64
				Subtotal	**$ 1,363,322**
			Additional Oncosts		
27	Contingencies	Rate	15%		$ 204,498.36
28	Wet Weather & Floating Plant Loose Tools Overhead Allocation	Rate	5%		$ 68,166.12
29	Design & Survey Charges	Rate	10%		$ 136,332.24
				Grand Total	**$ 1,772,319**

Note: Relocation of services has not been undertaken as part of this cost estimate

Note: Assumed that two pits will be located every 40m

Note: Land acquisition has not been included as part of this cost estimate

7. CONCLUSION AND RECOMMENDATIONS

This study has been prepared for the purposes of preliminary assessment of stormwater quantity and quality aspects of the Weinam Creek PDA.

The study has assessed stormwater infrastructure requirements relating to stormwater quantity and quality measures for the catchment. These measures have been sized in order to ensure that the proposed development can be undertaken without resulting in adverse stormwater management outcomes and to address Council's Codes and Policies relating to both stormwater quantity and water quality for the development.

The stormwater trunk infrastructure network was designed to convey the 1:2 AEP stormwater runoff through the underground pipe networks and the major flood (1:100 AEP) within the road network.

Water quality results indicate that the proposed treatment devices are able to achieve the water quality objectives for the overall Weinam Creek catchment. It is noted that the treatment train proposed in this study provides an option for the development to achieve the objectives; however it may be possible for alternative WSUD treatment methods to be adopted including point source treatment such as raingardens, green roofs and walls, road design retrofits, street trees, etc. The selection should be based on site opportunities and constraints.

The estimated total cost of the stormwater quality infrastructure is approximately $1.9M whilst stormwater quantity infrastructure is estimated to be approximately $1.8M. The construction cost estimates represent budget cost allocations based upon conceptual infrastructure sizing and should be updated as part of the future detailed infrastructure planning.

It should be noted that the stormwater infrastructure requirements identified and assessed in this study are preliminary and will require further concept and detailed design prior to construction.

It is recommended that the stormwater infrastructure locations, sizes and cost estimates are reviewed following any changes to the proposed development layout. It is also recommended that a flood impact study be undertaken for the Weinam Creek PDA to assess the potential impacts of the proposed development on external properties to ensure non-worsening objectives are achieved. The potential impacts from coastal flooding (i.e. storm tide) will also need to be considered along with the setting of development levels.

8. QUALIFICATIONS

a. In preparing this document, including all relevant calculation and modelling, Engeny Management Pty Ltd (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.

b. Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.

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d. Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.

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9. REFERENCES

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APPENDIX A

Examples of Backflow of Protection

Floodgates

The Hume-King floodgate (also known as reflux valve or tidal flap) is an end-of-line, non-return valve which protects a pipeline from tidal inundation, the entry of debris, animals and vermin, and backflow. The floodgates provide a seal on the minimal vertical end of the pipeline, as the mounting pin (located behind the sealing surfaces) creates a moment-arm to hold the gate closed.

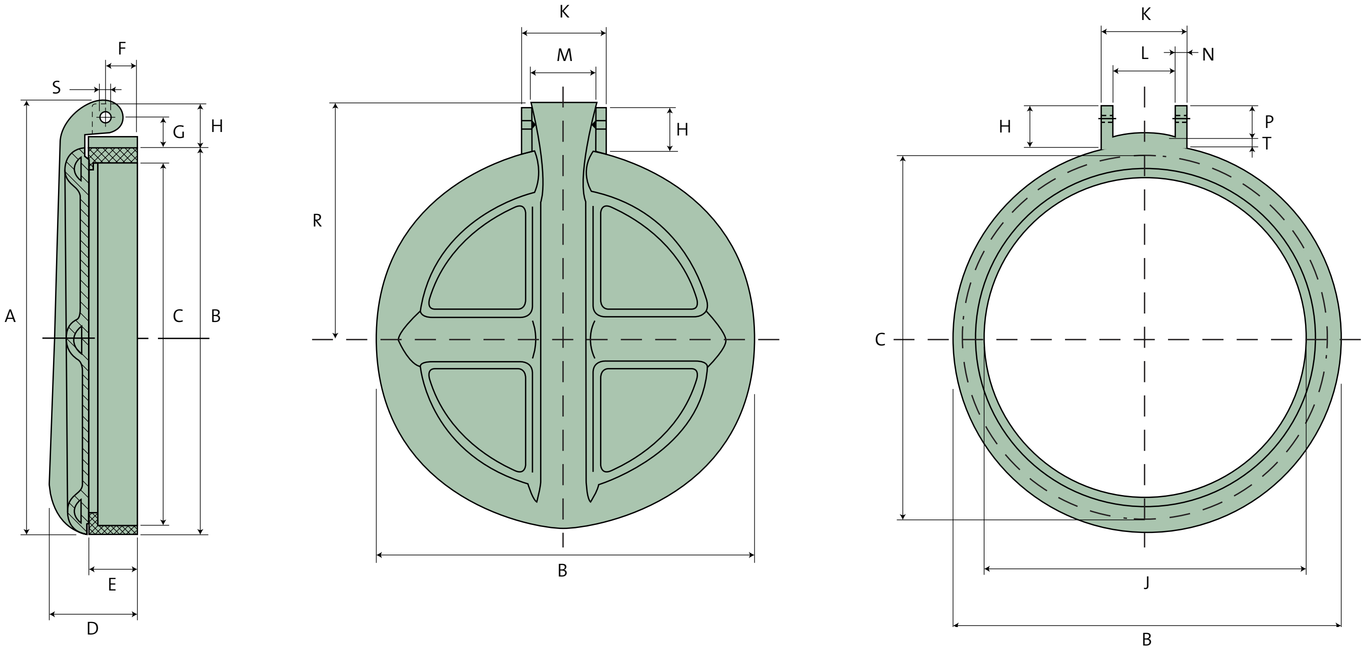
Hume-King floodgates benefit pipeline management through:

- high chemical resistance (to organic solvents, acids, alkalis, and salt water) which delivers a non-corrosive, durable pipeline solution
- resistance to sunlight, ensuring they will not warp in service
- manufacture from materials with low salvage value, discouraging theft and vandalism.

Hume-King floodgates are moulded from fibreglass reinforced polyester, with high tensile 316 stainless steel built-in hinges, and replaceable neoprene sealing rings. They are available to suit Humes standard pipe diameters, in a mounting-ring style for smaller diameter pipes, and a bolt-on style for DN1050 to DN1800 pipes.

Humes can develop and manufacture customised floodgates for non-standard applications.

Figure 1 – Mounting ring style floodgate (for pipes up to DN900) - refer to Table 1 below



Section   Outer face   Mounting ring

Table 1 – Mounting ring style floodgate details

Nominal pipe dia. (mm)	Mass (kg)	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T
100	2	192	154	141	64	38	19	21	27	111	44	38	37	3	24	110	8	3
150	3	251	211	198	76	38	19	21	27	159	44	38	37	3	24	140	8	3
225	4	338	298	281	92	51	30	24	30	238	64	57	54	3	27	184	8	3
300	11	457	387	370	133	57	38	38	64	311	102	79	76	11	56	260	16	8
375	16	540	473	451	133	57	38	38	64	387	102	79	76	11	56	302	16	8
450	17	625	562	540	133	59	38	38	64	467	102	79	76	11	56	341	16	8
525	22	714	651	625	133	59	38	38	64	543	102	79	76	11	56	391	16	8
600	30	800	730	705	133	59	41	38	64	619	114	89	86	13	56	438	16	8
675	36	879	816	791	133	59	41	38	64	692	114	89	86	13	56	471	16	8
750	50	968	905	876	133	59	41	38	64	778	114	89	86	13	56	516	16	8
900	65	1,127	1,064	1,035	133	64	41	38	64	921	114	89	86	13	56	595	16	8

Figure 2 – Bolt-on style floodgate (for pipes up to DN1050 - DN1800) - refer to Table 2 below

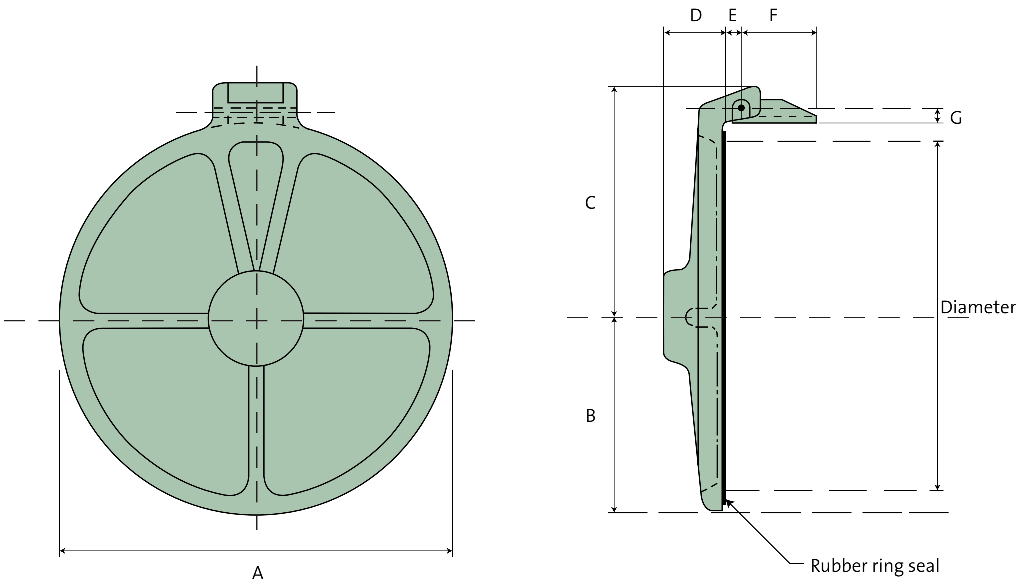


Table 2 – Bolt-on style floodgate details

Nominal pipe dia. (mm)	Mass (kg)	A	B	C	D	E	F	G
1,050	115	1,185	575	730	186	52	254	38
1,200	124	1,365	683	803	222	57	254	38
1,350	160	1,518	759	879	254	57	254	38
1,500	191	1,689	845	1,099	267	83	178	95
1,800	260	2,019	1,010	1,162	279	70	190	83

Note: Check with your local Humes office on availability of floodgates for other pipe diameters and other shapes (e.g box culverts).

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Humes Water Solutions

Strength. Performance. Passion.

Federation Park

HumeGard® GPT

Case study

Case study

Delivering a healthier Condamine

Project
Federation Park, Warwick Queensland

Client
Southern Downs Regional Council

Product supplied
Two HumeGard® Gross Pollutant Traps (GPTs)

Installing two HumeGard® Gross Pollutant Traps (GPTs) at Federation Park, Warwick, has improved public amenity for people enjoying the popular park on the Condamine River, while also **greatly improving water quality** in this important waterway before it feeds into the **Murray-Darling Basin.**

Federation Park is located upstream to the stretch of river skirting the town centre. The river is typically turbid, but enters the town with negligible anthropogenic litter. The park was previously the point where approximately 60% of stormwater and surface runoff from the Warwick CBD would discharge into the river without water quality treatment measures.

The Southern Downs Regional Council engaged Humes to provide a stormwater quality improvement device (SQID) to improve the quality of stormwater discharged to the river. The primary design considerations were that the GPTs had to be **retrofitted to an existing stormwater system**, and additional **headloss had to be minimised.** The two existing pipes were closely aligned, and the new storage chamber had to be able to capture pollutants in regular/frequent flow conditions, yet retain these during peak flows.

Humes supplied the HumeGard® GPTs which uses a floating boom, allowing for industry-leading **low headloss conditions** in peak storm-flow events (K = 0.2). Because the existing trunk network drains the Warwick CBD under pipe-full conditions, any reduction in performance of the system through increased headlosses would cause flooding in the CBD during major storm events.

The existing infrastructure comprised two parallel 1,200 mm diameter reinforced concrete pipes. The two HumeGard® GPTs were **oriented back to back.** One of the pipelines was offset to facilitate connection to the two GPTs. Another critical consideration in the design of the GPTs was the volume of pollutants the units could store, and the ability to retain captured pollutants during infrequent, high flow events. The HumeGard® GPT system was developed to meet this key consideration, through the combination of an offline pollutant storage chamber and a floating boom.

This project delivers a number of high-priority outcomes with a **cost effective solution.** The GPTs provide water quality treatment for gross pollutants (litter, large pollutants) and sediments (of particle size > 150 um) to 60% of the Warwick CBD, with a capture efficiency of 99% up to the treatable flow rate, effectively reducing the gross pollutant loading and sediment loading by 85% on an annual basis (allowing for peak flow bypass).

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