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Associates Pty Ltd

PLANS AND DOCUMENTS
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14th March 2022

Site-Based Stormwater Management Plan

for

Commercial Development

at

Aura Estate, Lots 1189-1190

Edison Crescent, Baringa QLD 4551

for

Newlink Property Group Pty Ltd

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Site Based Stormwater Management Plan
for
Aura Lots 1189-1190

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1.0 INTRODUCTION

Farr Engineers Associates Pty Ltd (Farr Engineers) have been commissioned to prepare a Site Based Stormwater Management Plan Report to address the *Sunshine Coast Regional Council* (SCRC) *Planning Scheme* and associated development guidelines, to support a development application for a commercial development located within the Aura Business Park, Baringa QLD.

2.0 PROJECT UNDERSTANDING

The objective of this report is to indicate the likely levels of stormwater quantity discharge and associated pollutants discharging from the subject site during the operational phase, once the site is considered "off maintenance", and subsequently to prepare a Site Based Stormwater Management Plan in accordance with the following:

- *Sunshine Coast Regional Council Planning Scheme and associated policies;*
- *Queensland Urban Drainage Manual; and*
- *Aura Precinct 3-5 Stormwater Quality Management Plan (v1.6) by DesignFlow*

3.0 SITE CHARACTERISTICS

3.1 Location

The proposed development site is located at property described as Lots 1189-1190 and is part of the Sunshine Coast Regional Council local government area. The lots are subdivided off parent Lot 345 SP308153 within Precinct 3 of the Aura Estate being developed by Stockland. The site has a combined lot area of 3012m^2.

Figure 3.1: Locality Plan
Source: QLD Globe (2021)

3.2 Topography

The topography of the subject site is currently of a general slope towards the south and south-east. The site is currently under construction and will be modified (using cut and fill processes) during construction the development of the lots, and further again to establish platforms for buildings, driveways and carparking for the planned commercial development.

3.3 Existing Land Use

The subject site is currently vacant and is under construction to establish commercial lots for wider Aura Business Park development.

3.4 Proposed Land Use

The developer is proposing to establish two (2) buildings that are to be used for Service Industry (Hardware and Trade supplies), Low Impact Industry and Warehouse (excluding self storage facility). A total GFA of 1,311m^2, 28 carparks, including 2 PWD, and approximately 301 m^2 of landscaping across the site. Site cover is 1,476 (49%). Refer to Appendix B for architectural plans.

3.5 Soils

A detailed geotechnical site investigation has yet to be undertaken and will be done prior to detailed design development.

3.6 Vegetation

The site contains no major vegetation.

4.0 SITE CLIMATE

4.1 Rainfall

The *Bureau of Meteorology* classifies the Site climate as **Sub-Tropical**[1] with storms in spring and early summer, and with the majority of rainfall occurring from January to April.

5.0 DESIGN RAINFALL AND RUNOFF

5.1 Design Rainfall - Intensity Frequency Duration

The *Intensity-Frequency-Duration* (IFD) relationship has been developed for Caloundra QLD based on Australian Rainfall and Runoff[2]. The values were developed using the program *Bureau of Meteorology IFD Program*.

The frequency analysis of rainfall data is an important part of hydrological design procedures. These IFD design rainfall values are used as input to determine hydrologic and hydraulic behaviour for stormwater calculations. The IFD curves extend from five (5) minutes to one-hundred and sixty-eight (168) hours and Average Recurrence Intervals (ARI) from one (1) year to one-hundred (100) years.

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	179	200	267	312	356	415	459
2 min	154	173	234	277	321	384	435
3 min	144	161	218	258	297	354	398
4 min	136	153	205	242	278	328	368
5 min	130	145	195	229	262	308	343
10 min	105	118	156	182	208	240	265
15 min	89.4	99.9	132	154	175	202	223
20 min	78.2	87.3	116	135	153	178	196
25 min	69.8	77.9	103	121	137	160	176
30 min	63.2	70.6	93.9	110	125	146	162
45 min	50.0	56.0	75.0	88.1	101	119	132
1 hour	41.9	47.0	63.4	74.8	86.2	102	114
1.5 hour	32.4	36.5	49.7	59.1	68.6	81.7	92.2
2 hour	26.8	30.3	41.8	49.9	58.2	69.7	78.9
3 hour	20.6	23.4	32.7	39.3	46.1	55.6	63.1
4.5 hour	15.8	18.0	25.6	31.0	36.5	44.2	50.3
6 hour	13.1	15.0	21.5	26.2	30.9	37.5	42.7
9 hour	10.1	11.7	16.9	20.6	24.4	29.7	33.8
12 hour	8.37	9.73	14.2	17.4	20.6	25.1	28.6
18 hour	6.46	7.54	11.1	13.6	16.2	19.7	22.5
24 hour	5.36	6.27	9.26	11.4	13.6	16.6	19.0
30 hour	4.63	5.43	8.02	9.88	11.8	14.4	16.6
36 hour	4.10	4.81	7.11	8.77	10.5	12.9	14.8
48 hour	3.37	3.94	5.85	7.21	8.61	10.7	12.3
72 hour	2.51	2.94	4.36	5.40	6.46	8.09	9.43
96 hour	2.01	2.36	3.50	4.34	5.21	6.56	7.68
120 hour	1.68	1.97	2.93	3.64	4.38	5.52	6.49
144 hour	1.44	1.69	2.52	3.13	3.78	4.77	5.60
168 hour	1.26	1.48	2.21	2.76	3.33	4.19	4.91

Table 5: Intensity-Frequency-Duration Table (Caloundra QLD)

6.0 STORMWATER DRAINAGE DESIGN & QUANTITY ANALYSIS

The proposed stormwater drainage system for the development has been designed as shown on Farr Engineers C200 series drawings under Appendix C. The design was undertaken in accordance with the *Queensland Urban Drainage Manual* (QUDM) and *AS/NZS 3500.3 Stormwater Drainage* for private stormwater and roofwater drainage. The stormwater system was designed for a 10% AEP (ground catchments), 5% AEP (roof catchments) Minor Drainage Criteria and 1% Major Drainage Criteria.

Lots 1189 and 1190 currently have been provided with individual stormwater connection points which were designed to accommodate a fully-developed lots. A copy of the survey plan with the existing drainage infrastructure, has provided within Appendix A. The stormwater connection for Lot 1189 will be capped and only Lot 1190's connection will continue to be used to service the development.

The site levels, grading and proposed stormwater drainage has been designed to generally maintain the design the general existing topography i.e. a fall generally towards the south and south-east. Drawing C205 shows the catchment breakup and corresponding Rational Method peak runoff calculations. The total peak developed peak (minor) flow is 179 l/s. The existing stormwater connection for Lot 1190, the one proposed to be retained to drain developed site, is a 375mm RCP with a built pipe gradient of 3.7% (USIL = 7.875, DSIL = 7.660, Length = 5.868m). A capacity check using the Manning's Equation shows a pipe capacity running full, but no under head of 336 l/s, which is substantially more than the calculated 179 l/s, post-development. On this basis, the existing connection will be able to service the development.

Lot 1190 Existing Stormwater Connection Capacity (Q) - Manning's		
Manning's n	n	0.013
Diameter [mm]	Ø	375
Cross-Sectional Area [sq.m]	A	0.110
Wetted Perimeter of Full Pipe [m]	WP	1.178
Hydraulic Radius of Full Pipe [m]	R	0.094
Energy Slope at Normal Depth [%]	S	3.67%
No. of Pipes		1
Velocity [m/s]	V	3.041
Single Pipe Capacity [L/s]	**Q_{single}**	**335.884**
Single Pipe Capacity [cumecs]	**Q_{single}**	**0.336**
Multiple Pipe Capacity [cumecs]	**Q_{multi}**	**0.336**

7.0 IN SERVICE WATER QUALITY

7.1 Compliance with Precinct-based Stormwater Quality Management Plan

The site's proposed stormwater quality management has been based on achieving compliance with the overarching precinct-based stormwater quality management plan developed by DesignFlow. The subject site, falls within Aura Precinct 3's Bells Creek North catchment, specifically the East Catchment as defined by DesignFlow in Version 1.6 of their report.

It is noted that Bells Creek North's stormwater quality design objectives and specifically the minimum reduction in mean annual pollutant load form unmitigated development areas exceeds that of the State Planning Policy. Table 7 below provides the stormwater quality design objectives as defined within DesignFlow's report.

Table 7: Bells Creek North Stormwater Quality Design Objectives

Source: DesignFlow (2019)

Pollutant	Objective - Minimum reduction in mean annual load from unmitigated development area[1]
Total Suspended Solids	95%
Total Phosphorus	89%
Total Nitrogen	68%
Gross Pollutants	90%

DesignFlow identify several precinct-based treatment measures, including in-line measures such as vegetated swales on trunk drainage reserves and end-of-line measures such as wetlands, bio-retention basins and swales. The subject site is larger than 1200m^2 in developable area, and as such requires an allotment-based treatment. It is understood that the allotment-based treatment for lots greater than 1200m^2 within Aura Precinct 3 are recommended to be a combination of bio-pods equating to 1% of the ground surface catchment and rainwater harvesting tanks receiving the roof catchment. DesignFlow have sized the in-line and end-of-line treatments for Aura Precinct 3-5 to achieve the stormwater quality objectives required for the Bells Creek North Catchment, without providing allomentbased treatment for lots greater than 1200 m^2 within their MUSIC modelling. As such, the recommendation for bio-pods equating to at least 1% of the ground surface catchments of future developments will be applied to this particular development site. The development will have 1420 m^2 of ground catchment and therefore 14.20m^2 of bio-retention area is required, of which has been provided as shown on the C200 Series drawings under Appendix C.

The roof catchments will be drained to rainwater harvesting tanks, one 3000L tank for each building, in this instance. The overflow will be discharged to the bio-retention basins, prior to draining off site.

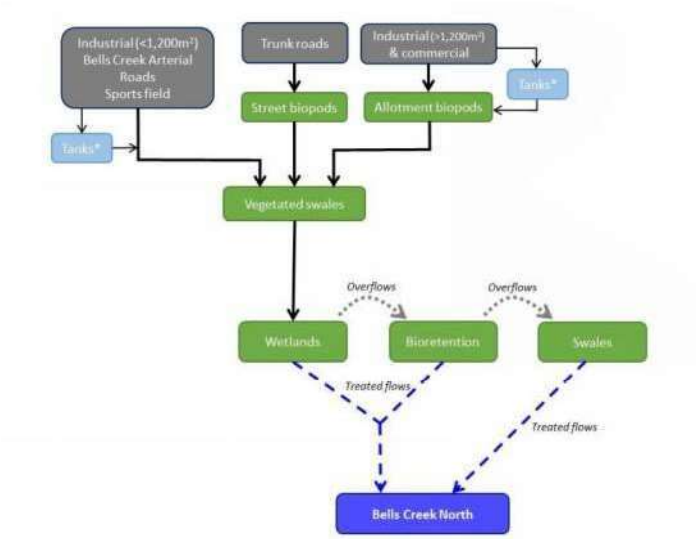

Figure 7: Bells Creek North Precinct-based Stormwater Treatment Strategy
Source: DesignFlow (2019)

8.0 CONSTRUCTION EROSION AND SEDIMENT CONTROL

8.1 Objectives

Additional erosion and sediment controls will be employed during the construction phase of the project. This chapter will detail the management of erosion, sediment and temporary drainage.

The objectives of SBSMP during the construction phase of development are to:

- minimise the probability of on-Site erosion; and
- reduce and limit sediment discharged from the Site.

These objectives will be achieved during construction, by using various erosion and sediment control systems and procedures to minimise runoff from construction areas.

The following objectives and criteria should be incorporated when setting out erosion and sediment controls.

Minimise Disturbance

- Minimise areas and duration of disturbance by stripping, grading and filling;
- Retain vegetation and soil cover for as long as possible;
- Minimise broad area clearing of vegetation and topsoil; and
- Stage earthworks within a work area to minimise areas of exposed soil at any one time.

Drainage Control

- Divert uncontaminated or "clean" water around areas of disturbance and sediment;
- Maintain non-eroding velocity in all artificial channels, or alternatively line channels to prevent erosion of underlying soils; and
- Ensure that channels are constructed to carry the design storm capacity.

Erosion Control

- Minimise raindrop impact to exposed soil areas by using soil cover materials;
- Control sheet erosion by using sediment/silt fences along contours;
- In areas of high silt/clay content concentrate on erosion control;
- In areas of high sand content concentrate on sediment control; and
- Re-vegetate and landscape an area as soon as possible.

Revegetation/Stabilisation

- Rapid stabilisation and/or revegetation of exposed soils at final grade; and
- Place stockpiles away from areas of concentrated flow.

Sediment Control

- Reduce water flow to non-eroding velocity or alternatively reinforce underlying soil to prevent erosion; and
- Discharge treated water via stable outlet structures or to vegetated areas.

Maintenance and Review

Appropriate maintenance of all erosion and sediment control measures to maintain full effectiveness of the system.

8.2 Temporary Erosion and Sediment Control

Temporary erosion and sediment controls during construction will be required. The controls that are suitable to this site are described as follows.

8.2.1 Access - Entrance/Exit

To remove any soil, mud and/or debris from vehicles accessing the site, rock pad construction exits/entrances will be constructed. However, these pads will not be used as a vehicle wash down area.

8.2.2 Stockpiles and Large Areas of Bare Soil

All stockpiles and large areas of bare soil must have sediment fences placed on the downslope side. Only woven fabric sediment fences are to be used based on the likely duration of this project.

8.2.3 Inlets to Stormwater Water Drainage System

Sediment barriers shall be placed around the stormwater drainage system inlets. These can consist of gravel or cloth filter with sandbags. These sediment barriers function by temporarily ponding runoff allowing suspended sediment to settle before entering the gully and stormwater drainage system.

Grassed filter strips with a minimum width of 600 mm can be placed directly behind kerb and channel to treat overland flow runoff. The strip works by filtering runoff from disturbed land before it flows on the road and into the stormwater system.

8.2.4 Erosion Control Measures

Event	Activity
Prior to vegetation disturbance or earthworks activity	Construction of temporary retardation basins downslope of areas subject to disturbance (i.e. in a band parallel to the waterway corridor) to remain effective while site clearing and earth platform construction are in progress.
Commencement of construction	Installation of silt fences using appropriate geotextile mesh or other material between the creek and earthworks, to capture all eroded material. Use of other mechanisms such as hay bales, rip-rap, drop structures, sediment traps and soil stabilisation techniques, to reduce runoff velocity and scour potential (particularly at creek bank discharge points), and further prevent sediment transport from the site. Construction of low earth bunds around the upstream side of any working area, so as to divert upstream drainage around the site.
During vegetation clearing and earthworks	Clearing of vegetation with a minimum of soil attached; on-site mulching or removal to a nearby off-site area for mulching. Stockpiling and stabilization of excavated topsoil to prevent erosion. Prompt covering with mulch and/or revegetation to minimise area of bare disturbed ground at any time.
After completion of earthworks	Revegetation and stabilisation of affected areas using earthworks stockpiled topsoil, so as to prevent erosion and sediment transport. Regular checking of discharge points for scour, repair of structures and effectiveness in prevention/reduction of creek erosion and siltation, especially after heavy rain and/or flooding. Check that the downstream Detention Basin/Bio-retention Basin has not been silted up as the result of the construction activities.
After completion of building works	Diversion of runoff and vegetation of overland flow paths and Filter strips to eliminate ongoing erosion; plus regular maintenance and monitoring as above. Removal of weeds, checking/repair of irrigation, clearing of sediment traps and other routine maintenance Recheck that the downstream Detention Basin/Bio-retention Basin has not been silted up as the result of the construction activities.

All runoff from disturbed areas of the site during the construction phase shall be collected in temporary sediment basins for settling and/or appropriate treatment prior to discharge to watercourses. Where necessary, sediment shall be removed by settlement or appropriate chemical treatment.

A screen shall be located between each construction site and its sediment basin to collect debris. Collected sediment may be used in landscaped areas.

The staging requires the following works sequence.

Stage 1: Install Silt fence on site boundary with roads.
Construct swale to low side site.
Install lined earth bund inside of swale.
Construct sediment basin and spillway.
Construct entry/exit shakedown.

Stage 2: Carry out cut and fill operation ensuring site falls towards sediment basin.
Ensure lined earth bund against retaining wall is 500mm min above filling level.
Maintain sediment basin; treat inflows after rain; discharge to drainage channel once Water Quality Targets achieved

Stage 3: Install permanent stormwater lines and protect pit entries/stormwater line at discharge to the stormwater system to have all gullies with block and aggregate protection and covered with geofabric.
Direct water from stormwater lines to sediment basin from this line to be monitored and inlets sealed if sediment entering drain.

Stage 4: Connect roofwater discharge direct to stormwater lines.
Maintain protection to stormwater gully pits.
Complete pavement sealing and remove pit protection.

Permanent control measures shall be provided as soon as possible after completion in each construction area. Permanent measures to be adopted for the project include:

- revegetation and engineering stabilisation of disturbed areas;
- use of existing drainage lines and gullies to carry stormwater runoff; retention of natural vegetation where possible within drainage lines to the basin prior to discharge to the stormwater system; and
- monitor closely water quality discharge and maintain local sediment controls to all exposed areas of soil.

Checklist To be filled out Weekly

Item	Inspection Description	Yes	No	Comments
1	**Sediment Basin**			
1.1	Has the sediment basin detailed in the ESC program been installed on site?			
1.2	Do the basin batters have adequate protection from erosion (i.e. erosion control mats/mulching and grass seeding etc)?			
1.3	Is erosion evident at the basin inlet, outlet and/or the emergency spillway?			
1.4	Is there evidence of erosion downslope of the basin?			
1.5	Is the water being pumped/siphoned from the basin only once suitable water quality has been achieved?			
1.6	Does the basin require cleaning (i.e. has sediment reached the line shown on the yardstick in the basin)?			
1.7	Is there anything else that should be addressed?			
2	**Rock Filter Spillway**			
2.1	Has the rock filter spillway detailed in the ESC program been installed on site?			
2.2	Is the dam in need of cleaning/ replacement (i.e. does the gravel/rocks appear clogged)?			
2.3	Is there anything else that should be addressed?			
3	**Sediment Detention Ponds**			
3.1	Have the sediment ponds detailed in the ESC program been installed on site?			
3.2	Is erosion evident in-or around the sediment ponds?			
3.3	Is there anything else that should be addressed?			
3.4	If required, is the water being pumped/ siphoned from the ponds only once suitable water quality has been achieved?			
3.5	Is there anything else that should be addressed?			
4	**Sediment Fences**			
4.1	Have the sediment fences detailed in the ESC program been installed on site?			
4.2	Has the fence been buried sufficiently to stop stormwater runoff migrating under the fence?			
4.3	Are the sediment fence posts spaced at a distance of approximately 1.5m apart (closer for higher volumes of flow)?			
4.4	Are any sections of fencing in need of cleaning/ replacement (i.e. are there any piles of sediment against sections of fence/ have any sections of fence been knocked down)?			
4.5	Is there anything else that should be addressed?			

5	**Catch Drains**			
5.1	Have the correct drains/ channels detailed in the ESC program been installed on site?			
5.2	Is any scouring/erosion evident along the drains/ channels used on site?			
5.3	Is there anything else that should be addressed?			
6	**Chutes**			
6.1	Have the temporary drop chutes detailed in the ESC program been installed onsite for the sub-soil stockpile?			
6.2	Have the chutes been sufficiently anchored down?			
6.3	Is water being channelled towards and down the drop chutes or is it bypassing the chutes (i.e. is any scouring evident along the sides of the drop chutes)?			
6.4	Is there anything else that should be addressed?			
7.	**Level Spreader**			
7.1	Has the level spreader detailed in the ESC program been installed on site?			
7.2	Is any erosion evident along and/or downslope of the level spreader?			
7.3	Is there anything else that should be addressed?			
8	Entry/Exit			
8.1	Has the entry/exit detailed in the ESC program been installed on site?			
8.2	Does the entry/exit require modification/ cleaning/ additional gravel (i.e. are there signs that vehicles are still tracking mud onto the road)?			
8.3	Is there anything else that should be addressed?			
9	**Bund**			
9.1	Has the bund detailed in the ESC program been installed on site?			
9.2	Is any erosion evident downslope of the log bund (i.e. does additional work need to be done to prevent concentrated flows of water through the logs)?			
9.3	Is there anything else that should be addressed?			
10	**Mulching/ Seeding/ Revegetation**			
10.1	Have the earthen batters and other areas shown in the ESC program been adequately mulched/seeded/revegetated and within the recommended time frames?			
10.2	Are all ESC measures in place until 70% ground coverage has been achieved for any seeded areas?			
10.3	Is there anything else that should be addressed?			
11	**Erosion Control Mats**			
11.1	Have the erosion control mats shown in the ESC program been installed on the rock batters?			
11.2	Is the geotextile mat secured at the top and bottom of each batter and does it wrap around the entire length of the batter?			
11.3	Is there anything else that should be addressed?			

Monitoring: The Contractor shall monitor construction and record details of all site drainage works and soil erosion control measures. The Contractor shall make regular site inspections including additional site inspections after flood or heavy rainfall events, and shall record details of any scour, soil erosion or sediment deposits, loss of plants etc. and advise on remedial work undertaken, as well as reporting on additional measures required or applied to prevent future occurrences.

Reporting: Monthly reporting by the Contractor to the Consultant covering all maintenance activities and corrective actions. (Copies to Council & Environmental Protection Agency (EPA) and Department of Natural Resources and Water).

Corrective Action: If vegetation growth fails in any area, vegetation is to be re-established, and the irrigation watering regime, planting density, weed management or other factors modified appropriately to prevent a repeat. Otherwise, corrective action will consist of replacement of damaged or failed control devices.

8.3 Removal of Temporary Erosion and Sediment Controls

The sediment barriers, construction entrance and exits and sediment fences are considered temporary erosion and sediment control measures and can be progressively phased out once the disturbed area contributing to the erosion has been rehabilitated.

9.0 MAINTENANCE PLANS

9.1 Inspection Forms and Plans

As built drainage drawings will be supplied to the local authority at the end of the construction phase to assist the local authority in the management of the assets. Digital copies of the maintenance form and maintenance plan will be supplied at the local authority's request so as this information may be entered into their asset register for the management and maintenance of all stormwater drainage infrastructure to be handed over.

9.2 Responsibilities for Maintenance of Structural Controls

It is understood that once developed, the Body Corporate will become responsible for the maintenance of structural controls.

9.3 Maintenance Frequency

It is envisaged that all internal stormwater drainage infrastructure will be maintained on an annual basis. All maintenance is undertaken from the surface in response to modern confined space regulations and under normal conditions there is no need to enter any structure. Routine inspection should be carried out on a monthly basis. The purpose of the inspection is to check that the infrastructure is functioning correctly and to help determine when clean out of the devices is required.

9.4 Maintenance Plant and Equipment

No plant and/or equipment are required for maintenance.

All maintenance activities must be specified in a maintenance plan (and associated maintenance inspection forms) to be developed as part of the design procedure. Maintenance personnel and asset managers will use this plan to ensure the stormwater quality improvement facilities continue to function as designed. The maintenance plans and forms must address the following:

- inspection frequency
- maintenance frequency
- data collection/storage requirements (i.e. during inspections)
- detailed cleanout procedures (main element of the plans) including:
- equipment needs
- maintenance techniques
- occupational health and safety
- public safety
- environmental management considerations
- disposal requirements (of material removed)
- access issues
- stakeholder notification requirements
- data collection requirements (if any)

A proforma operation and maintenance inspection form is included in the checking tools provided on the following page. Inspections are to be undertaken at least once per month, with TSS, TP and TN samples taken at least once per year during a precipitation event.

9.5 *Maintenance Cost of Proposed Strategy*

Maintenance costs are those costs that will be continually incurred. It is assumed that the maintenance costs (per annum) for the SBSMP would be in the order of costs provided in Table 9.1 below:

Table 9.1: Annual Maintenance Cost for SMP

Activity	**Annual Cost $ AUD**
Labour	$1000
Materials	$1200
Machine Hire	$1500
Total	$3700

10.0 ASSET MANAGEMENT

It is proposed that the assets associated with stormwater management and urban water quality control for this site would be the responsibility of the site owner.

11.0 REFERENCES

Department of Natural Resources & Water (2007) *Queensland Urban Drainage Manual*.

Healthy Waterways *Water-Sensitive Urban Design Technical Design Guidelines for South East QLD* (2006)

Institute of Engineers Australia (2016) *Australian Rainfall And Runoff*.