University of the Sunshine Coast
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School of Science and Engineering

Rise and Shine

Humes
Water Solutions

Characterisation of Water Quality Improvement Processes by GPTs at the University of the Sunshine Coast

(***Humegard®*** *HG27 Monitoring Program*)

Final Report

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1. General Approach to the Research

This project was a collaborative research project between **Humes**® and **USC** to install and monitor the **Humegard**® HG27 Gross Pollutant Trap (GPT) over a three year period with two main objectives:

a) To characterise the water quality of runoff from the field trial catchment before and after treatment by the HG27 with the aim to reach agreed criteria suitable for discharge to receiving waters;

b) To identify the removal efficiency of the HG27 in the field.

The Humegard® HG27 was monitored for a total of 15 valid storm events over the calendar years of 2011 to 2015.

2. Site Description and Catchment Characteristics

The Humegard® HG27 was installed at the University of the Sunshine Coast on 20th November 2011 (Figure 1).

Figure 1 – Humegard® HG27 Installation at USC

The catchment monitored is a relatively small, rectangular shaped catchment of approximately 6 ha in area with a sandy-clay soil type (Figure 2). The catchment is quite flat, with an average slope of between 1% and 2%. The catchment consists of approximately 50% car parks, 35% building roofs and 15% open space. This means that the catchment is approximately 85% impervious. The open space areas are mainly grass areas with only minimal vegetation, such as small sedge type bush plants (carex appressa) in the car park dividers and few isolated paper bark trees (melaleuca myrtaceae).

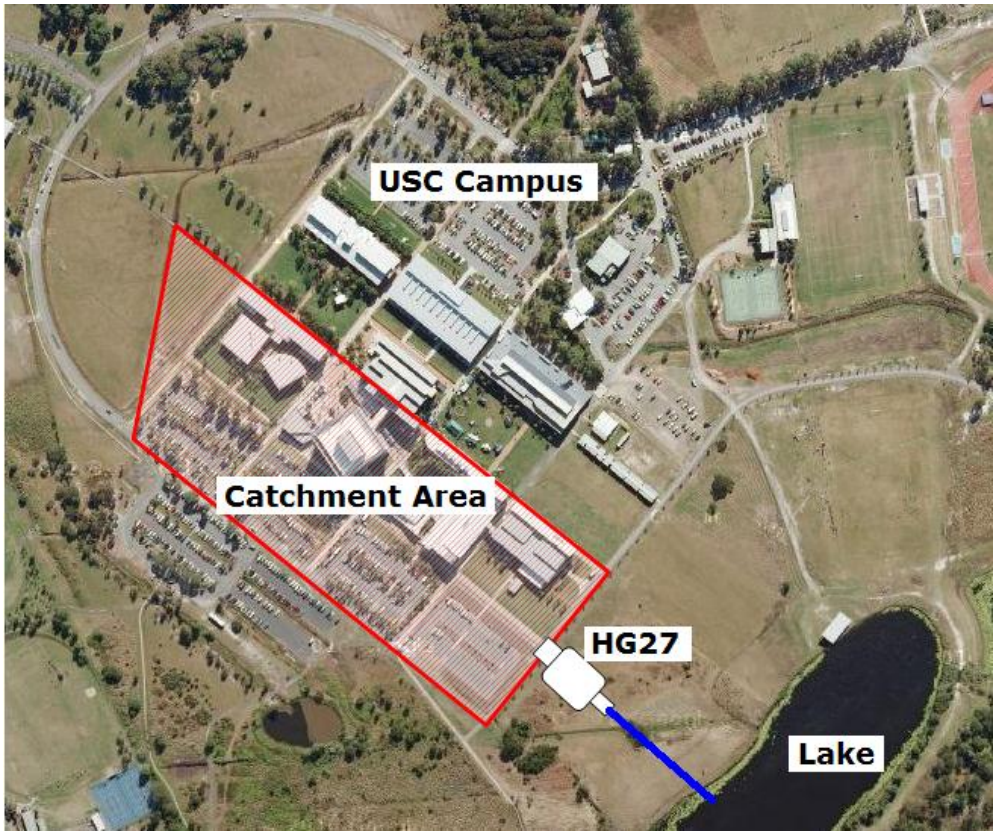

Figure 2 – Catchment and Location of HG27 Study

3. Instrumentation and Sampling Methodology

Two ISCO GLS auto-samplers were used to collect composite stormwater runoff samples from the inlet and outlet of the Humegard® HG27 GPT. A steel cabinet was fabricated in the USC engineering labs to house the samplers and this was installed on the lid of the Humegard® HG27 (Figure 3). The cabinet also contained a Campbell Scientific CR800 datalogger to record relevant monitoring data, and a battery pack and battery charger to ensure continual power for the samplers.

Figure 3 – Steel Monitoring Equipment Housing Installed on Lid of HG27

Sampling point 1 was located at the inlet of the Humegard® HG27 prior to any stormwater treatment occurring. Sampling point 2 was located approximately 2m downstream of the GPT and was fixed to the invert of the outflow pipe. This sampling point allowed the overall measured treatment performance of the GPT to be evaluated. A Unidata Starflow 6526G ultrasonic flow meter was installed at the same location. The Starflow continually monitored the flow volumes through the GPT and also triggered the sampling events. Figure 4 shows a sampler hose being installed by one of the USC lab technicians. A Hydrological Services TB3/P 0.2mm tipping bucket rain gauge was installed near the GPT to record site rainfall.

Figure 4 – Installing the hoses for the Automatic Samplers

4. Sample Handling and Test Methods

For assessment of the performance of the Humegard® HG27, a carefully formulated methodology was used. This included protocols for sample collection, handling and testing (Table 1). The inlet and outlet water samples from the 15 qualifying storm events were collected within four hours of the end of each storm event and transferred to the USC, NATA registered water analysis laboratory for processing and testing for all of the parameters listed in Table 1.

Table 1 - Test Methods and Sampling Protocol

Requirements	Criteria	Details
Minimum Qualifying Events	15	
Minimum Rainfall Intensity	2 mm in 30 minutes	Pluviometer (0.2mm increments)
Minimum Storm Duration	15 minutes	Necessary to achieve 8 aliquots.
Minimum Antecedent Period	6 hours	
Minimum number and volume of sample aliquots	8 @ 200 mL	Composite sample minimum volume 1.6L
Sample method	ISCO GLS Auto-samplers	Collected within 4 hours of storm end.
Flow-weighted samples	Every 2,000L	Starflow ultrasonic probes at pipe outlet
Total Suspended Solids (TSS)	APHA (2005) 2540 D	HDPE or glass bottles, Cool to 4^{o}C, maximum hold time 24 hours
Total Nitrogen & TKN	APHA (2005) 4500 N	HDPE or glass bottles, Cool to 4^{o}C, collect ASAP, maximum hold time 48 hours
Total Phosphorous & Orthophosphate	APHA (2005) 4500 P	HDPE or glass bottles, Cool to 4^{o}C, collect ASAP, maximum hold time 48 hours
Laboratory Certification	NATA registered for all parameters except PSD	
QA/QC	Random duplicates and blanks in accordance with relevant Australian Standards	

5. Results and Discussion

The pollution removal performance of the Humegard® HG27 GPT was monitored during fifteen qualifying rainfall events from 11th June 2013 to 25th March 2015 (Table 2). Composite water quality samples were collected at the inlet and outlet of the GPT over the duration of the 15 rainfall events and these were taken to the NATA accredited USC laboratory for analysis. The results of these analyses are presented in this section.

Table 2 – Qualifying Storm Events used for Evaluation of Humegard® HG27

Event Number	Event Date	Recorded Rainfall Depth (mm)	Total Flow Volume Treated (m^3)
1	11-Jun-13	22	131
2	18-Nov-13	8.2	157
3	19-Nov-13	9.0	410
4	24-Nov-13	9.4	124
5	30-Nov-13	7.6	130
6	13-Dec-13	6.8	162
7	7-Jan-14	5.2	134
8	10-Jan-14	1.6	25.0
9	16-Jan-14	5.0	146
10	22-Feb-14	6.8	243
11	24-Feb-14	1.4	348
12	4-Mar-14	31.2	151
13	18-Mar-15	6.4	129
14	23-Mar-15	12	269
15	25-Mar-15	8.0	167

5.1 Inlet and Outlet Pollution Concentrations

The measured inlet and outlet concentrations of Total Suspended Solids (TSS), Total Phosphorous (TP) and Total Nitrogen (TN) for the composite samples collected from the 15 qualifying rainfall events listed in Table 2 are provided in Table 3. The mean Concentration Removal Efficiencies (CRE) of the Humegard® HG27 for TSS, TP and TN were found to be 41%, 46% and 28%, respectively.

Table 3 – Measured TSS, TP and TN Results

Total Suspended Solids (TSS)			
Event Date	**EMC inflow** (mg/L)	**EMC ouflow** (mg/L)	**CRE %**
11-Jun-13	247	28	89%
18-Nov-13	300	280	7%
19-Nov-13	233	113	52%
24-Nov-13	21	16	24%
30-Nov-13	32	23	28%
13-Dec-13	19	14	26%
7-Jan-14	55	40	27%
10-Jan-14	27	8	70%
16-Jan-14	67	10	85%
22-Feb-14	28	20	29%
24-Feb-14	70	35	50%
4-Mar-14	45	14	69%
18-Mar-15	208	156	25%
23-Mar-15	121	114	6%
25-Mar-15	38	28	26%
Mean	101	59.9	41%
Median	55.0	28.0	28%
Std. dev.	96.4	75.9	27%
Difference in Sample Set Means (%)			**41%**

Total Phosphorus (TP)			
Event Date	**EMC inflow** (mg/L)	**EMC ouflow** (mg/L)	**CRE %**
11-Jun-13	0.167	0.081	51%
18-Nov-13	0.056	0.062	-11%
19-Nov-13	0.256	0.243	5%
24-Nov-13	0.193	0.146	24%
30-Nov-13	0.074	0.055	26%
13-Dec-13	0.072	0.07	3%
7-Jan-14	0.094	0.081	14%
10-Jan-14	0.971	0.32	67%
16-Jan-14	0.185	0.078	58%
22-Feb-14	0.149	0.09	40%
24-Feb-14	1.613	0.609	62%
4-Mar-14	0.418	0.156	63%
18-Mar-15	0.295	0.169	43%
23-Mar-15	0.217	0.047	78%
25-Mar-15	0.542	0.636	-17%
Mean	0.353	0.190	34%
Median	0.193	0.090	40%
Std. dev.	0.421	0.192	30%
Difference in Sample Set Means (%)			**46%**

Total Nitrogen (TN)			
Event Date	**EMC inflow** (mg/L)	**EMC ouflow** (mg/L)	**CRE %**
11-Jun-13	0.846	0.543	36%
18-Nov-13	0.647	0.661	-2%
19-Nov-13	0.772	0.688	11%
24-Nov-13	0.881	0.64	27%
30-Nov-13	0.57	0.593	-4%
13-Dec-13	1.089	1.068	2%
7-Jan-14	0.432	0.398	8%
10-Jan-14	2.052	1.365	33%
16-Jan-14	0.525	0.385	27%
22-Feb-14	1.096	0.709	35%
24-Feb-14	2.068	0.826	60%
4-Mar-14	0.676	0.342	49%
18-Mar-15	0.866	0.459	47%
23-Mar-15	0.968	0.995	-3%
25-Mar-15	0.911	0.64	30%
Mean	0.960	0.687	24%
Median	0.866	0.640	27%
Std. dev.	0.487	0.280	21%
Difference in Sample Set Means (%)			**28%**

Concentration Removal Efficiency (CRE) was calculated using this method: $CRE = \frac{EMC(in) - EMC(out)}{EMC(in)}$

Performance of the Humegard® HG27 device is demonstrated using the concentration reduction efficiency (CRE). CRE is defined as the percentage reduction of pollutant concentration for a particular event. Average of CRE is calculated to demonstrate overall performance. However, caution should be taken in interpretation due to the small sample size of the investigation and this should be considered in any comparison. Additionally, the stormwater inflow pollution concentrations were evaluated with respect to the typical values from urban areas in Brisbane recommended in the MUSIC guidelines (Table 4).

Table 4 - Comparison of Study Inflow Concentrations with Water Quality Guidelines

Parameter	Average stormwater quality (MUSIC)	Humegard® HG27	
	Brisbane	Inflow	Outflow
TSS (mg/L)	151.3	101	59.9
TP (mg/L)	0.34	0.353	0.190
TN (mg/L)	1.82	0.960	0.687

As evident from Table 4, the concentrations of TSS and TN in the runoff (Inflow) from the USC catchment were significantly lower than the typical Brisbane stormwater quality concentrations suggested in MUSIC guidelines. However, TP concentrations were similar. Therefore, the inflow pollution concentrations of the runoff evaluated in this study were considered equivalent to MUSIC concentration parameter values for the Brisbane region.

6. Summary

This final report provides the findings of the field performance monitoring trial of the Humegard® HG27 at the University of the Sunshine Coast. The Humegard® HG27 was monitored for a total of 15 valid storm events over the calendar years of 2011 to 2015. The objective of the monitoring was to characterise the water quality of runoff from the field trial catchment before and after treatment by the HG27. Key findings are as noted below:

- For the 15 events monitored, average concentration reduction efficiency (CRE) for Humegard® HG27 was 41%, 46% and 28% for TSS, TP and TN, respectively.
- Inflow pollutant concentrations of TSS and TN in the runoff (Inflow) from the USC catchment were significantly lower than the typical Brisbane stormwater quality concentrations recommended in MUSIC . However, TP concentrations were similar.

The **University of the Sunshine Coast** is committed to working closely with **Humes**® to meet regional development outcomes and we look forward to further research collaboration in future. Please feel free to contact me if you require further information or if you have any questions.

Yours sincerely, Dr. Terry Lucke 5th March 2015.