Appendix D – Storm Water Treatment Device Specifications

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HumeCeptor® system

The HumeCeptor® system is a patented hydrodynamic separator, specifically designed to remove hydrocarbons and suspended solids from stormwater runoff, preventing oil spills and minimising non-point source pollution entering downstream waterways.

The HumeCeptor® system is an underground, precast concrete stormwater treatment solution that utilises hydrodynamic and gravitational separation to efficiently remove Total Suspended Solids (TSS) and entrained hydrocarbons from runoff. First designed as an ‘at source’ solution for constrained, commercial and industrial sites it has been improved and expanded to service large catchments, mine and quarry sites, inundated drainage systems, and capture large volume emergency spill events. The system is ideal for hardstands/wash bays, car parks, shopping centres, industrial/commercial warehouses, petrol stations, airports, major road infrastructure applications, quarries, mine sites and production facilities.

Independently tested, and installed in over 30,000 projects worldwide, the HumeCeptor® system provides effective, and reliable secondary treatment of stormwater for constrained sites.

- The system reliably removes a high level of TSS and hydrocarbons
  The HumeCeptor® system was developed specifically to remove fine suspended solids and hydrocarbons from stormwater, and has been certified to achieve high pollutant removal efficiencies for TSS (>80%) and Total Nutrients (TN) (>30%) on an annual basis.

- It captures and retains hydrocarbons and TSS down to 10 microns
  Each system is specifically designed to maintain low treatment chamber velocities to capture and retain TSS down to 10 microns. It also removes up to 98% of free oils from stormwater.

- Each device is sized to achieve the necessary Water Quality Objectives (WQO) on an annual basis
  Utilising the latest build-up and wash-off algorithms, PCSWMM software for the HumeCeptor® system ensures that the device chosen achieves the desired WQO (e.g. 80% TSS removal) on an annual basis.

- Its performance has been independently verified
  The HumeCeptor® system’s technology has been assessed by independent verification authorities including the New Jersey Department of Environmental Protection (NJDEP), The Washington Department of Environment (USA), and by the Canadian Environmental Technology Verification program (ETV).

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• **The system is proven**
  The HumeCeptor® system was one of the first stormwater treatment devices introduced to Australia, and now after 30,000 installations worldwide, its popularity is testament to its performance, quality and value for money.

• **High flows won’t scour captured sediment**
  The unique design of HumeCeptor® units ensures that as flows increase and exceed the treatment flow, the velocity in the storage chamber decreases.

• **Nutrients are captured along with the sediment**
  The effective capture of TSS results in the capture of particulate nutrients shown to be >30% of TN and Total Phosphorous (TP).

• **Fully trafficable to suit land use up to class G**
  The HumeCeptor® system is a fully trafficable solution, it can be installed under pavements and hardstands to maximise above ground land use (loading up to class D as standard).

• **Custom designs allow for emergency oil spill storage, directional change, multiple pipes, tidal inundation and class G traffic loads**
  A range of HumeCeptor® systems are available, built specifically to manage emergency spills (50,000 L storage), change of pipe directions, the joining of multiple pipes, high tail water levels as a result of tides or downstream water bodies, and high levels of hydrocarbons with auxiliary storage tanks.

• **We are experienced in the provision of world class treatment solutions**
  Humes has a team of water specialists dedicated to the advancement of economical sustainable solutions, and the provision of expert advice and support.

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System operation

The HumeCeptor® stormwater treatment system slows incoming stormwater to create a non-turbulent treatment environment, allowing free oils and debris to rise and sediment to settle. Each HumeCeptor® system maintains continuous positive treatment of TSS, regardless of flow rate, treating a wide range of particle sizes, as well as free oils, heavy metals and nutrients that attach to fine sediment.

The HumeCeptor® system’s patented scour prevention technology ensures pollutants are captured and contained during all rainfall events.

Bypass chamber

1. Stormwater flows into the inlet (weir) area of the bypass chamber.
2. Design flows are diverted into the offline treatment chamber by a weir, orifice and drop pipe arrangement (refer to Figure 1).
3. The weir and orifice have been developed to create a vortex that sucks floating oils and sediment down into the treatment chamber.
4. During high flow conditions, stormwater in the bypass chamber overflows the weir and is conveyed to the stormwater outlet directly (refer to Figure 2).
5. Water which overflows the weir stabilises the head between the inlet drop pipe and outlet decant pipe ensuring that excessive flow is not forced into the treatment chamber, protecting against scour or re-suspension of settled material. The bypass is an integral part of the HumeCeptor® unit since other oil/grit separators have been found to scour during high flow conditions (Schueler and Shepp, 1993).
1. Once diverted into the treatment chamber through the weir and orifice, the drop pipe beneath the orifice is configured to discharge water tangentially around the treatment chamber wall.

2. Water flows through the treatment chamber to the decant pipe which is submerged similar to the drop pipe.

3. Hydrocarbons and other entrained substances with a specific gravity less than water will rise in the treatment chamber and become trapped beneath the fibreglass insert since the decant pipe is submerged.

4. Sediment will settle to the bottom of the chamber by gravity forces. The large volume of the treatment chamber assists in preventing high velocities and promoting settling.

5. Water flows up through the decant pipe based on the head differential at the inlet weir, and is discharged back into the bypass chamber downstream of the weir.

Independent verification testing

HumeCeptor® systems have been extensively researched by more than 15 independent authorities to validate its performance; it has now gained Environmental Technology Verification (ETV) certificates from ETV Canada, New Jersey Department of Environmental Protection (NJDEP) and Washington Department of Environment (WDOE).

A number of agencies have conducted independent studies; their results from these studies (over 100 test events) have been summarised in Table 1 below.

**Table 1 – HumeCeptor® system performance summary**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Average removal efficiency</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSS</td>
<td>80%</td>
<td>Laboratory and field results, stable, hardstand, roads, commercial and industrial sites</td>
</tr>
<tr>
<td>TN</td>
<td>37%</td>
<td>Field results</td>
</tr>
<tr>
<td>TP</td>
<td>53%</td>
<td>Field results</td>
</tr>
<tr>
<td>Chromium</td>
<td>44%</td>
<td>Field results</td>
</tr>
<tr>
<td>Copper</td>
<td>29%</td>
<td>Field results</td>
</tr>
<tr>
<td>TPH</td>
<td>65%</td>
<td>&lt;10 ppm inflow concentration</td>
</tr>
<tr>
<td></td>
<td>95%</td>
<td>10 ppm - 50 ppm inflow concentration (typical stormwater)</td>
</tr>
<tr>
<td></td>
<td>99%</td>
<td>&gt;500 ppm inflow concentration (emergency spills)</td>
</tr>
</tbody>
</table>
Figure 3 – HumeCeptor® system field performance results for Total Suspended Solids (TSS) removal

Note: Percentage values represent removal efficiencies

Figure 4 – HumeCeptor® system field performance for Total Petroleum Hydrocarbon (TPH) removal (influent concentration <10 ppm)

Note: Percentage values represent removal efficiencies
Figure 5 – HumeCeptor® system field performance for Total Petroleum Hydrocarbon (TPH) removal (influent concentration >10 ppm)

Note: Percentage values represent removal efficiencies

Figure 6 – HumeCeptor® system field performance for Total Petroleum Hydrocarbon (TPH) removal (influent concentration >1,000 ppm)

Note: Percentage values represent removal efficiencies

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Figure 7 – HumeCeptor® system field performance for Total Phosphorous (TP) removal

Note: Percentage values represent removal efficiencies

Figure 8 – HumeCeptor® system field performance for Total Nitrogen (TN) removal

Note: Percentage values represent removal efficiencies
System options

There are a number of HumeCeptor® systems available to meet the requirements of various WQO for maintaining catchments and local hydrology. The standard range is detailed in Table 2 below.

Table 2 – HumeCeptor® model range and details

<table>
<thead>
<tr>
<th>HumeCeptor® model</th>
<th>Pipe diameter (mm)</th>
<th>Device diameter (mm)</th>
<th>Depth from pipe invert* (m)</th>
<th>Sediment capacity (m³)</th>
<th>Oil capacity (l)</th>
<th>Total storage capacity (l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STC 2 (inlet)</td>
<td>100 - 600</td>
<td>1,200</td>
<td>1.7</td>
<td>1</td>
<td>350</td>
<td>1,740</td>
</tr>
<tr>
<td>STC 3</td>
<td>100 - 1,350</td>
<td>1,800</td>
<td>2.13</td>
<td>3</td>
<td>1,020</td>
<td>4,550</td>
</tr>
<tr>
<td>STC 5</td>
<td>100 - 1,350</td>
<td>2,440</td>
<td>3.03</td>
<td>5</td>
<td>1,900</td>
<td>6,820</td>
</tr>
<tr>
<td>STC 7</td>
<td>100 - 1,350</td>
<td>3,060</td>
<td>3.69</td>
<td>10</td>
<td>2,980</td>
<td>13,640</td>
</tr>
<tr>
<td>STC 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STC 14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STC 18</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STC 23</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STC 27</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: *Depths are approximate.

Variants

Continual improvement over the last 14 years of HumeCeptor® system installations has provided a number of enhancements to address specific treatment and design requirements.

- HumeCeptor® STC 2 (inlet) model
  This model features a grated inlet to directly capture runoff from hardstand areas, replacing the need for a stormwater pit (refer to Figure 9).
• **AquaCeptor™ model**

This model has been designed with a weir extension to increase the level at which flows bypass the treatment chamber, and accommodate downstream tail water levels or periodic inundation (e.g. tidal situations). This weir extension is provided in standard heights of 100 mm intervals, up to a maximum of 500 mm.

To maintain the hydrocarbon capture capabilities, an additional “high level” inlet pipe is also fitted. This facilitates the formation of the surface vortex from the bypass chamber into the treatment chamber and draws floating hydrocarbons into the unit.

The selection of the appropriate weir extension height is undertaken in conjunction with the downstream engineering design and/or tidal range charts for the specific location. The AquaCeptor™ model is available in the same sizes as the standard HumeCeptor® units (refer Table 2 on the previous page).
• MultiCeptor™ model

The MultiCeptor™ model (refer to Figure 11) was developed to facilitate the replacement of junction pits while still providing the treatment abilities of the original HumeCeptor® system and reducing time and costs during installation. These units reverse the weir structure to allow for:

• change of pipe direction
• multiple inlet pipes
• differing invert levels of multiple inlet pipes
• grated inlets.

The MultiCeptor™ model is available in the same sizes as the standard HumeCeptor® units (refer to Table 3 below) and a 2,440 mm diameter MultiCeptor™ unit is also available to accommodate drainage pipes up to 1,800 mm diameter.

The larger insert diameter allows for larger pipe connections that are more common where pipes are laid on very flat grades.

Table 3 – MultiCeptor™ model range and details

<table>
<thead>
<tr>
<th>HumeCeptor® model</th>
<th>Pipe diameter (mm)</th>
<th>Device diameter (mm)</th>
<th>Depth from pipe invert (m)</th>
<th>Sediment capacity (m³)</th>
<th>Oil capacity (l)</th>
<th>Total storage capacity (l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MI3</td>
<td>100 - 1,350</td>
<td>1,800</td>
<td>1.68</td>
<td>2</td>
<td>1,020</td>
<td>3,410</td>
</tr>
<tr>
<td>MI5</td>
<td></td>
<td></td>
<td>2.13</td>
<td>3</td>
<td></td>
<td>4,550</td>
</tr>
<tr>
<td>MI7</td>
<td></td>
<td></td>
<td>3.03</td>
<td>5</td>
<td></td>
<td>6,820</td>
</tr>
<tr>
<td>MI9</td>
<td></td>
<td></td>
<td>2.69</td>
<td>6</td>
<td>1,900</td>
<td>9,090</td>
</tr>
<tr>
<td>MI14</td>
<td></td>
<td></td>
<td>3.69</td>
<td>10</td>
<td>2,980</td>
<td>13,640</td>
</tr>
<tr>
<td>MI18</td>
<td></td>
<td></td>
<td>3.44</td>
<td>14</td>
<td></td>
<td>18,180</td>
</tr>
<tr>
<td>MI23</td>
<td></td>
<td></td>
<td>4.04</td>
<td>18</td>
<td></td>
<td>22,730</td>
</tr>
<tr>
<td>MI27</td>
<td></td>
<td></td>
<td>3.84</td>
<td>20</td>
<td>4,290</td>
<td>27,270</td>
</tr>
<tr>
<td>MI9 - MI27 (2,440)</td>
<td>100 - 1,800</td>
<td>2,440 top up to 3,600 base</td>
<td>2.69 - 3.84</td>
<td>6 - 20</td>
<td>1,900 - 4,290</td>
<td>9,090 - 27,270</td>
</tr>
</tbody>
</table>

Figure 11 – MultiCeptor™ model

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• **DuoCeptor™ model**

The DuoCeptor™ model has been developed to treat larger catchments (2 Ha - 6 Ha) because some constrained developments can only accommodate a single, large device instead of several smaller devices.

The unit operates by splitting the flow and treating half of the design flow through the first chamber. The untreated half of the design flow bypassed from the first chamber then passes through the split connection pipe into the second chamber for treatment. Treated flow from the first chamber exits and flows through the other side of the split connection pipe, and bypasses the second chamber to join the treated flow from the second chamber at the outlet of the DuoCeptor™ model.

Figure 12 displays the DuoCeptor™ model and Table 4 details the range of capacities available.

<table>
<thead>
<tr>
<th>DuoCeptor™ model</th>
<th>Pipe diameter (mm)</th>
<th>Device footprint (L x W)</th>
<th>Depth from pipe invert (m)</th>
<th>Sediment capacity (m³)</th>
<th>Oil capacity (l)</th>
<th>Total storage capacity (l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>STC 40</td>
<td>600 - 1,500</td>
<td>7,750 x 3,500</td>
<td>3.41</td>
<td>27</td>
<td>10,585</td>
<td>42,370</td>
</tr>
<tr>
<td>STC 50</td>
<td></td>
<td></td>
<td>4.01</td>
<td>35</td>
<td>10,585</td>
<td>50,525</td>
</tr>
<tr>
<td>STC 60</td>
<td>9,150 x 4,200</td>
<td>3.89</td>
<td>42</td>
<td>11,560</td>
<td>60,255</td>
<td></td>
</tr>
</tbody>
</table>

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• HumeCeptor® MAX model
The HumeCeptor® MAX model (refer to Figure 13) was developed to meet the market need for a single, large, end-of-pipe solution for TSS and hydrocarbon removal. Utilising the HumeCeptor® system's proven capture and scour prevention technology, it is ideal for very large commercial and industrial sites (>6 Ha) (eg. quarries, mine sites and stockpile areas) that need to achieve at least 50% TSS removal and hydrocarbon capture. The HumeCeptor® MAX model can be expanded to almost any capacity required.

As the HumeCeptor® MAX model uses two 2,400 mm diameter inserts, sizing must be calculated separately from the PCSWMM software for the HumeCeptor® system. Contact Humes Water Solutions for assistance.

• HumeCeptor® EOS model
The HumeCeptor® EOS (Emergency Oil Spill) system provides you with the maximum protection against hydrocarbon spills at petrol stations, highway interchanges and intersections. It combines the passive, always-operating functions of the HumeCeptor® system, with additional emergency storage to capture the volume of spill required by your road authority. Standard designs include 30,000 litres and 50,000 litres of total hydrocarbon storage but these can be modified to suit any specified volume.

Figure 13 – HumeCeptor® MAX model
Design information

To design a system suitable for your project it is necessary to review the configuration of the stormwater system, the location and purpose of other stormwater management (WSUD) controls, traffic loading, and the catchment area and hydrology.

Configuration of the stormwater system

As a cylindrical system, HumeCeptor® hydrodynamic separators are much more flexible for accommodating inlet and outlet pipes on angles than rectangular systems.

Location in the stormwater system

Specifically designed for capturing fine sediment and hydrocarbons, the HumeCeptor® system is best suited to “at source” applications. Therefore, it should be located immediately downstream of the catchment area to be treated, e.g. car parks, loading bays, refuelling stations, wash bays.

Catchment area

As a general rule, larger catchment areas require larger HumeCeptor® units. If the catchment area is unstable (e.g. exposed soil) or contributes unusually high pollutant loads (e.g. landscape supply yards), larger units are more appropriate. This can be modelled in PCSWMM software using the “Power Wash-off” or “Event Mean Concentration” TSS loading function.

Sizing HumeCeptor® systems

PCSWMM software for the HumeCeptor® system is the decision support tool used for identifying the appropriate model. A lite version of PCSWMM software is available to identify the HumeCeptor® system which best meets treatment criteria for conventional urban stormwater quality applications (commercial, industrial, residential etc).

Conventional sites typically have stable land cover, paved surfaces, or landscaped areas that do not easily erode during rainfall events. Please contact Humes for further assistance and modeling for unique or unconventional sites. Examples of unconventional sites are as follows:

1. Sites that exhibit unstable wash-off characteristics such as construction sites and sites with material storage. For example, council works depots, landscape supply yards, gravel surfaces etc.

2. Sites with specific suspended solids characteristics such as coal manufacturing facilities, cement manufacturers (sites with a particle size finer or coarser than what is identified in the program).

3. Sites with altered post-development annual hydrology. Alterations to the annual hydrology result from the implementation of stormwater detention upstream of the proposed HumeCeptor® system. Infiltration or detention of small storms (< 1 year) result in alterations to the annual hydrology. Sites with flood control (2 to 100 year detention facilities) will not significantly alter the annual hydrology since detention occurs infrequently. Upstream flood control facilities do not preclude the use of the software for water quality design.

The software calculates continuous runoff from rainfall and simulates sediment accumulation and sediment transport for the design area. Annual TSS removal rates are estimated from the particle size distribution with settling rates calculated using Stoke’s Law, corrected for drag. Assumptions for slope, depression storage, evaporation rates, build-up and wash-off parameters as well as the particle size distribution and settling rates are given in the description of the model calculations.

Users of the software should become familiar with these calculations and parameter values to ensure that they understand the software application. For sites that differ from the assumptions made in the software, please contact your local Humes Water Solutions representative for assistance.
In order to size a unit using the lite version of PCSWMM software, the following six design steps should be followed.

- **Step 1 – Project details and WQOs**
  Enter the project details in the appropriate cells, clearly identifying the water quality objectives (WQO) for the development. It is recommended that a level of annual sediment (TSS) removal be identified and defined by a Particle Size Distribution (PSD). In most Australian situations, this WQO is for 80% TSS removal, but a PSD is not defined. This can be determined from relevant research data or from site monitoring.

- **Step 2 – Site details**
  Identify the site development by the drainage area and the level of imperviousness. It is recommended that imperviousness be calculated based on the actual area of paved surfaces, sidewalks and rooftops.

- **Step 3 – Upstream detention/retention**
  HumeCeptor® systems are designed as a water quality device and is sometimes used in conjunction with on site water quantity control such as ponds or underground detention systems. Where possible, it is more beneficial to install a HumeCeptor® unit upstream of a detention system, as the sediment load is reduced and the maintenance interval between cleaning is maximised.

- **Step 4 – Particle Size Distribution (PSD)**
  It is critical that the PSD is defined as part of the WQO. The design of the treatment system relies on a Stoke’s Law settling (and floating) process, and selection of the target PSD influences the model outcomes.

Where the HumeCeptor® system is installed downstream of a detention system it will alter the hydrology of the catchment and will influence the size of the unit selected by the software. For those projects, enter the footprint area and flow characteristics into the model.

If the objective is for long term removal of 80% of TSS on a given site, the PSD should be representative of the expected sediment on the site. For example, a system designed to remove 80% of coarse particles (>150 microns) only provides relatively poor removal efficiency of finer particles (<75 microns) that may be naturally present in site runoff. PCSWMM software allows the user to enter their own PSD or select from a range of options in the program (refer to Figure 14 below).

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**Figure 14 – PCSWMM for HumeCeptor® system - PSD**

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• **Step 5 – Rainfall records**

The rainfall data provided with PCSWMM software provides an accurate storm hydrology estimation by modelling actual historical storm events including duration, intensities and peaks. Local historical rainfall has been acquired from the Bureau of Meteorology. Select the nearest rainfall station from the list.

• **Step 6 – Summary**

At this point, the software is able to predict the level of TSS removal from the site. Once the simulation has been completed, a table is generated identifying the TSS removal of each unit. Based on the WQO identified in Step 1, the recommended HumeCeptor® system unit will be highlighted.

**MUSIC/pollutant export model inputs**

Many local authorities utilise MUSIC or other pollutant export models to assist in stormwater treatment train selection, and recommend generic inputs for GPTs and hydrodynamic separators.

Considering these against the independent research results in Table 1 on page 4, and PCSWMM modelling used to size a HumeCeptor® unit, the conservative removal efficiencies in Table 5 below are recommended on an annual basis (i.e. no bypass). Humes Water Solutions can optimise the values to suit your specific site.

**Table 5 – MUSIC inputs for HumeCeptor® system**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Removal efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSS</td>
<td>80%</td>
</tr>
<tr>
<td>TN</td>
<td>30%</td>
</tr>
<tr>
<td>TP</td>
<td>30%</td>
</tr>
</tbody>
</table>
System installation

The installation of HumeCeptor® units should conform in general to local authority’s specifications for stormwater pit construction. Detailed installation instructions are dispatched with each unit.

The HumeCeptor® system is installed as follows:

1. Excavate and stabilise the site.
2. Prepare the geotextile and aggregate base.
3. Install the treatment chamber base section.
4. Install the treatment chamber section/s (if required).
5. Prepare the transition slab (if required).
6. Install the bypass chamber section.
7. Fit the inlet drop pipe and decant pipe (if required).
8. Connect inlet and outlet pipes as required.
9. Backfill to transition slab level.
10. Install the maintenance access chamber section (if required).
11. Install the frame and access cover/grate.
12. Backfill to finished surface/base course level and complete surface pavement.
System maintenance

The design of the HumeCeptor® system means that maintenance is conducted with a vacuum truck which avoids entry into the unit.

If the HumeCeptor® unit is sized using the PCSWMM guidelines, a maximum interval of annual maintenance is recommended.

A typical maintenance procedure includes:

1. Open the access cover.
2. Insert the vacuum hose into the top of the treatment chamber via the decant (outlet) pipe.
3. Remove the oily water until the level is just below the lower edge of the decant pipe.
4. Lower a sluice gate into the nearest upstream junction pit and decant the water from the treatment chamber into the upstream pit until the sediment layer is exposed.
5. Remove the sediment layer into the vacuum truck for disposal.
6. Raise the upstream sluice gate and allow water to return into the HumeCeptor® unit.
7. Replace the access cover.

FAQs

• Will it capture litter?
  The HumeCeptor® system is primarily designed for hydrocarbon and fine sediment removal, so if litter is expected from the catchment an upstream GPT is recommended. However, items such as cigarette butts, plastic bags and smaller gross pollutants will be captured by the system.

• Do I need to model a bypass flow for the HumeCeptor® system in MUSIC?
  No, PCSWMM software for the HumeCeptor® system analyses all flows from the catchment to determine 80% TSS removal on an annual basis. Therefore, the output efficiency of PCSWMM for the selected model can be incorporated into a MUSIC treatment node without a bypass flow.

• How often do I need to undertake maintenance?
  A maximum interval of 12 months is recommended, with 3 months ideal, however, these systems are designed with a factor of safety, so it will continue to retain sediment until it is completely full.

• What if the PSD from my site is different to those in the software?
  Humes Water Solutions has the ability to model a user-defined PSD in PCSWMM software for the HumeCeptor® system. If you have PSD results contact us for assistance.

• Do I have to use the model that PCSWMM software highlights?
  No, in most stormwater treatment trains, there are other measures upstream and/or downstream. Select the unit size that you need to achieve your desired removal efficiency in the context of your overall concept. Remember that selecting a model that removes less TSS will also remove less TN and TP.

• Is it possible to change the hydrology model defaults in PCSWMM?
  Yes, Humes Water Solutions has the ability to vary these inputs. Please contact us for further assistance.

• Will the HumeCeptor® system’s treatment chamber release nutrients?
  Over time, captured organic material will break down and release nutrients in all treatment measures whether natural or manufactured. As part of a treatment train, downstream natural measures can remove the small portion of nutrients released during dry weather flows. A regular maintenance program will reduce the amount of break down occurring (Ball and Powell, 2006).
• Why is the HumeCeptor® system not sized on flow rate?
The HumeCeptor® system is sized using actual historical rainfall and an algorithm based on research (Novotny and Chesters 1981, Charbeneau and Barrett, 1988, Ball and Abustan 1995, Sartor and Boyd 1972) showing that pollutants build up and wash off a catchment which is influenced by time, Particle Size Distribution (PSD), rainfall volume and intensity. These form a pollutograph that the software uses to calculate the HumeCeptor® system performance for all flows in every event over the rainfall period. The software then recommends the model that will remove a user selected removal target (usually set to 80%) of TSS load from all of these events.

• How is the HumeCeptor® system different to a GPT?
The HumeCeptor® system is specifically designed to target fine sediment and hydrocarbons. Therefore, it is designed to maintain velocities through the treatment chamber <0.02 m/s. A GPT is designed to capture gross pollutants (>1 mm). For a GPT to function in an equivalent way to a HumeCeptor® system, the treatment chamber velocity must be <0.02 m/s.

• Why would I use a HumeCeptor® system upstream of a biofilter?
Using a HumeCeptor® system upstream of a biofilter acts as a non-scouring sediment forebay, containing sediment to a confined location for easy removal. This protects the biofilter and lengthens its lifespan.

References

• Sartor, J.D and Boyd, G.B (1972) "Water Pollutant Aspects of Street Surface Contaminants", US EPA (EPA - R2 - 72 - 081) Washington, DC.
Appendix

HumeCeptor® system technical drawings

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Humes Technical Design
STC-9 Humeceptor
Standard Drawing

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Humes
STANDARD DRAWING
STC-27 HUMECEPTOR
ASSEMBLY DRAWING

IMPORTANT INSTALLATION INFORMATION

1. FOUNDATION REQUIREMENTS - MIN. ALLOWABLE BEARING CAPACITY REQUIRED 280 kPa
2. UNIT TO BE PLACED ON 15mm THICK BED ZONE MATERIAL IN ACCORDANCE WITH AS3725 REQUIREMENTS
3. TREATMENT CHAMBER SHOULD BE FILLED WITH WATER TO 2/3 DEPTH IMMEDIATELY AFTER INSTALLATION (UNIT MAY FLOAT PRIOR TO BACKFILLING)

RUBBER RING JOINT SPECIFICATION

MATERIAL: EPDM
HARDNESS: 43 ± 2 shore A (54±4A6)
PROFILE: L 30mm, Depth 6mm, 180°
ID: 3450 ± 10mm

SECTION A
SCALE: 1:25

PLAN
SCALE: 1:25

Humes
Technical Drawing
STC-27 HUMECEPTOR
Assembly Drawing

Bedrock Holdings Pty Ltd
3399 Bauraw Street, 4500 Rockhampton, Qld
Australia
Tel: +61 7 4930 3200
Fax: +61 7 4930 3201

2004

A2 HC-STC27-A
**FOR INFORMATION**

1. TYPICAL ASSEMBLY DETAIL ONLY - REFER TO PROJECT DRAWING FOR ACTUAL REQUIREMENTS.

2. DIMENSIONS INDICATED ARE STANDARD.

3. STORAGE VOLUMES
   - TOTAL = 50,525 LITRES
   - TREATMENT CHAMBER STORAGE VOLUME = 35 m³
   - TREATMENT CHAMBER BASE UNIT STORAGE VOLUME = 1500 LITRES
   - TREATMENT CHAMBER SUMP UNIT (NO. SHAFT) = 11,120 TONNE
   - TREATMENT CHAMBER SUMP UNIT (CIV. SLAB AND SHAFT) = 12,500 TONNE
   - Bypass Chamber = 0.74 TONNE

4. COMPONENT WEIGHTS
   - TREATMENT CHAMBER BAS UNT (INC. SHAFT) = 11,120 TONNE
   - SUMP UNIT (CIV. SLAB AND SHAFT) = 12.50 TONNE
   - Bypass Chamber = 0.74 TONNE

5. REFER TO INSTALLATION GUIDE FOR RECOMMENDED INSTALLATION PROCESSION.

6. SWIVEL LIFTING ANCHORS PROVIDED FOR LIFTING ALL COMPONENTS. THE FOLLOWING SWIVEL FITTINGS WILL BE REQUIRED:
   - 6 x 1.3 TONNES
   - 8 x 2.5 TONNES
   - 8 x 10.0 TONNES

7. OIL SAMPLE PORT, STEP IRONS AND DECANT PIPE TO BE VISIBLE AS PER PLAN VIEW

8. THE ABOVE WEIGHTS ARE ONLY APPROXIMATIONS OF THE ACTUAL WEIGHTS OF COMPONENTS AND ARE NOT TO BE USED.

---

**NOT FOR CONSTRUCTION**
NOT FOR CONSTRUCTION

1. TYPICAL ASSEMBLY DETAILS ONLY - REFER TO PROJECT DRAWING FOR ACTUAL REQUIREMENTS.
2. DIMENSIONS INCLUDED ARE STANDARD.
3. STORAGE VOLUMES
   TOTAL = 80,355 LITRES
   OIL STOREGE VOLUME = 10,920 LITRES
   SEDIMENT STORAGE VOLUME = 42 m³
4. COMPONENT WEIGHTS
   TREATMENT CHAMBER BASE UNIT (INC. 18 TONNE) = 16.20 TONNE
   TREATMENT CHAMBER TOP UNIT (INC. 18 1/2 TONNE) = 13.66 TONNE
   Bypass Chamber = 8.14 TONNE
5. REFER TO INSTALLATION GUIDE FOR RECOMMENDED INSTALLATION PROCEDURE.
6. SHOWN LIFTING ANCHORS PROVIDED FOR LIFTING ALL COMPONENTS. THE FOLLOWING SHOWN LIFT ANCHORS WILL BE REQUIRED:
   6 x 1.5 TONNES
   6 x 2.0 TONNES
   8 x 10.0 TONNES
7. OIL SAMPLE PORT, STEP BEADS AND DECANT PIPE TO BE VISIBLE AS PER PLN VIEW
8. THE ABOVE WEIGHTS ARE ONLY APPROXIMATIONS OF THE ACTUAL FINISHED WEIGHTS OF COMPONENTS AND ARE NOT TO BE USED.

FOR INFORMATION
*150 MIN FOR INLET / OUTFLOW PIPE < 635 mm
*300 MIN FOR INLET / OUTFLOW PIPE > 750 mm

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Precast solutions

Top:
StormTrap® system

Middle:
RainVault® system

Bottom:
Segmental shaft

Stormwater

Stormwater treatment
Primary treatment
  HumeGard® Gross Pollutant Trap
Secondary treatment
  HumeCeptor® hydrodynamic separator

Detention and infiltration
StormTrap® system
Soakwells

Harvesting and reuse
RainVault® system
ReserVault® system
RainVault® Mini system
Precast concrete cubes
Segmental shafts

Stormwater drainage
Steel reinforced concrete pipes – trench
Steel reinforced concrete pipes – salt water cover
Steel reinforced concrete pipes – jacking
Box culverts
Uniculvert® modules
Headwalls
Stormwater pits
Access chambers/Manholes
Kerb inlet systems
Floodgates
Geosynthetics

Sewage transfer and storage
Bridge and platform
Tunnel and shaft
Walling
Potable water supply
Irrigation and rural
Traffic management
Cable and power management
Rail
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Fax: (08) 9309 1625

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Fax: (08) 9351 6977

Northern Territory
Darwin
Ph: (08) 8984 1600
Fax: (08) 8984 1614
HumeGard® GPT
Technical manual

Issue 4
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HumeGard® GPT

The HumeGard® system is a Gross Pollutant Trap (GPT) that is specifically designed to remove gross pollutants and coarse sediments ≥ 150 microns, from stormwater runoff. A wide range of models are available to provide solutions for normal and super-critical flow conditions.

The patented HumeGard® GPT incorporates a unique floating boom and bypass chamber to enable the continued capture of floating material, even during peak flows. The configuration also prevents re-suspension and release of trapped materials during subsequent storm events.

The HumeGard® GPT is designed for residential and commercial developments where litter and sediment are the target pollutants. It is particularly useful in retrofit applications or drainage systems on flat grades where low head loss requirements are critical, and in high backwater situations.

The value of the HumeGard® GPT has proven it to be one of the most successful treatment devices in Australia today:

- **The system provides high performance with negligible head loss**
  The HumeGard® GPT has a head loss ‘k’ factor of 0.2, important for retrofit and surcharging systems.

- **It captures and stores a large volume of pollutants**
  For pollutant export rates reported by Australia Runoff Quality (1 m³/hectare/year), the HumeGard® GPT is sized for maintenance intervals up to annual durations.

- **It uses independently proven technology**
  The system was developed and tested by Swinburne University of Technology, Australia, in 1998, to demonstrate compliance with operational criteria from the Victorian EPA.

- **It has low operational velocities**
  Flow velocity in the storage chamber is <0.2 m/s to ensure the comb self-cleans and improves settling of coarse sediment.

- **It retains floating material even in bypass**
  All GPTs bypass at high flows. The patented floating boom will capture and retain floating materials even when bypass occurs.

- **It provides cost effective treatment for litter and coarse sediments**
  The system’s large capacity and long maintenance intervals reduces the overall lifecycle costs in comparison with other treatment measures.

- **It can reduce the footprint of the stormwater treatment train**
  Installation of a HumeGard® GPT prior to vegetated treatment measures can assist in reducing their overall footprint.

- **It maximises above ground land use**
  The HumeGard® GPT is a fully trafficable solution, so it can be installed under pavements and hardstands to maximise land use on constrained sites.

- **It is easy to maintain**
  Cleanout of the HumeGard® GPT can be performed safely and effectively from the surface using a vacuum truck.

- **It is made from quality componentry**
  All internal metal components are made from 304 stainless steel or fibreglass, and the system undergoes rigorous quality control prior to dispatch.
System operation

The HumeGard® GPT utilises the processes of physical screening and floatation/sedimentation to separate the litter and coarse sediment from stormwater runoff. It incorporates an upper bypass chamber with a floating boom that diverts treatable flows into a lower treatment chamber for settling and capturing coarse pollutants from the flow.

Bypass chamber

1. Stormwater flows into the inlet (boom) area of the bypass chamber (refer to Figure 1).
2. During flows up to and including the design treatment flowrate, the angled boom directs the total flow into the storage/treatment chamber.
3. During higher flow conditions, the angled boom continues to direct all floating litter from the bypass chamber into the storage/treatment chamber. The inlet area of the bypass chamber floor is angled towards the treatment chamber to ensure the bed load sediment material continues to be directed into the storage chamber even when the boom is floating.
4. At peak flows, the boom remains semi-submerged and enables excess flow to pass underneath, regulating the flow into the storage/treatment chamber. This ensures that higher flows, which could otherwise scour and re-suspend previously trapped materials, are not forced into the storage/treatment chamber. The floating boom bypass ensures previously trapped floating materials are retained. Each HumeGard® GPT is designed to achieve an operating velocity below 0.2 m/s through the storage chamber to ensure the settling of coarse sediment and keep the comb clean.

Treatment chamber

1. Once diverted into the treatment chamber, the flow continues underneath the internal baffle wall, passes through the stainless steel comb and flows over the flow controlling weir to the outlet.
2. Pollutants with a specific gravity less than water (S.G.<1) remain floating on the water surface in the storage/treatment chamber. Sediment and other materials heavier than water (S.G.>1) settle to the bottom of the chamber. The design and depth of the chamber minimises turbulent eddy currents and prevents re-suspension of settled material. The comb prevents any neutrally buoyant litter in the treatment chamber from escaping under the baffle wall.

Figure 1 – Operation during design flow conditions
Independent verification testing

Laboratory and field testing of the HumeGard® GPT for hydraulic performance and litter capture was conducted in Australia by Swinburne University of Technology, during 1996 and 1998.

Laboratory and field testing (Waste Management Council of Victoria 1998, Trinh 2007, Woods 2005, Swinburne University of Technology 2000) has proven the performance outlined in Table 1 below.

Further field testing was conducted by the University of the Sunshine Coast from 2013 to 2015, including a minimum of 15 qualifying storm events, to determine TSS, TP and TN removal efficiencies, which are also outlined in Table 1 below.

Table 1 – HumeGard® GPT performance summary

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Removal efficiency</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross pollutants (litter, vegetation)</td>
<td>90%</td>
<td>Annually</td>
</tr>
<tr>
<td>TSS</td>
<td>49%</td>
<td>Annually (including bypass)</td>
</tr>
<tr>
<td>Hydrocarbons</td>
<td>90%</td>
<td>In an emergency spill event</td>
</tr>
<tr>
<td>TP</td>
<td>40%</td>
<td>Particulate-bound</td>
</tr>
<tr>
<td>TN</td>
<td>26%</td>
<td>Particulate-bound</td>
</tr>
</tbody>
</table>

Notes:
1. Nutrient removal is influenced by individual catchment characteristics and partitioning between dissolved and particulate nitrogen.
2. For further details on performance testing contact Humes.
3. Gross pollutant traps are not specifically designed to capture hydrocarbons, though may do so during emergency spill events. When this occurs, maintenance is required immediately.
4. The unique design of the HumeGard® floating boom allows it to be modified to treat higher flows and capture more gross pollutants and sediment on request.
System options

A wide range of sizes are available to suit catchment pollutant generation rates and Water Quality Objectives (WQO). Table 2 below presents the standard model dimensions and total pollutant capacities. We recommend that designers contact Humes Water Solutions for detailed sizing on each project and for advice with larger units.

Pollutant export rates detailed in Australian Runoff Quality (Engineers Australia 2006) suggests that a typical urban catchment will produce 1 m³/hectare/year of gross pollutants and sediment. Humes Water Solutions advises that this be taken into account when selecting an appropriate model.

Table 2 – HumeGard® model range and dimensions

<table>
<thead>
<tr>
<th>HumeGard® model</th>
<th>Pipe diameter or box culvert width (mm)</th>
<th>Treatment flow rate (L/s)</th>
<th>Total pollutant capacity (m³)</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
<th>Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HG12</td>
<td>300</td>
<td>85</td>
<td>3</td>
<td>2,000</td>
<td>1,758</td>
<td>2,500</td>
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<td>HG12A</td>
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<td>2,000</td>
<td>1,758</td>
<td>2,500</td>
</tr>
<tr>
<td>HG15</td>
<td>450</td>
<td>130</td>
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<td>2,000</td>
<td>1,758</td>
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<td>HG18</td>
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<td>2,115</td>
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<td>HG24</td>
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<td>HG30A</td>
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<td>Custom</td>
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<td></td>
</tr>
</tbody>
</table>

Notes:
1. The unique design of the HumeGard® floating boom allows it to be modified to treat a wide range of flowrates. Contact Humes for details on the model to suit your project.
2. HumeGard® can be modified to suit a box culvert, larger pipe or skewed outlet. Please contact your Humes Water Solutions Manager.
3. HumeGard® should be sized for either pipe diameter or treatment flow rate.
4. Units listed are standard configurations. Custom units can be provided to meet specific project requirements.
5. For confirmation of HumeGard® sizing or to discuss project specific requirements please contact your Humes Water Solutions Manager.
6. Refer to current Humes Terms and Conditions of Sale.
7. Australian Rainfall Quality recommend a pollutant export rate for a typical residential catchment is up to 1m³/ha/yr of mixed waste and sediment.
8. HumeGard® can be modified to suit typical tail-water effects from downstream areas such as basins. Please contact Humes for design advice.
9. HumeGard® can be modified to suit high groundwater conditions. Please contact Humes for design advice.

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Variants

A number of additional innovations have been made to the HumeGard® GPT to facilitate their effective operation in a wider range of applications:

- Super-critical HumeGard® GPT – designed to operate under supercritical flow conditions in steep, high velocity drainage networks.
- Angled HumeGard® GPT – designed to replace a 45° or 90° junction in a drainage network.
- Dual outlet HumeGard® GPT – designed to divert the treatment flow to downstream natural Water Sensitive Urban Design (WSUD) elements such as wetlands and bio-retention whilst bypassing excess flows through a second outlet.

**Super-critical HumeGard® GPT**

The super-critical HumeGard® GPT (refer to Figure 2) was borne out of the original HumeGard® GPT, with modifications to deliver even greater performance under super-critical flow conditions. This model replaces the floating boom with a broad-crested weir that diverts the treatment flows into the treatment chamber under super-critical flow (Fr>1) conditions without creating hydraulic jumps and adversely impacting on performance.

Flow into the treatment chamber passes through a stainless steel screen at a velocity <0.2 m/s and exits the device via a slot beneath the broad-crested weir (refer to the red arrows in Figure 2). The inserts in these models are manufactured from fibreglass for increased durability. The stainless steel screen can be shaped with a curved profile upon request. When the treatment flow rate is exceeded, the excess flow bypasses over the broad-crested weir to the outlet. This maintains the treatment flow into the chamber but protects against scour of captured material.
• **Angled HumeGard® GPT**

The angled HumeGard® GPT (refer to Figure 3), was developed to facilitate the replacement of junction pits while still providing the treatment capabilities of the original HumeGard® device. These units simply alter the outlet location to allow for a change of pipe direction of 45° or 90°. The Angled HumeGard® GPT can be supplied in any of the standard unit sizes, however, the designer must allow for a minor head loss factor ‘k’ of 1.3 instead of 0.2 (which applies to the standard HumeGard® GPT design).

• **Dual Outlet HumeGard® GPT**

The Dual Outlet HumeGard® GPT has been designed to operate as a diversion structure upstream of natural WSUD options such as constructed wetlands, ponds, lakes, and bio-retention systems.

The units are designed such that one outlet conveys the treated flow into the natural WSUD measure and the standard outlet bypasses the excess flow around the downstream system (refer to Figure 4). Dual Outlet HumeGard® units are available in the same sizes as the standard HumeGard® units (refer Table 2 on page 4).

Figure 3 – Angled HumeGard® GPT

Figure 4 – Dual Outlet HumeGard® GPT

**Inundation/tidal applications**

The boom of the HumeGard® GPT enables the capture of floating pollutants even at peak flows, often when other fixed weir devices are in bypass mode. This unique feature also makes the HumeGard® GPT ideal for applications that are subject to both tidal and tail water effects.

In tidal applications the floating boom effectively traps the floating pollutants and prevents the loss of the gross pollutants from the system. In fixed weir devices, previously trapped floating litter may be backwashed out of the GPTs during the rising phase, to later bypass the GPT during the falling phase of the tide. As this happens twice daily, spring tides could quickly empty devices relying upon a fixed weir.

Marine grade 316 stainless steel is used for all internals in devices installed in tidal applications. In acidic/aggressive environments, these may also be epoxy-coated. Contact Humes Water Solutions for specific designs to suit these applications.

A plinth can also be added to the false floor under the boom to ensure sediment loads are captured during inundation.
**Design information**

To design a system suitable for your project it is necessary to review the configuration of the stormwater system, the location and purpose of other stormwater management (WSUD) controls, the catchment area and the hydrology.

**Configuration of the stormwater system**

The configuration of the stormwater system is important since the HumeGard® GPT operates with an “in-line”, 45° or 90° alignment. Inlet pipe grades between 0.5% and 5% are recommended for at least five pipe diameters upstream of the HumeGard® GPT. The pipe grade and flow velocity will determine whether a super-critical unit is required.

**Location in the stormwater system**

Depending upon the site, the GPT can be oriented to have the treatment chamber on the left or right side of the pipe to suit constraints. Humes Water Solutions can work closely with stormwater designers to select the appropriate location and orientation for their system.

**Catchment area**

Research presented in Australian Runoff Quality (Engineers Australia 2006) concluded that roughly 1 m³/hectare/year of gross pollutants and sediment could be expected from a typical residential catchment. Therefore, GPTs designed for an annual maintenance interval should have a pollutant storage capacity roughly equal to the number of hectares of catchment it treats (e.g. 10 hectare catchment = 10 m³ pollutant storage).

**Sizing HumeGard® GPTs**

The large storage volumes of the HumeGard® GPT enables more pollutants to be captured before maintenance is required, which greatly reduces its lifecycle costs. In accordance with accepted hydraulic principles the larger volumes in the HumeGard® GPT results in lower velocities through the device, minimising scour and re-suspension of sediment.

Humes Water Solutions has developed a design request form (see page 30) for stormwater designers to complete and return to obtain a detailed design of the appropriate device.

**MUSIC/pollutant export model inputs**

Many local authorities utilise MUSIC or other pollutant export models to assist in stormwater treatment train selection, and recommend generic inputs for GPTs. Considering these against the independent research results, the following conservative removal efficiencies (refer to Table 3 below) are recommended for the HumeGard® GPT on an annual basis (i.e. no bypass).

**Table 3 – MUSIC inputs for HumeGard® GPTs**

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Removal efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gross pollutants (litter, vegetation)</td>
<td>90%</td>
</tr>
<tr>
<td>TSS</td>
<td>49%</td>
</tr>
<tr>
<td>TP</td>
<td>40%</td>
</tr>
<tr>
<td>TN</td>
<td>26%</td>
</tr>
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System installation

The installation of the HumeGard® unit should conform to the local authority’s specifications for stormwater pit construction. Detailed installation instructions are dispatched with each unit.

The HumeGard® unit is installed as follows:

1. Prepare the excavation according to plans.
2. Prepare the compacted aggregate base.
3. Install the main treatment chamber section.
4. Install the main bypass chamber section/s (if required).
5. Fit the stainless steel comb (if required).
6. Connect the inlet and outlet pipes.
7. Place the main chamber lid.
8. Install the frame and access covers.
9. Backfill to specified requirements.

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System maintenance

The design of the HumeGard® GPT means that maintenance is best performed by vacuum trucks which avoids entry into the unit.

Additional access covers can be designed upon request.

A typical maintenance procedure includes:

1. Remove access covers.
2. With a vacuum hose, remove the floating litter from the treatment chamber.
3. Determine the depth of water and sediment layers.
4. Insert sluice gate into the upstream manhole.
5. Decant water from the treatment chamber into the upstream manhole until the sediment layer is exposed.
6. Remove the sediment layer with the vacuum hose; jet with a high pressure hose if required.
7. Remove sluice gate from the upstream manhole and allow water to return to the HumeGard® GPT.
8. Replace access covers.
FAQs

• Can the boom become stuck?
The boom weighs up to 80 kg. Unless there is a large branch, car wheel, or other large item carried through the drainage network, the mass of the boom will ensure it returns to the floor.

• Will the gross pollutants bypass when the boom floats?
All treatment measures are designed to treat a specific flow. Once this is exceeded, any entrained pollutants in the flow will bypass the treatment chamber. Often this is less than 5% of the annual load. A significant quantity of gross pollutants are buoyant when entering a GPT and, unlike fixed weir systems which bypass these floatable items, the HumeGard® boom provides continuous treatment of them, even in bypass.

• Will the retention of water in the treatment chamber lead to the release of nutrients as pollutants break down?
Over time, captured organic materials will breakdown and release nutrients in all treatment measures whether natural or manufactured. As part of a treatment train, downstream vegetated measures can remove the small proportion of nutrients released during dry weather flows. A regular maintenance program will reduce the amount of breakdown occurring.

• What is the design life of a HumeGard® GPT?
The entire product is designed to last a minimum of 50 years.

• Why is the HumeGard® GPT larger than other GPTs?
The design of the HumeGard® GPT is to ensure a velocity through the treatment chamber <$0.2 \text{ m/s}$ to ensure the comb self-cleans. From engineering principles, a larger cross-sectional area is required to reduce the loading rate. As proven by Stokes Law, lower chamber velocities mean smaller sediment particles can be captured.

• Why would I use a HumeGard® GPT upstream of a biofilter?
Using a HumeGard® GPT upstream of a biofilter acts as a sediment forebay and removes litter, containing it to a confined location for easy removal by a vacuum truck. This protects the biofilter, lengthens its lifespan and reduces the ongoing maintenance costs.

References

• Engineers Australia (2006) "Australian Runoff Quality".
• Lucke, T. 2015, Characterisation of Water Quality Improvement Processes by GPTs at University of the Sunshine Coast (HumeGard HG27 Monitoring Program), School of Science and Engineering, University of the Sunshine Coast, QLD, Australia.
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Precast solutions

Top:
StormTrap® system

Middle:
RainVault® system

Bottom:
Segmental shaft

Stormwater
Stormwater treatment
Primary treatment
HumeGard® Gross Pollutant Trap
Secondary treatment
HumeCeptor® hydrodynamic separator

Detention and infiltration
StormTrap® system
Soakwells

Harvesting and reuse
RainVault® system
ReserVault® system
RainVault® Mini system
Precast concrete cubes
Segmental shafts

Stormwater drainage
Steel reinforced concrete pipes – trench
Steel reinforced concrete pipes – salt water cover
Steel reinforced concrete pipes – jacking
Box culverts
Uniculvert® modules
Headwalls
Stormwater pits
Access chambers/Manholes
Kerb inlet systems
Floodgates
Geosynthetics

Sewage transfer and storage
Bridge and platform
Tunnel and shaft
Walling
Potable water supply
Irrigation and rural
Traffic management
Cable and power management
Rail
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