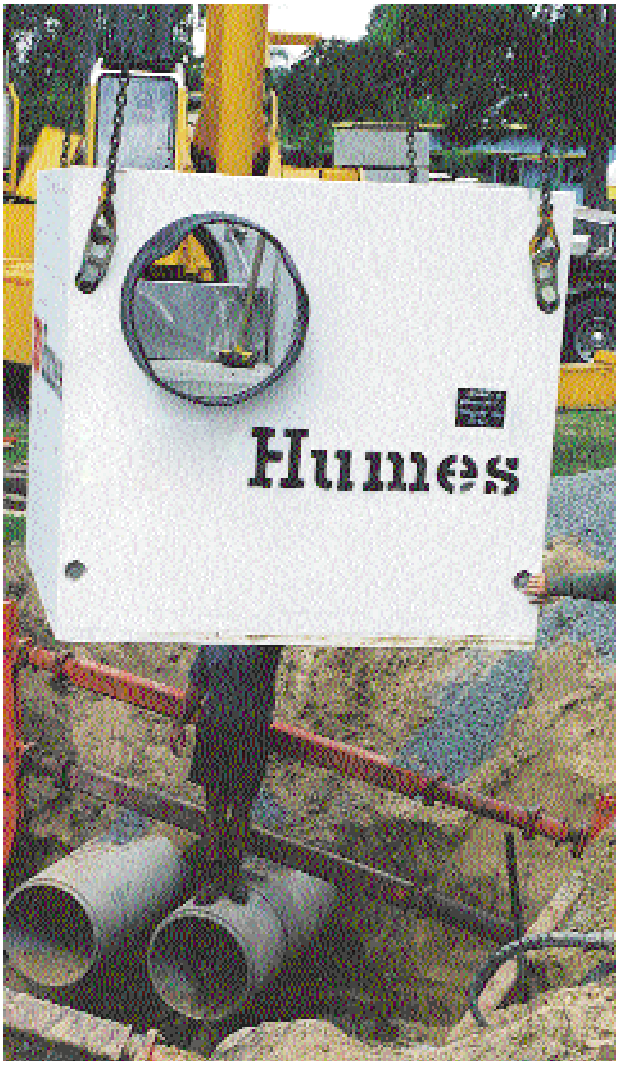
Humegard™

Technical Manual

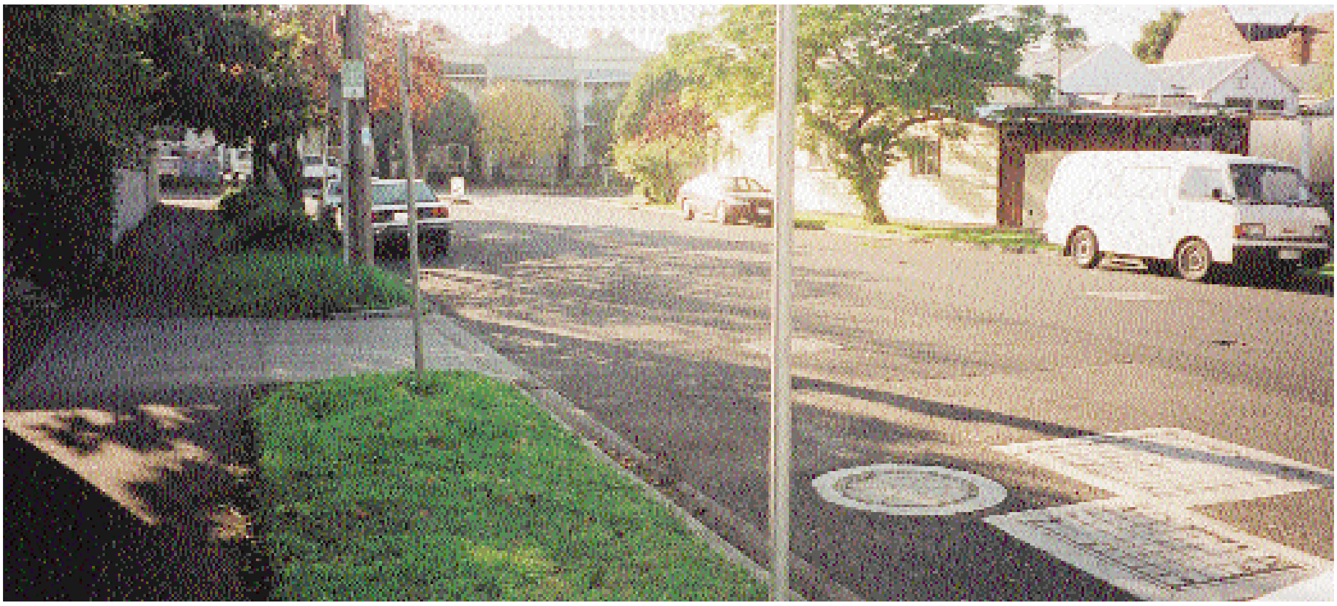
Build on our expertise

Humes™



Humes' precast concrete products provide cost effective installations.

CONTENTS



A typical **Hume***gard™ installation in an urban streetscape - O'Grady Street, South Melbourne.*

SUMMARY

Hume*gard*™ is manufactured under licence to Swinburne University of Technology. **Hume***gard*™ is a patented Gross Pollutant Trap that removes gross pollutants and sediment from stormwater. Developed in response to growing public concern over the accumulation of litter, floating matter and sediment spoiling urban creeks, rivers and beaches. **Hume***gard*™ removes a range of gross pollutants including plastic, aluminium, waxed packaging, drink containers, cigarette butts, syringes, polystyrene, paper and sediment.

A summary of the key features and benefits related to the implementation of a **Hume***gard*™ is as follows:

Customised Sizing Guidelines

- Easy to design using customised sizing guidelines which take into account local rainfall variations

Hume*gard*™ Effectively captures and retains Gross Pollutants

- Laboratory and field testing has proven capture rates up to 100% for gross pollutants prior to by-pass and up to 85% on an annualised basis, allowing for periods of high flow by-pass.
- The unique floating boom allows **Hume***gard*™ to continue capturing floating pollution, even during peak flows.
- The boom is designed to control the treatment flow entering the storage chamber, ensuring previously captured materials are retained.
- **Hume***gard*™ is designed to treat up to 90 % of the theoretical total annual flow, ensuring a high level of pollution removal.
- Can be implemented as part of a treatment train.

Hume*gard*™ Effectively captures and retains sediments ≥ 150 micron

- Laboratory and field surveys have proven capture rates up to 99% for sediment ≥ 150 micron prior to by-pass and up to 85% on an annualised basis, allowing for periods of high flow by-pass.
- The design of the bypass chamber allows **Hume***gard*™ to continue capturing coarse sediment, even during peak flows.

Hume*gard*™ Performs in Tidal Zones

- **Hume***gard*™ does not rely on a fixed weir to direct flow into the storage chamber.
- The floating boom remains in the optimal position to capture and retain unsightly litter even during high tides.
- Minor design modifications can be made to **Hume***gard*™ for applications where tailwater levels cause permanent or temporary submergence of the drainage line.

Gross pollutions retained in a **Hume***gard*™ *storage chamber prior to cleanout.*

Hume*gard*™ has low Head Loss

- **Hume***gard*™ generates a substantially lower head loss than other gross pollutant removal systems with a K value of 0.2 (Minor Loss = 0.2 $v^2/2g$).
- Is ideal to use in retrofit applications and locations with flat grades where low head loss is critical for hydraulic efficiency.

Hume*gard*™ is fast to install

- Delivered to site pre-assembled.
- Pre-engineered for traffic loadings.

Hume*gard*™ is an easy, low cost maintenance solution

- Easy to maintain using vacuum trucks.
- Generous storage capacity, designed for 6 to 12 month cleanouts - based on average litter loads.
- Is constructed of durable precast and stainless steel metal components designed for long life performance.

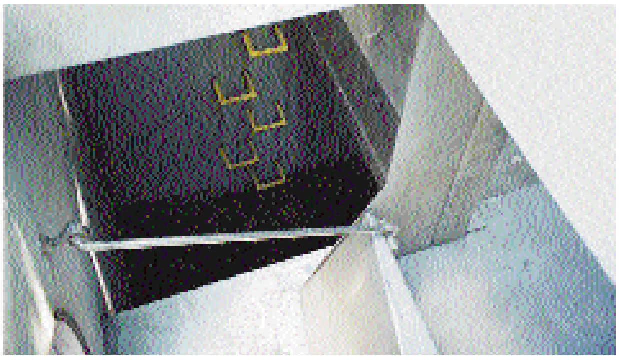
Hume*gard*™ is extremely versatile, however the following design criteria should be considered:

- The largest standard inlet/outlet size that can be accommodated without customisation is 1350mm. For pipe diameters larger than 1350mm we recommend you contact your nearest Humes office.
- **Hume***gard*™ currently can accommodate only one inlet pipe.
- Standard sizes of **Hume***gard*™ are designed to accommodate pipes, however **Hume***gard*™ can be specially designed to accommodate box culverts. Please contact your nearest Humes office for further information.

1.0 OVERVIEW OF **Hume***gard*™

Hume*gard*™ is a pollution control device that efficiently removes gross pollutants and coarse sediments ≥ 150 micron, from stormwater. **Hume***gard*™ is compatible with standard infrastructure components.

The key advantage of **Hume***gard*™ compared to other stormwater quality gross pollution control devices is the patented design incorporating the unique floating boom and bypass chamber which enables the continuing capturing of floating material and sediments even during peak flows. The **Hume***gard*™ configuration also prevents the re-suspension and release of trapped materials during subsequent storm events. **Hume***gard*™ will not release gross pollutants and sediments between servicing.



The stainless steel boom deflects pollutants into the storage chamber.

Hume*gard*™ was the outcome of a five year cooperative research and development program between Victorian State and Local governments, Swinburne University of technology and industry groups.

Hume*gard*™ was developed in 1995 in response to the Victorian State Government requests for a more economic, versatile and effective Gross Pollutant Trap that met specific criteria. These included cost effectiveness, retrofitting to existing pipelines, minimum headloss at peak flow, compactness, removal of floating litter at all flows, large holding capacity and easy maintenance. The State government endorsed the unique device and funded a two year prototype installation and monitoring project through EcoRecycle Victoria in 1996.

An earlier grant had funded a twelve month study into litter generation in which litter generated from three shopping precincts in the Melbourne metropolitan area was captured, sorted and recorded into some seventy categories. From this study of the composition of the litter stream and the generation rates of its various components was determined. This enabled the selection of the correct litter categories to be used in the prototype field testing of **Hume***gard*™ in order to ensure that trapping efficiencies were maximised.

1.1 **Hume***gard*™ Applications

Hume*gard*™ is applicable in a variety of development situations including:

- commercial and industrial areas.
- residential areas including new residential developments.
- residential and commercial estates subject to tidal and tailwater influences.
- stormwater quality retrofits for existing development where gross pollutants are determined to be a priority issue.

Existing development Retrofits

Existing development can comprise up to 80% of a watershed's tributary drainage area Whilst traditionally overlooked due to the overwhelming runoff generated from these areas, by targeting "hot spot" areas such a shopping strips and tourist locations where high level litter and gross pollutant generation is evident, cost effective water quality control can be implemented.

Existing developed areas generally provide numerous constraints to the implementation of water quality enhancement. Surrounding properties define the grading of the development and existing stormwater inverts and locations define the drainage system path. The very low headloss characteristics of **Hume***gard*™ offer the stormwater management professional an attractive option generally not available in other stormwater gross pollutant traps. The location of a **Hume***gard*™ stormwater quality device in the stormwater line will not induce upstream flooding into the drainage line. **Hume***gard*™ is an attractive and effective solution especially when considered with the other advantages due to its low cost, ease of installation and maintenance, and compatibility with the existing drainage system.

New Residential Subdivisions

Hume*gard*™ is an important part of the treatment train approach for residential subdivisions both large and small.

Hume*gard*™ provides effective gross pollutant and coarse sediment pre-treatment prior to wet ponds or residential lakes, creeks and streams, improving public amenity and reducing public health concerns including that of discarded syringes.

The use of **Hume***gard*™ for street drainage helps to mitigate long term maintenance costs with maintenance centralised at **Hume***gard*™ locations reducing the time and cost of stormwater maintenance.

The unique patented boom enables the capture of floating pollutants even at peak flows, when other fixed weir devices are in by-pass mode. This unique feature also makes **Hume***gard*™ suitable for applications subject to both tidal and tailwater 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 GPT's 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 the device. Where high tailwater levels occur, bypass or loss of trapped materials may also occur.

In general, fixed weirs and the like obstruct the pipeline and also cause water to back-up during high flows. This can result in upstream flooding, especially in pipelines laid on flat grades with no provision for additional headloss. The **Hume***gard*™ low headloss characteristics make it an effective solution for these situations.

1.2 **Hume***gard*™ Design and Operation

Hume*gard*™ can be divided horizontally into two components:

- by-pass chamber
- storage / treatment chamber.

Stormwater flows into the inlet boom area of the treatment chamber. During flows up to and including a three month ARI (Average Recurrence Intervals) event the angled boom directs the total flow into the storage / treatment chamber where gross pollutants and coarse sediments are separated and stored. The flow continues underneath the internal baffle, passes through the stainless steel metal comb and flows over the controlled weir to the outlet.

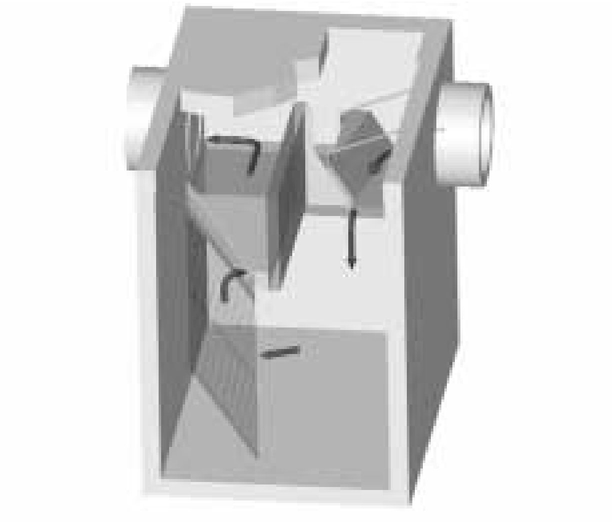


Figure 1. In-Line* Hume*gard*™ *operation during average flow conditions.

Substances with a specific gravity less than water will remain floating on the water surface in the storage/ treatment chamber. Sediment and other materials with a specific gravity greater than water will settle to the bottom of the chamber by gravity forces. The design and depth of the chamber prevents turbulent eddy currents from occurring and eliminates re-suspension of captured material.

During high flow conditions or under tidal influence, the angled boom continues to direct all floating litter in the stormwater from the bypass chamber into the storage/ treatment chamber. The bypass treatment chamber floor is angled to ensure the bed load sediment material continues to be directed into the storage chamber at high or peak flows.

At peak flows, the boom floats and enables excess flow to pass underneath, regulating the flow into the storage/ treatment chamber. This ensures that excessive flow will not be forced into the storage / treatment chamber which could scour and re-suspend previously trapped materials. The floating boom by-pass is an integral part of **Hume***gard*™ ensuring previously trapped materials are retained.

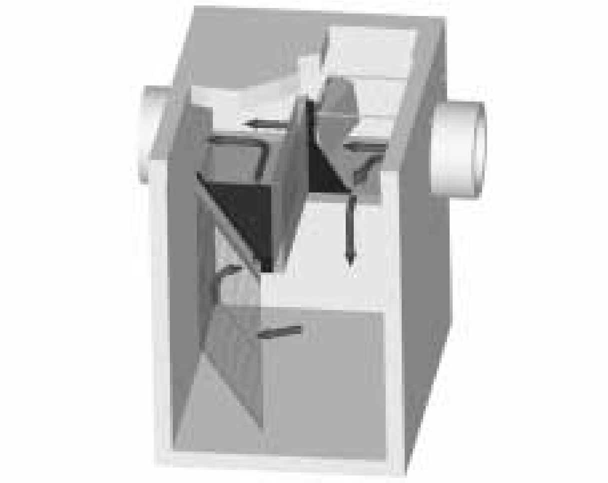


Figure 2. In-Line* Hume*gard*™ *operation during Peak flow conditions.

1.3 Construction Materials

Hume*gard*™ is manufactured in precast concrete by Humes. Current in-line separator sizes being manufactured range from storage capacities of 3cm to 19cm (2.0m to 5.0m width)

The boom, comb and weir inserts are manufactured in Grade 304 Stainless Steel. **Hume***gard*™ is designed to highway loading. It can be installed where the bottom of the treatment chamber is up to 10m below ground level. The component materials used in the manufacture of **Hume***gard*™ are consistent with the rest of municipalities infrastructure, and contractors / municipal works staff are familiar with the installation / maintenance of concrete structures.

1.4 **Hume***gard*™ Testing

Laboratory and field testing of the **Hume***gard*™ in-line gross pollutant trap for hydraulic performance and litter capture was conducted in Melbourne, Australia by Swinburne University of Technology, School of Civil Engineering during 1996 and 1998.

The Laboratory testing evaluated several internal component configurations to optimise the performance of **Hume***gard*™ under varying flow conditions and for various litter types. A numerical model was developed to size units as a result of testing. The model integrates the physical characteristics of **Hume***gard*™ and catchment together with local rainfall characteristics.

Field testing was carried out over an 18 month period on 10 prototypes which were installed downstream of shopping centres and residential areas in metropolitan Melbourne. The field test program assessed the trapping efficiency of Humegard‘ for targeted litter items which were identified as typical from a previous study into litter composition in urban runoff.

The boom arrangement went through a rigorous testing and development process to minimise the potential for malfunction. Final prototypes were tested over a nine month period, including many high flow conditions, and found to be performing exceptionally well. In total, testing of the booms showed 3 years of faultless boom performance.

The field test program trapping efficiencies for the targeted litter items at O'Grady Street and Lonsdale Street are detailed in Tables 1 to 4.

Table 1. Litter Capture Efficiencies, O'Grady St., Humegard™ (8 ha catchment)

Month of Litter Drop	Capture Efficiency percent for each category of litter				
	Plastic Bottles	Metal Cans	Waxed Paper Cartons	Polystyrene Cups	Corks
Feb 98	95	70	70	100	100
Mar 98	75	80	90	60	70
Jun 98	95	90	80	100	85
Aug 98	90	70	80	100	93.3
Oct 98	70	100	70	95	100
Progressive	**83.8**	**82**	**78**	**94**	**93**

Table 2. Gross Pollutants Recovered from O'Grady St., Humegard™

Date of Pump out	Gross Pollutants					
	Plastic Bottles (Items)	Metal Cans (Items)	Plastic Bags (Items)	Polystyrene (Items)	Corks (Items)	Organic/ Inorganic Sediments (kg)
16/3/98	9	2	2	23	11	*N/A
3/6/98	7	12	0	39	1	3000
29/7/98	4	2	8	60	5	**4000
8/9/98	4	0	1	2	1	3000
27/10/98	6	6	9	20	9	4400
Totals	**30**	**22**	**20**	**144**	**27**	**14,400**

*Sump not pumped out **Sump not completely pumped out

Table 3. Litter Capture Efficiencies, Lonsdale St., Humegard™

Month of Litter Drop	Capture Efficiency percent for each category of litter				
	Plastic Bottles	Metal Cans	Waxed Paper Cartons	Polystyrene Cups	Corks
Aug 98	96.7	100	100	95	96.7
Oct 98	78.4	90	90	100	96.7
Progressive	**86.7**	**95**	**95**	**97.5**	**96.7**

Table 4. Gross Pollutants Recovered from Lonsdale St., Humegard™

Date of Pump out	Gross Pollutants					
	Plastic Bottles (Items)	Metal Cans (Items)	Plastic Bags (Items)	Polystyrene (Items)	Corks (Items)	Organic/ Inorganic Sediments (kg)
23/9/98	22	24	6	26	1	1300
6/11/98	24	7	28	33	0	1800
Totals	**46**	**31**	**34**	**59**	**1**	**3,100**

*Sump not pumped out **Sump not completely pumped out

Laboratory and field testing has proven capture rates up to 100% for gross pollutants prior to by-pass and up to 85% on an annualised basis, allowing for periods of high flow by-pass. The smallest positively targeted litter item in the field study was 12mm in diameter (syringes), however, many items smaller than the targeted items were captured.

Whilst sediment capture was not the focus of this test program, a substantial volume of organic and inorganic sediment was collected within the storage chamber during the field testing, indicating high removal rates of at least organic and coarse grained sediments.

Laboratory tests to establish the sediment capture efficiency of **Hume***gard*™ were conducted in Melbourne, Australia by Swinburne University of Technology, School of Civil Engineering during August 2000.

Laboratory testing has proven capture rates up to 99% for sediments ≥ 150 micron with a specific gravity of 2.65 , prior to by-pass and up to 85% on an estimated annualised basis, allowing for periods of high flow by-pass.

Hume*gard*™ *model testing under laboratory conditions.*

1.5 Patent Issues

The **Hume***gard*™ System apparatus is protected by Australian Patent No. 704777. A true **Hume***gard*™ System apparatus must be purchased from an organisation licensed by Humes in Australia.

If engineers and designers specify equipment "equivalent" to the **Hume***gard*™ System apparatus, and that apparatus is truly an "equivalent", it will infringe the **Hume***gard*™ System patent, if literally then under a tenet well-established in the patent law and known as the "doctrine of pith and marrow".

Humes and Swinburne University of Technology have made significant investment in time and money preparing technical design information, laboratory testing, and field studies in order to prove the efficacy of the **Hume***gard*™ system apparatus. In situations where there is a question of whether a competitive product is outside the scope of the doctrine of pith and marrow and whether it will perform as well as **Hume***gard*™ equipment, a prospective purchaser or reviewer is advised to ask for laboratory and field testing data from the supplier of the competitive product, or contact the nearest Humes Sales Office.

2.0 DESIGN INFORMATION

The design of **Hume***gard*™ involves reviewing the configuration of the stormwater system, the location and purpose of other stormwater management controls for the proposed development, impervious area, pipeline diameter and assessment of the local rainfall data relative to regional rainfall sizing guidelines for residential and commercial areas.

2.1 Configuration of the Stormwater System

The configuration of the stormwater system is important as **Hume***gard*™ works efficiently from small through to medium/large catchment areas, depending on local rainfall characteristics, and one influent pipe.

Inlet Pipe

Humes recommends that a one inlet pipe - one outlet pipe arrangement be used (Figure 3). Junction pits upstream of the in-line separator may be required to provide this arrangement. The storage/treatment chamber can be located either side of the drainage pipeline to suit site conditions.

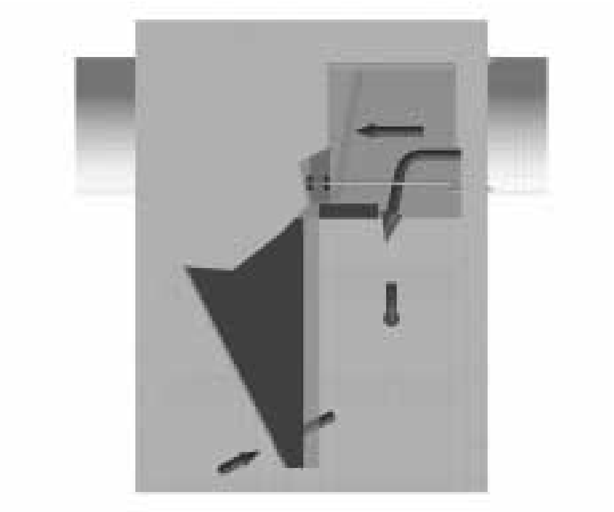


Figure3. Typical Humegard‘ Configuration

By-Pass Chamber

The bypass chamber is sized to suit the inlet/outlet pipe diameter. Table 5 indicates the **Hume***gard*™ model and associated pipe diameters accommodated. The largest pipe that can be currently accommodated in a standard **Hume***gard*™ is 1350mm diameter reinforced concrete pipe. For pipe diameters larger than 1350mm or box culvert applications we recommend you contact your nearest Humes Sales Office.

Table 5. Inlet and Outlet Pipe diameters (Concrete)

Hume*gard*™ model	One Inlet and one Outlet Pipe• apart
HG	Pipe Diameter (mm)
18	<=600
24	600
27	750
30	750
30A	900
35	900
40	900
35A	1050
40A	1050
40B	1200
45	1200
45A	1350

Location in the Stormwater System

Hume*gard*™ is designed to accommodate low to peak discharge flows. The frequency of the magnitude of the flow rate is dependant upon the upstream drainage area and the level on imperviousness of that drainage area.

The sizing guidelines (Section 2.4) provide limits for the amount of drainage area that can be accommodated for Residential and Commercial situations by each **Hume***gard*™ model, currently being manufactured.

Located in the stormwater drainage system - **Hume***gard*™ *does not require difference in elevation between the inlet and outlet invert of the pipeline.*

2.2 **Hume***gard*™ Technical Specifications

Hume*gard*™ dimensions vary with the size of the unit that is specified. Dimensions of the **Hume***gard*™ units that are being manufactured are provided in Table 6.

Table 6.* Hume*gard*™ *dimensions and capacity*

Model HG	Overall with (m)	Pipe invert to Bottom of Concrete (m)**	Overall length	Total holding capacity (m^3)
18	2.0	1.1	2.1	3
24	2.7	1.7	2.5	8
27	3.0	1.6	2.5	7
30	3.4	2.2	2.5	12
30A	3.4	1.9	2.5	11
35	3.9	2.0	2.5	12
40	4.4	2.0	2.9	16
35A	3.9	1.8	2.5	11
40A	4.4	1.8	2.9	14
40B	4.4	1.6	2.9	12
45	4.9	2.1	2.9	19
45A	4.9	1.9	3.2	19

*Dimensions are approximate   **invert to bottom of base slab

Hume*gard*™ units provide total holding capacities ranging from 3m^3 to 19m^3 (Table 6.)

2.3 **Hume***gard*™ Design Parameters

There are some standard design parameters that must be provided in any stormwater design with a **Hume***gard*™ installation.

Inlet Pipe Grade

Hume*gard*™ can be located on a pipe system with slopes up to 10% .

Inlet / Outlet Elevation Difference

Hume*gard*™ accommodates the grade in the pipeline. There is no difference in elevation between the inlet invert and outlet invert in a Humegard‘.

Hume*gard*™ Orientation

Hume*gard*™ can be orientated so that the storage/ treatment chamber is located in the most suitable site configuration. Left hand or right handed units are available to the stormwater quality designer, which enables the storage /treatment chamber to be located either side of the drainage pipeline in order to suit site constraints that may exist.

Inlet and Outlet Pipes

Hume*gard*™ must be designed as a straight through (180°) pit, angles between the inlet and outlet cannot be accommodated.

Flexible rubber boots are attached to the by-pass/ treatment chamber to facilitate the installation of the inlet/ outlet pipes to the **Hume***gard*™. In circumstances where these boots are not available or not required, Humes can provide the appropriate inlet/outlet diameter holes to accommodate the required pipes.

Humes should be contacted for custom manufacturing/installation details. The design engineer should ensure that Table 5 is reviewed.

Hume*gard*™ *HG27 delivered to site ready for installation (note flexible boots).*

Headloss Through the **Hume***gard*™

The Headloss through a **Hume***gard*™ at full pipe or peak flow discharge is approximately the same as an in-line stormwater pit. An appropriate K value to use in calculating minor losses through the stormwater system for a **Hume***gard*™ unit would be 0.2 (Minor loss = 0.2 v2/2g).

Installation Depth

There is a minimum inlet obvert (inside top of pipe) to grade elevation required to physically implement the **Hume***gard*™ due to the modular construction of the structure. Generally the minimum obvert to grade elevation is 0.75 metres. For situations where the minimum obvert to grade is less than 0.75 metres, contact Humes for advice.

The maximum installation depth (to underside of unit) for **Hume***gard*™ is 10 metres. The dimensions (ie., pipe invert to bottom of storage / treatment chamber) for various **Hume***gard*™ units is given in Table 6.

Hume*gard*™ installations at depths greater than those noted will require custom manufacturing. Humes should be consulted for recommendations in these instances.

2.4 **Hume***gard*™ Sizing Guidelines

The Hydraulic modelling has been subject to 3 revisions over the 3 year development period.

A brief history is as follows:

1. Original sizing guidelines based on sump capacity & DRN (dimensionless rating number).
2. Second generation unit designs based on theory incorporating weir flow velocities & return channel widths.
3. Latest design methodology upgrading the second generation units to enable variable rainfall intensities to be fully incorporated in the design.

Hume*gard*™ sizing overview

The key feature of **Hume***gard*™ is the floating boom. Most other stormwater quality device employ a fixed weir. This fact has resulted in the design of the device being influenced by different parameters and design theory developed accordingly.

The design has been based around pipelines designed for a five (5) year average storm return interval.

The weighting of the boom has been determined to limit the maximum flow diverted into the holding chamber to be 0.2Qp , where Qp is the pipe capacity.

The maximum velocity through the storage chamber comb is Vc. From laboratory tests, Vc is not to exceed 0.2 m/s if matting of the comb wires is to be avoided.

Hence, in order to achieve the above criteria, it is necessary for the boom to commence lifting at an average storm return interval of four times per year, or a 3 month ARI storm. Adopting these parameters for a Q5 pipe, results in the flow passing through holding/storage chamber of up to 90% of the mean annual flow.

We are therefore able to derive design equations to accommodate the rainfall intensities from the Australian Rainfall and Runoff Volume 1, land use characteristics and IFD curves (intensity/frequency/duration curves) for the region in question. A series of equations have been generated for each major Australian capital city or selected area for both commercial and residential areas relating Qp (pipe capacity), Ac (catchment area), boom, weir and return channel dimensions.

Sizing Guidelines for a range of locations around Australia can be found in Appendix 2.

Construction with precast components allows for immediate backfilling once the **Hume***gard*™ *has been positioned in place.*

3.0 INSTALLATION PROCEDURES

The installation of **Hume***gard*™ should conform in general to Local Authorities' Specifications for the construction of stormwater pits. Detailed installations instructions are dispatched with each unit.

3.1 **Hume***gard*™ Installation

Hume*gard*™ Construction Sequence

Hume*gard*™ is installed in sections in the following sequence :

1. geotextile (if required)
2. aggregate base
3. main chamber section with base slab
4. main chamber top section (if required)
5. fit stainless steel comb (if required)
6. connect inlet and outlet pipes as required.
7. main chamber lid
8. frame and access covers

Humes recommends the use of 200mm minimum depth of compacted crushed rock as adequate bedding for the **Hume***gard*™ for soil types in most situations. It is important to ensure that the bedding layer is well compacted and levelled correctly so that the openings in the **Hume***gard*™ will accurately coincide with the inlet/outlet pipes once fully installed.

The Main Chamber and Lid are designed to be handled with "Swiftlift" lifting devices located at 4 points on the product.

It is important for the operation of the unit that the base of the unit remains level and square horizontally after positioning in the excavation, this should be carefully checked particularly in the case of two part chambers where dimensions of each part are measured **before** set out and lowering into the excavation.

Adjustment of the **Hume***gard*™ can be performed by lifting the main chamber sections free from the excavated area and re-levelling the base aggregate layer.

In the case of a split chamber a sealed joint must be created between bottom and top section by means of the two part epoxy resin supplied which is to be mixed on site and placed along the rebate on the joint surface of the bottom section in a strip approximately 80mm wide and 6mm thickness

Fitting the stainless steel Comb

Single chamber models will have the stainless steel comb fitted prior to delivery at the Humes factory. In the case of a split chamber unit, the stainless steel comb is bolted into place against the diagonal weir face once the top section of the main chamber has been put in place.

Inlet and Outlet Pipes

Inlet and outlet pipes should be securely set into the bypass section of the main chamber using the approved pipe seals, or if required mortaring the pipes into the circular openings in the bypass section of the main chamber.

Installation of the flexible rubber connectors should follow the manufacturers' recommendations. The following procedure should be followed to attach the inlet and outlet pipes:

1 Lubricate the outside of the pipe and/or inside of the boot if the pipe outside diameter is the same as the inside diameter of the boot
2 Insert the pipe, centering it in the boot opening
3 Position the pipe clamp in the groove of the boot with the screw at the top
4 Tighten the pipe clamp screw to 7 Newton metres
5 On minimum outside diameter installations lift the boot such that it contacts the bottom of the pipe while tightening the pipe clamp to ensure even contraction of the rubber
6 Move the pipe horizontally and/or vertically to bring it to grade

Frame and Cover Installation

Precast concrete, masonry block or in-situ access shafts may be constructed from the level of lid openings to the finished surface level.

4.0 MAINTENANCE PROCEDURES

Maintenance of the **Hume***gard*™ is performed using vacuum trucks. Normally no entry into the unit is required for maintenance. Costs to clean the **Hume***gard*™ vary based on the size of the unit and transportation distances.

4.1 Maintenance Costs

A typical cleaning cost (equipment and personnel) will vary based on unit location and size. Disposal costs will vary depending on land use and local government requirements. Economies of scale are expected where there are multiple units for a given location. The time taken to clean the **Hume***gard*™ is approximately 45 - 90 minutes, depending on the size of the unit, excluding transportation.

Maintenance of the **Hume***gard*™ should be considered during the design stage, substantial savings in the on-going costs of maintenance can be achieved from a good design. Consideration should be given to :

- Access to the site by an inductor truck, considering that the truck will be substantially heavier on exit from the site as to when it arrived,
- Depth of **Hume***gard*™ as this effects the maximum vertical lift required, the larger the vertical lift the larger the truck require to clean it,
- Can shut off valves be located upstream or incorporated in the **Hume***gard*™ to allow decanting of clean water during maintenance,

4.2 Maintenance Frequency

If the **Hume***gard*™ design is based on the guidelines discussed in section 2.4, six monthly maintenance is normally required, however, the frequency of maintenance may need to be increased or decreased based on local conditions (ie, if the unit is filled up with litter more quickly than projected, maintenance may be required three monthly; conversely once the site has stabilised, the maintenance period may extended.)

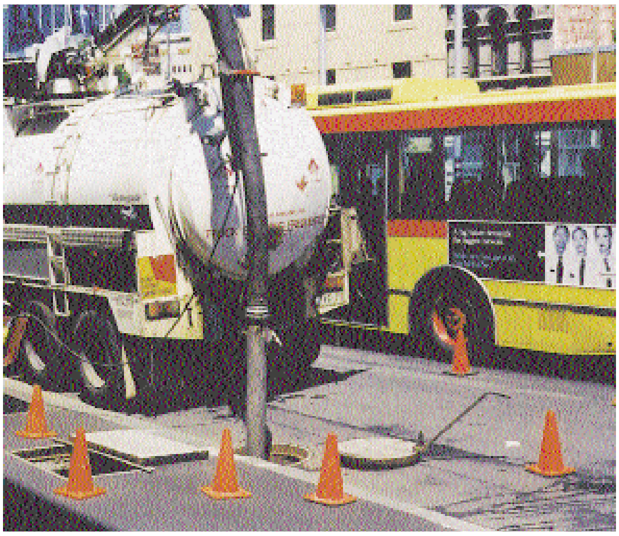
To establish the required cleaning frequency a regular level checking cycle of once every three months is recommended until this is established.

4.3 Spills

In the case where **Hume***gard*™ is subject to oil or hydrocarbon spills, the device should be cleaned out immediately by a licensed liquid waste management company. The Regulatory Authority should also be notified in the event of a spill.

4.4 Disposal

Waste products collected in the **Hume***gard*™ should be removed by a licensed waste management company, similar to any other stormwater treatment device.



Maintenance of **Hume***gard*™ *is carried out at surface level eliminating the need for confined space entry.*

4.5 Inspection

Hume*gard*™ can easily be inspected from the surface by removing the maintenance covers. The amount of gross pollutant material floating in the device can be easily viewed from the surface. Similarly, the depth of sediment can be measured from the surface without entry into the **Hume***gard*™ via a sediment depth measurement device.

Any potential obstructions at the inlet or boom can be observed from the surface. The by-pass chamber floor has been designed as a platform for maintenance personnel in the event that obstructions need to be removed, stormwater flushing needs to be performed, or camera surveys are required. Normal safety precautions for confined space access must be followed whenever a person enters a **Hume***gard*™.

Appendix 1

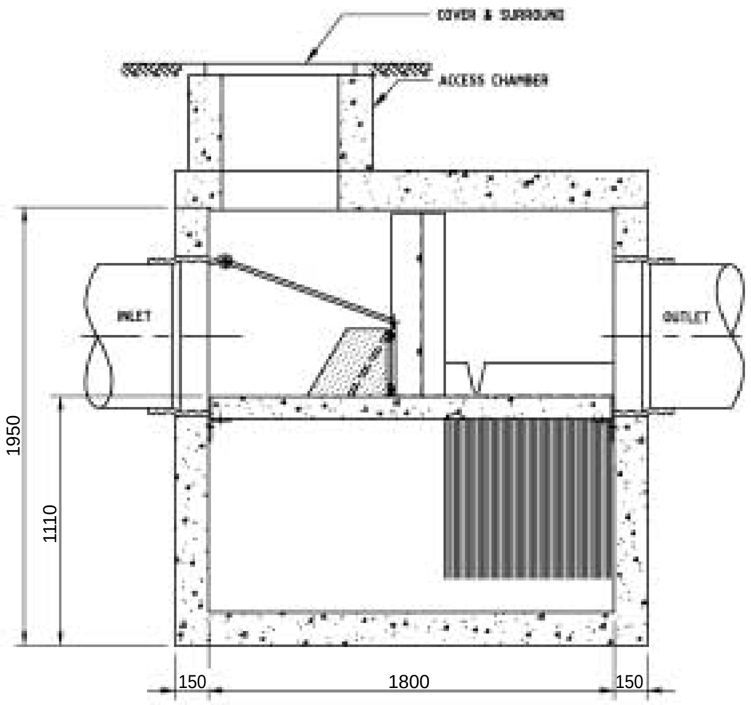
Hume*gard*™

Model HG18

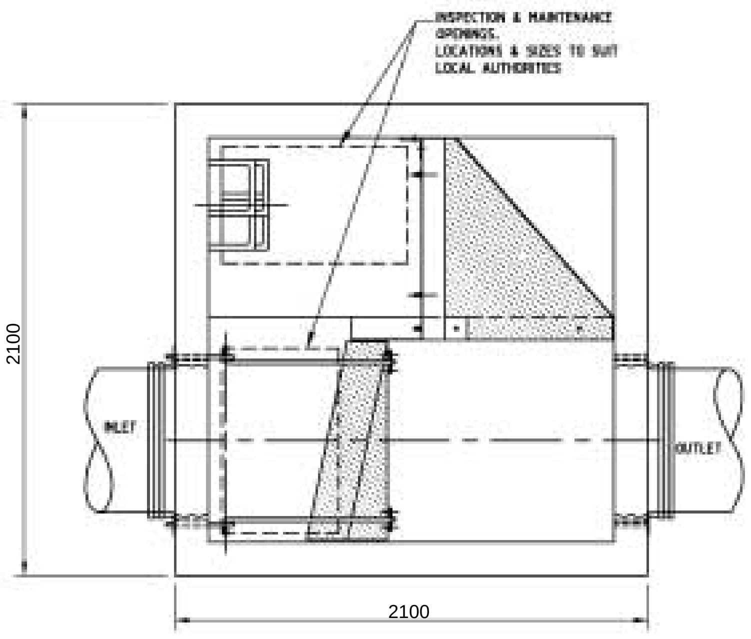
3.0m^3 Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 3m^3
4. Component Masses:
   Chamber Mass = 7.8 tonnes
   Chamber Lid = 1.6 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - 4No. 5 tonne
   For Lid 3No. - 1.3 tonne
7. Pipe Diameter accommodated on Model HG18 is < 600mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.



SECTION THROUGH CHAMBER



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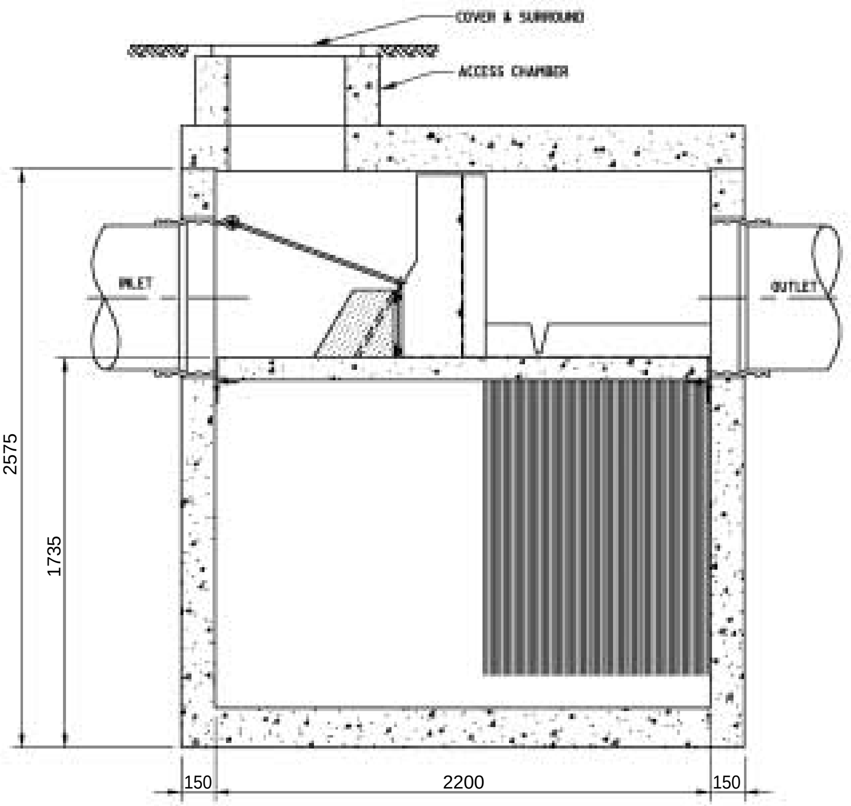

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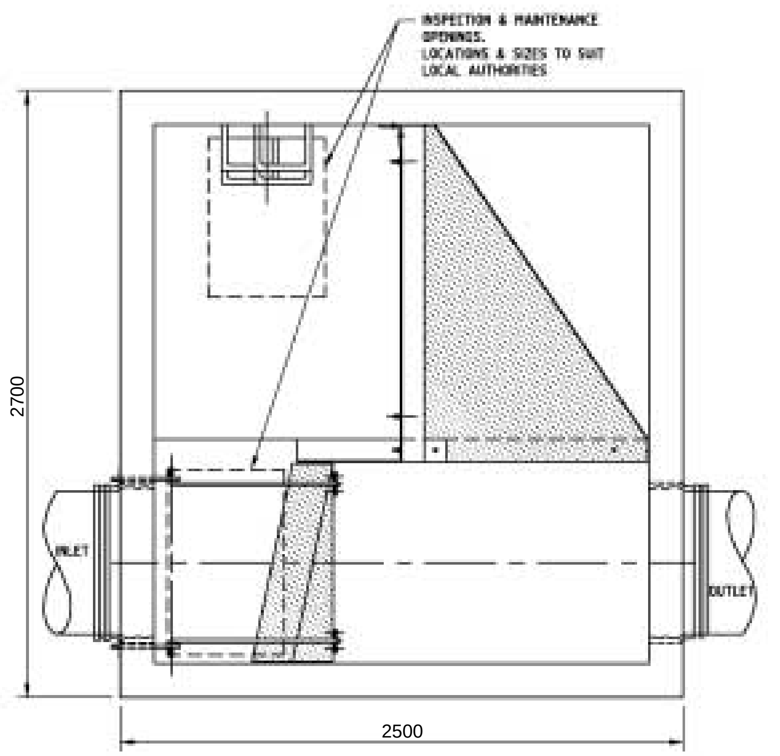


PLAN (LID REMOVED)

Hume*gard*™

Model HG24

8.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 8m³
4. Component Masses:
   Chamber Mass = 13.0 tonnes
   Chamber Lid = 2.9 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - 4No. 5 tonne
   For Lid 3No. - 5 tonne
7. Pipe Diameter accommodated on Model HG24 is < 800mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.

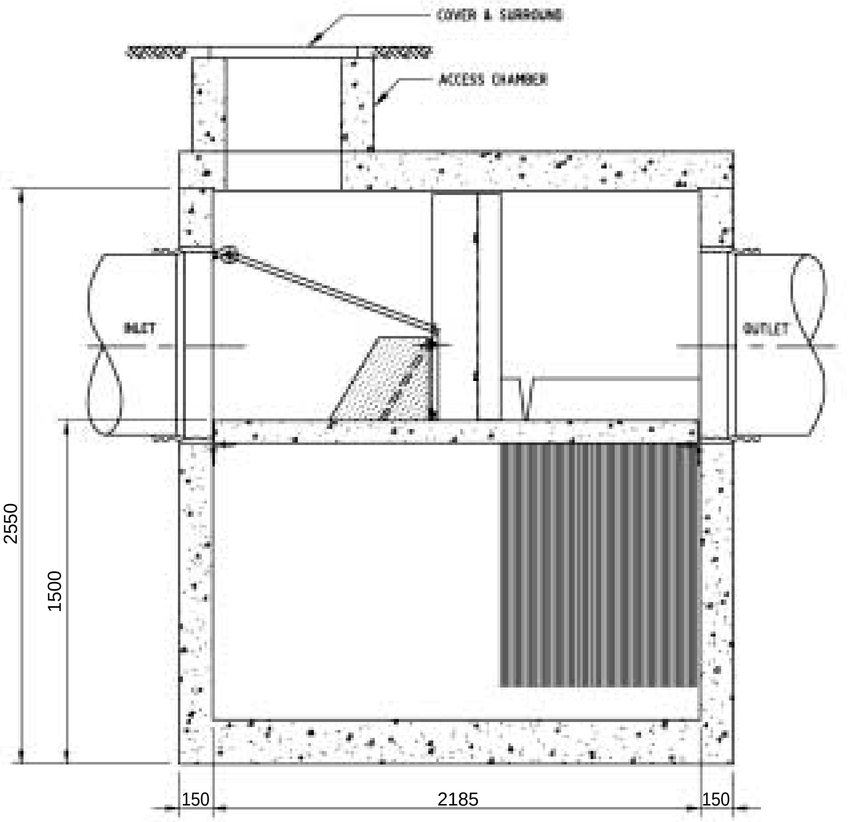
Hume*gard*™

Model HG27

7.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = $7m^3$
4. Component Masses:
   Chamber Mass = 13.9 tonnes
   Chamber Lid = 3.8 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - 4No. 5 tonne
   For Lid 3No. - 2.5 tonne
7. Pipe Diameter accommodated on Model HG27 is < 750mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.



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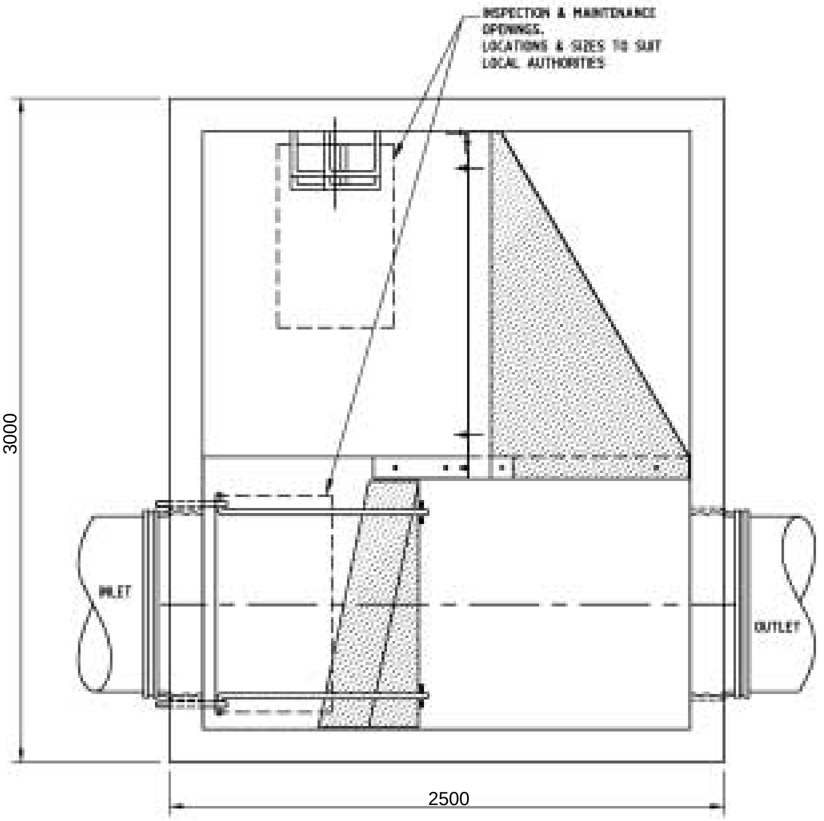

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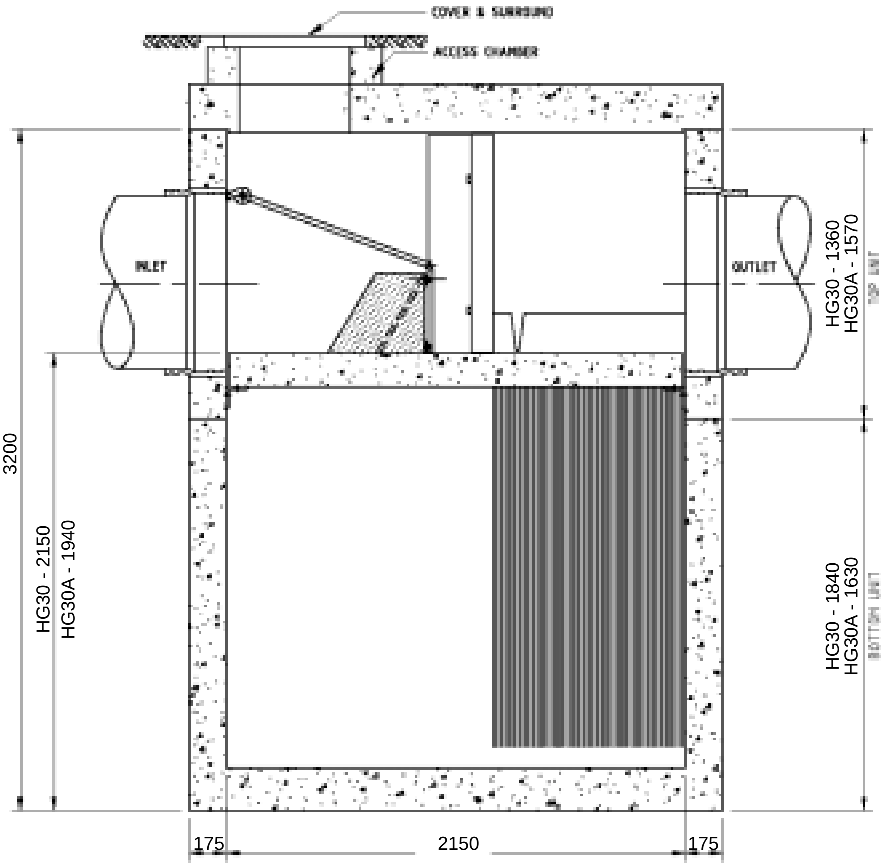

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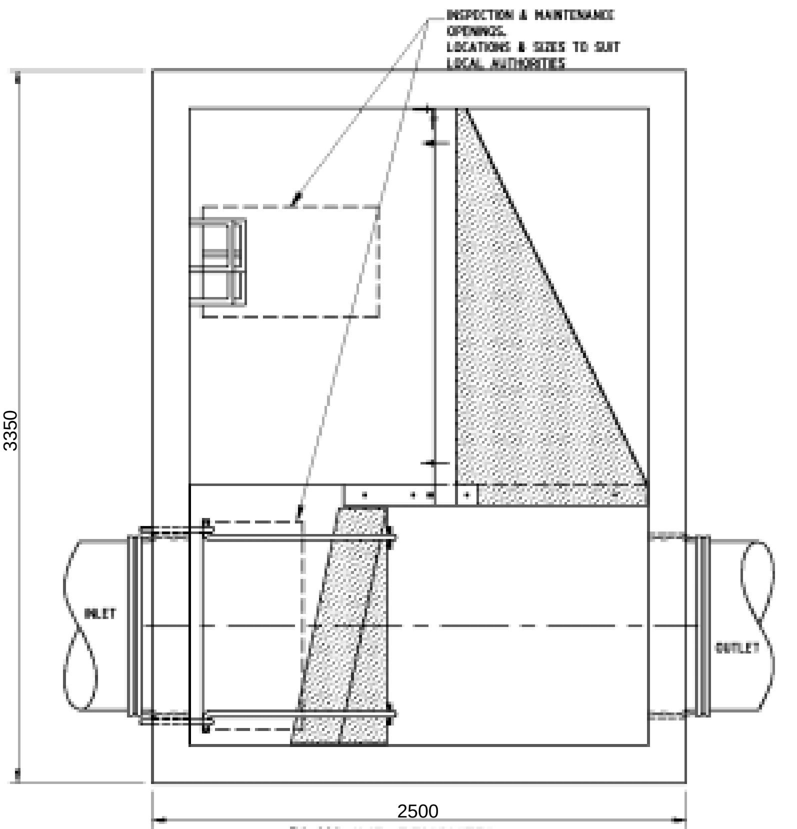


PLAN (LID REMOVED)

Humegard™

Model HG30A

11.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 11m³
4. Component Masses:
   Chamber Mass - Top Unit = 8.4 tonnes
   Chamber Mass - BTM Unit = 11.4 tonnes
   Chamber Lid = 3.9 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - BTM Unit - 4No. 10 tonne
   For Chamber - Top Unit - 4No. 5 tonne
   For Lid 3No. - 5 tonne
7. Pipe Diameter accommodated on Model HG30A is < 900mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.

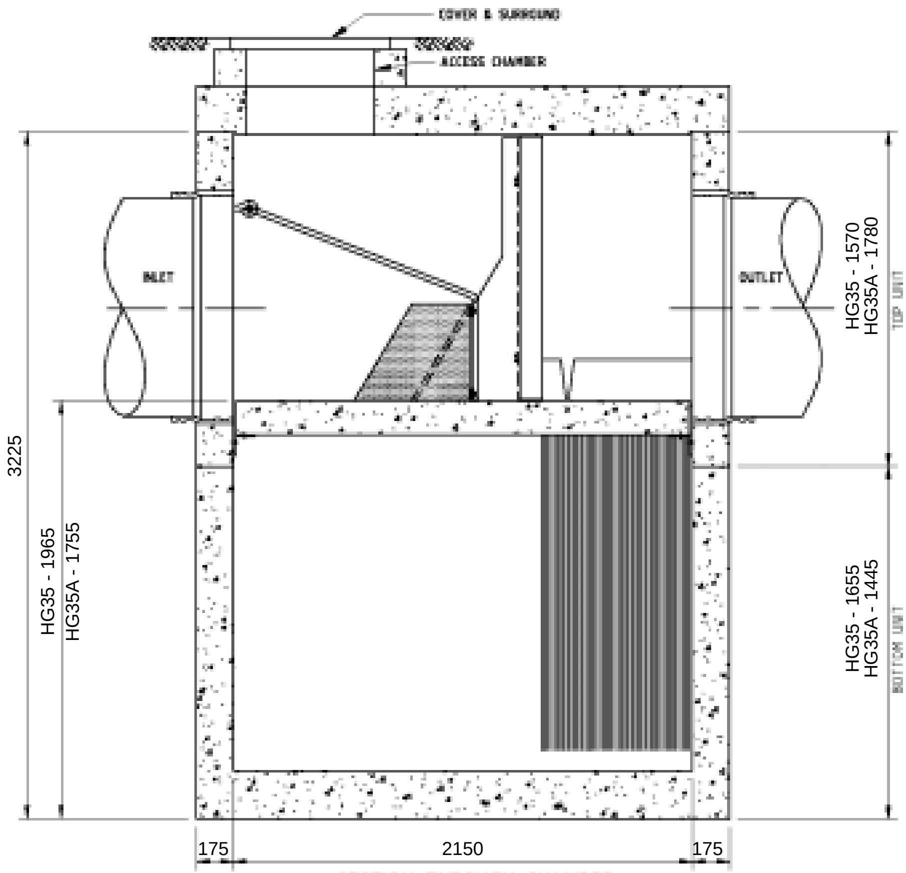
Humegard™

Model HG30

12.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 12m³
4. Component Masses:
   Chamber Mass - Top Unit = 7.5 tonnes
   Chamber Mass - BTM Unit = 12.4 tonnes
   Chamber Lid = 3.9 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - BTM Unit - 4No. 18 tonne
   For Chamber - Top Unit - 4No. 5 tonne
   For Lid 3No. - 5 tonne
7. Pipe Diameter accommodated on Model HG30 is < 750mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.



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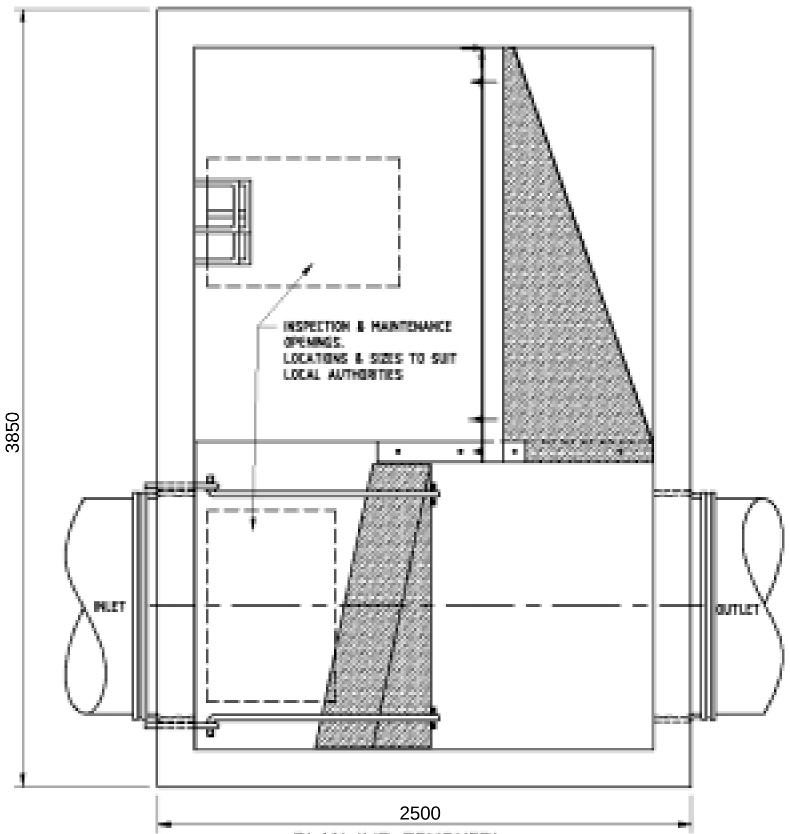


PLAN (LID REMOVED)

Hume*gard*™

Model HG35A

11.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 11m³
4. Component Masses:
   Chamber Mass - Top Unit = 10.2 tonnes
   Chamber Mass - BTM Unit = 12.2 tonnes
   Chamber Lid = 4.5 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - BTM Unit - 4No. 10 tonne
   For Chamber - Top Unit - 4No. 5 tonne
   For Lid 4No. - 5 tonne
7. Pipe Diameter accommodated on Model HG35A is < 1050mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.

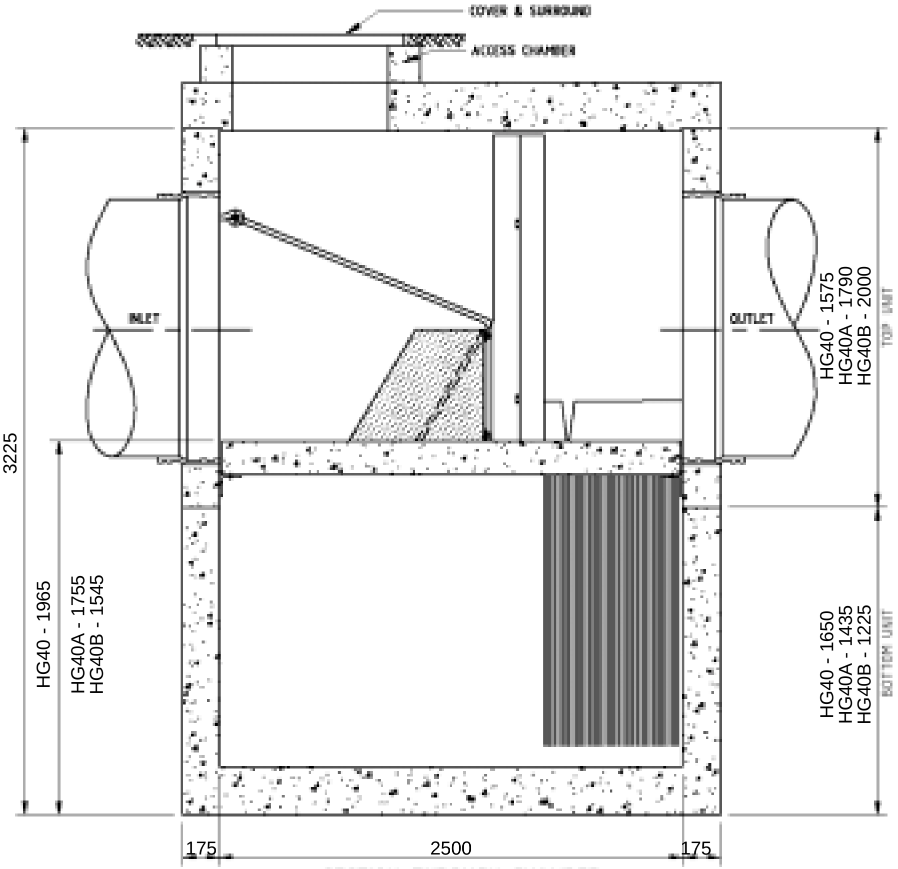
Hume*gard*™

Model HG35

12.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 12m³
4. Component Masses:
   Chamber Mass - Top Unit = 9.2 tonnes
   Chamber Mass - BTM Unit = 13.2 tonnes
   Chamber Lid = 4.5 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - BTM Unit - 4No. 10 tonne
   For Chamber - Top Unit - 4No. 5 tonne
   For Lid 4No. - 5 tonne
7. Pipe Diameter accommodated on Model HG35 is < 900mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.



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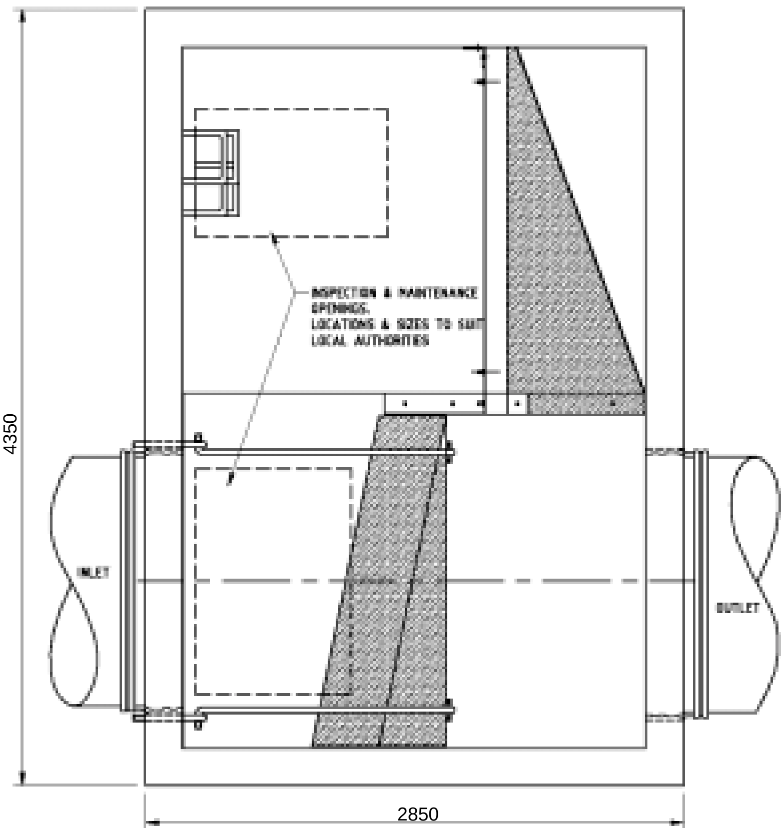


PLAN (LID REMOVED)

Humegard™
Model HG40B
12.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 12m³
4. Component Masses:
   Chamber Mass - Top Unit = 13.9 tonnes
   Chamber Mass - BTM Unit = 13.4 tonnes
   Chamber Lid = 6.6 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - BTM Unit - 4No. 10 tonne
   For Chamber - Top Unit - 4No. 10 tonne
   For Lid 3No. - 5 tonne
7. Pipe Diameter accommodated on Model HG40B is < 1200mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.

Humegard™
Model HG40A
14.0m³ Holding Capacity

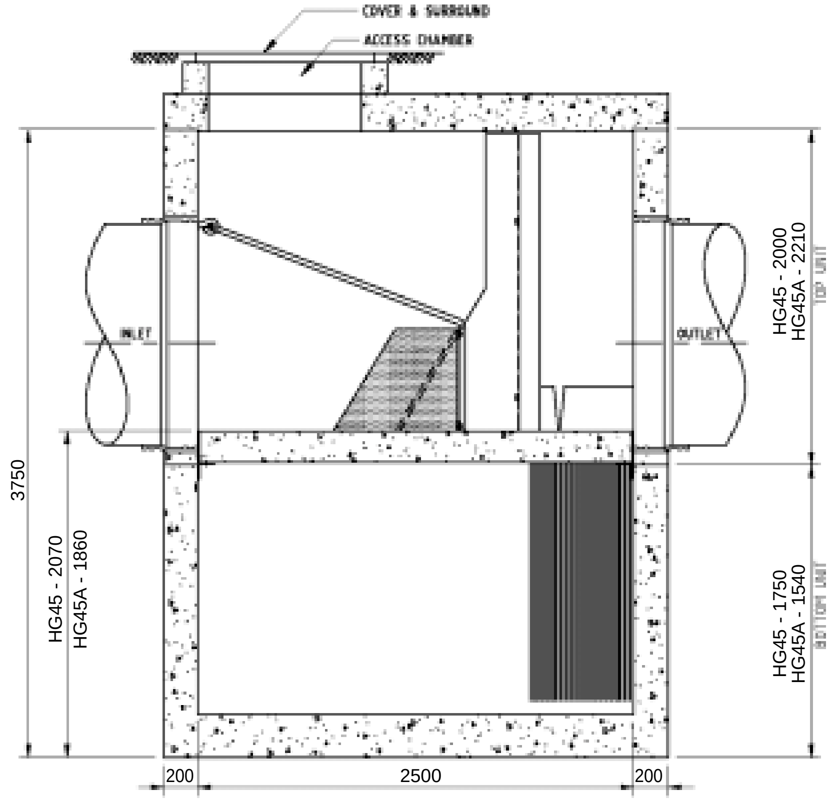
NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 14m³
4. Component Masses:
   Chamber Mass - Top Unit = 12.6 tonnes
   Chamber Mass - BTM Unit = 14.8 tonnes
   Chamber Lid = 6.6 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - BTM Unit - 4No. 10 tonne
   For Chamber - Top Unit - 4No. 10 tonne
   For Lid 3No. - 5 tonne
7. Pipe Diameter accommodated on Model HG40A is < 1050mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.

Humegard™
Model HG40
16.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 16m³
4. Component Masses:
   Chamber Mass - Top Unit = 11.3 tonnes
   Chamber Mass - BTM Unit = 16.2 tonnes
   Chamber Lid = 7.2 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - BTM Unit - 4No. 10 tonne
   For Chamber - Top Unit - 4No. 10 tonne
   For Lid 4No. - 5 tonne
7. Pipe Diameter accommodated on Model HG40 is < 900mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.



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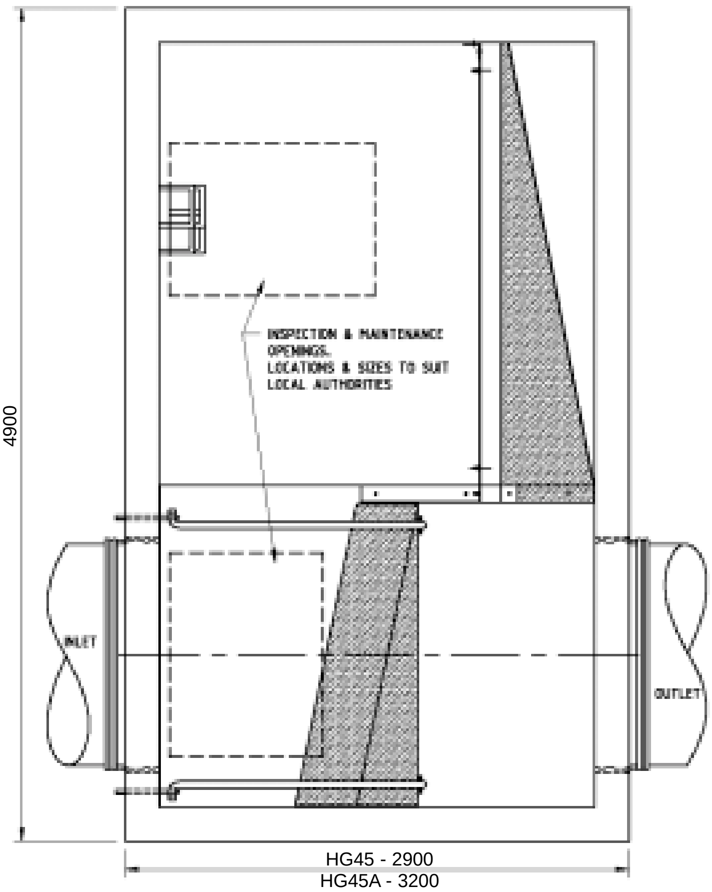

PLAN (LID REMOVED)

Hume*gard*™

Model HG45A

19.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 19m³
4. Component Masses:
   Chamber Mass - Top Unit = 19.2 tonnes
   Chamber Mass - BTM Unit = 20.7 tonnes
   Chamber Lid = 8.2 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - BTM Unit - 4No. 10 tonne
   For Chamber - Top Unit - 4No. 10 tonne
   For Lid 3No. - 5 tonne
7. Pipe Diameter accommodated on Model HG45A is < 1350mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.

Hume*gard*™

Model HG45

19.0m³ Holding Capacity

NOTES:

1. Typical assembly drawing only - refer to project drawing for actual requirements.
2. Dimensions included are standard.
3. Storage Volumes:
   Total = 19m³
4. Component Masses:
   Chamber Mass - Top Unit = 16.8 tonnes
   Chamber Mass - BTM Unit = 20.8 tonnes
   Chamber Lid = 7.5 tonnes
5. Refer to installation guide for recommended installation procedure.
6. Swiftlift Lifting Anchors provided for lifting all components. The following Swiftlift Knuckles will be required:
   For Chamber - BTM Unit - 4No. 10 tonne
   For Chamber - Top Unit - 4No. 10 tonne
   For Lid 3No. - 5 tonne
7. Pipe Diameter accommodated on Model HG45 is < 1200mm.
8. Step Irons, Inspection and Maintenance Openings to be as per Plan View.

Appendix 2

Hume*gard*™ *Sizing Guidelines*

Hume*gard*™ *Sizing Guidelines - Adelaide*
As at 1st March, 2000

Pipe diameter (mm)	Humegard™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	12	6	9.4
600	HG24	21	11	15.9
750	HG27	23	12	17.7
750	HG30	27	14	24.2
900	HG30A	22	12	24.2
900	HG35	30	16	27.3
900	HG40	41	21	35.2
1050	HG35A	26	13	27.4
1050	HG40A	36	19	34.5
1200	HG40B	31	16	34.4
1200	HG45	40	21	45.6
1350	HG45A	36	19	48.6

Notes: 1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume*gard*™ *Sizing Guidelines - Bendigo*
As at 1st March, 2000

Pipe diameter (mm)	Humegard™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	9	6	9.4
600	HG24	17	10	15.9
750	HG27	18	11	17.7
750	HG30	22	14	24.2
900	HG30A	18	11	24.2
900	HG35	25	15	27.3
900	HG40	35	21	35.2
1050	HG35A	21	13	27.4
1050	HG40A	30	18	34.5
1200	HG40B	25	15	32.4
1200	HG45	34	20	45.6
1350	HG45A	30	18	48.6

Notes: 1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume*gard*™ *Sizing Guidelines - Ballarat*
As at 1st March, 2000

Pipe diameter (mm)	Humegard™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	8	5	9.4
600	HG24	15	9	15.9
750	HG27	17	10	17.7
750	HG30	20	12	24.2
900	HG30A	17	9	24.2
900	HG35	23	13	27.3
900	HG40	32	18	35.2
1050	HG35A	19	11	27.4
1050	HG40A	27	15	34.5
1200	HG40B	23	13	32.4
1200	HG45	30	17	45.6
1350	HG45A	27	15	48.6

Notes: 1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume*gard*™ *Sizing Guidelines - Brisbane*
As at 1st March, 2000

Pipe diameter (mm)	Humegard™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	3	2	9.4
600	HG24	5	4	15.9
750	HG30	6	5	24.2
900	HG35	7	5	27.3
900	HG40	9	7	35.2
1050	HG35A	6	5	27.4
1050	HG40A	8	6	34.5
1200	HG40B	7	6	32.4
1200	HG45	9	7	45.6
1350	HG45A	8	7	48.6

Notes: 1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume*gard*™ *Sizing Guidelines*

Hume*gard*™ *Sizing Guidelines - Canberra*
As at 1st March, 2000

Pipe diameter (mm)	Humegard™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	9	4	9.4
600	HG24	16	8	15.9
750	HG27	18	8	17.7
750	HG30	22	10	24.2
900	HG30A	18	8	24.2
900	HG35	24	11	27.3
900	HG40	33	16	35.2
1050	HG35A	20	10	27.4
1050	HG40A	28	13	34.5
1200	HG40B	24	12	34.4
1200	HG45	32	15	45.6
1350	HG45A	29	14	48.6

Notes:
1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume*gard*™ *Sizing Guidelines - Gold Coast*
As at 1st March, 2000

Pipe diameter (mm)	Humegard™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	2	2	9.4
600	HG24	4	3	15.9
750	HG30	5	4	24.2
900	HG35	5	5	27.3
900	HG40	7	7	35.2
1050	HG35A	4	4	27.4
1050	HG40A	6	6	34.5
1200	HG40B	5	5	34.4
1200	HG45	7	6	45.6
1350	HG45A	6	6	48.6

Notes:
1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume*gard*™ *Sizing Guidelines - Darwin*
As at 1st March, 2000

Pipe diameter (mm)	Humegard™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	2	1	9.4
600	HG24	3	3	15.9
750	HG30	4	3	24.2
900	HG35	4	4	27.3
900	HG40	6	5	35.2
1050	HG35A	3	3	27.4
1050	HG40A	5	4	34.5
1200	HG40B	4	4	34.4
1200	HG45	5	5	45.6
1350	HG45A	5	5	48.6

Notes:
1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume*gard*™ *Sizing Guidelines - Hobart*
As at 1st March, 2000

Pipe diameter (mm)	Humegard™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	15	7	9.4
600	HG24	29	13	15.9
750	HG27	32	14	17.7
750	HG30	39	17	24.2
900	HG30A	31	14	24.2
900	HG35	44	19	27.3
900	HG40	62	27	35.2
1050	HG35A	36	16	27.4
1050	HG40A	52	23	34.5
1200	HG40B	44	19	34.4
1200	HG45	59	26	45.6
1350	HG45A	53	23	48.6

Notes:
1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume_gard_™ _Sizing Guidelines_

Hume_gard_™ _Sizing Guidelines - Melbourne_
As at 1st March, 2000

Pipe diameter (mm)	**Hume**_gard_™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	8	3	9.4
600	HG24	15	7	15.9
750	HG27	17	7	17.7
750	HG30	21	9	24.2
900	HG30A	16	7	24.2
900	HG35	24	11	27.3
900	HG40	34	15	35.2
1050	HG35A	19	9	27.4
1050	HG40A	28	13	34.5
1200	HG40B	24	11	34.4
1200	HG45	32	14	45.6
1350	HG45A	29	13	48.6

Notes:
1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume_gard_™ _Sizing Guidelines - Sydney_
As at 1st March, 2000

Pipe diameter (mm)	**Hume**_gard_™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	4	3	9.4
600	HG24	7	6	15.9
750	HG27	8	6	17.7
750	HG30	9	7	24.2
900	HG30A	8	6	24.2
900	HG35	10	8	27.3
900	HG40	14	11	35.2
1050	HG35A	9	7	27.4
1050	HG40A	12	9	34.5
1200	HG40B	10	8	34.4
1200	HG45	13	11	45.6
1350	HG45A	11	9	48.6

Notes:
1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume_gard_™ _Sizing Guidelines - Perth_
As at 1st March, 2000

Pipe diameter (mm)	**Hume**_gard_™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	8	4	9.4
600	HG24	14	8	15.9
750	HG27	15	9	17.7
750	HG30	18	11	24.2
900	HG30A	15	9	24.2
900	HG35	20	12	27.3
900	HG40	28	16	35.2
1050	HG35A	17	10	27.4
1050	HG40A	24	14	34.5
1200	HG40B	21	12	34.4
1200	HG45	27	15	45.6
1350	HG45A	24	14	48.6

Notes:
1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume_gard_™ _Sizing Guidelines - Townsville_
As at 1st March, 2000

Pipe diameter (mm)	**Hume**_gard_™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	2	2	9.4
600	HG24	4	3	15.9
750	HG30	5	4	24.2
900	HG35	5	5	27.3
900	HG40	7	6	35.2
1050	HG35A	4	4	27.4
1050	HG40A	6	5	34.5
1200	HG40B	5	5	34.4
1200	HG45	7	6	45.6
1350	HG45A	6	5	48.6

Notes:
1. Unit sizing applies to non-tidal applications. For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications. Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume*gard*™ *Sizing Guidelines*

Hume*gard*™ ***Sizing Guidelines - Wyong***
As at 1st March, 2000

Pipe diameter (mm)	**Hume***gard*™ Model #	Maximum Impervious Area (Ha)		Total Mass (t)
		Residential	Commercial	
<=600	HG18	3	2	9.4
600	HG24	6	5	15.9
750	HG27	6	4	17.7
750	HG30	9	6	24.2
900	HG30A	5	4	24.2
900	HG35	10	7	27.3
900	HG40	13	10	35.2
1050	HG35A	8	6	27.4
1050	HG40A	11	8	34.5
1200	HG40B	10	7	34.4
1200	HG45	13	9	45.6
1350	HG45A	11	8	48.6

Notes: 1. Unit sizing applies to non-tidal applications.
For tidal application sizing please contact Humes.
2. Unit sizing applies to non-submerged applications.
Contact Humes for sizing in submerged situations.
3. Design based on Q5 pipe and 3 month ARI storm event.

Hume*gard*™ *manufacture allows for installation in difficult site conditions including areas subject to tidal influence.*

Hume*gard*™ *installation - Teatree Gully, South Australia.*

Hume*gard*™ *installation for tidal application - Broadbeach, South East Queensland.*

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Humes™