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# APPENDICES

***The principles of ecologically sustainable development require that the management, including the quality of discharge, of stormwater be considered at all stages of a project***

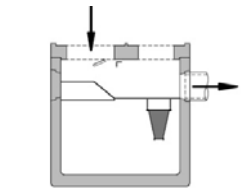
# 1 PURPOSE

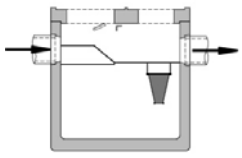
This Manual has been prepared for use by designers and regulators of stormwater drainage systems to:

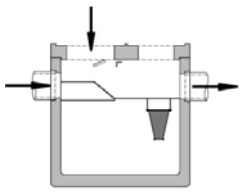
- describe ***Q-Guard™*** ULTRA Series Units and how they work
- provide design information on ***Q-Guard™*** Units
- provide installation and clean-out details (Appendices 1 and 2)

**Designers should also consult specific Local and State Government regulations and requirements with respect to stormwater drainage systems, and should not rely solely on this publication.**

# 2 OVERVIEW


Direct surface inflow


Pipe inflow


Direct surface and pipe inflow

The technology of ***Q-Guard™*** Units allows for the trapping, and storing for the controlled removal of pollutants from stormwater runoff. These pollutants include free oils, grease, sediment and aggregates, as well as litter and organic matter (ie gross pollutants). This technology has been developed in Australia, and for Australian conditions and has been subjected to laboratory testing. This involved the testing of full scale and very large scale models.

These Units can be incorporated into new or existing stormwater systems servicing a wide range of catchment types and areas including:

- car parks and transport depots
- commercial and industrial developments
- residential developments, and
- urban drainage systems

All ***Q-Guard™*** Units are manufactured from non-corrosive materials and have been designed to:

- minimise hydraulic head losses
- allow for fast and efficient installation, by requiring a minimum depth of excavation, having a rectangular footprint and by factory fitting the internal hardware

- allow for quick inspection and clean out using standard eduction or vacuum equipment by incorporating large hinged lids
- allow for piped inflow for all Units, and as either piped flow and/or direct surface inflow from a grate or side entry pit for UA1, UA2 and UA3 Models

**Further technical information is available at the following link** http://www.jameshardiepipes.com.au/q-guard-gross-pollutant-traps.html.

## 3 INFORMATION ON *Q·GUARD™* UNITS

***Q·Guard™ Units are manufactured from durable non-corrosive materials***

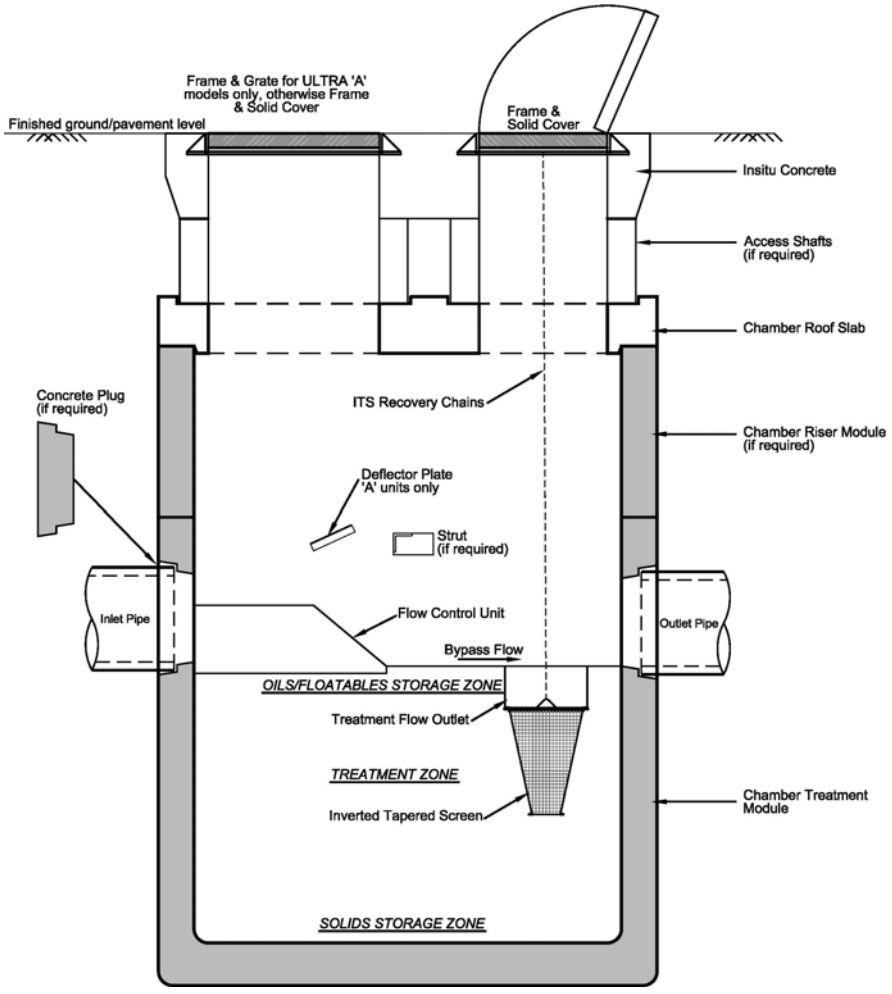



**Figure 3.1 Typical Configuration**

***Q·Guard™*** Units consist of a modular precast concrete components, and non-corrosive internal hardware as shown in Figure 3.1

The purpose and specification for key components of ***Q-Guard™*** Units are provided in Table 3.1 below:

| COMPONENT | PURPOSE | SPECIFICATION |
|---|---|---|
| Chamber Treatment Module (including Chamber Base Module for UB, UC and UD Models | Houses internal hardware and stores pollutants for removal. | Precast concrete to AS3600 (B1 Exposure Classification) and Stainless Steel to ASTM A240/A240M |
| Chamber Riser Module(s) (if required) | Allows for installation in deeper pipe systems. | Precast concrete to AS3600 (B1 Exposure Classification) |
| Chamber Roof Slab, including access openings | Encloses chamber. | Precast concrete to AS3600 and Austroads Bridge Design Code W7 loading |
| Treatment Zone (within Chamber) | Reduces the velocity of flows from the *flow control unit* to allow for the settling of solids, and the migration of floatables, free oils etc to the *floatables storage zone* | N/A |
| Oil/Floatables Storage Zone (within Chamber) | Provides storage for floatable litter, free oils etc for its controlled removal. | N/A |
| Solids Storage Zone (within Chamber) | Provides storage for sediments etc for its controlled removal. | N/A |
| Flow Control Unit, including inclined weir and side chutes | Diverts and regulates flows into the *treatment zone.* | Stainless Steel to ASTM A240/A240M |
| Treatment Assembly, including inverted tapered screen, treatment flow outlet | Refer sub components. | Refer sub components. |
| Treatment Flow Outlet | Conveys treated water to the *outlet pipe*. | Stainless Steel to ASTM A240/A240M |
| Inverted Tapered Screen | Ensures gross pollutant retention. | Stainless Steel to ASTM A240/A240M |
| Access Shafts (if required) | Allows for installation in deeper pipe systems, and access for cleaning etc. | Precast concrete to AS3600 (B1 Exposure Classification) |
| Covers and Insitu Concrete Surround | Provides security against unauthorised entry into unit. Includes accidental closure proof mechanisms. | Galvanised steel to AS 1650 and AS3679; loadings to AS3996 Class D, and accidental closure proof to AS3996 |

**Table 3.1: Key Components**

***Q-Guard™ Units suit most applications for stormwater treatment devices***

## 3.1 DIMENSIONS OF *Q-GUARD™* UNITS

Units are available in a variety of sizes to meet the requirements of most applications for stormwater treatment devices. The use of Chamber Riser Modules and Access Shafts allow for ***Q-Guard™*** Units to accommodate varying pipe depths.

Key dimensions of units, including the ranges of pipe depths for which standard ***Q-Guard™*** Units are suitable, are provided in

Figures UA to UD of Appendix 1 and summarised in Table 3.2 below:

| MODEL | EXTERNAL DIMENSIONS (MM) | | DEPTH BELOW PIPE INVERT (MM) | RANGE OF DEPTH OF PIPE INVERT (MM) | |
|---|---|---|---|---|---|
| UA1 | 1750 | 1000 | 975 | 900 | 2500 |
| UA2 | 1750 | 1000 | 1115 | 1000 | 2700 |
| UA3 | 1750 | 1000 | 1030 | 1100 | 2800 |
| UB1 | 2650 | 1450 | 1405 | 1000 | 2700 |
| UB2 | 2650 | 1450 | 1540 | 1200 | 2900 |
| UB3 | 2650 | 1450 | 1380 | 1300 | 3000 |
| UC1 | 3300 | 1800 | 1835 | 1200 | 3200 |
| UC2 | 3300 | 1800 | 1975 | 1400 | 3300 |
| UC3 | 3300 | 1800 | 1825 | 1500 | 3200 |
| UD1 | 3900 | 2100 | 1970 | 1400 | 3400 |
| UD2 | 3900 | 2100 | 2120 | 1500 | 3400 |
| UD3 | 3900 | 2100 | 1805 | 1900 | 3300 |

**Table 3.2: Key Dimensions**

Set out for ***Q-Guard™*** ULTRA Units should be from the intersection of the Outlet Pipe Invert and the internal wall of the Chamber (refer Figures UA to UD of Appendix 1).

## 3.2 *Q-GUARD™* TECHNOLOGY

### 3.2.1 General

***Q-Guard™ technology has been developed in Australia for Australian conditions***

The design of stormwater treatment devices is generally based on the philosophy of "treating" flow rates up to a "design treatment flow", which is normally less than the design flow of the stormwater system.

As such, the operation of ***Q-Guard™*** Units will depend on the actual flow rate within the system at any particular time (as compared to the "design treatment flow" of the unit). The two alternative modes of operation are described in Sections 3.3.2 and 3.3.3.

### 3.2.2 "Treatment" Mode

For flows up to the "design treatment flow", ***Q-Guard™*** Units operate in "treatment" mode and perform as follows:

- stormwater runoff enters the flow control unit and is directed into the treatment zone by the inclined weir and the side chutes

- the stormwater directed into the treatment zone creates an expanding 3 dimensional spiral flow pattern in a vertical plane which reduces flow velocities and provides sufficient retention times to allow for the segregation of pollutants
- free oils and hydrocarbons rise to the water surface and are stored in the floatables storage zone
- floating litter also rises to the water surface and is stored in the floatables storage zone (some floating litter, when water logged, will settle in the solids storage zone)
- aggregates and sediment settle to the solids storage zone on the chamber floor
- treated stormwater runoff passes through the inverted tapered screen which is designed to maximise the discharge area whilst retaining floating and submerged litter
- treated runoff then leaves the chamber via the treatment flow outlet and outlet pipe

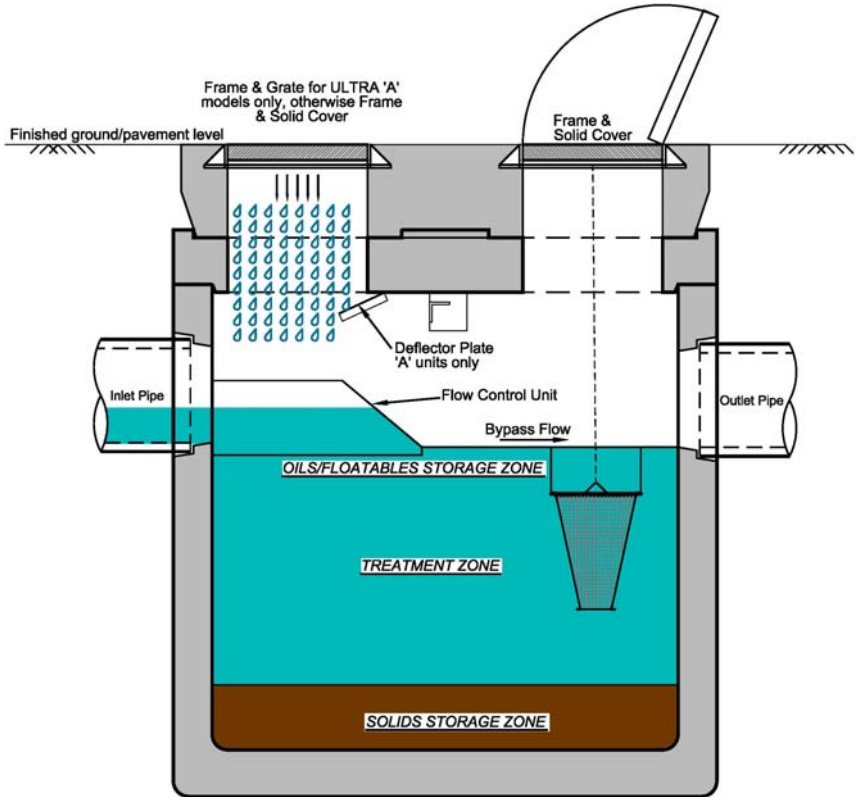



**Figure 3.2: Treatment Mode Operation**

### 3.2.3 "High Flow" Mode

For flows greater than the "design treatment flow", ***Q-Guard™*** Units operate in "high flow" mode as shown in Figure 3.3, and perform as follows:

- stormwater runoff enters the flow control unit and the "design treatment flow" is directed into the treatment zone and is treated as per flows less than the "design treatment flow"
- flow in excess of the "design treatment flow" passes over the inclined weir and discharges to the outlet pipe

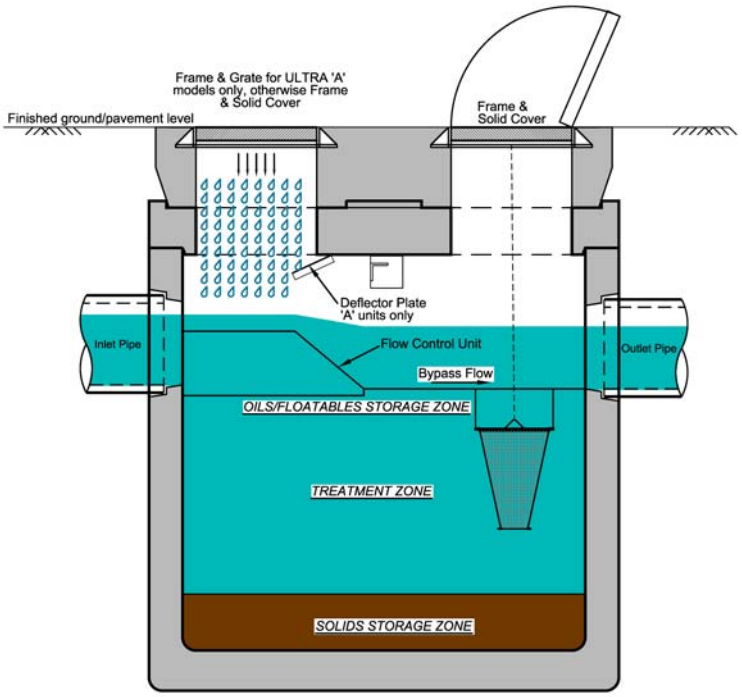



**Figure 3.3: High Flow Mode Operation**

### 3.2.4 Tidal Influences

***It is recommended that James Hardie Concrete Pipes be contacted for advice where there are tidal influences***

In applications where there are tidal influences, care should be taken to avoid inappropriate use of ***Q-Guard™*** Units (eg design treatment flows may be reduced). Expert advice should be sought for these applications.

# 4 DESIGN INFORMATION

## 4.1 OVERVIEW

***Designers should consult with specific Local and State government regulations and requirements with respect to stormwater drainage systems***

The design of stormwater treatment devices is generally based on the philosophy of treating flow rates up to a "design treatment flow", which is normally less than the design flow of the stormwater system. Many local authorities have established design criteria for the performance and sizing of stormwater treatment devices. These criteria generally allow for the "design treatment flow" to be in the range of 1 month ARI to 1 year ARI.

The following constraints of ***Q-Guard™*** Units should be considered:

- ***Q-Guard™*** Units can only accommodate one inlet and one outlet pipe
- both inlet and outlet pipes must be in the same plan alignment
- care should be taken in applications where there are tidal influences

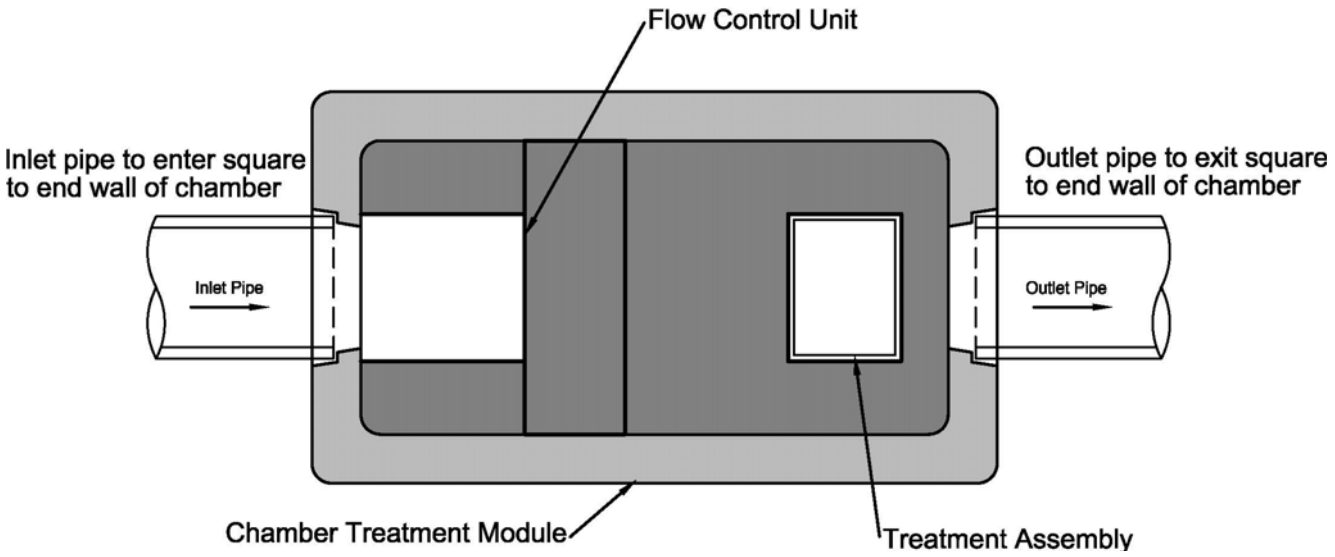



**Figure 4.1: Permissible Pipe Alignment**

## 4.2 TREATMENT RATES AND STORAGE CAPACITIES

Details of "design treatment flow rates" and storage capacities are provided in Table 4.2 below:

| MODEL | INLET PIPE SIZE (MM) | DESIGN TREATMENT FLOW RATE (L/S) | STORAGE CAPACITY *3 ($M^3$) | | CHAMBER HOLDING CAPACITY (M3) |
|---|---|---|---|---|---|
| | | | OIL / FLOATABLES | SOLIDS | |
| UA1 | 225 | 24 | 0.13 | 0.45 | 1.10 |
| UA1 | 300 | 36 | 0.13 | 0.45 | 1.10 |
| UA2 | 375 | 49 | 0.13 | 0.45 | 1.25 |
| UA2 | 450 | 62 | 0.13 | 0.45 | 1.25 |
| UA3 | 525 | 75 | 0.13 | 0.45 | 1.16 |
| UB1 | 375 | 76 | 0.51 | 1.30 | 4.05 |
| UB1 | 450 | 97 | 0.51 | 1.30 | 4.05 |
| UB2 | 525 | 119 | 0.51 | 1.30 | 4.44 |
| UB2 | 600 | 141 | 0.51 | 1.30 | 4.44 |
| UB3 | 675 | 163 | 0.51 | 1.30 | 3.97 |
| UB3 | 750 | 185 | 0.51 | 1.30 | 3.97 |
| UC1 | 525 | 160 | 0.89 | 2.25 | 8.26 |
| UC1 | 600 | 191 | 0.89 | 2.25 | 8.26 |
| UC2 | 675 | 222 | 0.89 | 2.25 | 8.89 |
| UC2 | 750 | 253 | 0.89 | 2.25 | 8.89 |
| UC3 | 900 | 314 | 0.89 | 2.25 | 8.21 |
| UD1 | 675 | 318 | 1.40 | 3.24 | 12.77 |
| UD1 | 750 | 365 | 1.40 | 3.24 | 12.77 |
| UD2 | 900 | 459 | 1.40 | 3.24 | 13.74 |
| UD3 | 1050 | 554 | 1.40 | 3.24 | 11.70 |
| UD3 | 1200 | 646 | 1.40 | 3.24 | 11.70 |

**Table 4.2: Treatment Rates and Storage Capacities**

***hs = K*V²/2*g, where***
***hs = the structure headloss***
***K = pressure change coefficient (dimensionless)***
***V = velocity in downstream pipe (for pipe design flows)***
***g = 9.81m/s²***

## 4.3 HYDRAULIC PERFORMANCE

As with all inlet type devices, the value of the pressure change coefficient (k) for ***Q-Guard™*** Units varies depending on the ratio of direct surface inflow to pipe outflow.

The values in the following table have been derived from initial laboratory testing and the application of the appropriate pressure

change coefficient charts from the Queensland Urban Drainage Manual (QUDM 1992).

| Qg/Qo* | SUGGESTED 'k' VALUE |
|---|---|
| 0.0 | 1.3 |
| 0.2 | 2.0 |
| 0.5 | 2.7 |
| 1.0 | 3.0 to 8.0 * |

* Qg = Direct Surface Inflow (grate inflow); Qo = Pipe Outflow; Refer to QUDM Chart 32 for appropriate 'k' values

## 4.4 POLLUTANT REMOVAL

Controlled large scale laboratory tests have been undertaken to provide the following pollutant removal and retention rates:

| CATEGORY OF POLLUTANT | TEST MATERIAL | REMOVAL AND RETENTION RATES AT FLOWS < "DESIGN TREATMENT FLOW" *1 | RETENTION RATES AT FLOWS > "DESIGN TREATMENT FLOW" *2 |
|---|---|---|---|
| Litter | Buoyant<br>Non Buoyant | 100%<br>100% | 100%<br>100% |
| Organics | Leaves and Organic Litter | 100% | 95% |
| Oils | Free Oil | 100% | 100% |
| Aggregates and sediments | Aggregates<br>Sands | 100%<br>>89% | 100%<br>89% |

*1 Represents the percentage of the test material removed and retained within the unit for flows < the "design treatment flow" of the unit during laboratory testing

*2 Represents the percentage of the test material retained within the unit for flows > the "design treatment flow", and less than 6 times the "design treatment flow" of the unit during laboratory testing

## 4.5 MUSIC MODEL DATA VALUES

MUSIC is an acronym for "Model for Urban Stormwater Improvement Conceptualisation". It is a product of the Cooperative Research Centre for Catchment Hydrology (now eWater CRC) and the licensor is Monash University. It has been designed to simulate urban stormwater systems.

MUSIC has had widespread acceptance from Local and State Regulatory Authorities throughout Australia.

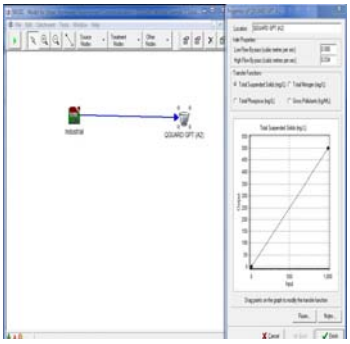
Recommended MUSIC model data values for ***Q-Guard™*** Units are provided in Table 4.5 below:

| DESCRIPTION | CAPTURE RATE | DATA VALUES (INPUT,OUTPUT) |
|---|---|---|
| Low Flow Bypass | 0 | 0 |
| High Flow Bypass | Refer Table 4.2 for Design Treatment Flow Rate | |
| Total Suspended Solids (TSS) *2 | 50% | Min (0,0) Max (100,50) |
| Total Phosphorus (TP) *2 | 20% | Min (0,0) Max (100,80) |
| Total Nitrogen (TN) *2 | 0% | Min (0,0) Max (0,0) |
| Gross Pollutants (>3mm) (GP) *1 | 95% | Min (0,0) Max (100,5) |
| Hydrocarbons (Free Oils and Greases) *1 | 95% | N/A |

*1 Indicators are based on large scale laboratory testing. It is widely accepted by the stormwater industry that catchment characteristics could be vastly different to the controlled environment of a laboratory.

*2 Indicators are based on qualitative observations of field applications.

**Table 4.5: Recommended MUSIC Data Values**



Also refer to Australian Runoff Quality (2006) for details of Water Sensitive Urban Design objectives for the removal of suspended solids, nutrients and gross pollutants from urban stormwater.

## 4.6 STRUCTURAL DESIGN CRITERIA

***Q-Guard™*** Units have been designed in accordance with relevant Australian Standards to suit most site conditions. Key design criteria are provided in Figures UA to UD of Appendix 1 and include:

- Austroads Bridge Design Code – W7 Loading
- ground bearing capacity of 100 kPa
- internal soil friction angle of 10$^{o}$
- coefficient of active soil pressure (ka) of 0.7
- height of the water table is greater than 900 mm below the finished surface level.
- exposure Classification (AS 3600 Table 4.3) - B1

***It is recommended that James Hardie Concrete Pipes be contacted for advice where these criteria are not met***

**Designers should assess these criteria against actual site conditions for compliance.** Where the bearing capacity at the bottom of the excavation is low, it may be necessary to over excavate, and use geotextile and imported replacement materials to achieve a suitable foundation.

### 4.7 DESIGNER'S CHECKLIST

Designers should confirm compliance with relevant Local and State Government regulations and requirements with respect to stormwater drainage systems, and generally consider the following:

| CRITERIA | REFERENCE |
|---|---|
| Stormwater system configuration – both inlet and outlet pipes must be in the same plan alignment, and only one inlet and one outlet pipe | Section 4.1 |
| Distance from the finished ground level to the outlet pipe invert* | Section 3.1; Figures UA to UD in Appendix 1 |
| Inlet and Outlet Pipe sizes | Section 4.2; Figures UA to UD in Appendix 1 |
| Impacts of tidal influences | Section 3.2.4; Contact ***James Hardie Concrete Pipes*** |
| Impacts of headloss caused by the Unit on the stormwater system | Section 4.3 |
| Design treatment flow | Section 4.2 |
| Free oil/floatables storage capacity | Section 4.2 |
| Solids storage capacity | Section 4.2 |
| Pollutant removal | Sections 4.4 and 4.5 |
| High water table | Section 4.6; Contact ***James Hardie Concrete Pipes*** |
| Site Geotechnical Conditions | Section 4.6 |
| Service locations | Service Authorities; Dial Before You Dig – Telephone 1100 |

* There is a nominal 1% fall between the inlet and outlet of "***Q·Guard™***" units

## 5 ORDERING *Q·GUARD™* UNITS

***Q·Guard™ Units can be ordered from the James Hardie Concrete Pipes National Customer Service Centre (Phone 1800 659 850, Fax 1800 639 908)***

When placing an order for ***Q·Guard™*** Units, the following information must be provided:

- inlet Pipe size
- outlet Pipe size
- depth to Outlet Pipe Invert (this is the distance from the finished ground level to the invert of the outlet pipe). There is a nominal 1% fall between the inlet and outlet of each unit.