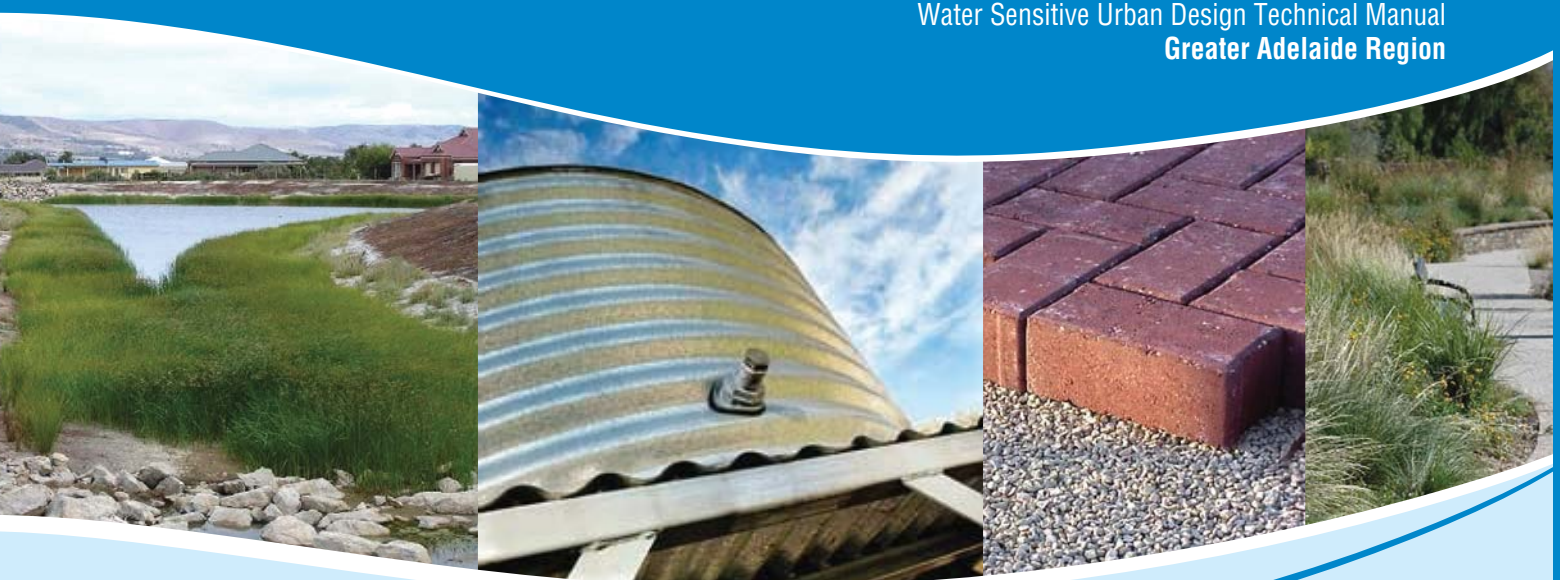December 2010

Chapter 9

Gross Pollutant Traps

Water Sensitive Urban Design Technical Manual
Greater Adelaide Region

Government of
South Australia

Australian Government
Department of the Environment,
Water, Heritage and the Arts

Securing tomorrow's water today.

Water Sensitive Urban Design

Water Sensitive Urban Design (WSUD) is an approach to urban planning and design that integrates the management of the total water cycle into the urban development process. It includes:

■ Integrated management of groundwater, surface runoff (including stormwater), drinking water and wastewater to protect water related environmental, recreational and cultural values;

■ Storage, treatment and beneficial use of runoff;

■ Treatment and reuse of wastewater;

■ Using vegetation for treatment purposes, water efficient landscaping and enhancing biodiversity; and

■ Utilising water saving measures within and outside domestic, commercial, industrial and institutional premises to minimise requirements for drinking and non drinking water supplies.

Therefore, WSUD incorporates all water resources, including surface water, groundwater, urban and roof runoff and wastewater.

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9.1   Overview

As detailed in **Chapter 1**, there are many different WSUD measures which together form a 'tool kit' from which individual measures can be selected as part of a specific design response suiting the characteristics of any development (or redevelopment). Gross Pollutant Traps (GPTs) are one of those measures.

There are numerous techniques available for removing gross pollutants from water. The most effective strategies involve a combination of non-structural measures (e.g. education and waste management programs, and source controls) and structural treatments.

This chapter of the Technical Manual for the Greater Adelaide Region is aimed at providing an overview of Gross Pollutant Traps (GPTs) (i.e. structural controls) and how they can be utilised to assist in achieving the objectives and targets of WSUD.

Description

Gross Pollutant Traps (GPTs) are devices for the removal of solids conveyed by runoff that are typically greater than 5 millimetres. There is a variety of GPTs currently suitable for use in urban catchments including gully baskets, in-ground GPTs, trash racks and pipe nets.

Purpose

The main function of GPTs is water quality control.

All forms of development and land use generate gross pollutants (litter and debris greater than 5 millimetres) of one kind or another. Gross pollutants are a threat to wildlife and aquatic habitats, look unpleasant, smell and attract vermin.

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The primary purpose of GPTs is to remove gross pollutants and coarse sediments washed into the stormwater system before the stormwater enters the receiving waters. While most GPTs capture both categories of pollutants, there are some that target litter and debris exclusively and others that are designed for sediment removal only.

Generally GPTs are used to provide primary treatment within a WSUD treatment train. GPTs do not contribute to flood control. Indeed, unmaintained inline GPTs can contribute to increased flooding by generating additional backwater effects.

Scale and Application

The typical application scale for GPTs is the precinct (neighbourhood) or regional (catchment wide) scale. A precinct system would involve smaller traps in side inlet pits and pit systems that filter runoff from a small number of blocks. Precinct systems are those that include racks and booms across rivers and major stormwater flow corridors.

GPTs serve as a component of traditional conveyance drainage networks. GPTs can operate in isolation to protect immediate downstream receiving waters, or as part of a more comprehensive treatment system. When acting in isolation they are used primarily for aesthetic reasons, to protect downstream waters from litter or to address specific items.

In integrated treatment systems (or treatment trains) they are the most upstream measure and play an important role in protecting the integrity of the downstream treatments (such as wetlands) by removing the coarsest fraction of contaminants and preventing downstream treatments from becoming overloaded.

GPTs represent a significant public investment in the capital cost of the device as well as ongoing cleaning and maintenance costs.

Performance Efficiency

There are limited field studies which quantify removal efficiency of GPTs. However, Fletcher et al. (2004) report on the performance of litter and sediment management systems along with the rationale for these estimates and considerations for their application. Based on the outcomes of this report, performance estimates of GPTs for a range of pollutants are shown in **Table 9.1**.

Table 9.1   Estimate of Performance Efficiencies for GPTs

Pollutant	Expected Removal	Comment
Litter	10-30%	Depends on effective maintenance, specific design (hydraulic characteristics, etc). 10% where trap width is equal to channel width, 30% where width is three or more times channel width
Total suspended solids	0-10%	Depends on hydraulic characteristics; will be higher during low flow
Total nitrogen	0% (negligible)	Transformation processes make prediction difficult
Total phosphorus	0% (negligible)	Total phosphorus trapped during storm flows may be re-released during inter-event periods, due to anoxic conditions
Coarse sediment	10-25%	Depends on hydraulic characteristics; will be higher during low flow
Heavy metals	0%	

Source: Fletcher et al. (2004)

Gross pollutant trapping devices should be considered at the scoping stage of any WSUD project. As the pollutants trapped by GPTs may interfere significantly with the performance of other WSUD measures, they are an important consideration for any stormwater treatment train (in most cases, depending on scale).

9.2 Legislative Requirements and Approvals

Before undertaking a concept design of a GPT (or purchase of a GPT) it is important to check whether there are any planning regulations, building regulations or local health requirements that apply to GPTs in your area.

The legislation which is most applicable to the design and installation of GPTs in the Greater Adelaide Region includes:

- *Development Act 1993* and Development Regulations 2008; and
- *Environment Protection Act 1993.*

Development Act 1993

Installing a GPT will generally be part of a larger development (for new developments), however whenever GPTs are planned (such as retrofitting), it is advised that the local council be contacted to:

- Determine whether development approval is required under the *Development Act 1993*; and
- Determine what restrictions (if any) there may be on the installation of GPTs on a particular site.

Environment Protection Act 1993

Any development, including the installation of a GPT, has the potential for environmental impact, which can result from vegetation removal, stormwater management and construction. There is a general environmental duty, as required by Section 25 of the *Environment Protection Act 1993*, to take all reasonable and practical measures to ensure that the activities on the whole site, including during construction, do not pollute the environment in a way which causes or may cause environmental harm.

Aspects of the *Environment Protection Act 1993* which must be considered when installing GPTs are discussed below.

Water Quality

Water quality in South Australia is protected using the *Environment Protection Act 1993* and the associated Environment Protection (Water Quality) Policy 2003. The principal aim of the Water Quality Policy is to achieve the sustainable management of waters by protecting or enhancing water quality while allowing economic and social development. In particular, the policy seeks to:

■ Ensure that pollution from both diffuse and point sources does not reduce water quality; and

■ Promote best practice environmental management.

Through inappropriate management practices, construction sites can be major contributors of sediment, suspended solids, concrete wash, building materials and wastes to the stormwater system. Consequently, all precautions will need to be taken on a site to minimise potential for environmental impact during construction. Guidance can be found in the *EPA Handbook for Pollution Avoidance on Building Sites* (see **Section 9.8**).

The installation of a GPT will assist in improving the water quality that is discharged to receiving waters. However, the GPT needs to be designed so that it prevents resuspension of captured contaminants.

Air Quality

Air quality may be affected during the installation of a GPT. Dust generated by machinery and vehicular movement during site works, and any open stockpiling of soil or building materials at the site, must be managed to ensure that dust generation does not become a nuisance off site.

Waste

Any wastes arising from any excavation and construction work on a site should be stored, handled and disposed of in accordance with the requirements of the *Environment Protection Act 1993*. For example, during construction, all wastes must be contained in a covered waste bin (where possible) or alternatively removed from the site on a daily basis for appropriate off-site disposal. Guidance can be found in the *EPA Handbook for Pollution Avoidance on Building Sites* (see **Section 9.8**).

Odour

The maintenance of GPT systems must be able to demonstrate that captured contaminants can be stored so as not to cause significant adverse environmental impact or nuisance (e.g. odours and putrefaction).

9.3   Design Tools

A range of design tools is available for the concept and detailed design of GPTs as detailed in Chapter 15 and discussed briefly below.

The Cooperative Research Centre for Catchment Hydrology (now eWater) has recently developed stormwater management evaluation software called MUSIC (Model for Urban Stormwater Improvement Conceptualisation). The software serves as a planning and decision support system, and packages the most current knowledge of the performance of a range of stormwater treatment measures into an easily used tool. MUSIC is designed to operate at a range of temporal and spatial scales, suitable for modelling stormwater quality treatment systems for individual lots up to regional scales.

MUSIC is designed to simulate urban stormwater systems operating at a range of temporal and spatial scales and provides a user-friendly interface to allow complex stormwater management scenarios to be quickly and efficiently created, with results viewed using a range of graphical and tabular formats. MUSIC provides the ability to simulate both quantity and quality of runoff from catchments and the effect of treatment facilities on these components.

MUSIC is an aid to decision making. It enables users to evaluate conceptual designs of stormwater management systems to ensure they are appropriate for their catchments. By simulating the performance of stormwater quality improvement measures, MUSIC determines if proposed systems can meet specified water quality objectives.

GPTs can be modelled in MUSIC as part of a treatment train.

MUSIC requires the user to describe the performance of the GPT (using a graphical function editor) for each pollutant type, and does not provide default performance figures. The reason for this is that there are many GPTs available, including several proprietary products, which may perform very differently.

9.4   Design Considerations

The following design considerations should be used when the installation of a GPT is proposed, or as a basis for the information required when selecting an appropriate proprietary product.

Flood Capacity

Litter booms are usually designed to float and therefore adjust with increasing flow. Trash racks should be designed to act as weirs if their design flow rate is exceeded. Inground GPTs often operate with a bypass system that is designed to divert the treatment flows into a separation chamber. Flows higher than this are diverted over or around a diversion weir. Alternative bypass techniques include a release mechanism for a net system, triggered by increasing upstream flow levels.

Every GPT should be designed with provision for a high flow bypass system. The bypass should:

■ Protect the operational integrity of the trap during floods;

■ Ensure no flooding is caused by the trap in surrounding areas; and

■ Prevent excessive scour of collected pollutants in a trap.

It is important that a hydraulic analysis of the drainage system incorporating a GPT is performed. This analysis needs to include headloss of the GPT and diversion weir under flood conditions (IEAust 2006). The design of a bypass system should also be checked to assess impacts on the local drainage system.

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Figure 9.1   Gross Pollutants at the Torrens Weir – December 2007

Source: Courtesy of Australian Water Environments

Trapped Pollutant Storage

Holding trapped pollutants until removed is achieved by containing pollutants in a wet sump (in baskets or chambers) or by storing pollutants in baskets, nets or behind screens that are free draining.

The GPT needs to be designed so that it prevents resuspension of captured contaminants during flows in excess of the design ARI.

The continuous wet conditions in a pollutant containment sump and possibly limited turn over, mixing or aeration can lead to organic material decomposition, with depleted oxygen levels creating severe reducing conditions. Under these conditions, collected pollutants can be transformed from a relatively innocuous state to highly bio-available forms that are then released to downstream waters with any through flow.

Therefore, when installing as a stand alone GPT (i.e. without downstream treatment measures) the impact on downstream waterways from the release of potentially bio-available pollutants from wet sumps should be considered. In some cases, it may be the only option for a GPT. If so, a low flow treatment system downstream should be considered.

Maintenance

The main environmental issues with GPTs are associated with:

- Long-term storage of pollutants that may be remobilised or cause odour; and

- Limitations on the disposal of the trapped material.

A poorly maintained treatment measure may not only perform badly, it may become a flood hazard or a source of pollution itself. Maintenance is the most commonly overlooked aspect of GPT selection, yet it is one of the most important for gross pollutant reduction (IEAust 2006).

GPT operation and maintenance requirements vary widely. When considering a treatment measure's maintainability and operability, the following issues should be considered:

- Access to the treatment site (i.e. by vehicle);

- Ease and frequency of maintenance; and

- Disposal of waste.

The ease of maintenance relates to the systems and equipment required to clean a GPT. Cleaning systems range from:

- Manual handling of collected pollutants;

- Vacuuming collected pollutants;

- Using a crane to retrieve collected pollutants from a basket or net; or

- Using large excavators to remove pollutants.

The design of any removable sump or basket collection system must ensure that floatable contaminates do not overspill the basket during lifting or clean out operations.

Some GPT devices will allow the removal of pollutants to be undertaken during periods of dry weather. It is considered appropriate practice to disregard the need to include a flow isolation option in the design and installation of these GPTs.

Due to the seasonal nature of rainfall in the Greater Adelaide Region, cleaning and other maintenance procedures will be easier to undertake in the summer months. It may be appropriate to consider basing monitoring and maintenance on the occurrence of summer storms during this period. However, a regular inspection and maintenance schedule should be put in place for the wet winter period.

It is important that an assessment of the catchment pollutant load be undertaken in winter months to determine the likely pollutant 'wash off' and collection load. This load can be used to determine the holding capacity (or pollutant storage volume) required of the GPT for the catchment. This knowledge can also be applied in

combination with winter climatic conditions to determine the frequency of clean out procedures required to ensure the trap is working efficiently.

Further information on maintenance is contained in **Section 9.5**.

Siting a GPT

A GPT should only be located at sites where access for inspection and maintenance can be carried out using standard maintenance vehicles. Adequate access and hardstand areas for maintenance plant (vacuum loader, crane, tippers etc) from the street to the device should be provided.

The siting of GPTs in inaccessible locations, such as at the bottom of embankments, should not be undertaken. Where practicable, GPTs should not be located near electrical equipment.

Consideration should be given to whether:

- Any road closures are required (during installation and subsequent maintenance) and how much disturbance this will cause;

- There are any services required for maintenance (e.g. wash down water);

- There are any potential odour concerns at the location;

- There will be an impact on the aesthetics of the area;

- There is an area nearby to dry the waste material.

GPT devices are to be located such that a downstream overland flow path through a public road or open space is available to carry any surcharge flows which may occur due to blockage of the GPT device or other causes. However, a downstream overland flow path through private land or easement is not appropriate.

Waste Disposal

Disposal costs depend on whether the collected material is retained in wet or free-draining conditions. Handling of wet material is more expensive and requires sealed handling vehicles.

Issues to consider regarding waste disposal include:

- Will the material be in wet or dry condition and what cost implications are there?

- Are there particular hazardous materials that may be collected and will they require special disposal requirements (e.g. contaminated waste)? What are the cost implications?

- What is the expected load of material and what are the likely disposal costs?

- Where is the material going to be disposed?

9.5   Design Process

Overview

The design process for GPTs consists of a number of steps including:

- Assess site suitability and catchment analysis;
- Determine design objectives and targets;
- Consult with council and other relevant authorities;
- Select type of GPT;
- Determine the design flows;
- Size the GPT system;
- Determine land and asset ownership;
- Check the design objectives;
- Obtain approvals;
- Develop a construction plan; and
- Develop a maintenance plan.

Figure 9.2   Inside a GPT

Source: Courtesy of University of South Australia

The design process is also discussed in general in Chapter 3.

A Design Calculation Checklist is provided in **Appendix A**.

A number of the steps in the design process are discussed below.

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Site Suitability and Catchment Analysis

WSUD responds to site conditions and land capability and cannot be applied in a standard way. Careful assessment and interpretation of the site conditions is therefore a fundamental part of designing a development that effectively incorporates WSUD.

Careful selection of where to place a GPT is important. An assessment of site conditions is necessary to identify what measures, if any, are required to ensure that the GPT will perform for its entire lifetime.

It is also important to understand the pollutant profile of the catchment when undertaking the site suitability assessment, which will assist in the selection and sizing of the GPT.

The pollutant profile of a catchment area is determined largely by the area's land use and stormwater management measures.

For GPTs, the primary target pollutants are:

■ Gross pollutants: litter and vegetation larger than 5 millimetres; and

■ Sediment: particles larger than 0.125 millimetres.

To isolate pollutants in any catchment, the designer needs to examine receiving water degradation in light of the area's land use and current management practices. The sections below provide information to assist the site suitability analysis.

Source and Type of Gross Pollutants

All forms of development and land use generate gross pollutants of one kind or another.

In assessing the source and type of pollutant to be collected, consideration needs to be given to the potential change in pollutant source and type of pollutant which may occur as a catchment develops or is redeveloped.

In residential areas, the bulk of the volume of pollutant is organic matter such as leaves from street trees, grass clippings, etc with only small volumes of materials such as plastic, bottles and cans. Residential areas also contribute pollutants such as paint, pet droppings, detergents and oils as a result of household activities.

Studies and logic indicate that a significant proportion of gross pollutants discharged to waterways are generated by residential catchments (including the surrounding street network), as this type of development constitutes a significant proportion of the land use in most catchments.

Figure 9.3   Image of Various Types of Gross Pollutants

In tourist areas and general commercial and office areas, the type of pollutant is more likely to be floatable (i.e. cans, cigarette butts, paper and food wrappers) and motor vehicle generated pollutants (e.g. oils, brake linings, etc). These items, when discharged to waterways, are highly visible to the public. The volume of pollutant may be small in comparison with pollutants generated elsewhere in the system, but degrade the appeal of the waterway.

Industrial areas are more likely to generate gross pollutants such as sediment, polystyrene, wood particles, cardboard and wrappings. Industrial sites are also more likely to generate spills of oil, chemicals and similar liquid contaminants, which are not generally trapped by physical gross pollutant control devices.

Shopping centre developments are more likely to concentrate pollutants related to food, packaging and motor vehicles (i.e. parked vehicles leak oils, cars deposit brake linings).

Rural developments are likely to generate volumes of organic matters (i.e. grass, leaves, etc) and chemical pollutants associated with farming type land use.

In general, gross pollutants are composed of approximately 20% litter (plastic, paper and metal) and 80% organic material (such as leaves and twigs). The majority of gross pollutants are carried during times of the highest flows. Less than 20% of litter is transported as floating material; the remainder is either entrained in the flow or sinks.

The general composition of urban gross pollutants and urban litter is demonstrated in **Figure 9.4**.

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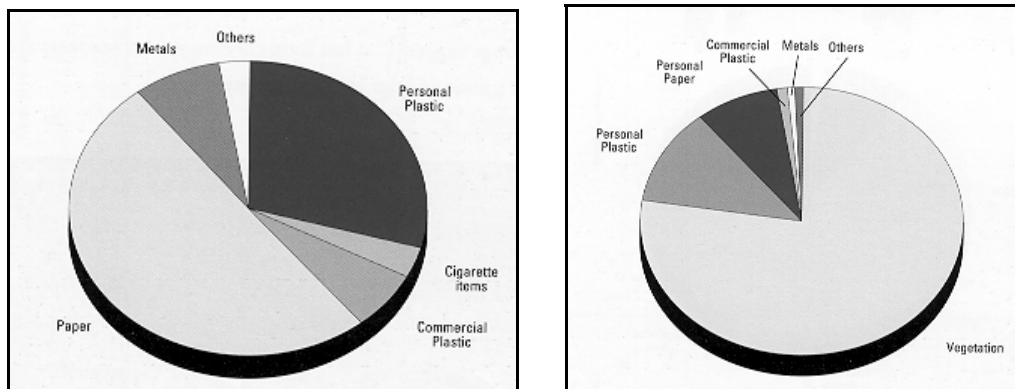
Figure 9.4   Composition of (a) Urban Gross Pollutants and (b) Urban Litter

Source: Allison et al (1997)

Locating a GPT

When determining the location for a GPT, its relevance to other stormwater treatment measures in the catchment should be considered. A location for a GPT should be complementary to other treatment measures and be consistent with the strategic catchment treatment objectives. In addition, other factors such as topography, available space and proximity to pollutant source areas determine the best location for a GPT and its catchment size.

Site Characteristics

The characteristics of a particular site can severely limit the choice of a treatment GPT suited to an area. Constraints fall broadly into categories of physical and social.

Physical factors to consider include:

■ Topography – GPTs may not operate effectively on sites with steep grades, while on mild slopes head losses can cause local flooding;

■ Soils and geology;

■ Groundwater/tides;

■ Space;

■ Access; and

■ Overhead restrictions.

Social factors include issues of health and safety, aesthetics and impacts on recreation facilities. Factors to consider include:

■ Odour problems;

■ Visual impacts;

■ Safety concerns; and

■ Vermin.

Design Objectives and Targets

Specifying the objectives for a GPT is an important step in ensuring that it operates as intended. The objectives should include details and consideration of the following:

■ Treatment objectives;

■ Design flows;

■ Flood capacity;

■ Trapped pollutant storage; and

■ Maintenance requirements.

The design objectives and targets will vary from one location to another and will depend on site characteristics, development form and the requirements of the receiving ecosystems. It is essential that these objectives are established as part of the conceptual design process and discussed with the relevant council prior to commencing the engineering design.

An example design target is that a GPT will capture a minimum of 90% of all solid gross pollutants (including floatables) greater than 2 mm in any dimension and sediment greater than 0.125 mm in diameter.

Further information on objectives and targets can be found in **Chapter 3** of the Technical Manual.

Consult with Council and Other Relevant Authorities

The designer should liaise with civil designers and council officers to ensure:

■ GPTs will not result in water damage to existing services or structures;

■ Access for maintenance to existing services is maintained; and

■ No conflicts arise between the location of services and WSUD devices.

The council will also be able to advise whether development approval is required and whether any other approving authorities should be consulted.

Select Type of GPT

(Note and acknowledgment: information in this section draws heavily from IEAust 2006)

The design of GPTs has evolved considerably since their inception in Australia in the 1980s. Most current designs are proprietary products and available 'off the shelf'.

The most pressing issue for managers of stormwater systems is specifying the requirements of a GPT and selecting an appropriate GPT for a particular location, as there is a wide range of available products.

GPTs vary in size, cost and trapping performance by orders of magnitude. GPTs are continuously being developed and modified as vendors research the operation of their traps and respond to treatment requirements.

Selection of the type of GPT device for a particular application must occur as part of the conceptual design process.

The decision of which type (and brand) of trap to select is a trade-off between the life cycle costs of the trap, the expected pollutant removal performance in regard to the values of the downstream water body and any social or political considerations. Selection of the type of GPT must take into consideration an assessment of the site conditions against the relative merits of the different available devices.

The filtration efficiency and effectiveness of the GPT must be sustainable during intervals between cleaning and the treatment flow capacity and hydraulic performance must not be reduced by accumulation of contaminants within the captured area.

Construction related issues which may sway a decision on which trap is most suitable, include:

- Does the cost include a diversion structure that will be required?

- Is specialist equipment required for installation (e.g. special formwork, cranes or excavators) and what are the cost implications of these?

- Is particular below ground access required, or will ventilation and other safety equipment be needed? If so, at what cost?

- Will the trap affect the aesthetics of the area?

- Will landscape costs be incurred after the trap installation? If so, how much?

- Will the trap be safe from interloper or misadventure access?

- Do the lids/covers have sufficient loading capability (particularly when located within roads)? What is the cost of any increase in load capacity and will it increase maintenance costs?

- Will the trap be decommissioned (e.g. after the development phase) and what will remain in the drainage system?

- Are there tidal influences on the structure and how will they potentially affect performance or construction techniques?

- Will protection from erosion be required at the outlet of the device (particularly in soft bed channels) and what are the cost implications?

A checklist for assisting in the selection of a GPT is contained in **Appendix A**.

The following sections divide the array of GPTs available into five categories:

- Drainage entrance treatments;
- Direct screening devices;
- Non-clogging screens;
- Floating traps; and
- Sediment traps.

Drainage Entrance Treatments

Entrance type treatment systems are generally used in locations where it is not practical to utilise larger 'end-of-line' systems that are capable of servicing a much larger catchment area. Entrance systems are usually the best option when the receiving water environments are close to the catchment or in situations where the catchment area is small.

Examples include:

- Grate entrance systems;
- Side entry pit traps;
- Return flow litter baskets; and
- Channel nets.

Method of Pollutant Removal

Drainage entrance treatments involve preventing entry into the stormwater drainage system, or capturing the pollutants at drainage entrance points. This can be achieved by restricting the stormwater entrance size, capturing pollutants as stormwater falls into the drainage system, or retaining the pollutants in the entrance pit. Entrance treatments are free draining as collected pollutants are suspended above the base of a drainage pit. More recent designs use fine mesh bags or nets that can contain much finer material including gravel and coarse sediments.

Benefit

Entrance treatments are usually located close to a pollutant source, allowing the most polluted areas to be targeted. Use of entrance treatments can also help reduce downstream pipe blockages, which was their original intended use. Entrance treatments can target specific high pollutant generation areas. Their size and accessibility is governed by existing drain conditions.

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Disadvantages

Often in low lying areas the depth of drain entrances limits their applicability because pits can be too shallow to provide sufficient pollutant storage. Another issue for established urban areas is the presence of connections to the drainage network that do not connect via street entrances e.g. private carparks and roof areas.

Maintenance

Maintenance can involve numerous locations and the size of inlets can limit the capacity of traps, thus requiring more frequent cleaning. Maintenance involves lifting an access lid and removing collected pollutants manually or with a vacuum system. Cleaning times can be governed more from gaining access to the many pits than the actual pollutant removal task.

Direct Screening Devices

Examples of direct screening devices include:

- Litter collection baskets (see **Figure 9.5** and **Figure 9.6**);
- Release nets;
- Trash racks (see **Figure 9.8**);
- Diversion weirs (see **Figure 9.9**);
- Return flow litter baskets; and
- Channel nets (see **Figure 9.7**).

Figure 9.5   Litter Collection Baskets at Sunshine, Victoria

Source: IEAust (2006)

Figure 9.6   Litter Collection Basket in Collingwood, Victoria

Source: IEAust (2006)

Figure 9.7   Channel Nets at West Torrens, Adelaide, SA

Source: IEAust (2006)

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Figure 9.8   Trash Rack Installed at Broadmeadows, Victoria

Source: IEAust (2006)

Figure 9.9   Vane Style Diversion Weir, Sebastopol, Victoria

Source: IEAust (2006)

Method of Pollutant Removal

Direct screening traps retain gross solids by passing flow through a grid, mesh, rack or net barrier assembly with flows perpendicular to the screening surface. As pollutants build up behind a barrier, material smaller than the pore sizes may also be retained due to the reduced effective pore size. There are various trapping methods using baskets, prongs, racks or perforated bags, and this category of GPT contains the most products.

Direct screening devices are installed in drainage lines (usually in pipes) with catchment areas typically between five and 200 hectares. Much larger catchments have been targeted, usually with lower trapping efficiencies.

While most of the direct screening devices are installed 'in line', many are located next to drainage pipes and have treatment flows diverted into them via diversion weir arrangements. Flow rates above treatment flows overtop the diversion weirs and bypass treatment. This is a way to protect collected pollutants from scour and the device from damage.

The configuration of diversion weirs can vary and includes solid walls, slotted pipes, staggered vanes and diversions forced by outflows from collection chambers. In each case the intention of the bypass system is the same.

Some direct screening traps are located completely within channels, which is mainly because of space limitation or the scale of the channels. Older designs located within channels were prone to scouring of collected pollutants and subsequent transport downstream when overtopped. Newer in-channel designs have means of retaining gross pollutants during flood events, typically with nets, and are designed to withstand the forces associated with floods. Direct screening devices can be installed above or below ground and this typically determines whether the pollutants are retained in a wet sump (underground units) or free draining.

Some above ground GPTs, such as trash racks and those with solid diversion weirs, can collect considerable quantities of coarse sediment as it settles out when flows are backed up behind an obstruction and flow velocities fall significantly. Predicting removal rates is difficult and depends on local conditions.

Benefit

An advantage of underground systems is the ability to locate them in highly developed urban areas with little or no visual impact.

There are obvious benefits of above ground systems including being able to monitor collection rates, keeping material in an aerobic state and simplified cleaning procedures.

Coarse sediments can be retained by many direct screening devices, particularly below ground installations. Underground GPTs can act as a sump and collect bed load sediment as it is transported through the drainage network.

Disadvantages

A limitation with underground traps is the potential transformation of pollutants into more bio-available forms in wet sumps and an 'out of sight, out of mind' mentality towards maintenance.

While above ground systems have a larger visual impact, this can be exploited and used to raise public awareness of stormwater pollution and urban waterway

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protection. Consideration should be given to health and safety issues associated with exposed systems that are easily accessible to the public.

Maintenance

Cleaning systems for direct screening GPTs involves removing material that has collected behind the screening surfaces (or in sumps) and cleaning the screen of debris. Collected pollutants can be removed with vacuum machines, small excavators, small truck-mounted cranes for nets or larger cranes to lift baskets from sumps.

Figure 9.10   Clean Out of GPT Baskets Across Third Creek, Adelaide

Cleaning debris from screens can represent a more substantial task. It involves manual scraping of the screen surface to remove entangled debris, or knocking debris from the screen, depending on the type of screen arrangement. Cleaning a screen of debris is a critical component of maintenance for direct screening GPTs so they can collect gross pollutants with maximum efficiency at the start of the next storm event.

Non-clogging Screens

Examples of non-clogging screens include circular and downwardly inclined screens.

Only a few GPTs have non-clogging screens. These direct flows along or around a screen such that the flows maintain a tangential direction to the screen face. In addition, screens are aligned such that blockages of material are minimised.

Method of Pollutant Removal

The tendency of in-line screens to block is their main limitation. To improve screen performance, numerous attempts have been made to design a non-clogging trash screen. The principle is to align flows tangentially to the screen surface, thus encouraging flows to move debris along the screen while flows move through the

screen. The configuration of the screen face must also be appropriate for a device to remain free of blockages during storm events.

Two types of non-clogging screens include an underground and an above ground device. Underground systems use circular screens with rotating flows in a collection sump, whereas above ground systems use a drop in the channel bed to force flows down an inclined screen.

Non-clogging screen GPTs have pollutant holding chambers or areas, much the same way as direct screening GPTs. They are also cleaned in similar ways to direct screening traps (with vacuum systems, sump basket retrieval or small excavators).

Benefit

The main advantage of non-clogging screens is that they maintain flows through a trap for the duration of a storm event, thus treating more runoff volume for any given storm event. Direct screening GPTs tend to have reduced flow through the device with increasing load accumulation progressively leading to early system bypass (if not maintain regularly) compared with non-clogging screens.

Maintenance

They share the advantages and limitations associated with above ground and underground direct screening GPTs for maintenance and collected pollutant breakdown.

Floating Traps

Examples of floating traps include:

- Flexible floating booms; and
- Floating debris traps.

Figure 9.11   Floating Boom Operating at Netley, West Adelaide

Floating traps are usually intended to remove highly buoyant and visible pollutants. These are typically installed in lower reaches of waterways where velocities are lowest and where upstream attempts of litter control have been exhausted. One benefit of floating traps is their high visibility and that they have the potential to be used as a public education and awareness tool.

Method of Pollutant Removal

As their name suggests, floating traps target only the most buoyant material. For litter this is typically 10% of the total load.

Floating traps usually consist of a partly submerged floating barrier fitted across the waterway, which retains the pollutants or deflects them into a retention chamber. More recent developments incorporate pollutant retention chambers and advanced trap-cleaning methods.

Silting of floating traps is a key consideration. The main issues include selecting areas where flow velocities are low, where litter tends to accumulate, where they are protected from high flows and not in the way of waterway traffic.

Benefits

Floating GPTs have the advantage of portability and can be repositioned to areas that tend to collect litter (in eddies along rivers for example). Maintenance is easily monitored because of their high visibility.

Disadvantages

The main limitations with floating traps relate to their limited holding capacity, poor capture efficiency during high flows and maintenance difficulties. Recent designs incorporate submerged barriers suspended below floating traps and pollutant retention chambers in an attempt to increase holding capacity and prevent losses from wind or tidal movements.

However, when flow velocities increase, this material is often washed out from beneath a trap or entrained in the flow around the boom arms.

Maintenance

Floating traps are typically maintained from boat access, which can be time consuming and expensive. Some small booms are manually cleansed with vacuum devices and specially designed barges are now used to streamline this process. Flood flows can present difficulties for floating traps positioned in the lower reaches of waterways, subjecting them to large forces, and their inability to bypass high flows. Their structural integrity can be compromised when subjected to high velocities and this reinforces the importance of site selection in slow moving waterways.

Sediment Traps

Examples of sediment traps include:

- Sediment settling basins (see **Figure 9.12**);

- Ponds;

- Circular settling tanks; and

- Hydrodynamic separators (see **Figure 9.13**).

Figure 9.12   Sediment Settling Basin in Perth, WA

Source: IEAust (2006)

There is a number of sediment traps available to control sediment transport once mobilised. These range from simple earthen or concrete basins to complex structures using vortices and secondary flows for sediment retention. Each trapping system aims to create favourable flow conditions for sedimentation, but the footprint per unit of flow for each device varies depending on the processes employed.
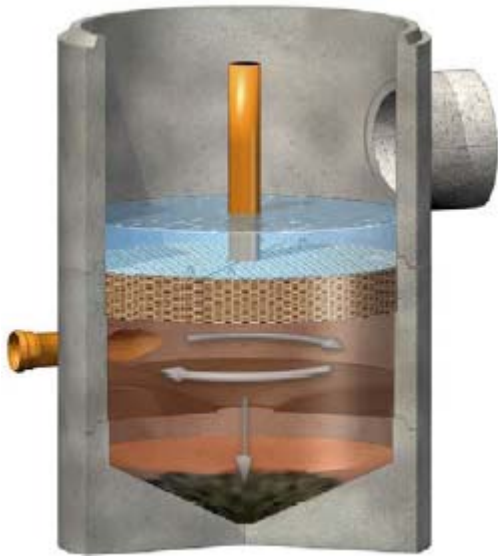
Figure 9.13   A Hydrodynamic Separation Device Cross Section

Note: inlet is on the left, encouraging rotation and enhanced settling of solid matter

Source: Courtesy of Hydrocon Australasia

Method of Pollutant Removal

The two processes of sediment removal involve: (i) fine screening or secondary flow motions and (ii) simple sedimentation processes. Devices using secondary flow patterns or screening systems, including direct screening and non-clogging screen GPTs, are typically proprietary products and design information is limited.

The basin type sediment traps can be concrete basins or more natural ponds constructed with site soil. They retain sediments by simply enlarging a channel so that velocities are reduced and sediments settle to the bottom.

There are also smaller scale sediment traps which can be fitted into stormwater drainage pipe network systems including some proprietary products.

Maintenance

Proprietary products are usually maintained with vacuum equipment. For simple basin sediment traps, maintenance is performed by excavating collected sediments following dewatering of the basin or pond. This can involve significant works and disturbance to an area. Therefore, sediment traps (or basins) are designed for maintenance frequencies of one to five years, depending on the catchment disturbance and activities.

The cleaning procedure involves dewatering the basin, removing sediments and re-establishing the area. The nature of collected pollutants can determine their suitability for disposal. Sediment traps are typically designed for coarse sediments

only (typically larger than 0.125 mm) and this material is expected to have relatively low quantities of contaminants but should nevertheless be monitored during maintenance.

Design Flows

The overall treatment effectiveness of a GPT is a function of its pollutant removal rate for flows that pass through a trap and the volume of runoff treated. The maximum flow rate at which a GPT is designed to operate effectively is termed the 'design flow'.

A high flow bypass is usually adopted to protect GPTs from large flood flows that could damage the device or scour and transport previously collected pollutants downstream. This will be dependent on the design pipe or channel capacity.

Selecting a design flow rate is a trade-off between the cost and space requirements of the device (a higher design flow will usually require a larger facility with additional costs) and the volume of water that could potentially bypass the measure and avoid treatment.

GPTs will generally be designed to treat a minimum design flow of a 1 in 3 month ARI, as this will lead to hydrological effectiveness of greater than 97% (see **Figure 9.14**). Above this design flow, where possible, flows should bypass the filtration systems via an alternative bypass arrangement that can accommodate flows up to the 100 year ARI flow without creating any additional flooding issues to those that might already exist.

At specifically defined locations it may be necessary to design GPTs to treat flows from a recurrence interval greater than the one in three month event. This will depend on an assessment of the capacity of the receiving waterway downstream of the GPT to accept a pollutant load and the hydraulics of the drainage system.
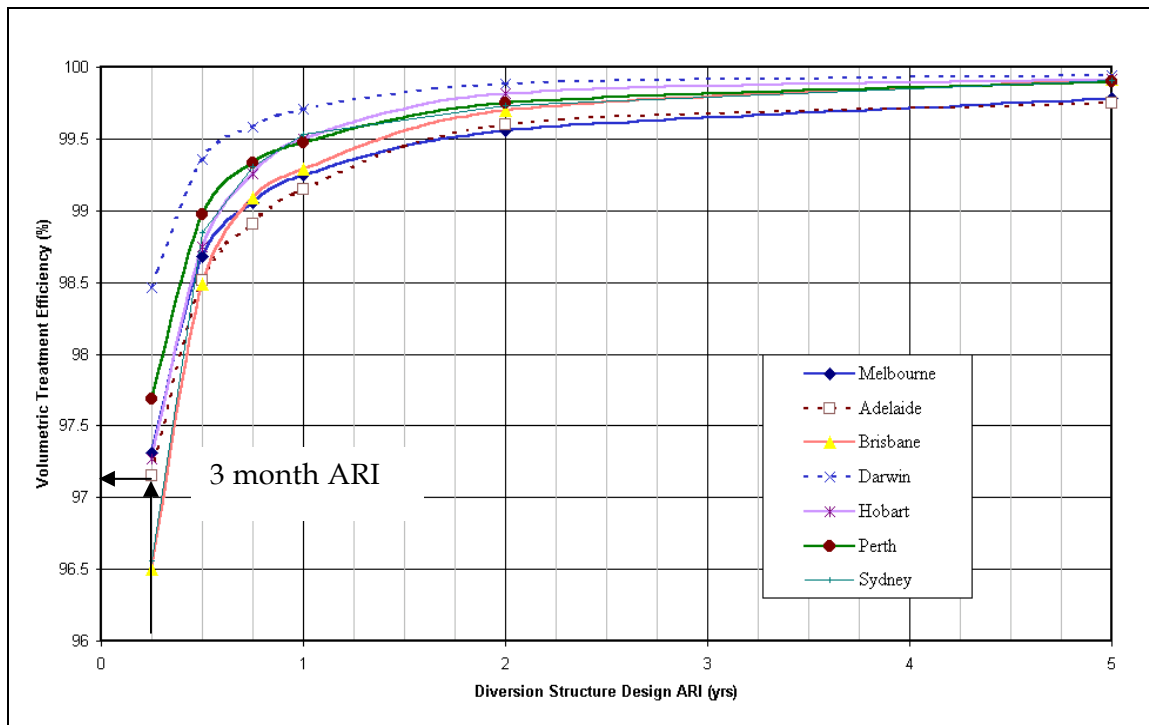
Figure 9.14   Typical Trap Efficiencies vs Design Standard of Stormwater Hydraulic Structures for Time of Concentration Equal to 1 Hour

Source: Wong et al (1999)

Sizing GPTs

To estimate the size of a required storage and containment chamber, catchment gross pollutant loads should be estimated, and a maintenance frequency selected. From this information an appropriate pollutant holding capacity can be determined.

Typically, GPTs should be sized for cleaning between four and 12 times per year (IEAust 2006). Alternatively, the capacity of the GPT should be sized based on intended cleaning frequency.

Loads can be estimated using a simple decision support system that requires rainfall and land use information (see Allison et al (1998)). If no other information is available, the values in **Table 9.2** could be adopted for litter and gross pollutant loading rates.

For the sizing of the adopted GPT, detailed hydraulic calculations will need to be prepared to establish the hydraulic response of the drainage system downstream and upstream of the devices.

Table 9.2   Approximate Litter and Gross Pollutant Loading Rates for Melbourne

Land Use Type	Litter Volume (L/ha/yr)	Litter Mass (kg/ha/yr)	Gross Pollutants (Litre/ha/yr)	Gross Pollutants Mass (kg/ha/yr)
Commercial	210	56	530	135
Residential	50	13	280	71
Light industrial	100	25	150	39

Source: IEAust (2006)

Check the Design Objectives

This step involves confirming the design objectives, defined as part of the conceptual design, to ensure the correct GPT system design method is selected. The treatment performance of the system should be confirmed (including revisiting and checking of any modelling used to assess treatment performance).

Obtain Approvals (If Required)

If a development application is required, key GPT information to be collated and provided with the application may include (if available/appropriate):

■ Objectives of the GPT;

■ Details of the size, hydrological and hydraulic response of the catchment;

■ Details of the source and type of pollutants likely to be generated by the catchment both now and in the future;

■ Sketches/plans of the proposed GPT;

■ Facts detailing the performance of the GPT device;

■ Details of the verification procedure to be applied by the body operating the GPT to confirm that the GPT is performing as stated by the designers;

■ Copies of reports on the performance of the device from laboratory and/or field trials;

■ Details of cleanout/maintenance procedures to be adopted. Cleanout/maintenance will need to utilise plant and equipment currently in use or readily available;

■ Structural calculations showing the device, the roofs and access covers are designed for heavy traffic load. Access covers are to be large enough to enable vertical removal of components where required;

■ Details of the inspection/maintenance access lids to the GPT;

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- Details regarding method to isolate the device from upstream and downstream flows;

- Maintenance plan for the GPT.

Construction Process

There exists a number of challenges that must be appropriately considered to ensure successful construction and establishment of a GPT.

The risks to successful construction and establishment of WSUD measures, including GPTs, during the construction phase of work are generally related to the following:

- Construction activities which can generate large sediment loads in runoff; and

- Construction traffic and other works that can result in damage to the GPT structure.

To overcome the challenges associated with installing GPTs, the following steps are recommended:

- Construction of the functional elements and structures associated with the GPT should occur at the end of any landscaping works; and

- Temporary protective measures to preserve the functional infrastructure of the GPT against damage should be installed.

An example Construction Checklist in **Appendix A** presents the key items to be reviewed when inspecting the GPT during and at the completion of construction.

Maintenance Requirements

GPTs require a considerable amount of maintenance to ensure that they continue to operate at the design level of performance. A maintenance and monitoring management plan to: (i) monitor the performance of, and (ii) service the given GPT device, should therefore be developed during the design process.

The maintenance plan should include the following information:

- The location and type of device proposed;

- Who is going to perform the routine maintenance and who will incur the costs of maintenance;

- What parts of the device are to be cleaned and how;

- Type of maintenance and likely frequency;

- What, if any, machinery is required to maintain the device;

- Expected maintenance and inspection frequency;

- Expected maintenance costs or other resource requirements;

- Access issues such as locked gates, entry through private property etc including contact telephone numbers;

- Any environmental safeguards required during cleaning (i.e. hay bales required to filter stormwater drained from device);

- Occupational Health and Safety issues (i.e. is confined spaces accreditation required to clean the device?);

- Alternatives to proposed cleaning method (i.e. device may be cleaned by lifting out baskets by crane or by vacuum truck);

- Any other information that is important to the routine maintenance of the device; and

- Monitoring, measurement, recording and reporting of system capture performance.

The maintenance/cleanout procedure to be adopted for the GPT device should utilise plant and equipment readily available or currently in use by the management body.

All maintenance activities should be developed to ensure they require no manual handling of collected pollutants because of safety concerns with hazardous material.

The minimum level of maintenance and cleanout required to ensure the GPT system operates at the design level of performance to maximise pollutant capture without causing adverse environmental or hydraulic impacts should be specified. The maintenance of GPT systems must be able to demonstrate that captured contaminants can be stored so as not to cause significant adverse environmental impact or nuisance (e.g. odours and putrefaction, or flooding).

The maintenance program should allow for the costs of collection, transport and delivery of captured gross pollutants to an appropriate waste disposal facility.

Where monitoring of the GPT cleanout is required, allowance should be provided in the maintenance program to undertake the necessary on-site or laboratory processing to separate the contaminants into the specified categories.

Until written approval is received from council indicating that the device has been taken over, the developer retains responsibility to ensure routine maintenance is performed.

Maintenance personnel and asset managers will use the maintenance plan to ensure the GPT continues to function as designed. An example operation and maintenance inspection form is included in the checking tools provided in **Appendix A**. These forms should be developed on a site-specific basis as the nature and configuration of GPTs varies significantly.

9.6   Approximate Costs and Manufacturer Information

Overview

The costs of GPTs vary significantly based on size and application (i.e. total area from which the GPT is receiving stormwater). Taylor (2004) reported the following costs, which are based predominantly on cost surveys completed in NSW:

■ Stream guard – catch basin insert: capital $290 and maintenance $200 per year;

■ Ecosol RSF100: capital $430 to $903 and maintenance $200 per year;

■ Ecosol RSF1000: capital $4,000 to $12,000 and maintenance $12 per hectare per month;

■ CSR Humes Humeceptor: capital $10,000-$50,000 and maintenance $20 per hectare per month (suction cleaning);

■ Rocla Downstream Defender: capital $12,000 to $36,000 and maintenance $20 per hectare per month (suction cleaning).

Life cycle costs are a combination of the installation and maintenance costs and provide an indication of the true long-term cost of the infrastructure. It is particularly important to consider life cycle costs for GPTs because maintenance costs can be significant compared with the capital cost of installation.

Version 3 of the MUSIC model provides a methodology that can be used to estimate life cycle costs for GPTs.

To determine life cycle costs, an estimated duration of the project needs to be assumed (e.g. 20 or 25 years) or if the trap is to control pollutants during the development phase only, it may be three to 10 years.

A checklist for determining the life cycle costs of GPTs is contained in **Appendix A**.

Factors which should be considered when determining installation, maintenance and disposal costs are discussed below.

Installation Costs

Installation costs include the cost of supply and installation of a GPT. Variables related to ground conditions (such as rock or groundwater conditions) or access issues may vary construction costs significantly.

To estimate the installation costs there are a number of local issues that will need to be considered. These include:

- Design flow rate;
- Size and configuration of the trap (with regard to site constraints);
- Hydraulic impedance and the requirements for operation; and
- Safety and other construction issues.

If any of the above factors cannot be adequately satisfied by a particular trap it should be deemed as potentially inappropriate for that location.

Maintenance Costs

Maintenance costs can be more difficult to estimate than the installation costs (but are sometimes the most critical variable). This is due to variances of the techniques used, the amount of material removed and the unknown nature of the pollutants exported from a catchment. In many cases maintenance costs are the most significant cost of a treatment measure. It is therefore imperative to carefully consider the maintenance requirements and estimated costs when selecting a GPT.

One important step is to check with previous installations by contacting current owners of GPTs and asking about their annual costs (vendors can usually supply contact information).

Disposal Costs

Disposal costs will vary depending on whether the collected material is retained in wet or dry conditions (i.e. either under water or left so it can drain). Handling of wet material is more expensive and will require sealed handling vehicles.

Addressing the following questions will assist in determining disposal costs:

- Is the material in a wet or dry condition and what cost implications are there?
- Are there particular hazardous materials that may be collected and will they require special disposal requirements (e.g. contaminated waste)? If so, what cost implications are there?
- What is the expected load of material and what are the likely disposal costs?

As discussed in **Section 9.5**, loads can be estimated using the decision support system developed by the CRCCH (see Allison et al (1998)) which requires rainfall and land use information. In the event that there is no other data, the values in **Table 9.2** could be adopted.

Product Information

A range of proprietary products are available. Product information is available at several websites that are intended as 'product registers' for GPTs and can be updated as new products emerge. A summary of a number of the products available is included in **Table 9.3**.

Table 9.3   Range of Proprietary Products Available

Supplier	Products	Websites
CSR Humes	Humegard (gross pollutant trap) Humes Humeceptor	www.humes.com.au
Rocla	CleansAll CDS Units X-Wave Screen Downstream Defender	www.rocla.com.au
Ecosol	Rapid Stormwater Filtration (RSF 100, 1000 and 4000) Net Tech	www.ecosol.com.au
Baramy	Deflector Trap Dual Vane Trap Vane Ttrap Basket Drop Side Drop Thru Saw Tooth	www.baramy.com.au
Diston	Little Miser Series	www.distonsewage.com.au

9.7 Case Study

Gross Pollutant Traps, City of Holdfast Bay

The City of Holdfast Bay has seven GPTs in place. These are located at the beach end of Edwards Street, Pier Street, Moseley Square, Wigley Reserve, Young Street, Augusta Street and Jetty Road, Brighton. All of these collect debris from residential, industrial, and/or commercial areas; many of which have very large catchment areas. Edwards Street for example has a catchment of 500 hectares of which two-thirds is collected from within the City of Marion boundary.

Figure 9.15   Augusta Street, Glenelg - GPT Installation

Source: Courtesy of City of Holdfast Bay

In addition to the GPTs, the former Patawalonga Catchment Water Management Board (now Adelaide and Mt Lofty Ranges Natural Resources Management Board) has also contributed to the installation of trash racks within the City of Holdfast Bay. An example of this can be seen at the top of the Patawalonga Lake and along the Sturt River.

Since the first GPT installation in 1997, the City of Holdfast Bay has worked collectively with the Adelaide and Mt Lofty Ranges Natural Resources Management Board towards implementing additional GPTs within Holdfast Bay. Site location, installation, and ongoing cleaning and maintenance costs can hinder the process.

The City of Holdfast Bay's GPTs are cleaned out by a contractor on a quarterly basis (more or less, largely dependent on the amount of rainfall received). A summary of the GPTs and the average amount of pollutants removed each year is contained in **Table 9.4**.

Figure 9.16   GPT Maintenance – Pier Street, Glenelg

Source: Courtesy of City of Holdfast Bay

As four of the City of Holdfast Bay's GPTs receive stormwater from the City of Marion, the former Patawalonga Catchment Water Management Board established a cost share agreement to assist with the cleaning and maintenance costs. For the 2007/08 financial year, $60,000 was budgeted.

Table 9.4   City of Holdfast Bay GPT Locations and Average Amount of Pollutants Removed Every Year

Location	Average Tonnes Removed per Year	Type	Dimensions	Cost	Construction Date
Augusta Street	40	Ecosol RSF 4900	Length 6.7m width 2.7 m depth 3.51m	$53,916 ($92,152.50)	Oct 2005
Edwards Street	220	CDS 4500	NA	$284,632	Jan 1997
Jetty Road, Brighton	8	Ecosol RSF 6000	NA	$36,946	Jan 2000
Young Street, Seacliff	40	Rocla – Cleansall 1350	NA	$201, 828	July 2001
Pier Street	24	CDS P2018L	NA	$159, 013	Dec 2000
Wigley Reserve	64	CDS 3000 – P3030	NA	$263, 242	Feb 1998
Moseley Square	32	CSR Humes - Humegard HG30A/L	width 3.4m length 2.5m capacity 11m³	$76,627 (Oct 2002)	October 2002
Average Total	**428**				

Source: City of Holdfast Bay

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9.8 Useful Resources and Further Information

Fact Sheets

www.epa.sa.gov.au/pdfs/water_general.pdf

Stormwater Pollution General Information fact sheet

www.yarracity.vic.gov.au/IgnitionSuite/uploads/docs/wsud-c-factsheets.pdf

Fact sheet 3 – Gross Pollutant Traps – Yarra City Council Victoria

www.melbourne.vic.gov.au/Environment/SavingWater/Documents/WSUD_part3.pdf

Fact sheet 3d – Gross Pollutant Traps – City of Melbourne Victoria

Legislation

www.legislation.sa.gov.au/LZ/C/POL/ENVIRONMENT%20PROTECTION%20(NOISE)%20POLICY%202007/CURRENT/2007.-.UN.PDF

Environment Protection (Industrial Noise) Policy 1994

www.epa.sa.gov.au/pdfs/info_construction.pdf

EPA information sheet on Construction Noise

www.epa.sa.gov.au/pdfs/info_noise.pdf

EPA information sheet on Environmental Noise

www.epa.sa.gov.au/pdfs/building_sites.pdf

EPA Handbook for Pollution Avoidance on Building Sites

www.epa.sa.gov.au/pdfs/bccop1.pdf

Stormwater Pollution Prevention Code of Practice for the Building and Construction Industry

General Information

www.stormwatervictoria.com.au/

Stormwater Industry Association – Victorian Chapter

www.epa.nsw.gov.au/stormwater/usp/

EPA (NSW)

www.stormwater.asn.au

Stormwater Industry Association

www.urbanwater.info/engineering/BuiltEnvironment/GrossPollutantTraps.cfm

Urban Water Info

www.bmpdatabase.org

International Stormwater Best Management Practice (BMP) Database

www.epa.gov/ost/stormwater

US EPA – Stormwater Best Management Practices Study

www.amlrnrm.sa.gov.au/ProjectsTaskforce/TrashRacks.aspx

Adelaide and Mt Lofty Ranges Natural Resources Management Board

www.holdfast.sa.gov.au/site/page.cfm?u=860

City of Holdfast Bay – Gross Pollutant Traps

(Websites current at August 2010)

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9.9 References

Allison, R., Chiew, F. H. S., McMahon, T. (1997). *Stormwater Gross Pollutants*. Cooperative Research Centre for Catchment Hydrology. December. **www.catchment.crc.org.au/pdfs/industry199711.pdf**.

Allison, R., Chiew, F. H. S., McMahon, T. (1998). *A Decision Support System for Determining Effective Trapping Efficiencies for Gross Pollutants.* Cooperative Centre for Catchment Hydrology. **www.catchment.crc.org.au/archive/pubs/1000089.html**.

Fletcher, T. D., Duncan, H., Lloyd, S., Poelsma, P. (2004). *Stormwater Flow and Quality and the Effectiveness of Non-proprietary Stormwater Treatment Measures*. Co-operative Research Centre for Catchment Hydrology. Melbourne, Victoria. **www.catchment.crc.org.au/pdfs/technical200408.pdf**.

Gold Coast City Council (2007). *Water Sensitive Urban Design Guidelines*. June. **www.goldcoast.qld.gov.au/gcplanningscheme_policies/policy_11.html#guidelines**.

IEAust (2006). *Australian Runoff Quality: A Guide to Water Sensitive Urban Design*. New South Wales.

Taylor, A. C., Fletcher, T. D. (2004). *Estimating Life Cycle Costs of Structural Measures that Improve Urban Stormwater Quality*. Cities as Catchments - International Conference on Water Sensitive Urban Design, Adelaide, South Australia **www.wsud.org/downloads/Info%20Exchange%20&%20Lit/WSUD_04_Conf_Papers/WS040007.PDF**.

Wong, T., Wootton, R. M., Argue, J. D., Pezzaniti, D. (1999). *Bringing Order to the Pollution Control Industry – Issues in Assessing the Performance of Gross Pollutant Traps.* Proceedings of the International Congress on Local Government Engineering and Public Works, Sydney, NSW.

(Websites current at August 2010)

Appendix A
Checklists

The *Site Inspection Checklist* was developed specifically for these guidelines. The remaining checklists have been modified for South Australian designs and conditions from checklists and forms provided in Upper Parramatta River Catchment Trust (2004), Melbourne Water (2005b), IEAust (2006), Gold Coast City Council (2007) and BMT WBM (2008).

All parts of all checklists should be completed. Even if design checks or field inspections were not performed, it is important to record the reasons for this in the relevant checklists.

Pervious Pavement

Site Inspection Checklist

Asset ID:		Date of Visit:	
Location:		Time of Visit:	
Description:			
Inspected by:			
Weather:			

Site Information:	Comments
1. Site dimensions (m)	
2. Area (m²)	
3. Current site use	
4. Existing structures: Age Condition Construction	
5. Sealed pavements (type and condition)	
6. Unsealed surface	
7. Drains: Presence Type Condition Outlet point	
8. Surface runoff	

Site Safety:	Comments
1. Potential contamination sources	
2. Identify any confined spaces (indicate if specific training required for access)	
3. Environmental hazards (snakes, sun exposure, etc)	
4. Other hazards	

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Photographs:	Comments
1. Number of photographs taken	
2. Location of stored photographs	
3. Any further information regarding photographs	
Local and Regional Information:	**Comments**
1. Topography	
2. Hydrology	

3. Adjacent sites (including current use, buildings, physical boundaries):
 	
        North
        East
        South
        West	

Fieldwork Logistics:	**Comments**
1. Access (include width, height, weight restrictions)	
2. Other restrictions	
Other Information:	**Comments**
Attachments:	**Comments**

Sketch of Site

(on this page please provide a rough sketch of the site plan)

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Gross Pollutant Trap

Design Calculation Checklist

Asset ID:		
GPT Location:		
Hydraulics:	Design operational flow (m³/s):	
	Above design flow (m³/s):	
Area:	Catchment area (ha):	

Treatment	Y/N
1. Treatment performance verified	
GPT Component	**Y/N**
2. Appropriate hydraulic calculations and IFD used	
3. GPT capacity sufficient for maintenance period	
4. Maintenance access provided	
5. Public access to system prevented	
6. Drainage facilities/dewatering provide for cleanout	
7. Overall flow conveyance sufficient for design flood event	
8. No headloss in drainage system	
9. No surcharge upstream	
10. Bypass sufficient for conveyance of design event	
11. Tidal influence assessment undertaken (if appropriate)	
Comments	

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Gross Pollutant Trap

Selecting a GPT Checklist

General	Y/N
12. Space available for the device (i.e. required footprint, access routes, services)	
13. Location suit the catchment treatment objectives (e.g. position in a treatment train)	
14. Holding chamber suitable (wet or dry retention)	
15. Sufficient safety precautions (i.e. preventing entry, access for cleaning)	
16. Visual impact (and odour potential) satisfactory	
17. Treatment flow sufficient to meet treatment objectives	
18. Flooding impact been satisfactorily addressed	
19. Sufficient consultation taken place with operational staff and the local community	
20. Expected pollutant removal rate sufficient to meet treatment objectives	
Installation	**Y/N**
21. Price include installation	
22. Sufficient contingencies for ground conditions (e.g. rock, shallow water table, soft soils etc)	
23. Relocation of services been included	
24. Sufficient access or traffic management systems proposed as part of construction?	
Maintenance	**Y/N**
25. Method of cleaning applicable to local conditions (e.g. OH&S issues, isolation of the unit from inflows etc)	
25. Maintenance (cleaning) techniques suitable for the responsible organisation (i.e. required equipment, space requirements, access, pollutant draining facilities etc)	
26. Size of the holding chamber sufficient (for a maximum of 12 cleans per year)	
27. Disposal costs been accounted for	

Gross Pollutant Trap

Construction Inspection Checklist (During Construction)

Asset ID:		Date of Visit:	
Contact During Site Visit:		Time of Visit:	
Location:			
Description:			
Inspected by:			
Constructed by:			
Weather Conditions:			

Items Inspected	Checked Y/N	Satisfactory Y/N
Preliminary works		
1. Erosion and sediment control plan adopted		
2. Temporary traffic/safety control measures		
3. Location same as plans		
4. Site protection from existing flows		
Earthworks		
5. Excavation as designed		
Pre-treatment		
6. Contributing catchment stabilised / not a sediment source		
Structural Components		
7. Location and levels of inlet and outlet and overflow points as designed		
8. Pipe joints and connections as designed		
9. Concrete and reinforcement as designed		
10. Inlets appropriately installed		

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Items Inspected	Checked Y/N	Satisfactory Y/N
Sediment and Erosion Control		
11. Stabilisation immediately following earthworks		
12. Silt fences and traffic control in place		
13. Temporary protection in place (if appropriate)		
Operation Establishment		
14. Temporary protection removed		
15. GPT diversion removed		
Comments on Inspection		
Actions Required		
1.		
2.		
3.		
4.		
5.		
Inspection Office Signature:		

Gross Pollutant Trap

Construction Inspection Checklist (After Construction)

Asset ID:		**Date of Visit:**	
Contact During Site Visit:		**Time of Visit:**	
Location:			
Description:			
Inspected by:			
Constructed by:			
Weather:			

Items Inspected	Checked Y/N	Satisfactory Y/N
1. Confirm levels of inlets and outlets		
2. Traffic control in place		
3. Confirm structural element sizes		
4. Maintenance access provided		
5. Construction generated sediment and debris removed		
Comments on Inspection		
Actions Required		
1.		
2.		
3.		
Inspection Officer Signature:		

Gross Pollutant Trap

Maintenance Inspection Checklist

Asset ID:		Date of Visit:	
Location:			
Description:			
Site Visit by:			
Purpose of Site Visit:	Routine Inspection:		
	Routine Clean Out of Trash Rack and Baskets:		
	Annual Inspection:		

Inspection	
1. Percentage of GPT covered by debris (%)	
2. GPT clean out required if above >50% (Y/N)	
3. Any visible damage to GPT (if yes, complete section on condition) (Y/N)	
Cleanout of GPT	
4. Volume of debris removed (m³)	
5. Visible damage to GPT (if yes, complete section on condition) (Y/N)	

Component Condition	Checked? Y/N	Condition	Remarks
6. Concrete walls			
7. Trash rack			
8. Baskets			
9. Access ladders			
10. GPT inlet			
11. GPT outlet			
12. Lids			

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Comments on Inspection:	

Actions Required:	
1.	
2.	
3.	
4.	
5.	

Gross Pollutant Trap

Lifecycle Costs Checklist

Installation	Y/N
1. Does the trap satisfy:	
(i) the design flow rate	
(ii) the available space constraints	
(iii) hydraulic and flooding issues	
(iv) other concerns (e.g. safety and aesthetics)	
If no to any of the above, then go no further	
2. Trap cost	
3. Installation cost	
4. Other costs (rock excavation, lid loading, access road for maintenance etc.)	
Maintenance	
5. Annual maintenance costs	
6. Cost of any special maintenance equipment	
7. Expected costs of disposal	
Life Cycle Cost	
8. Estimated project duration (in years)	
9. Life cycle costs = $\dfrac{\text{Installation costs} + (n \times \text{maintenance costs})}{n}$ *where n = project duration (years)*	

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