Report to

Environment Protection Authority

South Australia

Investigation of potential market based instruments to minimise the effect of stormwater on Adelaide's coastal water quality

Final Report

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Acknowledgements

The South Australian Environment Protection Authority engaged BDA Group, in collaboration with EconSearch and Ms Megan Dyson, to advise on potential market based instruments to minimise the effect of stormwater on Adelaide's coastal water quality.

This report documents our scoping of the environmental impacts of stormwater, opportunities and costs to manage stormwater, the legislative context for stormwater management, the range of available market based instruments that could be used, and their broad design, effectiveness and attractiveness in the Adelaide context. The report draws on catchment modelling being undertaken by WBM as part of the development of the Adelaide Coastal Water Quality Improvement Plan.

Despite every effort to verify data and clarify issues raised, any remaining errors or omissions are the responsibility of the authors. Accordingly this report does not necessarily reflect the views of the South Australian Environment Protection Authority.

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1 INTRODUCTION

Adelaide's coastal environment has been significantly degraded over the last 60-70 years. Growing concern about the effects of coastal and catchment development on the marine environment near Adelaide prompted the South Australian government to initiate the Adelaide Coastal Waters Study in 2001. The study focused on water quality degradation, seabed instability and seagrass loss.

The Adelaide Coastal Waters Study analysis suggests that a reduction of around 75% in nitrogen loads to coastal waters (from 2003 levels) is required in order to encourage seagrass re-growth and re-colonisation. The report also recommends that, commensurate with efforts to reduce the nitrogen load, a targeted reduction of total suspended sediment load is required with an aspirational target of a 50% reduction from the current load. This recommendation was made because the combined effect of high nutrient levels and increased turbidity may result in worse environmental outcomes than from either effect alone.

The Adelaide Coastal Water Quality Improvement Plan (ACWQIP) is being developed in 2008 under the Australian Government's Coastal Catchment Initiative. The aim of the ACWQIP is to achieve improved water quality along Adelaide's coast. The ACWQIP will assess the discharges from the full range of land-based sources and compare this to the capacity of the adjacent coastal waters. Where the current discharge load of pollutants exceeds capacity, strategies for reduction will be developed. The ACWQIP will enhance water quality planning and management processes for Adelaide's coastal waters, which extend from Port Gawler in the north to Sellicks Beach in the south.

The Environment Protection Authority engaged BDA Group and EconSearch to investigate potential market based instruments to minimise the effect of stormwater on Adelaide's coastal water quality. The key pollutants important to managing the impact of stormwater on coastal waters are suspended solids and coloured dissolved organic matter (CDOM). While the primary purpose of the market based instruments (MBIs) is to improve water quality, the interactions between water quality and quantity have also been considered.

2 IMPACTS OF STORMWATER ON ADELAIDE'S COASTAL WATERS

This section summarises available information on the environmental impacts of stormwater, current and likely future stormwater volumes and pollutant loads and the relative impact of different stormwater discharges. It also briefly discusses the impacts of new development and climate change on future loads and the future management of stormwater in Adelaide.

2.1 Environmental impacts of stormwater

Seagrass provides a key habitat for many species in Adelaide's coastal waters. Adelaide's urban pollution has caused large scale seagrass loss with approximately 5,000 hectares lost between Sellicks Beach and Port Gawler since the 1930's. Seagrass loss reduces biodiversity, increases sand drift and allows foreign species to take hold[1].

The main cause of seagrass loss has been nutrients entering coastal waters from Wastewater Treatment Plants (WWTPs) and stormwater via drains and watercourses. A significant reduction in current nitrogen levels (around 75%) is thought to be required to enable seagrass levels to stabilise with a possibility of regrowth. A secondary (relatively misunderstood) problem is the interaction of turbid sediment/suspended solid filled water with the nutrients and its effects on seagrass.

A complex interaction between nutrients, light, turbidity, and colour is thought to be involved in seagrass loss suggesting a need to reduce sediments levels in stormwater. Ideal optical properties of the water are necessary for seagrasses and these can be highly affected by storm events. Reducing or retarding peak flows into rivers and streams can help to stem the loss of seagrass. Outflows from the Barcoo Outlet and the River Torrens play a significant role during these periods.

Seagrass loss has been most pronounced in the northern part of Adelaide's coastal waters due to several factors. Tidal flows tend to be stronger in the south and flow northward, bringing pollutants north. Stormwater drains, sludge outfalls, wastewater discharges, coastal development and the diversion of the River Torrens have all contributed to increased pollutants entering coastal waters and impacting more heavily in the north. There have been significant losses in the north around Bolivar WWTP and Barker Inlet and fragmentation of seagrass meadows in central and southern Holdfast Bay. There is no colonisation within the 'Blue Line[2]', historically 200 metres from the coast, but now about 1 kilometre offshore. There is little evidence of loss in the south, possibly due to nutrients flowing from south to north[3].

Table 2.1 outlines the range of stressors or threats to Adelaide's coastal waters. While stormwater has a significant impact on water quality, it is only one of several sources contributing to coastal pollution.

1 CSIRO 2007

2 The 'blue line' is the edge of the seagrass meadow.

3 CSIRO 2007

Table 2.1: Summary of Problems Affecting Water Quality in Adelaide's Coastal Waters

Stressor or threat	Summary
Stormwater	Around 30% of volume discharged into coastal waters contains high levels of suspended sediments, dissolved organic materials and nutrients. Engineering works and urban development responsible for dramatic increase in pollutant loads.
Wastewater Treatment Plants	Approximately 43% of water discharged into coastal waters contains high levels of nitrogen, particulates, phosphorous, copper and lead.
Dissolved organic matter	Due to decomposition of seaweed and other plant material.
Suspended sediments	Highly turbid near shore waters after significant rainfall events. Three times higher in the north than south, particularly around Barker Inlet.
Reduced salinity	Increased fresh water into a naturally 'hyper saline' Gulf St Vincent.
Biological activity	Increased nutrient load increases risk of algal blooms in near shore waters. Risk increased in certain natural conditions.
Toxicants	High levels considered a threat to ecosystem. High nickel concentrations at Glenelg, Brighton and Port Noarlunga. High zinc levels along coastline.
Non land based pollutants	20% of particulate matter is delivered to coastal water from atmosphere. Rainfall contributes 33t/y of nitrogen and 5t/y of phosphorus.
Pollutants from industry	A range of organic contaminants found sporadically in low levels, not thought to have adverse affect on seagrass.

Source: CSIRO 2007

Stormwater-derived sediments are largely responsible for turbidity in the coastal zone (peaking between August to November). Removal of suspended solids will increase the aesthetic value of the streams and creeks. Large discharges due to storms will also have less impact on aesthetics. Problems regarding stormwater are prevalent all along the coast due to drain outlets but are magnified around these rivers outlets.

Growing concern about the effects of coastal and catchment development on the marine environment near Adelaide prompted the South Australian government to initiate the Adelaide Coastal Waters Study in 2001. The study was recently finalised recommending the following priority pollutants for reduction:

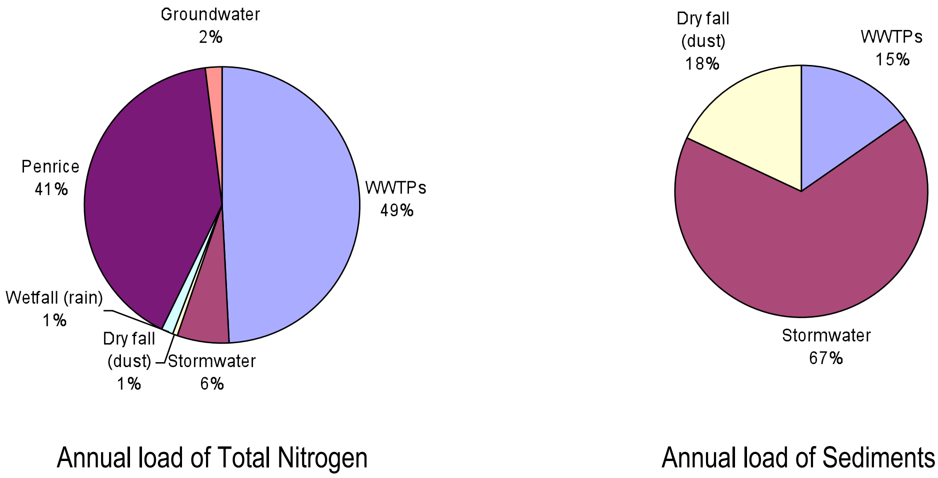
- Nitrogen - to encourage seagrass re-growth and re-colonisation;
- Suspended sediment - to encourage seagrass re-growth and re-colonisation;
- Coloured dissolved organic matter (CDOM) - to assist in the improvement of the optical qualities of Adelaide's coastal waters.

2.2 Stormwater loads and volumes

Stormwater volumes historically made a very small contribution to total discharges but now contribute around 30% of total discharge volumes in Adelaide's coastal waters[4]. The contribution from the River Torrens is around 20GL/yr, with around 15GL/yr for each of the Onkaparinga, Patawalonga and Gawler Rivers, and around 30 GL/yr from Barker Inlet.

Nutrients and other pollutants are introduced to near-shore waters from urban and rural runoff (particularly in the southern streams), wastewater treatment plants, and some industrial sources. Figure 2.1 shows the approximate contributions of different sources to total nitrogen and sediment loads.

Figure 2.1: Contribution of sources to key pollutant loads in Adelaide coastal waters



Source: CSIRO 2007

Sediments attributable to stormwater make up 67% of the total delivered into coastal waters. By contrast, nitrogen delivered via stormwater only contributes 6% of the total load. The load data confirms that stormwater is the key contributor for loads of suspended solids and this should therefore be a key focus of any MBI aimed at stormwater sources.

Diversion of the River Torrens, drains, dune modification and urban development have all contributed to the dramatic increases in stormwater loads. Urban areas create more runoff than vegetated land with differing pollutants. Table 2.2 shows indicative stormwater concentrations of the two priority pollutants identified for stormwater sources in the Adelaide Coastal Waters Study: suspended solids and total organic carbon (as a proxy for CDOM). Table 2.3 provides estimates of total pollutant loads from stormwater being emitted into Adelaide's coastal waters.

4 CSIRO 2007

Table 2.2: Indicative concentrations of priority pollutants in stormwater (mg/L)

Pollutant	Lower	Typical	Upper
Suspended solids	40	140	500
Total organic carbon	13	24	40

Sources: SS from Fletcher et al 2004, TOC from Engineers Australia 2005 and Duncan 1999

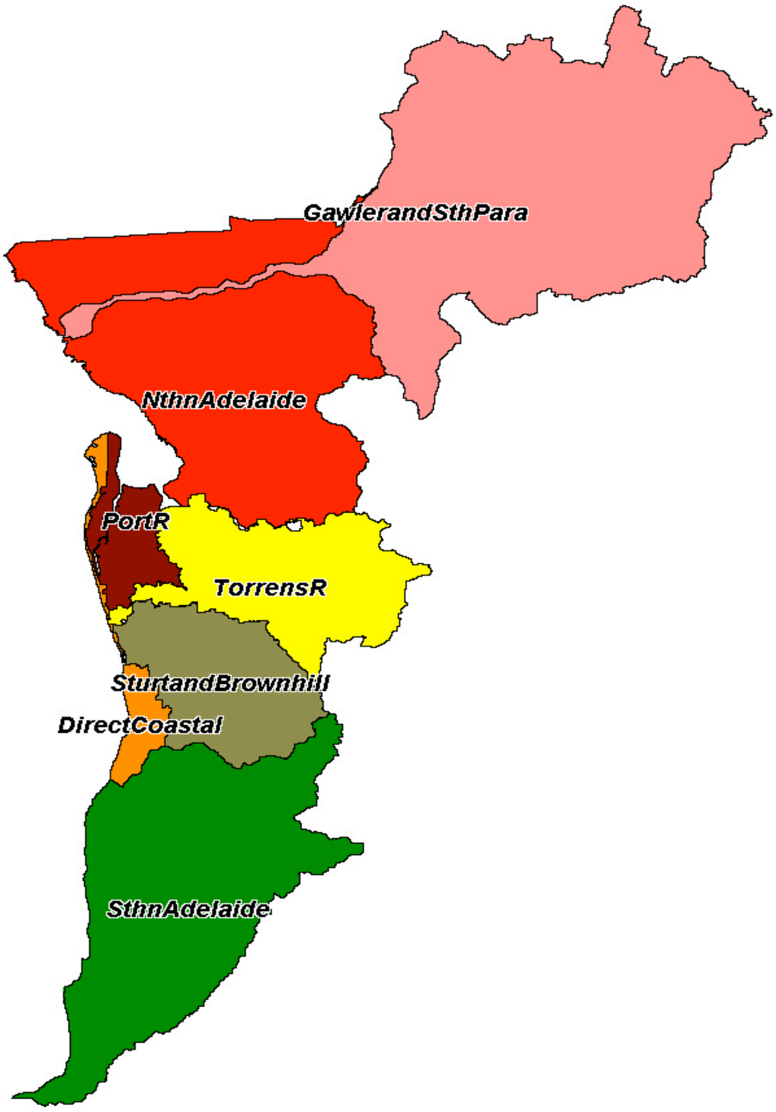
Table 2.3: Annual pollutant loads of stormwater to Adelaide coastal waters

Pollutant	Tonnes
Nitrogen	153
Phosphorous	20
Copper	1.3
Lead	1.5
Sediment	7,000

Source: CSIRO 2007

The seven catchments contributing stormwater pollution loads into Adelaide's coastal waters are shown in Figure 2.2 and are the areas reported in Figures 2.3 to 2.7.

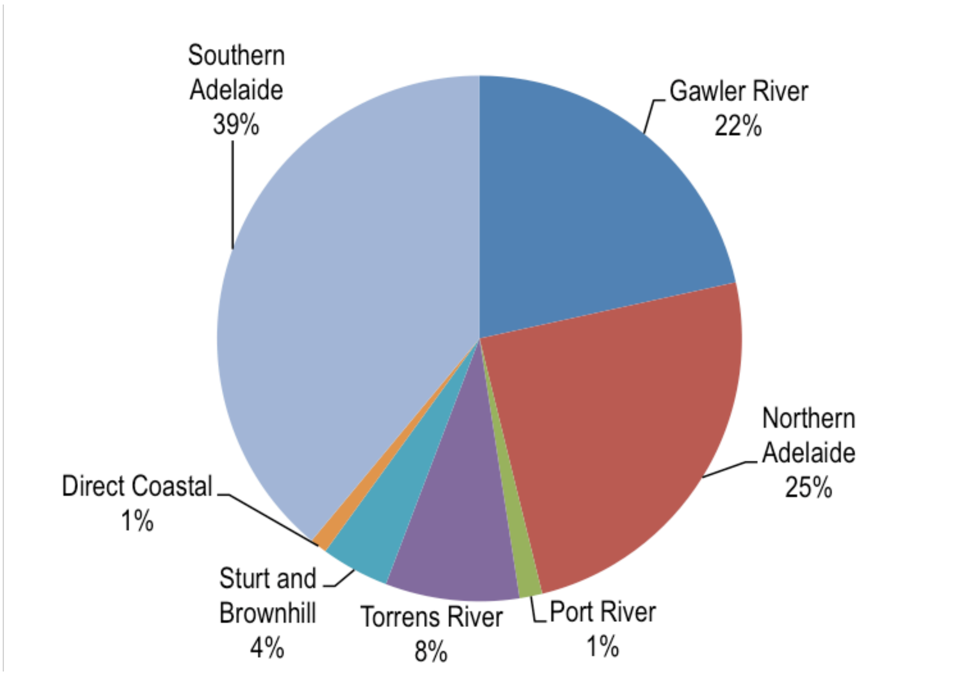
Figure 2.2: Catchments contributing stormwater loads to Adelaide coastal waters



The catchments with the largest area contribute the greatest loads of suspended solids as shown in Figure 2.3.

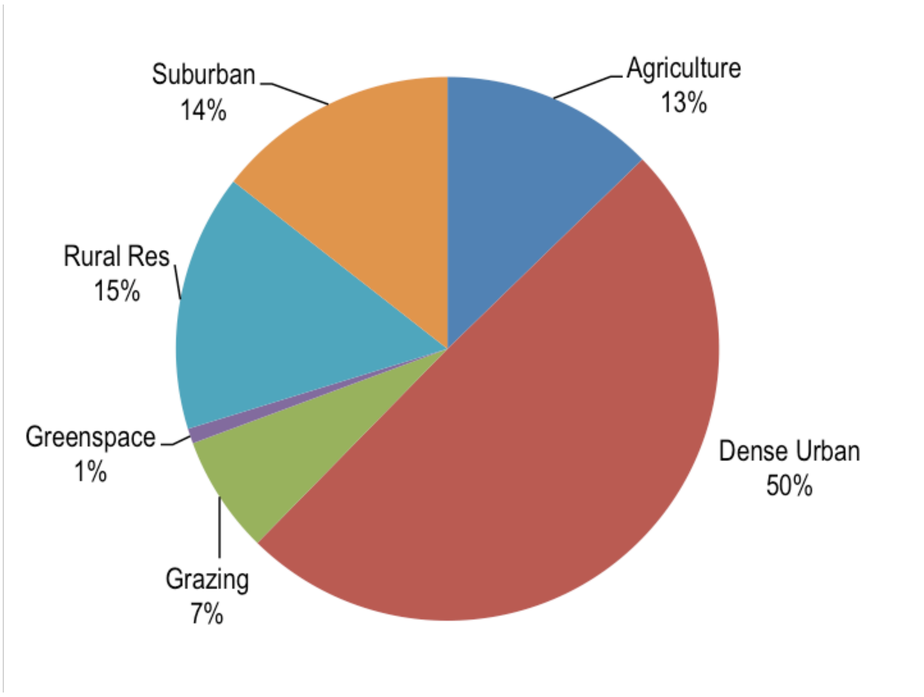
Figure 2.4 shows a breakdown of the total loads of suspended solids from stormwater by land use with urban areas dominating the overall loads.

Figure 2.3 Breakdown of loads of suspended solids from stormwater by catchment



Source: WBM catchment modelling for WQIP 2008

Figure 2.4 Breakdown of loads of suspended solids from stormwater by land use



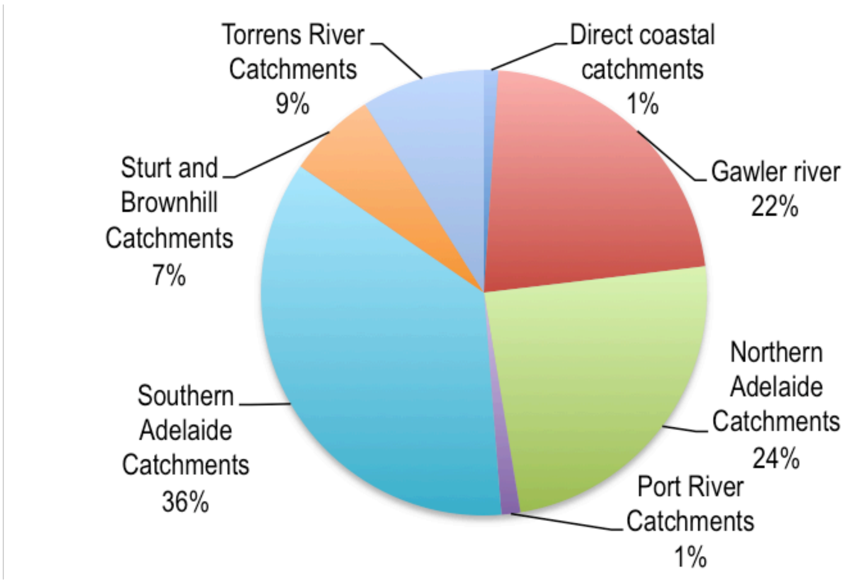
Source: WBM catchment modelling for WQIP

Around 50% of the total loads of suspended solids are from dense urban areas with another 14% from suburban areas and 15% from rural residential properties. The overall contribution from agriculture is around 20% (including grazing).

The contributions of suspended solids from different sources within catchments differ. For example, the contribution from agriculture is higher in the Gawler River and Southern catchments (at around 34% and 28% respectively), compared with the Northern Adelaide catchment (around 6%) reflecting the varying land uses. The load data by land use suggest that urban and rural residential areas dominate the loads of suspended solids overall. However, agriculture does make a significant contribution (particularly in the outer catchments) and the role of agriculture should be considered for any MBI addressing stormwater.

Figures 2.5 and 2.6 show similar breakdowns by catchment and land use for the other key pollutant identified as important to managing the impact of stormwater: coloured dissolved organic matter.

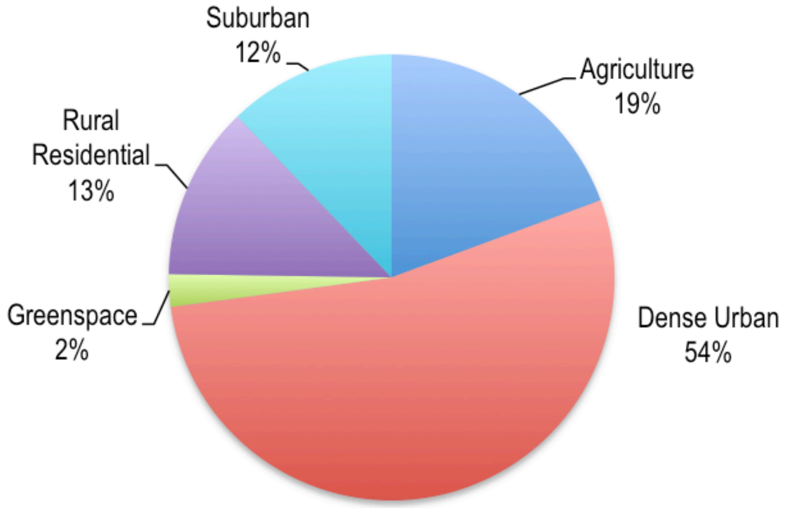
Figure 2.5: Breakdown of loads of CDOM from stormwater by catchment



Source: WBM catchment modelling for WQIP 2008

The contribution of different catchment to CDOM loads is similar to that for suspended solids – with slightly higher contributions from the Sturt and Brownhill catchments and Torrens River catchment and slightly lower contributions from the Southern Adelaide catchments.

Figure 2.6: Breakdown of loads of CDOM from stormwater by land use



Source: WBM catchment modelling for WQIP 2008

The contribution of different land uses to CDOM is also similar to that for suspended solids – with around 20% from agriculture and the remainder from urban sources.

2.3 Environmental equivalence

In the preceding discussion, no distinction was made between pollution loads from different sources in terms of how they may ultimately impact on environmental issues and water quality goals. To the extent that differences exist, they must be accounted for in policy design as offset trading requires a metric that defines the good being traded.

The term environmental equivalence refers to the difference between the impacts of pollution from different sources on an environment issue. The environmental equivalence is often stated as a ratio – for example an environmental equivalence ratio of 1:3 for two sources means that 1 tonne of pollutant from the first source is expected to have a similar impact on environmental amenities to 3 tonnes from the second source.

The reason for the difference in impacts between two sources may be due to:

- Location
- Types of discharges
- Timing of the discharges

For example addressing suspended solids and CDOM lower in the catchment (closer to the seagrasses) may have a greater environmental benefit. However, abatement measures upstream may have higher value because of the aesthetic value of clear water.

2.4 Future stormwater loads

There are two key pressures likely to impact on future stormwater loads - new development and climate change.

Adelaide's population is forecast to grow by around 100,000 people between 2006 and 2021[5]. Experience has shown that increased development leads to more water entering streams. Seagrass growth was damaged at its highest rate after Adelaide experienced its highest population growth[6].

Urban run-off is faster than runoff from vegetated catchments running off quickly carrying nutrients and suspended solids from roofs, roads and gardens. Strong summer flows have increased more rapidly as a result of population growth. Summer flows were once almost zero but now account for 5-8 GL/y and are characterised by highly coloured water.

A developing catchment can be expected to discharge between 50 m^3/ha and 200 m^3/ha of sediment each year. In a developed catchment, the annual sediment export is generally one or two orders of magnitude lower with an expected mean annual rate of 1.6m^3/ha [7].

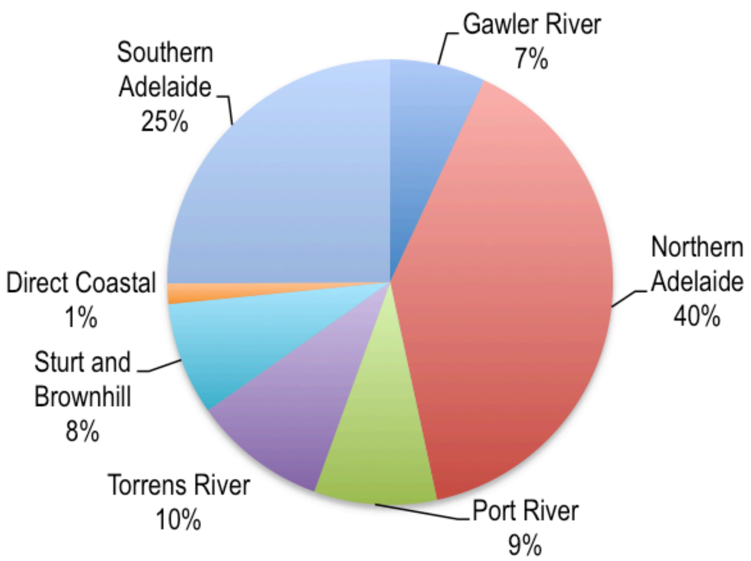
As part of the catchment modelling for the development of the WQIP, WBM have estimated pollutant loads expected with new development by 2014 under different on-site management scenarios. The new development represents an increase of around 4,000 hectares of urban areas across the coastal catchments – with around 95% of this expected to be suburban development and 5% dense urban development. This includes a mix of greenfield and brownfield (infill/redevelopment) sites. Figure 2.7 shows the expected location of new development across the catchments.

5 Population projections for South Australia, Planning SA, June 2007

6 CSIRO 2007

7 Melbourne Water 2005, AWE 2008b

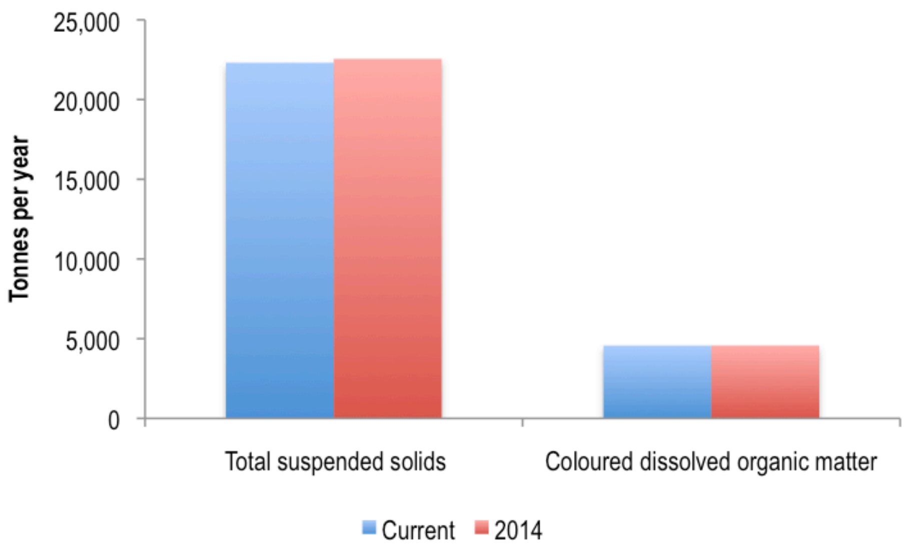
Figure 2.7: New development by catchment (share of total hectares)



Source: WBM catchment modelling for WQIP 2008

Around 40% of the new development (by land area) is expected in the Northern Adelaide catchment and around 25% in the Southern Adelaide catchment. Figure 2.8 shows the expected increase in key pollutant loads from this new development without any on-site management.

Figure 2.8: Key pollutant loads from stormwater by 2014 without management



Source: WBM catchment modelling for WQIP 2008

Figure 2.8 shows that the expected increase in key pollutant loads from new development is very small (around 1% for suspended solids and <1% for CDOM). WBM also modelled the likely impact of new development on key pollutant loads under two scenarios for on-site management. The first is installation of individual rainwater tanks on each new lot and the second is implementation of full water sensitive urban design (WSUD) for each lot (including rainwater harvesting as well as lot scale rain gardens and streetscape infiltration/bioretention). These on-site management measures reduce the expected increase in loads of suspended solids even further, with full WSUD reducing the expected increase from 1% down to 0.25%. The WSUD measures were also estimated to reduce flows from these new urban areas by around 30%.

The figures suggest that efforts to reduce the priority stormwater pollutants (suspended solids and CDOM) will need to focus on existing land uses. While it will be important to minimise the impact of new development by continuing current development approval processes requiring minimisation of pollutant loads, significant reductions will only be possible by addressing stormwater pollution from existing land uses.

The impact of climate and population change on water quality in Adelaide's coastal waters is currently being investigated by Balance Carbon as part of the development of the Adelaide Coastal Water Quality Improvement Plan.

2.5 Future management of stormwater

The Adelaide Coastal Water Quality Improvement Plan (ACWQIP), being developed under the Australian Government's Coastal Catchment Initiative, aims to achieve improved water quality along Adelaide's coast. The ACWQIP will assess the discharges from the full range of land-based sources and compare this to the capacity of the adjacent coastal waters. Where the current discharge load of pollutants exceeds capacity, strategies for reduction will be developed.

There were 14 recommendations made as part of the Adelaide Coastal Waters Study in 2007, and five of these are of direct relevance to the management of stormwater. These are:

> ***Recommendation #1***
>
> *As a matter of priority, steps must be taken to reduce the volumes of wastewater, stormwater, and industrial inputs into Adelaide's coastal environment.*
>
> ***Recommendation #2***
>
> *The total load of nitrogen discharged to the marine environment should be reduced to around 600 tonnes (representing a 75% reduction from the 2003 value of 2,400 tonnes).*
>
> ***Recommendation #3***
>
> *Commensurate with efforts to reduce the nitrogen load, steps should be taken to progressively reduce the load of particulate matter discharged to the marine environment. A 50% load reduction (from 2003 levels) would be sufficient to maintain adequate light levels above seagrass beds for most of the time. The reduced sediment load will also contribute to improved water quality and aesthetics.*

Recommendation #4

To assist in the improvement of the optical qualities of Adelaide's coastal waters, steps should be taken to reduce the amount of coloured dissolved organic matter (CDOM) in water discharged by rivers, creeks, and stormwater drains.

Recommendation #5

While the available data suggests that toxicant levels in Adelaide's coastal waters pose no significant environmental risk, loads from point sources such as the Port River, WWTPs, and drains should continue to be reduced[8]*.*

8 CSIRO 2007

3 STORMWATER POLLUTION ABATEMENT OPPORTUNITIES AND COSTS

This section briefly summarises methods for improving the quality or reducing volumes of stormwater discharged, and available information on the costs and effectiveness of those measures. It covers common structural controls such as stormwater retention & use, infiltration systems, conveyance systems, detention and pollution control. It also briefly discusses key issues relevant to retrofitting existing urban areas.

All estimates of cost-effectiveness ($ per kilogram pollutant removal) in this section are calculated by dividing the net present value of capital, operating and maintenance costs over a 20 year period at a 7% discount rate by the total kilograms of the pollutant removed per year.

The estimates of costs and effectiveness are indicative only as the schemes for which data is available are not necessarily representative of the broader categories of pollution control measures. However, we believe they provide an adequate comparison to comment on whether there is a diverse set of abatement actions and enough differences in costs to pursue a market based instrument.

3.1 Structural controls

3.1.1 Stormwater retention and reuse

Rainwater tanks are designed to capture and store runoff from buildings and can reduce downstream stormwater flows and demand for mains water. Generally applied at lot level, they can contribute to control of stormwater pollution. Reduction in overflows to streets has been measured at around 70%[9]. However, they do not result in an equivalent reduction in pollution loads, as the run-off retained from roofs is relatively clean. Rainwater tanks help to mitigate flood peaks for some (more frequent) storm events, particularly local flash floods, by reducing the volume of nuisance urban stormwater runoff.

While rainwater tanks are often used for water harvesting, this section provides an assessment of indicative costs and effectiveness if they are used as a pollution control measure (to enable a comparison with other potential stormwater pollution control measures). WBM has estimated the capital cost of rainwater harvesting through rainwater tanks on individual lots in association with the modelling of loads from future development. The capital cost of tanks is estimated at $41,000 per hectare10. Under the scenarios for future developments if rainwater harvesting was applied to the 4,000 hectares of new development, this is expected to reduce suspended solids by around 9,000 kilograms per year in total across the catchment. The cost is therefore estimated at around $18,000 per kilogram per year. The capital cost per hectare is expected to be similar for both new development and retrofitting tanks in existing urban areas.

9 Marsden Jacob Associates 2007

10 Personal communication Tony Weber WBM 2008

Stormwater harvesting schemes can also reduce stormwater flows and pollution. They are generally more centralised systems and can reduce stormwater flows from a catchment collecting pollutant loads in runoff from roads and other paved areas (rather than just relatively clean roof runoff). Data on costs and effectiveness is available for a number of stormwater harvesting and reuse projects operating in NSW funded, or partly funded, by the NSW Government between 1998 and 2003. The costs range from $10 per kg per year of suspended solids removed to around $2,000 per kg per year[11].

3.1.2 Infiltration Systems

There are four basic types of infiltration systems: soakaways, infiltration trenches, infiltration basin and leaky walls. They are usually made up of a storage consisting of void spaces in media such as single sized gravel. The storage is wrapped in geotextile type fabric and clean water is allowed to filtrate through. They are similar to basins however they store runoff water below ground to infiltrate surrounding subsoil[12].

The primary purpose is to capture and retain water. Infiltration systems reduce pollution into urban waterways in two ways. Firstly, by minimising the conveyance of stormwater from urban surfaces, they prevent the accompanying pollutants from entering the urban drainage system. Secondly, they have a primary filtration function.

Infiltration trenches are best suited to catchments under 2 hectares. They can be used with any type of land use however a high percentage of impervious area is desirable[13]. Used with overlying pervious pavements they can be an effective water treatment chain. Infiltration basins are best suited to medium to large catchments (5 to 50 ha) of any land use with a high percentage of impervious areas. Infiltration systems are only useful for certain soils types and the land must meet other requirements relating to slope and depth of rock and groundwater.

The costs of building an infiltration trench are highly dependent on the surface area, width and depth and the volume of excavation required. The costs are estimated at around $138 per metre[14]. Maintenance costs vary depending on the amount of sediment being discharged into the trench and the size of the trench.

Another type of infiltration is pervious pavement - load bearing pavement that is permeable to water. Although pavement types differ, they have common features including a permeable surface layer overlying an underlying storage layer. The reservoir storage layer consists of crushed stone or gravel which will hold the water until discharged to subsoil or to an existing drainage system[15].

The benefits of pervious pavers include:

- Reduce area dedicated solely to stormwater management

11 NSW Department of Environment and Conservation 2006
12 AWE 2008b.
13 Upper Parramatta River Catchment Trust 2004
14 Ibid
15 AWE 2008b

- Potential to harvest runoff for reuse
- Reduced stormwater discharges
- Delaying runoff peaks

Pervious pavement can be effective in areas with light traffic loads such as car parks. They have been found to be most effective when serving areas between 0.1 and 0.4 hectares[16]. As a guide the catchment area to pervious area should not exceed 4 to 1. Where sediment and organic loads are high the ratio should be reduced to 2 to 1[17]. Table 3.1 below shows estimates of the efficiency of pervious pavements in removing a range of pollutants.

Table 3.1: Estimated removal efficiency for pervious pavements

Pollutant	% removal
Coarse sediment	50 - 80
Medium/fine sediment	30 - 50
Total nitrogen	40 - 80
Total phosphorus	50 - 80
Metals	10 - 50
Free oil and grease	10 - 50

Sources: Upper Parramatta River Catchment Trust 2004; Melbourne Water 2005

The costs of pervious pavers in one small scale development with paving on driveways and courtyards were estimated at around $58,000 compared with $38,000 for regular pavement under the conventional approach[18]. A US study estimated the cost-effectiveness of porous pavement to be around AUS$180 per kilogram of suspended solids removed per year[19].

3.1.3 Conveyance

Bioretention systems are a measure in which stormwater is treated by vegetation prior to filtration of stormwater through prescribed media. The stormwater is then filtered into subsoil or then collected in sub soil pipes for further retention, treatment or disposal. Bioretention systems can come in the form of either swales or basins. Bioretention basins provide flow control and water quality treatment functions. They are characterised by the ability to detain stormwater in a depression storage above a bioretention system. Table 3.2 shows the expected effectiveness of bioretention systems in terms of pollutant removal.

16 Upper Parramatta River Catchment Trust 2004
17 AWE 2008b
18 Boubli and Kassim (2003)
19 Lamdphair et al 2000

Table 3.2: Estimated removal efficiency for bioretention system

Pollutant	% removal
Coarse sediment	80 - 100
Medium sediment	50 - 80
Fine sediment	30 - 50
Nutrients	30 – 50
Metals	30 – 50
Free oil and grease	30 - 50

Sources: Upper Parramatta River Catchment Trust 2004

The cost of a bioretention system is estimated at around $410 per metre with maintenance costs of around $1.5 to $2.5/m^2. Bioretention systems are best suited to catchments less than 5 hectares in residential, commercial or industrial developments with high percentages of impervious areas[20].

One example of a bioretention system had a capital cost of around $25,000, annual maintenance costs of around $600 and sediment removal of around 200 kilograms per year[21]. The resulting cost-effectiveness is around $150 per kilogram of sediment per year.

Swales, a type of bioretention, are used to convey stormwater in lieu of, or with, underground pipe drainage systems. With the help of natural vegetation they filter out coarse to medium sized sediments whilst delaying run-off peaks through slowing flow velocity. They also promote infiltration of stormwater into sub-soils and hence reduce run-off volumes. Generally they are used in lower density areas. In catchments greater than 4 hectares swales should not be used as their long term function will be compromised as flow depths and velocities increase[22].

Construction cost for swales depend on surface area / width, type of vegetation and steepness of the area. The efficiency of swales for the removal of various pollutants is summarised in Table 3.3 below. An indicative estimate of construction costs for a nominal 3 metre wide swale is estimated at $30 per metre. Indicative maintenance costs are around $3.13 per m^2 [23].

20 AWE 2008b

21 Provided by City of Mitcham 2008

22 AWE 2008b

23 Ibid

Table 3.3 Estimated removal efficiency for swales

Pollutant	% removal
Coarse sediment	50 - 80
Medium sediment	30 - 50
Fine sediment	10 - 50
Nutrients	10 – 50
Metals	10 – 50
Free oil and grease	10 - 50

Sources: Upper Parramatta River Catchment Trust 2004

Another conveyance measure is buffer strips. These are predominately intended to remove sediments as well as some nutrients and hydrocarbons. They can be used as edges to swales, particularly where flows are distributed along the banks of the swale. They reduce run-off volumes and attenuate storm flows through promotion of infiltration into sub-soils. Buffer strips are most applicable at subdivision scale with catchment areas under 2 hectares. Often used at allotment level, buffering from run-off from driveways and overflows from rainwater tanks[24]. Expected removal efficiencies are similar to swales.

The cost of construction of buffer strips depends on the surface area and type of vegetation used but is generally between \$10 to \$15 / m^2. The cost would extend to around \$20 to 50 m^2 if the area was established with native grasses. Ongoing maintenance costs would be around \$2.5/m^2 [25].

Rain gardens are a shallow planted depression designed to take excess rainwater runoff from building roofs. They are designed for water to soak into the subsoil and recharge groundwater supplies. These can be a very effective small scale, point source measure which can have a large effect on stormwater management[26].

Rain gardens can be applied on any scale from domestic through to commercial and industrial sites. Soils such as clay may result in building damage due to wetting and drying cycles causing expansion and contraction.

Green roofs consist of a series of layers including a vegetated strip and a drainage layer. Benefits include stormwater management, water quality and reduced impervious surface. A series of other benefits to private households can be generated through heating costs and additional living space[27].

24 Ibid

25 Upper Parramatta River Catchment Trust 2004

26 AWE 2008b

27 AWE 2008b

Rooftop areas can range between 30 to 35% in urban areas and increase to 70 to 75% in business districts. This can increase to as high as 80% in some warehouse districts. Benefits come in the form of natural processes such as water being evaporated or stored by plants. Rainwater can also be stored within the roof's drainage system. Overseas studies suggest retention rates can be as high as between 70 and 100% in summer and between 40-50% in winter (Peck et al. 1999). Developments in retention technology have shown a summer retention rate of 100% and near that the rest of the year. Green roofs can be installed on slopes up to 30 degrees.

3.1.4 Detention

Constructed wetlands are complex, natural, shallow water environments that are dominated by water loving vegetation. They are designed to take advantage of natural wetland functions including enhanced sedimentation, fine filtration and biological uptake processes to remove pollutants from stormwater. They are most efficient when the catchment area is greater than 1 hectare and when there are no steep slopes or slope stability issues. The likely efficiency of constructed wetlands in removing a range of pollutants is shown in Table 3.4 below.

Table 3.4 Estimated removal efficiency for constructed wetlands

Pollutant	% removal
Litter	> 95
Suspended solids	65 - 95
Nitrogen	40 - 80
Phosphorus	60 - 85
Coarse sediment	> 95
Heavy metals	55 - 95

Sources: Department of Environment WA 2004

As an example of the indicative cost-effectiveness of wetlands, a case study of a wetland in Adelaide is used. The wetlands had a capital cost of around $2-3 million and the amount of sediment removed since construction is estimated at around 692,000 kg per year[28]. Annual maintenance costs are assumed to be around 2%[29]. The resulting cost-effectiveness is estimated at $4-5 per kilogram per year.

Another form of detention is sediment basins. These promote the settling of sediments through reduction of flow velocity and temporary water detention. They target coarse to medium sized sedimentary units to improve water quality before downstream treatment. This allows for downstream water treatments to focus on smaller sediments and nutrient removal[30].

28 Personal communication, Phil Coles, Wetlands Coordinator, Urrbrae Agricultural High School 2008

29 Department of Environment WA 2004

30 Ibid

3.1.5 Pollutant control

Gross pollutant traps (GPTs) are typically used to remove solids conveyed by stormwater greater than 5mm, mostly trash, debris and coarse sediment. GPTs suitable for use in urban areas are gully baskets, in ground GPTs, trash racks and pipe nets. They play an important role in maintaining the integrity of downstream treatments such as wetlands. They involve a significant capital cost and maintenance costs. Although they are not effective in removing nutrients, they are expected to remove litter (10-30%), suspended solids (0-10%) and coarse sediment (10-25%)[31].

Typical catchment sediment loads suggest that between 50-80% of suspended solids conveyed in urban stormwater are 125µm or larger. Almost all sediment bed loads are larger than this target sediment size[32]. Above this level sediment is regarded to be medium to coarse sized. The cost of GPTs varies significantly depending on their size and application.

3.2 Issues associated with retrofitting existing urban areas

In established urban areas where stormwater quality needs to be improved, installation of some types of structural controls can be difficult and/or expensive because of space constraints and existing infrastructure. The Metropolitan Adelaide Stormwater Management Study[33] found that many WSUD solutions are only suitable for new developments, where there is opportunity to incorporate open space into the planning of the development. Opportunities for stormwater harvesting were thought to be limited in existing built up areas due to the lack of suitable open space along or adjacent to trunk drainage systems. However, recent urban retrofit projects in several Australian cities and regional centres suggest some of the challenges can be overcome[34]. Retrofitting has been focused on smaller scale measures that can be implemented more easily in existing urban areas, such as rainwater tanks, porous pavements for carparks, streetscape biofiltration and bioretention basins.

Weber 2008 discusses the multiple benefits possible from streetscape implementation including treating a major pollutant source (roads) and controlling hydraulic load. He identifies the largest constraint as the identification and navigation around existing services (eg. gas, electricity, sewer etc). He suggests an ideal implementation strategy is opportunistic inclusion of WSUD measures within existing road rehabilitation schedules.

WBM has estimated the capital costs associated with water sensitive urban design measures in association with the modelling of loads from future development. The measures costed for each lot include rainwater harvesting as well as lot scale rain gardens and streetscape infiltration/bioretention. The capital costs of these measures are estimated at around $58,000 per hectare[35]. Under the scenarios for future developments the WSUD measures are expected to

31 Fletcher et al 2004

32 AWE 2008b

33 CSIRO 2007

34 Weber 2008

35 Personal communication Tony Weber WBM 2008

reduce suspended solids by around 188,000 kilograms per year – with an equivalent cost per kilogram per year of $1,200. The capital costs are expected to be around 40-50% higher for retrofits.

3.3 Agricultural best management practices

Many of the structural controls discussed in section 3.1 above could be used to address stormwater pollution in agricultural areas as well as urban areas. For example buffer strips are often used to trap sediments and nutrients. A recent review of the efficacy and costs of management practices to reduce sediments and nutrients on agricultural land examined a range of measures including gully treatment, riparian buffer strips, livestock exclusion, conservation tillage, groundcover maintenance, diversions banks and grassed drains, contour banks and strip cropping[36]. The efficiency and costs of two key measures to reduce sediments were quantified from the available literature. Riparian buffers were estimated to achieve 48%-98% sediment removal at a cost of $6,540/ha for establishment and $1,150/ha ongoing. Conservation tillage was estimated to remove 71-98% of suspended solids at a cost of $5,000 - $15,000 for conversion of farm machinery.

3.4 Diversity of abatement actions and costs

The available data on the cost-effectiveness of abatement actions are presented in Table 3.5. The cost information is indicative only for the purpose of assessing whether there is a diverse set of abatement actions and cost differentials sufficient to support the use of an MBI. It is based on outcomes and studies considered most relevant for Adelaide.

There is significant variation in the costs in Table 3.5 and the costs and effectiveness of individual measures would also be expected to vary across different sites depending on the physical catchment characteristics. For example the Metropolitan Adelaide Stormwater Management Study found that the effectiveness of on-site detention and on-site retention is very catchment specific.

36 WBM catchment modelling for WQIP 2008

Table 3.5: Cost effectiveness of alternative stormwater abatement actions to reduce sediments

Abatement measure	Cost effectiveness of sediment removal ($/kg/yr)	Other benefits
Rainwater tanks for new developments (lot scale)	~ $18,000	Reduces flows from roofs to the stormwater system
Stormwater harvesting/reuse projects - NSW	~ $10 - 2,000 (TSS)	Can reduce stormwater flows
Constructed wetland – Adelaide	~ $5	Significant nutrient reduction benefits
Bioretention system	~ $150	Reduces peak flow Doubles as conveyance system
Porous pavement – USA	~ $180 (TSS)	Reduces peak flows
WSUD measures for new developments	~ $1,200	Combination of above

Sources: WBM estimates 2008, NSW DEC 2006, Urrbrae Agricultural High School, City of Mitcham, Lamdphair et al (2000)

4 EXPERIENCES WITH MARKET BASED INSTRUMENTS FOR WATER QUALITY

This section provides a menu of market based instruments characterising the key approaches that have been used. It also provides a review of market based instruments used within and outside Australia to improve water quality as well as market based approaches used for other objectives that may have relevance for stormwater management. Applications designed specifically to address stormwater runoff and pollution are also highlighted.

4.1 Menu of market based instruments for water quality

There are two main types of market based instruments. They are:

- *Price based instruments* that assign a price to impacts on water quality within existing markets through the imposition of charges, taxes or subsidies; and
- *Quantity based instruments* that create a market in the rights to engage in an activity (that may be impacting on water quality) by restricting the total level of activity and allocating rights to participate in that activity.

A price based instrument cannot provide certainty that an environmental outcome will be achieved, as the outcome will depend on the response to the price signal. A quantity based instrument can provide certainty that an environmental goal will be achieved, however the costs of achieving the desired outcome cannot be controlled by government as it is determined by the market.

Table 4.1 describes the main types of schemes used to improve water quality.

Table 4.1: Menu of market based instruments used to improve water quality

Type of scheme	Description
Price based instruments	
• Taxes & charges	Sources of pollution pay charges based on pollution loads (or a proxy for pollution loads) to reflect the environmental damage caused by those loads. The purpose of the tax or charge is to provide an incentive to reduce pollution (not to raise revenue).
• Subsidies & grants schemes	Incentive payments are made to encourage actions to reduce pollution or to minimise the impact of pollution on water quality.
• Subsidies by auction or tender	An alternative way of distributing incentive payments. Individuals offering pollution abatement services bid for funds in a competitive setting revealing the nature of their services and cost-sharing payment terms. Government selects service providers based on best environmental outcomes per dollar.
Quantity based instruments	
• Trading schemes	Sources of pollution are regulated and allocated permits based on sustainable loads and can offset/trade to meet new requirements.
• Offset schemes	Requirement for new sources to arrange in-kind offsets for residual loads (eg. to ensure no net increase or net decrease in pollution). Offset approvals either on a case by case basis or through rules based assessment. Brokers or offset banks may emerge to assist offset trading and may create "offset credits" for sale to developers prior to new impacts occurring.
• Offset contributions schemes	Requirement for pollution sources to make financial contributions to an offset fund to manage the impact of their nutrient loads. Contributions are typically required from developers but can also extend to other sources, such as existing urban and agricultural activities. Rules based table of offset contributions. Funds aggregated and used for regional water quality improvement programs. Fund manager is responsible for the catchment "balance sheet".

4.2 Price based instruments

4.2.1 Range of price based instruments

Emission charges payable by licensed industry based on the quantity of water pollutants in effluent are used widely across the world. Emission fees have typically been applied to point sources, and primarily for revenue generation to meet public administration and treatments costs. More recently charges are being applied to actual emissions and being increased to (at least partly) reflect environmental damage costs and provide an incentive for reducing emissions.

Stormwater charges are also commonly used to manage urban runoff with more than 400 stormwater utilities in the US charging property owners a fee for using the stormwater drainage network[37]. In many applications these fees are similar to user charges with the revenue used to finance capital and operating expenses of local stormwater quality and quantity management. The charges are generally based on a measure of the approximate *quantity* of runoff that leaves a parcel of land, with impervious area being broadly accepted as reflecting the property's relative contribution to the problem. Some systems use a combination of hydraulic and pollutant load factors to determine stormwater rates.

Stormwater charges have the potential to provide an economic incentive for water sensitive urban design for both developing areas and existing areas. Many utilities in the US offer credits or fee reductions to landowners who install and maintain onsite stormwater management systems or other practices to reduce runoff. Most utilities only offer credits to non-residential properties based on the volume of on-site detention. There are some utilities offering credits based on annual pollutant load reduction. However, one review of these experiences indicate they have failed to encourage adoption of best management practices because the fees are set too low, the credits are usually limited to non-residential properties and there are problems with the accuracy of the models used to predict stormwater contributions.[38]

There is also some use of stormwater charging for urban areas in Europe. In Austria, Switzerland and Germany, 44% of municipalities charge separate stormwater fees. In Germany, owners of private, industrial and municipal properties pay a wastewater fee based on the amount of fresh water consumed and a stormwater fee based on the paved area connected to the sewer system[39].

Product charges are also used in some countries, for example with taxes on fertilisers and pesticides.

Subsidies and grants are common tools used to manage diffuse pollution from both urban and agricultural areas. In Europe, diffuse pollution from agriculture is the main source of nitrate in water, contributing to eutrophication in coastal and marine waters and pollution of drinking water. The 1991 Nitrates Directive required Member States to designate nitrate vulnerable zones and implement programs to reach the objective of reducing water pollution caused or induced by nitrates from agricultural sources. In response to these directives, regulation has been used in many European countries along with supporting financial support schemes. Stewardship schemes (known as agri-environment schemes) are widespread and grants programs are also used.

In the United States, the main approach to addressing diffuse water pollution from agriculture has focused on education and best management practice programs with financial support. A federal program provides matching financial support under State programs for farmers to access funds for implementing best practice.

37 Kaspersen 2008

38 Parikh, et al 2005

39 Ristenpart 2003

A number of farm-based conservation insurance products underwritten by government have been trialled in the United States in recent years (EconSearch 2006) with the specific aim of reducing nutrient and pesticide loads in stormwater from farms. These include:

- Manure Crediting Nutrient Management aimed at reducing nitrogen application – an insurance product available to corn farmers in Iowa who factor in their use of manure and legumes in determining how much additional nitrogen to apply
- Corn Rootworm integrated pest management related insurance product aimed at reducing insecticide sprays. Enables farmers to rely on the advice of an expert who uses an approved system of crop monitoring and IPM treatment thresholds. Piloted in Wisconsin and Illinois.
- Potato Late Blight related insurance product aimed at reducing fungicide sprays. This policy permits potato farmers to follow "wait until potato late blight conditions exist" announcements in some states (Maine, Wisconsin, New York). Indemnity is paid if late blight is detected before or within 10 days of recommendation to spray.
- Nutrient Best Management Practice (BMP) related insurance product aimed at reducing fertiliser applications. Requires a certified crop consultant to recommend BMP for the crop. Available in Iowa, Minnesota, Pennsylvania and Wisconsin

4.2.2 Australian experience with price based instruments

Similar to the overseas experiences, the main price based instruments used for water quality management in Australia are water pollution charges, stormwater charges and grants and subsidies.

Water pollution charges

Emission charges have become widespread in Australia over the last decade. Most State EPA's impose fees on licensed premises for the discharge of pollutants to water and in some cases land. Fee levels are usually set to recover licence administration costs and are typically linked to activity type and emission limits. Some States also incorporate separate pollutant load fees based on actual discharges. In NSW load fees are significantly higher than in other States and provide a much stronger incentive.

Stormwater charging

Hornsby Shire Council in NSW has levied a catchment remediate rate for a number of years with funding used to remediate waterways and reduce stormwater pollutants. Other jurisdictions such as Melbourne Water Corporation, Sydney Water and Western Australia's Water Corporation also levy specific stormwater management charges[40]. From July 2006 NSW councils can charge ratepayers a stormwater charge under amendments made in 2005 to the *Local Government Act 1993*. The amendments acknowledge that stormwater management services include services to manage the quality (as well as quantity) of stormwater flows. The charge is set as a fixed annual

[40] Industry Commission 1992

fee, based on an average block size and impervious fractions (or discharge factors) for different land uses. A constant impervious area is assumed for single residential dwellings to simplify the charging system – for other land uses impervious area is a function of land area.

In areas of Australia where major stormwater-related grants programs have been in existence for several years and then removed, local government authorities are increasingly establishing their own dedicated funding mechanisms.

In some areas, broader environmental levies collected by catchment management organisations have been able to be used for stormwater management projects (eg: the regional natural resource management board levies in SA).

Interest in stormwater charging to provide an economic incentive is increasing in Australia. The WA stormwater management manual provides an example of a funding mechanism structured so that properties with a large amount of directly connected impervious area (e.g. a traditional carpark) pay a relatively high fee, while properties with a small amount of directly connected impervious area (e.g. a carpark with bioretention systems) pay a relatively low fee. The manual suggests this approach may be particularly attractive in developed areas where stormwater quality and quantity needs to be managed but there is little room downstream for stormwater detention and treatment structures.

Subsidy and grant programs

Stormwater grants programs have been used widely in Australia, with resources typically obtained from:

- Short-term grants (e.g. Natural Heritage Trust, Swan-Canning Cleanup Program Funding, NSW Stormwater Trust, Victorian Stormwater Action Program, etc.);
- Consolidated revenue or general rates (e.g. a local government may fund stormwater management initiatives through its general rate base);
- Environmental levies (e.g. a local government may charge a separate levy as part of its rates, to fund specific environmental initiatives); and
- Stormwater-related fees (e.g. a local government or regional stormwater authority may charge properties a fee to use downstream stormwater drainage infrastructure).

Funds have been used for a wide range of projects from structural controls such as constructed wetlands to education programs aimed at achieving behavioural change.

4.3 Quantity based instruments

4.3.1 Range of quantity based instruments

Over the past 20 or so years a range of nutrient trading schemes have been trialled in the United States to help States meet requirements under the Clean Water Act. Under this Act, US states must develop pollutant control strategies, known as Total Maximum Daily Loads (TMDLs), for 'impaired' water bodies that do not meet water quality standards. A TMDL determines the daily, seasonal or annual maximum amount of a particular pollutant that a water body may receive and still meet the required pollutant limits for that water body. Once a TMDL is established regulators must introduce measures to reduce pollutant loads. Pollutant trading programs are looked to as the way to minimize the cost of achieving water quality goals in these impaired waters[41].

A range of trading structures has been explored, from bilateral trading through to brokers and pollutant banks. To facilitate trade pollution credits must be approved by the regulator, trades must accord with established rules and trade outcomes need to be monitored and enforced. Where trading rules are not established, regulators approve individual trades. The majority of pollution credit buyers to date have been public sector operators of WWTPs as well as a mix of industrial discharges. Increasingly, these point source dischargers are looking to purchase credits from diffuse sources. This has focused considerable attention on whether trades are equivalent in terms the ultimate environmental effect of a tonne of pollution reduced from one source compared to a tonne from another, perhaps distant source.

By 1999, some 25 trials had been initiated, ballooning to around 70 by 2004 (if schemes currently under development are included). Despite over 20 years of activity, only a handful of schemes have actually recorded trades and the number of trades in these schemes in turn has been few, primarily due to the lack of regulatory underpinnings and / or poor enforcement[42].

Key observations from nutrient trading experiences to date include:

- Phosphorus has been the most common pollutant targeted and the subject of most trades. Nitrogen discharges have also been a focus, but have largely not been traded. Sediments have been the focus of several schemes, but trades are restricted to the Piasa Creek scheme and indirectly the Rahr Malting Company initiative (where diffuse P, N and sediment reductions were credited for downstream impacts on BOD).
- The majority of schemes and trades have been focussed on freshwater waterways and reservoirs, although more recent initiatives such as Chesapeake Bay are focussed on estuarine and marine water quality.
- Early schemes focussed on trades between point sources, with the focus in more recent years shifting to regulated point sources seeking voluntary non-point credits from diffuse sources such as cropping and grazing operations, intensive livestock and urban stormwater sources. No initiatives have introduced statutory limits on existing diffuse sources, although limits on new diffuse sources have recently been introduced in the Lake Dillon scheme (although no purchases by such sources have been recorded to date).
- Offset payments to a state fund for the development of diffuse source controls are a feature of several schemes, making the instruments more akin to a hypothecated tax.

41 Ecosystem Marketplace 2005

42 Breetz, et al 2004

- The most common instances of trading are those where there is only one regulated point source purchasing diffuse offsets to allow an expansion of their activity. Trading is usually bilateral and more akin to 'fee for service' rather than a more structured market with price discovery. The key barriers to more widespread trading appear to be;
    - limited demand as regulatory imposts on point sources have been well within the capacity of on-site abatement and / or perceived unwillingness for regulators to enforce limits;
    - the greater cost-effectiveness of on-site abatement compared to those forecast; and
    - difficulties negotiating non-point offsets.

Another key development is the use of offset 'banks'. Offset banks seek to reduce the transaction costs involved in finding and securing offsets, and in this way can offer significant benefits to offset trading schemes where large numbers of trades are likely.

Offset banks have been variously administered by government agencies or third parties, and can also play a role in developing demonstration offsets and developing a reserve of offsets ahead of regulations introducing new offsetting requirements. As effort is required in establishing offset banks and the ongoing regulatory oversight of them, anticipated benefits need to outweigh these costs.

Experiences in the US, both for air and water emission trading, demonstrate an 'evolution' of trading instruments from opportunistic point source to point source offsets, to more expansive permit trading schemes and the subsequent inclusion of voluntary diffuse source offsets. The mandatory inclusion of diffuse sources in trading schemes has been the focus of recent court challenges and the prescription of statutory nutrient discharge limits on diffuse sources is only just being incorporated in trading structures. This evolution has been critical to fostering a cultural change among stakeholders, developing the scientific and regulatory skills to support trading and in garnering political support for more expansive schemes.

There has been some research into the potential for trading schemes to be applied to stormwater runoff management to create incentives for the construction of smaller scale dispersed best management practices and reduce the overall costs of a targeted level of runoff reduction and detention[43].

4.3.2 Australian experience with quantity based instruments

In Australia, quantity based instruments have been used to reduce nutrients through the South Creek bubble licence scheme in NSW and subsequent South Creek nutrient offset pilot, the Busselton Environmental Improvement Initiative in Western Australia and, more recently, a Stormwater Quality Offset Strategy by Melbourne Water. There are also a number of investigations underway into the potential for market based instruments to manage nutrient pollution as part of the National MBI Pilots Program.

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43 Thurston, et al 2007

South Creek Nutrient Offset Pilot

Increasing population and development predicted for the catchment prompted Sydney Water to investigate opportunities for effluent re-use, and in conjunction with the DEC to examine opportunities for diffuse source offsets. This has led to the subsequent introduction of the South Creek nutrient offset pilot.

The South Creek nutrient trading scheme is the first pollution offset scheme to be trialled in NSW. Participation in the two year pilot is voluntary, and will allow premises licensed by DEC (particularly Sydney Water) and developers to offset nitrogen and phosphorus nutrient loads by reducing nutrient pollution at locations outside (but near to) their sites.

Currently, the majority of nutrient loads into South Creek are from diffuse sources such as agriculture and urban stormwater. The Pilot was instituted on the basis of research suggesting that low cost abatement may be available from diffuse sources.

Sydney Water agreed to participate in the South Creek pilot and committed $100,000 to trial nutrient reduction measures in the catchment. Landcom, a statutory corporation that plans and constructs new residential developments, also contributed $50,000 towards the scheme[44].

Under the Pilot scheme these funds are paying for nutrient reduction measures to be put in place in return for a commitment from the landholder to maintain the measures and allow access to their site for monitoring and demonstration of the results. Under a permanent scheme, Councils could be invited to require developers to acquire offsets to achieve a no net emissions goal. Similarly, the NSW Government could impose the same requirement on new developments and allow existing licensees subject to pollution reduction orders to do so via purchasing offsets.

An initial set of trading ratios have been established to account for the different impacts of pollutants from different sources on water quality, to account for uncertainty around nutrient reductions associated with the various diffuse source measures and to provide a risk margin for under-performing offsets.

Busselton Environmental Improvement Initiative

The Busselton Environmental Improvement Initiative was developed by the Water Corporation, in partnership with the EPA, to offset the impact of additional nutrient loads associated with increasing the capacity of the Busselton wastewater treatment plant in 1999. The EPA was concerned with the potential impacts of additional nutrient loads on sea grass meadows in Southern Geographe Bay and the Ramsar-listed Vasse Wonnerup wetlands. Initially a zero discharge option was examined involving disposal of treated wastewater to a woodlot, however cheaper nutrient abatement actions were found from the rural community in the Geographe Bay catchment.

44 See www.epa.nsw.gov.au/greenoffsets/epapilots

The program spent about $2.3m, with about $1.1m[45] in government funding and $1.2m in in-kind assistance for rural landholders to voluntarily implement nutrient abatement projects. The initial funding program involved a 50:50 cost sharing arrangement and was improved over time to increase uptake by landholders. Examples of abatement projects included dairy waste management, dairy composting, potato growers fertiliser management, groundwater denitirification trench, waterway fencing, and perennial pastures.

Over 5 years the projects achieved a load reduction of 73.5 tonnes of nitrogen and 18 tonnes of phosphorus per year at a cost of $2.3m. The woodlot disposal option would have cost $4m and would have abated significantly lower quantities of N and P, 29 tonnes and 4 tonnes respectively.

Melbourne Water's Stormwater Quality Offset Strategy

In July 2005 Melbourne Water introduced a stormwater quality offsets program to mitigate pollution impacts of urban development. Under the program developers make a financial contribution to Melbourne Water for regional water quality works elsewhere in the catchment to offset pollution loads not treated within the development. Nitrogen was chosen as the unit of measurement for the offsets strategy because it was identified as the critical pollutant for Port Phillip Bay as well as the critical factor in sizing the dimensions and capital cost of water quality treatment infrastructure.

Melbourne Water had been delivering a regional nitrogen reduction program since 2000 and estimated the average cost to treat nitrogen off-site at $800 per kilogram. The offset contribution is calculated on a sliding scale according to the percentage of best practice that is achieved on the site as well as the location, size and density of the development. To be consistent with existing developer contributions for hydraulic works the offset contribution rates are expressed as a standard residential rate in dollars per hectare. Given the predicted quantity and type of new development, Melbourne Water expects to receive around $1 million per year in offset contributions for regional water quality works in the Port Phillip and Western Port catchments under the program between 2005/06 and 2007/08.

Other schemes under investigation or development

Pollution offsets are able to be used for meeting water quality standards in Sydney's drinking water catchments as part of *Sustaining the Catchments- the Regional Plan for the drinking water catchments of Sydney and adjacent regional centres*. Under the Plan any new developments that require approval under a council's local environmental plan must have a neutral or beneficial effect on water quality. Offsets will be considered on a case by case basis and implemented by negotiated agreement.

The Swan River Trust in Western Australia is currently investigating the potential to use nutrient offsets to improve regional water quality in the Swan Canning catchment. The Trust is consulting with stakeholders on a proposal for a nutrient offset contributions scheme involving liable parties

45 This figure includes $600,000 in government funds for individual projects and $500,000 in administration costs

(offset contributors) paying financial contributions to an independent nutrient management fund. The fund would use the monies raised to invest in nutrient reductions to deliver better regional water quality outcomes. The scheme would focus on offsetting both nitrogen and phosphorus loads separately. The offset contributors would include developers and could potentially be extended to existing urban landholders and agriculture.

The Queensland Government has been investigating the potential for using tradeable rights to manage nutrient discharges in Moreton Bay. A 2005 scoping study by BDA Group recommended a modest pilot scheme – the Bramble Bay Bubble Licence Nutrient Trading Pilot. In 2006 the announcement of the Western Corridor Recycled Water Scheme made the proposed nutrient trading pilot less attractive. The Government is currently investigating a recommendation from BDA Group for a broader South East Queensland nutrient offset scheme. Under such a scheme individual regulated entities could seek, on an opportunistic basis, to secure off-site nutrient reductions (offsets) in lieu of on-site measures to meet regulatory limits.

The potential for tradeable rights to manage nutrient discharges was also examined by the South Australian Government for nutrient discharges into the Port Waterways. Due to the limited number of contributing nutrient sources, preliminary analysis has indicated that feasible trading structures are likely to be limited to opportunistic licensing offsets, or subject to a significant increase in pollution discharge fees, license fee offsets.

The feasibility of an offset scheme for nutrient discharges in Port Phillip and Western Port Bay is also being explored by the Department of Sustainability and Environment. The project falls under Victorian EPA's "Better Bays and Waterways" water quality improvement plan for Port Phillip Bay and is funded through the Coastal Catchments Initiative. The approach to the investigation is to design an offset scheme and test it using experimental economics.

The University of Adelaide has been investigating a tradeable stormwater credit system aimed at reducing the need to fund, build and maintain more stormwater infrastructure[46]. The system would create incentives for existing owners of houses, buildings and carparks to reduce run-off during peak periods. New developers would be required to provide credits to obtain building approval creating a demand for credits. The Stormwater Management Authority would empower local government authorities to issue and collect stormwater credits. Developers would meet their obligations by generating credits themselves, purchasing them from other landowners or buying them from the Stormwater Management Authority. This type of scheme is discussed further in section 5.

46 Young and McColl 2006

5 SUITABILITY OF MARKET BASED INSTRUMENTS FOR STORMWATER

This section identifies the objectives of a stormwater MBI for Adelaide's coastal waters and assesses the suitability of MBIs to the stormwater pollution problem. It then provides a discussion about the relative merits of different types of MBIs that could be used to manage stormwater in the context of Adelaide's coastal waters.

5.1 Objectives

The primary purpose of an MBI will be to reduce the load of stormwater pollutants to improve water quality in Adelaide's coastal waters. The key pollutants important to managing the impact of stormwater on coastal waters are suspended solids and coloured dissolved organic matter (CDOM). The suitability of the range of MBIs available to reduce the loads of these two pollutants delivered to coastal waters through stormwater runoff is considered. The discussion in section 2 on the current and future contributions of different sources to these pollutants loads indicates that existing urban areas dominate the overall loads of these pollutants and the ability of an MBI to address pollution from existing urban areas will be important[47].

5.2 Suitability of MBIs to the stormwater quality problem

The scope of this study is to examine instruments that could be applied to sources of the key stormwater pollutants: SS and CDOM. The key questions for considering the application of a trading scheme (or an MBI more generally) are:

- Do the costs of abatement differ across sources of stormwater pollution?
- Would the benefits of the MBI outweigh the costs?

Section 3 examined the economic context for considering the value of an MBI. It suggests that the costs of abating sediments/suspended solids are likely to differ across land uses and across catchments. Given this, an MBI would have the potential to provide significant cost savings in achieving a target reduction in pollutants loads.

The second question is just as important with the cost of developing and implementing different types of MBIs varying widely. For example, the costs of a traditional subsidy scheme would be quite low compared with the high cost of implementing a trading scheme requiring supporting regulatory requirements on diffuse sources. The costs of different types of MBIs will be considered further in the assessment of the suitability of different instruments below.

5.3 Assessment of suitability of different types of MBIs

The key types of MBIs that have been used for water quality management were introduced in the menu of instruments outlined in section 4.1 and are listed again in Table 5.1. This section

47 Note that some commentators have raised with us concerns that the modelling presented in Section 2 may not adequately account for pollution generated in rural environments which is being assigned to urban rivers / sources. If this were the case, addressing pollution from rural sources would take on greater importance.

explores how they could be applied to stormwater pollution and how they would compare in terms of their ability to target existing urban areas and key pollutants, level of certainty that environmental goals could be achieved, their efficiency (ability to promote least cost abatement), compliance flexibility, need for legal and legislative change, administrative simplicity and resources required, and stakeholder acceptance.

Table 5.1: MBIs for stormwater management

Price based instruments	Quantity based instruments
• Taxes and charges	• Trading schemes
• Subsidies and grants schemes	• Physical offset schemes
• Subsidies by tender or auction	• Offset contribution schemes

A *stormwater pollution charge* has the potential to be applied to the primary source of stormwater pollution - existing urban landholders. A charge could be collected in a range of ways, perhaps being integrated with an existing collection structure such as through local government rates (eg. Hornsby Council's Catchment Remediation Rate in Sydney) or water supply charges.

A charge could vary according to the key factors affecting the quantity of suspended solids and CDOM in runoff, for example varying by land use, size, impervious area (or another set of proxies). A charge would not provide certainty around the expected reduction in stormwater pollution as this would depend on the level of the charge, costs of measures under the control of landowners and resultant behavioural changes. It would require a balance between introducing complexity in the charging structure to provide equity and a more targeted incentive and keeping it simple in order to minimise the administrative resources required. It may not have stakeholder support unless the funds raised are hypothecated to local or perhaps regional stormwater management.

A *subsidy or grants scheme* for stormwater improvement projects focusing on water quality improvements for Adelaide's coastal waters could be implemented. A state-wide subsidy scheme is already being implemented by the new Stormwater Management Fund. However, the Fund's primary focus is on flood mitigation with reuse and water quality improvement components of projects considered additional benefits. It would make sense to build on the existing subsidy system, making Adelaide's coastal waters a priority area for funding of water quality improvement projects rather than establish a new one. This instrument could easily be used to target the priority sources (existing urban areas) and pollutants (SS and CDOM).

A subsidy scheme would not provide as much certainty for a desired reduction in stormwater pollution as the quantity based instruments as it is a voluntary instrument (project proponents are not required to come forward) and the overall reduction in stormwater pollution achieved depends on the level of funds available from government, and the success of the fund manager in selecting cost-effective projects and managing uncertainties and risks.

Of all the market based instruments being considered a traditional subsidy scheme is likely to be the least efficient approach. This is because traditional approaches to distributing funds cannot reveal the true costs of the projects or services being offered. Proponents hold all the knowledge/information and governments are often not in a position to ensure they get the best outcomes for the dollars spent. Some advantages of a subsidy approach are that it would not require legislative change, it would be relatively simple to administer and would have stakeholder acceptance. However, it would require significant dedicated funds to be allocated from government to achieve the desired reduction in pollutant loads.

A variation on the traditional subsidy or grants scheme is delivery of subsidies by competitive tender. While competitive tender approaches are commonplace for a range of works and actions sought by government, their extension to purchasing management practice changes on private property to deliver environmental benefits is relatively new. Conservation tenders (sometimes called auctions) have been used successfully across Australia for securing native vegetation and biodiversity benefits on private lands, following the success of the *BushTender* trials in Victoria.

These mechanisms have now been extended to a range of other environmental purchasing programs by governments including in water right buyback programs (as recently conducted under the Living Murray initiative) and in purchasing irrigator changes in water use (such as the timing of diversions from rivers) to protect in-stream water quality (such as under Victoria's *StreamFlow* Tender).

The potential role of a tender mechanism could be considered for application to both urban and agricultural lands. Tender processes involve inviting bids from land owners for works on their properties, with bids assessed, ranked and funded based on their relative value for money in terms of cost per kg of priority pollutants abated. Formal agreements between the funding body and the land owner are then established, which incorporate monitoring and reporting requirements as well as remedial actions or penalties if agreed outcomes fail to be achieved.

Typically, payments to land owners consist of an up-front payment for capital expenses as well as on-going annual payments (often for up to 10 years) to meet any operating expenses and to provide an incentive to maintain the works. The main advantage of adopting a competitive tender approach would be to improve the efficiency of the subsidy instrument and therefore the overall potential for reducing stormwater pollution.

A stormwater *trading scheme* could also be considered with discharge limits applying to sources of stormwater. As discussed in section 4 trading schemes have generally been applied to major point sources of pollution, and the involvement of diffuse sources such as existing agricultural and urban areas has been limited to a voluntary role as an offset or credit provider, offering a more cost-effective way for the point source to meet its pollution limits. In theory a trading scheme could be applied to stormwater sources – for example by putting limits on loads of stormwater pollution on catchments, councils or individual land owners. However, the difficulty in linking these loads to responsible parties and the high number of dispersed parties involved makes it impractical to apply.

There are also legal obstacles to such an approach – and there are very limited examples around the world where regulatory limits on discharges of diffuse sources of pollution have been imposed. Even if the legal issues and stakeholder acceptance could be managed the key question would be whether the benefits of such a scheme would be likely to outweigh the costs. The costs of both the development and administration of trading schemes can be quite high.

The tradeable stormwater credit system being investigated by the University of Adelaide (introduced in section 4 above) does not propose legal obligations on existing land owners. The regulatory driver for the demand for credits is proposed to be placed on new development with existing land owners having a voluntary role as a credit provider. In this sense the scheme is similar to an offset scheme.

An *offset scheme* could also be considered for improving the quality of stormwater impacting Adelaide's coastal waters. We distinguish between two key types of offset schemes:

- Physical offset schemes; and
- Offset contribution schemes.

A physical offset scheme could be introduced for urban greenfield developments. The scheme would involve a compliance requirement for developers to offset residual loads of stormwater pollutants. It would be a physical 'in-kind' offset scheme where trades would only be approved where like for like outcomes were secured. Developers could secure offsets through direct bilateral agreements with offset sellers, potentially with the aid of an offset broker. Alternatively, offsets could be purchased through an accredited offset bank (eg. such as the SA Stormwater Management Fund as proposed in the University of Adelaide's proposed tradeable stormwater credit system).

Alternatively, an offset contribution scheme could be implemented with liable parties paying financial contributions to an independent stormwater quality management fund. The fund would use the monies raised to invest in stormwater pollutant reduction to deliver improved water quality outcomes for Adelaide's coastal waters.

The liable parties would include urban developers (eg. similar to the Melbourne Water Stormwater Quality Offsets Program), but could also be extended to existing urban land owners and agriculture. The contributions could vary according land use, impervious area and stormwater management practices on-site to provide an incentive to reduce stormwater pollution loads.

Both types of offset schemes have the potential to involve the target stormwater pollution contributors and key pollutants in different ways. The physical developer offset scheme would involve existing urban and rural areas in a *voluntary* way – with regional stormwater management works, retrofitting projects or potentially individual landowner measures (eg. installing a rainwater tank or buffer strip) generating credits for sale. This is similar to the scheme suggested by the University of Adelaide. Under the offset contribution scheme, existing urban and rural areas could be included in a *mandatory* way – with an obligation to pay a contribution.

The level of certainty that an overall environmental goal of reducing pollutant loads could be achieved would be greater under an offset contribution scheme. This is because the physical offset scheme for new developers is geared towards holding the line on pollutant loads, whereas the offset contribution scheme requires offset projects equivalent to all existing contributions to the stormwater pollution load problem. However, one key difference in the environmental outcomes is that the physical offset scheme requires a tighter link between the increased impact from a development and the offset measure, thereby ensuring better environmental equivalence for new impacts.

Both types of offset schemes would be efficient at achieving their individual objectives (of either holding the line or reducing pollutant loads) as long as an efficient investment process was established for the offset bank or fund manager. The offset contribution scheme would provide the greatest compliance flexibility for new development – requiring a one-off contribution for offset works rather than development of a suitable bilateral offset agreement with obligations over time. Both types of offset schemes would require legislative change – for the requirements for offsets or offset contributions, the enforcement of offset arrangements and the investment of funds from contributions in pollution reduction actions.

There would be different levels of acceptance from different stakeholders under each offset scheme. If a physical offset scheme for new developers were pursued, developers would argue this is inequitable given the substantial contribution of existing urban areas to the water quality problems. An offset contribution scheme requiring contributions across the community may be seen as more equitable and general acceptance would depend on the community's perception about the significance and urgency of the problem, recognition of their part in the problem and level of confidence/trust in the contributions fund manager.

The key advantage of the offset contribution scheme is the potential to include a wider set of pollutant sources as liable parties under the scheme and therefore achieve a greater overall level of pollution abatement. Moreover, if the pollution problem for Adelaide's coastal waters is regional in nature, then an offset contribution scheme may be more suitable as matching sites are not required on a case-by-case basis, reducing transaction costs in matching individual buyers and sellers and also allowing collected contributions to be invested strategically to maximise regional benefit. Investment rules, such as investing contributions collected in the same ecological zone could ensure broad environmental equivalence and avoid 'hot spot' problems occurring.

The management fund in an offset contribution scheme would provide similar benefits as an offset bank does for a traditional physical offset scheme, in relation to scale economies, reducing transaction costs and managing non-compliance risk.

5.4 Short list of MBIs

The preliminary assessment above suggests the following types of MBIs would be most suited to improving stormwater quality and reducing impacts on Adelaide's coastal waters:

- Stormwater quality charges
- Subsidy program by competitive tender
- Stormwater offset contribution scheme

A stormwater trading scheme with regulatory discharge limits applying to sources of stormwater is not included on the short list because of the likely high costs of administration, the legal obstacles and issues with stakeholder acceptance discussed above.

A conceptual framework and key design features for each of the short listed MBIs is outlined in section 7.

6 LEGISLATIVE/POLICY CONTEXT FOR STORMWATER MANAGEMENT IN SA

This section examines the current legislative and institutional arrangements and policy settings relevant to the management of stormwater in SA. It also provides a preliminary assessment of the potential to implement the short-listed MBIs to address the impacts of stormwater on coastal water quality in Adelaide.

6.1 Legislative and institutional arrangements for stormwater management in SA

Local government has had the primary responsibility for provision and maintenance of local stormwater infrastructure in South Australia in the past. The state government has enacted legislation providing for construction and funding of specific sections of the metropolitan drainage system. Funding for local stormwater drainage has also been a local government responsibility, with some access to State government subsidies since the late 1960s (where a catchment exceeds 40 hectares under the Catchment Management Subsidy Scheme).

Stormwater quality in South Australia is affected by various laws including the Environment Protection Act 1993, the Environment Protection (Water Quality) Policy 2003, the Development Act 1993, the Public and Environmental Health Act 1987 and the Waterworks Act 1932. The Natural Resources Management Act 2004 provides for Natural Resource Management (NRM) Boards to play a role in reducing stormwater pollution, with catchment levies used for purposes including promoting improvements in stormwater quality[48].

Recent State/Local Government agreements and resulting amendments to the Local Government Act 1999 have provided a framework for planning and funding stormwater management.

In 2005 the Urban Stormwater Management Policy for South Australia was developed setting out a range of strategies to improve stormwater management relating to the roles and responsibilities of state and local government. The strategies cover the key areas of risk minimisation, governance, planning, environmental sustainability, and funding. One of the key policy goals is to reduce the environmental impacts of stormwater as a conveyor of pollution.

The Policy required the State to collaborate with local government in developing a legally binding agreement for the future management of stormwater. In 2006 an Agreement on Stormwater Management was signed by the State of South Australia and the Local Government Association providing improved finance and governance arrangements for stormwater management throughout South Australia. The agreement provided for the creation of a Stormwater Management Authority with representation from State and Local Government to implement the Agreement. The new bilateral agreement included new arrangements for the state support for funding of stormwater (in place of the Catchment Management Subsidy scheme). Amendments to

[48] It has not been possible in this scoping study to examine the design and performance of the previous levy initiated under the Water Resources Act 1997 (which was repealed by the Natural Resources Management Act 2004 in July 2005). At a stakeholder workshop it was commented that the levy had originally been introduced to fund stormwater management programs. It would be prudent to understand the operation of the previous levy prior to any further development of a stormwater market based instrument.

the Local Government Act by the Local Government (Stormwater Management) Amendment Act 2007 implemented the agreement, including by establishing the Stormwater Management Authority on 1 July 2007.

A key element of the new governance arrangements is the development of stormwater management plans for catchments to ensure stormwater management is addressed on a total catchment basis. Steering Committees with representatives from constituent councils and representatives from the NRM Board and other State government agencies will oversee the preparation of the plans. The plans require approval by the Stormwater Management Authority.

Funding arrangements for any proposed works and their maintenance are to be decided by the local councils within the catchment. There are principles for cost-sharing that may be used by councils in the absence of inter-council agreement. The Authority may become involved in resolving cost sharing by councils if they are unable to agree.

Applications may be made to the Stormwater Management Authority for funding towards the production of stormwater management plans and stormwater infrastructure works. An applicant may be a local council, group of councils, a statutory drainage authority or any other person, company or body. To be eligible for funding projects must demonstrate:

> *'a significant flood mitigation component as well as addressing, wherever practicable, value adding opportunities such as stormwater reuse and water quality enhancements'.*

The 2005 Urban Stormwater Management Policy also requires the EPA to develop stormwater quality targets on a catchment by catchment basis for reducing the environmental impact on watercourses and other receiving waters to inform the stormwater management planning process by local councils.

6.2 Legislative scope for implementing short-listed instruments

6.2.1 Stormwater quality charges

The EPA's existing ability to levy stormwater quality charges by way of differentiated licence fee on licensed activities would not be suitable as licensed activities would make up a very small proportion of sources of stormwater pollution.

The Local Government Act allows local councils to impose a range of different rates on existing urban landholders, including 'service rates' for specified services. Service rates may be imposed only in respect of a service provided or made available by the council. The services in respect of which a service rate may be charged do not include stormwater management services. Stormwater management could become a prescribed service by amendment of the Local Government (General) Regulations 1999. Incorporating pollution-related factors into calculating the rate (such as impervious area) would also require amendment to the Regulations. A risk in attempting to use a service rate as a stormwater pollution charge is the possible argument that the service rate could not be hypothecated to general regional stormwater management activities provided outside of the council area.

The Natural Resources Management Act allows NRM Boards to impose a levy based on land ownership. Such a levy is to be collected by local councils as if it were a rate under the Local Government Act. The levy, and hence the rate collected by councils, may be imposed by the Board on factors including land use, land area and location. Factors which could be used as a better proxy for pollution (such as impervious area) could not be used without amendment of the NRM Act. The administrative burden involved in implementing rating based on proportion of impervious area could be expected to be significant.

The levy imposed by an NRM Board is collected in order to fund the range of activities specified in the Board's NRM Plan, not just stormwater management. Accordingly, a levy collected through this mechanism would not be properly described as a stormwater pollution levy, and would not be able to be hypothecated solely for stormwater management.

NRM Boards are able to offer rebates on the landholder's levy through setting out either in the NRM Plan or Regulations under the Act, natural resources management practices which are designed to conserve, protect, maintain or improve the quality or state of specified natural resources (for example, stormwater quality) and providing that a person who has undertaken the practices may apply for a refund of the whole or part of a levy. The Act includes as examples of the type of management practice that may be specified, the establishment of, or participation in, a drainage scheme, the establishment or maintenance of infrastructure, or other initiatives.

Water supply charges are imposed by SA Water Corporation under the Waterworks Act on all rateable land – properties that are connected to the mains supply infrastructure or abut land on which the mains supply is located. Rates may be imposed for the right of supply, the water actually supplied, and the 'Save the River Murray' levy. An amendment of the Act would be required to impose a stormwater pollution charge as part of the water rates. Without legislative change any attempt to impose a charge through water rates could be expected to be resisted due to the absence of a link with stormwater quality.

6.2.2 Subsidy program by competitive tender

The Stormwater Management Authority was established with a range of roles including administering the Stormwater Management Fund. The Fund is comprised of appropriations from Parliament, contributions received from NRM Boards, money received from the Local Government Disaster Fund, any other money paid to the Fund with the approval of the Minister or Treasurer, gifts, grants and bequests, income from investment of the Fund, and any money paid into the Fund under any other Act.

The Fund may be used for projects or measures relating to water quality or pollution abatement. The Authority would have the ability under the Local Government Act (Schedule 1A) to apply the Fund by inviting bids from landholders for conservation works on their properties. The 2005 Policy on funding arrangements does seem to indicate however that funding would be directed to activities identified in stormwater management plans rather than in the Authority's absolute discretion.

NRM Boards could also use their funds to subsidise stormwater management activities or works through competitive bidding.

6.2.3 Stormwater offset contribution scheme

An offset contribution scheme would require the establishment of a liability to pay the contribution, and an appropriate entity to receive, hold and invest the contributions and to ensure that investments delivered intended benefits.

Liability to pay the offset contribution

Liability would have to be established through legislation. Suitability of the different statutes depends mainly on their respective coverage (on whom could the contribution be imposed). Legislation that could be considered for amendment to sustain an offset contribution is –

- Development Act – this Act could be amended to impose offset contributions (or the option of either an offset or offset contribution) on new developments. The legislation already provides for developers to be required to provide open space or carparking, or pay a contribution into a designated fund in lieu thereof. The Act could not be used to raise a contribution from existing landholders.
- Local Government Act – amendment could allow an offset contribution to be imposed on existing landholders through the rating system. If the contribution were to be paid on to a third party to pool and invest the contributions (ie, such as the Stormwater Management Authority or an NRM Board), amendments would also need to specify this obligation. Resistance to such a proposal would be expected on the basis that Local Government rejects any perceived role as 'tax collector' for other (State) bodies.
- NRM Act – amendment of this Act could allow an offset contribution to be imposed on existing landholders in addition to, or possibly as a separate component of, the existing levy. As presently, the levy would be collected through the Local Government rating system. Establishing a system which allowed a stormwater levy to be calculated on the basis of factors not presently available under the Local Government Act or NRM Act (namely, impervious area) would be expected to be complex and costly. Complexity and therefore cost would be greatly amplified if such a levy were to be collected as a 'part' of the existing levy, the other part of which is calculated on a different basis (in most cases, property value).
- Waterworks Act – amendment of this Act could allow an offset contribution to be imposed through the water rating system on existing landholders. Resistance may stem from the lack of linkage between water supply and stormwater drainage.

Entity to receive, hold and invest contributions

Funds raised through a stormwater offset contribution would need to be hypothecated for that purpose. An appropriate entity would need to be entitled to receive the contributions, hold them and invest them in offset activities.

In South Australia, appropriate entities would be the Stormwater Management Authority and NRM Boards. Both control statutory Funds that would be appropriate to receive a stormwater offset contribution. Both have powers to spend money from the Funds for the purposes of improving stormwater quality or manage stormwater quantity, enter contracts, and acquire, deal with and dispose of real and personal property. The Stormwater Management Authority has authority throughout the State, whereas each regional NRM Board operates predominantly within its region. However, the entire area of greater Metropolitan Adelaide is under the jurisdiction of a single regional NRM Board, the Adelaide and Mount Lofty Ranges NRM Board.

Amendments required to establish the liability to pay would also need to establish the obligation on the collecting agency to pay the contributions to the managing entity. If the entity had other functions apart from stormwater management (such as the NRM Boards), amendments could also be made requiring the entity to keep and account for expenditure of the contribution separate from other funds.

7 PRELIMINARY DESIGN FOR SHORT LISTED MBIS

This section discusses possible conceptual frameworks and preliminary design features for the three MBIs considered most suitable to assist in achieving reductions in priority pollutants from stormwater sources.

7.1 Stormwater quality charges

7.1.1 Objectives of stormwater quality charges

The purpose of a pollution charge is to create an incentive to reduce environmental impacts by including the external costs of a damaging activity in prices. A theoretically ideal charge for stormwater pollution would be based on the individual marginal damage cost associated with loads of stormwater pollutants in runoff from each parcel of land. The charges collected would go to consolidated revenue and the charge would provide an incentive to reduce discharges wherever the damage cost was greater than the cost of abating the pollution, resulting in a socially optimal outcome. In practice, it is very difficult to determine the physical environmental damage and the value to the community of the damage from stormwater pollution loads in order to set an appropriate charge.

An alternative approach is a charge based on the costs of programs to reduce stormwater pollutant loads and manage its impacts. This is consistent with the COAG pricing principles for water charges where the lower bound of cost recovery pricing is defined as “attributable” environmental and natural resource management costs. Appendix 1 provides more background on the COAG pricing principles. As discussed in section 4, this approach is being used in the US and in other states of Australia to recover the costs of managing stormwater more broadly. Under this approach there is a link between revenues raised from charges and expenditure on stormwater management.

7.1.2 Scheme participants

The participants of the scheme would include all land owners in Adelaide’s coastal catchments including residential owners, commercial and industrial owners, institutions and agricultural land owners.

7.1.3 Basis and structure of charging

The charges would be based on the costs of programs to reduce loads of sediments and CDOM in Adelaide’s coastal waters (both now and in the future taking into account the total load of pollutant reductions likely to be required) and including a margin for risk and uncertainty and monitoring, administration and enforcement.

Ideally the charge would be payable in line with the loads of suspended solids and CDOM which are the key stormwater pollutants of concern in the Adelaide context. It would be very costly to determine precisely the load of these stormwater pollutants from each parcel of land in Adelaide’s coastal catchments. However, coefficients for pollutant loads (kg/ha/yr) for different land uses have been developed as part of the catchment modelling exercise for the development of the ACWQIP. These coefficients could be used (or refined) incorporating the key factors affecting the loads of suspended solids and CDOM such as rainfall, land use, soil type, physical catchment characteristics, and vegetation cover. The coefficients could be developed at a sub-catchment level or by council/locality and for an appropriate set of land uses depending on the likely variation in pollutant runoff across the coastal catchments. In order to simplify the sediment export coefficients could be used as a proxy for loads of both sediment and CDOM.

A balance would need to be found between equity and complexity, providing for an equitable sharing of costs based on contribution to pollutant loads while minimising the costs to government and landowners of implementing the charging system.

In the load based licensing schemes around Australia pollution loads from significant sources of industrial pollution are estimated on a regular basis and charges are levied per kilogram of annual discharge of each targeted pollutant. Any action by the licence holder to reduce pollution leaving the site is rewarded with a lower licence fee, providing an ongoing incentive for improvement. It is impractical to estimate individual stormwater pollution loads from each land parcel, however there are ways to provide an incentive in stormwater charging schemes to improve on-site management.

Many US stormwater utilities offer fee reductions for landowners who implement management measures to reduce runoff. These fees are generally aimed at runoff volume rather than stormwater quality. However, the fee systems provide useful background. The table below provides some examples of fee reductions.

Table 7.1 Examples of fee reductions in US stormwater fee schemes

Utility	Eligible Users	Basis for fee reduction	Maximum fee reduction
Orlando, FL	Commercial and multifamily residential	Onsite retention or detention	42%
Charlotte, NC	Commercial, industrial, institutional, multifamily, residential, and homeowner associations	1. Peak discharge	1. 50%
		2. Total runoff volume	2. 25%
		3. Annual pollutant loading reduction	3. 25%
Bellevue, WA	All properties	Onsite detention; intensity of development	Reduction of one rate class

Source: Doll et al 1999

Providing fee reductions for on-site management measures to reduce pollutant loads would be important for providing an incentive as well as increasing the acceptability of the scheme. There are a number of different ways a stormwater quality charging scheme for Adelaide's coastal waters could incorporate fee reductions. One option would be to reduce the applicable fee (for the relevant land use/location) by a certain % depending on the type of on-site measures in place. As the primary purpose of the charge is to improve stormwater quality, the percentages for different on-site measures would need to reflect their performance in reducing pollutant load (not volume). However, many on-site measures reduce both runoff volume and pollutant load and the scheme would therefore provide additional benefits of volume reduction.

For example, use of a rainwater tank may provide a 10% fee reduction (to recognise the small reduction in pollutant load likely) whereas a bioretention system might provide a 50% fee reduction. Another option would be to provide fee reductions where land owners demonstrated good stormwater management practices (perhaps through compliance with a relevant code of practice). For compliance with the code of practice a newly developed area might achieve a 90% fee reduction, whereas in an older urban area compliance with the code of practice may achieve a 75% reduction.

The inclusion of incentives for improving on-site stormwater management through fee reductions would increase the resources required for enforcement of the scheme. A mechanism would need to be developed to identify, monitor and enforce performance of on-site stormwater management measures wherever fee reductions were sought. This could be achieved via certification of assessors, and the challenge would be to provide a targeted incentive for on-site management without imposing too great a cost on households, businesses and government.

7.1.4 Collection and use of funds

The review in section 6 suggests that introducing any stormwater quality charge would require legislative change. The key options for imposition and collection of a stormwater quality charge in Adelaide's coastal catchments discussed were:

- Charges imposed and collected by councils
- Charges imposed by NRM Board and collected by councils
- Charges imposed and collected by SA Water Corporation

The simplest framework could be collection by SA Water Corporation along with water supply charges – as this single entity already imposes charges on all relevant land owners in Adelaide's coastal catchments.

Once collected the charges would need to be hypothecated to an entity responsible for using the funds to improve stormwater quality in Adelaide's coastal catchments. The key options discussed in section 6 were:

- South Australia's Stormwater Management Authority
- Adelaide and Mount Lofty Ranges NRM Board.

The entity would be responsible for using the funds to reduce loads of key stormwater pollutants entering Adelaide's coastal catchments to improve regional water quality outcomes. The types of works/programs funded may include:

- Large scale structural controls – such as construction of wetlands and centralised stormwater harvesting schemes.
- Better agricultural management practices - such as improved riparian management.
- Small scale retrofitting of water sensitive urban design measures – such as rainwater tanks, porous pavements for carparks, streetscape biofiltration and bioretention basins.

There would need to be appropriate governance arrangements in place for the use of the funds. This would involve the entity being accountable for the use of the funds through standard requirements including financial and management reporting and auditing requirements.

7.1.5 Resourcing

In the stormwater management manual for Western Australia it is estimated that it would cost a local government or regional stormwater authority approximately $50,000 to establish a property-based stormwater management fee that is structured in relation to each property's directly connected impervious area. The bulk of this cost is associated with calculating a suitable fee for each property.[49]

However, the costs are likely to be higher for a scheme that is focused on stormwater quality and designed to provide an ongoing incentive for reducing stormwater pollutant loads. Under the type of scheme discussed above extra resources would be required for:

- Set up costs of the legislative amendments, development of charging structure and basis for fee reduction, administrative process, preparation of guidance documents.
- Set up costs of certification scheme for assessing applications for fee reductions and ensuring maintenance of infrastructure over time where fee reductions were granted.
- Administrative costs of ongoing collection of contributions.
- Ongoing managerial, project management and technical resources needed for the organisation managing the funds for improving stormwater quality.

7.2 Stormwater quality competitive tender subsidy program

7.2.1 Objectives of competitive tender subsidy program

The information that government has on the costs of different stormwater pollution abatement activities is poor. Stormwater stakeholders have information on their own unique costs. The aim of competitive purchasing approaches is to overcome this information asymmetry and allow low-cost opportunities to be revealed.

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[49] Department of Environment WA 2004

The Productivity Commission has highlighted that well-designed approaches can promote efficient allocation of resources without requiring governments to have prior knowledge of resource values or costs. Compared with administrative allocations, market approaches are more transparent and less dependent on official's subjective judgement, and can yield greater cost savings for governments[50].

7.2.2 Provision of subsidies

The Stormwater Management Authority could use performance subsidies – that is, direct subsidies based on the tonnes of suspended solids and CDOM removed – and allocated through a competitive approach.

Approaches that could be employed to competitively 'purchase' stormwater abatement services include by:

- Bilateral negotiation – involves the direct negotiation between government and one or more sellers.
- Competitive tender – involves a discrete sales process where government retains significant flexibility in how the successful seller will be chosen and can allow negotiation on final terms with that bidder.
- Auction format – involves a more structured sales process of a clearly defined commodity with clear rules on how prices will be struck and bidders chosen to complete the sale.

Negotiated outcomes allow the unique circumstances of individual sellers to be considered and factored into price or non-price aspects of contracts. However the negotiations are only informed by the price information that the participants bring to the negotiations, rather than the collective valuations of all potential sellers. Consequently tender or auction approaches are more useful when the services – stormwater pollution abatement – do not have a fixed or determined market value. Auctions in particular can be used to maximise 'price discovery' by providing an explicit mechanism that identifies market depth and describes how prices are formed. They can also be less costly and time consuming than a series of individual negotiations.

A disadvantage with an auction format is the need for well-defined and standardised performance outcomes. As movement to competitive and performance based subsidy approaches is new, the use of a tendering process is more likely initially.

As under a traditional grant process, providers would indicate the estimated amount and type of stormwater pollution to be abated as part of their bids. The major difference would be that rather than having a fixed funding ratio, each applicant would nominate the level of funding sought. In this way, applicants would compete against each other for funding and reveal their cost-effectiveness in providing stormwater controls. Competition would ensure that successful bidders would receive just enough to facilitate the action while minimising costs to the grants scheme.

50 Productivity Commission 2003

If the focus of the program was only on reducing the loads of suspended solids and CDOM, the bids would be ranked from most to least desirable based on the cost to the program in terms of $/tonne of pollution abatement. Other objectives, such as reductions in stormwater volume, could be taken into account through a weighting process or the use of minimum and maximum caps.

Importantly, agreement would need to be struck on how abatement outcomes would be measured, reported and audited, and if appropriate how risks would be shared. For example, low-cost but risky ventures (such as involving new technology development) may require a greater proportion of support to be provided upon successful outcomes. Similarly, non-performance conditions for all recipients would need to be specified.

7.2.3 Resources

Use of subsidies to improve stormwater quality would rely on additional funds being provided by government. No legislative changes would be required to implement subsidies by competitive tender, however there would be extra administrative resources required to run a competitive tender program.

7.3 Stormwater quality offset contribution scheme

7.3.1 Objectives of scheme

The scheme canvassed here is based on a proposal currently being considered in Western Australia to manage nutrient pollution in the Swan-Canning catchment[51], which in turn has drawn on some design parameters from Melbourne Water's Stormwater Quality Offsets Program. The objective of the WA scheme is to offset residual loads of stormwater pollutants from new development so as to improve regional water quality outcomes. Earlier variants of the proposed scheme canvassed the potential inclusion of existing urban and rural sources as additional contributors.

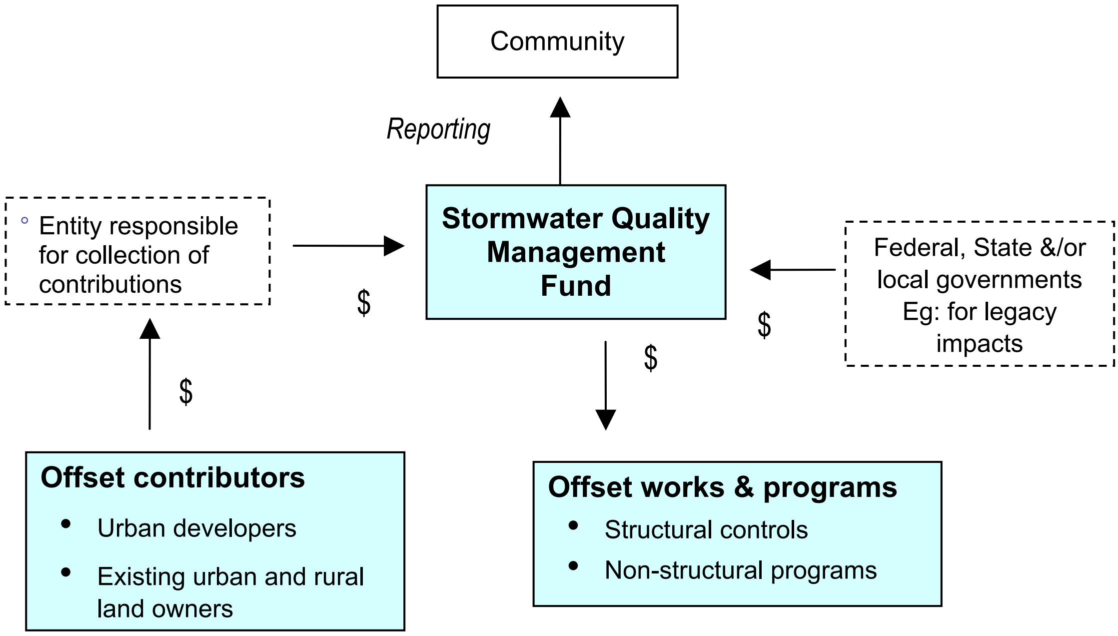
In the context of Adelaide's coastal catchments, the scheme would need to be broadened to include existing sources as they represent the key stormwater loads to be mitigated.

7.3.2 Scheme participants

A stormwater quality offset contribution scheme would involve new urban developments and existing urban and rural landowners paying financial contributions to an independent management fund. The fund would use the monies raised to invest in works to reduce priority stormwater pollutants to deliver better regional water quality outcomes. Figure 7.1 shows the key participants.

51 BDA Group 2008

Figure 7.1: Conceptual framework for a stormwater quality offset contribution scheme



The following principles would underlie the stormwater quality offset contributions scheme:

- Offset contributions must be expected to result in an equivalent or better regional water quality outcome, taking into account information uncertainties, management risks, compliance and enforcement provisions;
- All standard regulatory requirements must still be met by all parties; and
- The scheme should not reward poor environmental performance by prospective offset sellers (ie: those undertaking offset works and programs).

The scope of the scheme would cover Adelaide's coastal catchments. However separate environmental zones could be established within the region if needed to require contributions collected in an environmental zone to be spent within that zone. The aim would be to provide as much flexibility as possible for the siting of cost-effective works while ensuring communities across the catchments share in water quality improvements.

7.3.3 Offset contributions

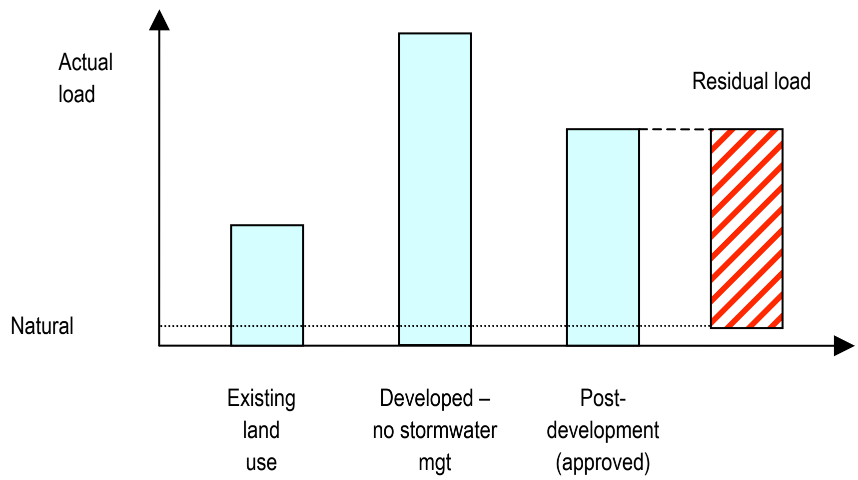
Offset contributions could be required for a range of key stormwater pollutants such as sediment, CDOM, metals, etc or a proxy pollutant could be chosen. For example, nitrogen was chosen as the proxy pollutant in Melbourne Water's Stormwater Quality Offsets Program. For Adelaide's coastal catchments the metric could be sediment load.

Developers of both greenfield and infill developments in Adelaide's coastal catchments could be required to meet the *capital* costs of measures to offset sediments equivalent to their residual loads through one-off developer charges. This contribution requirement would be similar to the requirement for other developer charges. Existing urban and rural land owners could be required to meet the *ongoing* costs of measures to offset sediments equivalent to their residual loads through annual stormwater quality charges[52].

These contribution arrangements mirror the approach being used by Melbourne Water with the Stormwater Quality Offsets Program collecting charges from developers to cover capital costs for off-site impacts and leaving the collection of maintenance costs under general stormwater management charges from existing urban households. The Government would continue to invest in regional works to address *legacy* impacts on water quality in the catchments.

A financial contribution would be required from offset contributors for each tonne of estimated residual load. The residual load could be defined as the load of sediments above the natural load. This approach is shown in Figure 7.2.

Figure 7.2 Definition of residual sediment load



For many developments a scheme could rely on estimation methods and models that are currently used as part of development approvals for developments for determining residual loads. For other developments, standard residual loads could be developed varying according to the location, area and density of development.

Contributions from existing urban and rural landowners could also be based on estimated sediment loads (through standard look up tables). The issues associated with developing contribution rates for existing landowners would be similar those considered for stormwater quality charging. Provision of reductions in contributions could also be considered to provide an incentive for on-site management (as discussed in section 7.1.3).

Offset contribution rates (the $ per tonne of sediments) would be determined ahead of implementation based on estimated abatement costs identified in the Stormwater Quality Management Fund's Business Plan. Contribution rates would include margins for risk, performance monitoring and reporting and scheme administration. The $ per tonne contributions

52 Note that greenfield and infill development subsequently become "existing urban" and so are then liable for ongoing costs – that is, they first pay the one-off capital cost and then pay ongoing costs

would be based on the annualised capital and operating cost of sediment abatement works over 30 years.

7.3.4 Governance framework for collection and use of funds

The review in section 6 highlighted that a stormwater offset contribution scheme would require legislative change to establish a liability to pay contributions. The developer contributions could be levied by amending the Development Act. Existing urban and rural landowners could be levied along with water supply charges as discussed in section 7.1. The review also highlighted that existing entities appropriate to receive contributions and invest them in offset activities include South Australia's Stormwater Management Authority and the Adelaide and Mount Lofty Ranges NRM Board. The contributions would need to be managed as a separate fund within the chosen entity. The following key governance criteria are considered important for the entity managing the fund:

- The entity will have the authority to receive and spend contributions;
- The entity will have the power to enter into contracts;
- The entity will be bound by the rules of the stormwater offset contribution scheme as set out in the business plan (for example relating to the limitations on the location of offsets, and not purchasing offsets below minimum performance standards);
- the entity will be separate from competing or possibly competing interests in the offset market;
- purchasing offsets will be a core business of the entity;
- the entity will possess the skills required to carry out the function; and
- the entity will be accountable for the use of the funds through standard requirements including financial and management reporting and auditing requirements.

7.3.5 The stormwater quality management fund

The role of the fund is to reduce loads of key stormwater pollutants entering Adelaide's coastal catchments to improve regional water quality outcomes. The fund will make strategic investments to maximise regional water quality benefits taking into account:

- Any constraints on the location of offset measures associated with funds collected;
- Any equivalence ratios established by the Fund to assess the relative effectiveness of different abatement options taking into account the location, timing of discharge and uncertainties (both over the measurement of loads and performance of actions).

The Fund will also establish a minimum level of management performance for offset sellers in the catchments before they are allowed to sell abatement services to the management fund.

The key types of works/programs for reducing sediments include:

- Large scale structural controls – such as construction of wetlands and centralised stormwater harvesting schemes.
- Better agricultural management practices - such as improved riparian management.
- Small scale retrofitting of water sensitive urban design measures – such as rainwater tanks, porous pavements for carparks, streetscape biofiltration and bioretention basins.

Offset contracts of different duration would be entered into taking into account the nature of the measure, ongoing maintenance commitments, preferences of negotiating parties and associated risks. The potential role of competitive tender mechanisms could also be considered by the Fund in order to maximise sediment reductions given available contributions.

The Fund would adopt an investment portfolio approach to manage risk and allow investment in some higher risk programs and for research and trials. The fund would work with other agencies and programs to create synergies to improve regional stormwater management and maximise all environmental benefits of sediment reduction activities. The Fund would need to forge close partnerships with other government agencies, local councils, catchment groups, service providers, land managers etc.

7.3.6 Resources

The main resource requirements to implement the scheme would be:

- Set up costs of legislative amendments, revisions to policy and administrative process, preparation of guidance documents, and preparation of the initial Stormwater Quality Management Fund business plan setting initial contribution rates;
- Additional resources required for development of estimates of residual loads by developers;
- Ongoing additional resources required for review of estimation of residual loads by the planning and/or relevant referral agencies;
- Ongoing collection of contributions; and
- Ongoing managerial, project management and technical resources needed for the Stormwater Quality Management Fund.

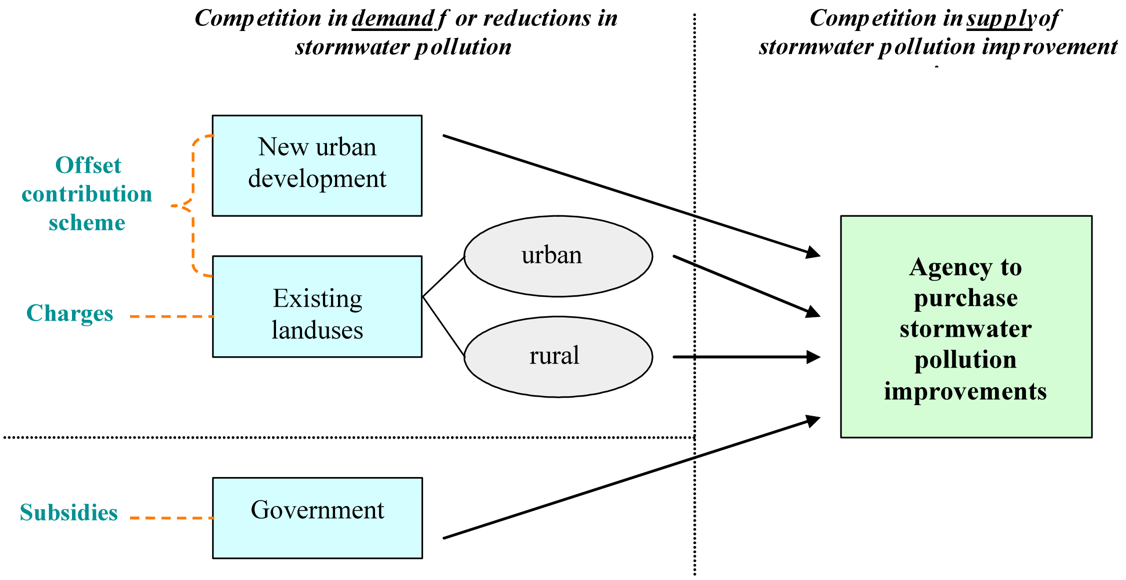
8 EVALUATION OF SHORT LISTED MBIS

The investigation has identified three MBIs that could be used to help improve stormwater quality from key stormwater sources and reduce impacts on Adelaide's coastal waters, namely:

- Stormwater quality charges
- Subsidy program by competitive tender
- Stormwater offset contribution scheme.

The key participants in each are shown in Figure 8.1.

Figure 8.1: Key participants in the short-listed MBIs



The stormwater quality charges would require existing urban and rural land owners to pay for improvements in stormwater quality and would require significant resources for legislative reforms and ongoing administration. The subsidy program using competitive tender would require a lower level of resources for implementation but the outcomes would be dependent on securing additional government funding.

The stormwater offset contribution scheme is similar in operation to the stormwater quality charges, with the key difference being its extension to include new developments. All three MBIs use a central agency to manage the commissioning of offsetting works and programs. Importantly, the agency could use competitive tender processes to invest in works to improve stormwater quality.

All three MBIs are likely to make stormwater reuse more attractive and their impact on flow management and water allocation plans will depend on the relative cost-effectiveness and scope for using different abatement measures to reduce stormwater pollutants. The extent to which each

MBI affects flow management and water allocation plans would depend on the level of charges, funding and contributions under each scheme.

Climate change is likely to increase mean temperatures, decrease annual average rainfall, increase drought conditions and reduce the volume of runoff. The impact of climate change on water quality conditions (including sediment loads) is being modelled under a separate project as input to the development of the ACWQIP.

Climate change is likely to impact on loads of sediments (and other stormwater pollutants) expected from new and existing landholdings and therefore charging/contribution schedules under relevant MBIs would need periodic review. Climate change will also create baseline issues for investing funds in sediment offset works under all MBIs. Programs would need to ensure that the funds are used to achieve additional reductions in pollutant loads from landholders (not reductions that would have occurred anyway as a result of climate change).

Table 8.1 provides a broad evaluation of the likely outcomes under each scheme.

Table 8.1 Evaluation of short listed MBIs

Market based instrument	Incidence of costs	Environmental outcomes	Resources for implementation
Stormwater quality charges	Existing urban and rural land owners.	Level of improvement would depend on level of charges and scope for implementing abatement measures in catchments.	New legislation required to charge existing stormwater sources. Significant set up & ongoing administrative costs.
Subsidy program by competitive tender	General community through government funding.	Least certainty over improvements in stormwater quality as reliant on new & ongoing government funding.	No new legislation required. Lowest set up & administrative resources required.
Stormwater offset contribution scheme	Existing urban and rural land owners and developers.	Improvement in water quality not likely to be much greater than for stormwater quality charges as contributions from new development likely to be small.	New legislation required to impose charges on developers as well as existing stormwater sources. Greatest set up & ongoing administrative resources required.

The relative merits of each instrument will depend on the extent to which they can capture the '*benefits of competition'* and the transaction costs involved in implementing the instrument. As shown in Figure 8.1, instruments may promote competition in the demand for opportunities to discharge pollutants to waterways as well as competition in the supply of stormwater pollution improvements. Some supply opportunities may be unrelated to those landuses making discharges to waterways (such as interception works like wetlands), while other supply opportunities may be directly related to particular landuses and their 'demand' for discharges (such as stormwater retention in existing urban areas).

Competition in opportunities to discharge pollution seeks to ensure that the community benefits from limited discharge opportunities (associated with various landuses) are maximised. Similarly, competition in the supply of projects to improve stormwater quality seeks to minimise the costs to the community of achieving stormwater quality targets. The instruments vary in their ability to cost-effectively maximise the benefits from competition.

On the supply side, the short-listed instruments employ a similar strategy, namely the generation of a revenue base for use by a central agency to commission cost-effective water quality improvements. Given the significant variation in cost found between alternative water quality improvement projects, competitive tender instruments are likely to generate benefits in driving down the cost of water quality improvements. This will particularly be the case with regional works, such as wetlands. However tender instruments may introduce high transaction costs for participants at the householder level, and hence fail to realise these opportunities. That is, the time and effort required for single households to participate may be high relative to the stormwater benefits that could be achieved from a single property. These transaction costs may be lessened through the engagement of intermediaries who could 'bundle' bids.

On the demand side, the subsidy instrument will generate no benefits through competition in demand as the revenue base draws on consolidated funding (which in itself is a further limitation).

The other instruments can influence the behaviour of urban and rural land managers, through incentives that would encourage those who could reduce stormwater pollution discharges at lowest cost to do so. So for example, stormwater charges would provide an incentive for small scale management measures by existing landholders that would (for the reasons argued above) be costly to pursue through supply-side programs. This would however require the variation in performance across existing urban lands to be captured in simple metrics that could cost-effectively be applied and enforced.

The stormwater offset contribution scheme would engage a wider set of landuses on the demand side by including new developments. However it may not be worth the extra effort required for legislative reforms and ongoing administration as part of development approval processes, because the additional pollutant loads expected from new development are very small.

The results of catchment modelling provided in section 2 suggest that the loads of suspended solids across the catchments would increase by only 1% with new development even in the absence of any on-site stormwater management measures (for CDOM the figure is less than 1%). This suggests that the introduction of stormwater quality charges would be likely to provide most of the demand side benefits of the offset contributions scheme without the additional reforms required to introduce developer contributions within the development approval process. Also, as occupants of completed developments would be required to pay the annual stormwater quality charges, over time this would provide an incentive for developers to deliver projects with lower residual stormwater discharges and associated financial liabilities.

A regime of stormwater charges would also provide a revenue stream for a central entity to seek cost-effective supply side measures to reduce residual loads of stormwater pollutants from the entire range of sources of pollution. Activities funded could vary from large scale structural controls to lot scale measures depending on the opportunities and their costs and likely effectiveness across the catchment. The entity could use an adaptive management approach investing primarily in proven practices initially and using a small proportion of funds to trial more innovative measures with potential for more cost-effective gains in future.

Therefore it is suggested that stormwater quality charges are likely to be the most suitable MBI for addressing the impacts of stormwater on Adelaide's coastal waters.

9 STAKEHOLDER ASSESSMENT

This section outlines the key stakeholders relevant for the further development of a market based instrument for stormwater management for Adelaide's coastal waters, some questions for discussion with stakeholders and key issues of relevance to individual stakeholders.

9.1 Key stakeholders

The key stakeholders include:

- Adelaide and Mount Lofty Ranges Natural Resource Management Board
- Local Government Association of South Australia
- Local councils
- Department of Water, Land and Biodiversity Conservation
- Department of Planning and Local Government
- SA Water
- Stormwater Management Authority
- CSIRO (as principal authors of the ACWS)
- General community
- Developers

9.2 Questions for discussion with stakeholders

General

- Do you think that the MBIs on the short list are suitable for consideration in the context of Adelaide's coastal catchments? Which MBI would you prefer?
- What pollutant would be the best proxy for implementing an MBI? (ie. what pollutant is broadly representative of impacts of stormwater pollutants and would measures to reduce it also reduce other pollutants?)
- To ensure improvements in Adelaide coastal water quality are achieved, which sources of stormwater pollutants do you think should be required to participate in an MBI? Existing urban landowners, rural landowners, new developers?

Stormwater quality charges

- Could stormwater quality charges be based on pollutant export rates for different land uses at a catchment level? Or would pollutant export rates differ substantially across sub-catchments/suburbs?
- Should incentives for on-site stormwater management be provided through reductions in charges? Should reductions relate to specific on-site measures or a compliance with a general code of practice? Could a certification system work?

- Which existing entity/entities in the region would be best placed to collect stormwater quality charges? Which entity is best placed to manage the funds and invest in works to reduce the impact of stormwater on water quality?

Competitive tender subsidy program

- Would a competitive stormwater pollution abatement tender scheme be suitable? Could stormwater pollutants be estimated/measured? Is it likely to achieve cost savings in the Adelaide context?

Stormwater quality offset contribution scheme

- To ensure improvements in Adelaide coastal water quality are achieved, which sources of stormwater pollution should be included? Are the benefits of including new developers in the scheme likely to outweigh the costs?
- Should contributions collected be able to be spent anywhere within Adelaide's coastal catchments or should separate environmental zones be established? (that is, are we addressing a regional environmental problem or local ones?)
- Which existing entity/entities in the region would be best placed to collect stormwater offset contributions? Which entity is best placed to manage the funds and invest in works to reduce the impact of stormwater on water quality?

9.3 Key issues for each stakeholder

- Adelaide and Mount Lofty Ranges Natural Resource Management Board – The Board could act as the fund manager under a charging or contribution scheme, or would be an important partner if another body was fund manager. The Board is likely to be supportive of the two MBIs that provide an ongoing revenue stream focusing on reducing the impact of stormwater on water quality.
- Local Government Association of South Australia & local councils – The LGA may be concerned about the potential financial impact on constituents. Councils would resist having any fee collection role for other entities. They would support the creation of a revenue stream to ensure that stormwater infrastructure provided by developers can be maintained over time (instead of falling to them).
- Department of Water, Land and Biodiversity Conservation – The Department may be supportive of creating a revenue stream to focus on reducing the impact of stormwater on water quality. However they may be concerned about the possible impact on river flows and are also likely to seek integration and consistency of any proposed MBI with broader stormwater management programs.
- Department of Planning and Local Government – The Department may be supportive of creating a revenue stream focusing on reducing the impact of stormwater on water quality.

They may be concerned about integration of any new MBI with existing development approval processes.

- SA Water Corporation – SA Water would be a potential charge/contribution collection entity and may be concerned about additional resources required for this role. They would also be a potential service provider for stormwater infrastructure/programs and may therefore support creation of an ongoing revenue stream.
- Stormwater Management Authority – The Authority could deliver stormwater quality subsidies by competitive tender and/or act as fund manager under a charging or contribution scheme. Alternatively, they would be an important partner if another body was appointed as fund manager. They would want to ensure integration of proposed MBIs relating to stormwater quality with policies/programs addressing stormwater quantity and broader stormwater management objectives.
- General community – Some members would support creating an ongoing revenue stream to address the impact of stormwater on water quality. They may also support recognition of efforts by individual households/businesses with on-site management being reflected in an MBI. There is likely to be concern about financial impacts especially on low income households.
- Developers – Developers are likely to argue that the major source of stormwater pollution is existing urban and rural runoff and that existing approval processes already address their contribution. They are also likely to argue there should be no new developer charges as they would impact on housing affordability.

GLOSSARY

Abatement - Pollution abatement refers to technology applied or measures taken to reduce pollution and/or its impacts on the environment.

Best management practices - Devices, practices or methods for removing, reducing, retarding or preventing stormwater pollutants and contaminants from reaching receiving waters and for reducing the volume of stormwater runoff.

Brownfield development – Further development on areas of land already developed for urban land uses such as infill or redevelopment sites.

Buffer strip - Areas of vegetation through which runoff passes while travelling to a discharge point and which are therefore aligned perpendicular to the direction of flow.

Competitive subsidies - The process of contracting out delivery of services (in this case stormwater abatement services) with the preferred provider of the activity selected from a range of bidders by evaluating offers against predetermined selection criteria. Various different types of approaches could be employed including bilateral negotiation, competitive tender and auctions.

Constructed wetland - A vegetated detention area designed and built to remove contaminants from stormwater runoff, but which can also provide secondary benefits of habitat enhancement/creation and active and passive recreational and educational opportunities.

Diffuse pollution - Pollution without a single point of origin or specific discharge point.

Environmental equivalence – The relative harmfulness of different discharges for an environmental issue. The environmental equivalence is often stated as a ratio – for example an environmental equivalence ratio of 1:3 for two sources means that 1 tonne of pollutant from the first source is expected to have a similar impact on environmental amenities to 3 tonnes from the second source.

Greenfield development – Development on land zoned for urban development usually located on the fringe of an urban area.

Gross pollutant traps - A type of litter and sediment management system. GPTs typically consist of a sediment trap with a weir and trash rack at the downstream end of a piped drainage system.

Load based licensing – Places regulatory limits on pollution loads from licensed / industrial sources of pollution and links licence fees payable with the level of pollutant loads.

Market based instruments – Instruments to address the market failure of 'environmental externalities' either by incorporating the external cost of production or consumption activities through taxes or charges on processes or products, or by creating property rights and facilitating the establishment of a proxy market for the use of environmental services.

Non-structural controls - Practices designed to prevent or minimise contaminants from entering stormwater runoff and/or reduce the volume of stormwater requiring management that do not involve fixed / permanent facilities. They usually work by changing behaviour through government regulation (e.g. planning and environmental laws), education and/or economic instruments.

Offset - An action taken to compensate for a negative environmental impact that would otherwise arise from an approved activity or development.

Offset scheme – Scheme to allow regulated sources to achieve pollution abatement requirements through sponsoring abatement effort from other regulated or unregulated (often diffuse) sources. Offset schemes may be voluntary / opportunistic providing a compliance option for regulated entities to meet regulatory requirements when an opportunity arises for lower cost off-site actions. Offset schemes are mandatory in some cases with regulated entities required to arrange and/or fund off-site actions for 'residual' environmental impacts which (generally) cannot be overcome on-site.

Retrofitting – Retrofitting involves applying stormwater management devices or approaches which are installed or undertaken in an existing developed area. Retrofitting can occur at the lot, block / neighbourhood or catchment scale.

Sediment - Solid fragment of organic and inorganic material that is transported, suspended and/or deposited by water and wind.

Stormwater - Rainwater that runs off the land, frequently carrying various forms of pollution such as litter and debris, animal droppings and dissolved chemicals. This untreated water is carried in stormwater channels and discharged directly into creeks, rivers, the harbour and the ocean.

Stormwater harvesting - The collection and reuse of rainwater that would otherwise end up in the stormwater channels that lead to a river or the ocean. Harvesting stormwater generally involves two stages: storage and treatment.

Stormwater system - The system of pipes, canals and other channels used to carry stormwater to bodies of water, such as rivers or oceans.

Structural controls - Engineered devices implemented to manage runoff quality and quantity, to control, treat, or prevent stormwater pollution and/or reduce the volume of stormwater requiring management.

Suspended solids - Organic or inorganic particles that are suspended and transported by water. This includes sand, mud and clay particles (and associated contaminants) in stormwater.

Swale - A drainage interception and conveyance system with relatively gentle side slopes and shallow flow depths.

Transaction costs - The costs associated with buying and selling for example in collecting information and processing trades.

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APPENDIX 1: COAG PRICING PRINCIPLES

In February 1994, the Council of Australian Governments (CoAG) agreed to a package of measures with the objective of achieving an "efficient and sustainable water industry". This was followed a decade later by Intergovernmental Agreements on a *National Water Initiative* and *Addressing Water Overallocation and Achieving Environmental Objectives in the Murray-Darling Basin*, both signed in June 2004. These agreements compliment and extend the reforms agreed to in the 1994 water agreement.

The 1994 reforms recognised the environment as a legitimate user of water and obliged governments to give priority to determining "formal" allocations to the environment. In 1999 it was further agreed that each State/Territory would identify stressed and over-allocated river and groundwater systems and give priority to creating a more sustainable balance between consumptive use and the environment. In the 2004 CoAG NWI agreement, signatory governments agreed to the statutory provision of water access entitlements to meet environmental needs.

However beyond these formal environmental allocations, the continued diversion and consumptive use of water, and discharge of wastewaters and stormwaters to waterways still create residual environmental impacts. These impacts impose a cost more broadly on the community, either through the cost of other programs directed at overcoming the environmental damage or through the loss of environmental amenity.

In recognition of the on-going environmental impacts from water use, governments have also committed to full cost water pricing. The nature of this commitment is described by the National Water Commission (2005):

> *Pricing to reflect the adverse environmental impacts associated with providing and using water and wastewater services has been an integral feature of the COAG water reforms. Pricing may be used to recover costs associated with repairing environmental damage or with meeting standards applied to protect the environment from impacts associated with consumptive water supply. The price charged for water services may also be used to signal to consumers the environmental costs of water supply and use activities.*
>
> *The COAG pricing principles stipulate that water charges should reflect the true economic (including environmental) costs of water service provision and should recover a range of costs, including externalities, in order to achieve full cost recovery. Externalities were defined in the COAG pricing principles as meaning the environmental and natural resource management costs attributable to and incurred by the water business (for the lower bound of cost recovery) and all external costs and benefits (for the upper bound of cost recovery). While the National Water Initiative has distinguished the costs associated with resource management and planning from environmental impact costs, it continues to uphold the externalities cost recovery requirement to achieve lower and upper bound pricing, to the extent that this is feasible.*
>
> *Under the National Water Initiative, governments agreed to continue to manage environmental externalities through a range of regulatory measures; and to continue to examine the feasibility of using market-based mechanisms, such as pricing, to account for positive and negative environmental externalities associated with water use.*

The area of attributable environmental costs is an evolving one and jurisdictions have approached this commitment to varying degrees and in different manners, in light of their particular circumstances. Recognising that the concept and practice of fully and robustly incorporating externalities in pricing is inherently complex, governments have agreed to implement pricing that includes externalities where found to be feasible. The Commission expects that, where governments have decided the inclusion of externalities in pricing arrangements is not feasible, that this decision has been informed by a rigorous assessment and analysis.