

# PARRAMATTA CBD

## *STORMWATER MANAGEMENT PLAN*



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## Background

This report has been prepared in response to a brief prepared by Parramatta City Council in November 2001 to investigate causes of stormwater pollution generated within the Parramatta CBD and make recommendations as to structural controls. Within the context of this report consideration has been given to three elements:

- To maximise the control of stormwater runoff at the source
- To implement best practices for stormwater management; and
- To achieve cost effective and balanced environmental solutions that reflect the needs and characteristics of the CBD.

The focus on structural elements within this report has arisen from the decision by the Department of Local Government to allow Parramatta City Council to raise a special levy on ratepayers within the CBD to fund programs to lessen the impact of activities within the area on the Parramatta River. While maintenance of structural stormwater quality improvement devices cannot be funded from the improvement levy, this report gives considerable weight to maintenance issues in assessing options to ensure all recommendations are sustainable and affordable for Council and its ratepayers.

Non-structural activities such as environmental education, auditing of businesses and interpretative art have not been considered in this report and are discussed along with some structural recommendations in the Upper Parramatta River Stormwater Management Plan (1999). This Plan identified the need for an integrated package of stormwater management solutions for the CBD area as a short to medium priority reflecting the significant impact the CBD plays as a source of pollution affecting the health of Parramatta River.<sup>1</sup>

There are five (5) tasks required for this project as summarised below:

1. Conduct an audit and verify the existing pollution hot spots.
2. Establish the current drainage network and limitations within the catchment.
3. Identify issues and causes of pollution and their associated management implications.
4. Establish strategies to improve stormwater management.
5. Make a list of recommendations for future works.

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<sup>1</sup> Morison P (1999) Upper Parramatta River Stormwater Management Plan. Refer to recommendation J3.

## Catchment context

The Parramatta CBD is defined in the Sydney Regional Environmental Plan (REP) No 28 – Parramatta. Church Street is backbone to the CBD and Parramatta River and the main rail line roughly divide the CBD into thirds (refer to figure 1).

The southern end of the CBD, bounded by Church and Raymond Streets, is dominated by automotive premises. These extend beyond the CBD area to the Great Western Highway and Parramatta Road.

The north of the CBD narrows along Church Street to Pennant Hills Road and contains a mix of retail, offices and food premises.

Offices dominate what is defined by the REP as the ‘city core’. Many of the office towers contain service businesses on the ground floor, such as cafés, stationers, and printers.

The Westfield complex, an enclosed shopping centre bounded by Church, Argyle, O’Connell and Campbell Streets, dominates the retail area. South of Westfield’s along Church Street lies Parramatta’s Chinatown containing numerous restaurants.

The Church Street Mall is the main ‘outdoor’ retail space supported by street furniture and landscaping to encourage passive use and a community ownership of the city. Food premises are dotted throughout the central and northern parts of the CBD, with a focus on outdoor eating along Church Street between Phillip Street and the river.

To the west of the CBD lies the Parramatta Regional Park, Parramatta Stadium and a golf course. In other directions retail and residential premises dominate the land use.

Medium to high density residential development surrounds most of the CBD with a continuation of commercial activity along Church Street in both directions.

## Regional context

The Parramatta CBD forms part of the upper Parramatta River stormwater catchment. Within this catchment lies thousands of hectares of developed land that drains to the Parramatta River via a developed pit and pipe network. The consequence of runoff from the surrounding region has a significantly greater impact on the health of the Parramatta River than the runoff generated from the CBD area. Stormwater planning to control pollution and other contaminants is being addressed through the Upper Parramatta River Catchment Management Trust and the Upper Parramatta River Catchment Stormwater Management Plan.<sup>2</sup>

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<sup>2</sup> Morison P (1999) Upper Parramatta River Catchment Stormwater Management Plan.

**Figure 1. Location of the Parramatta central business district**

## Stormwater catchments

For the purposes of this project the Parramatta CBD has been divided into three parts.

1. Northern area – this comprises 5 main sub-catchments that drain directly to the northern bank of the river.
2. Central area – this comprises 8 main sub-catchments that drain to the southern bank of the river within the CBD area.
3. Southern area – this comprises 11 minor sub-catchments that drain to the Parramatta River via the Clay Creek stormwater channel.

Figure 2 illustrates the main sub-catchments referred to in this report and Table 1 provides a brief description. Further details of the catchment are provided in the section titled ‘Options.’

**Table 1. Main sub-catchments within the CBD**

Number	Catchment name	Location	Approx. area (ha)	Drains to
1	Old Kings School catchment	North of river encompassing church and school land bounded by Victoria Road to the north, Marsden Road to the east and O’Connell Street to the west.	4.2	North side of river between O’Connell Street and Marsden Street
2	Villiers Street catchment	North of River extending in a narrow band either side of Marsden/Villiers Streets to the intersection of Albert Street, Pennant Hills Road and Church Street.	7.4	North side of river beneath the Marsden Street bridge
3	Riverside Theatre catchment	North of River taking in the eastern half of Alfred Square and the Riverside Theatre extending east to Church Street. The northern end is bounded by Victoria Road.	1.2	North side of river to the west of the Lenox Bridge
4	Carlton Hotel catchment	North of River bounded by Church Street to the west, Victoria Road to the north and extending approximately 90 metres along Palmer street as the eastern boundary.	1.0	North side of river just east of the Lenox Bridge
5	Brickfield Creek catchment	This is a sub-catchment of the Brickfield creek stormwater catchment. The section in the CBD is bounded by Harold Street to the north, Sorrell Street to the east and the Villiers Street and Carlton Hotel catchments to the west.	12	Brickfield creek stormwater channel discharging east of the Sorrell Street Bridge on the north side of river
6	Westfield catchment	This is a large catchment extending from the Great Western Highway in the south, O’Connell Street to the west and Church Street to the east.	21	South side of river east of the Marsden Street Bridge
7	Old court house catchment	South of the river bounded by George Street to the south and Marsden Street to the west; the eastern boundary lies between Marsden Street and Church Street.	1.2	South side of river discharging beneath the walkway between the river and the adjacent car park

Number	Catchment name	Location	Approx. area (ha)	Drains to
8	South Lenox Street Bridge catchment	South of the river draining many of the commercial premises along Church Street from George street in the south	1.9	South side of river and east of the Lenox Street bridge
9	David Jones car park catchment	South of the river draining the area bounded by Church, Phillip and Smith Streets taking in the River Bank site and the adjacent car parking stations.	2.2	South side of river between Church and Smith Streets
10	Phillip Lane catchment	South of the river bounded by George, Smith and Phillip Streets	3	South side of river west of the Smith Street bridge
11	CBD catchment	South of the river taking much of the high density office space between Smith and Church Street extending back to Parramatta railway station	17.5	South side of river west of the Smith Street bridge
12	Barrack Lane catchment	South of the river west to Smith Street south to the northern boundary of the Lancer Barracks east mid-way between Barrack Land and Charles Street.	5.2	South side of the river underneath the pedestrian overpass
13	Arthur Phillip High School catchment	South of the river bounded by George Street to the north, Charles Street to the east and Little Street to the south. The western boundary lies mid-way between Barrack Lane and Charles Street	6.2	South of the river extending in line with Argus Lane
14	Rowland Hassall Special School catchment	South of the river in the Claycliff Creek channel. It is bounded by Charles Street to the west and Hassall Street to the south; the commercial properties drain to the north of Macquarie Street to the north and west of Harris Street to the east.	1.4	South of the river via the Clay Cliff stormwater channel intersection along Harris Street
15	Clay Cliff Creek catchment	South of the river draining most of the southern third of the CBD area. It extends from Parramatta railway station in the north, back to the intersection of the Great Western Highway and Marsden Street in the north west, along the ridge line in Lancer Barracks east extending south to take in a number of sub-catchments south of the CBD.	70	South of the river via the Clay Cliff stormwater channel

## Land use

The CBD contains a diversity of land-use types, as illustrated in Figure 2 and summarised in Table 2. In a catchment audit undertaken in December 2001 nine (9) land use activities were identified including:

- residential
- open space
- special use

- retail
- commercial
- motor vehicle sales and repair
- sealed car park
- unsealed car park
- under development.

Commercial activities dominate the catchment mostly comprising office accommodation and retail businesses. Scattered throughout the CBD are restaurants, cafés and takeaway food businesses. Motor vehicle sales and repair premises are the notable activity in the southern end of the CBD. Low, medium and high-density housing occurs on the outer sections of the CBD and more commonly outside the CBD district. The density of housing of residential development is increasing as reflected by a number of development sites that will be replacing low and medium housing with multi-storey units. The ribbon of grass adjacent to the river largely defines the open space within the CBD. To the west of the CBD lies Parramatta Regional Park and stadium.

**Table 2. Proportion of land uses in the CBD stormwater sub-catchments**

Number	Name	Land use (%)							
		Residential	Special use	Open space	Retail	Commercial	Road/rail	Motor vehicle	Car park
1	Old Kings School catchment		95				5		
2	Villiers Street catchment	35	5	5	15	25	10		5
3	Riverside Theatre catchment			35	20	35	10		
4	Carlton Hotel catchment	50	5			30	15		
5	Brickfield Creek	30			15	25	15	15	
6	Westfield catchment	15	5	10	5	40	15		10
7	Old court house catchment				10	60	5		25
8	South Lenox Street Bridge catchment				20	65	15		
9	David Jones car park catchment				10	50	5		35
10	Phillip Lane catchment			5	10	45	20		20
11	CBD catchment		5		5	55	20		15
12	Barrack Lane catchment		10		5	70	15		
13	Arthur Phillip High School catchment	10	45			30	15		
14	Rowland Hassall Special School catchment	20	20		5	20	5		30
15	Clay Cliff Creek catchment	25	10	10	10		15	25	5

**Figure 2. Stormwater sub-catchment in the Parramatta CBD**

## Contributions and causes

### Land use

Sources of stormwater pollution can be generically described in terms of land use types and activities. In *Managing Urban Stormwater Source Control*,<sup>3</sup> attention is given to land use planning in the context of developing or modifying land use such that the capacity of the receiving water can cope with the level and intensity of development and its subsequent runoff with assistance from structural and non-structural intervention. The Parramatta CBD area, like most highly urban areas, has been developed with little consideration to the direct or indirect impacts on the receiving environment.

The Parramatta City Centre Plan<sup>4</sup> has identified that growth will continue in the CBD as it confirms its status as Sydney's second CBD. From a land use perspective this will mean a greater land use intensity to accommodate office, retail and residential activities with a corresponding increase in pressure on open space and the natural environment. From a stormwater quality perspective, present and future land use will place increasing pressure on Parramatta River and its environs. The extent of the impact will in part be determined by the development of appropriate policy and its implementation, enforcement and regulation.

Table 3 provides an estimate of the average annual gross pollutants and nutrients that can be expected for Western Sydney.<sup>5</sup> As there is insufficient data in Sydney to relate the nine land use types identified in the CBD area to the generation of gross pollutants, it has been necessary to group certain land use types to fit the three generic types: residential contains residential land, open space and special use; commercial contains retail and commercial; and industrial contains road, rail, car park and automotive sales and repair. Table 4 shows the figures calculated for the CBD based on the land use type and generic estimates for western Sydney.

**Table 3. Annual pollutant loading rates for western Sydney**

Land use	Coarse sediment		Organic matter		Litter		Total phosphorus (kg/ha/yr)	Total nitrogen (kg/ha/yr)
	kg/ha/yr	m <sup>3</sup> /ha/yr	kg/ha/yr	m <sup>3</sup> /ha/yr	kg/ha/yr	m <sup>3</sup> /ha/yr		
Residential	500	0.33	100	0.25	15	0.05	0.8	4.8
Commercial	900	0.6	80	0.2	135	0.45	1.6	8.1
Industrial	900	0.6	72	0.18	105	0.35	1.7	9.5

<sup>3</sup> New South Wales Environment Protection Authority (1998) *Managing Urban Stormwater: Source Control*.

<sup>4</sup> Parramatta City Council (2001) *Parramatta City Centre Plan – Public Domain Plan*.

<sup>5</sup> Adapted from Hunter G (2001) *Procedure for determining the appropriate size and maintenance requirements of stormwater quality improvement devices*. Unpublished report for INGAL Civil Products. kg/ha/year have been calculated using wet weight: sediments 1500 kg ≈ 1m<sup>3</sup>; organics 400 kg ≈ 1m<sup>3</sup>; litter 300 kg ≈ 1m<sup>3</sup>.

**Table 4. Predicted generation of gross pollutant for the Parramatta CBD**

Number	Catchment name	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
		Sediment	Organics	Litter	Total
1	Old Kings School catchment	1.44	1.04	0.26	2.74
2	Villiers Street catchment	6.39	1.62	1.60	9.62
3	Riverside Theatre catchment	1.09	0.26	0.33	1.69
4	Carlton Hotel catchment	0.82	0.22	0.18	1.22
5	Brickfield Creek catchment	11.70	2.61	2.61	19.93
6	Westfield catchment	19.66	4.41	4.86	28.93
7	Old court house catchment	1.30	0.23	0.39	1.92
8	South Lenox St Bridge catchment	2.05	0.37	0.75	3.18
9	David Jones car park catchment	2.38	0.42	0.65	3.42
10	Phillip Lane catchment	3.17	0.58	0.79	4.54
11	CBD catchment	18.48	3.42	5.01	26.92
12	Barrack Lane catchment	5.37	1.05	1.85	8.27
13	Arthur Phillip High School catchment	5.06	1.39	1.09	7.55
14	Rowland Hassall Special School catchment	1.24	0.30	0.21	1.75
15	Clay Cliff Creek catchment	60.48	14.95	5.71	81.13
TOTAL		140.62	32.88	26.28	199.79

In addition to gross pollutants, urban catchments generate a variety of other contaminants as identified in Table 5. Of particular interest to the CBD and this report is the high number of open car parking areas, roads and automotive premises. These activities would be a major contributor of oils, fine sediments and metals.

## Impervious area

As with most city centres impervious surfaces dominate the landscape. This is a combination of roads, footpaths, buildings, car parks, and transport corridors. Landscaping is often limited to box planters and street trees embedded within formalised impervious footpaths that have little effect on reducing the impervious nature of the catchment. Where grass or other porous surfaces are present (such as compacted soil and gravel) infiltration of runoff tends to be limited due to the compacted sub-base of the soil. This effectively increases the areas which are impervious. For the Parramatta CBD this is likely to result in 90 per cent of the area being impervious. The impact of this is threefold:

1. Surface flow dominates for all rain events resulting in the quick movement of runoff to the adjacent drain or gutter. This in turn means any pollutants mobilised by the runoff will be readily transported to the stormwater system.
2. Following from above there is usually a first flush phenomenon (provided the period between rainfall events is sufficient to allow a build up of pollutants) associated with rain that results in a surface ‘cleaning’ of the CBD.

3. Where the capacity of the stormwater system is undersized, flooding will become an increasing problem as the pit and pipe network reaches its capacity under a number of storm events resulting in roads, footpaths and other areas having to act as the secondary flow path.

In the context of stormwater pollution control, the selection, location and maintenance of structural devices is critical to the success of any program as discussed in the sections following.

**Table 5. Land use and major pollutant type**

Land use	litter	oil & grease	Metals	organic	sediment	detergents	nutrients	bacteria
Road	*	*	*		*			
Motor vehicle sales and repairs		*	*		*	*		
Unsealed car parks		*	*		*			
Sealed car parks		*	*					
Pedestrian thoroughfares	*	*						
Transport nodes	*	*	*		*	*	*	
Retail	*	*	*			*		
Office / business	*	*	*		*	*		
Food premises	*	*		*		*	*	
Parks and open space	*			*	*		*	*
Street trees/ landscaping	*			*	*		*	
Temporary construction sites	*	*	*		*		*	
Pubs and hotels	*	*				*	*	

## Issues

### Site constraints

The Parramatta city centre by its nature as the second largest CBD in Sydney, creates numerous difficulties in planning for suitable stormwater management control devices. Some of these include:

- Intensity of land use
- Flatness of land, particularly to the north of the railway – this limits the type and capacity of structural devices that require moderate fall and head loss to operate
- Flooding particularly along the banks of the river and other low points such as the stormwater channels
- Lack of open space, particularly when flood prone land is excluded
- The shift towards utilising footpaths and other pedestrian areas for secondary purposes such as passive recreation with benches and gardens for a place to sit and talk or more active uses such as integrating alfresco eating tied to ground floor cafés and restaurants
- Major transport routes crossing the city
- Location of major stormwater outlets into the river that can limit access, particularly downstream of the ferry wharf
- Focus of the river as a recreational space requiring a high degree of aesthetic planning and safety.

### Flow

Treatable flow for this project has been calculated on flow for a 3 month ARI storm event (refer to Table 6) for western Sydney of 60l/s/ha.<sup>6</sup> This should allow for the treatment of the majority of storm events and capture most of the ‘first flush’ of pollutants during larger storm events.

### Maintenance

Maintenance is one of the most important aspects of any stormwater management plan. The selection of any structural program will only achieve the desired outcomes if maintenance is carried out both regularly and properly. As such a detailed maintenance plan must be prepared by Council prior to the implementation of any recommendations.

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<sup>6</sup> Hunter G (2001) Procedure for determining the appropriate size and maintenance requirements of stormwater quality improvement devices. Unpublished report for INGAL Civil Products.

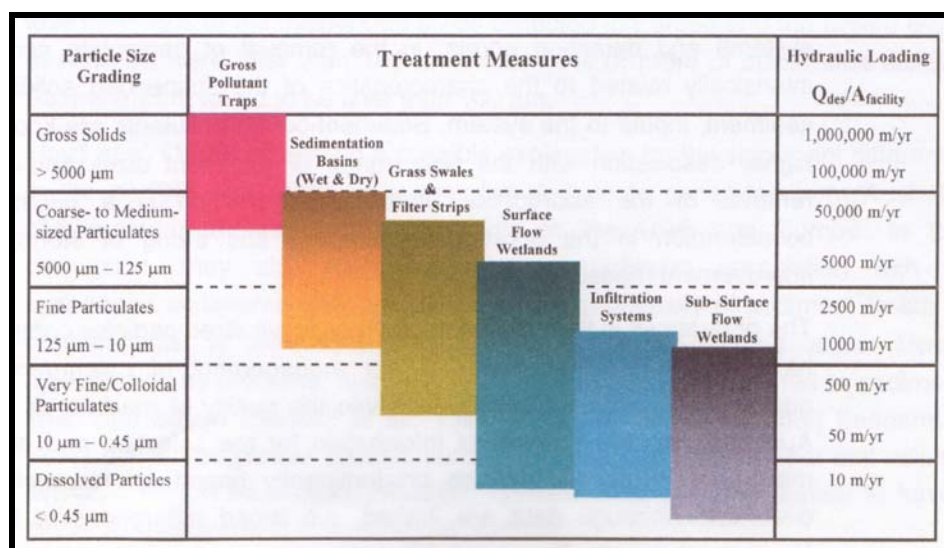
**Table 6. Treatable flow estimates for the CBD sub-catchments**

Number	Catchment name	Area (ha)	Treatable flow (m <sup>3</sup> /s)	Pipe outlet diameter (mm)
1	Old Kings School catchment	4.2	0.252	525 (to be confirmed)
2	Villiers Street catchment	7.4	0.444	600
3	Riverside Theatre catchment	1.2	0.072	350
4	Carlton Hotel catchment	1.0	0.06	400
5	Brickfield Creek catchment	12	0.75	channel
6	Westfield catchment	21	1.26	1650
7	Old court house catchment	1.2	0.072	600
8	South Lenox St Bridge catchment	1.9	0.114	825
9	David Jones car park catchment	2.2	0.132	750
10	Phillip Lane catchment	3	0.18	1650 x 600
11	CBD catchment	17.5	1.05	1650 x 600
12	Barrack Lane catchment	5.2	0.312	900
13	Arthur Phillip High School catchment	6.2	0.372	1200
14	Rowland Hassall Special School catchment	1.4	0.084	750
15	Clay Cliff Creek catchment	70	NA	channel

## Strategies

The treatment of stormwater pollution requires the use of a variety of approaches that need to be implemented in series to maximise water quality improvements. This is referred to in the literature as a treatment train. It is important to note that there is not one single treatment to ‘clean’ urban runoff. For this reason treatment measures are generally divided into broad categories related to their ability to improve runoff water quality (refer to Figure 3).

**Figure 3. Stormwater Quality Improvement Measures, target Particle Size Range and Operating Hydraulic Load Range (Breen 1999)**



In built-up catchments such as the Parramatta CBD there is limited space for stormwater treatment, and as such treatment options have focused on the removal of gross solids and coarse to medium sized particulates. The treatment of finer particulates and dissolved particles would require a much larger land area than is cost effectively available.<sup>7</sup> However in situations where the generation of dissolved particles, oils and fine particulates can be treated closer to source, such as a car park, options have been recommended.

### Source control

As a starting point, a fundamental strategy for the management of urban stormwater is to minimise the generation of excessive runoff and pollution of stormwater at or near its source; that is, source control.<sup>8</sup> This approach is preferred as a key element in the proposed program as it is able to capture pollutants close to their point of origin and in so doing minimise any dilution with other runoff that would otherwise require larger and more expensive treatment options.

<sup>7</sup> Refer to Breen, P. F (1999) Assembling the Stormwater Treatment Train, Lecture Notes, Shortcourse on Planning and Design of Stormwater management Measures, Cooperative Centre for Catchment Hydrology and Department of Civil Engineering, Monash University.

<sup>8</sup> New South Wales Environment Protection Authority (1997) *Managing Urban Stormwater: Source Control*.

The most appropriate option for source control for the Parramatta CBD area is the use of pit baskets. Pit baskets have an advantage in that they can generally be designed specifically for the intended pit at a low capital and maintenance cost. Council has previously trailed a number of pit traps along Church Street as part of a regional council initiative funded by the NSW Government Stormwater Trust grant (refer to Appendix 1).

Since this study a number of newer designs have come onto the market that have the ability to capture and retain very fine particles via the use of finely woven bag inserts (up to 100 microns) as well as gross pollutants and allow for adequate bypass during intense storm events so as to prevent blockage and subsequent flooding. The Enviropod pit basket is considered most suitable for the CBD area due to its variable size, relatively large capacity, ease of maintenance and hydraulic performance.<sup>9</sup>

Many pits in the CBD are not appropriate for pit baskets due to their shallow depth, relative position of the inlet and outlet pipes and potential flooding problems. As such the selection of pits has had to take into account these limitations.

## Inline

Inline treatment can be provided by devices that can take and return flows to the stormwater system. Their capacity to be located between the pit and the outlet can allow more flexibility when selecting appropriate locations or catchment sizes. Typically these devices have some head loss and will require fall to move the polluted stormwater through the filtering component of the device and back to the system. As such they are not as well suited to flat areas or where the capacity of the stormwater system is under-sized, unless adequate bypass is a design feature. Most inline devices can also be used at the end of pipe.

The Parramatta CBD is both old and intensively developed which means that services such as water, sewer, telecommunications and electricity will be buried around the area in a far from ordered and planned manner. This will mean the site selection of any inline device is likely to be limited by the location or cost of moving services.

## End of pipe

For this project the open space area along the Parramatta River provides a good opportunity for the installation and maintenance for devices at or near the end of pipe. The types of devices considered for this project include medium to large gross pollution control structures that will not be significantly affected by the regular flooding of Parramatta River. In some areas filtration devices (refer to below) in tandem with gross pollutant traps may be able to be incorporated into the design though their treatment will be limited to a lower flow due to size and cost constraints.

Nets and other 'loose' structures such as litter booms that are attached to the ends of the pipes can be impacted by high flows and the associated debris carried down river. Because of the potential damage that can be caused by floating logs and other matter these types of units are not considered appropriate for this area.

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<sup>9</sup> University of South Australia, Urban Water Research Centre (2001) *Evaluation of Gully Pit Inlet Control Systems*. Report prepared for Brisbane City Council. Date of issue 5 November 2001 p 20.

## Instream

Instream devices such as booms and floating devices (such as the Bandalong Trap) provide some level of capture and retention of buoyant pollutants. However the fluctuation in flows and river height preclude the use of such devices in this section of the Parramatta River as it is during these period that the booms and traps tend to self-clean, therefore defeating their purpose. As such no further consideration is given to their application in this report.

## Filtration devices

Filtration devices have been considered as a specific control option for the CBD. A filtration device uses some three dimensional media such as sand or organic matter to provide secondary or tertiary treatment of stormwater. The filter is designed to remove fine particles as well as to absorb metals, nutrients, oils and other products. However in order to work effectively, the devices will require pre-treatment to remove gross pollutants to allow the filtration media to work effectively and efficiently.

Types of units under consideration for the Parramatta CBD include Delaware design sand filter and proprietary devices such as the StormFilter.

Within the CBD there are numerous car parks in operation. These can be divided into three types:

- the purpose built multi-storey car parks owned by Council and the private sector;
- the single storey bitumen paved sites operated by private management companies; and
- the single storey unpaved sites, typically smaller and possibly holding less tenure than the paved sites.

For the purpose built car parks this report has recommended the investigation and possible installation of StormFilter or similar units on the top floor level of the car park to treat the oils, fine sediment and metals that are washed off after rain. Where Council owns the car parks the feasibility and costs associated with the stormwater treatment can be funded from the Improvement Levy or by agreement with the licensee of the facility. For the sites that are under private ownership and management any improvement needs to be negotiated by Council as part of an auditing and improvement program.

For the 'temporary' sites (ie less than 3 years), an assessment needs to be undertaken as to likely ongoing use and potential construction on the site. If the 'temporary use' is to be for a period greater than 3 years, Council should investigate opportunities to seal any of the unsealed sites to prevent the export of fine and coarse sediments to the stormwater system. Where the site is to continue to be used as a car park for more than 5 years, Council should investigate options for installing combined gross pollution control and sand filters to treat runoff before leaving the site. Any units constructed for these sites should be able to be removed and reused at other facilities in the Council area when the current car park or similar activity is displaced.

## Options

This section provides details on each of the 15 catchments. The following information is provided:

Description of the catchment including its location, stormwater pit and pipe network, land use and other key features;

Pollution hot spots;

Key pollutants of concern – this is also referenced against Table 4 that has estimated the annual pollutant load for sediment, organics and litter;

Hydraulic or physical limitations of the catchment;

Treatment options; and

Recommendations drawing on the catchment information to identify optional solutions at the present time.

## 1. Old Kings school catchment

### **Description**

This catchment lies north of river encompassing church and school land bounded by Victoria Road to the north, Marsden Road to the east and O’Connell Street to the west.

Runoff from the built section is presumed to discharge to the 450mm diameter stormwater pipes along O’Connell Street and then discharges via the 525mm diameter pipe beneath the O’Connell Street bridge.

Land use in this catchment is ‘special use’ and includes a school, a church, some boarding housing and a large area of grassed open space to the south.

O’Connell street to the west and Victoria Road to the north are major roads in the catchment.

Street trees are not dominant in this catchment although O’Connell Street and Victoria Road are proposed to have street trees as part of the Parramatta City Public Domain Plan.

### **Pollution hot spots**

Sediments and associated heavy metals generated as a result of traffic are likely to be the most significant sources of pollutants in the catchment.

Organics are likely to present a problem along Victoria and O’Connell Streets after the street tree planting occurs. Further up the catchment organics from street trees will be a major source of pollutants.

### **Pollutants of concern**

- Litter from pedestrians particularly associated with the nearby football oval, public swimming pool, school and the users of the oval within the church grounds
- Oil, grease and metals from vehicles
- Sediment from unpaved areas adjacent to O’Connell Street. The grass oval and strip of vegetation adjacent to the river will provide significant cover and filtering of sediments and other pollutants that move via sheet flow during rain events. This is likely to reduce the net export of sediment and organics from half this catchment.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Old Kings School catchment	1.44	1.04	0.26	2.74

***Limitations***

The construction and maintenance of an end of pipe solution would require the construction of an access path through private property.

Further investigations is required to determine where the stormwater from the built section of the catchment flows.

***Treatment options***

Pit baskets along O'Connell Street after the planting of the street trees. There are 4 pits on the eastern side of O'Connell Street to Victoria Road and 2 pits on Victoria Road near the intersection with O'Connell Street.

***Recommendations***

No treatment at this stage pending determination of the street tree planting program.

If a broad pit basket program is considered, the 6 pit basket locations identified should be included.

## 2. Villiers Street catchment

### *Description*

This catchment is located north of the river extending in a narrow band approximately 100 metres wide either side of Marsden/Villiers Streets. The northern boundary is at the intersection of Albert Street, Pennant Hills Road and Church Street. The southern boundary is at Market Street.

Stormwater is discharged to the river via a 600mm outlet pit beneath the Marsden Street Bridge into the low flow channel of the river beneath the weir.

Land use in the catchment incorporates a mix of activities from schools, takeaway food and restaurants, to commercial businesses, medium to high density residential and half of Alfred Square.

The north-western part of the catchment falls outside the CBD area as defined by the Parramatta LEP.

### **Outlet of the stormwater pipe under the Marsden Street Bridge**



### *Pollution hot spots*

- Takeaway food shops and their adjacent car parks at the northern end of the catchment
- Primary schools to the north and centre of the catchment generating litter, organics and sediment
- Commuter/office car park at the intersection of Fennell Street and Villiers Street will generate sediments, oils and metals
- Prince Alfred Park and the street trees along Market Street and Marsden Street will contribute to sediment and organics and probably litter from within and adjacent uses.

**Pollutants of concern**

- Litter from the takeaway food premises and schools
- Organics from street trees along Villiers Street/Marist Place and Market Street and school play grounds
- Sediment from school gardens, residential areas, footpaths and to a lesser extent Prince Alfred Park.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Villiers Street catchment	6.39	1.62	1.60	9.62

**Limitations**

Possible drainage low point along Market Street that may present flooding problems for source controls.

**Treatment options**

**End of pipe**

CDS P2018. The location should be beneath the Marsden Street bridge adjacent to existing bitumen access path. The flood levels should be verified to minimise this impact on the performance of the unit. The location of services would need to be investigated.

**Source control**

- Two (2) pit baskets at Villiers Street between Fennel and Gross Street (2 pits) targeting sediments and organics
- Two (2) pit baskets at the corner of Fennell Streets and Villiers Street (east side) to capture litter and sediments from car park and takeaway food premises
- Pit baskets as a source control for organics along Marist Place and Market Street (5 pits) although flooding risk may limit this option. This will need to be investigated and has therefore not been included in the cost estimates.

Council could investigate the potential for treating runoff that flows from the Council commuter car park. Treatment options should investigate the use of devices that can capture free oils and sediment such as Humeseptor or Stormfilter. Further investigation is required for these options before inclusion in the stormwater program as it would require reconfigurations to the drainage system in the car park.

**Recommendations**

*Priority 1*

Pit baskets as a source control technique for litter on Villiers Street between Fennel and Gross Street (2 pits).

*Priority 2*

2 pits at the corner of Fennell Streets and Villiers Street (east side)  
End of pipe CDS device.

### 3. Riverside theatre catchment

#### **Description**

This catchment is located north of the river taking in the eastern half of Alfred Square and the Riverside Theatre extending east to Church Street. The northern end is bounded by Victoria Road.

Prince Alfred Park and the Riverside Theatre including the restaurant largely dominate the land use in this sub-catchment.

Church Street is a major transport route and the western half is incorporated in this catchment.

#### **Pollution hot spots**

- Litter from the fast food premises (McDonald's) uphill of the catchment and associated with the Riverside Theatre and restaurant.
- Organics from Prince Alfred Park.

#### **Pollutants of concern**

- Litter
- Organics.

Sediments are likely to be less of a problem than estimated due to the highly impervious nature of the catchment or the high maintenance of the grassed sections of Prince Alfred Park.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Riverside Theatre catchment	1.09	0.26	0.33	1.69

#### **Limitations**

The outlet from this pipe is close to the western side of Lennox Bridge and discharges approximately 1.5 metres from the ground level with a drop of 4 metres to the low flow level of the river. Access to the outlet is limited by a walkway and would require the construction of a more robust access path if larger structural works were to be undertaken

#### **Treatment options**

The size of this catchment limits the use of an expensive end-of-pipe solution where access for construction and maintenance is difficult.

Most of the stormwater pits in this catchments along Church Street allow for the use of Enviropod unit and 5 should be installed on the western side of Church Street. These include one upslope of the low point McDonald's pit, two at the intersection of Church Street and Ross Street, 2 on the Church Street openings intersecting Gross Street.

The junction pit immediately outside McDonald's on Church Street is shallow and diverts runoff under the road in a south east direction. This pit is likely to subject to intense hydraulic loads during storm events and therefore is not appropriate for an insert.

***Recommendations***

Install 5 Enviropod units along Church Street.

## 4. Carlton Hotel catchment

### *Description*

This is a small catchment draining to the north of the river bounded by Church Street to the west, Victoria Road to the north and extending approximately 90 metres along Palmer Street as the eastern boundary.

The land use is dominated by high density residential with some retail, the Carlton Hotel and some commercial activity.

Stormwater discharges east of the bridge adjacent to the walkway.

### *Pollution hot spots*

- The Carlton Hotel and its adjacent storage/loading area
- Church Street and Victoria Road

### *Pollutants of concern*

- Organics associated with the proposed street tree planting along Victoria Road and to a lesser extent the small scale plantings proposed along Church Street from Victoria Road to the river
- Litter and sediments from the main roads
- Oils from around the Carlton Hotel car park and possibly loading dock

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Carlton Hotel catchment	0.82	0.22	0.18	1.22

### *Limitations*

Access for the construction and maintenance of end of pipe units would require entry via the ramp near Sorrell Street. Load bearing design of the current footpath would need to be verified if this was chosen as a treatment option.

Access to maintain pit baskets along Church Street could be difficult and would have to be undertaken outside peak traffic hours and periods where parking may be a difficulty. Some of the side entry pits are very shallow precluding the use of Enviropod units.

### *Treatment options*

- Two (2) pit baskets in the pits at the corner of Palmer Street and Church Street
- Three (3) pit baskets along Church street opposite Market Street to the Bridge. Note one pit nearer the bridge is not suitable due to limited depth.

### *Recommendations*

- Priority 1: install 3 pit baskets in the pits opposite the Riverside Theatre
- Priority 2: install 2 pit baskets in the pits near the intersection of Palmer Street and Church Street.

## 5. Brickfield Creek catchment

### *Description*

This catchment is a sub-catchment of the Brickfield Creek stormwater catchment. The section in the CBD is bounded by Harold Street to the north, Sorrell Street to the east and the Villiers Street and Carlton Hotel catchments to the west. The catchment drains via an open channel east of the Sorrell Street bridge.

Parramatta City Council and Sydney Water are currently preparing a report on possible stormwater treatment options for the entire Brickfield Creek. This report should be able to give direction to controls in the portion of the catchment in the CBD area and further afield.

### *Pollution hot spots*

- Auto sales and repair between Victoria Road and Palmer Street particularly oils, grease and nutrients from detergents
- Sediments and metals associated with the major roads including Church Street, Victoria Road and Wilde Avenue
- Organics from the existing street along the north-eastern side of Church Street and the existing mature plantings along Sorrell Street
- Considerable areas identified for future street tree planting including along Sorrell Street Wilde Avenue and Victoria Avenue
- Litter from takeaway food premises along Church Street
- Further into the catchment other pollutants will contribute to the type and quantity of gross pollutants entering this catchment.

### *Pollutants of concern*

- Organics from street and private trees
- Oils and grease from motor vehicle premises
- Sediments from road and landscaped areas within and outside the catchment.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Brickfield Creek catchment	11.70	2.61	2.61	19.93

### *Limitations*

The size of the catchment and the configuration of the various sub-catchments within a highly developed area limits opportunities for in-line treatment. The pit and pipe network within the CBD area is undersized and therefore pit inserts need careful design so as not to impact on cross flows through the pipe network. The pipe network between Victoria Road and Ross Street is shallow and undersized and may require replacement to accommodate the design flows.

End of pipe treatment may be an option provided suitable land area is available and the expected flows from the catchment can be calculated so as to accommodate a 3 month ARI storm event or, if necessary and desired from a quality perspective, a lesser storm. Construction and maintenance of an end of pipe structure would be possible via the existing access path.

***Treatment options***

Oil and grease from private car yards should be treated by lessees or owners using Humeguard or Stormfilter or equivalent device. This is to be negotiated by Council as part of an auditing program.

There are 10 pits along the western side of Church Street, including the corners of Ross and Gross Streets, that have the potential for pit baskets. The low point in the network outside McDonald's would be excluded due to flooding and the limited depth of the pit itself.

A low flow diversion weir and end of pipe large gross pollution control devices may be appropriate near the outlet of the river adjacent to the access path. This will require further investigation.

There are a number of pits along Sorrell Street that could be incorporated in a pit program at a later stage to target organics from the present and future street trees and sediments from the road.

***Recommendations***

Installation of 10 pit baskets along the western side of Church Street.

Refer to the investigations by Council and Sydney Water into the potential of inline and end of pipe devices along the entire catchment.

## 6. Westfield catchment

### *Description*

This is a large catchment extending from the Great Western Highway in the south, O’Connell Street to the west and Church Street to the east. The catchment takes in the Westfield shopping centre complex in the south and legal precinct.

The land use in this catchment is particularly varied with commercial and retail dominating 40 per cent of the land.

Stormwater is discharged via a 1650mm pipe east of the Marsden Street Bridge. However the drainage maps are not able to clarify the location of this trunk drain from the vicinity of George Street. It is assumed it passes beneath the Hospital grounds providing possibly an ideal location for an inline treatment device.

### **Photo 2. Stormwater outlet pipe draining the Westfield Catchment with the Marsfield Bridge in Background**



### *Pollution hot spots*

- Oils, metals and sediments from the car park areas associated with Westfield, within the legal precinct and adjacent major streets including O’Connell, Marsden, and Macquarie Streets and the Great Western Highway
- Bus stops along Argyle Street to the north of Westfield
- Considerable street tree plantings along Campbell, Argyle, O’Connell and Marsden Streets and along the railway corridor. These and all the other streets in the catchment have been identified for further street tree plantings.

### *Pollutants of concern*

- Organics from street trees
- Oils, metals and sediments from the car park areas and major roads
- Litter along Argyle Street adjacent to the bus stop and along the small stretch of Church Street.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Westfield catchment	19.66	4.41	4.86	28.93

### **Limitations**

- Drainage low point adjacent to the railway line
- Unknown location of the drainage network at the bottom of the catchment
- Limited Council owned land at the end of the catchment suitable for end of pipe/inline treatment
- Private ownership of most of the car park areas and the influence that Council may have on implementing some form of runoff controls from these sites.

### **Treatment options**

#### *End of pipe*

Investigations need to be undertaken to assess the location of the stormwater pipe and the available land on the west side of Marsden Street near the intersection of Phillip Street or by negotiation with the Department of Public Health for access in the hospital site for a CDS P2028 with a larger sump to collect the potential high amounts of sediments that are generated from this catchment. Given the potential depth of the 1650mm pipe a wider rather than deeper sump would be preferable to reduce construction and maintenance costs. If an end of pipe or inline site cannot be found further investigation of potential pit basket sites should be undertaken.

#### *Source control*

Oil, fine sediment control from Westfield and other commercial car parks via a modified sand filter or StormFilter. As a priority these should be placed on the exposed levels of the car park that receive runoff.

There are 4 pits along Argyle Street between Church and Marsden that have the potential for pit baskets. This would enable the source control of litter and organics from this high use area in addition to sediments and organics associated with the rail corridor.

Other sites pending the outcome of an investigation of the CDS device would include the following intersections: Macquarie and Marsden Streets (5 pits); Eastern half of Hunter Street from the Marsden Street intersection (6 pits).

### **Recommendations**

Further investigation of the location of the pipe outlet and possible location of a CDS device on the west side of Marsden Street or in the Department of Public Health grounds is needed.

Four (4) pit baskets should be installed along Argyle Street

## 7. Old court house catchment

### *Description*

This catchment is located south of the river bounded by George Street to the south, Marsden Street to the west with the eastern boundary lying between Marsden Street and Church Street. It takes in the sealed car park at the rear of the shops on the west of Church Street comprising about 25 per cent of the total catchment area.

### **Photo 3 Outlet of stormwater pipe downstream of car park**



### *Pollution hot spots*

- Car park generating sediments, oils, metal and organics associated with the street/car park trees
- Litter from the commercial activities along Church Street.

***Pollutants of concern***

Organics, sediments and oils from the car park.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Old court house catchment	1.30	0.23	0.39	1.92

***Limitations***

The intensive use of the car park and need to maximise the available car park spaces will mean that any end of pipe device or inline device may have to be realigned with the last pit and pipe at the northern end of the car park adjacent to the path parallel to the river to pick up the runoff from the lower half of the catchment.

***Treatment options***

The small size of the catchment lends itself to either one pit basket in the car park or a small end of line device at the northern extremity of the car park. Given the current pit and pipe configuration at the northern end of the catchment a single pit basket is the preferred option.

***Recommendations***

Installation of one (1) Enviropod pit baskets within the car park area.

## 8. South Lenox Street Bridge catchment

### *Description*

This catchment incorporates the main restaurant precinct of Parramatta incorporating many outdoor cafés and eateries. It extends south of the river draining many of the commercial premises along Church Street from George Street.

In May 2002 a CDS unit FO908 was installed adjacent to the river east of the Lennox Street bridge.

In 2000 a number of stormwater pit inserts were trailed along Church Street from the Lennox Street bridge in the north to Chinatown in the south. A few shallow 'self-cleaning' baskets remain in this catchment with the majority in the CBD catchment.

Small scale planting of street trees are proposed to line Church Street in this catchment.

### **Photo 4. Installation of the CDS device adjacent to the Lennox Street Bridge**



### ***Pollution hot spots***

Litter along the restaurant strip from George Street to the Lennox Bridge. The rear of these premises may also prove to be a pollutant source for waste oil illegally discharged to stormwater and rubbish from garbage storage areas.

When the proposed street trees are planted organic loading captured by the CDS unit is expected to increase.

**Pollutants of concern**

- Litter from cafés and restaurants
- Organics in a limited extent from current street trees and possibly to a greater extent the proposed street trees
- Sediments and oils from vehicles along Church Street
- Illegal discharges of oils and other matter from restaurants.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
South Lenox St Bridge catchment	2.05	0.37	0.75	3.18

**Limitations**

Pits between Phillip Street and Lennox bridge are very shallow and are not appropriate for pit inserts.

**Treatment options**

Use the current CDS unit.

There are a number of pit inserts that were installed under a previous trial program by Parramatta City Council and others. These should be removed as there is little storage capacity due in part due to the shallow nature of the pits and the units self clean during storm events thereby re-introducing any stored pollutants back to the environment (refer to Appendix 1).

**Recommendations**

Nil.

## 9. David Jones car park catchment

### **Description**

This catchment is located south of the river draining the area bounded by Church, Phillip and Smith Streets taking in the River Bank David Jones commercial site and the adjacent car parking stations.

In May 2002 a CDS unit FO908 was installed on the 750mm diameter pipe along the river foreshore between the Lennox Street bridge and Smith Street.

### **Pollution hot spots**

- Car park generating oils, metals and fine sediments
- Current and future street trees along Phillip Street contributing to the organic load.

### **Pollutants of concern**

- Oil, grease and sediments from the car park
- Organics from Phillip Street.
- 

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
David Jones car park catchment	2.38	0.42	0.65	3.42

### **Limitations**

The recently installed CDS unit will capture most of the gross pollutants generated from the catchment. However it is not designed to capture oils and fine sediments that will be generated from the car park areas. At-source control is required to capture the 'free' oils prior to them becoming mixed and emulsified in the runoff.

### **Treatment options**

Humeceptor or StormFilter or Delaware sand filter for the top storey of the car park to capture free oils and sediment. The StormFilter and sand filter will need some pre-treatment to remove gross pollutants that could be designed prior to the pits on the sections of the car parks exposed to runoff. The devices can be fitted within the stormwater drainage systems in the car park with the size of unit proportional to the catchment area – refer to manufacturer's recommendation.

### **Recommendations**

StormFilter for the car park areas exposed to runoff.

## 10. Phillip Lane catchment

### *Description*

This is a sub-catchment that drains to a 1650 x 600mm box culvert along with the office catchment into the river just west of the Smith Street bridge. George, Smith and Phillip Streets form the boundary of this catchment.

It contains mostly office space accompanied by ground floor retail and food premises and contains a multi-storey car park.

**Photo 5 Box culvert draining the Phillip Lane and CBD catchment**



### *Pollution hot spots*

- Car park generating oils, metals and fine sediments
- Current and future street trees along Phillip Street and Horwood Place contributing to the organic load
- Litter along George and Phillip Streets associated with office workers.

### *Pollutants of concern*

- Oil, grease and sediments from the car park
- Organics from Phillip Street
- Litter.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Phillip Lane catchment	3.17	0.58	0.79	4.54

***Limitations***

None.

***Treatment options***

Humeceptor or StormFilter or Delaware sand filter for the top storey of the car park to capture free oils and sediment. The StormFilter and sand filter will need some pre-treatment to remove gross pollutants that could be designed prior to the pits on the sections of the car parks exposed to runoff. The devices can be fitted within the stormwater drainage systems in the car park with the size of unit proportional to the catchment area – refer to manufacturer’s recommendation.

As this catchment drains via a box culvert with the runoff from the office catchment an end-of pipe option is the preferred solution to treat both the David Jones car park and Phillip Lane catchments.

In the short term a series of pit baskets could be installed along Phillip and George Streets.

***Recommendations***

This catchment should be considered alongside the CBD catchments in terms of end of pipe solutions. This is primarily centred on the use of a CDS 2018 unit

The top storey of the car park should be treated with a StormFilter .

## 11. CBD catchment

### *Description*

This catchment incorporates much of the high density office space between Smith and Church Streets extending back to Parramatta railway station. Much of the southern portion of this catchment surrounding the Council Chambers has been identified for redevelopment that will further intensify the land use.

Litter and sediments are estimated to be significant sources of gross pollutants in the catchment with organics sourced from the street trees, many of which are deciduous that will have a seasonal effect.

In 2000 a number of stormwater pit inserts were trailed along the Church Street from the Lenox Street bridge in the north to Chinatown in the south which incorporates most of the Church Street section of this catchment. The devices included Enviropod units along the Mall, Ecosol RSF 100 along the southern sections of Church Street and a variety of shallow trays. The shallow tray units are not playing any significant role in reducing gross pollutants and the other units require maintenance.

Stormwater is discharged via the box culvert also draining the Phillip Lane catchment.

### *Pollution hot spots*

- Mall and associated litter, and organics associated with the deciduous street trees
- Area around the railway station and bus terminal at the corner of Smith Street and Darcy Avenue.
- Council car park and the major multi-storey car park between Macquarie and George Streets.

### *Pollutants of concern*

- Oil, grease and sediments from the car park and at bus terminus
- Organics from street trees
- Litter around public transport nodes (rail station and bus stop)

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
CBD catchment	18.48	3.42	5.01	26.92

### *Limitations*

- Drainage low points along Church Street under the rail overpass
- Poor drainage capacity of the current pit and pipe network in the upper sections of the catchment
- Shallow pit depths restricting the use of pit baskets
- Potential redevelopment of the Mall and other commercial areas. These sites will require review by Council officers to ensure that appropriate stormwater quality improvement treatments are incorporated in the design and maintenance.

### ***Treatment options***

#### *End of pipe*

The treatment of this catchment should be considered in parallel with the Phillip Lane catchment as both drain via a box culvert from the intersection of Phillip and Smith Streets to the river. The total catchment area of the two catchments is approximately 20.5 ha with an estimated treatable flow of 1.23 m<sup>3</sup>/s. A low flow diversion weir could be constructed in association with a CDS P2018 to treat the 3 month ARI event. This should cater for the highly impervious area of the catchments and resultant runoff flows and gross pollutant mobilisation.

#### *Source control*

There are a number of hot spots that should be served with pit baskets including:

- bus and train terminal area along Argyle and Smith Streets (8 pits)
- pits at the intersection of George and Smith Streets to capture organics (particularly during autumn) and litter (4 pits)
- northern end of the Mall to capture organics and litter (3 pits).

#### *Car parks*

Humeceptor or StormFilter or Delaware sand filter for the top storey of the car park to capture free oils and sediment. The StormFilter and sand filter will need some pre-treatment to remove gross pollutants that could be designed prior to the pits on the sections of the car parks exposed to runoff. The devices can be fitted within the stormwater drainage systems in the car park with the size of unit proportional to the catchment area – refer to manufacturer's recommendation.

In relation to the redevelopment it has been identified that fine stainless steel grates will be installed consistent with the treatment of the paved areas along Church Street towards Lennox Bridge. If this is the case the current Enviropod baskets should be removed and gross pollution control be replaced by regular street sweeping by Council staff. This should occur at least in the morning and evening to minimise the build-up and possible mobilisation of pollutants to the stormwater system. Further commercial redevelopment should place the responsibility for stormwater pollution control with the developer, which should correspond with the land use and expected pollution generation rates as outlined in this report.

### ***Recommendations***

- Retain current Enviropod units in Mall until redevelopment. Remove other units (refer to Appendix 1)
- Install Enviropod units at: the northern end of the Mall at the intersection of George Street (pits 46, 47, 48); and around the bus terminal area (8 pits)
- Should an end of line device be delayed for more than 3 years, 4 pit baskets should be installed at the corner of George and Smith Street
- Treatment of the top storey of the car park with a StormFilter
- CDS 2018 along the river bank to treat this catchment and the Phillip Lane catchment.
- Incorporate stormwater treatment into all future redevelopments particularly along Church Street and around the railway precinct.

## 12. Barrack Lane catchment

### *Description*

This catchment is located south of the river and extends west to Smith Street, south to the northern boundary of the Lancer Barracks and east midway between Barrack Lane and Charles Street. It drains via a 900mm pipe under the pedestrian bridge linking Elizabeth Street on the northern side of the river.

The land use is heavily dominated by office accommodation with a small section of Arthur Phillip High School at the southern end.

### **Photo 6 stormwater pipe outlet adjacent to reconstruction works for the pedestrian footbridge**



### *Pollution hot spots*

- Playground associated with Arthur Phillip High School contributing litter and organics
- Organics associated with the street trees along George Street
- Sediments generated from Macquarie, George and Phillip Streets.

### *Pollutants of concern*

- Organics and litter.

The highly impervious nature of this catchment is likely to lead to a reduction in the total sediments generated than that estimated.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Barrack Lane catchment	5.37	1.05	1.85	8.27

### ***Limitations***

The capacity of the pit and pipe network is quite poor and will preclude any inline device upstream of Phillip Street. Construction of the pedestrian overpass and other site access works either side of the river are currently being undertaken. The treatment of stormwater from this catchment could have been incorporated in the design of these works which would have presented some economies in construction costs.

### ***Treatment options***

#### *End of line*

The fall from Phillip Street to the riverbank would allow for the use of a modified Baramy trap (Direct flow D1500) to capture organics and litter from the catchment. A headwall and flume would need to be constructed in a manner compatible and sympathetic with the proposed landscaping of the area. The device would have to be constructed as an in-line trap to allow the re-piping of flow prior to being discharged to the river. This device would allow for users of the river to see a pollution control trap and therefore having some educational role, and being stored dry would not have the odour problems associated with wet vault systems such as the CDS units. However sediment capture is very poor and the educational benefits would have to off set this limitation.

(\$25,000 including landscaping)

#### *Source control*

There are three (3) pits on the western corner of Macquarie and Charles Streets and two (2) on the corner of George and Charles Streets that are well positioned to capture organics and sediments from the adjacent street tree plantings.

### ***Recommendations***

Five pit baskets as the immediate treatment with a Baramy trap mid way down the pipe on the embankment pending its compatibility with the river walk recreation plan.

## 13. Arthur Phillip High School catchment

### *Description*

This catchment is bounded by George Street to the north, Charles Street to the east and Little Street to the south. The western boundary lies midway between Barrack Lane and Charles Street. Runoff is transported via a 1200mm diameter pipe to the southern bank of the river approximately in line with Argus Lane. A new development on the corner of George and Charles Streets will augment the capture of runoff along George Street via a new series of pits and pipe connecting to the main line.

The outlet of this pipe is downstream of the ferry terminal beyond the current access path and heritage walk. A 3-metre retaining wall adjacent to the river bank has been constructed to protect against flooding which limits public access to the outlet by vehicles.

### **Photo 7 Stormwater outlet from Arthur Phillip High School catchment adjacent to the Parramatta River**



### *Pollution hot spots*

- Litter, organics and sediment from the Arthur Phillip High School
- Organics from the street trees along Macquarie Street
- Most roads in this catchment have been identified for future street tree planting which will result in a considerable increase in organics.
- Vehicle and pedestrian traffic along Macquarie and George Streets generating litter and sediments.

**Pollutants of concern**

- Organics from the street trees and landscaping within the school grounds
- Sediments from the roads, playground areas and associated with the street trees.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Arthur Phillip High School catchment	5.06	1.39	1.09	7.55

**Limitations**

While the capacity of the system is relatively good, the catchment is very flat which would limit any in-line treatment requiring hydraulic force or fall to operate.

Access to the outlet of the pipe adjacent to the river will present challenges for the construction and maintenance of any end of pipe device.

**Treatment options**

*Source control*

- Three (3) pits at the corner of Little Street and Charles Street to capture organics and litter from present land use. The construction and later use of the high density residential towers to the south-west of this corner will also generate gross pollutants that can be captured by the pit baskets.
- Four (4) pits on the corner of Macquarie and Charles Streets to capture organics, sediment and litter.

**Recommendations**

Seven (7) pit baskets along Charles Street at the intersections of Little Street and Macquarie Street.

## 14. Rowland Hassall Special School catchment

### *Description*

This is a sub-catchment of the Claycliff Creek catchment draining into the southern bank of the river via the Claycliff stormwater channel. The catchment is bounded by Charles Street to the west, Hassall Street to the south, the commercial properties draining on the northern side of Macquarie Street to the north and mid-way between Harris and Wigram Streets to the east.

The catchment contains a diversity of land uses include a sealed open car park, two unsealed car parks and presently one major site is under construction for high density units.

### *Pollution hot spots*

- Sealed and unsealed car parks generating fine and coarse sediments, metals and oils
- Organics from the present streets (particularly on the eastern corner of Macquarie and Charles Streets) and private landscaped areas. All the streets in this catchment have been identified for street tree planting which will have an impact on the net export of organics.

### *Pollutants of concern*

- Sediments from the unpaved car parks and landscaped areas
- Organics.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Rowland Hassall Special School catchment	1.24	0.30	0.21	1.75

### *Limitations*

As this is a sub-catchment of a very large and hydraulically limited catchment any inline or end of pipe treatment of this catchment in the channel is not possible.

### *Treatment options*

- Sealing of the two (2) unsealed car parks
- Installation of pit baskets along Macquarie Street between Charles and Argus Streets.

### *Recommendations*

Seal the unsealed car parks.

## 15. Clay Cliff Creek catchment

### *Description*

This catchment incorporates approximately one third of the CBD area and drains via the Clay Cliff Creek channel to the southern side of the river east of the CBD area. The catchment extends from the eastern boundary of the CBD area on Hassall Street to the Parramatta railway station in the north, south-west to the intersection to the Great Western Highway and Marsden Street and then due south incorporating many sub-catchments within and outside the CBD area.

The key land use activities include the motor vehicle sales and repair premises concentrated along Church Street and the surrounding residential properties particularly to the south-east. Church Street and the Great Western Highway forming to Park Street and Harris Street are the major roads in this sub-catchment and carry significant through traffic for the region.

### *Pollution hot spots*

- Motor vehicle sales and repair premises along Church Street generating oils, nutrients from detergents, fine sediments and metals. The actual impact of the private businesses on the stormwater system would need to be determined via an industry audit to see what treatment runoff is given for the activities in the sales yards and workshops.
- Major roads generating litter, oils and fine sediments
- Organics from the residential areas and the few locations of street tree planting. It should be recognised that most of the streets in this catchment are identified for tree planting that will increase the load of organics significantly.

### *Pollutants of concern*

- Oils, grease and detergents from auto premises at the southern end of Church Street and Park Street.

	Estimated pollutant load (m <sup>3</sup> /ha/yr)			
	Sediment	Organics	Litter	Total
Clay Cliff Creek catchment	60.48	14.95	5.71	81.13

### *Limitations*

- Hydraulic flows in the open channel prevent any on-line treatment.
- Limited opportunities to treat piped stormwater flows prior to entering channel due to lack of available open space and intensive land use.

### *Treatment options*

Source control via the use of pit baskets in key gross pollution generating land uses and areas.

The options described are dependent on the timing and extent of the redevelopment of the Parramatta rail interchange. As a reference stormwater treatment should be incorporated in the design, construction and maintenance of the new facilities as a core feature.

China Town end of Church Street, 2 pits at the intersection of Campbell Street and Church Street (west side), 5 pits between Campbell and the Great Western Highway (3 west side 2 east side)

Valentine Avenue and Wentworth Street commercial block: 3 pits on Valentine Avenue at the intersection of Parkes Street and 5 pits on either side of Wentworth Street.

Great Western Highway two pits outside property number 6 and 7 (approximately 40 metres from the intersection with Church Street)

Parks Street: 1 pit outside number 5-7 (Lone Star restaurant); 2 pits on the corner of the entry to the car park between Wentworth Street and Church Street; and 4 pits on the corner of Cowper Street.

Church Street - motor vehicle retail section: there are approximately 20 pits on and in the immediate side streets of Church Street between the Highway and Boundary Street. Given the use of this road and the potential pollutants generated by current activities and the planned street tree planting, pits baskets should be fitted into each of these pits.

Where oils may be a problem such as along Church Street and the Great Western Highway sand filters may be appropriate if there is sufficient capacity and fall within the existing pit baskets. These will require specific design to maximise their efficiency and will need to be integrated within the proposed pit basket or similar gross pollution control device.

Seal car park near the corner of Marion and West street.

### ***Recommendations***

#### Priority 1

- 7 pits along the China Town end of Church Street
- 7 pits along Parkes Street
- 2 pits on Great Western Highway

#### Priority 2

- 8 pits within the Valentine Avenue and Wentworth Street commercial area
- 20 pits along the motor vehicle retail section of Church Street
- seal car park

## Ranking

To assist in the selection of catchments for treatment a cost and benefit ranking has been undertaken against the recommendations given the Options section. This has been used to assist decision makers determine areas for expenditure.

The cost rank has been calculated by taking into consideration the capital (including an estimate for installation) and annual maintenance cost of the recommended options. The lower the value greater the cost effectiveness of the recommendation. The costs are calculated in 2002 dollars against prices quoted by manufacturers in Contract 019- Stormwater Treatment Devices.<sup>10</sup>

The benefit rank has been calculated by considering the total gross pollution load generated in the catchment, the proportion of area protected by the recommended measures and the effectiveness of the recommended structural options to control sediment, organic and litter. The higher the value the greater the catchment benefit.

It should be noted that this ranking methodology is a guide and was not designed to factor and weight factors such as timing of significant redevelopment, such as the rail interchange, other works in the catchment that may provide opportunities for the installation of certain devices due to economies of scale, political and community pressures for catchment protection and so forth. Neither has the ranking system incorporated a compensation factor for effective non-structural programs that may reduce the overall pollution generated in the catchment.

A combined cost and benefit rank has not been calculated as such an approach can be subject to manipulation when multiplying the respective cost and benefit values. The use of this approach can also place a far greater emphasis on the final score by uninformed managers without giving due consideration to the component parts of the algorithms.

As the intent of the stormwater improvement is to improve the quality of water in the Parramatta River, the benefit rank is used as the primary criteria for identifying and prioritising works. Council must however examine the capital cost and its affordability via the revenue raised through the special rate and importantly the associated and cumulative maintenance costs that will be funded through the recurrent budget.

Appendix 2 provides details of the calculations and methodology used for this ranking exercise.

Table 7 provides a summary of the cost rank calculated for the various works within the 15 catchments. Excluding the South Lenox Street and Rowland Hassell Special School catchments that have no additional works identified, the catchments that have recommended the installation of a small number of pit baskets are given a favourable cost rank index. This reflects the relative low capital cost and moderate maintenance costs. Where large end of pipe solutions are recommended their relative high capital cost disadvantages their overall rank, likewise where high number of pit baskets are recommended the overall higher maintenance costs disadvantages the weighting. This is evident of the Westfield, CBD and Clay Cliff catchments.

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<sup>10</sup> Refer to NSW Department of Public Works and Services (2001) Contract 019 – Stormwater Treatment Devices. User Guide 1 June 1998 to 31 May 2002. Further details can be obtained from DPWS [gary.edwards@dpws.nsw.gov.au](mailto:gary.edwards@dpws.nsw.gov.au).

**Table 7 Cost weighted index**

Catchment	Cost rank
Rowland Hassall Special School	0.255
South Lenox Bridge	0.255
Riverside Theatre	0.255
Carlton Hotel	0.7
Old court house	0.7
Old Kings School	0.95
Arthur Phillip High School	0.95
David Jones car park	1
Phillip Lane	1
Brickfield Creek	1.325
Villiers Street	2.625
Barrack Lane	2.625
Westfield	3.875
CBD	5.125
Clay Cliff Creek	5.375

Table 8 provides a summary of the benefit rank calculated for each of the catchments including a summary of the specific recommendations actions and capital and maintenance costs. In general the larger the catchment and thus its higher estimated pollutant load, coupled with an efficient end of pipe or series of source control strategies the greater the benefit. This is reflected by the Westfield, CBD and Clay Cliff Creek catchments having a favourable rank. Of particular note is the recommendation for a joint end of pipe device for the Phillip Lane and CBD catchments. Given the high benefit and shared cost of this recommendation it should be reviewed favourably when determining the actual implementation program.

The installation of Stormfilters in the car parks around the CBD area have been given a priority of 3 pending further investigation by Council. This is also the case for the sealing of the unsealed car parks. In the case of the unsealed car parks, no cost has been calculated as it is unclear of the exact area or timeframe for redevelopment of these sites.

**Table 8 Benefit rank and summary of catchment recommendations and costs**

Catchment	Benefit rank	Recommendation		Cost	
		Action	Priority	Capital (\$)	Maintenance (\$/yr)
Westfield	7.08	CDS	1	80,000	4,000
		4 pit baskets	1	4,000	700
CBD	70.1	11 pit baskets	1	10,300	1,925
		CDS (split with Phillip Lane)	1	30,000	2,000
		Stormfilter	3	25,000	1,000
Clay Cliff	6.94	44 pit baskets	1	44,000	7,700
		Seal car parks	3	not costed	
Villiers Street	6.44	4 pit baskets	1 / 2	4,000	2,800
		CDS	2	42,000	3,500
Phillip Lane	6.15	CDS (split with CBD)	1	30,000	2,000
		Stormfilter	3	25,000	1,000
Barrack Lane	6.11	5 pit baskets	1	5,000	875
		Baramy unit	2	25,000	2,000
David Jones car park	5.17	Stormfilter	3	25,000	1,000
South Lenox Bridge	5.16	No new actions		0	0
Old court house	4.96	1 pit basket	1	1,000	175
Brickfield Creek	4.46	10 pit baskets	1	10,000	1,750
Carlton Hotel	4.27	5 pit baskets	1 / 2	5,000	1,500
Arthur Phillip High School	4.15	7 pit baskets	1	7,000	1,225
Old Kings School	2.99	6 pit baskets	2	6,000	1,050
Rowland Hassall Special School	0.09	No action		0	0
Riverside Theatre	0.08	5 pit baskets	1	5,000	875

## Appendix 1 Church Street stormwater pit program

The following table provides a summary of the depth of the stormwater pits primarily along Church Street between China Town and the Lenox Street Bridge. The pit numbers refer to marking on the top of the pit lintel as observed during field inspections early 2002. At a number of locations pit basket or similar control measure are present that formed part of a trail program funded by the NSW Stormwater Trust. Comment is made as to whether these baskets should remain or be removed as part of this stormwater improvement program.

Number	Status	Recommendation
1	Not found	NA
2	Insert capturing organics and litter present. Good depth	Remove
3	Insert capturing organics and litter present. Good depth	Remove
4	No basket	Leave as is
5	Not found	
6	No basket	Leave as is
7	Insert capturing organics. Good depth	Remove
8	No basket shallow pit	Leave as is
9	Shallow pit. Oil and grease evident	Leave as is
10	Shallow pit. Oil and grease evident	Leave as is
11	Insert capturing organics and litter present. Good depth	Remove
12	Insert capturing organics and litter present. Good depth	Remove
13	Insert capturing organics and litter present. Good depth	Remove
14	Shallow pit.	Leave as is
15	Not found	
16	Not found	NA
17	Not found	NA
18	No insert	Leave as is
19	No pit. Good depth	Leave as is
20	No pit. Good depth	Leave as is
21	No pit. Good depth	Leave as is
22	Not found	NA
23	Enviro pod capturing organics and litter. Good depth	Leave pit basket
24	Enviro pod capturing organics and litter. Good depth	Leave pit basket
25	Not found	NA
26	Not found	NA
27	Not found	NA
28	Not found	NA
29	Not found	NA
30	Not found	NA
31	Not found	NA
32	Not found	NA
33	Not found	NA
34	Not found	NA
35	Not found	NA
36	Not found	NA
37	Not found	NA
38	Enviro pod capturing organics and litter. Good depth	Leave pit basket
39	Enviro pod capturing organics and litter. Good depth	Leave pit basket

Number	Status	Recommendation
40	Enviropod capturing organics and litter. Good depth	Leave pit basket
41	Enviropod capturing organics and litter. Good depth	Leave pit basket
42	No control	Leave as is
43	Enviropod capturing organics and litter. Good depth	Leave pit basket
44	Enviropod capturing organics and litter. Good depth	Leave pit basket
45	Not found	NA
46	Pit basket with high organic load. Moderate depth	Remove
47	Pit basket with high organic load. Moderate depth	Remove
48	Shallow basket with high organic load. Moderate depth	Remove
49	Wire basket full with organics	Remove
50	Not found	NA
51	Not found	NA
52	Shallow wire basket full with organics	Remove
53	Shallow wire basket full with organics	Remove
54	Shallow wire basket full with organics	Remove
55	Not found	NA
56	Not found	NA
57	Shallow wire basket full with organics	Remove
58	Not found	NA
59	Not found	NA
60	Not found	NA
61	Not found	NA
62	Shallow wire basket full with organics	Remove
63	Shallow wire basket full with organics	Remove
64	Shallow wire basket full with organics	Remove
65	Shallow wire basket full with organics	Remove
66	Wire basket full with organics	Remove
67	Wire basket full with organics	Remove
68	Wire basket full with organics	Remove
69	Not found	NA
70	Not found	NA
71	Not found	NA
72	Wire basket full with organics	Remove
73	Wire basket full with organics	Remove
74	Deep pit	No action
75	Wire basket full with organics	Remove

## Appendix 2 Calculations of the cost and benefit index

## Ranking methodology

	Proprietary device	Pollutant						treatable flow (1)	Combination of pollutants	sediments, metals, oils grease	organics, nutrients	organics, nutrients, sediments
		litter	organics	sediment	oil and grease	metals	nutrients					
In-line	Baramy Trap	8	8	3	1	4	2	8	6.3	2.7	5.0	4.3
	CDS	9	9	6	5	6	2	8	8.0	5.7	5.5	5.7
	Ecosol	8	7	5	5	5	2	7	6.7	5.0	4.5	4.7
	Humeceptor	2	3	5	7	5	3	6	3.3	5.7	3.0	3.7
	Cleasall	7	7	4	3	4	2	6	6.0	3.7	4.5	4.3
	Stormfilter	2	3	9	9	8	6	2	4.7	8.7	4.5	6.0
	Stormceptor	2	3	6	8	6	3	6	3.7	6.7	3.0	4.0
end of pipe	Net Tech	7	7	1	1	1	1	6	5.0	1.0	4.0	3.0
	Pratten trap	7	7	1	1	1	1	6	5.0	1.0	4.0	3.0
Pit baskets	Enviropod (100um mesh)	9	9	8	5	6	2	8	8.7	6.3	5.5	6.3
	Pratten insert (100um mesh)	9	9	8	5	6	2	5	8.7	6.3	5.5	6.3
Bioremediation	Wetlands swales with trash racks											
	Swales without tash racks											

Note:

1 Treatable flow assumes appropriate sizing for the catchment and flow for a 'normal' unit that takes into consideration storage capacity)

<b>Cost ranking</b>			
Capital Cost		Maintenance Cost	
0	0.01	0	0.5
1001	0.06	501	0.75
10001	0.15	1001	1.25
20001	0.35	1501	1.75
50001	0.75	2001	2.5
100001	1.75	3001	3.5
250001	3.75	4001	4.5
500001	6.25	5001	6
750001	8.75	7001	8.5
1000001	10	10001	10