6. Design and costing information for existing devices

In this section:

There is very little readily available detailed information on the design details and costings of existing on-site stormwater devices. One of the recommendations in section 1.4 of this guideline is therefore that a management and monitoring framework be developed for on-site stormwater devices, in order to encourage the gathering and sharing of monitoring data in a way that is sufficiently robust and detailed to be useful to stormwater practitioners for comparing costs and performance for different sites and devices.

This section presents available information on existing on-site stormwater devices that may be of some use to stormwater practitioners.

6.1 Devices in the Auckland region

The four major territorial councils in the Auckland region have been approached to provide information on stormwater devices used in their area and their responses are summarised below.

6.1.1 North Shore City Council (NSCC)

Devices owned by NSCC include:

34	dry flood attenuation ponds
2	dry extended detention water quality ponds
31	wet ponds
4	wetlands
5	sand filters
1	swale
1	rain garden
2	Continuous deflective separators
9	Downstream defenders
1	Ecosol
294	Enviropods
1	woolspill
1	permeable paving (under construction July 2004)

NSCC also advises that there are a number of privately owned devices including rain tanks and detention tanks.

6.1.2 Waitakere City Council

Waitakere City has a number of urban stormwater demonstration projects. Those relevant to on-site stormwater management devices are:

- permeable paving at Parrs Park reserve
- rain garden at Moselle Avenue
- rain tank – discussion of recommendations for the use of rain tanks at a subdivision in Golf Road, New Lynn
- discussion of detention ponds, stormwater quality ponds and wetlands at several sites (part of catchment wide management)

There are also a number of privately owned rain gardens and stormwater treatment filters within Waitakere City.

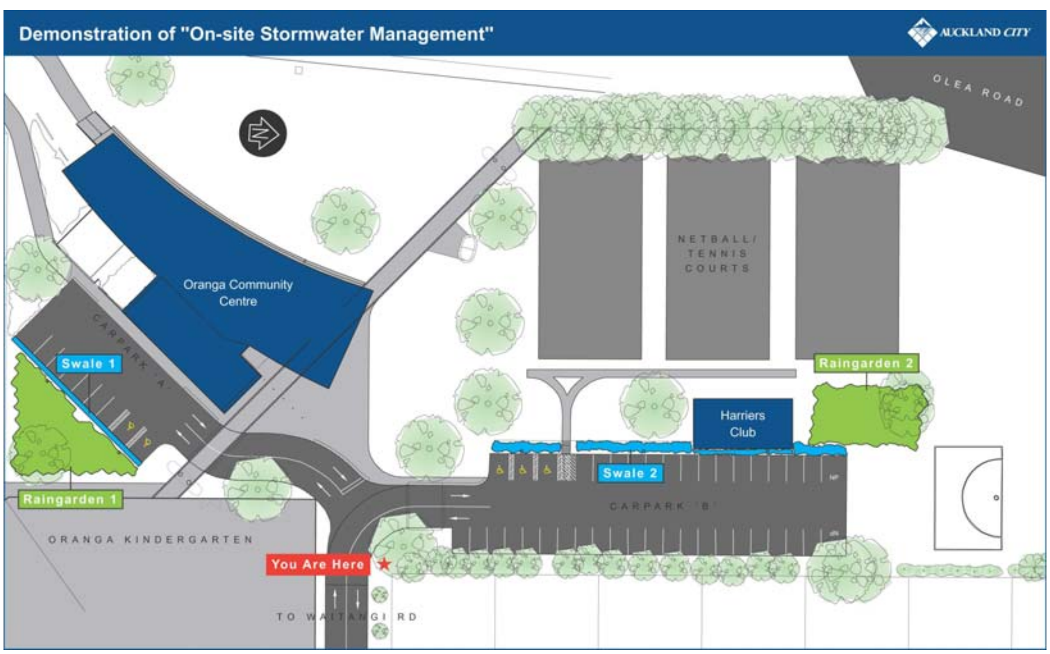
6.1.3 Auckland City Council demonstration projects

Auckland City Council demonstration projects include:

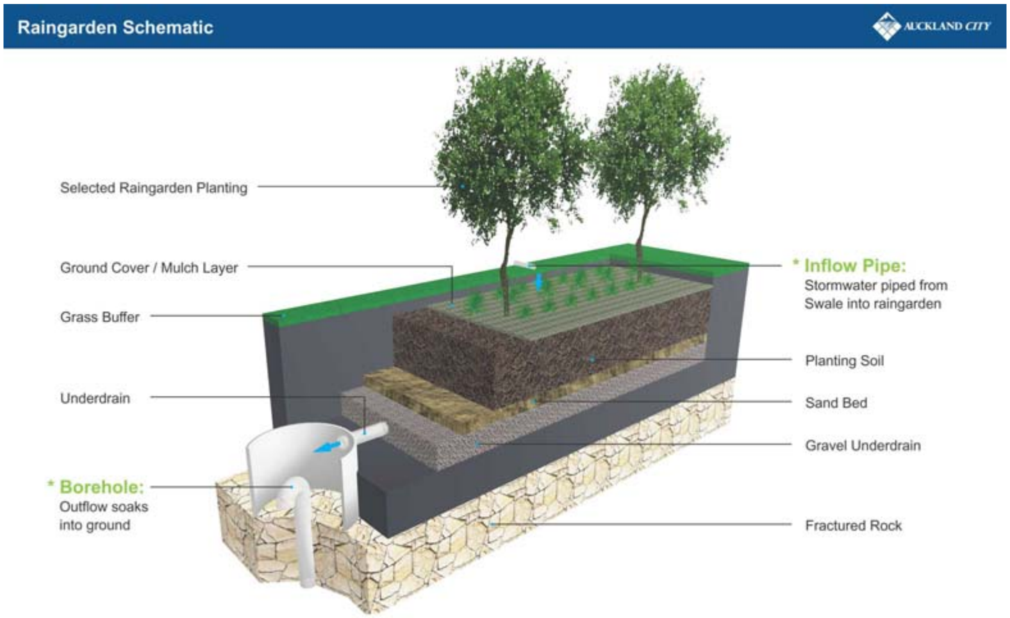
- **New Oranga Community Centre, Fergusson Park**
- **New Wesley Community Centre**

6.1.3.1 New Oranga Community Centre, Fergusson Park

The new Oranga Community Centre is off Waitangi Road, Onehunga, in an area where stormwater disposal is by soakage. The facility is a demonstration project for on-site stormwater soakage devices designed in accordance with the City's new Soakage design manual. The stormwater treatment and disposal system incorporates a series of swales, rain gardens and soakholes, with educational signs showing how they work.



Oranga Community Centre site layout



Oranga Community Centre rain garden

6.1.3.2 New Wesley Community Centre

The new Wesley Community Centre is on the corner of Sandringham Road and Gifford Avenue, with a new building close to Sandringham Road together with car parking and outdoor space areas. The Oakley Creek is a major feature of the site and stormwater stormwater runoff from the site goes into it. The facility is a demonstration project for on-site stormwater management devices designed in accordance with the City's new On-site design manual. The chosen design incorporates a series of five rain gardens and two catchpit filters designed to treat site runoff, with educational signs showing how they work.

Signboard for Wesley Community Centre

6.1.4 Sand filter for industrial site (Auckland)

Site description: paved with building, flat <5% slope, overlying fractured basalt

Land-use / contaminants: Industrial yard with sediment and hydrocarbons from vehicle and plant (plant hire outlet) together with small polystyrene pellets spilled from storage warehouse during loading/unloading

Device purpose: the treatment aim was removal of 75% of sediment in accordance with ARC TP 10

Design methodology: as per ARC TP 10, 1993 - note this differs from the methodology in ARC TP10, 2003

Contributing catchment area: 3600 m2

Disposal: soakage to fractured basalt (previous soakhole had clogged up with sediment)

Device components:

- old soakhole (1050 mm manhole) with a concrete base, utilised as a coarse sediment trap
- sediment chamber: 3300 litre septic tank
- ponding on low lying parking area (detention storage), utilised as part of the live storage: total live storage 73 m^3
- filter chamber: 2 x 2.5m x 2.8 m x 1.5 m long precast concrete culvert units on end, with removable timber lids (located on grassed garden area adjacent to paved area)
- outflow through the sand filter is direct to underlying fractured basalt with geotextile filter cloth used to retain the sand
- overflow to manhole (1050 mm) with open base – disposal to underlying fractured basalt

Cost: construction cost in 2001 (competitive tender): $18,000 + GST

6.2 Life cycle costing approach

This subsection discusses a lifecycle costing and life cycle analysis that may help practitioners choose on-site stormwater devices. The purpose of the discussion is to help to improve the sustainability of LIUDD technologies and their application by:

- outlining the need for a lifecycle perspective when evaluating low impact urban design and development (LIUDD) technologies
- describing two useful evaluation technologies that address the lifecycle impacts of LIUDD technologies

6.2.1 Why do we need a lifecycle perspective of LIUDD technologies?

LIUDD technologies must be seen as part of a complex, dynamic urban system. The technologies are intimately linked with social and economic activity. For example, the greater the area in urban subdivision, the greater the impervious surface area and the greater the water volume that needs to be ‘treated’ by LIUDD technologies.

LIUDD technologies are also dynamic in that they are reasonably long lived, and must respond to water events over time. A lifecycle perspective captures both the complexity of the physical linkages (such as energy and material flows) through the socio-economic system, and the dynamic nature of LIUDD technologies over the life time of the technologies. A lifecycle perspective considers the whole life of a technology from its construction, through to use and decommissioning.

6.2.2 How do we know whether low impact urban design and development (LIUDD) technologies are truly low impact?

To answer this question, we need to apply suitable evaluation techniques. There are two important considerations when selecting evaluation techniques. First, we need to select a technique that measures the system wide impact of the technology over its lifecycle. Second, we also need to use an evaluation technique that informs us about the relative efficiency of resource use over time.

Two evaluation techniques can assess these elements of LIUDD technologies:

- LCA measures the physical and economic system-wide impacts over the lifecycle of a technology
- present equivalent analysis (or lifecycle costing) measures financial costs over the life of the technology and converts them to a 'present value'

6.2.3 What is lifecycle assessment?

LCA is defined as the 'compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its lifecycle' (International Organization of Standards, 1997).

LCA traces physical energy and material inputs and outputs throughout the lifecycle of a technology. Thus, in order to conduct such a study, biophysical information needs to be collected. For example, in the case of a pond, information on the energy and materials required to construct, maintain and decommission the pond needs to be collected. This energy and material input information is currently not available.

6.2.4 What is lifecycle costing?

Lifecycle costing attempts to calculate a 'present value' of the costs incurred over the life of a technology. 'Present value' is the value now of a sum, or sums, of money in the future.

The present value metric is important because money now is regarded as worth more then money in the future. This difference in value is because of uncertainty and because money can be invested how to produce a greater sum in the future.

The present value of future money is calculated by 'discounting' it at a rate of interest (or discount rate) equivalent to the rate at which it could be invested. For example, $105 in a year's time has a present value of $100 if the interest rate is 5% per annum.

The present value of a sum of money is calculated as:

$$PV = \sum_{i=1}^{n}\left(\frac{C_i}{(1+r)^i}\right) = \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \dots \frac{C_n}{(1+r)^n}$$

Where:

PV = present value
i = year
r = discount rate
C = future cash amount
n = life of project.

Several lifecycle costings have been conducted in New Zealand on LIUDD technologies, for example to compare catchment wide treatment devices in North Shore City.

However, these results should not be used as generic present values. This is because each LIUDD technology faces unique biophysical, economic and social challenges. For this reason, it is important that a lifecycle costing is conducted for each LIUDD technology.

A template for calculating lifecycle costings is overleaf.

Benefit/cost assessment and funding options under sections 32 and 36 of the Resource Management Act are briefly reviewed in section 1.8 of this guideline.

6.2.5 Conclusions

The following points have been made in this subsection:

- a lifecycle perspective of LIUDD technologies is needed so as to understand the dynamic system impacts of the technology
- lifecycle assessment (LCA) and lifecycle costing (LCC) are two useful evaluation techniques in this context.
- LCA is the focus of future research
- LCC is relatively straightforward. A template is provided overleaf for such calculations

6.3 Reference

International Organization of Standards. (1997). *Environmental management - lifecycle assessment - principles and frameworks* (ISO 14040). Geneva: International Organization of Standards.

6.4 Life cycle costing template

Location	Street address
Coordinates	x-coord
	y-coord
Owner	
Designer	
Supplier	
Contractor	
Installation Date	
Catchment Area	m^2
Catchment Type	Forest
	Green
	Res
	Com
	Ind
	Rd
Impermeable	%
Soil	Type
Primary	
Secondary	
Design Basis	
Design Flow	L/s
Design Vol	m^3
Footprint	m^2
Sediment	%
Metals	%
Nutrients	%
	%
Monitored	Y/N

(continued overleaf)

FINANCIAL COSTS						
Year project began						
Design life						
Discount rate	10%					
ACTUAL/ESTIMATED COSTS						
Enter ACTUAL costs in the year they are expected fall						
			Year 0	1	2	3 etc
Capital Costs ($NZ)						
	Council overheads					
	Design fees					
	Land costs					
	Consent costs					
	Construction costs					
	Other capital costs					
	Total capital costs		$ -	$ -	$ -	$ -
Maintenance Costs	Council overheads					
	Maintenance costs					
	Consent fees					
	Maintenance frequency					
	Total maintenance costs		$ -	$ -	$ -	$ -
Decommissioning costs	Council overheads					
	decommissioning costs					
	Consent fees					
	Total decommissioning costs		$ -	$ -	$ -	$ -
PRESENT VALUE COSTS						
Capital costs						
Maintenance costs						
Decommissioning costs						
TOTAL PV						