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ENVIROPOD

Enviropod NZ Ltd
E.T.S.
Management Plan

North Shore City Council
Enviropod Trial
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INTRODUCTION

The Enviropod™ Total Solution (E.T.S) is a managed approach to implementation and management of stormwater pollution source control. It delivers a package of "Best Management Practices" (BMP's), supplying a treatment device and maintenance system, establishing a framework for site assessments, inspections, record keeping, preventive maintenance, external and internal reporting. It is a unique stormwater treatment approach, in that it supplies more than a stand-alone product or design but rather an on-going system for managing contaminants in stormwater.

The following report details the results of approximately 5 months monitoring of 294 Enviropod filters installed in selected catchpits within North Shore City. The Enviropod filters were installed in the Takapuna, Browns Bay, Lake Pupuke, Kaipatiki, Birkenhead and Milford catchments (see Fig 1 Location Plan).

The Management Plan is an integral component of the E.T.S system. The plan outlines operation of the system, installation / removal of filters, maintenance requirements and the frequency of maintenance and inspections required. It ensures that the system continues to perform at its optimal performance and allows remote assessment of the Enviropods performance for the owner and regulatory authority. This is done by way of service receipts (see example included) which lists cleaning procedures and records site specific data and must be completed by the contractor during each service and then sent to the client. When an E.T.S. has been applied to a catchment as a requirement of a regulatory body, the service receipts can be collated and transferred to them annually, or as required.

The Enviropod™ filter is a catchpit insert, which comprises a supporting framework, overflow system and a replaceable filter cartridge, which is routinely serviced. Filter cartridges are emptied, removed and rejuvenated during each service. Normal catchpit maintenance techniques are employed in maintaining the Enviropod™ Filter. The Enviropod™ Filter is only supplied as an integral component of the ETS.

There is more to managing a stormwater asset than removal and disposal of the contaminants

Maintenance is an essential component of stormwater management. Surveys in the state of Maryland, USA Showed that 75.2% of existing dry ponds, 24.4% of wet ponds and 33% of infiltration practices were not functioning as designed because of mismanagement.[1] Maintenance will prevent failures such as structural failure (e.g. prevents blocked outlets) or aesthetic failure (e.g. debris accumulation)[2]

Each stormwater treatment device must be inspected and maintained regularly to ensure it is working properly throughout the estimated design life. Unlike traditional treatment devices that require contaminant removal and disposal

[1] J.Kamer, *Urban Stormwater Quality Control*, Project for Masters of Engineering, University of Auckland,1989

[2] J.Kamer, *Urban Stormwater Quality Control*, Project for Masters of Engineering, University of Auckland,1989

every few years, the Enviropod filters require servicing every 2 to 6 months depending on site characteristics. Inspections are carried out, recording and reporting removal information every time the filters are serviced. Enviropods' computer tracking system and maintenance procedures ensure inspections and maintenance are performed, eliminating the need for additional inspections.

An essential component of maintaining and inspecting a stormwater treatment device is reporting and record keeping. It is essential that failures are reported to the owner of the treatment device and remedial measures organised and put in place as soon as possible. All maintenance and inspection activities must be recorded and reported back to the owner of the treatment device to ensure they are being undertaken. Reporting and record keeping also allows for easy compliance auditing ie desktop auditing as opposed to on site investigations.

The science of stormwater is not fully understood. Many factors of land use effect contaminant loadings in stormwater. By accurate reporting and recording of these factors, maintenance activities and inspections lead to a greater knowledge of localised stormwater issues and in turn greater efficiency in combating their effects and planning for the future.

Targeting of education to polluters is greatly improved through accurate reporting and record keeping eg. Illicit discharge of contaminants into the stormwater treatment device can be noted and tracked to the polluter. The polluter can then be educated about their effect on stormwater quality and the consequences, both environmental and financial, that it may have.

It is essential that maintenance (including inspections, recording and reporting) be carried out in a systematic manner and is carried out by qualified and experienced personnel. It is also advisable that the treatment device owner has a nominated person responsible of overseeing the management process.

Enviropod is a specialised stormwater consultancy with trained and experienced staff. The company has a comprehensive database with detailed information on every Enviropod filter sold and serviced by Enviropod, collecting site specific data that can be easily accessed and analysed as required.

MONITORING METHODOLGY

An initial site inspection was carried out prior to the installation of the Enviropods on the North Shore. This identified the following:

- Pit dimensions.
- Catchment areas.
- Organic loadings.
- Traffic loadings.
- Potential pollutant generating activities.
- Surrounding land use.
- Suitable filter grade.
- Specific design requirements.

Following installation of the Enviropod filters, monthly inspections were carried out on all 294 filters, observing the following:

- Remaining storage capacity for removed sediment.
- Degree of clogging of the filter media.
- Presence of illicit discharge and polluter if identifiable.
- Evidence of overflow.
- Suitability of filter selection.
- General structural performance.
- General hydraulic performance.

Enviropods were grouped in street sub-catchments to allow an efficient and useable management program. Typically the contaminant generating factors are consistent in any one street and the Enviropods on that street can be maintained at the same frequency. At the end of the monitoring period all Enviropods were serviced and removal loads were obtained from each street or sub-catchment. A representative sample was taken from the cleaning truck for the Takapuna Beach, Browns Bay, Lake Pupuke and Kaipatiki catchments. The sample was analysed for moisture content, metal concentration, nutrients and particle size distribution. Contaminant removal loadings were calculated from these results.

SITE CHARACTERISTICS

Takapuna Beach Catchment.

Takapuna Beach catchment is a highly developed commercial area. The catchment discharges at numerous points along Takapuna beach. There are high traffic volumes on most of the streets in the catchment. Most of the catchment is on a gentle grade falling towards the beach. The catchment has a medium organic loading with few deciduous trees. There is only one flood risk area in the catchment at the Western end of Huron Street.

At the time of installation the following contaminant-generating activities were noted;

1. Construction Site at 17 Byron Ave.
2. Construction Site at 72 Hurstmere Rd.
3. Gravel Carpark on the Strand (77A Hurstmere Rd).
4. High pedestrian movements along Hurstmere Road producing a large amount of litter.

111 Enviropod filters were installed in the catchment. The Following Table lists the number of Enviropods installed on each street or sub-catchment within the catchment, as well as the traffic and organic loading factors.

Takapuna Beach catchment	No. of Enviropods	Traffic Loading	Organic Loading
Allison Ave & Boat Ramp	3	Low	Med
Anzac St and Int of The Terrace	5	High	Med
Auburn St	6	High	Low
Blomfield Spa	3	Low	High
Byron Ave & Int with Lake Rd	7	Med	Low
Campbell Rd	5	Low	Med
Channel View Rd (Car Park)	5	Med	Med
Como St and Int with Lake Rd	5	Med	Med
Huron St	2	Med	Med
Hurstmere Rd (Main Shop Area)	21	High	Med
Hurstmere Rd (Northern End)	5	High	Med
Hurstmere Service Lane	9	Low	Low
Killarney St	4	High	Med
Northcroft St	6	Med	Med
NSCC Carpark	2	Low	Low
The Promenade	2	Med	Med
The Strand	21	Med	Med

Table 1: Takapuna Beach Catchment Site Characteristics

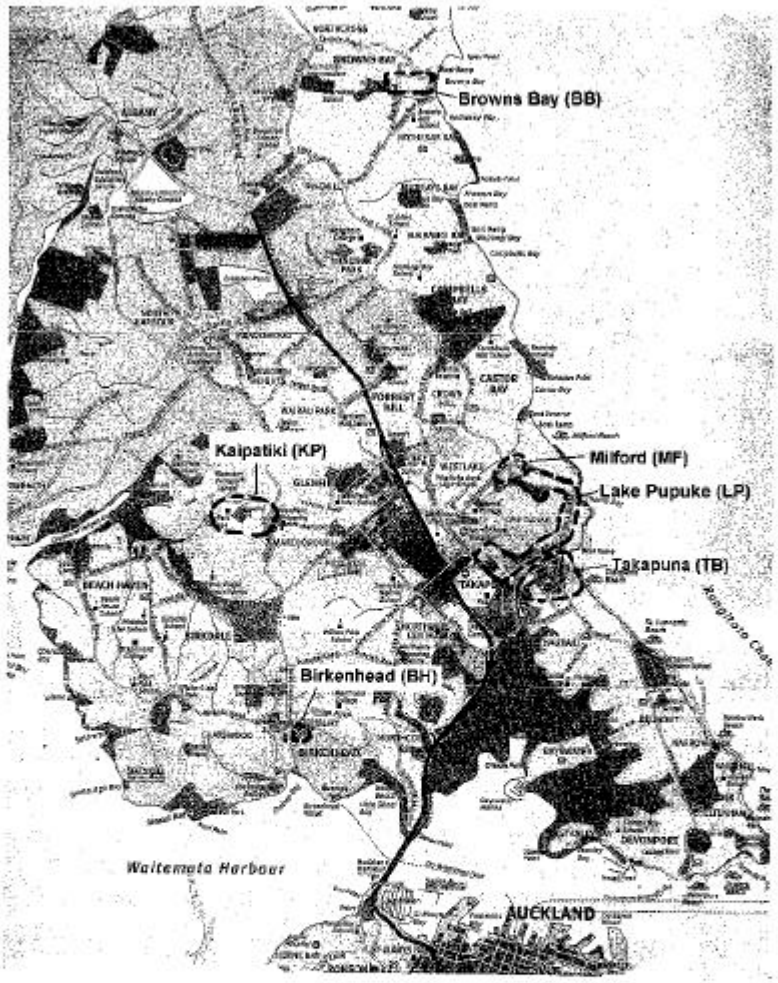


Figure 1: Locality Plan

Browns Bay (Taiaotea) Catchment.

Taiaotea catchment is a developed catchment covering residential and commercial areas. 70 Enviropod filters were installed in the commercial area at the bottom of the catchment. The commercial area is situated on the flood plane of the Taiaotea Creek and is on a very flat grade.

The catchment discharges at numerous points to the Taiaotea Creek and Browns Bay Beach. The North Shore City Council GIS Plans shows four flood prone areas within the commercial area, two along Inverness Rd, one at the intersection of Bute Road and Clyde Rd and one at the northern end of the beach service lane. Consultation with residents and businesses in the area revealed there is a large amount of localised flooding in the area. The catchment has a high organic loading, with most streets clad with evergreen trees. While the catchment is a commercial area, there is only a medium traffic loading on most of the streets.

It was apparent from observations of the drainage system around the Browns Bay shopping area that many attempts have been made to alleviate localised flooding. The area has numerous stormwater pipes laid very shallow and on a flat grade however localised flooding still exists. A possible cause of this is reduced flow capacity of the stormwater lines from the combination of high organic loading and flat grade pipes.

At the time of installation the following contaminant-generating activities were noted;

Construction site at 7-11 Bute Rd.

The Following Table lists the number of Enviropods installed on each street within the catchment and the traffic and organic loading factors.

Browns Bay Catchment	No. of Enviropods	Traffic Loading	Organic Loading
Anzac Rd	10	Med	Med
Argle Rd	2	Low	High
Beach Service lane	6	Med	Med
Bute Rd	13	Med	High
Clyde Rd	6	Med	Med
Glen Rd	16	Med	High
Inverness Rd	17	Med	High

Table 2: Browns Bay Catchment Site Characteristics

Lake Pupuke Catchment

The Lake Pupuke Catchment is predominantly a residential area. The catchment drains to multiple discharge points around Lake Pupuke. 60 Enviropods were installed along most roads in the catchment. The catchment is on a steep grade, however the roads tend to run parallel to the grade. As the majority of the catchment is residential there is only a medium traffic loading, however there is a high organic loading in the catchment.

At the time of installation the following contaminant-generating activities were noted;

1. Gravel and Hydrocarbons from Quarry on Northcote Rd.
2. Residential Construction Site at 1B Eric Price Ave.

The Following Table lists the number of Enviropods installed on each street in the catchment and the corresponding traffic and organic loading factors.

Lake Pupuke Catchment	No. of Enviropods	Traffic Loading	Organic Loading
Ander Place	3	Low	High
Bridge Club Car Park	2	Med	Med
Dodson Ave.	1	Low	High
Eric Price Ave.	2	Low	Med
Henderson Park.	3	Low	High
Fenwick Ave.	1	Low	Med
Killarney Street	5	High	Med
Killarney Street (Pumphouse)	2	Low	Med
308 Hurstmere Rd.	2	High	Med
Kowhai PL, Lake View Rd & Rangitira Ave.	11	Low	High
Mary Poynton Cress, Northcote Rd (East) & Shea Tce.	7	Med	Low
Manurere Ave.	11	Low	High
Sylvan Park Ave.	7	Low	High
The Promenade.	3	Low	High

Table 3: Lake Pupuke Catchment Site Characteristics

Kaipatiki Catchment

24 Enviropods were installed in three streets in the Kaipatiki Catchment. The drainage system of the area discharges to the Kaipatiki Stream at the bottom of Kaipatiki Road. Kaipatiki Rd and Esto Park Parade are on steep grades. Kaipatiki Road is planted with Pine trees, which contribute greatly to the high organic loading. Enviropods installed on Glenfield Rd are installed in an area with high pedestrian movements. The catchment is predominantly residential.

The Following Table lists the number of Enviropods installed on each street in the catchment and the traffic and organic loading factors.

Kaipatiki Catchment	No. of Enviropods	Traffic Loading	Organic Loading
Esto Park Parade.	2	Low	High
Glenfield Rd.	6	High	Low
Kaipatiki Rd.	16	Med	High

Table 4: Kaipatiki Catchment Site Characteristics

Milford Catchment

20 Enviropods were installed around the Milford Shopping Centre. The land use of the area is both commercial and residential. Stormwater from the area discharges into the Wairau Creek, which flows to Milford Beach. Kitchener Rd is a main arterial route on the North Shore and subsequently has a high traffic loading. There is moderate vegetation around the Enviropods.

The Following Table lists the number of Enviropods installed on each street within the catchment and the traffic and organic loading factors.

Milford Catchment	No. of Enviropods	Traffic Loading	Organic Loading
Fenwick Rd.	4	Low	Med
Kitchener Rd & Int Fenwick	5	High	Med
Omana Rd	8	Med	Low
Service Lane	3	Low	Med

Table 6: Milford Catchment Site Characteristics

Birkenhead (little Shoal Bay) Catchment.

Only Enterprise Street has been targeted in the Little Shoal Bay catchment. The land use of the street is a mixture of commercial and industrial. The street is a Cul de sac with low traffic movements and no vegetation around it.

At the time of installation the following contaminant generating activities were noted;

1. The land use of the majority of properties in the street are auto repair businesses, which have no measures in place to prevent any accidental spills from entering the stormwater system.
2. The business at the end of Trader Street has a gravel carpark for the storage of cars.

The Following Table lists the number of Enviropods installed on Enterprise St reet and the corresponding traffic and organic loading factors.

Birkenhead (little Shoal Bay Catchment)	No. of Enviropods	Traffic Loading	Organic Loading
Enterprise Street	9	Low	Low

Table 5: Birkenhead Site Characteristics

Monitoring and Removal Load

Takapuna Beach Catchment.

111 Enviropod Filters were installed, treating runoff from 5.4 hectares of road, footpath and car parking areas. 200-micron filters were installed throughout the catchment.

The 47 Enviropods west of Lake Road were installed in November 2000. The Other 64 Enviropods were installed in August, September and October 2000. As delays prevented all the Enviropods in the catchment from being installed at approximately the same time these Enviropods were cleaned in the first week of December to allow comparison with other Enviropods installed west of Lake Road.

6735 kg of material was removed from Enviropods in the Takapuna catchment over the 5-month monitoring period. This equates to approximately 2985 kg/hectare/year (wet weight). A representative sample was collected from the truck during the cleaning process this was found to have a moisture content of 76.4%. The dry weight removal load was approximately 704 kg/hectare/year

The following Enviropods were effected by illicit discharge. It is estimated that 200kg of the removal load (wet weight) could be attributable to illicit discharge.

Pit Number	Location	Reason
TB03	Cnr of The Promenade and Allison Ave	Roading Chip from re-sealing of Allison Ave.
TB104	Cnr The terrace and Anzac Ave	Roading Chip from re-sealing of int. of The terrace and Anzac Ave.
TB15	Cnr Campbell Rd and Anzac Ave	Roading Chip from re-sealing of int. Campbell Rd and Anzac Ave.
TB19	Anzac Ave outside Grain and Grape	Roading Chip from re-sealing of int. Campbell Rd and Anzac Ave.
TB105	Cnr Byron Ave and Lake Rd	Sediment and Concrete deriving from pipe and footpath work in the road reserve.
TB61	The Strand	Gravel deriving from unsealed carpark at 77A Hurstmere Rd.
TB83	Northcroft Street	Construction Debris from cable works in the road reserve.

TB36	Byron Ave.	Construction runoff deriving from 17 Byron Ave.
TB74	Hurstmere Service Lane.	Construction runoff deriving from an unknown source.
TB99	Cnr Of Byron and Lake Rd.	Sediment and Concrete deriving from pipe and footpath work in the road reserve.
TB35	Hurstmere Service lane.	Construction runoff deriving from an unknown source.

Table 7: Illicit Discharges Observed in Takapuna Catchment

High contaminant loading was the main determining factor in calculating most of the maintenance frequencies. Generally Enviropods in the catchment reached maximum storage capacity before the filter media was clogged. It is suggested that most of the streets in the catchment be maintained on a 3-month cycle.

The Enviropods along the main shopping area on Hurstmere Road, The Promenade, Auburn Street, The Strand, and the Hurstmere Service Lane can be maintained on a 4-month cycle. Catchment areas for the catchpits along these streets were relatively small. While selected Enviropods along the main shopping area of Hurstmere Road could be maintained on a longer frequency, it is not recommended as several pits are greatly affected by trees along the road.

Allison Ave (at the northern end of the catchment) is a residential street and subsequently has lower sediment and litter loading and can be maintained on a 6-month cycle.

The catchpits along the North Shore City Council Service Lane have been installed very shallow (less than 400mm to the base of the pit). Subsequently the Enviropods installed have limited storage capacity for retained contaminants, it is suggested that they be maintained on a two-month maintenance frequency.

The following table lists the suggested maintenance frequencies for the catchment.

Takapuna Beach Catchment	Suggested Maintenance Frequency
Allison Ave & Boat Ramp.	6 months
Anzac St and Int. of the Terrace.	3 months
Auburn St.	4 months
Blomfield Spa.	3 months
Byron Ave & Int Lake Rd.	3 months
Campbell Rd & Int. Anzac Rd.	3 months
Channel View Rd (Carpark).	3 months
Como St and Int with Lake Rd.	3 months
Huron St.	3 months
Hurstmere Rd (Main Shopping Area).	4 months
Hurstmere Rd (Northern End) & The Promenade.	3 months
Hurstmere Service Lane.	3 months
Killarney St.	4 months
Northcroft St.	3 months
NSCC Carpark.	2 months
The Promenade.	4 months
The Strand.	4 months

Table 8: Suggested Maintenance Frequencies for Enviropods in the Takapuna Beach Catchment

Browns Bay (Taiaotea) Catchment.

A large number of catchpits in the Browns Bay catchment were shallow or were direct inlets into the stormwater system ie the catchpit dropped straight onto the pipe. This has limited the capacity of storage in many Enviropods. This combined with the high organic loading has resulted in a suggested maintenance frequency of 2 months for the Enviropods along Bute Road, Glen Road and Inverness Road. 200-micron filters were installed in the catchment.

A large volume of trash was observed in the Enviropods along Clyde Road and along the beachfront. This can be expected, as the areas are associated with high pedestrian movements.

The majority of the Enviropods were installed in August and September 2000 however delays meant that installation was not completed until the 30th of November 2000. Two additional cleans were carried out on Enviropods that were full or had clogged filters over the monitoring period. The first removed 270 kg (wet) and the second removed 300kg (wet) of contaminants from the catchment. During the monitoring period an overall quantity of 2524-kg (2063 kg/hectare/year) of material was removed from the catchment. A representative sample taken from the gully sucker truck was found to have a moisture content of 75.3%. The dry weight removal load was 509 kg/hectare/year.

The following table lists the suggested maintenance frequencies for the Enviropods installed in the Browns Bay catchment.

Browns Bay Catchment	Maintenance Frequency
Anzac Rd	6 months
Argle Rd	6 months
Beach Service lane	4 months
Bute Rd	2 months
Clyde Rd	3 months
Glen Rd	2 months
Inverness Rd	2 months

Table 9: Suggested Maintenance Frequencies for Enviropods in the Browns Bay Catchment

Lake Pupuke Catchment

100-micron filters were installed in the Enviropods in the Lake Pupuke Catchment.

2880 kg of material was removed from stormwater discharging into Lake Pupuke. A representative sample taken from the gully sucker truck was found to have moisture content of 45.9%. The dry weight removal load was 1785 kg/hectare/year. Organic loading was the main factor in the catchment. Land use of the area is predominantly residential with trees along the roadside property boundaries.

Road sealing contributes greatly to the contaminants being removed from the catchment. Approximately 400 kg of the pollutant loading can be attributed to roading and illicit discharges. It is important that roading contractors are made aware that discharging of roading materials into the catchpits is harmful to the environment and that discharging of roading chip into the Enviropods may cause damage to the system.

Two private sites were identified to be illicitly allowing concrete and sediment to escape from the property and discharge to a catchpit. These have been identified in the list of illicit discharges noted. These polluters should be contacted and informed that their actions are illicit and that they can be fined.

Pit Number	Location	Illicit Discharge
LP41	Killarney Street 37	Road Chip from resealing of Bridge Club Car park.
LP42	Killarney Street near LP40	Road Chip from resealing of Bridge Club Car park.
LP13	Dobson Ave 19	Road Chip From Resealing of Dobson Rd.
LP21	Eric Price Ave 1	Construction material from Development at 18 a Kitchener Rd.
LP22	Eric Price Ave 7	Construction material from Development at 18 A Kitchener Rd.
LP12	Fenwick Ave 19	Road Chip From Resealing of Fenwick Ave.
LP33	Killarney Street 35	Road Chip From Resealing of Manurere Ave.
LP49	Kowhai Road 14	Road Chip From Resealing of Lake View Road.
LP50	Lake View Road 7	Road Chip From Resealing of Lake View Road.
LP51	Lake View Road 29	Road Chip From Resealing of Lake View Road and Construction material from 12 Lake View Road.
LP52	Lake View Road 29	Road Chip From Resealing of Lake View Road.
LP53	Lake View Road 24	Road Chip From Resealing of Lake View Road.
LP54	Lake View Road 24	Road Chip From Resealing of Lake View Road.
LP55	Lake View Road 37	Road Chip From Resealing of Lake View Road.
LP56	Lake View Road 30	Road Chip From Resealing of Lake View Road.
LP57	Lake View Road 45	Road Chip From Resealing of Lake View Road.
LP04	Manurere Ave 47	Road Chip From Resealing of Manurere Ave.
LP05	Manurere Ave 36	Road Chip From Resealing of Manurere Ave.
LP28	Manurere Ave 43	Road Chip From Resealing of Manurere Ave.
LP29	Manurere Ave 30	Road Chip From Resealing of Manurere Ave.
LP30	Manurere Ave 10	Road Chip From Resealing of Manurere Ave.
LP31	Manurere Ave 10	Road Chip From Resealing of Manurere Ave.
LP32	Manurere Ave 19	Road Chip From Resealing of Manurere Ave and Construction material from 19 Manurere Ave.
LP35	Manurere Ave behind pools	Road Chip From Resealing of Manurere Ave.
LP36	Manurere Ave behind pools	Road Chip From Resealing of Manurere Ave.
LP09	Mary Poynton Cres, Northcote Road Corner	Road Chip From Resealing of Mary Poynton Cres.
LP10	Northcote Rd. Opp end of Mary Poynton Cres.	Road Chip From Resealing of Mary Poynton Cres.
LP11	Northcote Rd. Opp end of Mary Poynton Cres.	Road Chip From Resealing of Mary Poynton Cres.

Table 10: Illicit Discharges Observed in Lake Pupuke Catchment

It is recommended that all Enviropods in the catchment be placed on 3 or 4-month maintenance cycles because of the high organic loading. For the same reason 200-micron filters should be used. These have been fitted in the last clean.

Lake Pupuke Catchment	Maintenance Frequency
Ander Place.	6 months
Bridge Club Car Park.	3 months
Dodson Ave.	3 months
Eric Price Ave.	3 months
Henderson Park.	3 months
Fenwick Ave.	4 months

Killarney Street.	3 months
Killarney Street (Pumphouse).	6 months
308 Hurstmere Rd.	3 months
Kowhai PL, Lake View Rd & Rangitira Ave.	3 months
Mary Poynton Cres, Northcote Rd (East) & Shea Terrace.	3 months
Manurere Ave.	3 months
Sylvan Park Ave.	3 months
The Promenade.	6 months

Table 12: Suggested Maintenance Frequencies for Enviropods in the Lake Pupuke Catchment

Kaipatiki Catchment

Only a small percentage of the Kaipatiki Catchment was fitted with Enviropods. Kaipatiki Road is lined with pine trees and pine needles from these greatly effected the longevity of the filters. On the other hand the Enviropod filters along Glenfield Road were more effected by the high traffic and pedestrian movement around Glenfield Mall.

Installation was carried out between August and October 2000. One additional clean was required to maintain a standard monitoring cycle. This removed 320 kg (wet) of contaminants. Overall 1630 kg (2985 kg/hectare/year) of contaminants was prevented from discharging into the Kaipatiki Creek.

During monitoring of the Enviropods, it was observed that there were a large number of cigarette butts in the Enviropod filters adjacent to Glenfield College. It would be beneficial to educate the pupils of the school about their role in preventing stormwater pollution. Construction debris was also observed in Enviropod KP07, however the source of the contaminant was not identified.

It is suggested that all Enviropods in the catchment be place on a 3-month maintenance frequency.

Kaipatiki Catchment	Maintenance Frequency
Esto Park Parade	3 months
Glenfield Rd	3 months
Kaipatiki Rd	3 months

Table 12: Suggested Maintenance Frequencies for Enviropods in the Kaipatiki Catchment

Milford Catchment

All Enviropod filters in the Milford Catchment were installed in November 2000. A 200-micron filter grade was chosen for the catchment

It is suggested that the filters along Kitchener Road be maintained on 3-month frequency due to the high traffic load and the effect of clogging the filters. The unsealed service lane produced a lot of gravel and particulate matter, which was

washed into the Enviropods. It is therefore suggested that the service lane has a 2-month maintenance frequency. Fenwick Road is predominantly a residential area with low traffic volume, allowing a 6-month maintenance frequency. After 3 months the Enviropods along the Omana Road showed a degree of clogging, and it is suggested they should be maintained 4 monthly.

When the Enviropods were serviced in the last week of March 2001, 760 kg (wet weight) of material was removed. This equates to 1434 kg/hectares/year.

Milford Catchment	Maintenance Frequency
Fenwick Rd	6 months
Kitchener Rd 7 Int. Fenwick	3 months
Omana Rd	4 months
Service Lane	2 months

Table 13: Suggested Maintenance Frequencies for Enviropods in the Milford Catchment

Birkenhead (Little Shoal Bay) Catchment.

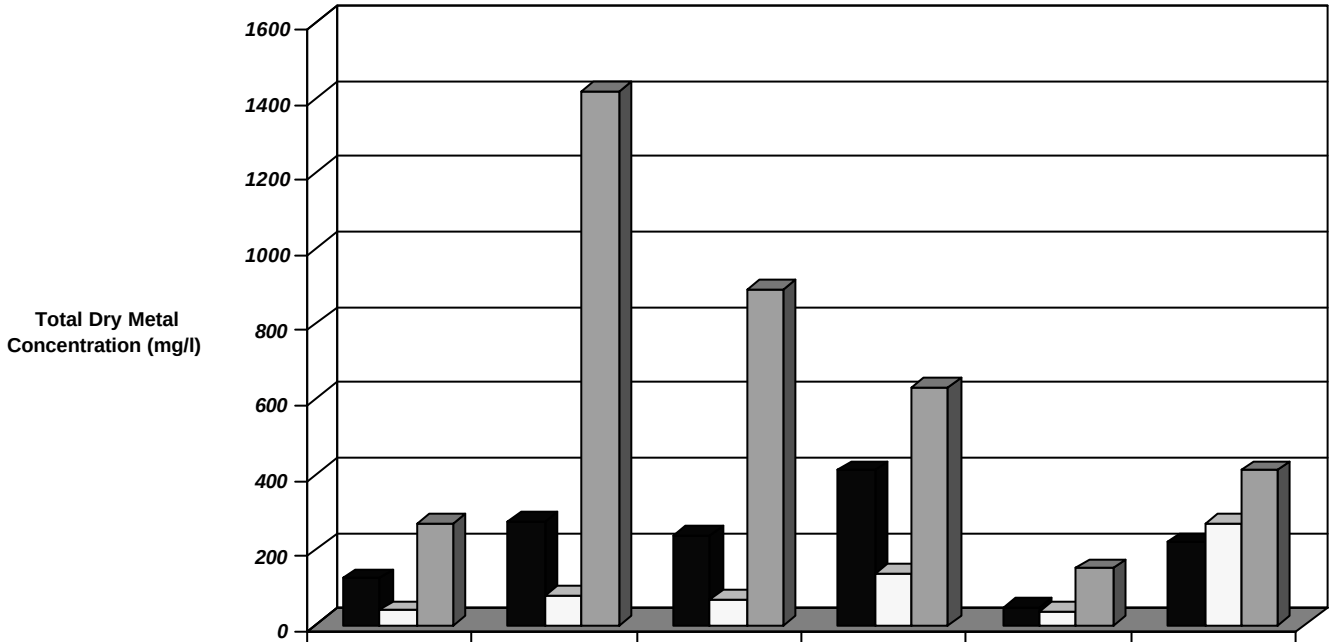
Nine Enviropods were installed along Enterprise Street in Birkenhead. The surrounding land use is dominated by vehicle workshops and the contaminants retained in the Enviropods reflected this. A large amount of Hydrocarbons, paint and trash were found in the Enviropods, so it is recommended that the filters be maintained on a 3 month maintenance frequency. Additionally it is suggested that an education campaign be focused on the surrounding industries and polluting businesses and that they be encouraged to install cut off drains and treatment devices to control their sites pollution.

Retained Material Analysis

Heavy Metal Concentrations

Representative samples were collected from the Takapuna, Glenfield, Browns Bay and Lake Pupuke Catchments. These were analysed for their concentrations of Lead, Copper and Zinc. The results have been evaluated in terms of the National Oceanic and Atmospheric Administration (NOAA) guidelines for estuarine and marine aquatic protection[3] with regard to a low effect range and a median effect range.

Metal Concentrations in Sediments removed from North Shore Cities Enviropod™ Filters

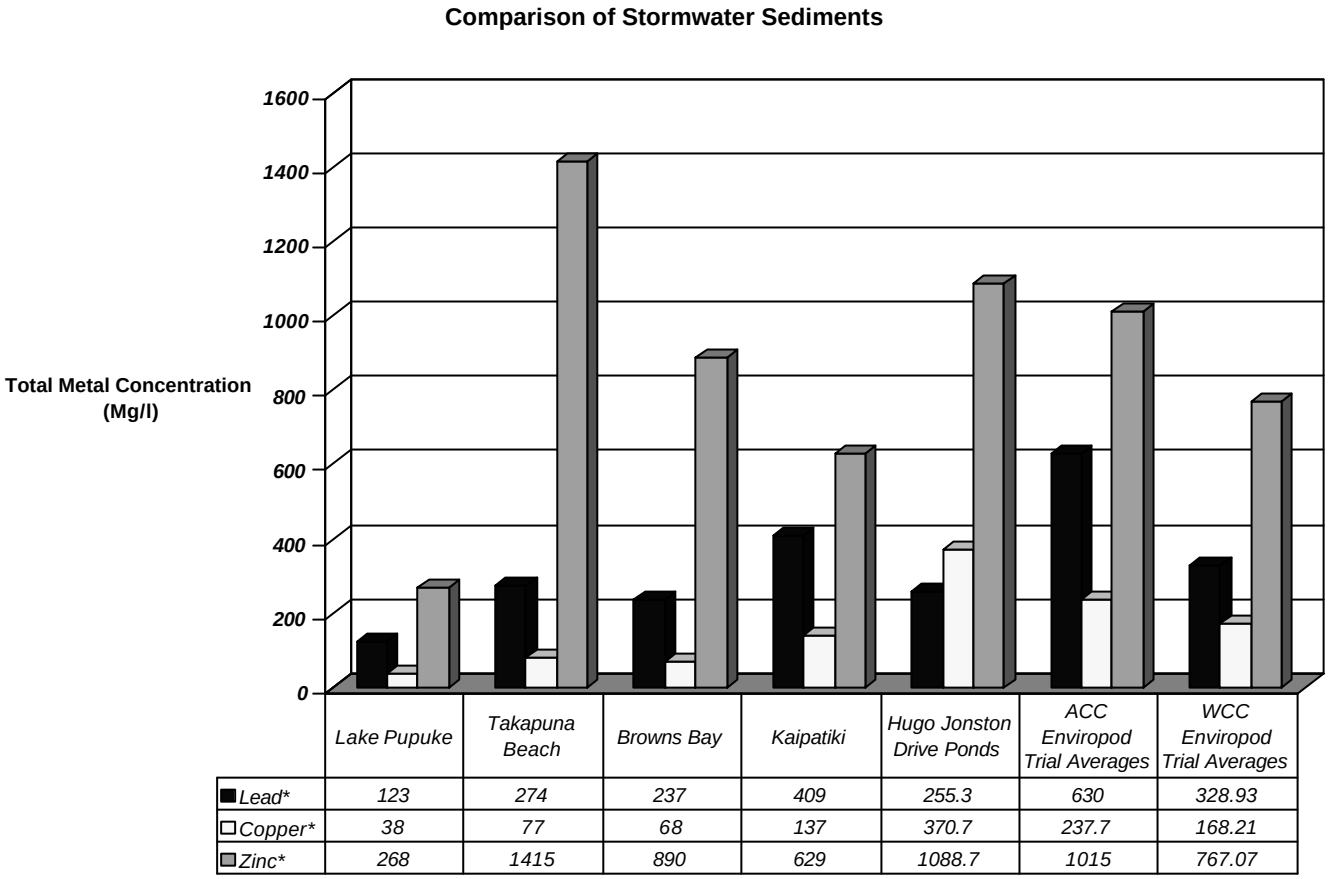


	Lake Pupuke	Takapuna Beach	Browns Bay	Kaipatiki	N.O.A.A. Low Effects Range (ERL)	N.O.A.A. Medium Effects Range (ERM)
Lead* Dry (mg/kg)	123	274	237	409	46.7	218
Copper* Dry (mg/kg)	38	77	68	137	34	270
Zinc* Dry (mg/kg)	268	1415	890	629	150	410

Chart 1: Metal Concentrations in Retained Sediments

Concentrations of heavy metals in the retained sediments varied greatly from catchment to catchment. All retained sediments had concentrations that will, at least cause low-level effects in the receiving environment. The retained sediment from the Lake Pupuke catchment had the least heavy metal contamination. This is probably because of the low traffic loading in the catchment and the discharge of roading material from resealing into the Enviropod Filters. Of particular concern are the concentrations of Lead and Zinc in the Takapuna, Browns Bay and Kaipatiki Catchments. Lead was removed from petrol in 1996 yet high concentrations are consistently found in sediments retained in Enviropod Filters (Waitakere City Council, Auckland City Council & North Shore City Council results, Chart 2).

[3] National Oceanic and Atmospheric Administration, *National Benthic Surveillance Project: Pacific Coast, Technical Memo 16*, USA, 1994



	Lake Pupuke	Takapuna Beach	Browns Bay	Kaipatiki	Hugo Jonston Drive Ponds	ACC Enviropod Trial Averages	WCC Enviropod Trial Averages
Lead*	123	274	237	409	255.3	630	328.93
Copper*	38	77	68	137	370.7	237.7	168.21
Zinc*	268	1415	890	629	1088.7	1015	767.07

Chart 2: Metal Comparison of Retained Stormwater Sediments

Chart 2 compares the Concentrations of North Shore Sediments with those retained in a Stormwater treatment pond and with results from other trials in the Auckland Area.

The concentrations of heavy metals in the North Shore sediments were generally lower than the concentrations found in the Auckland City Council Enviropod Trial. This can be expected as the ACC Enviropod trial was held in the Viaduct area, which has a very high traffic loading and the land use is predominantly industrial.

The Waitakere City Council trial was located along Lincoln Rd which has a mixed land use of residential and commercial with a high traffic loading, similar to the trial areas of Takapuna Beach, Browns Bay and Kaipatiki. The heavy metal concentrations were consistent with the exception of Copper, which was generally low in the North Shore catchments. One of the principal sources of Copper in stormwater sediments is wear of vehicle brake pads. The trial areas were predominantly flat with the exception of Kaipatiki (which had the highest Copper concentrations). Vehicles tend to brake less in flatter areas.

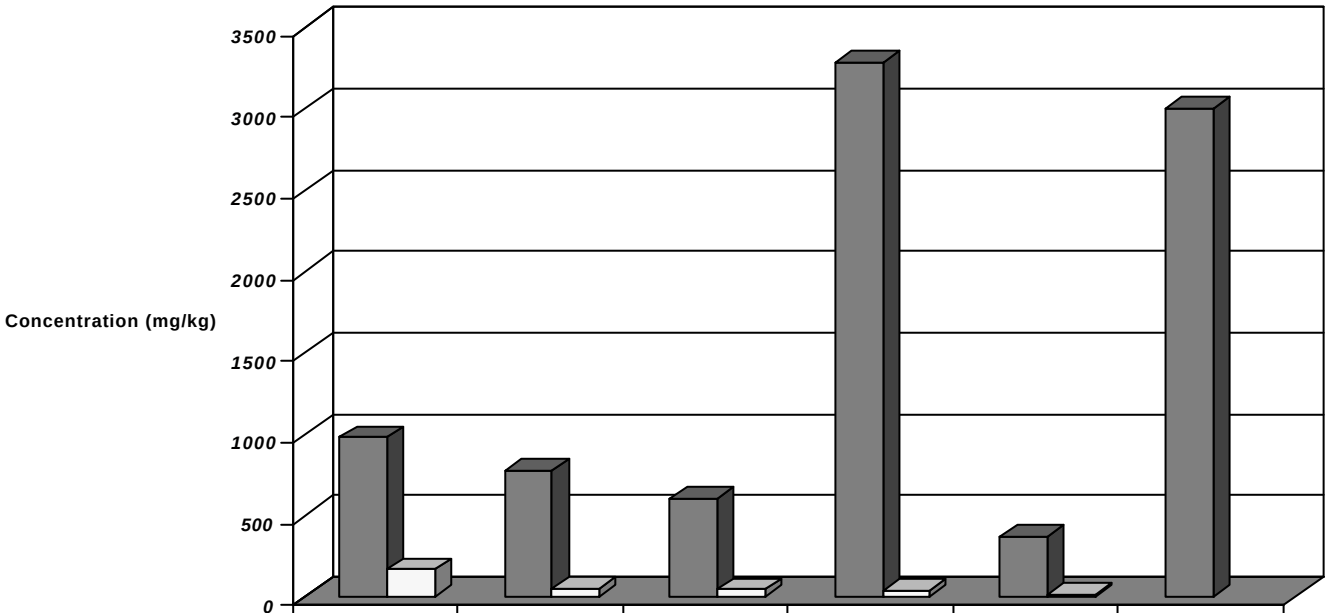
The concentration of sediments in the Hugo Johnston Ponds[4] has been included to allow comparison with another treatment device. Hugo Johnston Drive Ponds are situated at the bottom of the Southdown catchment in Auckland. The catchment is exclusively high-density industrial, which includes food processing, chemical processing, light/heavy engineering, warehousing, transportation businesses, vehicle servicing, panel beating and a scrap yard.

The stormwater sediment generating from the Southdown catchment are more likely to have a higher degree of heavy metal contamination than the stormwater sediments. However the concentration of lead and zinc in the sediments retained in the Enviropods installed in the Takapuna, Browns Bay and Kaipatiki Catchments are similar to the settled sediments in the Hugo Johnston Ponds.

Nutrients Concentrations

Samples were also analysed for Nitrogen and Phosphorous and compared with results from other studies in the Auckland Region[5] (Chart 3). The results show high levels of nitrogen in the retained sediments from the Lake Pupuke catchment, similar to the levels in retained sediment in the Hugo Johnston Ponds. The levels of Phosphorous were also high in all catchments especially Takapuna Beach.

Nitrogen and Phosphorus in Retained sediments from NSCC Enviropod Filters



Treatment of Stormwater in the Auckland Region, ARC Environment and Planning Division Technical Publication 5 Auckland Regional Council, Auckland, 1992

[5] Auckland Regional Council, *An Assessment of Stormwater Quality and the Implications for the Treatment of Stormwater in the Auckland Region*, ARC Environment and Planning Division Technical Publication 5 Auckland Regional Council, Auckland, 1992

Chart 3: Comparison of Nutrients in Sediments retained in NSCC Enviropods

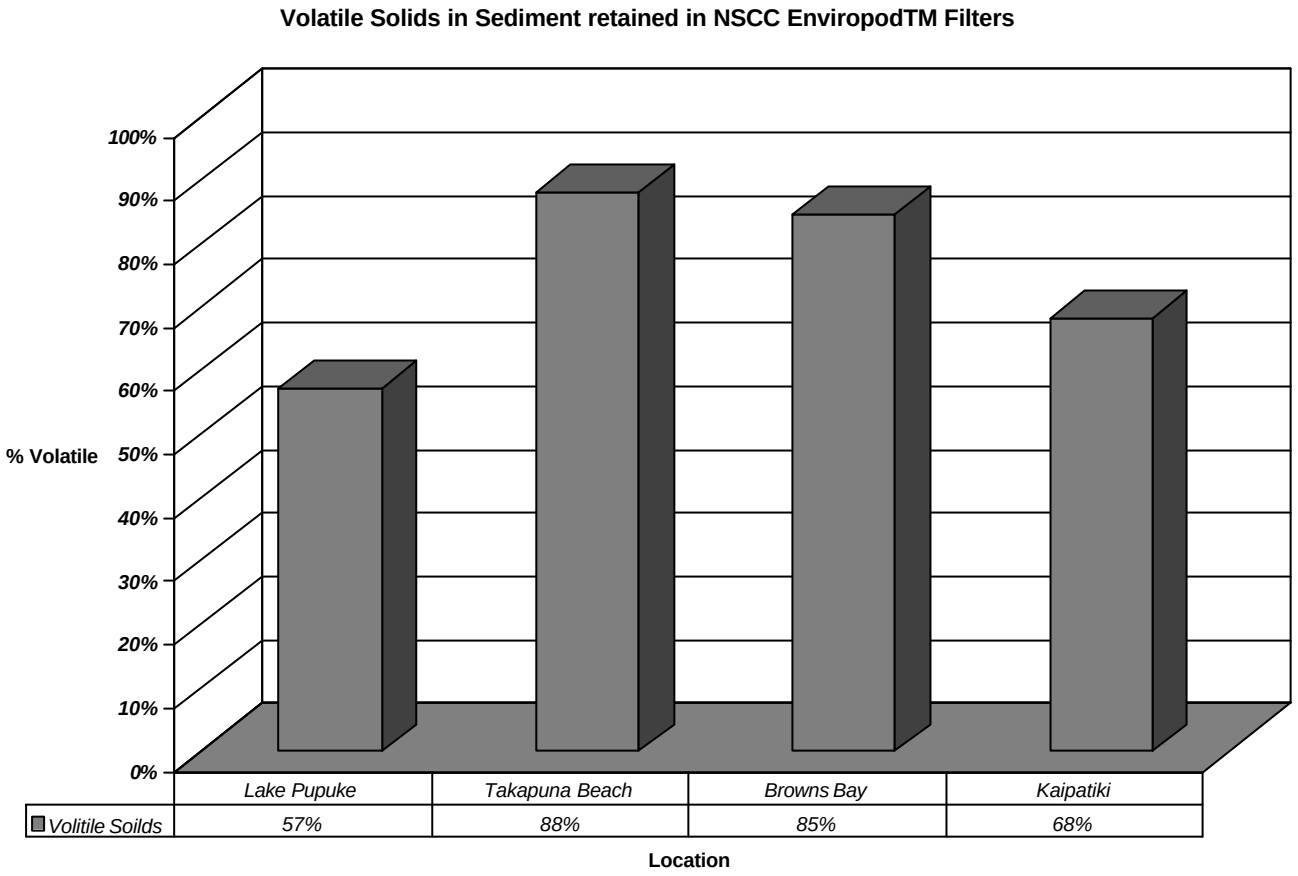


Chart 4: Percentage of Volatile Solids in Sediments retained in NSCC Enviropods

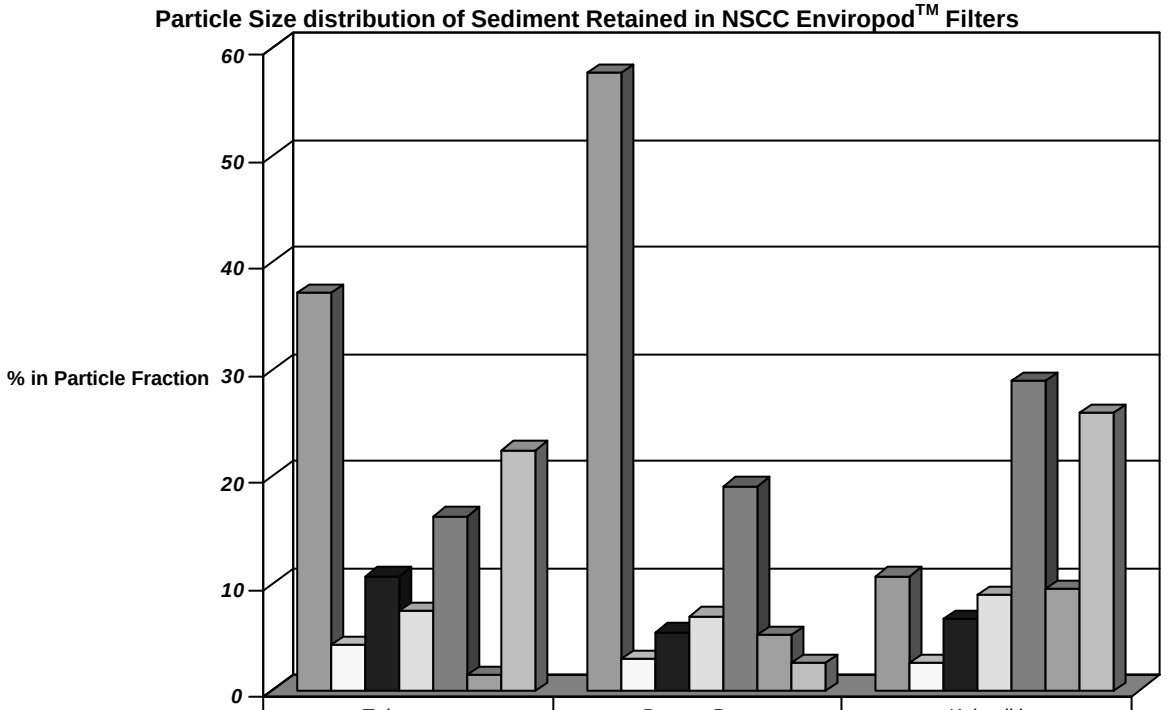
Chart 4 shows the level of volatile solids in the retained sediments. Volatile is an indication of the organic component of the samples. The levels for Lake Pupuke were lower than expected. The Lake Pupuke Catchment has a high organic loading because of the large number trees in the catchment, however there was resealing of many of the roads during the monitoring period resulting in discharge of roading material into the Enviropods. This is a possible explanation for the lower than expected readings. The level of volatile solids in the sediments retained in the Takapuna catchment was higher than initially estimated in the site assessment.

The percentage of volatile solids in the retained sediments shows a correlation with the heavy metal concentrations. Overseas studies[6] have shown that leaf matter can remove dissolved heavy metals and hydrocarbons. From these results it is apparent that the organic material may be a factor in improving the performance of the Enviropod filter in removing heavy metals from stormwater.

[6] S Clark, P Brown & R Pitt, Wastewater Treatment Using Low-Cost Absorbents and Waste Materials, University of Alabama, Birmingham, Alabama, USA,

Particle Size Distribution

The particle size distribution was varied for the retained sediments from each catchment. The samples from the Browns Bay and Takapuna catchment had a high percentage of particles greater than 2800 microns. This correlates with the high organic loading for these catchments shown in the volatile solids analysis i.e. leaves will have a larger particle sizes. The particle size analysis also shows the ability of the Enviropod filter to remove silt size particles with the high percentage of particles below 63 microns in the samples obtained from the Takapuna and Kaipatiki catchments. Chart 5 below details the results.



	Takapuna	Browns Bay	Kaipatiki
>2800	37.2	57.7	10.7
2799 - 2000	4.3	2.9	2.6
1999 - 1000	10.7	5.5	6.7
999 - 500	7.5	7	8.9
499-125	16.3	19.1	28.9
124-63	1.5	5.2	9.5
< 63	22.5	2.6	26

Chart 5: Particle Size Analysis of Material retained in NSCC Enviropod™ Filter

OPERATIONS

It is recommended that a suction truck with a 150-mm diameter hosepipe be used to maintain the pits. Hand maintenance is discouraged as it can lead to damage of the filters as well as health and safety implications as sediments are highly contaminated.

Sediment is to be extracted from the filter bag by the sucker truck. Sediment retained in the catchpit grate is to be removed. Back opening channels are to be cleared of any debris. Care is to be taken by the operator not to damage the filter. **All catchpit waste including excess sump water is to be removed from the pit. Catchpit sediments under no circumstances are to be backwashed into the catchpit.**

Filter bags are to be removed from the Enviropod frame and replaced with rejuvenated filter bags. The metal ring is removed from the expired filter bag and installed in the next rejuvenated filter bag. The used filter bag must be delivered to the washing contractor for rejuvenation, or alternatively can be water blasted with a degreasing agent at the disposal point.

All catchpit wastes from the site are to be taken off site and disposed of at a transfer station or similar approved disposal site.

Stormwater Sediments can contain Lead, Copper, Zinc, Mercury and PCBs, which are harmful to both humans and the receiving environment. The ARC advise that cesspit/catchpit tailings be regarded as 'Special Waste'.

Waste is to be tested and disposed of at a disposal site approved for the toxicity of the sediment. Acceptable disposal sites in the Auckland Region are Greenmount, Redvale and Whitford landfills.

MAINTENANCE AND INSPECTION FREQUENCY

Attached in the appendix is a schedule of the 3 maintenance cycles suggested. The schedule lists the Enviropod locations requiring servicing every 3, 4 and 6 month period. Attached also in the appendix is an example of an Enviropod Service Receipt to be completed by Enviropod when servicing any Filters. Relevant information is recorded and forwarded to the client following each maintenance clean.

It is recommended that this Management Plan be reviewed after the first 12 months to account for any seasonal variations that may not have occurred during the monitoring period.

Maintenance and inspection frequencies should be reviewed if there is a change of land use in an area that may effect the contaminant generation eg. A new vehicle entrance to a shopping centre that would create high traffic movements.

EMERGENCY PROCEDURES

Spill Procedure

In the event of a spill discharging into any catchpit all sediment is to be removed from the catchpit and filter bags are to be removed and replaced with a rejuvenated filter bag. Normal operation procedures apply to additional cleaning as a result of spills.

Blockages

In the unlikely event of surface flooding around a catchpit fitted with an Enviropod the following steps should be carried out:

1. Check over flow. The Enviropod filter has been designed with a built in overflow capable of discharging approximately 50 l/sec. If surface flooding exists, check the overflow slots underneath the rubber seal. If debris is lodged in the overflow slots these can be easily cleared by hand or steel rod.

2. If overflow is clear and surface flooding still exists, remove Enviropod and check outlet pipe for blockages.

Removal of the Enviropod may be difficult if the filter is clogged and the Enviropod is holding water. If the filter is clogged, brush the sides of the filter with a yard broom or similar. This will dislodge particles trapped at the interface, allowing contained water to flow through the filter.

If the outlet pipe is blocked, it is likely that a gully sucker truck will be required to unblock it. Debris should be removed from the Enviropod with the gully sucker truck before removal of the Enviropod filter.

If a gully sucker truck is not available and the Enviropod needs to be removed by hand, follow the steps below;

1. Remove excess debris by hand or brush the side of the filter.
2. Lift and place filter ring through the filter box and into cage.
3. Remove Filterbox.
4. Lift cage containing filter bag and ring out of the pit.
5. Unblock outlet pipe.

FILTER CLEANING

Filters are to be rejuvenated by an approved contractor. ENVIROPOD NZ approves the following contractors:

C&F Presses,
4 Kinston St
Pamure
Auckland.
Ph (9) 570 9813

Action Drainage
PO Box 24113
Royal Oak
Auckland 6
Ph (9) 636 7574

AUDIT PROCEDURES

The maintenance contractor is to complete the attached Service Receipt (Appendix 6) and submit it to the client every 12 months.