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# soakage design manual

## **PREFACE**

*This Soakage Design Manual has been prepared to provide assistance in areas of Auckland City where stormwater runoff must be controlled by ground soakage. The information will be useful for Auckland City residents, land developers and the professionals who advise them.*

*The development of many parts of Auckland City has relied heavily on the use of ground soakage for stormwater disposal. While this practice was often adopted for necessity (rather than for environmental benefit), it has also helped to maintain a valuable groundwater resource and to reduce the pollution of Auckland's marine receiving waters. The use of stormwater soakage is in agreement with modern international "best practice" which emphasises the importance of "at source" controls such as stormwater soakage.*

*The first edition of the "Stormwater Soakage Design Manual" was produced in 1991 (and later reprinted in 1994). This 2003 version of the Soakage Manual builds on the earlier editions and has been produced as part of Auckland City's "On-site Stormwater Management" (OSM) project. The OSM project has focused on ways of controlling the increased quantity of stormwater generated by intensified development (both in soakage areas and areas serviced by reticulated stormwater networks).*

## **DISCLAIMER**

*The information regarding stormwater soakage systems in this Manual has been prepared for the purpose of assisting applicants to deal with the typical stormwater soakage situations which occur in the Auckland City area. This Manual represents a significant amount of analysis about the problems of stormwater management in Auckland City, and can help you in dealing with the adverse effects of stormwater on your own and neighbouring properties.*

*The Manual is a useful consolidated summary of information about common stormwater soakage issues and the regulatory requirements for sites within Auckland City. In particular, the Manual details a suggested design approach complete with worksheets and design charts to assist applicants to determine which stormwater soakage system should be adopted.*

*However, you as the applicant are responsible for the application of the Manual to your site and making the decision regarding which soakage system is adopted as required. While this Manual can assist you, the Council is not responsible for any consequences or effects of any system that may be installed solely as a result of the application of the Manual. The Council encourages applicants to obtain specific advice (in addition to the general advice contained in this Manual) to confirm that the stormwater soakage system you choose is efficient and adequate for your site and that it is installed correctly.*

*The information in the Manual regarding resource consents and building consents is in summary only for the convenience of the reader. It is the responsibility of the reader to always check and confirm the regulatory requirements in the provisions in the relevant planning document as appropriate e.g. Proposed District Plan (Central Area), the Auckland City District Plan (Isthmus), the Auckland City District Plan (Hauraki Gulf Islands) and the Auckland Region Plans.*

# AUCKLAND CITY COUNCIL

## SOAKAGE DESIGN MANUAL

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Preparation of this Manual has been made possible by the contributions of many organisations, companies and individuals. Pattle Delamore Partners Ltd would particularly like to acknowledge contributions from:

## **(a) Organisations:**

Auckland Regional Council (In particular Earl Shaver & Alastair Small)

## **(b) Individuals:**

All the Development Engineers at Auckland City Environments

## **(c) Auckland City Council Departments:**

- i. Utility Planning.
- ii. Auckland City Environments
- iii. City Planning

## **(d) Groups formed for the OSM Project:**

- i. Project Steering Committee:  
Roger Mills, Mitre Consultancy  
Murray Menzies, WRCG  
Greg Paterson, Auckland City  
Penny Pirrit, Auckland City  
Earl Shaver, Auckland Regional Council  
Ghida Sinawi, Metrowater
- ii. Auckland City Staff:  
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- iii. Technical Reviewers:  
Charl du Toit, Camdek  
Michael Taylor, URS

**(d) Companies who provided information:**

Note: The following list of companies is not a comprehensive summary of all the firms that can assist with the supply or materials or services for soakage systems, and is not intended to imply that the products and services provided by these firms are superior to other companies. Nevertheless, these companies have provided helpful information and input, and their contributions are gratefully acknowledged:

Firth Industries (Porous Paving)  
Formpave Ltd (Porous Paving)  
Hynds Environmental (Sand Filters)  
W Stevenson & Sons Ltd (No-Fines Base Course)  
B and B Plumbers (Soakhole Cleaning and Replacement)  
Liquid Waste (Soakhole Cleaning)  
Winstone Aggregates (50/20 Scoria)  
Ihumatao Quarries Ltd (50/20 Scoria and 50/150 Scoria)  
Niederer Drilling (Soakage Bore Drilling)  
Ingal Environmental Services (Pre-treatment Systems)



## LIST OF ABBREVIATIONS

ACC	Auckland City Council
ACE	Auckland City Environments
AEP	*Annual Exceedance Probability
ARC	Auckland Regional Council
IANZ	International Accreditation New Zealand
L	Litre
LIM	*Land Information Memorandum
MPD	Maximum probable development
m	Metre
OSM	*On-Site Stormwater Management
O&M	Operation and Maintenance
PIM	*Project Information Memorandum
RMA	Resource Management Act, 1991
[no.]	Document reference, as listed in Appendix A
[comment]	Additional note to aid the Manual user

\* the "List of Definitions" (below and overleaf) explains the terminology

## LIST OF DEFINITIONS

**Note: definitions apply to the context in which they are used in this Manual**

Annual exceedance probability	The probability, expressed as a percentage, that a flood of a given magnitude will be equalled or exceeded in any one year: <b>1% AEP</b> corresponds to a 1 in 100 year return period storm. <b>2% AEP</b> corresponds to a 1 in 50 year return period storm. <b>10% AEP</b> corresponds to a 1 in 10 year return period storm. <b>50% AEP</b> corresponds to a 1 in 2 year return period storm.
Catchment	Area contributing flow at a point on a drainage system
Catch-pit	Small chamber incorporating a sediment trap that runoff flows through
Contours	Lines on a drawing that join points of equal elevation

Equivalent impervious area	The area of impervious surface that would contribute the same amount of runoff as an area made up of both pervious and impervious surfaces.
Filter-strip	Broad grassed surface conveying runoff
Flood frequency	The probability that a flood discharge rate will be equalled or exceeded in any year (refer also “annual exceedance probability” above)
Groundwater	Water stored and/or moving under the ground surface
Impermeable/impervious surface	Surface through which water cannot pass (eg roof, concrete)
Infiltration	The passage of water through soil to reach groundwater
Land Information Memorandum	A report detailing all information about a property that is known by the Council. This includes hazards, drainage plans and information on rates, permits and zones. The report is normally requested by people considering purchasing a property.
On-site stormwater management	The detention and/or retention of runoff on a site before discharging it to a disposal system
Orifice	A hole of a specified size designed to discharge flow at a pre-determined rate (it is normally machine-drilled in a plate and attached at the entry to a pipe)
OSM device	An on-site stormwater management system, designed to meet water quantity and/or quality goals, which utilises detention and/or retention of runoff before discharging it to a disposal system
Overland flow path	Route taken by flood runoff not able to be contained in the main pipe or channel stormwater conveyance system
Paved area	Any impervious ground-level area, such as driveways or patios
Pervious area	Any area covered in vegetation or garden.
Permeable surface	Surface through which water passes by infiltration
Porosity	Represents the proportion of water in a saturated gravel or soil. Multiply by the total

	volume of gravel/soil to give the volume of storage
Porous pavement	A paved surface through which water can infiltrate
Porous paved area	Any area covered in porous paving.
Project Information Memorandum	A report prepared by the Council for an owner considering a building project. The report contains information on hazards, public drainage systems and other services (e.g. electricity).
Rainwater tank	A tank that stores roof runoff (normally for re-use and flow attenuation purposes)
Rain garden	Device that receives and filters runoff and then disposes of the water by infiltration
Runoff	The flow of water across the ground or an artificial surface generated by rain falling on it
Soakage pit (or trench)	Sub-surface structure into which runoff is conveyed for disposal by infiltration
Time of concentration	Time taken for rain falling at the head of the catchment to reach a designated point as runoff
Watercourse	Natural or artificial channel which conveys runoff

## 1.0 INTRODUCTION

This Section provides important introductory material that will assist readers in correctly applying the Manual. Subsections cover:

- 1.1 An overview of the Manual (including photographs of devices)
- 1.2 Circumstances that require resource consents
- 1.3 The relationship of the Manual to other manuals and documents
- 1.4 Finding out if the property is in a soakage area

This material is for guidance only; please refer to the disclaimer statement below the preface of this Manual.

## 1.1 Overview

**Soakage devices allow stormwater to percolate into the ground**

The purpose of this Manual is to provide guidance in the design of stormwater soakage devices for residential and commercial properties in soakage areas of Auckland City. Soakage areas have limited stormwater reticulation, and are primarily located in parts of Ellerslie, Penrose, Onehunga, Mt Eden, Epsom, Mt Roskill and Mt Albert. Public soakage devices are provided for runoff from roadways in these areas, but individual property owners must construct and maintain their own soakage devices for runoff from private properties. The soakage devices allow stormwater to percolate into the ground, and generally consist of either boreholes into fractured rock or large holes filled with scoria.

**A building consent is required to install soakage devices**

The installation of new soakage devices requires a building consent, and this is applied for by submitting a building consent application to Auckland City Environments (ACE). This Manual explains the site plans, calculations and documented maintenance procedures that must be included in the application. The design methodology in this Manual is in agreement with council policy, and following the methodology will assist the application process.

**All soakage systems now require pre-treatment or settling devices**

Experience has shown that soakage devices have a high failure rate, often caused by dirty stormwater clogging the surfaces that the stormwater soaks into. This Manual addresses this problem in three ways. Firstly, if the total paved area on the site exceeds 20 m<sup>2</sup> then runoff from these areas must be treated before it enters the soakage device, and worksheets are included for sizing pre-treatment devices. Secondly, all runoff from roof areas must pass through a settling device. Thirdly, guidelines are given to assist with the operation and maintenance of all these devices.

**Rainwater tanks can reduce the size of soakage devices**

Finding sufficient space for soakage devices can be difficult, especially if soils have a low capacity for soakage. To assist with situations such as these, the Manual includes a methodology for sizing rainwater tanks. The rainwater tanks

**The OSM Manual is intended to be used with this Soakage Manual if the property is covered by more than 60% of impervious surfaces.**

provide a temporary storage space for rainwater, and allow a reduction in the size of soakage systems. If a permanent storage space is also included in the rainwater tanks, they can be used to supply some of the water required for household use. The rainwater tanks must have an orifice on the outlet, and this must be sized to be compatible with the soakage system.

In some circumstances resource consents are required to install soakage devices. Typical circumstances include if the property is covered by more than 60% of impervious surfaces, has more than 1000 m<sup>2</sup> of impervious surfaces or if land use is an industrial or trade process. For the case of more than 60% cover by impervious surfaces, the Auckland City Council has consenting authority and has published an On-Site Stormwater Management (OSM) Manual as a guideline to the design and consenting process. The OSM Manual [6] is specifically intended to be used with this Soakage Manual for these properties.

## Photographs of Devices

The following photographs have been included to help readers get an idea of what the various devices look like. Note that the devices in the photographs are for illustrative purposes only, and do not necessarily comply with the standards set out in this Manual.



**Photo 1 Nominal Soakhole:** Installed beneath a grassed area--This example has an inspection well topped off with an alloy toby box.

**Photo 2 Onehunga Soakhole:** Installed beneath a grassed area, with manhole visible





**Photo 3 Filter-strip Soakhole**  
(photo from ARC TP10 [3])

**Photo 4 Rain-garden:**  
This example receives stormwater from a car parking area (photo from ARC TP10 [3])



**Photo 5 Rockbore Soakhole**  
Installed beneath the pavement of a high density development

**Photo 6 Porous Paving**  
80mm Enviropaver  
(photo supplied by Firth)



**Photo 7 Sand-filter 1**  
Large sand-filter on a commercial site  
(photo supplied by Hynds)

**More detailed information on resource consents is given in the Regional Plan and District Plan**

**Photo 8 Sand-filter 2**

Source-control type filter (site still in construction phase)



**Photo 9 Filter-strip**

(photo from ARC TP10[3])

**Photo 10 Rain-water Tank**

Plastic type, with first flush diverter



## 1.2 Circumstances that Require Resource Consents

This Manual is primarily for advice for building consent applications. If a resource consent is required for a soakage device, this Soakage Manual should not be used as the sole source of design and consenting information. The situations that require resource consents are summarised below, along with additional manuals that should be consulted and the authority responsible in each case. Note that more detailed information on situations that require resource consents is given in the Regional Plan [4] and District Plan [7].

In general, soakage systems in Auckland City require resource consents in the following situations:

1. **If more than 60% of the property is covered with impervious surfaces (District Plan, Part 7 and Part 8).** In this situation, the

**Properties with greater than 60% cover by impervious surfaces require a resource consent**

Soakage Manual should be used in conjunction with the On-Site Stormwater Management Manual [6]. If the property has an impervious area less than 1000m<sup>2</sup> in total, a resource consent must be obtained from Auckland City Environments. For properties with impervious areas greater than 1000m<sup>2</sup> (see (2) below), a resource consent must normally be obtained from the Auckland Regional Council (unless there is a comprehensive catchment wide consent; check the Regional Plan and District Plan for the latest controls).

**Properties larger than 1000m<sup>2</sup> require a resource consent**

2. **If the stormwater originates from an impervious area that is greater than 1000m<sup>2</sup> in total (Regional Plan, Section 5.5.2).** For these properties, a resource consent is normally required from the Auckland Regional Council (unless there is a comprehensive catchment wide consent; check the Regional Plan and District Plan for the latest controls). Calculations of soakage capacity should still be carried out according to the Soakage Manual, but pre-treatment requirements may be different. The Auckland Regional Council should be consulted for further information on the consenting process.

**Industrial and trade processes require a resource consent**

3. **If the stormwater originates from an industrial or trade process (Regional Plan, Section 5.5.2).** These properties also require a resource consent from the Auckland Regional Council. Calculations of soakage capacity should still be carried out according to the Soakage Manual, but pre-treatment requirements may be different. The Auckland Regional Council should be consulted for further information on the consenting process. [Industrial and trade processes are defined in Schedule 3 of the Regional Plan].

**Some soakage bores may require resource consents**

4. **If soakage bore drilling cannot comply with the range of permitted activities listed in the Regional Plan (Regional Plan, Section 6.5.21).** In this case a resource consent is required from the Auckland Regional Council for the actual drilling of the bore. The rockbore soakhole itself (and any associated pre-treatment devices) can still be designed according to the Soakage Manual. Note that most soakage bores in Auckland City will comply with the range of permitted activities, providing that the drilling and decommissioning of the hole complies with NZS4411:2001 Environmental Standard for Drilling of Soil and Rock. Most drilling contractors are aware of, and comply with, this standard.

**Some earthworks may require resource consents**

**If the proposed earthworks do not comply with the range of permitted activities (District Plan, Part 7).** For example, excavations of more than 5 m<sup>3</sup> currently require a resource consent for residential zones 3a and 3b. Developers should consult the latest District Plan for the latest controls.



### 1.3 Other Important Manuals and Documents

The Soakage Manual is part of a wider body of design manuals and policy documents. Some of the most important of these are described below:

#### 1.3.1 Auckland City Council and Metrowater

**Development and Connection Standards [9]:** All stormwater systems in Auckland City must comply with the standard designs and specifications given in Section 4 and Section 7 of the Development and Connection Standards. The Soakage Design Manual is intended to complement these standards, but in the event of conflict the Development and Connection Standards shall take precedence.

**On-Site Stormwater Management (OSM) Manual [6]:** Stormwater systems for properties with more than 60% cover by impervious surfaces must comply with guidelines given in the OSM Manual. Generally, this requires that an 'OSM device' be installed, and a resource consent obtained. For properties in soakage areas, the 'OSM devices' are soakage devices designed according to the Soakage Manual. The process of designing the soakage devices is therefore the same as for properties with less than 60% cover by impervious surfaces, but a resource consent is required. The OSM Manual explains the consenting process and the requirements that must be met.

#### 1.3.2 Auckland City Council

**Operative District Plan – Isthmus Section [7]:** All development work must be consistent with the District Plan or else a resource consent is required. Relevant sections of the District Plan include Part 5D (natural hazards), Part 7 (residential activity) and Part 8 (business activity).

**Consolidated Bylaw, 1998 (and amendments): Part 18 – Stormwater Management [5]:** All stormwater systems must meet the requirements laid down in this bylaw. Part 18.4.5 requires owners of private soakage systems to carry out adequate maintenance. Part 18.4.6 requires the same owners to demonstrate that their soakage system is functioning in such a way as to prevent harmful effects in up to a 10% AEP storm, and to carry out any required works if this is not the case.

#### 1.3.3 Auckland Regional Council

**Proposed Regional Plan – Air, Land and Water [4]:** All stormwater discharges and borehole drilling operations must comply with the list of permitted activities listed in the Regional Plan, or else a resource

All stormwater systems in Auckland must comply with the Development and Connection Standards

The OSM Manual gives guidelines for properties with greater than 60% cover by impervious surfaces

The District Plan gives guidance for development work

Part 18 of the Consolidated Bylaw 1998 lays out requirements for stormwater management

The Regional Plan lists permitted activities

**TP10 gives guidelines for stormwater treatment devices**

consent will be required. Relevant sections of the Regional Plan include Section 5.5.2 (permitted activities for private stormwater networks) and Section 6.6.21 (permitted activities for drilling stormwater bores).

**Stormwater Treatment Devices – Design Guideline Manual (ARC – TP10) [3]:** TP10 gives guidelines for designing, operating and maintaining treatment systems for stormwater. The pre-treatment devices in the Soakage Manual have been based on these guidelines. Compared to the Soakage Manual, the design methodology in TP10 is more fundamental, is explained in more detail and is applicable to a wider number of situations. Guidelines for operation and maintenance are given.

**TP108 provides methods for estimating runoff in Auckland**

**Guidelines for Stormwater Runoff Modelling in the Auckland Region (ARC – TP108) [1]:** TP108 is the basis for calculating flows used to size soakage devices in the Soakage Manual. TP108 provides guidelines for estimating runoff in the Auckland region.

**TP90 gives guidelines for sediment control**

**Erosion & Sediment Control – Guidelines for Land Disturbing Activities (ARC - TP 90) [2]:** Development work must meet the guidelines for sediment and erosion control given in TP90. This is particularly important for the construction of soakage devices, as inadequate sediment control can cause premature failure.

#### **1.3.4 Central Government**

**All building work is governed by the Building Act**

**The Building Act 1991 [10]:** All building work is governed by the Building Act, including stormwater systems. Section 36 outlines policy relating to building on land subject to flooding.

**All building work must comply with the Building Code**

**The New Zealand Building Code [11]:** Under the Building Act, all work must comply with the Building Code. The Building Code sets out the objectives that buildings must be designed to achieve. Clause E1 sets out objectives relating to stormwater.

### **1.4 Finding out if the Property is in a Soakage Area**

**Only some areas of Auckland are soakage areas**

This Stormwater Soakage Manual is intended for use on properties that are not able to be connected to a piped stormwater system. Confirmation that properties are in this category may be obtained from a Land Information Memorandum, a Project Information Memorandum, or an application for a Building Consent. Each of these documents is summarised below:

**LIMs will note if a property is in a soakage area**

- 1. Land Information Memorandum (LIM).** LIMs are normally applied for by people intending to purchase a property. The LIM is sent out by the Council and contains information from Council records about a

**PIMs will note if a property is in a soakage area**

**Building consent applicants may be informed that they need to consider Stormwater soakage**

property. This may include information on services, potential hazards, planning issues and rates. The information on services will include details of any public or private stormwater systems (providing the information is available). If the property is in a soakage area then this will be noted. [Section 6.2 explains how to obtain the correct forms to apply for a LIM].

2. **Project Information Memorandum (PIM).** PIMs are normally applied for by people intending to carry out building work. The PIM is sent out by the Council and contains a list of specific things that need to be considered before planning the work. This may include information on services, potential hazards, and planning issues. If the property is in a soakage area, this will be noted and the applicant will be referred to the Soakage Manual for further information. [Section 6.2 explains how to obtain the correct forms to apply for a PIM].
3. **Building Consent Application.** In some circumstances people may choose to apply for a building consent without first obtaining a PIM. If the property is in a soakage area then the application (prepared by the applicant) must contain information relating to stormwater disposal by soakage. If this information is not included, the application will be declined with a note that the property is in a soakage area, and that further work needs to be carried out. [Section 6.1 contains further information on consent applications].

The design steps are summarised in Figure 1

## 2.0 PRELIMINARY CONSIDERATIONS

This section outlines things that should be considered before choosing positions for soakage devices, or beginning detailed design. Sub-sections cover:

- 2.1 A summary of the design process
- 2.2 Obtaining flood hazard information
- 2.3 Designing structures to comply with flood hazard policy
- 2.4 Positioning soakage devices

This material is for guidance only; please refer to the disclaimer statement below the preface of this Manual.

### 2.1 A Summary of the Design Process

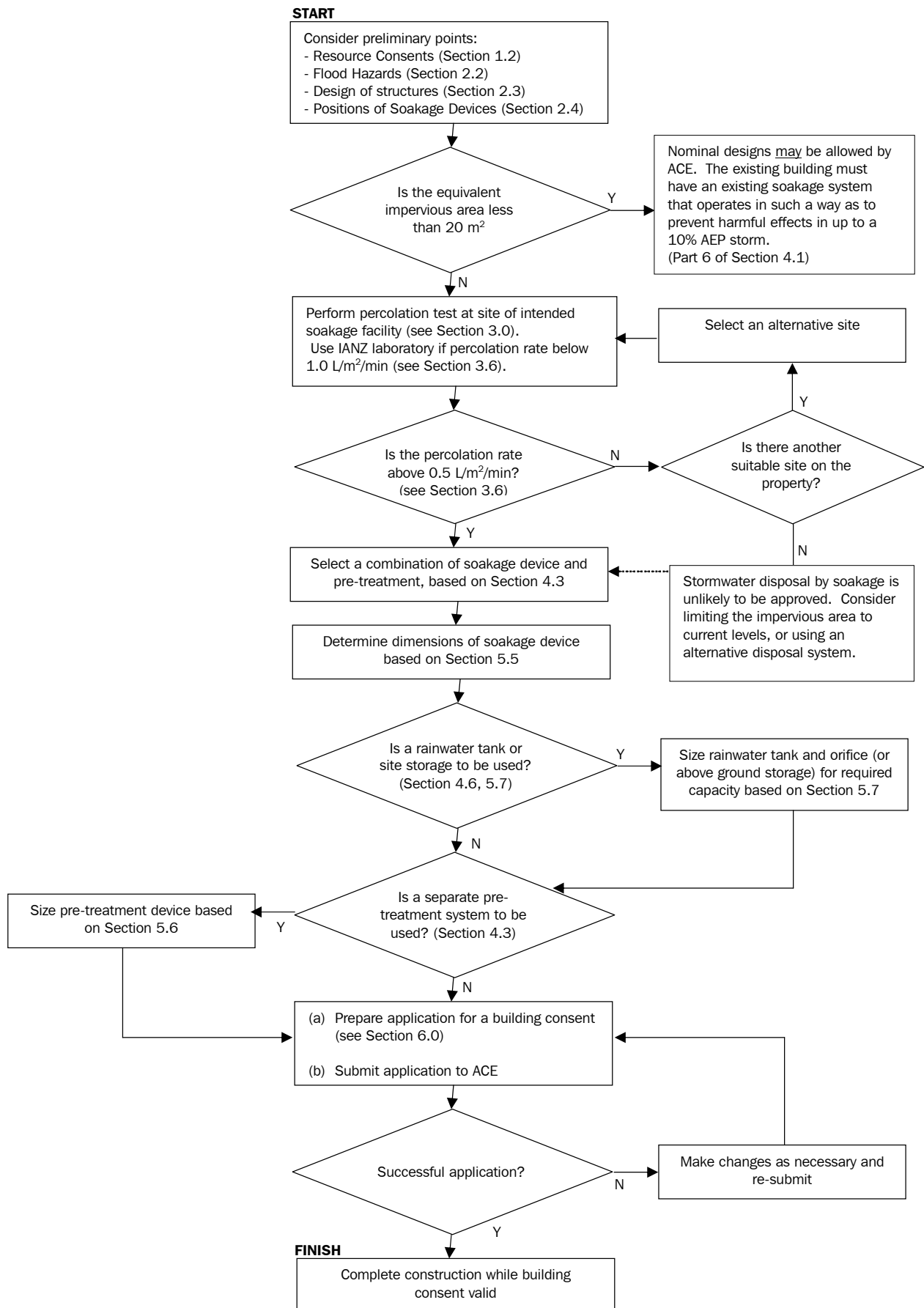
A flow chart illustrating the steps involved in designing a soakage device and submitting an application for a building consent is shown in Figure 1. The flow chart has references to the different sections of the Manual that will help complete each step. In addition, a summary of the main design steps is given below:

**Preliminary considerations (Section 2.0)** involve considering flooding risks, stability issues, ownership issues and planning suitable locations to carry out percolation tests.

**Percolation tests (Section 3.0)** assess the rate at which stormwater will soak into the ground, called the percolation rate. The percolation rate is needed so that the soakage device can be sized correctly. Percolation tests must be carried out on-site, and involve adding water into either a test-pit or a borehole, then either measuring the maximum flow rate at which the water can be added (constant head test) or switching the water off and measuring the rate at which the water falls (falling head test).

**Selecting soakage systems (Section 4.0)** involves selecting a soakage system that will meet Council regulations, fit in the available space and provide the best long-term performance at a reasonable cost. The designer must also decide whether rainwater tanks will be used to reduce the size of the soakage system.

*(continued on Page 11)*



**Figure 1: Flowchart for Soakage System Design**

**Proposed work must  
comply with policy on  
flood hazards**

**Sizing of soakage devices (Section 5.5)** involves determining the volume (depth and area) of the soakage device that is needed to allow the stormwater to soak away, given the percolation rate. The design areas (**Section 5.3**) are needed to carry out the sizing.

**Sizing of rainwater tanks and on-site storage (Section 5.7)** involves determining the volume of rainwater tank (or on-site storage) that is needed so that an under-sized soakage device will still be able to provide acceptable performance. If the rainwater tank is to be used to supply household water as well, the volume of water needed for this purpose is also determined.

**Sizing of pre-treatment devices (Section 5.6)** involves determining the area of pre-treatment device needed so that runoff from paved areas can pass through the device.

**Preparing a building consent application (Section 6.0)** involves documenting the design process and filling out forms for submission to ACE.

## **2.2 Obtaining Flood Hazard Information**

Building consents can only be issued if proposed works comply with both ACC and central government policy on flood hazards. This section details steps to help obtain the information needed to correctly design any structures on the property (Section 2.3) and correctly position soakage devices (Section 2.4). The steps are as follows:

1. **Apply for a Project Information Memorandum (PIM) or a Land Information Memorandum (LIM)**, if they have not already been obtained. The PIM or LIM will show if the property has any identified stormwater issues. This may include information on flooding such as flood plain levels and overland (secondary) flow paths. The PIM or LIM will also identify if there is a catchment or flood hazard report for the area. [Section 1.4 and Section 6.2 contain further information on obtaining a PIM or LIM].
2. **Consult catchment management plans and flood hazard maps.** These documents will provide more detail than a PIM or LIM. Catchment management plans and flood hazard maps are not available for all areas, but may be viewed at Council Offices if available (copies can be obtained for a fee). This step may sometimes be omitted for small developments (unless otherwise directed by ACE).
3. **Visit the site to confirm or identify overland flow paths.** This step is necessary because no detailed mapping of overland flow paths on

**Structures must  
comply with policy on  
flood hazards**

private property has been carried out. While ACC records are continuously being updated as information becomes available, there is no guarantee that the PIM and LIM process will identify all flow paths.

### **2.3 Designing Structures to Comply With Flood Hazard Policy**

All buildings and related structures constructed on a site must comply with both ACC and central government policy on flood hazards if building consents are to be issued. In general, it is convenient to consider these policies at the same time that the stormwater system is designed, and for this reason the policies are summarised here. Relevant policy documents include:

- The Building Act (Section 36) [10].
- The Building Code (Clauses E1 and E2) [11].
- The District Plan (Part 5D of the Isthmus Section) [7].
- Consolidated Bylaw 1998: Part 18 – Stormwater Management [5].
- The Resource Management Act (Section 76) [13].

**For all properties, the following policies apply:**

- All structures (including decks, fences etc) must be designed so there is no obstruction of overland flow paths. This is required by Part 18.2.4 of the Auckland City Consolidated Bylaw 1998.
- All buildings with timber floors must have adequate sub-floor ventilation. This requirement is to meet Clause E2 of the Building Code.

**For land that may be subject to flooding, the following policies apply:**

- All building work (and land on the property) must be adequately protected from flooding, in accordance with Section 36 of the Building Act and Part 5D of the District Plan. At a minimum, flood protection for building work is required to prevent floodwaters from a 2% AEP flood entering houses, communal residential buildings and communal non-residential buildings, in accordance with Clause E1 of the Building Code. However, note that ACE will consider each case individually and may decline a building consent if they do not consider that Section 36 of the Building Act and Part 5D of the District Plan have been adequately complied with. Building consents may also be issued subject to Section 36(2) of the Building Act, which will mean that a note will be placed on the title of the land indicating that

**Positions for soakage devices should be considered before percolation tests are carried out**

the land is subject to flooding.

- The development must not increase the extent of flooding on any other property, either upstream or downstream, in either the 10% or 2% AEP storm. This is required by Section 36 of the Building Act and Section 76 of the Resource Management Act.

## **2.4 Positioning Soakage Devices**

Soakage devices must be placed in an appropriate position on the property if they are to work effectively and comply with flood hazard policy. The positioning of soakage devices needs to be considered before percolation tests are carried out, to guide the location of the percolation tests. The following points give guidelines for locating soakage devices:

1. **Soakage devices must not be located within a 10% AEP storm flood plain**, and if possible should be located outside the 2% AEP storm flood plain. They should also be located away from overland flow paths. Following the steps outlined in Section 2.2 will help determine the location of flood plains and overland flow paths.
2. **Soakage devices must be located where there is adequate access for maintenance.** The frequency at which maintenance is carried out is one of the most important factors affecting the long term performance of soakage systems. Guidelines on access for maintenance are given in Section 7.2.
3. **Soakage devices must not be located close to buildings, as identified on the standard details [refer Section 5.8 and Appendix A].** A clearance of 3 m is generally required, but this can be reduced to 2 m for rockbores and 1 m for porous paving. Where it is not practically possible to meet these guidelines, a site-specific geotechnical design must be completed to take into account the effect of the soakage device on building foundations.
4. **Soakage devices must not be located close to property boundaries, as identified on the standard details [refer Section 5.8 and Appendix A].** A clearance of 3 m is generally required, but this can be reduced to 1.5 m for rockbores and 1 m for porous paving. Where it is not practically possible to meet these guidelines, an assessment should be carried out to determine the risk of flooding to neighbouring properties.
5. **Soakage devices should not be located beside retaining walls.** For walls less than 2 m high, the clearance must not be less than a horizontal distance equal to the retaining wall height plus 1.5 m, unless a site-specific design is carried out. The site-specific design



must take into account geotechnical considerations, and ensure stormwater from the soakage device will not enter the cut-off drain for the retaining wall. For walls higher than 2 m, a site specific design must always be carried out.

6. **Soakage devices must not be located within 2 m of sanitary sewers.**
7. **Soakage devices should not be positioned on unstable slopes.** Project Information Memoranda [see Section 1.4] can help identify stability issues.
8. **Soakage devices should be positioned above the winter water table.** The position of the winter water table can be estimated when boreholes or test-pits are constructed [see Section 3.2].
9. **Soakage devices should not be shared between properties** unless a legally constituted “Body Corporate” is established to take responsibility for maintenance and eventual replacement.
10. **Consideration should be given to the path that water will follow during storms that exceed the design capacity of the soakage device.**
11. **Locate the soakage devices so that all site runoff can be fed to them.**

## 3.0 PERCOLATION TESTS

This section on percolation tests describes methods for estimating the rate at which stormwater will soak into the ground. Sub-sections cover:

- 3.1 An overview of the procedures
- 3.2 Boreholes/test pits
- 3.3 Preparation of boreholes/test pits for percolation tests
- 3.4 Falling-head percolation tests
- 3.5 Constant head percolation tests
- 3.6 Minimum soakage rate for soil areas

This material is for guidance only; please refer to the disclaimer statement below the preface of this Manual.

**Percolation tests are required for all soakage devices except nominal soakholes**

### 3.1 Overview

The ability of the ground to accept stormwater can vary enormously within soakage areas, even within individual properties. Because of this, at least one percolation test will normally be required for every soakage device that is constructed.

The exception to this rule is if the soakage device is for an impervious areas less than 20m<sup>2</sup>. Small impervious areas such as these can often be served by 'nominal' designs that do not require percolation tests. Nominal soakholes are described in Section 4.1, Part 6.

For soils with low permeability rates, tests must be carried out by an IANZ (International Accreditation New Zealand) Laboratory. Refer to minimum soakage statement in Section 3.6.

**Boreholes/Test Pits must be deep enough and in the correct location**

### 3.2 Boreholes/Test Pits

Percolation tests are normally carried out in boreholes. These may be bores drilled in rock using a drilling rig or bores drilled in soil using a hand auger or post hole auger. If drilling is attempted with a drilling rig but found to be impossible due to ground conditions (such as in scoria areas), then percolation tests can be carried out in testpits. Boreholes and testpits should be constructed according to the following guidelines:

- Boreholes of 100 mm to 150 mm diameter should be bored to at least 1.5 m below the bottom of the intended soakage device.
- Testpits must only be constructed after drilling has failed. The pits

**Ground conditions  
must emulate winter  
conditions**

should be excavated to the level of the proposed soakage device, have a minimum base area of 1 m<sup>2</sup> and be laid back at a suitable angle to prevent caving-in and erosion during the test. Note that the testpit methodology in the Soakage Design Manual is intended for use in scoria areas. It is not suitable for use in soil areas.

- Boreholes and test pits should be logged (that is, geological layers and soil types should be recorded).
- At least one borehole or test pit should be constructed for every soakage device. Soakage devices with a large surface area (such as porous paving) will need at least one borehole/ test pit for every 50 m<sup>2</sup> of soakage device.
- Water-table levels should be recorded at the time of excavation (if observed). If the fieldwork is carried out between October and May (spring – autumn), winter water table levels should be estimated at 1.0 m higher than observed water table levels.
- The locations of boreholes and test pits should correspond with the position of the proposed soakage devices.

### **3.3 Preparation of Boreholes/Test Pits for Percolation Tests**

- Boreholes in soil should be prepared for testing by carefully scratching the sides with a sharp-pointed tool to remove any smeared soil surfaces and to provide a natural soil interface through which water may infiltrate.
- All loose materials should be removed from the hole.
- If collapse of a drilled borehole seems likely, a PVC pipe should be inserted into the hole to prevent collapse. If scouring of a test pit seems likely, about 50 mm of sand or fine gravel should be added to the pit to protect the bottom from scouring or sediment blinding.
- Holes in soil areas must be thoroughly pre-soaked to emulate winter conditions. **In spring, summer or autumn (October to May), holes must be kept full for a minimum of 17 hours prior to testing.** This will normally provide adequate time for the soils surrounding the hole to become saturated, and for any clay soils to swell. During wet winter conditions, holes must be kept full for a minimum of 4 hours.
- Holes in rock areas must be pre-soaked to ensure that any cavities in the rock are filled before testing begins. The hydrant must be open at a high flow rate for a minimum of 10 minutes before testing begins.

**Falling-head tests are most suitable for soils of medium to low permeability**

### 3.4 Falling-Head Percolation Tests

Falling-head percolation tests determine the percolation rate of an area by filling a borehole with water and recording the rate at which it drains away. This test method is most suitable for use in soils with medium to low permeability.

Equipment required to carry out a falling head test includes a suitable water supply, tape measure or water dipper, stopwatch, a copy of WORKSHEET 1 and pen for recording information. A torch may also be useful.

To carry out a falling head percolation test on a borehole:

- Note that if percolation rates are likely to be below 1.0 litres/m<sup>2</sup>/min then the test should be carried out by an IANZ laboratory. Refer to Section 3.6.
- Thoroughly pre-soak the hole according to the instructions in Section 3.3. **In spring, summer or autumn (October to May), holes must be filled to the top and maintained full for a minimum of 17 hours prior to the test.**
- Fill the hole to within 0.75 m of ground level and record the drop in water level against time at evenly spaced intervals of no greater than 30 minutes, until the water level is around 0.25 m from the base of the hole or 4 hours has passed. Where the hole drains quickly, the test should be repeated several times.
- Graph the results according to the method on WORKSHEET 1 and **derive the percolation rate in L/m<sup>2</sup>/min from the minimum slope of the curve.**

### 3.5 Constant-Head Percolation Tests

**Constant-head tests are most suitable for areas with high permeability**

Constant-head percolation tests determine the percolation rate of an area by maintaining a constant head of water in a test pit or borehole. The water that drains out of the test hole is replenished at the same rate from a water source such as a fire hydrant or reservoir. The stabilised flow rate of water entering the hole is measured over time to determine the permeability of the soil. This test method is most suitable for use in rock areas (or areas with high permeability).

Equipment required to carry out a constant-head test includes a hose and fire hydrant, flow meter, tape measure or water dipper, stopwatch, a copy of WORKSHEET 2 and pen for recording information.

To carry out a constant head test on a rockbore:

- Obtain permission from Metrowater to use water from the hydrant.
- Fill the bore using a pipe connected to a flow meter. Observe the water level and adjust the hydrant valve until the bore is maintained close to full. **This step must be continued for at least 10 minutes to ensure the hole is adequately pre-soaked.**
- Bores positioned within 10 m of each other must be tested simultaneously.
- Continue the test for a further 10 to 15 minutes, and ensure a constant rate is achieved.
- Use WORKSHEET 2 to record the instantaneous flow rate required to maintain a constant head.
- Apply a factor of safety of 1.4 to account for the likely reduction in future soakage rate due to clogging.

To carry out a constant head test on a test pit:

- Obtain permission from Metrowater to use water from the hydrant.
- Fill the hole to about half the maximum depth using a pipe connected to a flow meter and adjust the hydrant valve to maintain the water level. **This step must be continued for at least 10 minutes to ensure the hole is adequately pre-soaked.**
- Continue the test for a further 10 to 15 minutes, and ensure a constant rate is achieved.
- Use WORKSHEET 2 to record the instantaneous flow rate required to maintain constant head.
- Apply a factor of safety of 1.4 to account for the likely reduction in future soakage rate due to clogging.
- Use WORKSHEET 2 to convert the flowrate into a L/m<sup>2</sup>/min percolation rate.

In practice, the use of a fire hydrant will only be appropriate for soakage holes which have capacities below the maximum flow rate able to be provided by the fire hydrant (usually 20 L/s). For holes with excessive soakage capacity, a water truck can be used to provide higher flow rates.

**The guideline for the minimum percolation rate is 0.5 litres/m<sup>2</sup>/min**

### **3.6 Minimum Percolation Rate for Soil Areas**

The guideline for the minimum percolation rate is 0.5 litres/m<sup>2</sup>/min. If percolation rates are near or below this value, it will be difficult to obtain building consents for soakage systems.

When soil types are such that the percolation rate is less than 1 litres/m<sup>2</sup>/min—or is likely to be less than 1 litres/m<sup>2</sup>/min—or may drop to less than 1 litres/m<sup>2</sup>/min over the lifetime of a building—then the percolation tests are to be carried out by an IANZ (International Accreditation New Zealand) Laboratory qualified to do percolation tests (refer IANZ's website for details [www.ianz.govt.nz](http://www.ianz.govt.nz)).

## 4.0 SELECTION OF SOAKAGE SYSTEMS

This section provides descriptions of the different devices, and suggestions for selecting the most appropriate system. Sub-sections cover:

- 4.1 Descriptions of the approved soakage devices
- 4.2 Descriptions of the approved pre-treatment devices
- 4.3 Pre-treatment requirements
- 4.4 Cost of Devices
- 4.5 Difficult Sites
- 4.6 Descriptions of rainwater tanks and on-site storage
- 4.7 Rainwater tanks and Metrowater charges

This material is for guidance only; please refer to the disclaimer statement below the preface of this Manual.

### 4.1 Descriptions of the Approved Soakage Devices

There are six main types of soakage devices, and each of these are described below [refer to drawings in Appendix A]:

**A number of different soakage devices may be suitable, depending on the site layout and soil conditions**

1. **Onehunga soakholes** are scoria filled pits with a central chamber (constructed from either concrete or brick) to increase storage capacity slightly and provide a space for sediments to settle out. The scoria filled part is normally covered with around 300 mm of soil, but the main chamber normally extends to the surface with a cast iron lid to allow access. Rainwater enters the main chamber through pipes.

The main chamber extends the life of the soakhole by allowing access for maintenance, and also provides more storage space than the same volume of scoria. Providing the percolation rate is above 0.7 L/m<sup>2</sup>/min, this allows a reduction in the size of the soakhole. The reduction in size is normally only significant if the chamber takes up more than 50% of the soakhole volume. The chambers get very expensive above 1.0m diameter, so it is often more economic to increase the size of the soakhole rather than increase the size of the chamber.

2. **Filter-strip soakholes** are for use when a filter-strip is used as a pre-treatment device. This design does not have a chamber, and the scoria layer is covered with cobbles or shingle rather than soil. Runoff from the filter-strip enters the soakhole through the cobbles.
3. **Rain-gardens** are scoria filled pits covered with a layer of sandy soil (the soil is planted with suitable plants). Stormwater drains onto the

rain-garden, and percolates through the soil into the scoria. An overflow is provided so that stormwater can bypass the soil layer for large storms. Rain-gardens may also function purely as pre-treatment devices (the scoria layer is reduced, and an underdrain installed).

4. **Rock-bore soakholes** are bores drilled into fractured rock, and surrounded by a concrete chamber. They are used in fractured rock areas.
5. **Porous paving** consists of layers of gravel and sand overlain by permeable paving (such as modular paving or porous concrete). Stormwater normally percolates directly through the pavement layer. Porous paving can only dispose of stormwater that actually falls on the paving, and should not be used to dispose of stormwater from nearby impervious areas. Porous paving can be used on both residential and commercial properties.
6. **Nominal soakholes** are scoria filled pits, normally covered with around 300 mm of soil. They do not have a chamber, and are only intended for use in small catchments less than 20 m<sup>2</sup>.

Nominal soakholes are approved at the discretion of ACE, and have the advantage that percolation tests do not need to be carried out. For nominal designs to be used, the owner may be required to demonstrate that the property currently has adequate stormwater disposal to prevent harmful effects in up to a 10% AEP storm.

#### 4.2 Descriptions of the Approved Pre-Treatment Devices

The four approved types of pre-treatment systems are described below (refer to drawings in Appendix A):

Different pre-treatment devices may be suitable, depending on the site layout and type of soakage device

1. **Sand-filters** are normally pre-cast concrete structures installed below ground (refer Photo 7). They have a sedimentation chamber and a chamber filled with filter-sand. Contaminants are removed as stormwater passes through the filter sand. Of the three pre-treatment devices, sand-filters are the most compact and the easiest to maintain, but they must be maintained regularly if they are to function correctly.
2. **Rain-gardens** have sandy soil layers overlying scoria. They may also function as soakage devices if designed to do so. Contaminants are removed as stormwater filters through the soil layer. Although the soil area of rain-gardens is approximately 5-10 times the area required for sand-filters, they may still be cost-effective (refer to Table 4 for examples). Rain-gardens can look attractive and need only infrequent



maintenance, as the large soil surface area does not clog readily.

3. **Filter-strips** are grassed open channels that remove pollutants by slowing flows and allowing particles to settle out. Of the three pre-treatment devices, filter strips require the largest area and this may prevent their use on many properties. Filter-strips are an economical option if the required space is available.
4. **Scoria trenches** are trenches filled with scoria (but possibly topped with alternative media such as decorative rock). They are intended to run along the down-slope edge of paved areas, and will act as an infiltration device for low-flow conditions and a stormwater collection/settling device for high flow conditions. They are essentially a sacrificial soakage device that disposes of smaller storms, and helps keep contaminants out of the main soakage device. Scoria trenches are the cheapest pre-treatment device (refer to Table 1 for examples), and take up less space than raingardens and much less space than filter-strips. Scoria trenches will only need infrequent maintenance, but the maintenance is likely to be more expensive and time-consuming than for sand-filters.

Note that additional pre-treatment devices will be added to this Manual as they are approved. Pre-treatment devices will be assessed by Auckland City Asset Standards, and users of this Manual should consult ACE to find out the status of any particular device.

### 4.3 Pre-Treatment Requirements

**All soakage systems require pre-treatment or settling devices.** Table 1 and Table 2 (following page) are intended to assist with selecting soakage and pre-treatment devices. The reasoning behind the tables is based on the following guidelines:

**All soakage systems  
require pre-treatment  
or settling devices**

- All runoff from paved areas that are larger than 20 m<sup>2</sup> is required to be pre-treated to a standard where 75% removal of suspended solids is achieved on a long-term average basis.
- All runoff from roof areas must pass through a settling device.
- Runoff from paved areas less than 20 m<sup>2</sup> need only pass through a standard catchpit.

**Table 1: Summary of Pre-treatment Requirements**

Situation	Pre-treatment Devices
Paved areas of more than 20 m <sup>2</sup>	Sand-filter Raingarden Filter-strip Scoria trench Porous paving  <i>Provide a high level of treatment</i>
Paved areas of less than 20 m <sup>2</sup>	Catchpit (300 x 450 standard catchpit)  <i>Provides minimal treatment</i>
Roof areas	Settling chamber (600 diameter mini-chamber, 1 m deep)  <i>Removes coarse solids only</i>

**Table 2: Summary of Pre-treatment and Soakage Combinations**

Pre-treatment Device	Suitable for Paved Areas Larger than 20 m <sup>2</sup> ?	Suitable for Paved Areas Smaller than 20 m <sup>2</sup> ?	Suitable for Roof Areas	Can Function as a Soakage Device by itself?	Can Feed to the Following Soakage Devices:
Sand-filter	✓			No	- Onehunga Soakhole - Rockbore Soakhole
Raingarden	✓			Yes – in soil areas, the scoria base can be deepened to provide soakage	- Onehunga Soakhole - Rockbore Soakhole
Filter-strip	✓			No	- Filter-strip soakhole - Rockbore soakhole (via scoria trench) - Onehunga soakhole (via scoria trench)
Scoria Trench	✓			No	- Onehunga Soakhole - Rockbore Soakhole
Porous Paving	✓	✓		Yes, but cannot accept external stormwater	
Catchpit Only		✓		No	- Nominal soakhole
Settling Chamber			✓	No	- Onehunga soakhole - Filter-strip soakhole - Rockbore soakhole - Rain-garden

Costs will vary depending on the site chosen and the site specific characteristics

#### 4.4 Cost of Devices

The following costs will provide an approximate comparison between the different soakage and pre-treatment devices. [Note that rainwater tanks were not included in the costing exercise, but approximate costs are set-out in Section 9.3 of the OSM Manual[6]]. Costs for soakage and pre-treatment devices have been determined for a site with the following characteristics::

- Roof Area: 200 m<sup>2</sup>
- Paved Area: 100 m<sup>2</sup>
- Grass Area: 100 m<sup>2</sup>

**Table 3: Approximate costs<sup>1,2</sup> of soakage devices for entire property (excl GST):**

<u>Non-Rock Area, Percolation Rate<sup>3</sup> = 0.5 L/m<sup>2</sup>/min</u>	
Onehunga Soakhole (42 m <sup>3</sup> , with 1050 mm chamber)	\$6,500 <sup>1</sup>
<u>Non-Rock Area, Percolation Rate<sup>3</sup> = 1.5 L/m<sup>2</sup>/min</u>	
Onehunga Soakhole (28 m <sup>3</sup> , with 1050 mm chamber)	\$5,500 <sup>1</sup>
<u>Rock Area, Capacity of Bore<sup>4</sup> = 5.0 L/s</u>	
Rockbore Soakhole (1 x bore, with 1 x 1050 mm chamber)	\$3,600 <sup>1</sup>
<u>Rock Area, Capacity of Bore<sup>4</sup> = 2.5 L/s</u>	
Rockbore Soakhole (2 x bore, with 2 x 1050 mm chambers)	\$6,500 <sup>1</sup>

- Notes:**
1. Costs are 2002, and to an accuracy of +/- 25%
  2. Costs include materials and labour but exclude consulting fees.
  3. Percolation rates typically vary from 0.4 - 100 L/m<sup>2</sup>/min.
  4. Rockbore capacities typically vary from 1-20 L/s.

**Table 4: Approximate costs<sup>1,2</sup> of pre-treatment devices for paved area (excl GST).**

Sand-filter	\$4,500 <sup>1</sup>
Rain-garden (for pre-treatment only)	\$2,500 <sup>1</sup>
Filter-strip	\$500 <sup>1</sup>
Scoria Trench	\$1,500

- Notes:**
1. Costs are 2002, and to an accuracy of +/- 25%
  2. Costs include materials and labour but exclude consulting fees.

**Site-specific solutions may need to be found for sites with low percolation rates or limited space.**

## **4.5 Difficult Sites**

The following notes are relevant to sites with low percolation rates or limited space:

1. **Sites with low percolation rates.** The space required for soakage devices increases dramatically as the percolation rate reduces. Options for properties with a low percolation rate include [see Section 3.6 for statement on the minimum soakage rate]:
  - i. Increasing the number of soakage devices to reduce the impervious area feeding to each device. Soakage is much more likely to be effective if impervious areas are kept below 100 m<sup>2</sup>.
  - ii. Installing rainwater tanks to reduce the size of soakage devices. Refer to Section 4.6.
  - iii. Installing porous paving to reduce site runoff. Porous paving can function effectively at low percolation rates. Refer to Section 4.1.
2. **Sites with limited space.** Finding sufficient space for soakage devices can be difficult, especially on properties with a high proportion of impervious area. Options for sites with limited space include:
  - i. Using a sand-filter or scoria trench for pre-treatment, as these have the smallest space requirement. Alternatively, raingardens may be an efficient use of space if they are incorporated into landscaping features. Note that if raingardens are only used for pre-treatment and have an impermeable liner, they may be located directly beside these buildings. Scoria trenches may be placed within 1 m of buildings and property boundaries.
  - ii. Installing rainwater tanks to reduce the size of soakage devices.
  - iii. Installing several smaller soakage devices rather than one large device.
  - iv. Installing porous paving to reduce site runoff. Porous paving can be placed within 1 m of buildings and property boundaries.
  - v. Considering alternative options, such as connection to public stormwater mains. Sometimes roof areas are able to syphon to stormwater lines, even if paved areas cannot be connected.

Rainwater tanks and on-site storage can increase the capacity of soakage devices

#### 4.6 Descriptions of Rainwater Tanks and On-Site Storage

Rainwater tanks and on-site storage are described below:

1. **Rainwater tanks** are tanks that collect stormwater from the roof spouting system. The purpose of the tanks is to reduce the peak flow feeding to soakage systems, and also to provide a reservoir of fresh water for non-potable domestic purposes. To achieve both functions, the tanks have two zones, called a 'permanent storage zone' and a 'temporary storage zone'. The zones are separated by an outlet which has an orifice plate to control the flow.
2. **On-site storage** is a low-cost way of providing storage outside of a soakage device. The additional storage volume is achieved by temporarily ponding water on suitable areas such as driveways, lawns or gardens. The ponded water must not exceed a maximum depth of 250 mm, so large areas are needed to provide significant storage. The volume of on-site storage must not exceed 40% of the combined storage volume provided by the soakhole and on-site storage. This is to ensure that the 50% AEP storm (2-year storm) is kept below ground level.

#### 4.7 Rainwater Tanks and Metrowater Charges

Metrowater may charge rainwater tank owners for water discharged to the sewer system.

Metrowater is the utility responsible for water supply and wastewater disposal in the Auckland City area. In most cases, soakage devices will not impact on these services. However, rainwater tanks include provision for re-use of stormwater. This will, in turn, affect the amount of mains water purchased from Metrowater, and also wastewater charges since these are related to mains water consumption. Having considered the likely impact of rainwater tanks, Metrowater has advised the City that the following policy shall apply (note, however, that while this policy was current at the time of writing this Soakage Manual, prospective users of rainwater tanks should check with Metrowater as to the operative policy at the time of installation):

*The latest MetroWater water and wastewater charging policy will be applied. When the wastewater network is to be utilized by connecting rainwater tanks to household plumbing system, Metrowater will reserve the option to install a water meter to measure the wastewater discharge. For this purpose, authority for access to property will be as identified in Metrowater's latest "Terms of Contract".*

This means that water meters may be required on the water tank installation in order for Metrowater to measure water consumption. From this, it would be possible to calculate the appropriate wastewater charge, based on the criterion that 75% of the water used is disposed of to the wastewater system.

## 5.0 DESIGN PROCEDURES

This section describes procedures for sizing the devices. Sub-sections cover:

- 5.1 Design standards for soakage devices
- 5.2 Design standards for pre-treatment devices
- 5.3 Design areas for sizing
- 5.4 Ratios used for sizing
- 5.5 Sizing of soakage devices
- 5.6 Sizing of pre-treatment devices
- 5.7 Sizing of rainwater tanks and on-site storage
- 5.8 Standard details
- 5.9 Innovative designs

This material is for guidance only; please refer to the disclaimer statement below the preface of this Manual.

## 5.1 Design Standards for Soakage Devices

The design methodology for soakage devices in this Manual has the following basis:

**Soakage devices must be designed to meet the appropriate design standards**

1. Soakholes must accept runoff from all paved areas and roof areas, and from pervious areas if they will contribute runoff.
2. Soakholes are designed to accept rainfall events up to the 10% AEP storm.
3. Estimations of stormwater runoff are based on the ARC method detailed in TP108 [1], but with the following simplifications:
  - A time of concentration of 10 minutes is assumed.
  - A uniform rainfall depth is applied over all areas of the City.
  - The 10% AEP 24-hour rainfall depth is taken to be 130mm.
4. The surface area available for soakage is assumed to be the base area of the soakhole plus half the wall area.
5. The soakhole must drain within 24 hours of the end of the design rainfall event.
6. The guideline for the minimum soakage rate is 0.5 litres/m<sup>2</sup>/min [see statement in Section 3.6].

Pre-treatment devices must be designed to meet the appropriate design standards

## 5.2 Design Standards for Pre-Treatment Devices

The design methodology for pre-treatment devices in this Manual has the following basis:

1. Pre-treatment devices must accept runoff from all paved areas.
2. Pre-treatment devices are designed to remove around 75% of solids in the stormwater for rainfall events up to a 25 mm water quality storm. This is consistent with ARC guidelines in TP10 [3].
3. Estimations of stormwater runoff are based on the ARC method detailed in TP108 [1], assuming a time of concentration of 10 minutes and a runoff depth of 25 mm.
4. Filter-strip sizing in the Manual has been based on a filter-strip slope of 1%. For other slopes, designers are referred to TP10 [3].

## 5.3 Design Areas for Sizing

Design areas must be determined before sizing calculations are carried out.

The sizing of soakage devices, pre-treatment devices and rainwater tanks is determined by the type of surface that covers the property, and the amount of area it covers. In general, design areas can be divided into the categories shown in Table 5.

**Table 5: Symbols for design areas**

Roof Area	$A_R$
Paved Area (concrete, patio etc)	$A_C$
Pervious Area (grass or garden )	$A_P$
Porous Paved Area	$A_{PP}$
Equivalent impervious area (see Table 4)	$A_E$

The following points should be noted with respect to these areas:

$A_R$

1. **Roof area** is the area of roof feeding to the spouting system. Roof area must be included in the sizing of soakage devices and rainwater tanks, but not in the sizing of pre-treatment devices.

$A_C$

2. **Paved area** is any sealed ground-level area, such as driveways or patios. Paved area must be included in the sizing of soakage devices and pre-treatment devices.

$A_P$

3. **Pervious area** is the area covered in vegetation or garden. Pervious

area should be included in the sizing of soakage devices if it will contribute runoff to the soakage system. This normally requires that the pervious area is at a higher elevation than the paved areas, and typically only applies to a small portion of the total pervious area.

$A_{PP}$

4. **Porous paved area** is the area of the property that is covered in porous paving. The porous paving must be designed as a soakage device.

$A_E$

5. **Equivalent impervious area** must be calculated before sizing soakage systems. For roof and paved areas, the equivalent impervious area is simply the sum of the areas. For pervious areas, the equivalent impervious area must be calculated using the ratios and equation listed in Table 6.

**Table 6: Equation for calculation of equivalent impervious area**

Ratio for pervious area	$R_E = 0.3$
Equivalent impervious area	$A_E = A_R + A_C + R_E \times A_P$

## 5.4 Ratios used for Sizing

Ratios must be applied correctly

The charts and worksheets in this Manual use a number of ratios. These must be applied correctly for correct sizing of soakage devices and rainwater tanks, and each is described below (the Charts referred to are given in Appendix B):

$R_1$

1. **The Soakhole Area Ratio  $R_1$**  ( $m^2$  soakhole/ $m^2$  equivalent impervious area) is read off CHART 1 for a known percolation rate and soakhole depth.  $R_1$  is multiplied by the amount of equivalent impervious area feeding to the soakhole, to give the required area of soakhole. The area of soakhole is the plan area and is only applicable to soakholes filled with scoria (with a porosity of 0.5).

[See Example 1 in Appendix C]

$P_3$

2. **The Catchment Soakage Ratio  $P_3$**  (L/min/ $m^2$  equivalent impervious area) must be known to use CHART 2 and CHART 6.  $P_3$  is the soakage capacity of the soakhole (in L/min) divided by the amount of equivalent impervious area feeding to the soakhole.

[See Example 2, Example 7 and Example 8 in Appendix C]

$R_2$

3. **The Storage Ratio  $R_2$**  ( $m^3/m^2$  equivalent impervious area) is read off CHART 2 for a known catchment soakage ratio.  $R_2$  is multiplied by the amount of equivalent impervious area feeding to the soakhole, to



Z

give the required volume of storage.

[See Example 2 and Example 7 in Appendix C]

4. **The Orifice Area Ratio Z** ( $\text{mm}^2/\text{m}^2$  roof area) is read off CHART 6. Z is multiplied by the amount of roof area to give the required orifice area.

[See Example 8 in Appendix C]

## 5.5 Sizing of Soakage Devices

**Soakage devices must be sized to accept runoff from roof areas, paved areas and any pervious areas that will contribute runoff**

Soakage devices must be sized to accept runoff from all roof areas and paved areas and any pervious areas that can contribute runoff (pervious areas will normally only contribute runoff if they are above the level of paved areas). The following notes outline the procedures to follow (refer Appendix C for Worksheets and Appendix B for Charts):

1. **Onehunga soakholes** can be sized by one of two methods, depending on the circumstances and the accuracy that is required:

The first method is easier and faster, and uses WORKSHEET 3 and CHART 1. This method is only suitable if the equivalent impervious area is less than  $1,000 \text{ m}^2$ , and if there is no use of rainwater tanks or on-site storage. The method does not take into account the additional storage space provided by the chamber, but in most cases this does not result in a significant difference in the size of the final soakhole. [For situations where the chamber takes up the entire soakhole, there may be a 35% reduction in the final size. However, because most chambers are only about 1 m in diameter, the overall reduction in the surface area of the soakhole is normally around  $0.45 \text{ m}^2$ .]

The second method uses WORKSHEET 8 and CHART 2. This method is more difficult to use (iteration is required), but is more flexible and provides more accurate sizing. It must be used if the impervious area is greater than  $1,000 \text{ m}^2$ , if additional storage is going to be used, if the percolation rate is outside the range of CHART 1, or if the media to be used in the soakhole does not have a porosity of 0.5.

The significant difference in accuracy between the two methods occurs for rectangular soakholes with a large length to width ratio.

2. **Filter-strip soakholes** should be sized in the same manner as Onehunga Soakholes, but the filter-strip should be designed first [see Section 5.6] so that the length of the soakhole can be adjusted to suit

**Pre-treatment devices must be sized to accept runoff from all paved areas**

the width of the filter-strip.

3. **Rockbore Soakholes** should be sized using WORKSHEET 4 and CHART 2.
4. **Rain-gardens** for soakage and pre-treatment should be sized using WORKSHEET 5 and CHART 1.
5. **Nominal Soakholes** should be sized using part 1 of WORKSHEET 7.
6. **Porous Paving** does not need to be sized unless a site specific design is completed. However, designers must check that the slope of the paving and the percolation rate comply with the details given on Drawing 6 (Appendix A).

## 5.6 Sizing of Pre-Treatment Devices

Pre-treatment devices must be sized to accept runoff from all paved areas. The following notes outline the procedures to follow:

1. **Rain-gardens** that are for pre-treatment only should be sized using steps 1 and 2 of WORKSHEET 6.
2. **Filter-strips** should be sized using CHART 4 and steps 1 and 4 of WORKSHEET 6. (Note that this design methodology is only valid for a filter-strip slope of 1%. The methodology in TP10 [3] should be applied for slopes greater than 1%). If the filter-strip is to be used with soakage devices other than a filterstrip soakhole, a scoria trench can be used to transfer the runoff from the filter-strip to the soakage device.
3. **Sand-filters** may be approximately sized using steps 1 and 3 of WORKSHEET 6. Note that this is not a formalised design procedure, and is only intended to give approximate sizing. Commercially available sand-filters are specified by the amount of impervious area they can serve, so an appropriate filter can normally be selected without carrying out detailed design procedures. Detailed design procedures must be carried out for any sand-filters constructed on-site, and in this case reference should be made to TP10 guidelines [3].
4. **Scoria trenches** should be sized using steps 1 and 5 of WORKSHEET 6.

**Rainwater tanks and on-site storage can be used to reduce the size of the soakage device**

## **5.7 Sizing Of Rainwater Tanks and On-Site Storage**

Rainwater tanks and on-site storage are two means of increasing the capacity of a soakage system without enlarging the soakage device. They should be sized as follows:

1. Temporary storage volume is determined using WORKSHEET 8 and CHART 2. This is the minimum volume that must be provided by the rainwater tank or on-site storage.
2. Rainwater tanks are sized using WORKSHEET 9, CHART 4, CHART 5 and CHART 6. The sizing process will determine the volume of the rainwater tank and size of the orifice.
3. On-site storage must be large enough to accept the required volume, within the following guidelines:
  - i. The ponded water must not exceed a maximum depth of 250 mm, and there must be a freeboard of 20 to 50 mm above this.
  - ii. The volume of the on-site storage must not exceed 40% of the combined storage volume provided by the soakhole and on-site storage. This can be checked by step 2 on WORKSHEET 7.
  - iii. The ponded water is classified as a flood water, and must comply with policies on flood hazards, as set-out in Section 2.3.

## **5.8 Standard Details**

**Standard details are shown on the drawings in Appendix A**

Standard details are shown on the Drawings in Appendix A, and compliance with these standards must be demonstrated (for example on building permit drawings). The drawings corresponding to each device are as listed below:

Nominal soakhole .....	DRAWING 1
Onehunga soakhole .....	DRAWING 2
Filter-strip and filter-strip soakhole .....	DRAWING 3
Rain-garden	
for soakage and pre-treatment .....	DRAWING 4
for pre-treatment only .....	DRAWING 7

Rockbore soakhole .....	DRAWING 5
Porous paving .....	DRAWING 6
Scoria trench .....	DRAWING 8
Settling chamber (for roof runoff) .....	DRAWING 9

## 5.9 Innovative Designs and Variation of Soakage and Pre-treatment Devices

**There will be cases when the design approach in this Manual needs to be modified**

It is recognized that there will be cases when the design approach in this Manual may need to be modified. For example:

- If site parameters are outside the ranges given in the charts
- Cases where the applicant wants to vary the design, such as to rework the design/sizing or change the design detail and standard dimensions
- The applicant wishes to use an alternative device, such as a proprietary system

For cases such as these, it is recommended that the following course of action is adopted:

- Discuss broad plans with ACE, and provide explanations for the need to depart from the normal design approach
- Receive guidance from ACE regarding the preparation of the site specific design. In general, appropriate analysis/modeling will be required, and will need to be accompanied by clear documentation
- Proceed to prepare and document the design as necessary, ensuring compliance with all ACC standards and policies.

## 6.0 BUILDING CONSENTS

This section describes the material that should be included in an application for a building consent. Sub-sections cover:

- 6.1 Obtaining a building consent
- 6.2 How to obtain the correct forms

This material is for guidance only; please refer to the disclaimer statement below the preface of this Manual.

**A building consent must be obtained to install a new soakage device**

### 6.1 Obtaining a Building Consent

A building consent must be obtained to install a new soakage device. The building consent may also cover a new building or house extension, or it may be solely for the soakage device. Building consents for soakage devices will only be granted if the applicant clearly demonstrates the design meets the required standard. This section details the documents that should be included in the building consent application, and the certificates that should be obtained following construction of the soakage device.

Applications for building consents to install soakage devices should normally include:

1. **Building consent application form.** The Building consent application form contains details of the project, building plans and site plans. [Section 6.2 explains how to obtain this form].
2. **Percolation test worksheet.** This documents the percolation tests used to determine the soakage capacity of the ground in the property. The worksheet will be either WORKSHEET 1 or WORKSHEET 2 from Appendix C in this Soakage Manual, depending on the type of test that is used. Section 3.0 explains how to use these worksheets. [This worksheet may be omitted if a nominal design is used—refer Section 3.1].
3. **Soakage device worksheet.** This contains the calculations used to size the soakage device, and will be one of WORKSHEETS 3, 4, 5, 7 or 8, and also WORKSHEET 9 if this has been used. Section 5.5 explains how to use these worksheets.
4. **Pre-treatment device worksheet.** This contains the calculations used to size any pre-treatment devices, and will be one of the three

sections on WORKSHEET 6. Section 5.6 explains how to use this worksheet. [WORKSHEET 6 does not need to be included if WORKSHEET 5 is the soakage device worksheet].

5. **Plan of site.** The plan should show all site details relevant to the pre-treatment and soakage devices. This includes:
  - i. All proposed and existing buildings
  - ii. Locations where on-site percolation tests were performed [Section 3.0]
  - iii. The scale of the plan, so that area measurements can be checked
  - iv. Clear outlines of all pervious and impervious areas, labelled  $A_R$ ,  $A_C$ ,  $A_P$ ,  $A_{PP}$  [Table 3, Section 5.3]
  - v. Proposed location of pre-treatment devices [Section 4.0]
  - vi. Proposed location of soakage devices [Section 4.0]
  - vii. Any existing soakage devices
  - viii. Driveways
  - ix. Overland flow paths and storm floodplains [Section 2.0]
  - x. Property Boundaries [Section 2.0]
  - xi. Contours or spot levels
  - xii. Existing sewers
  - xiii. Access ways for maintenance [Section 7.2]
6. **Dimensioned Drawings.** These are required for both pre-treatment devices and soakage devices, so that storage volumes and surface areas can be checked. If the storage calculations are complex then all working should be shown.
7. **Operation and Maintenance forms.** The forms that need to be used are described in further detail in Section 7.1. With the exception of nominal designs, it is required that an "O&M Plan" Form, "Device Specific O&M Detail" Form and drawings be submitted for each of the devices.

Following construction, the owner of the soakage device is required to obtain the following documents:

**Forms can be picked up in person, downloaded from the internet or found in the Soakage Manual.**

1. **Completion Certificate.** This is based on a final inspection of the completed device by ACE.
2. **As-built Drawings.** These drawings must clearly show any differences between the as-built and planned design, and may need to be supported by additional calculations or analysis.
3. **O&M Certificates.** As detailed in Section 7.0, 2 yearly inspections of all devices must be carried out except for nominal designs. The contractor who carries out the inspections must fill in an 'OSM-O&M-Cert' Form. The completed form must be submitted to ACE.

## **6.2 How to Obtain the Correct Forms**

A number of different forms are needed for to apply for LIMs, PIMs, and Building Consents. The following notes are intended to assist with obtaining the correct forms:

1. **Application forms** for Land Information Memoranda, Project Information Memorandum and Building Consents can be:
  - i. Picked up in person from Council Offices.
  - ii. Downloaded from the internet. The forms are on the council website at [www.akcity.govt.nz](http://www.akcity.govt.nz), and can be found by using the search engine. Try searching for 'property AND brochures AND forms AND guides', and then look under 'land information'. If you have difficulty, phone ACC customer service on (09) 379 2020.
2. **Worksheets** to design soakage devices can be found in Appendix C.
3. **Operation and Maintenance Forms** can be found in Appendix D.

## 7.0 OPERATION AND MAINTENANCE

This section describes the requirements for operation and maintenance of the devices. Subsections cover:

7.1 Owner's obligations

7.2 Access requirements

This material is for guidance only; please refer to the disclaimer statement below the preface of this Manual.

**The owner is obliged to maintain all pre-treatment and soakage devices**

### 7.1 Owner's Obligations

This section is intended to be compatible with Section 11.0 of the On-site Stormwater Management Manual. The forms to be used are the same, except for the 'Device-Specific O&M Detail' forms, which are specific to the individual devices.

It should be noted that the various forms referred to in this section (and included in Appendix D) were prepared for guidance purposes at the time of writing this Manual, but are subject to change from time to time. Current versions of the forms should be obtained from ACE.

Once installed, soakage and pre-treatment devices must not be modified or removed (unless written permission is obtained from ACE). In addition, the owner is obliged to carry out the following tasks for all devices except nominal designs:

[Refer to Section 4.1 for information on nominal designs, and see Appendix D for copies of the forms listed below].

1. Fill out the standard form "OSM-O&M Plan" giving owner/site details etc (page D1).
2. Make a copy of the "OSM-O&M Routine" sheets listing the routine operation and maintenance requirements (pages D2 and D3).
3. Fill-out a 'Device-Specific O&M Detail' form for each device on the property (pages D5 to D24).
4. Submit all forms to ACE along with a schematic drawing of each device. The drawings in this soakage Manual may be copied for this purpose but should be modified (or an alternative drawing submitted) if any details do not match the site-specific design.
5. Carry out periodic inspections, as detailed in the device-specific O&M



plans.

6. Engage a qualified service contractor to carry out 2 yearly inspections. When inspections are carried out, the contractor must fill out an 'OSM-O&M-Cert' Form (page D4). This form must be submitted to ACE once completed.
7. Allow ACC staff access to inspect any device, as required by the Building Act 1991. The access must be requested in writing and within normal working hours.
8. Make any repairs requested by ACC staff in writing, as required by the Building Act 1991. The owner may be required to demonstrate that the repairs have been performed, such as by submitting appropriate certification.
9. Ensure that all operations are carried out to a safe standard. Note that particular care should be taken with confined spaces, which are found on Sand-filters, Onehunga Soakholes and Rockbore Soakholes. Entry to confined spaces can be dangerous, and should only be attempted by suitably qualified people. In general, operations should be undertaken according to the Australian/New Zealand Standard AS/NZS 2865:2001 Safe Working in a Confined Space.

## 7.2 Access Requirements

Effective maintenance relies on ready access to the soakage or pre-treatment device. The following points should be considered:

**Effective maintenance relies on ready access to the soakage or pre-treatment device**

1. Sand-filters, Onehunga Soakholes and Rockbore Soakholes are cleaned most effectively using vacuum-type systems. These systems are generally mounted on trucks and can only be used if the vacuum pipes are able to stretch from the truck to the soakage or pre-treatment device. Smaller trucks normally need to be within 20 to 30m of the soakhole. Large street-cleaning trucks may have pipes that can stretch 75m or more, but will be much more expensive to hire.
2. All soakage devices (except Rockbore Soakholes) may eventually require excavation of soil or scoria/gravel layers, so that repairs can be made. An access way at least 2m wide should be allowed for, so that at least a small excavator can gain entry.
3. Re-drilling Rockbore Soakholes normally requires an access way that is around 3 m wide. This is not a regular maintenance procedure, but may be required eventually.

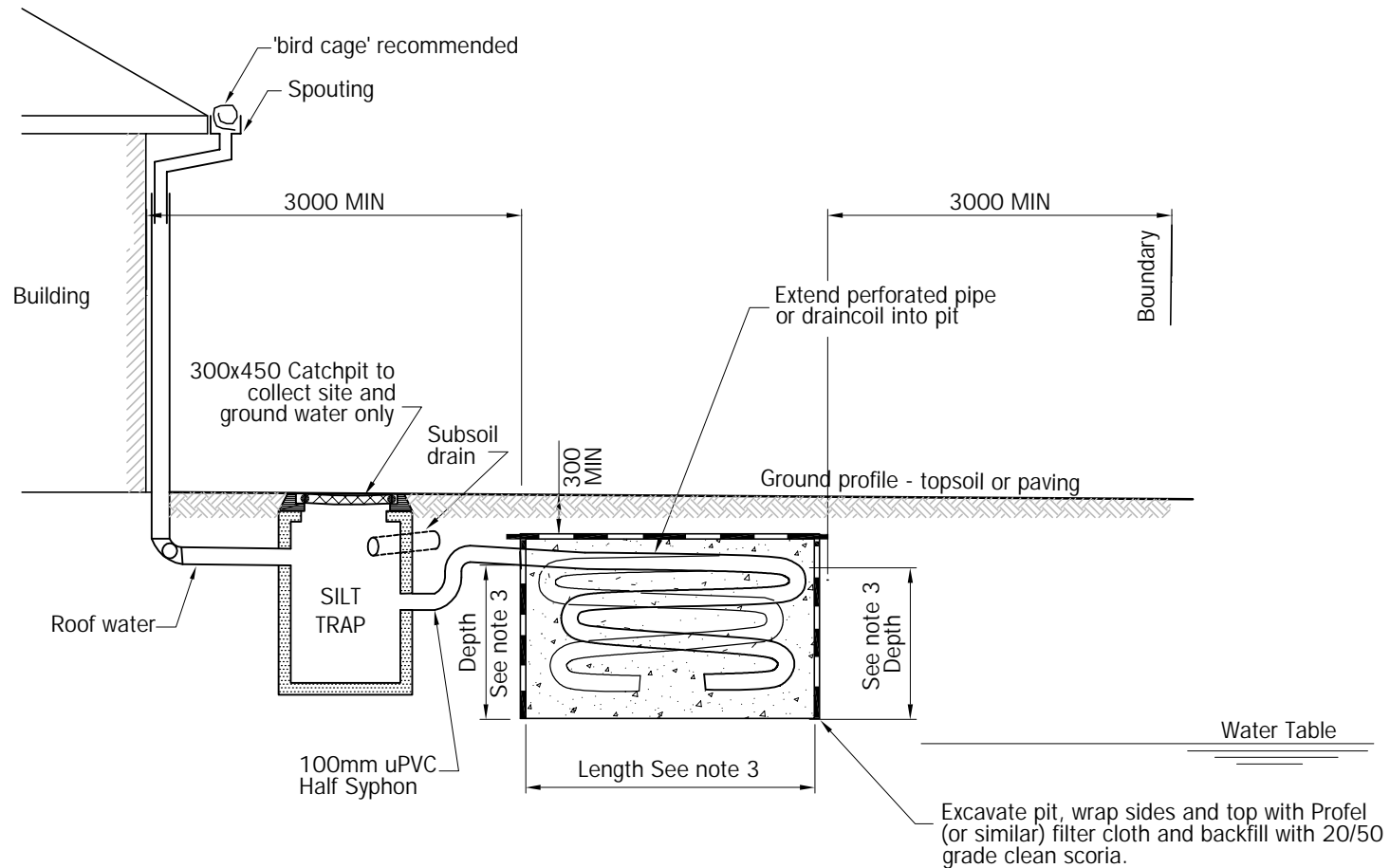
## 8.0 REFERENCES

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- [2] Auckland Regional Council 1999, *Guidelines for Land Disturbing Activities*, Technical Publication no 90.
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- [4] Auckland Regional Council 2002, *Proposed Auckland Regional Plan – Air, Land and Water*, [Online, accessed 27 June 2002]. URL: [www.arc.govt.nz](http://www.arc.govt.nz) [then searched for 'policies and plans'].
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- [8] Auckland City Council 1994. *Stormwater Soakage Design Manual*.
- [9] Auckland City Council/ Metrowater 1997, *Development and Connection Standards*.
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- [14] United States Federal Government 2001. *Hydraulic Engineering Centre – Hydraulic Modelling System*. Version 2.1.3, October 2001. [computer program]

# Appendix A

## Drawings

<u>No.</u>	<u>Title</u>
1	Nominal Soakhole
2	Onehunga Soakhole
3	Filter-strip and Soakhole
4	Rain-garden (soakage and pre-treatment)
5	Rockbore Soakhole
6	Porous Paving
7	Rain-garden (pre-treatment only)
8	Scoria Trench
9	Settling Chamber (for roof runoff)
10	Sand-filter – Definition Sketch
11	Rainwater Tank – Definition Sketch



Notes :

1. All dimensions are in mm (unless otherwise specified)
2. This type of soakpit is only suitable as a pit. Strip soakpits are not acceptable.
3. Provide 1m<sup>3</sup> of soakpit for every 10m<sup>2</sup> of impervious area. Maximum depth 1.0m.
4. Soakpit shall be positioned NOT closer than 2.0m to any sanitary sewer.

Client :



Project :

## Stormwater Soakage Design Manual

Title :

### Nominal Soakhole



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Auckland, Wellington, Christchurch

Scale: NTS

Project No. :	Drawing No. :	Revision :
AJ88301	01	A

ONLY FOR SMALL OUTBUILDINGS AND HOUSE  
EXTENSIONS LESS THAN 20m<sup>2</sup>

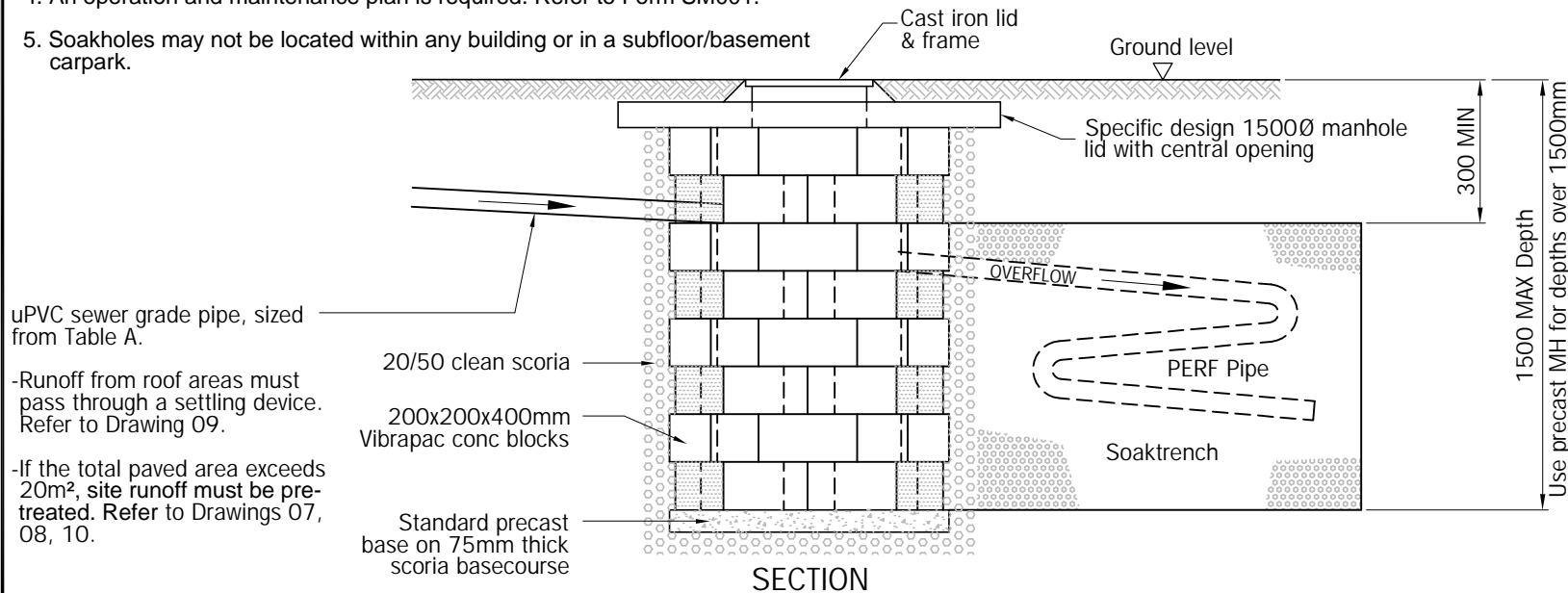
**Notes :**

1. All dimensions are in mm (unless otherwise specified).
2. Exact depth to be determined by site soakage test rate and contributing area.
3. Soakholes shall not be located within 3.0m of buildings or boundaries or 2.0m of sanitary sewers without specific geotech report.
4. An operation and maintenance plan is required. Refer to Form SM001.
5. Soakholes may not be located within any building or in a subfloor/basement carpark.

**Table A**

MAX Catchment Area*	MIN Overflow Pipe Size (mm)	
210 m <sup>2</sup>	100	
350 m <sup>2</sup>	125	
550 m <sup>2</sup>	150	
1000 m <sup>2</sup>	200	

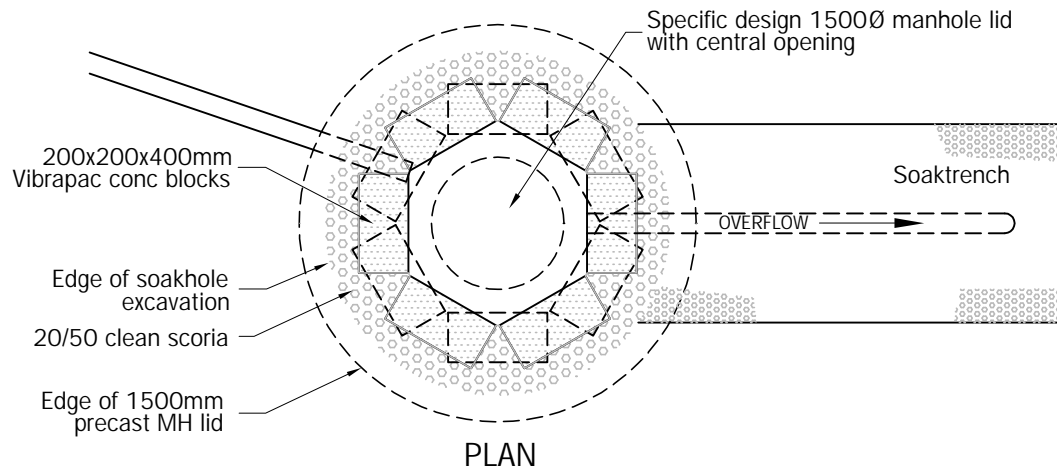
\* Measured as equivalent impervious area (tick)




uPVC sewer grade pipe, sized from Table A.

-Runoff from roof areas must pass through a settling device. Refer to Drawing 09.


-If the total paved area exceeds 20m<sup>2</sup>, site runoff must be pre-treated. Refer to Drawings 07, 08, 10.



Client : 

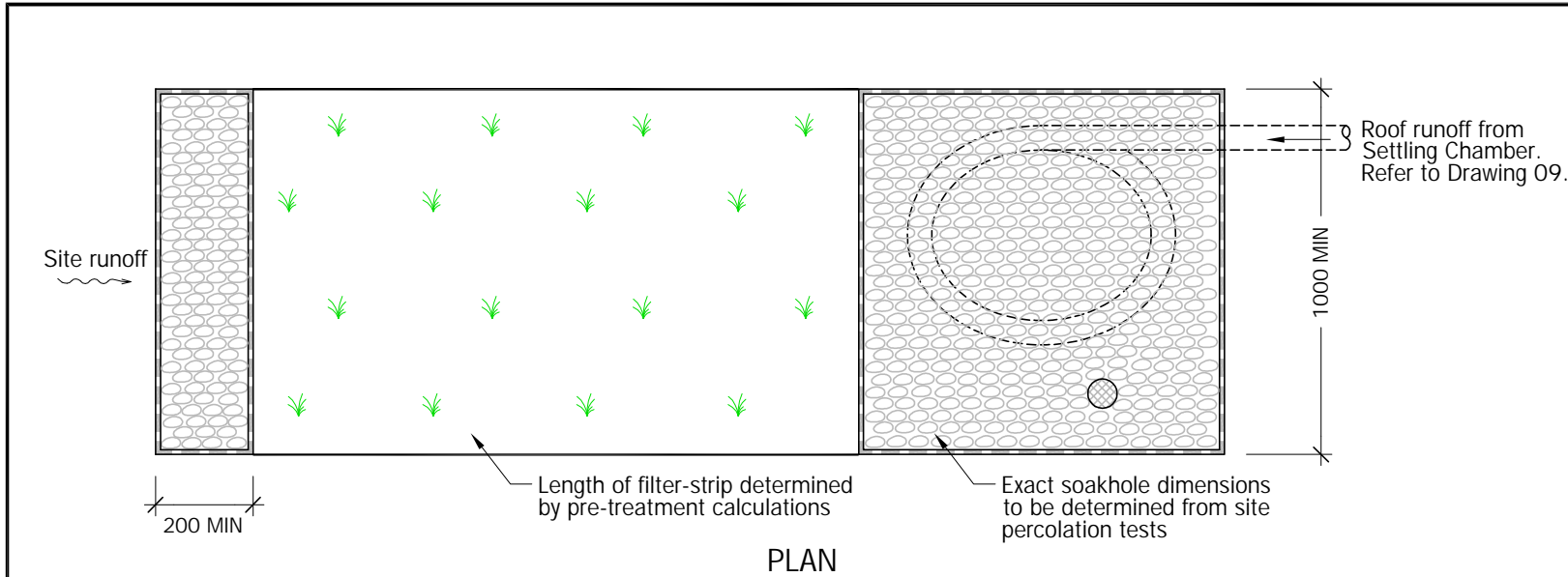
Project : **Stormwater Soakage Design Manual**

Title : **Onehunga Soakhole**

  
**PATLE DELAMORE PARTNERS LTD**  
 Auckland, Wellington, Christchurch

Scale: NTS

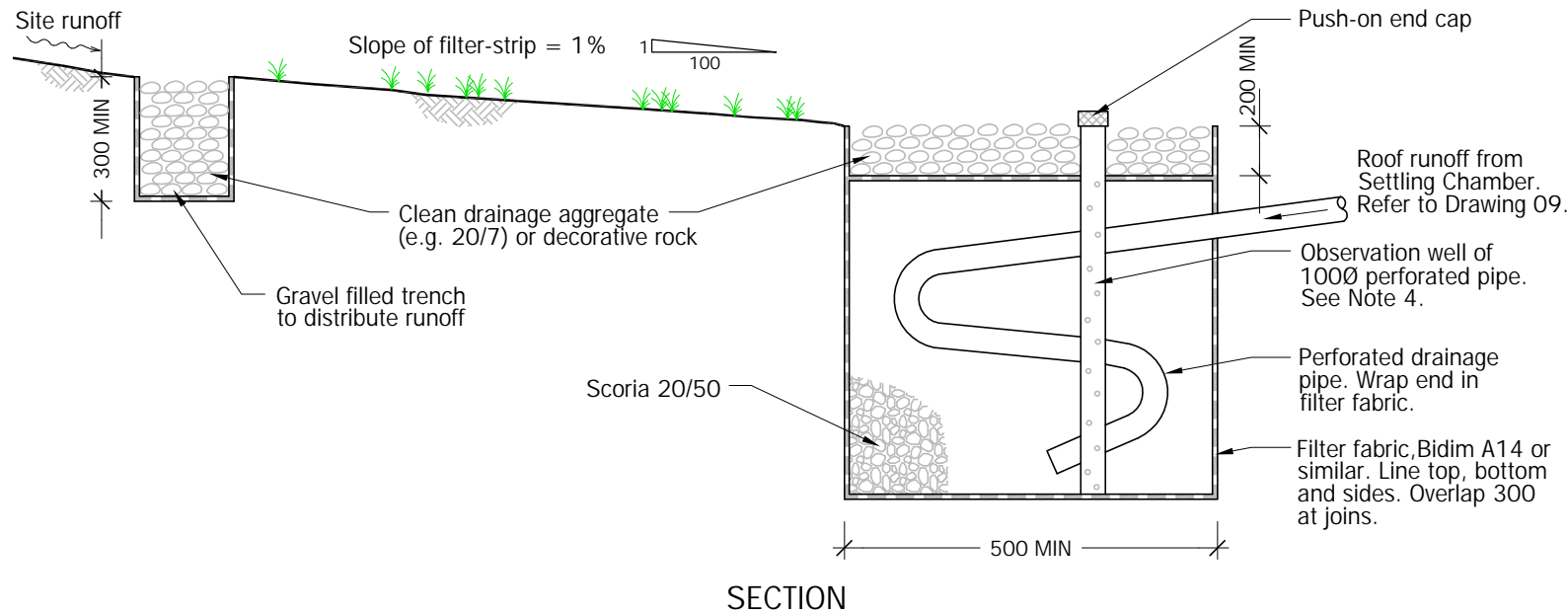
Project No. : <b>AJ88301</b>	Drawing No. : <b>02</b>	Revision : <b>A</b>
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**Notes :**

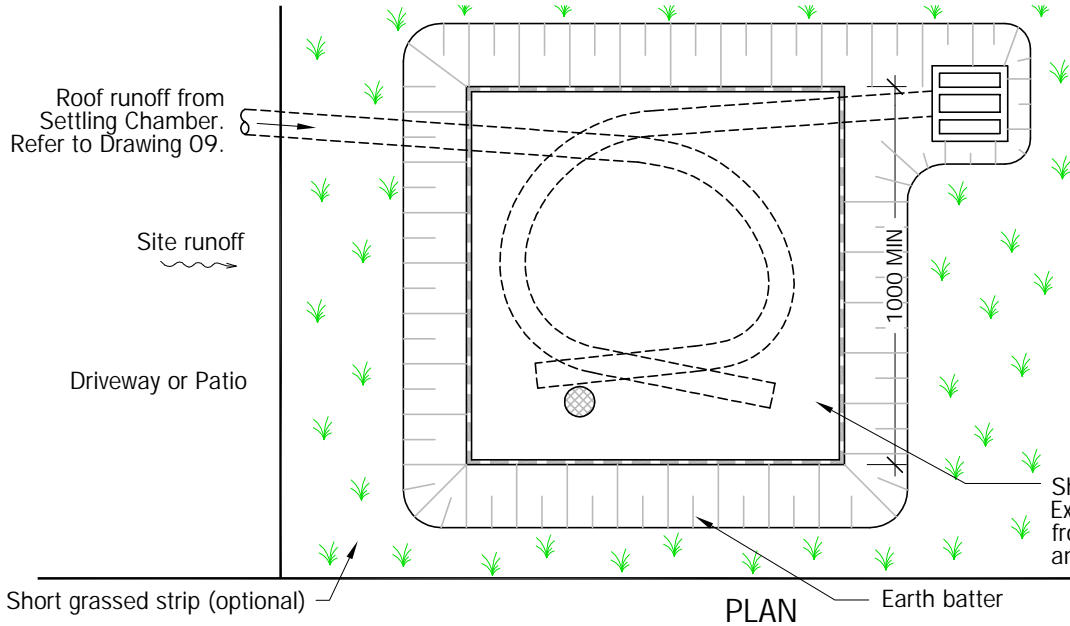
1. All dimensions are in mm (unless otherwise specified).
2. Soakholes must not be located within 3.0m of buildings or boundaries or 2.0m of sanitary sewers.
3. An operation and maintenance plan is required. Refer to Forms SM002 and SM008.
4. Observation well to be uPVC sewer grade, with at least 4 100 holes per 100 length and anchored at base.

**PLAN**



**SECTION**

Client : 		
Project : <b>Stormwater Soakage Design Manual</b>		
Title : <b>Filter-strip and Soakhole</b>		
PATTLE DELAMORE PARTNERS LTD <small>Auckland, Wellington, Christchurch</small>		
Scale: NTS		
Project No. : <b>AJ88301</b>	Drawing No. : <b>03</b>	Revision : <b>A</b>



**Notes :**

1. All dimensions are in mm (unless otherwise specified).
2. Raingarden must not be located within 30m of buildings or boundaries or 2.0m of sanitary sewers.
3. An operation and maintenance plan is required. Refer to Form SM003.

**Table A**

MAX Catchment Area*	MIN Overflow Pipe Size (mm)	
210 m <sup>2</sup>	100	
350 m <sup>2</sup>	125	
550 m <sup>2</sup>	150	
1000 m <sup>2</sup>	200	

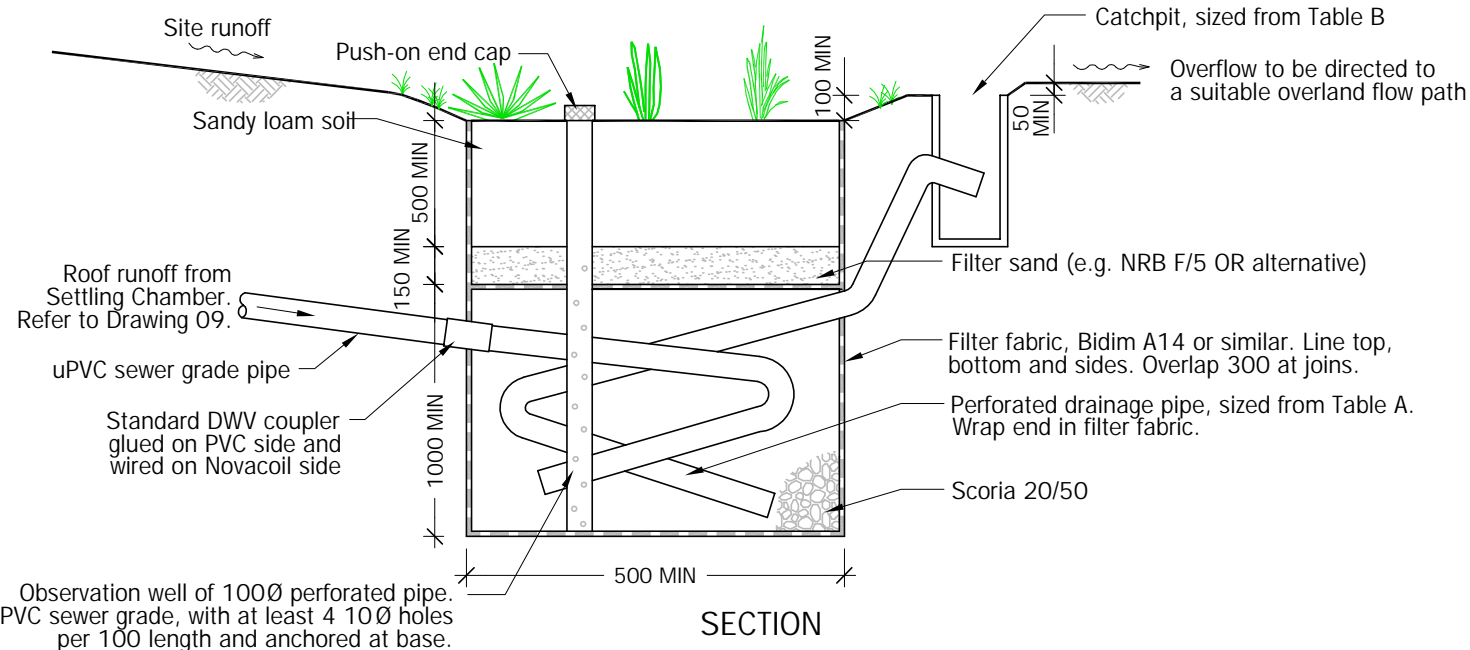
(tick)

**Table B**

MAX Catchment Area*	MIN Catchpit Size (mm)	
210 m <sup>2</sup>	300 x 300	
350 m <sup>2</sup>	300 x 300	
550 m <sup>2</sup>	450 x 300	
1000 m <sup>2</sup>	450 x 300	

\* Measured as equivalent impervious area (tick)

Shape raingarden to suit site. Exact dimensions to be determined from site percolation tests and pre-treatment calculations.



Client :



Project :

**Stormwater Soakage Design Manual**

Title :

**Raingarden (soakage and pre-treatment)**



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Scale: NTS

Project No. :	Drawing No. :	Revision :
AJ88301	04	A

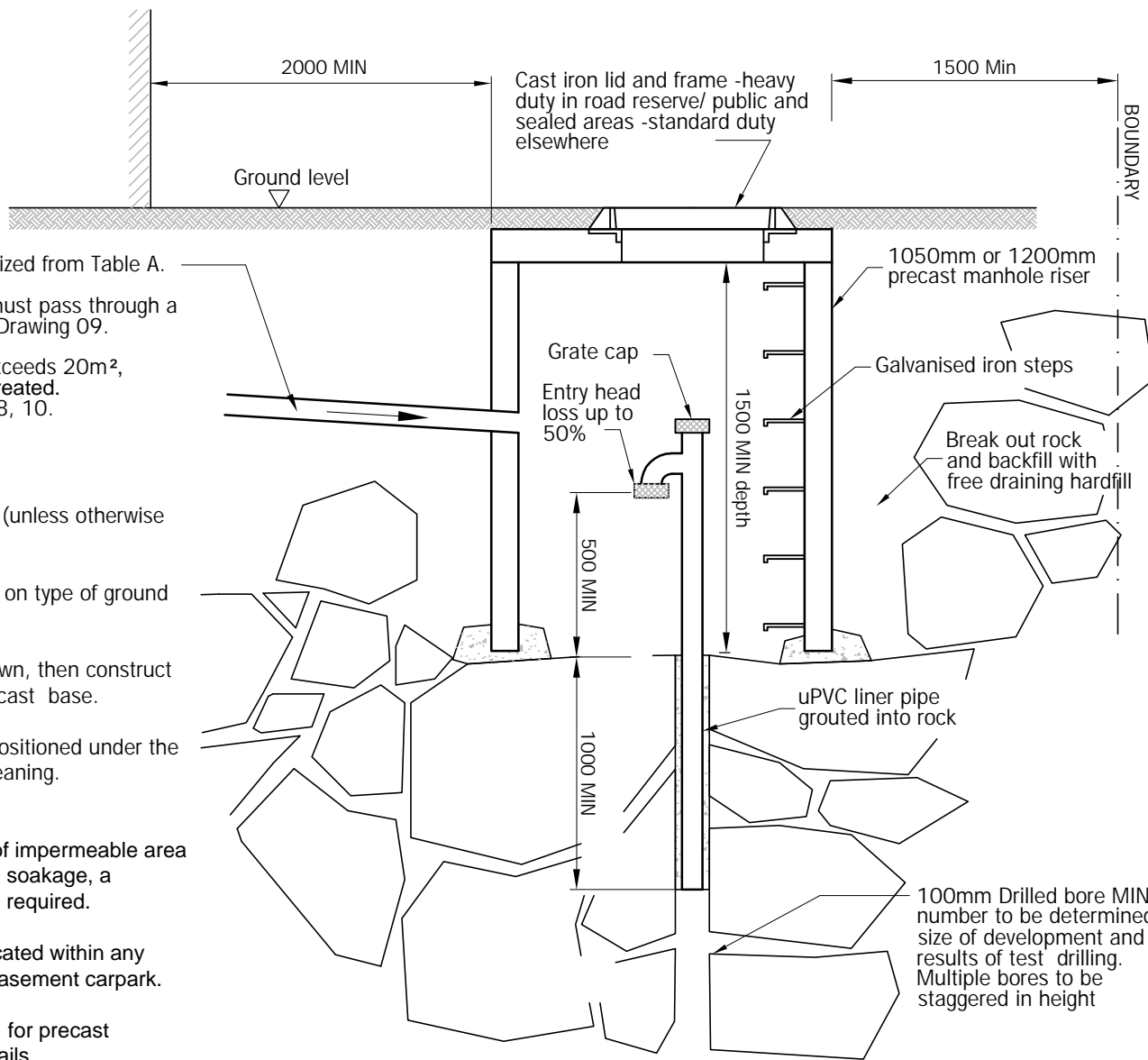


Table A


MAX Catchment Area*	MIN Overflow Pipe Size (mm)	
210 m <sup>2</sup>	100	
350 m <sup>2</sup>	125	
550 m <sup>2</sup>	150	
1000 m <sup>2</sup>	200	

\* Measured as equivalent impervious area (tick)

uPVC sewer grade pipe, sized from Table A.  
 -Runoff from roof areas must pass through a settling device. Refer to Drawing 09.  
 -If the total paved area exceeds 20m<sup>2</sup>, site runoff must be pre-treated. Refer to Drawings 07, 08, 10.


Notes :

1. All dimensions are in mm (unless otherwise specified).
2. Depth will vary depending on type of ground encountered.
3. If rock is deeper than shown, then construct manhole on standard precast base.
4. The drilled bore is to be positioned under the MH access for ease of cleaning.
5. ARC requirements:-  
Where 1000m<sup>2</sup> or more of impermeable area is to be drained to ground soakage, a Resource Consent will be required.
6. Soakholes may not be located within any building or in a subfloor/basement carpark.
7. Refer plan No. 12908/201 for precast manhole construction details.
8. An operation and maintenance plan is required. Refer to Form SM005.

Client : 

Project : **Stormwater Soakage Design Manual**

Title : **Rockbore Soakhole**



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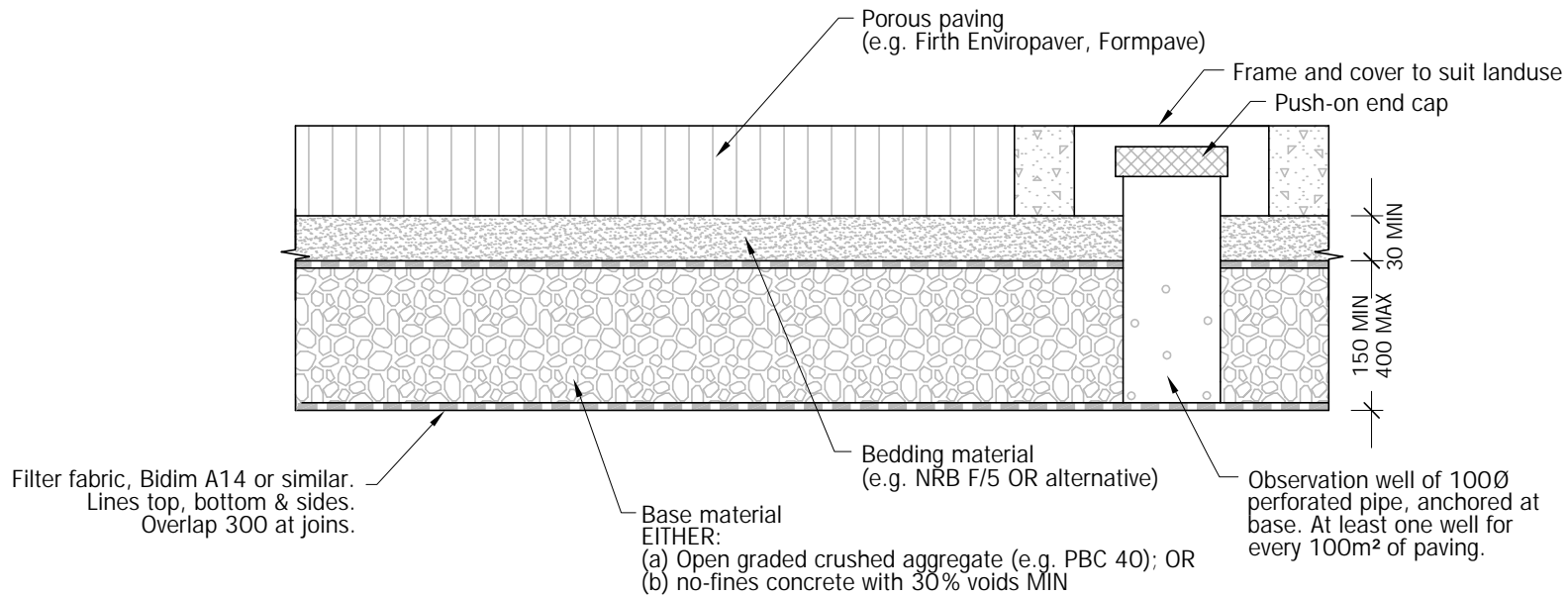
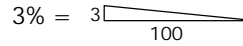
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Project No. :	Drawing No. :	Revision :
<b>AJ88301</b>	<b>05</b>	<b>A</b>



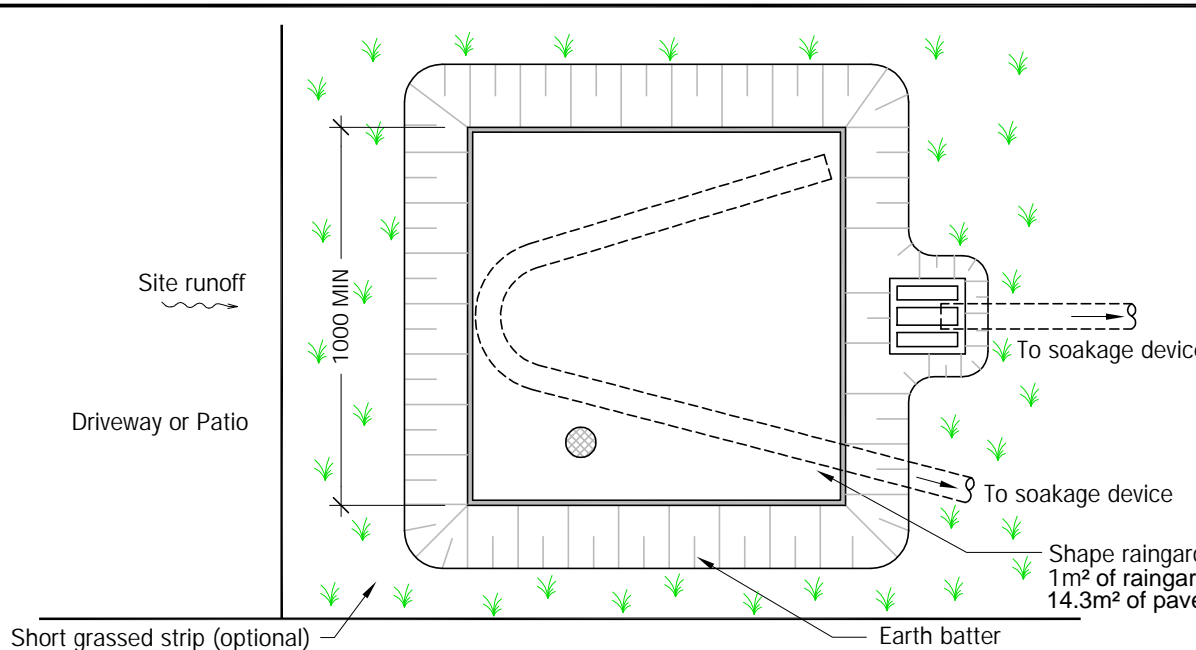
Notes :

1. All dimensions are in mm (unless otherwise specified).
2. Maximum slope = 3% unless baffles installed. These must be designed specifically to suit the site.  $3\% = \frac{3}{100}$
3. The porous base material must not be located within 1.0m of buildings or boundaries.
4. Only approved pavers may be used e.g. Firth Enviropaver or Formpave Aquaflow (all layers must have a minimum permeability of  $2.5 \times 10^{-4} \text{m/s}$ , and blocks must have proven long term performance).
5. Area to be paved must not be excessively travelled by heavy construction equipment either before or after paving installation.
6. Excavation to design depth should be left until all other construction is complete. Once paving is installed, it should only be used by light vehicles (unless otherwise specified by the manufacturer).
7. Paving to be installed according to manufacturers specification.
8. An operation and maintenance plan is required. Refer to Form SM006.



Client : 		
Project : <b>Stormwater Soakage Design Manual</b>		
Title : <b>Porous Paving</b>		
 <b>PATTLE DELAMORE PARTNERS LTD</b> <small>Auckland, Wellington, Christchurch</small>		
Scale: NTS		
Project No. :	Drawing No. :	Revision :
<b>AJ88301</b>	<b>06</b>	<b>A</b>

A:88301D001.dwg [Layout: 07]



PLAN

- Notes :**
1. All dimensions are in mm (unless otherwise specified).
  2. Use sealed impervious lining if within 3.0m of buildings or 2.0m of property boundaries, otherwise use filter fabric.
  3. Not to be located beside retaining walls or within 2.0m of sanitary sewers.
  4. An operation and maintenance plan is required. Refer to Form SM004.

**Table A**

MAX Catchment Area*	MIN Overflow Pipe Size (mm)	
210 m <sup>2</sup>	100	
350 m <sup>2</sup>	125	
550 m <sup>2</sup>	150	
1000 m <sup>2</sup>	200	

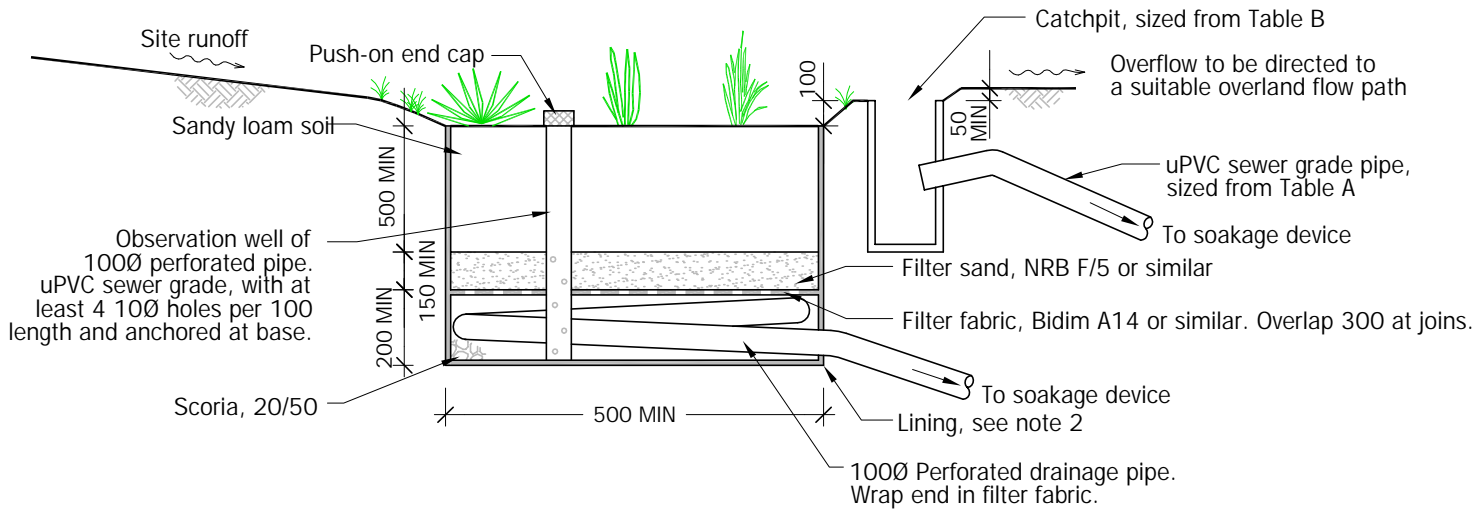
(tick)

**Table B**

MAX Catchment Area*	MIN Catchpit Size (mm)	
210 m <sup>2</sup>	300 x 300	
350 m <sup>2</sup>	300 x 300	
550 m <sup>2</sup>	450 x 300	
1000 m <sup>2</sup>	450 x 300	

\* Measured as equivalent impervious area (tick)

Shape raingarden to suit site.  
1m<sup>2</sup> of raingarden for every 14.3m<sup>2</sup> of paved area.



SECTION

Client : 

Project : **Stormwater Soakage Design Manual**

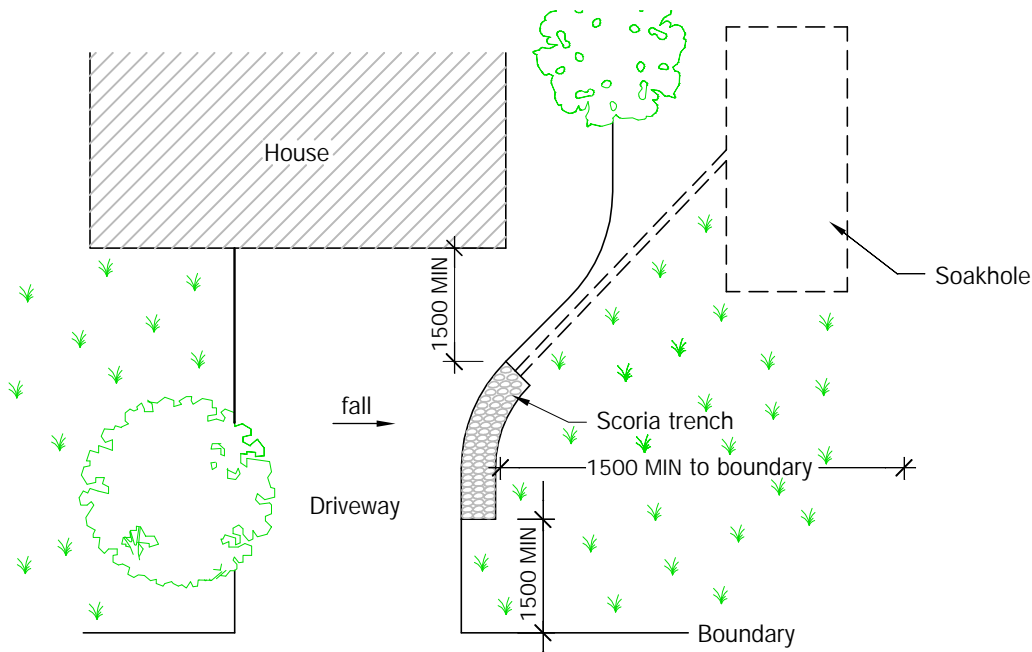
Title : **Raingarden (pre-treatment only)**



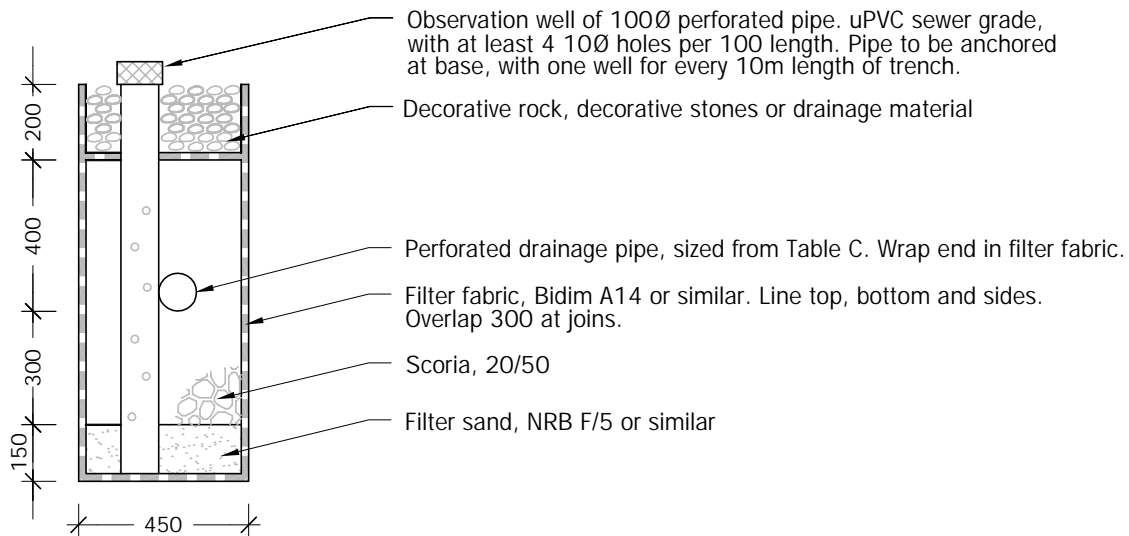
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Scale: NTS

Project No. :	Drawing No. :	Revision :
<b>AJ88301</b>	<b>07</b>	<b>A</b>



TYPICAL APPLICATION



SECTION

Notes :

1. All dimensions are in mm (unless otherwise specified).
2. Trench not to be located beside retaining walls or within 2.0m of sanitary sewers.
3. Slope of trench to be between 0.5% and 5%.
4. Maximum driveway gradient of 5%.
5. Catchment to be less than 500m<sup>2</sup> equivalent impervious area.
6. 1.0m of trench to be provided for every 15m<sup>2</sup> of paved area.
7. An operation and maintenance plan is required. Refer to Form SM010.

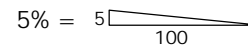


Table C

MAX Catchment Area*	MIN Pipe Size (mm)	
210 m <sup>2</sup>	100	
350 m <sup>2</sup>	125	
500 m <sup>2</sup>	150	

\* Measured as equivalent (tick) impervious area

Client :



Project :

## Stormwater Soakage Design Manual

Title :

## Scoria Trench



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Scale: NTS

Project No. : Drawing No. : Revision :

AJ88301

08

A

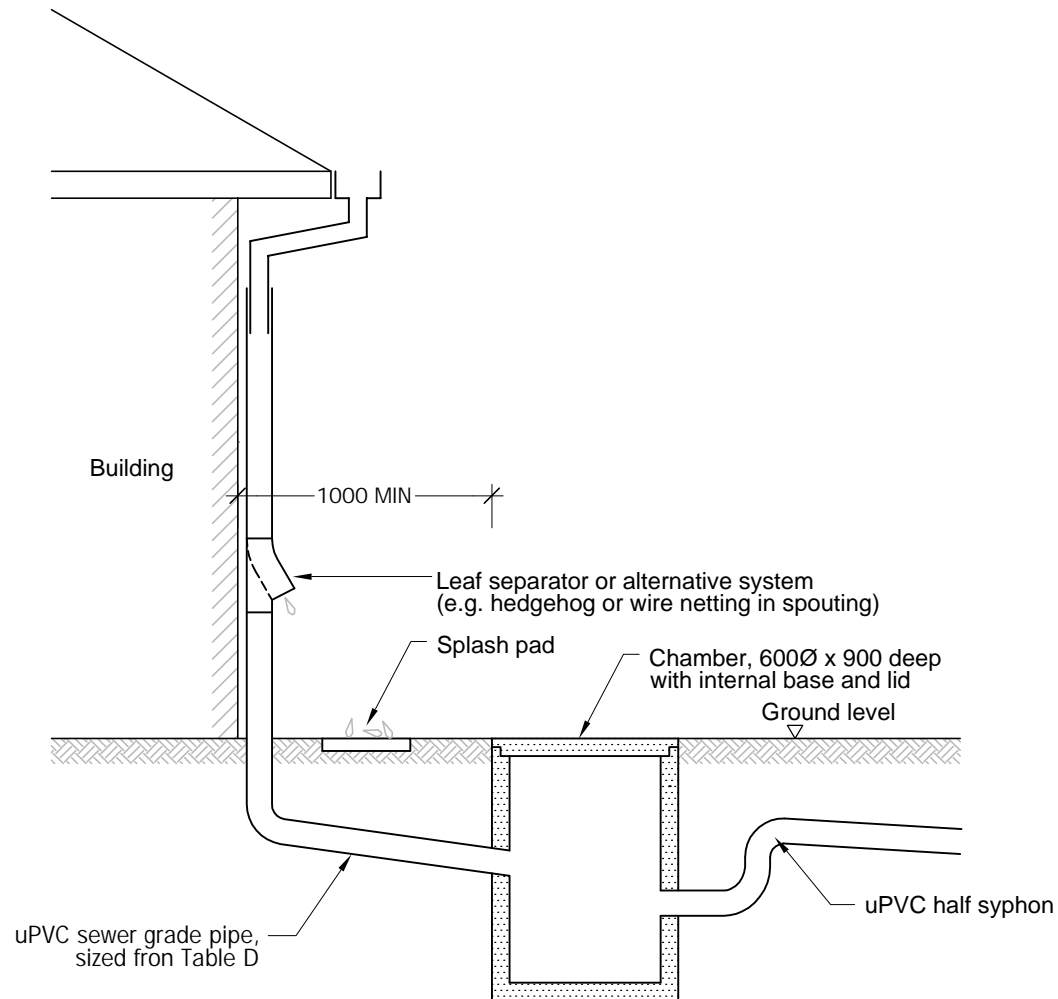
Notes :

1. All dimensions are in mm (unless otherwise specified).

Table D

MAX Roof Area	MIN Pipe Size (mm)	
210 m <sup>2</sup>	100	
350 m <sup>2</sup>	125	
550 m <sup>2</sup>	150	
1000 m <sup>2</sup>	200	

(tick)



Client :



Project :

## Stormwater Soakage Design Manual

Title :

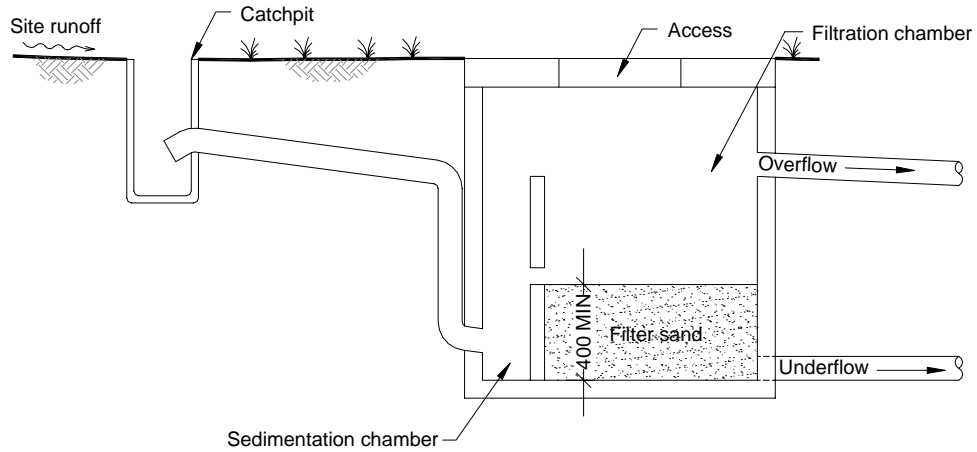
### Settling Chamber (for roof runoff)



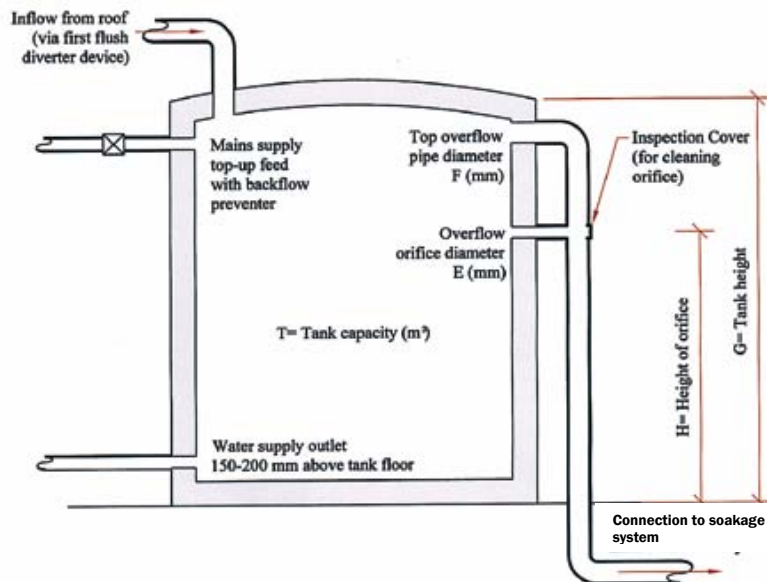
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Auckland, Wellington, Christchurch

Scale: NTS

Project No. :	Drawing No. :	Revision :
AJ88301	09	A



**Drawing 10: Sand-filter – Definition Sketch**



**Drawing 11: Rainwater Tank – Definition Sketch**

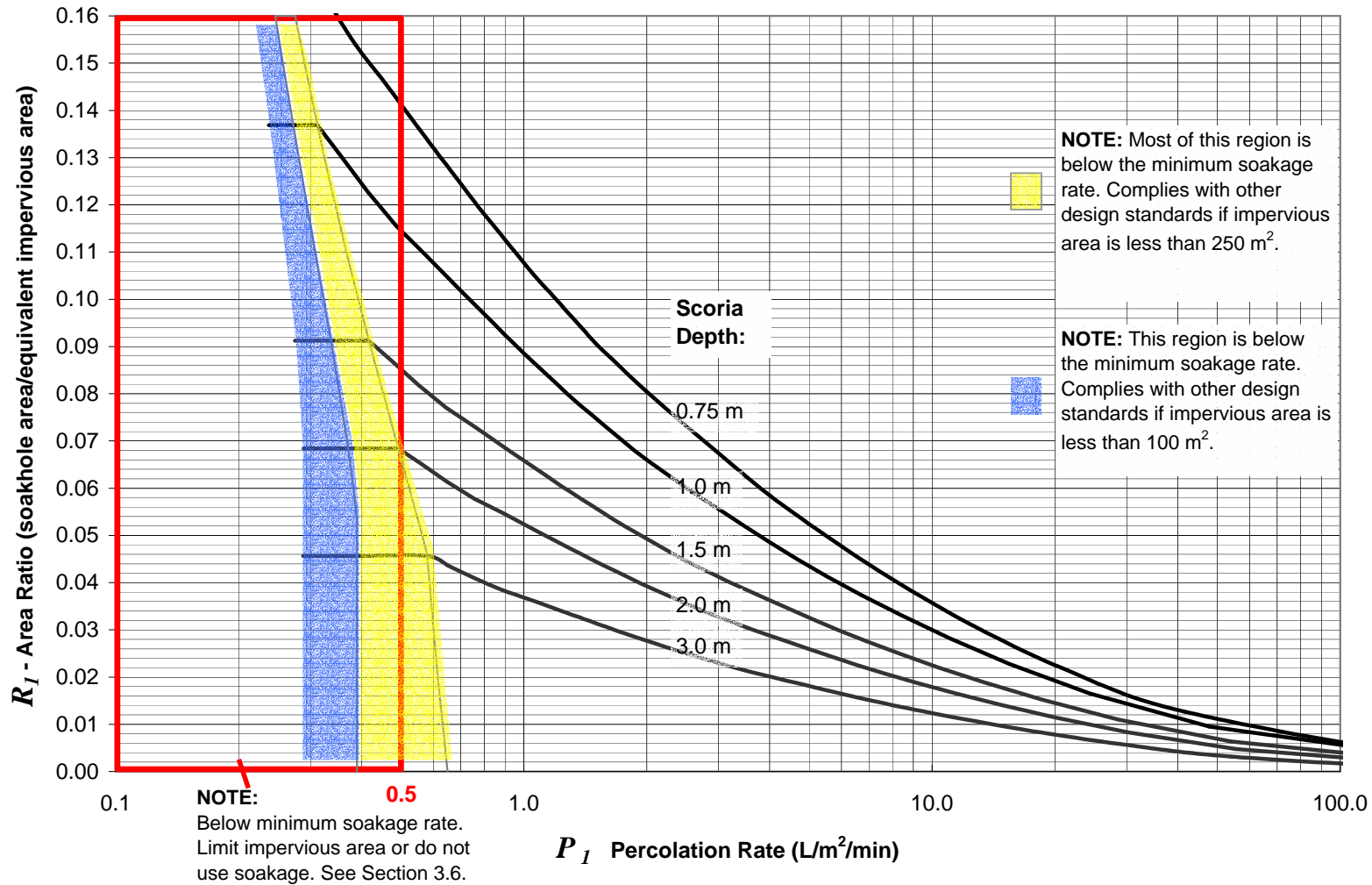
Note: Minimum orifice diameter is 10mm. All orifice must be screened, and details of the screen must be submitted for approval.

# Appendix B

## Charts

<u>No.</u>	<u>Title</u>
1	Area Ratios for Soakholes
2	Storage Requirements for all Soakholes
3	Filter-strip Sizing
4	Permanent Storage Sizing
5	Orifice Area to Diameter Conversion
6	Orifice Area Sizing

**CHART1. Area Ratios for Soakholes (only valid if equivalent impervious area < 1000 m<sup>2</sup>)**



## CHART2 -Storage Requirements for all Soakholes

# C2

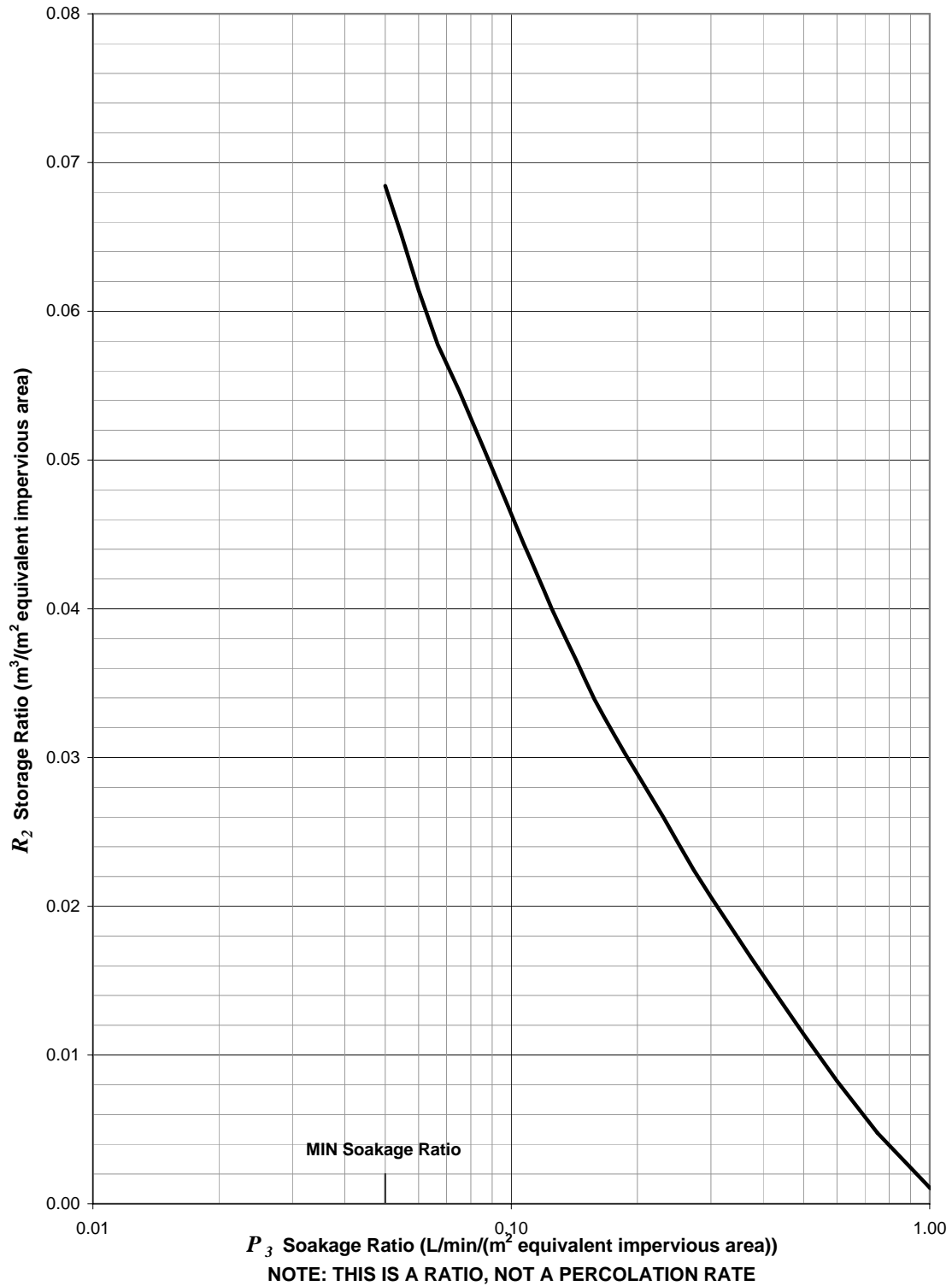




CHART 3. Filterstrip Sizing

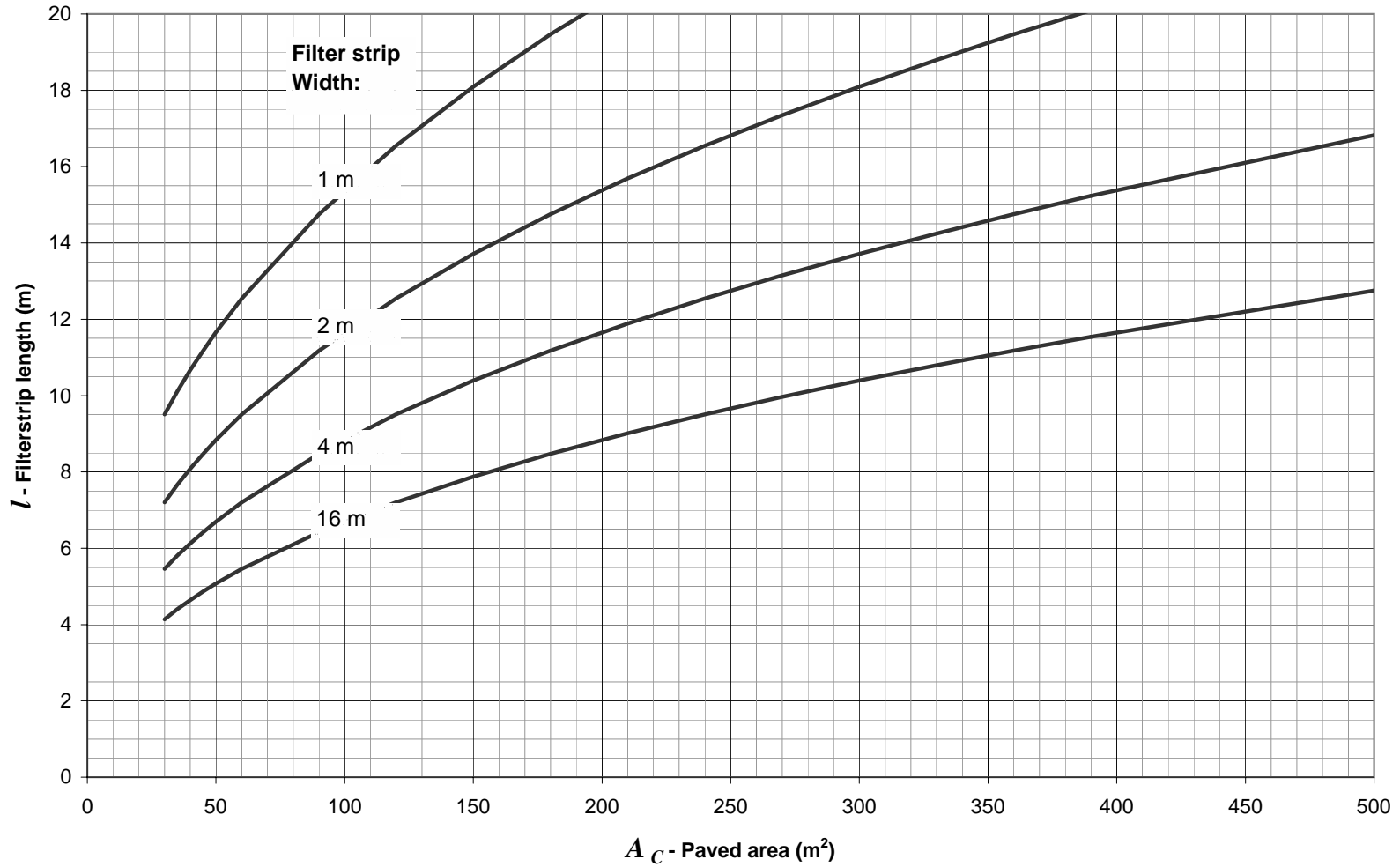


CHART 4: Permanent Storage Sizing

**C4**

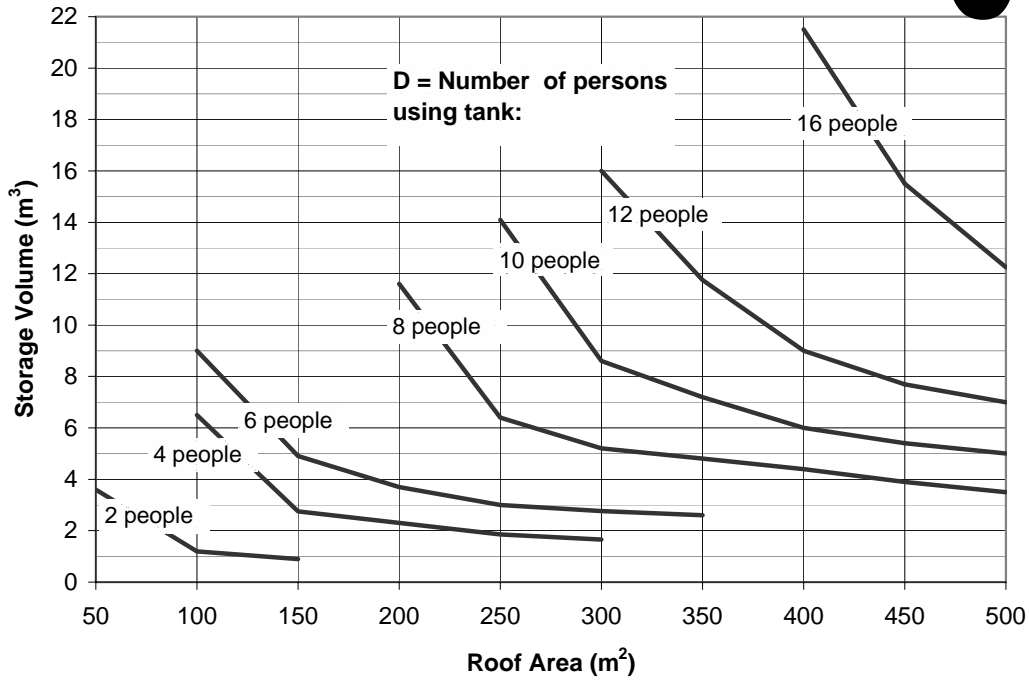
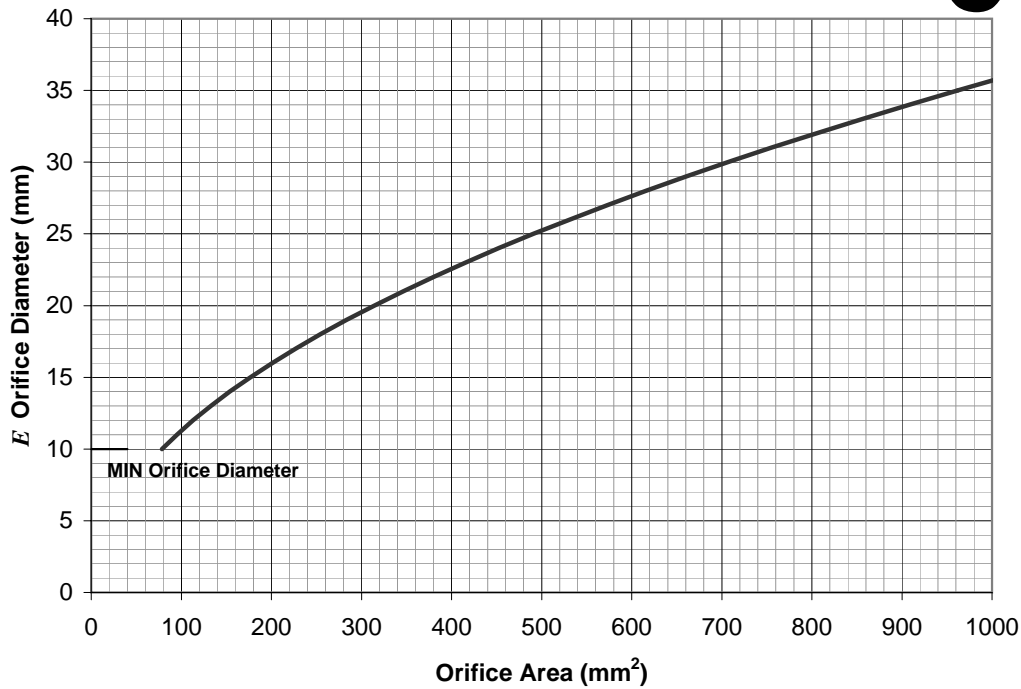


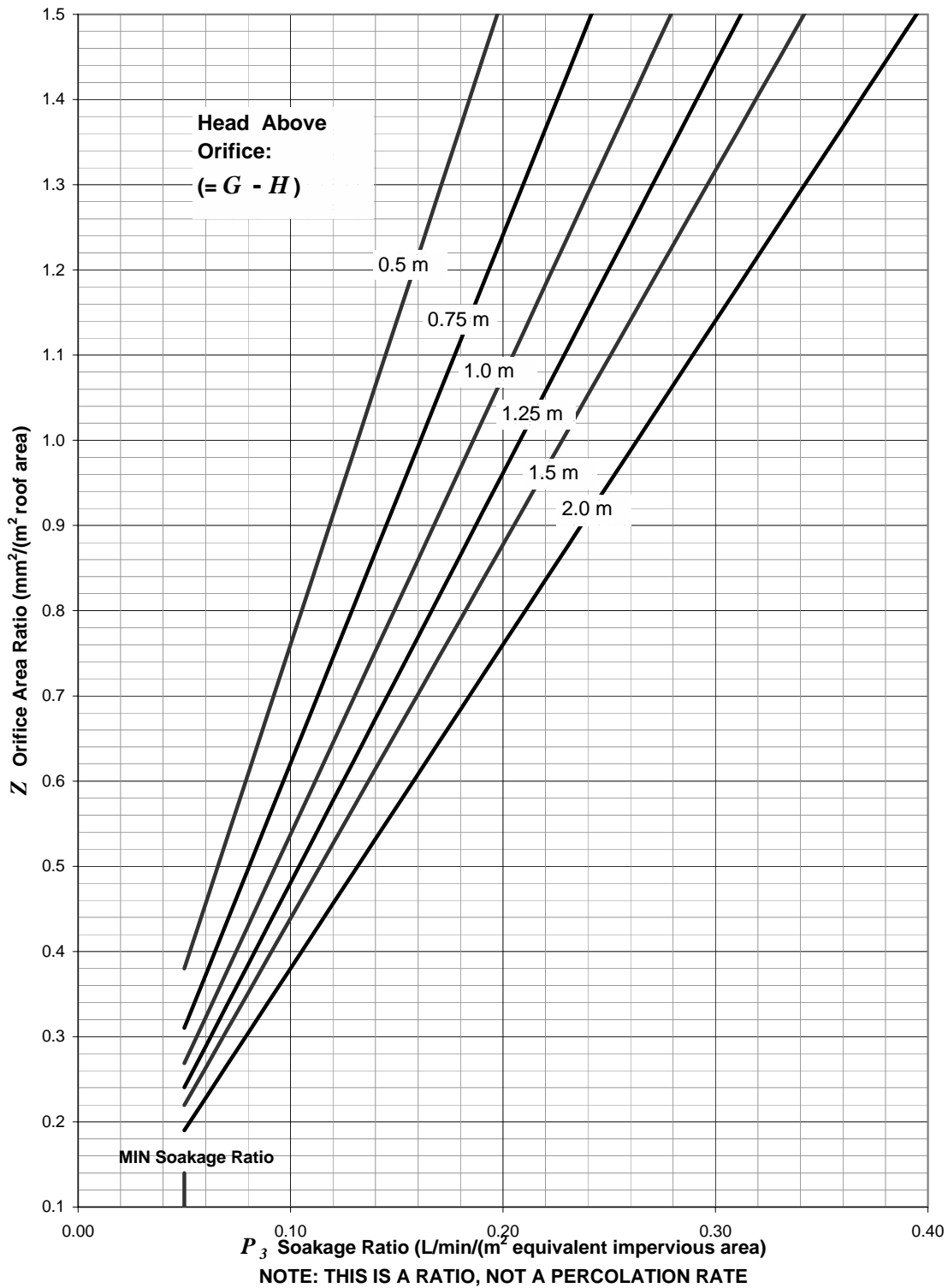
CHART 5: Orifice Area to Diameter Conversion

**C5**



# CHART 6 -Orifice Area Sizing

# C6



# Appendix C

## Worksheets and Examples

### WORKSHEETS:

<u>No.</u>	<u>Title</u>
1	Falling Head Percolation Test
2	Constant Head Percolation Test
3	Onehunga and Filter-strip Soakholes
4	Rockbore Soakhole
5	Rain-garden for Soakage and Pre-treatment
6	Pre-treatment Devices
7	Nominal Soakhole and On-site Storage
8	All Soakholes except Rockbore
9	Raintank Sizing

### EXAMPLES:

<u>No.</u>	<u>Title</u>
1	Worksheet 3
2	Worksheet 4
3	Worksheet 5
4	Worksheet 6
5	Worksheet 7
6	Worksheet 7
7	Worksheet 8
8	Worksheet 9

## WORKSHEET 1. FALLING-HEAD PERCOLATION TEST

Site Address: \_\_\_\_\_

Completed by: \_\_\_\_\_

Date of test: \_\_\_\_\_

Signature: \_\_\_\_\_

### Attach the following:

- Log of hole showing depth, soil type and moisture content
- Site-plan showing the location of the hole
- Graph of water level against time  
(tick when attached)

- Civil Engineer
- Engineering Technician
- Engineering Geologist  
(tick one)

### Ensure the following procedures are followed:

- Hole is kept full for 17 hours prior to test (for pre-soaking)
- Drop in water level is recorded at intervals of 30 minutes or less
- Test is continued for 4 hours or until hole is empty
- Stop test or refill hole when water level is 0.25m above the base of the bore
- Percolation rate is determined from the minimum slope of the curve  
(tick when complete)

### 1. Test Details

a) diameter of bore =  $D =$  \_\_\_\_\_ m

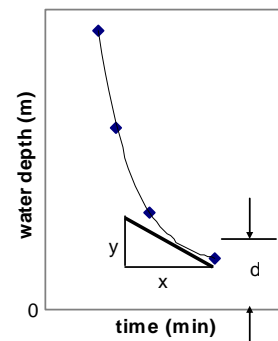
(b) Water Depth(m)	Time (min)

Water Depth(m)	Time (min)

### 2. Calculate minimum gradient

(a) Minimum gradient\*\* =  $\frac{y}{x} =$  \_\_\_\_\_ m/min

\*\*a straight line interpolation between the last two points on the graph



### 3. Calculate percolation rate

(a) Percolation rate =  $P_1 = \frac{D \times \text{gradient} \times 1000}{4 \times d^*} =$  \_\_\_\_\_ L/m<sup>2</sup>/min

\*  $d$  = distance between the midpoint of the last two readings and the base of the borehole.

## WORKSHEET 2. CONSTANT-HEAD PERCOLATION TEST

Site Address: \_\_\_\_\_

Completed by: \_\_\_\_\_

Date of test: \_\_\_\_\_

Signature: \_\_\_\_\_

### Attach the following:

- Log of borehole showing depth, geological layers and water table
- Site-plan showing the location of the hole  
(tick when attached)

- Civil Engineer
- Engineering Technician
- Engineering Geologist  
(tick one)

### Ensure the following procedures are followed:

- A permit is obtained from Metrowater
- Hole is pre-soaked for 10 minutes prior to test
- Test is continued for 10 to 15 minutes
- Rockbores are maintained full
- Testpits are maintained ½ full
- Bores within 10m of each other are tested simultaneously
- Borehole drilling is attempted before constructing a testpit  
(tick when complete)

### 3. Test Details

Time	Flowrate (L/s)

Time	Flowrate (L/s)

### 4. Determine capacity of rockbore/testpit :

(a) Capacity of bore =  $P_2 = \frac{\text{Flowrate}^*}{1.3} =$  \_\_\_\_\_ L/s

\* Use the end-of-test flowrate.

### 6. Percolation Rate (testpit only)

(do not complete this step for rockbores)

(a) Soakage surface ( ½ total wall area + base area) = \_\_\_\_\_ m<sup>2</sup>

(b) Percolation rate =  $P_1 = \frac{P_2 \times 60}{(\text{soakage\_surface})} =$  \_\_\_\_\_ L/m<sup>2</sup>/min

**WORKSHEET 3. ONEHUNGA AND FILTER-STRIP SOAKHOLES**

**W3**

Site Address: \_\_\_\_\_

Design by: \_\_\_\_\_ Date: \_\_\_\_\_

**1. Equivalent Impervious Area**

Cover Type	Area (m <sup>2</sup> )	Ratio, $R_E$	Area x $R_E$ (m <sup>2</sup> )
Roof	$A_R =$	1	
Paved	$A_C =$	1	
Pervious (lawn etc)	$A_P =$	0.3	

(a) Equivalent impervious area ( $A_E$ ):  $\Sigma A_E =$  \_\_\_\_\_ m<sup>2</sup>

**2. Determine Soakhole Area**

(a) Percolation rate (from WORKSHEET 1 or WORKSHEET 2) =  $P_1 =$  \_\_\_\_\_ L/m<sup>2</sup>/min

(b) Choose soakhole depth =  $d =$  \_\_\_\_\_ m

(c) Read off soakhole area ratio (from CHART 1) =  $R_I =$  \_\_\_\_\_ m<sup>2</sup>/m<sup>2</sup>

(d) Calculate soakhole area =  $A_1 = R_I \times A_E =$  \_\_\_\_\_ m<sup>2</sup>

**Notes:**

1. Use WORKSHEET 8 if  $A_E > 1000\text{m}^2$
2. Minimum soakhole width = 0.5 m
3. Minimum soakhole length = 1.0 m
4. Sizing is based on a porosity of 0.5
5. WORKSHEET 8 can be used for more accurate sizing

## WORKSHEET 4. ROCKBORE SOAKHOLE

# W4

Site Address: \_\_\_\_\_

Design by: \_\_\_\_\_ Date: \_\_\_\_\_

### 1. Equivalent Impervious Area

Cover Type	Area (m <sup>2</sup> )	Ratio, $R_E$	Area x $R_E$ (m <sup>2</sup> )
Roof	$A_R =$	1	
Paved	$A_C =$	1	
Pervious (lawn etc)	$A_P =$	0.3	

(a) Equivalent impervious area ( $A_E$ ):  $\Sigma A_E =$  \_\_\_\_\_ m<sup>2</sup>

### 2. Rockbore Capacity (if no storage provided)

(a) Constant-head flow (from WORKSHEET 2) =  $P_2 =$  \_\_\_\_\_ L/s

(b) Maximum area that can be served by bore =  $\frac{P_2 \times 60}{1.1} =$  \_\_\_\_\_ m<sup>2</sup>

(c) If area from (b) >  $A_E$ , no storage is needed and step 3 does not need to be completed.

### 3. Storage Required

(a) Catchment soakage ratio =  $P_3 = \frac{P_2 \times 60}{A_E} =$  \_\_\_\_\_ \*

(b) Read off storage ratio (from CHART 2) =  $R_2 =$  \_\_\_\_\_ m<sup>3</sup>/m<sup>2</sup>

(c) Calculate storage required =  $R_2 \times A_E =$  \_\_\_\_\_ m<sup>3</sup>

(d) Compare to available storage = \_\_\_\_\_ m<sup>3</sup>

\*L/min/(m<sup>2</sup> equivalent impervious area)



**WORKSHEET 5. RAIN-GARDEN FOR SOAKAGE AND PRE-TREATMENT**

**W5**

Site Address: \_\_\_\_\_

Design by: \_\_\_\_\_ Date: \_\_\_\_\_

**1. Equivalent Impervious Area**

Cover Type	Area (m <sup>2</sup> )	Ratio, $R_E$	Area x $R_E$ (m <sup>2</sup> )
Roof	$A_R =$	1	
Paved	$A_C =$	1	
Pervious (lawn etc)	$A_P =$	0.3	

(a) Equivalent impervious area ( $A_E$ ):  $\sum A_E =$  \_\_\_\_\_ m<sup>2</sup>

**2. Minimum Soil Area for Treatment**

(a) Minimum area of soil =  $A_T = A_C \times 0.07 =$  \_\_\_\_\_ m<sup>2</sup>

**3. Minimum Scoria Area for Soakage**

(a) Percolation rate (from WORKSHEET 1 or WORKSHEET 2) =  $P_1 =$  \_\_\_\_\_ L/m<sup>2</sup>/min

Trial 1      Trial 2

(b) Choose scoria depth =  $d =$  \_\_\_\_\_ m

(c) Read off soakhole area ratio (from CHART 1) =  $R_I =$  \_\_\_\_\_ m<sup>2</sup>/m<sup>2</sup>

(d) Calculate scoria area =  $A_I = R_I \times A_E =$  \_\_\_\_\_ m<sup>2</sup>

(e) Compare  $A_I$  and  $A_T$ . Designs are most cost effective if  $A_I$  approximately equals  $A_T$ .

**4. Raingarden Area**

(a) Raingarden area is largest of  $A_I$  and  $A_T =$  \_\_\_\_\_ m<sup>2</sup>

**Notes:**

1. Maximum  $A_E = 1000$  m<sup>2</sup>. If  $A_E > 1000$  m<sup>2</sup>, use two or more smaller raingardens
2. If  $A_I > A_T$ , consider increasing scoria depth and repeating 3(b) to 3(d).
3. If  $A_I < A_T$ , consider decreasing scoria depth and repeating 3(b) to 3(d).
2. Minimum raingarden width = 0.5 m
3. Minimum raingarden length = 1.0 m

**WORKSHEET 6. PRE-TREATMENT DEVICES**

**W6**

Site Address: \_\_\_\_\_

Design by: \_\_\_\_\_ Date: \_\_\_\_\_

**1. Area feeding to Pre-treatment Devices**

(a) Paved area =  $A_C =$  \_\_\_\_\_  $m^2$

**2. Rain-garden**

(a) Minimum area of soil =  $A_C \times 0.07 =$  \_\_\_\_\_  $m^2$

**Notes:**

1. Maximum  $A_C = 1000 m^2$
2. Minimum width = 0.5 m
3. Minimum length = 1.0 m

**3. Sand-filter (approximate sizing only)**

(a) Minimum area of sand =  $A_C \times 0.007 =$  \_\_\_\_\_  $m^2$

**Notes:**

1. This sizing is based on a sand depth of 0.5 m, with 0.5 m of water above the sand.
2. Sandfilters should be constructed according to ARC design specifications in TP10[3].

**4. Filter-strip**

(a) Choose width of filter strip =  $W =$  \_\_\_\_\_ m

(b) Read off minimum filter strip length (CHART 4) = \_\_\_\_\_ m

**Notes:**

1. Minimum width = 1.0 m
2. Only valid for filterstrip slopes of 1% (0.01 m/m). See ARC TP10[3] for other slopes.
3. Design the filterstrip soakhole using WORKSHEET 3.
4. The filterstrip soakhole must be at least as long as the filterstrip is wide.
5. The grass length must be between 50 mm and 150 mm.

**5. Scoria Trench**

(a) Minimum length of trench =  $A_C \times 0.067 =$  \_\_\_\_\_ m

**Notes:**

1. If using with a filter-strip, length of trench should equal width of filter-strip.

## WORKSHEET 7. NOMINAL SOAKHOLE & ON-SITE STORAGE

# W7

Site Address: \_\_\_\_\_

Design by: \_\_\_\_\_ Date: \_\_\_\_\_

### 1. Nominal Soakhole

(a) Roof area + paved area =  $A_R + A_C = A_E =$  \_\_\_\_\_  $m^2$

(b) Soakhole volume =  $A_E \times 0.1 =$  \_\_\_\_\_  $m^3$

#### **Notes:**

1.  $A_E$  must be less than  $20 m^2$ .
2. Soakhole must be at least 0.5 m wide.

### 2. On-site Storage

(a) Storage required (from WORKSHEET 8) =  $V_I =$  \_\_\_\_\_  $m^3$

(b) Additional storage required (from WORKSHEET 8) =  $V_3 =$  \_\_\_\_\_  $m^3$

(c) Maximum onsite storage allowed =  $V_5 = 0.4 \times V_I =$  \_\_\_\_\_  $m^3$

#### **Notes:**

1. If  $V_3 > V_5$ , the dimensions of the soakage system must be increased.
2. On-site storage must not exceed a maximum depth of 250 mm.
3. Attach sheet showing calculations of on-site storage.
4. Stored water must comply with Building Act and District Plan requirements for floodwaters.
5. There must be a freeboard of 20 to 50 mm.

**WORKSHEET 8. ALL SOAKHOLES EXCEPT ROCKBORE**

**W8**

Site Address: \_\_\_\_\_

Design by: \_\_\_\_\_ Date: \_\_\_\_\_

**1. Equivalent Impervious Area**

Cover Type	Area (m <sup>2</sup> )	Ratio, $R_E$	Area x $R_E$ (m <sup>2</sup> )
Roof	$A_R =$	1	
Paved	$A_C =$	1	
Pervious (lawn etc)	$A_P =$	0.3	

(a) Equivalent impervious area ( $A_E$ ):  $\Sigma A_E =$  \_\_\_\_\_ m<sup>2</sup>

**2. Soakhole Area**

(a) Percolation rate (from WORKSHEET 1 or WORKSHEET 2) =  $P_1 =$  \_\_\_\_\_ L/m<sup>2</sup>/min

Trial 1                  Trial 2

(b) Choose dimensions of soakage system  
(width, length and depth of scoria: see Notes 1,2)

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

(c) Calculate surface area for soakage  
=(soakhole base area) + 0.5(soakhole wall area) =  $A_2 =$  \_\_\_\_\_ m<sup>2</sup>

(d) Catchment soakage ratio =  $P_3 = \frac{P_1 \times A_2}{A_E} =$  \_\_\_\_\_ \*

(e) Read off storage ratio (CHART 2) =  $R_2 =$  \_\_\_\_\_ m<sup>3</sup>/m<sup>2</sup>

(f) Calculate storage required =  $V_1 = R_2 \times A_E =$  \_\_\_\_\_ m<sup>3</sup>

(g) Calculate available storage (see Notes 3, 4) =  $V_2 =$  \_\_\_\_\_ m<sup>3</sup>

(h) Additional storage required (see Note 5) =  $V_3 = V_1 - V_2 =$  \_\_\_\_\_ m<sup>3</sup>

**Notes:**

\*L/min/(m<sup>2</sup> equivalent impervious area)

- WORKSHEET 3 and CHART 1 may assist with 2(b)
- Minimum soakhole length = 1.0 m, minimum soakhole width = 0.5 m
- Use 0.5 as the void ratio for scoria
- For scoria-filled holes,  $V_2 =$  length x width x depth x 0.5
- If  $V_3 > 0$ , either provide site storage (WORKSHEET 7), a raintank (WORKSHEET 9) or increase dimensions of soakage system and repeat 2(a)-(h).

**WORKSHEET 9. RAINWATER TANK SIZING**

**W9**

Site Address: \_\_\_\_\_

Design by: \_\_\_\_\_ Date: \_\_\_\_\_

**1. Data (from WORKSHEET 8):**

(a) Storage required =  $V_1 =$  \_\_\_\_\_  $m^3$

(b) Additional storage required =  $V_3 =$  \_\_\_\_\_  $m^3$

(c) Roof area =  $A_R =$  \_\_\_\_\_  $m^2$

(d) Equivalent impervious area =  $A_E =$  \_\_\_\_\_  $m^2$

**2. Check that the Raintank can Provide Adequate Storage:**

(a) Calculate roof component of storage =  $V_4 = V_1 \times \frac{A_R}{A_E} =$  \_\_\_\_\_  $m^3$

**check:**  $V_4$  must be larger than  $V_3$ . If  $V_4 < V_3$ , the size of the soakage device should be increased.

**3. Size Permanent Storage:**

(a) Design number of people (= no. of bedrooms + 1) =  $D =$  \_\_\_\_\_ people

(b) Permanent storage capacity (CHART 4) =  $S =$  \_\_\_\_\_  $m^3$

**4. Select Tank**

(a) Calculate minimum tank capacity =  $T = V_3 \times 1.2 + (A_R \times 0.01) + S =$  \_\_\_\_\_  $m^3$

(b) Select tank from available sizes: tank capacity =  $C =$  \_\_\_\_\_  $m^3$

**note:** minimum  $C = 2m^3$

tank height (to overflow) =  $G =$  \_\_\_\_\_ m

**5. Orifice Sizing**

(a) Catchment soakage ratio (from Worksheet 8) =  $P_3 =$  \_\_\_\_\_ \*

(b) Orifice height from base of tank =  $H = \frac{G \times S}{C} =$  \_\_\_\_\_ m

(c) Read off orifice area ratio (CHART 6) =  $Z =$  \_\_\_\_\_  $mm^2/(m^2 \text{ roof area})$

(d) Calculate orifice area =  $A_R \times Z =$  \_\_\_\_\_  $mm^2$

(e) Read off orifice diameter (CHART 5)\*\* =  $E =$  \_\_\_\_\_ mm

\*\*OR calculate using  $E = 1.13 \times (\text{orifice area})^{0.5}$

\*L/min/( $m^2$  equivalent impervious area)

**note:** Orifice diameters must be 10mm or larger. The orifice must be screened and details of the screen must be submitted for approval.

**Example 1**

This example demonstrates the use of Worksheet 3 for a property with the following characteristics:

Roof area: 200 m<sup>2</sup>

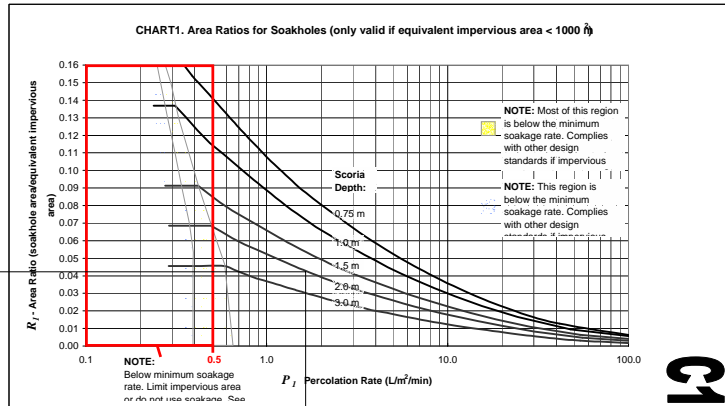
Paved area: 100 m<sup>2</sup>

Grassed area that will contribute runoff: 100 m<sup>2</sup>

Soil conditions: Non-rock area

Percolation rate = 1.5 L/m<sup>2</sup> /min

The design will be used as an Onehunga soakhole, with a 1.05 m diameter chamber placed inside the soakhole.



0.044

1.5

**WORKSHEET 3. ONEHUNGA AND FILTER-STRIP SOAKHOLES**

**W3**

Site Address: 130 Example Ave, Epsom

Design by: Joseph Bloggs

Date: 03/09/02

**1. Equivalent Impervious Area**

Cover Type	Area (m <sup>2</sup> )	Ratio, R <sub>E</sub>	Area x R <sub>E</sub> (m <sup>2</sup> )
Roof	A <sub>R</sub> = 200	1	200
Paved	A <sub>C</sub> = 100	1	100
Pervious (lawn etc)	A <sub>P</sub> = 100	0.3	30

(a) Equivalent impervious area (A<sub>E</sub>): ∑ A<sub>E</sub> = 330 m<sup>2</sup>

**2. Determine Soakhole Area**

(a) Percolation rate (from WORKSHEET 1 or WORKSHEET 2) = P<sub>I</sub> = 1.5 L/m<sup>2</sup>/min

(b) Choose soakhole depth = d = 2.0 m

(c) Read off soakhole area ratio (from CHART 1) = R<sub>I</sub> = 0.044 m<sup>2</sup>/m<sup>2</sup>

(d) Calculate soakhole area = A<sub>I</sub> = R<sub>I</sub> x A<sub>E</sub> = 14.5 m<sup>2</sup>

**Notes:**

1. Use WORKSHEET 8 if A<sub>E</sub> > 1000m<sup>2</sup>
2. Minimum soakhole width = 0.5 m
3. Minimum soakhole length = 1.0 m
4. Sizing is based on a porosity of 0.5
5. WORKSHEET 8 can be used for more accurate sizing

If width = 3 m,  
length = 5 m.

Example 2

This example demonstrates the use of Worksheet 4 for a property with the following characteristics:

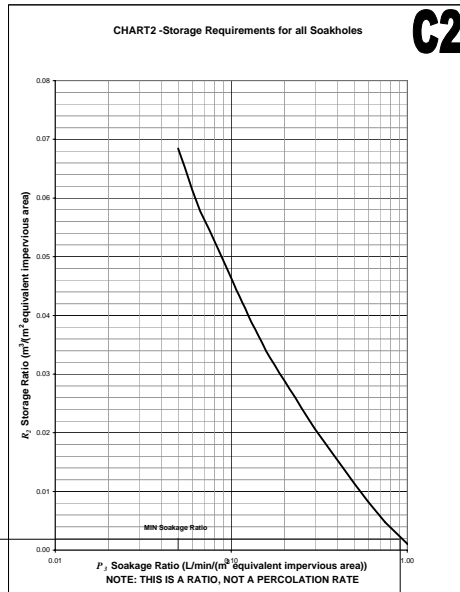
Roof area: 200 m<sup>2</sup>

Paved area: 100 m<sup>2</sup>

Grassed area that will contribute runoff: 100 m<sup>2</sup>

Soil conditions: Rock area

Capacity of bore = 5.0 L/s



0.002

0.91

**WORKSHEET 4. ROCKBORE SOAKHOLE**

**W4**

Site Address: 130 Example Ave, Epsom

Design by: Joseph Bloggs Date: 03/09/02

**1. Equivalent Impervious Area**

Cover Type	Area (m <sup>2</sup> )	Ratio, $R_E$	Area x $R_E$ (m <sup>2</sup> )
Roof	$A_R = 200$	1	200
Paved	$A_C = 100$	1	100
Pervious (lawn etc)	$A_P = 100$	0.3	30

(a) Equivalent impervious area ( $A_E$ ):  $\Sigma A_E = 330$  m<sup>2</sup>

**2. Rockbore Capacity (if no storage provided)**

(a) Constant-head flow (from WORKSHEET 2) =  $P_2 = 5$  L/s

(b) Maximum area that can be served by bore =  $\frac{P_2 \times 60}{1.1} = \frac{273}{1.1}$  m<sup>2</sup>

(c) If area from (b) >  $A_E$ , no storage is needed and step 3 does not need to be completed.

**3. Storage Required**

(a) Catchment soakage ratio =  $P_3 = \frac{P_2 \times 60}{A_E} = \frac{273}{330} = 0.91$  \*

(b) Read off storage ratio (from CHART 2) =  $R_2 = 0.002$  m<sup>3</sup>/m<sup>2</sup>

(c) Calculate storage required =  $R_2 \times A_E = 0.66$  m<sup>3</sup>

(d) Compare to available storage =  $1.3$  \* m<sup>3</sup>

*\*If a 1.05 m diameter chamber is used (1.5 m deep);*

\*L/min/(m<sup>2</sup> equivalent impervious area)

**Example 3**

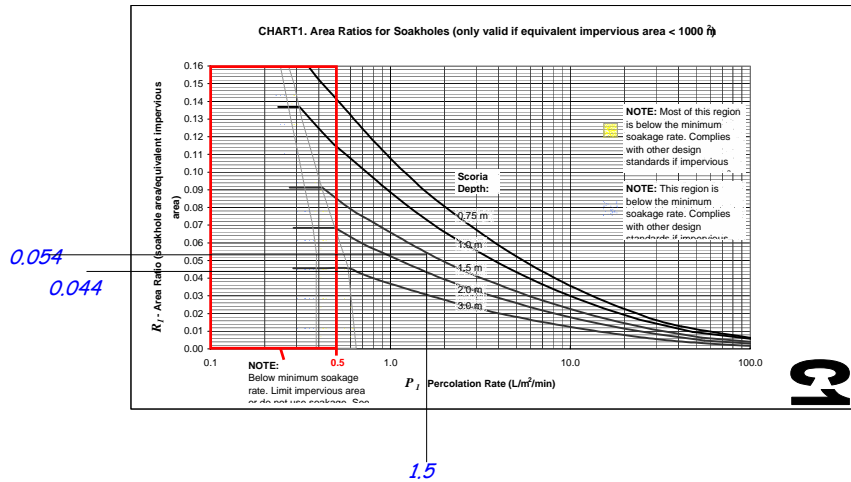
This example demonstrates the use of Worksheet 5 to size a raingarden to dispose of site runoff only:

Paved area: 100 m<sup>2</sup>

Grassed area that will contribute runoff: 100 m<sup>2</sup>

Soil conditions: Non-rock area

Percolation rate = 1.5 L/m<sup>2</sup> /min



**WORKSHEET 5. RAIN-GARDEN FOR SOAKAGE AND PRE-TREATMENT**

**W5**

Site Address: 130 Example Ave, Epsom

Design by: Joseph Bloggs

Date: 03/09/02

**1. Equivalent Impervious Area**

Cover Type	Area (m <sup>2</sup> )	Ratio, R <sub>E</sub>	Area x R <sub>E</sub> (m <sup>2</sup> )
Roof	A <sub>R</sub> = 0	1	0
Paved	A <sub>C</sub> = 100	1	100
Pervious (lawn etc)	A <sub>P</sub> = 100	0.3	30

(a) Equivalent impervious area (A<sub>E</sub>): ∑ A<sub>E</sub> = 130 m<sup>2</sup>

**2. Minimum Soil Area for Treatment**

(a) Minimum area of soil = A<sub>T</sub> = A<sub>C</sub> x 0.07 = 7 m<sup>2</sup>

**3. Minimum Scoria Area for Soakage**

(a) Percolation rate (from WORKSHEET 1 or WORKSHEET 2) = P<sub>I</sub> = 1.5 L/m<sup>2</sup>/min

Trial 1 Trial 2

(b) Choose scoria depth = d = 2.0 1.5 m

(c) Read off soakhole area ratio (from CHART 1) = R<sub>I</sub> = 0.044 0.054 m<sup>2</sup>/m<sup>2</sup>

(d) Calculate scoria area = A<sub>I</sub> = R<sub>I</sub> x A<sub>E</sub> = 5.7 7.0 m<sup>2</sup>

(e) Compare A<sub>I</sub> and A<sub>T</sub>. Designs are most cost effective if A<sub>I</sub> approximately equals A<sub>T</sub>.

**4. Raingarden Area**

(a) Raingarden area is largest of A<sub>I</sub> and A<sub>T</sub> = 7 m<sup>2</sup>

**Notes:**

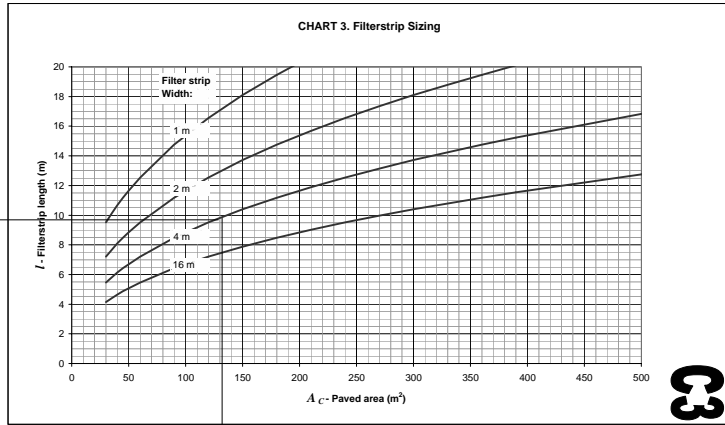
- Maximum A<sub>E</sub> = 1000 m<sup>2</sup>. If A<sub>E</sub> > 1000 m<sup>2</sup>, use two or more smaller raingardens
- If A<sub>I</sub> > A<sub>T</sub>, consider increasing scoria depth and repeating 3(b) to 3(d).
- If A<sub>I</sub> < A<sub>T</sub>, consider decreasing scoria depth and repeating 3(b) to 3(d).
- Minimum raingarden width = 0.5 m
- Minimum raingarden length = 1.0 m



**Example 4**

This example demonstrates the use of Worksheet 6 to size pre-treatment devices for site runoff:

Paved area: 130 m<sup>2</sup>



9.8

130

**WORKSHEET 6. PRE-TREATMENT DEVICES**

**W6**

Site Address: 130 Example Ave, Epsom

Design by: Joseph Bloggs Date: 03/09/02

**1. Area feeding to Pre-treatment Devices**

(a) Paved area = A<sub>c</sub> = 130 m<sup>2</sup>

**2. Rain-garden**

(a) Minimum area of soil = A<sub>c</sub> x 0.07 = 9.1 m<sup>2</sup>

**Notes:**

1. Maximum A<sub>c</sub> = 1000 m<sup>2</sup>
2. Minimum width = 0.5 m
3. Minimum length = 1.0 m

**3. Sand-filter (approximate sizing only)**

(a) Minimum area of sand = A<sub>c</sub> x 0.007 = 0.9 m<sup>2</sup>

**Notes:**

1. This sizing is based on a sand depth of 0.5 m, with 0.5 m of water above the sand.
2. Sandfilters should be constructed according to ARC design specifications in TP10[3].

**4. Filter-strip**

(a) Choose width of filter strip = W = 4 m

(b) Read off minimum filter strip length (CHART 4) = 9.8 m

**Notes:**

1. Minimum width = 1.0 m
2. Only valid for filterstrip slopes of 1% (0.01 m/m). See ARC TP10[3] for other slopes.
3. Design the filterstrip soakhole using WORKSHEET 3.
4. The filterstrip soakhole must be at least as long as the filterstrip is wide.
5. The grass length must be between 50 mm and 150 mm.

**5. Scoria Trench**

(a) Minimum length of trench = A<sub>c</sub> x 0.067 = 8.7 m

**Notes:**

1. If using with a filter-strip, length of trench should equal width of filter-strip.

Example 5

*This example demonstrates the use of Worksheet 7 to size a nominal soakhole:*

Roof area:  $20 \text{ m}^2$

Example 6

*This example demonstrates the use of Worksheet 7 to check that on-site storage can be used for the soakhole sized in Example 7.*

WORKSHEET 7. NOMINAL SOAKHOLE & ON-SITE STORAGE		W7
Site Address:	<u>130 Example Ave, Epsom</u>	
Design by:	<u>Joseph Bloggs</u>	Date: <u>03/09/02</u>
<b>1. Nominal Soakhole</b>		
(a) Roof area + paved area = $A_R + A_C = A_E =$	<u>20</u>	$\text{m}^2$
(b) Soakhole volume = $A_E \times 0.1 =$	<u>2</u>	$\text{m}^3$
<b>Notes:</b>		
1. $A_E$ must be less than $20 \text{ m}^2$		
2. Soakhole must be at least 0.5 m wide.		
<b>2. On-site Storage</b>		
(a) Storage required (from WORKSHEET 8) = $V_I =$	<u>12.2</u>	$\text{m}^3$
(b) Additional storage required (from WORKSHEET 8) = $V_3 =$	<u>3.2</u>	$\text{m}^3$
(c) Maximum onsite storage allowed = $V_5 = 0.4 \times V_I =$	<u>5.0</u>	$\text{m}^3$
<b>Notes:</b>		
1. If $V_3 > V_5$ , the dimensions of the soakage system must be increased.		
2. On-site storage must not exceed a maximum depth of 250 mm.		
3. Attach sheet showing calculations of on-site storage.		
4. Stored water must comply with Building Act and District Plan requirements for floodwaters.		
5. There must be a freeboard of 20 to 50 mm.		

Example 7

This example demonstrates the use of Worksheet 8 for a property with the following characteristics:

Roof area: 200 m<sup>2</sup>

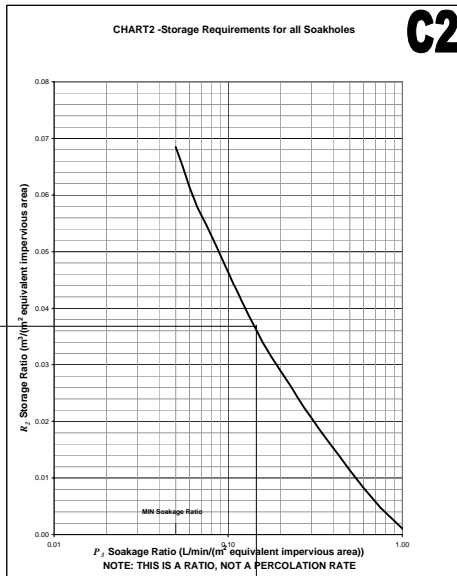
Paved area: 100 m<sup>2</sup>

Grassed area that will contribute runoff: 100 m<sup>2</sup>

Soil conditions: Non-rock area

Percolation rate = 1.5 L/m<sup>2</sup> /min

The soakhole has been undersized slightly, so that additional storage is required



0.037

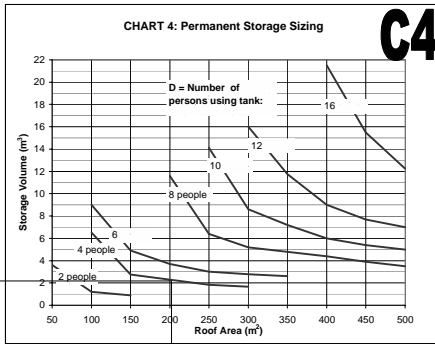
0.14

WORKSHEET 8. ALL SOAKHOLES EXCEPT ROCKBORE			
Site Address: <u>130 Example Ave, Epsom</u>			W8
Design by: <u>Joseph Bloggs</u>		Date: <u>03/09/02</u>	
<b>1. Equivalent Impervious Area</b>			
Cover Type	Area (m <sup>2</sup> )	Ratio, R <sub>E</sub>	Area x R <sub>E</sub> (m <sup>2</sup> )
Roof	A <sub>R</sub> = 200	1	200
Paved	A <sub>C</sub> = 100	1	100
Pervious (lawn etc)	A <sub>P</sub> = 100	0.3	30
(a) Equivalent impervious area (A <sub>E</sub> ):			∑ A <sub>E</sub> = 330 m <sup>2</sup>
<b>2. Soakhole Area</b>			
(a) Percolation rate (from WORKSHEET 1 or WORKSHEET 2) = P <sub>1</sub> =		<u>1.5</u>	L/m <sup>2</sup> /min
		Trial 1	Trial 2
(b) Choose dimensions of soakage system		<u>width = 1.8 m</u>	
(width, length and depth of scoria: see Notes 1,2)		<u>length = 10 m</u>	
		<u>depth = 1.0 m</u>	
(c) Calculate surface area for soakage		<u>(1.8m x 10m) + 0.5(10m x 1m x 2) + 1.8m x 1m x 2,</u>	
= (soakhole base area) + 0.5(soakhole wall area) = A <sub>2</sub> =		<u>29.8</u>	m <sup>2</sup>
(d) Catchment soakage ratio = P <sub>3</sub> = $\frac{P_1 \times A_2}{A_E}$ =		<u>0.14</u>	*
(e) Read off storage ratio (CHART 2) = R <sub>2</sub> =		<u>0.037</u>	m <sup>3</sup> /m <sup>2</sup>
(f) Calculate storage required = V <sub>1</sub> = R <sub>2</sub> x A <sub>E</sub> =		<u>12.2</u>	m <sup>3</sup>
(g) Calculate available storage (see Notes 3, 4) = V <sub>2</sub> =		<u>9.0</u>	m <sup>3</sup>
(h) Additional storage required (see Note 5) = V <sub>3</sub> = V <sub>1</sub> - V <sub>2</sub> =		<u>3.2</u>	m <sup>3</sup>
<b>Notes:</b>			
1. WORKSHEET 3 and CHART 1 may assist with 2(b)			
2. Minimum soakhole length = 1.0 m, minimum soakhole width = 0.5 m			
3. Use 0.5 as the void ratio for scoria			
4. For scoria-filled holes, V <sub>2</sub> = length x width x depth x 0.5			
5. If V <sub>3</sub> > 0, either provide site storage (WORKSHEET 7), a raintank (WORKSHEET 9) or increase dimensions of soakage system and repeat 2(a)-(h).			

**Example 8**

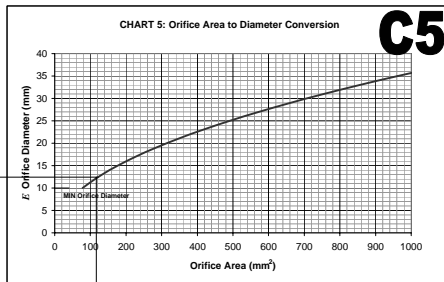
This example demonstrates the use of Worksheet 9 to size a rainwater tank for the soakhole sized in example 7.

Note that two smaller rainwater tanks have been used instead of one large tank. The tanks will be connected together so they function as one tank, with a single orifice. This reduces the head above the orifice, and allows a larger orifice to be used.



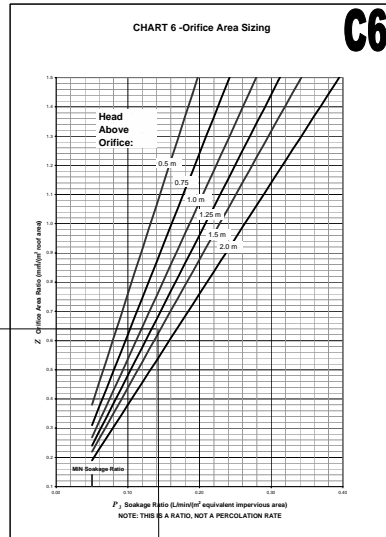
2.2

200



13

128



0.14

**WORKSHEET 9. RAINWATER TANK SIZING**

**W9**

Site Address: 130 Example Ave, Epsom

Design by: Joseph Bloggs

Date: 03/09/02

**1. Data (from WORKSHEET 8):**

- (a) Storage required =  $V_1 =$  12.2 m<sup>3</sup>
- (b) Additional storage required =  $V_3 =$  3.2 m<sup>3</sup>
- (c) Roof area =  $A_R =$  200 m<sup>2</sup>
- (d) Equivalent impervious area =  $A_E =$  330 m<sup>2</sup>

**2. Check that the Raintank can Provide Adequate Storage:**

(a) Calculate roof component of storage =  $V_4 = V_1 \times \frac{A_R}{A_E} =$  7.4 m<sup>3</sup>

check:  $V_4$  must be larger than  $V_3$ . If  $V_4 < V_3$ , the size of the soakage device should be increased.

**3. Size Permanent Storage:**

- (a) Design number of people (= no. of bedrooms + 1) =  $D =$  4 people
- (b) Permanent storage capacity (CHART 4) =  $S =$  2.2 m<sup>3</sup>

**4. Select Tank**

- (a) Calculate minimum tank capacity =  $T = V_3 \times 1.2 + (A_R \times 0.01) + S =$  8.04 m<sup>3</sup>
- (b) Select tank from available sizes: tank capacity =  $C =$  2x4.4 m<sup>3</sup>

note: minimum  $C = 2m^3$

tank height (to overflow) =  $G =$  1.87 m

**5. Orifice Sizing**

- (a) Catchment soakage ratio (from Worksheet 8) =  $P_3 =$  0.14 \*
- (b) Orifice height from base of tank =  $H = \frac{G \times S}{C} =$  0.47 m
- (c) Read off orifice area ratio (CHART 6) =  $Z =$  0.64 mm<sup>2</sup>/(m<sup>2</sup> roof area)
- (d) Calculate orifice area =  $A_R \times Z =$  128 mm<sup>2</sup>
- (e) Read off orifice diameter (CHART 5)\*\* =  $E =$  13 mm

\*\*OR calculate using  $E = 1.13 \times (\text{orifice area})^{0.5}$  \*L/min/(m<sup>2</sup> equivalent impervious area)

note: Orifice diameters must be 10mm or larger. The orifice must be screened and details of the screen must be submitted for approval.

# Appendix D

## Operation and Maintenance Forms

<u>Page No.</u>	<u>Title</u>
D1	Form "OSM-O&M Plan"
D2	Form "OSM-O&M Routine"
D4	Form "OSM-O&M Cert"
D5	Form SM001– Onehunga Soakhole
D7	Form SM002– Filter-strip Soakhole
D9	Form SM003– Rain-garden for Soakage
D11	Form SM004– Rain-garden for Pre-treatment
D13	Form SM005– Rockbore Soakhole
D15	Form SM006 – Porous Paving
D17	Form SM007 – Sand-filter
D19	Form SM008– Filter-strip
D21	Form SM009– Rainwater tank
D23	Form SM010– Scoria Trench

**FORM "OSM-O&M-PLAN"**

**(A) SITE & OSM DEVICE DETAILS:**

(1) Site Address: \_\_\_\_\_

(2) Owners Name: \_\_\_\_\_

**(3) Details of OSM Device(s):**

Ref. No	Type	Size (eg m <sup>2</sup> or m <sup>3</sup> )	Location	Runoff Source*
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

\* eg roof, paved area

**(4) Name & Address of Parties Responsible for Inspecting and Maintaining the Devices:**

\_\_\_\_\_  
\_\_\_\_\_

**(B) O&M PLAN PREPARED BY:**

(1) Firm: \_\_\_\_\_

(2) Responsible Individuals Name: \_\_\_\_\_

(3) Firms Address: \_\_\_\_\_

**(C) ATTACHED FORMS:**

(1) Form "OSM-O&M-Routine"

(2) Forms "DEVICE-SPECIFIC O&M DETAILS":

(one for each OSM device)

Ref. No	Type
_____	_____
_____	_____
_____	_____
_____	_____

\_\_\_\_\_  
**Signed**

\_\_\_\_\_  
**Date**

**ACE Office Use:**

Reference No. \_\_\_\_\_

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_

Entered by: \_\_\_\_\_ Date: \_\_\_\_\_

**FORM "OSM-O&M-ROUTINE"**  
**List of Routine Maintenance Requirements**

(a) Monitoring & Inspection Programme:

Routine monitoring and inspections are required to:

- Develop a condition history
- Improve scheduling efficiency
- Apply preventative maintenance

Inspection records are to be used to:

- Determine where special maintenance conditions exist
- Determine optimal frequencies for future inspection and maintenance
- Establish scheduled and unscheduled maintenance provisions
- Assure OSM device operation and aesthetics

Specific requirements cover:

- The owner will be responsible for conducting inspections (or having them done on his/her behalf) with the OSM device "as-built" plans in hand, generally at the following intervals (noting that this may vary, depending on site-specific conditions):
  - quarterly basis for the first 2 years
  - minimum of semi-annually thereafter
- The owner will be responsible for keeping inspection records to track the progressive development of the OSM device(s) over time, covering (note that these are to be available to the maintenance contractor noted in Section 11.2 and/or the City/ACE as may be required):
  - general condition of vegetation area(s), predominant plant species, distribution, and success rate (where applicable)
  - sediment condition and depth in forebay (or other pre-treatment structure), treatment facility, bench planting zones, and other sediment removal components
  - water elevations/observations (sheen, smell, etc.)
  - condition of the inlet, outlet, and overflow structures/devices, etc
  - unscheduled maintenance needs
  - components that do not meet performance criteria and require immediate maintenance
  - common problem areas, solutions, and general observations
  - aesthetic conditions

(b) Soils in Stormwater Planters & Rain Gardens:

The following requirements apply:

- Test the pH of planting bed soils in areas where vegetation has died:
  - if the pH is below 5.2, apply limestone
  - if the pH is above 7.0, add iron sulfate plus sulfur to reduce the pH
- Use core aeration of unvegetated areas if the surface of the bed becomes clogged with fine sediments over time: redesign plantings to correct problems, and re-establish soil coverage

(c) Vegetation Management:

Vegetated stormwater facilities may require a number of control practices, especially during the 2-year establishment period. Corresponding required practices cover:

- Maintain plantings for a period of 2 years after date of the Building Consent final inspection
- During the establishment period, remove undesired vegetation with minimal (or preferably no) use of toxic herbicides and pesticides at least three times in year 1, and once or twice in the summer of year 2; replace plants that die during this period within 3 months
- At the end of the second year, healthy plant establishment shall be achieved for at least 90% of the vegetation
- Selectively irrigate if necessary during the establishment period, during times of drought, or until the vegetation becomes established: it is preferred that the facility be designed to sustain its function without a permanent irrigation system
- Replenish mulch at least annually, and specify the mulching schedule in the O&M Plan; noting also that mulching shall be done to retain topsoil, heat, and moisture, and to inhibit weed growth
- Schedule maintenance outside sensitive wildlife and vegetation seasons
- Minimise plant disturbance during maintenance activities
- Do not use fertilisers, herbicides, or pesticides for vegetation maintenance, unless it is specifically called for in the O&M Plan
- Use replacement plants that conform with the initial planting plan

(d) Sediment Management/Pollutant Control:

Sediment and other pollutants that degrade water quality will accumulate in OSM devices and require removal to ensure proper operational performance. Corresponding requirements cover:

- Remove sediment when accumulations reach 100 mm in depth, or 50% of the designed sediment storage depth, or if sediment accumulation inhibits facility operation
- Dispose of the sediment in a safe manner
- If sediment and/or other pollutants are accumulating more rapidly than assumed when the O&M Plan was formulated, investigate and rectify the cause

(e) Access and Safety:

O&M programmes must provide for safe and efficient access to a facility. The following are general requirements; specific conditions may require site-specific modifications:

- Secure easements necessary to provide facility and maintenance access (if applicable)
- Use only suitably trained personnel to access confined spaces
- Maintain ingress/egress routes to design standards, in a manner that allows efficient maintenance of the facility
- Ensure that fencing is in good repair



**FORM "OSM-O&M-CERT"**

**(A) SITE & OSM DEVICE DETAILS:**

Site Address: \_\_\_\_\_

Owners Name: \_\_\_\_\_

Device(s):	Ref. No	Type	Size	Date Installed
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

**(B) MAINTENANCE CONTRACTOR'S DETAILS:**

Firms Name: \_\_\_\_\_

Firms Address: \_\_\_\_\_

Name of Serviceperson: \_\_\_\_\_

Date(s) of Service: \_\_\_\_\_

**(C) SERVICE DETAILS:**

Device Ref No	Checklist Completed*	MAINTENANCE ACTION	
Ref No	Completed*	Item	Action (describe, eg "pipe replaced")
1		(a) _____	_____
		(b) _____	_____
		(c) _____	_____
		(d) _____	_____
2		(a) _____	_____
		(b) _____	_____
		(c) _____	_____
		(d) _____	_____
3		etc....(continue on a separate sheet)	

\* on attached form "Device-Specific O&M Details"

**(D) CERTIFICATION:**

I/we hereby certify that:

- The OSM device inspection and maintenance programme has been undertaken in accordance with the provision of Section 11 of the City's "OSM Manual" dated 2002
- The details above and on the attached form(s) are a full and correct record of the work performed
- The OSM device(s) are in sound working order
- The owner has been advised of the problems found (if any) and alerted as to the need to inspect for any recurrences and rectify such promptly

\_\_\_\_\_  
**Signed**

\_\_\_\_\_  
**Date**

**ACE Office Use:**

Reference No. \_\_\_\_\_

Checked by: \_\_\_\_\_ Date: \_\_\_\_\_

Entered by: \_\_\_\_\_ Date: \_\_\_\_\_

**FORM “DEVICE SPECIFIC O&M DETAIL SM001”- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF ONEHUNGA SOAKHOLE**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF ONEHUNGA SOAKHOLE**

The Onehunga soakhole is a scoria filled pit that has a cavity constructed from either concrete or brick, called the “main chamber”. The scoria filled part is covered with at least 300mm of soil, but the main chamber normally extends to the surface with a steel lid to allow access. Rainwater enters the main chamber through pipes, and then seeps away into the ground.

**(B) OPERATIONAL POINTS**

- The main chamber provides storage space, and helps catch silt and dirt that would otherwise travel into the scoria filled pit. While cleaning the chamber is an added expense, it will increase the lifetime of the soakage device.
- The soakhole should be empty 24 hours after a storm event. This can be checked by observing the water level in the main chamber.
- Any site runoff (from paved areas) feeding to the soakhole must first pass through a pre-treatment device. Maintenance of the pre-treatment device is covered under a separate O&M form, which also covers maintenance of any catchpits or stormwater pipes feeding to the pre-treatment device.

- Roof runoff flows through a separate smaller chamber before entering the main chamber (does not apply to soakholes installed prior to 2003). The small chamber will be connected to the pipework between the spouting and the soakhole.

**(C) GENERAL O&M NEEDS**

- Maintenance of flow through the spouting and downpipe system.
- Removal of leaves and sediment from the small chamber.
- Removal of accumulated sediment from the main chamber.
- Checking the soakage capacity of the soakhole.

**(D) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an “OSM-O&M Cert” form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form “OSM-O&M-Plan”): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM001"- PAGE 2 OF 2**  
**CHECKLIST – ONEHUNGA SOAKHOLE**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
√	√	√	√	<b>Spouting, downpipes and small chamber:</b> <ul style="list-style-type: none"> <li>• Check for debris accumulation, blockages and leaks.</li> <li>• Remove waste material and maintain as necessary.</li> </ul>	
			√	<b>Soakhole and main chamber:</b> <ul style="list-style-type: none"> <li>• Check sediment level in chamber. Keeping sediment depths below 300mm will help extend the life of the soakhole.</li> <li>• Remove sediment as necessary. This is best achieved using an air vacuum system, and should be carried out at least every 4 years on commercial sites or 6 years on residential sites.</li> <li>• Check the water level in the chamber. Providing there has been no heavy rainfall for 24 hours, the chamber should be dry. If there is standing water in the soakhole, it should be repaired or replaced.</li> </ul>	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM002"- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF FILTERSTRIP SOAKHOLE**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF FILTERSTRIP SOAKHOLE**

The Filterstrip soakhole is a rock filled pit that extends to the surface. There is 200mm of clean gravel or river rock on the top of the soakhole, followed by a filter fabric layer and then a scoria layer extending to the base. The soakhole also has an observation well, and this should be visible on the surface.

Rainwater from paved areas first flows over a grass filterstrip before entering the soakhole through the gravel or river rock layer. If the soakhole accepts rainwater from roof areas, this will be piped to a small chamber (for litter removal) then directly into the soakhole.

**(B) OPERATIONAL POINTS**

- The soakhole should be empty 24 hours after a storm event. This can be checked by observing the water level in the observation well.
- Maintenance of the filterstrip is covered under a separate O&M form.

**(C) GENERAL O&M NEEDS**

- Removal of debris and sediment from the top of the soakhole.
- Checking the soakage capacity of the soakhole.
- Maintenance of flow through the spouting, downpipe system and small chamber (if roof areas are connected).

**(D) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an "OSM-O&M Cert" form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM002"- PAGE 2 OF 2**  
**CHECKLIST – FILTERSTRIP SOAKHOLE**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
	√	√	√	<b>Spouting, downpipes and small chamber:</b> <ul style="list-style-type: none"> <li>• Check for debris accumulation, blockages and leaks.</li> <li>• Check that the overflow is not obstructed.</li> <li>• Carry out maintenance as necessary.</li> </ul>	
		√	√	<b>Soakhole:</b> <ul style="list-style-type: none"> <li>• Check for debris and sediment accumulation.</li> <li>• Remove debris and sediment as necessary.</li> </ul>	
			√	<b>Soakhole:</b> <ul style="list-style-type: none"> <li>• Check the water level in the inspection well. Providing there has been no heavy rainfall for 24 hours, the inspection well should be dry.</li> <li>• If there is standing water in the soakhole it should be repaired or replaced.</li> <li>• Remove top 200mm of stones to check filter fabric layer and sediment build up in stones.</li> <li>• Remove sediment and replace filter fabric as necessary.</li> </ul>	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM003"- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF RAINGARDEN FOR SOAKAGE**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF RAINGARDEN**

Raingardens are scoria filled pits covered with a layer of sand and a thick layer of sandy soil (500mm or more). The sandy soil is planted with suitable plants, and rainwater from paved areas is directed onto the surface. The rainwater percolates down through the sandy soil layer to the scoria, and contaminants are filtered out in the process.

Raingardens for soakage have a large scoria layer in the base and function both as a pre-treatment and soakage device. An overflow is provided so that the sandy soil layer can be by-passed during large storm events. The overflow is a standard concrete or plastic catchpit.

**(B) OPERATIONAL POINTS**

- The plants growing in the sandy soil are a key part of the raingarden operation. They remove contaminants and help maintain the permeability of the soil.
- When the flow of water onto the raingarden exceeds the amount that can drain away through the soil, water will begin to pond. When the ponding exceeds a depth of 100 to 200 mm, water will begin to flow through the catchpit overflow.
- The catchpit pipes the water directly into the scoria layer at the base of the soakhole.

- The raingarden should be empty 24 hours after a storm event. This can be checked by observing the water level in the observation well.
- The raingarden may accept roof runoff. The roof runoff is piped directly to the scoria layer and bypasses the soil.
- Roof runoff normally flows through a small chamber before being piped directly into the scoria. The small chamber will be connected to the pipework between the spouting and the soakhole.

**(C) GENERAL O&M NEEDS**

- Maintenance of flow to the soil layer.
- Maintenance of flow through the spouting, downpipe system and small chamber (if roof areas are connected).
- Maintenance of vegetation.
- Removal of debris and sediment from the top of the raingarden.
- Checking the soakage capacity of the raingarden.

**(D) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an "OSM-O&M Cert" form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM003"- PAGE 2 OF 2**  
**CHECKLIST-RAINGARDEN FOR SOAKAGE**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
√	√	√	√	<b>Spouting, downpipes and small chamber (for litter removal):</b> <ul style="list-style-type: none"> <li>• Check for debris accumulation, blockages and leaks.</li> <li>• Check that the catchpit overflow is not obstructed.</li> <li>• Carry out maintenance as necessary.</li> </ul>	
		√	√	<b>Catchpit (for overflow):</b> <ul style="list-style-type: none"> <li>• Remove leaves and debris</li> </ul>	
		√	√	<b>Vegetation:</b> <ul style="list-style-type: none"> <li>• Add mulch and fertiliser as necessary.</li> <li>• Remove leaves, debris and weeds.</li> <li>• Replace dying plants.</li> </ul>	
			√	<b>Soil and Scoria layers:</b> <ul style="list-style-type: none"> <li>• Check that the soil layer is draining adequately. If water ponds for longer than 24 hours, the soil layer is clogged and maintenance will need to be carried out.</li> <li>• Maintenance of the soil layer involves removing sediment that is clogging the layer. This may involve removing plants and removing clogged soil layers. Following the maintenance, the soil layers and plants should be restored to original conditions.</li> <li>• Check the water level in the inspection well. Providing there has been no heavy rainfall for 24 hours, the inspection well should be dry.</li> <li>• If there is standing water in the inspection well, the scoria layer may require rehabilitation.</li> </ul>	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM004"- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF RAINGARDEN FOR PRETREATMENT**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF RAINGARDEN**

Raingardens are scoria filled pits covered with a layer of sand and a thick layer of sandy soil (500mm or more). The sandy soil is planted with suitable plants, and rainwater from paved areas is directed onto the surface. The rainwater percolates down through the soil layer to the scoria, and contaminants are filtered out in the process.

Raingardens for pre-treatment have only a shallow scoria layer in the base, and may have an underflow connected to a soakhole. There will also be an overflow to carry rainwater directly to the soakhole during large storm events. The overflow is a standard concrete or plastic catchpit.

**(B) OPERATIONAL POINTS**

- The plants growing in the sandy soil are a key part of the raingarden operation. They remove contaminants and help maintain the permeability of the soil.
- When the flow of water onto the raingarden exceeds the amount that can drain away through the soil, water will begin to pond. When the ponding exceeds a maximum depth of 100 to 200 mm, water will begin to flow through the overflow.
- The overflow will pipe the water to a separate soakhole.

- The raingarden should be empty 24 hours after a storm event. This can be checked by observing the water level in the observation well.

**(C) GENERAL O&M NEEDS**

- Maintenance of flow to the soil layer.
- Maintenance of vegetation (including removal of undesirable vegetation).
- Removal of debris and sediment from the top of the raingarden.
- Checking the flow out the base of the raingarden (this is either soakage into surrounding soils or flow to a soakhole via an underdrain).

**(D) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an "OSM-O&M Cert" form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_



**FORM "DEVICE SPECIFIC O&M DETAIL SM004"- PAGE 2 OF 2**  
**CHECKLIST – RAINGARDEN FOR PRETREATMENT**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
	√	√	√	<b>Catchpit (for overflow):</b> <ul style="list-style-type: none"> <li>Remove leaves and debris.</li> </ul>	
	√	√	√	<b>Vegetation:</b> <ul style="list-style-type: none"> <li>Add mulch as necessary.</li> <li>Fertilise if required, and remove weeds.</li> <li>Remove leaves and debris.</li> <li>Replace dying plants.</li> </ul>	
			√	<b>Soil and Scoria layers:</b> <ul style="list-style-type: none"> <li>Check that the soil layer is draining adequately. If water ponds for longer than 24 hours, the soil layer is clogged and maintenance will need to be carried out.</li> <li>Maintenance of the soil layer involves removing sediment that is clogging the layer. This may involve removing plants and removing clogged soil layers. Following the maintenance, the soil layers and plants should be restored to original conditions.</li> <li>Check the water level in the inspection well. Providing there has been no heavy rainfall for 24 hours, the inspection well should be dry.</li> <li>If there is standing water in the inspection well, the scoria layer may require rehabilitation.</li> </ul>	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM “DEVICE SPECIFIC O&M DETAIL SM005”- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF ROCKBORE SOAKHOLE**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF ROCKBORE SOAKHOLE**

The rockbore soakhole is a concrete chamber with a borehole extending down into fractured rock beneath the chamber. The chamber normally extends to the surface with a steel lid to allow access. The top of the borehole is lined with a PVC liner that ends in syphon or a coil of perforated pipe. Rainwater is piped into the concrete chamber, and flows into the borehole through the syphon or perforated pipe.

**(B) OPERATIONAL POINTS**

- Any site runoff (from paved areas) feeding to the soakhole will first pass through a pre-treatment device, such as a raingarden or a sandfilter. Maintenance of the pre-treatment device will be covered under a separate O&M form, and this will also cover maintenance of any catchpits or stormwater pipes feeding to the pre-treatment device.
- Roof runoff flows through a small chamber before entering the soakhole (does not apply to soakholes installed prior to 2003). The small chamber will be connected to the pipework between the spouting and the soakhole.

**(C) GENERAL O&M NEEDS**

- Maintenance of flow through the spouting and downpipe system.
- Removal of leaves and sediment from the small chamber.
- Removal of accumulated sediment from the soakage chamber.
- Cleaning of the rockbore soakage surface.
- Checking the soakage capacity of the soakhole.

**(D) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an “OSM-O&M Cert” form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form “OSM-O&M-Plan”): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM005"- PAGE 2 OF 2**  
**CHECKLIST – ROCKBORE SOAKHOLE**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
√	√	√	√	<b>Spouting, downpipes and small chamber:</b> <ul style="list-style-type: none"> <li>• Check for debris accumulation, blockages and leaks.</li> <li>• Remove waste material and maintain as necessary.</li> </ul>	
			√	<b>Rockbore and soakage chamber:</b> <ul style="list-style-type: none"> <li>• If chamber is dry, remove sediment manually (eg using a shovel and bucket).</li> <li>• If chamber is wet, remove sediment using an air-vacuum system.</li> <li>• Check syphon or perforated pipe for clogging and correct operation. Clean and repair as necessary.</li> <li>• Remove borehole cap (if present) and check borehole is dry.</li> <li>• Carry out rockbore cleaning as required and at least every 4 years on commercial sites and 6 years on residential sites (process detailed below).</li> </ul> <hr/> <b>Rockbore cleaning:</b> <ul style="list-style-type: none"> <li>• Remove accumulated sediment from borehole using an air-vacuum system.</li> <li>• Hydro-blast borehole.</li> <li>• Use the air vacuum system to remove sediment loosened by hydroblasting.</li> <li>• Check that rockbore is draining correctly (if not, it may require replacement).</li> </ul>	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM006"- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF POROUS PAVING**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF POROUS PAVING**

Porous paving is a permeable paving surface covering a layer of gravel or no-fines concrete. Rain falling on the porous paving percolates through the paving surface, is temporarily stored in the gravel or no-fines concrete, and then seeps away into the ground. There is a layer of filter sand underneath the paving, and this helps filter out any contaminants in the rainwater. There is an observation well extending down into the gravel layer (normally installed beneath a plastic or metal cover).

**(B) OPERATIONAL POINTS**

- The gravel layer should be dry 24 hours after a storm event. This can be checked by observing the water level in the observation well.
- The porous paving can only accept runoff from grassed areas, not other paved areas paved with conventional paving.

**(C) GENERAL O&M NEEDS**

- Maintenance of plants overhanging the paving surface.
- Removal of debris and sediment from the permeable paving surface.
- Removal of debris and sediment from the overflow.
- Checking the soakage capacity of the gravel or no-fines concrete layer.

**(D) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an "OSM-O&M Cert" form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM006"- PAGE 2 OF 2**  
**CHECKLIST – POROUS PAVING**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
	√	√	√	<b>Paving Surface:</b> <ul style="list-style-type: none"> <li>Remove debris and sweep, vacuum or mechanically brush surface as appropriate.</li> </ul>	
			√	<b>Paving Drainage:</b> <ul style="list-style-type: none"> <li>Check that paving is draining adequately, with no ponding on the surface.</li> <li>Testing may be required to show that the pavement structure has a minimum permeability of <math>2.4 \times 10^{-5}</math> m/s.</li> <li>If necessary, lift paving and replace sand layer.</li> </ul>	
			√	<b>Gravel/ no-fines concrete layer:</b> <ul style="list-style-type: none"> <li>Check the water level in the inspection well. Providing there has been no heavy rainfall for 24 hours, the inspection well should be dry.</li> <li>If there is standing water in the layer, it will need to be dug up and rehabilitated or replaced</li> </ul>	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM007"- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF SAND FILTER**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF SAND FILTER**

Sand filters are designed to treat site runoff. They are normally concrete structures installed below ground and have a sedimentation chamber and a chamber filled with filter sand. Rainwater from paved areas flows into the sedimentation chamber and then passes through the filter sand. Both the sedimentation chamber and the filter sand remove contaminants.

**(B) OPERATIONAL POINTS**

- Sand filters have an overflow so that the sand layer is bypassed during large storm events. This means that if the sand filter becomes clogged (due to poor maintenance), the overflow will operate continuously and there will be no treatment of the stormwater
- Rainwater passing through the sand layer is called the underflow. Both overflow and underflow are normally piped to the formal stormwater system in the same pipe.

The filtration chamber should be empty 24 hours after a storm event. This can be checked by manually observing the water level in filtration chamber

(note that it is normal for the sedimentation chamber to remain full of water).

**(C) GENERAL O&M NEEDS**

- Maintenance of flow to the sandfilter
- Replacing clogged sand layers
- Removing debris and sediment

**(D) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an "OSM-O&M Cert" form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM007"- PAGE 2 OF 2**  
**CHECKLIST – SAND FILTER**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
	√	√	√	<b>Catchpit:</b> check for debris accumulation, blockages, leaks, etc & rectify	
		√	√	<b>Filter chamber:</b> <ul style="list-style-type: none"> <li>Inspect for clogging with sediment.</li> <li>Rake sediment from the sand surface and remove.</li> <li>Remove clogged/dicoloured sand, using a flat-bottomed shovel.</li> <li>Add new sand if sand depth is less than 400 mm.</li> </ul>	
			√	<b>Concrete structures:</b> <ul style="list-style-type: none"> <li>Check for structural deficiencies, leaks, etc &amp; rectify.</li> </ul>	
		√	√	<b>Sedimentation chamber:</b> <ul style="list-style-type: none"> <li>Inspect the sediment level in the chamber - if sediments are within 100 mm of the sand layer in the filter chamber, or if the flow is obstructed in any way, the maintenance interval should be reduced.</li> <li>Remove sediment as detailed below. This must be carried out at least every 4 years.</li> </ul> <hr/> <b>Sedimentation chamber cleaning:</b> <ul style="list-style-type: none"> <li>Remove sediment using a vacuum system and suck chamber clean.</li> </ul>	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM “DEVICE SPECIFIC O&M DETAIL SM008”- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF SWALE OR FILTER STRIP**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF SWALE / FILTER STRIP**

Swales and filter strips are open channels, generally grassed, that act as stormwater treatment devices. The swale is longer and narrower and may have a gravel base. These devices remove contaminants by slowing flows and allowing particles to settle out.

**(B) OPERATIONAL POINTS**

- Filter strips are often preceded by a spreader device (such as a gravel filled pit) to create sheet flow of rainwater. Alternatively, impervious areas may be designed to drain evenly onto the filter strip.
- Grassed swales or filter strips are designed to operate with a grass length of 50 mm to 150 mm - it is important that the grass length is kept within this range.

**(C) GENERAL O&M NEEDS**

- Removal of debris and sediment from the swale or filter strip and its inlet/outlet
- Rectification of erosion
- Care of grass, including watering, mowing, fertilising and weed removal
- Care of gravel check-dams (applies to swales only)
- Maintenance of correct slope

**(D) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an “OSM-O&M Cert” form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form “OSM-O&M-Plan”): \_\_\_\_\_

Date Installed: \_\_\_\_\_



**FORM "DEVICE SPECIFIC O&M DETAIL SM008"- PAGE 2 OF 2**  
**CHECKLIST – SWALE OR FILTER STRIP**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
	√	√	√	<b>General:</b> Remove any debris accumulations and waste vegetation	
	√	√	√	<b>Inlets &amp; outlets:</b> remove sediment	
√	√	√		<b>Grass:</b> mow (with catcher) to maintain grass length 50 – 150 mm	
	√	√	√	<b>Grass:</b> <ul style="list-style-type: none"> <li>• remove nuisance weeds</li> <li>• fertilise or treat to maintain vigorous growth, as required</li> <li>• fill any erosion holes &amp; re-seed</li> </ul>	
	√	√	√	<b>Gravel (gravel-bed swale &amp; check-dams only):</b> rectify any erosion holes and/or check-dam damage (with larger stones)	
		√	√	<b>Flow spreader (filter strip only):</b> <ul style="list-style-type: none"> <li>• remove sediment</li> <li>• replace aggregate if necessary</li> </ul>	
			√	<b>Flow spreader (filter strip only):</b> <ul style="list-style-type: none"> <li>• check alignment &amp; re-level if necessary</li> </ul>	
	√	√	√	<b>Pipework (if any):</b> check for debris/blockages/leaks & rectify	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM “DEVICE SPECIFIC O&M DETAIL SM009”- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF RAINWATER TANK**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF RAINWATER TANK**

Rainwater tanks can be constructed in concrete, steel, plastic or fibreglass. The tank is fed from roof runoff and comprises two “zones”, namely:

- “Temporary Storage” (or “air space”):
  - the upper part of the tank, dedicated to retaining runoff in short duration, high intensity storm events
  - has an orifice outlet at the bottom (i.e. this defines the interface between the temporary and permanent storage zones); this serves to “throttle” the flow
  - has an overflow at the top of the tank, connected to the City’s stormwater system
- “Permanent Storage” (or “rainwater space”):
  - the bottom portion, dedicated to storing water for re-use
  - **water can be plumbed to the dwelling for the following uses, but must not be used for drinking water:**
    - **toilet**
    - **outdoor use**
    - **cold water feed to the clothes washing machine (where the machine has a fixed connection to the cold water supply)**
  - to ensure continuity of supply in dry periods, it includes a mains connection for “topping-up” the storage

**(B) GENERAL O&M NEEDS**

Aside from routine inspections to identify and rectify minor problems, the main maintenance needs relate to:

- ensuring that there are no cracks/leaks in the tank, pipework, etc
- checking that the first-flush diverter is functioning properly
- checking the quality of the water in the tank is adequate for the re-use requirements to which it is put (eg check clarity, smell, etc)

Refer also to the additional information given in “Code of Practice—Private Rainwater Supplies” (this is reproduced in Appendix B of the OSM Manual [6]).

**(C) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an “OSM-O&M Cert” form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form “OSM-O&M-Plan”): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM009"- PAGE 2 OF 2**  
**CHECKLIST – RAINWATER TANK**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
√	√	√	√	<b>Spouting &amp; downpipes:</b> check for problems such as debris /blockages and leaks & rectify	
√	√	√	√	<b>First-flush diverter device:</b> check for blockages; empty debris/sediment	
	√	√	√	<b>Tank water quality:</b> check for clarity and odour	
	√	√	√	<b>Tank inlet/outlet pipework, orifice, float valve &amp; backflow preventer :</b> perform visual check for problems such as debris/blockages/leaks & rectify	
		√	√	<b>Tank structure:</b> check for leaks & rectify	
		√	√	<b>Pump &amp; electrical system:</b> check & carry out any necessary maintenance	
			√	<b>Float valve, backflow preventer &amp; first-flush device:</b> test for correct functioning; repair/replace where faulty or badly worn	
			√	<b>Tank water quality:</b> collect water sample (before emptying tank, as below), submit for testing & copy test results to ACE	
			√	<b>Tank cleaning :</b> empty the tank & clean out any sediment accumulations and growths	
			√	<b>Plumbing:</b> examine plumbing from the tank to the dwelling to check that tank water is not connected to any unauthorised taps/fixtures (refer list of suitable uses in B above); rectify any faults	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM010"- PAGE 1 OF 2**  
**OPERATION AND MAINTENANCE OF SCORIA TRENCH**

Note: One form required for each OSM device on a site

**(A) DESCRIPTION OF SCORIA TRENCH**

The scoria trench is a pre-treatment device to treat stormwater runoff from paved areas, and is essentially a trench filled with scoria. The trench may be topped with alternative material such as decorative rock, and will normally run along the down-slope edge of paved areas.

The scoria trench is not intended to function as a stand-alone soakage device, and will normally have an overflow connected to a separate soakhole. During small storms the stormwater will infiltrate through the base of the trench, but during large storms stormwater will be transferred to the soakhole.

**(B) OPERATIONAL POINTS**

- The trench has a layer of filter fabric beneath the top 200mm of drainage material. This is a design point of failure to keep the underlying stone clean, and the fabric will need regular inspection and eventual replacement.
- The top layer of stones (and filter fabric beneath) must be kept clean if the trench is to function correctly. If this layer becomes clogged, stormwater will not feed into the trench correctly and flooding may occur.

**(C) GENERAL O&M NEEDS**

- Removal of leaves and debris from the top of the trench.
- Inspection of the filter fabric layer and replacement when necessary.
- Checking the infiltration capacity of the trench.

**(D) RECORD KEEPING**

- Completed form must be submitted to ACE. For 2 yearly inspections, the form must be submitted with an "OSM-O&M Cert" form.
- A copy of the completed form (and any additional inspection records) is to be kept on-site and made available to the plumber/drainlayer.

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_

**FORM "DEVICE SPECIFIC O&M DETAIL SM010"- PAGE 2 OF 2**  
**CHECKLIST-SCORIA TRENCH**

Frequency				Action	Notes
After storm	Every 3 months	Every year	Every 2 years*		
√	√	√	√	<b>Surface of trench:</b> <ul style="list-style-type: none"> <li>Remove any debris or vegetation</li> </ul>	
			√	<b>Filter fabric layer and scoria:</b> <ul style="list-style-type: none"> <li>Inspect the top layer of stones and filter fabric surface. If clogging has occurred, remove the entire top layer and replace the filter fabric. Reinstall the stones, cleaning or using fresh material where necessary.</li> <li>Check the water level in the inspection well. Providing there has been no heavy rainfall for 24 hours, the chamber should be dry. If there is standing water in the well, the trench may need to be dug out and clogged layers replaced.</li> </ul>	

\* Plumber/Drainlayer Checklist

Plumber/Drainlayer's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Name: \_\_\_\_\_ Reg Number: \_\_\_\_\_

Company Name: \_\_\_\_\_

Company Address: \_\_\_\_\_

Site Address: \_\_\_\_\_

Building Consent Number: \_\_\_\_\_

Reference Number (from Form "OSM-O&M-Plan"): \_\_\_\_\_

Date Installed: \_\_\_\_\_