HCC 03: Soakage

1. INTRODUCTION

This practice note[1] has been developed to provide information for on-site stormwater soakage devices. Design information is provided for the standard soakage device designed to have capacity for the 10-year ARI event and for a soakage reduced at-source measure, sized for a smaller event. Refer to Sections 2, 3 and 4 below.

1.1 What is soakage?

Soakage is the process of helping stormwater soak into the ground using specially designed soakage devices. Soakage allows for the infiltration of stormwater into the soil which recharges the groundwater table below.

1.2 Description

Soak pits/trenches and surface soakage features are the two main soakage systems. Soak pits/trenches provide volume for storage below ground level for stormwater to infiltrate into the surrounding ground.

Surface soakage devices include swales, tree pits[2] or porous paving[3]. The advantage of surface soakage devices is that they include pre-treatment before the stormwater infiltrates the ground. Their ability to provide water storage is dependent on their designed dimensions. Surface soakage devices can also provide amenity benefits.

1.3 Advantages of on-site soakage

On-site stormwater soakage provides the following benefits:

- ***Improved water quality by filtering out contaminants.***
- ***Improved hydrological response of stormwater peak flow by holding and releasing stormwater in a controlled and more natural manner.***
- ***Supports groundwater recharge.***
- ***The design of surface soakage devices can add to the amenity of the site and surrounding area.***

1.4 Definitions

ARI: Annual Recurrence Interval. The average number of years that are predicted to pass before an event of a given magnitude occurs.

Building Code: Acceptable solutions and verification methods set out under the Building Code. For more information, contact Council's Building Control Unit on (07) 838 6699.

Impermeable Surfaces: Surfaces that water does not soak into. For example, roads, roof tops, footpaths, paving, decking which does not allow water to drain through to a surface which can absorb water, swimming pools, patios or highly compacted soils that are not vegetated and do not infiltrate runoff.

Infiltrate: Water soakage into the soil.

Percolation Rate: The rate at which water is able to soak into the soil.

Porous: A surface that water is able to pass through, also called permeable.

Pre-treatment: Cleaning of stormwater prior to entry into a soak pit.

Soakage device: A device that is designed to encourage water to infiltrate into the soil.

Stormwater: Rainwater that collects on impermeable surfaces (also called runoff).

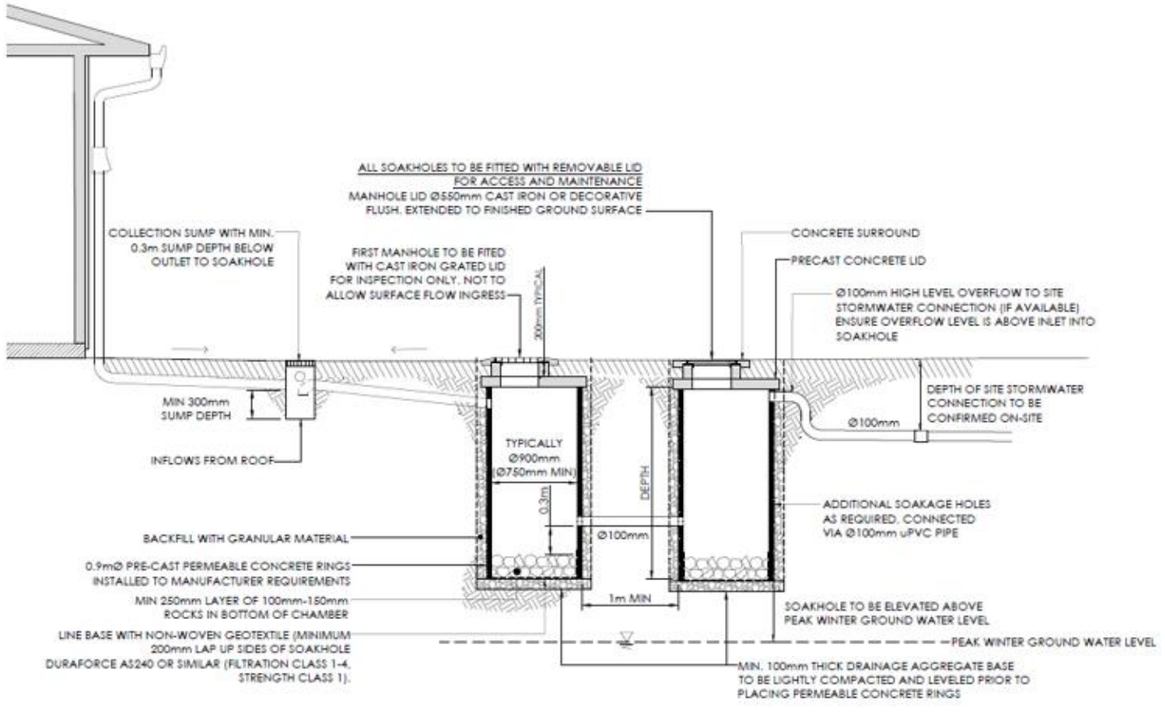

Figure 1: Typical soakhole arrangement

[1] The Three Waters Management Practice Notes are a Hamilton City Council controlled document and will be subject to an ongoing review process. The latest version of the Practice Notes can be downloaded from the Hamilton City Council Website http://www.hamilton.govt.nz/our-council/council-publications/manuals/Pages/Three-Waters-Management-Practice-Notes.aspx

[2] Refer Practice Note HCC04 Bioretention devices

[3] Refer Practice Note HCC07 Permeable surfaces

2. SOAKAGE – 10-YEAR ARI

2.1 Minimum design requirements

The following information is intended as a guide only. All soakage systems within Hamilton City require specific design by a suitably qualified Engineer and approval from Hamilton City Council's Building Control Unit.

Where there is a Water Impact Assessment (WIA) for your site, follow the specific site requirements outlined in the WIA. Otherwise, general design requirements for soakage devices are provided below. Approved soakage device designs have been prepared for a standard residential lot, for details refer to Council's standard detail:

- Standard residential soak-hole – refer to Drawing HCC-04.1

Soakage systems must meet the following minimum design requirements (in accordance with the Regional Infrastructure Technical Specification (RITS)[4]

a) Capacity adequate for a 10-year ARI event, maximum potential impermeable area and located in such a way to maximise the collection of site runoff.

b) Soakage devices must not be located within a 10-year ARI event flood extent, and if possible, should be located outside the 50-year ARI event flood extent. They shall be located away from overland flow paths.

c) Rate of soakage determined through a soakage test with an appropriate reduction factor (at least 0.5, as per NZS 4404) applied to accommodate loss of performance over time.

d) Secondary flow paths shall be provided for water to follow during events that exceed the design capacity of the soakage device.

e) Confirmation that the soakage system will not have adverse effects on surrounding land and properties from land stability, seepage, or overland flow issues.

f) Pre-treatment device to minimise silt ingress.

g) Interception of hydrocarbons.

h) Access for maintenance.

i) Soakage devices must not be located close to buildings or boundaries.

j) A clearance of 3.0m is generally required, but this can be reduced to 1.0m for porous paving or, can be reduced to 1.5m where the neighbouring property is required to have a 1.5m setback to any new building. Setback to roadside boundaries shall be 0.5m (to avoid fence footings). Where it is not practicable to meet these guidelines, a site-specific geotechnical design (including PS1 certification) must be completed which considers the effect of the soakage device on building foundations and neighbouring properties.

k) Soakage devices should not be located beside retaining walls.

i. For walls less than 2.0m high, the clearance must not be less than a horizontal distance that is equal to the retaining wall height plus 1.5m, unless a site-specific design (including PS1 certification) is carried out. The site-specific design must consider geotechnical advice and ensure stormwater from the soakage device will not enter the cut-off drain for the retaining wall.

ii. For walls higher than 2.0m, a site-specific design must always be carried out.

l) Soakage devices must not be located within 2.0m of public sanitary sewers or 1.0m of private sewers.

m) Soakage devices must not be positioned on unstable slopes.

n) A stormwater diversion and discharge resource consent may be required from the Waikato Regional Council.

o) Soakage devices are to be positioned above the 'winter' high water table unless specifically approved to operate as predominately summer soakage systems. The peak soil wetness period for Hamilton is usually July-September. In the absence of specific field data, the position of the high-water table can be estimated when boreholes or test pits are constructed from observations of soil colouration and wetness. If no high-water table can be discerned in the field, then a suggested adjusting factor for investigations done at other times is shown in Table 1 below:

Table 1: Groundwater seasonal adjustments[5]

TIME OF TESTING	ADJUSTMENT TO SITE OBSERVATION – ASSUME GROUNDWATER RAISES
Dec-March	1.0m higher than found during inspection
April-May, November	0.65m higher than found during inspection
June, October	0.35m higher than found during inspection

p) Soakage devices shall not be shared between properties, unless a legally constituted 'Body Corporate' is established to take responsibility for maintenance and eventual replacement.

Soakage devices can be used to meet Waikato Regional Council's Waikato Stormwater Management Guideline volume control criteria[6]. This criterion is as follows:

> *A minimum retention of the site pre-development initial abstraction from all impermeable areas shall be provided. If soil conditioning is provided for permeable areas then retention of initial abstraction is not required for these areas. If soil conditioning is not proposed then initial abstraction is to be retained for the whole site (permeable and impermeable areas).*

2.2 Design procedure

Local consulting engineers and contractors should be able to provide advice and guidance on soakage appropriate to your property based on their technical knowledge of soakage devices they have previously specified for Hamilton City properties. An Integrated Catchment Management Plan (ICMP) may be available providing some soakage information.

Consulting engineers are also able to provide site-specific design services for difficult locations and soil situations. If in doubt as to what is appropriate for your property, consultation with such professionals is advised. For soakage design, talk to engineers with geotechnical capabilities and experience.

The following methodology will generally be adopted to design a soakage device.

Step 1: Determine soil conditions

Depending on the location of your property, the soil condition can vary. The principal characteristics of the soil profile determine overall soil drainage capability. The following table is a brief guide to soil soakage suitability.

Table 2: Soil soakage suitability

	SOIL TYPE* LEGEND ON MAP	SOIL TYPE/DESCRIPTION	OCCURRENCE	COMMENTS
UNSUITABLE	Kn	Kainui silt loam	Mainly in eastern part of city	Soil of the Low Rolling Hills
	Hm	Hamilton clay loam	Mainly in southern and western parts of the city	
	O	Ohaupo silt loam	Southern part of the city	
	Rk	Rotokauri clay loam	Small pockets all over the city	
	Rkv	Rotokauri clay loam, Very gently sloping phase	Small area near Dinsdale	
	K	Kaipaki peaty loam and loamy peat	Mainly west of the Waikato River	Soil of the plain
	V	Tamahana soils	Hinuera Terrace	Soils of Gully Bottoms
	Kk	Kirikiriroa complex	Waikato River flood plain	Soil of the Terrace Scarps and Gully Sides
SUBJECT TO SOIL TEST	Tk	Te Kowhai silt loam and clay loam	Mainly east of the Waikato River	Soil of the plain. Refer to your engineer and Building Code for test results.
	Tkp	Te Kowhai peaty clay loam	Near Ruakura	
	R	Rukuhia peat	Outskirts of the city west of Melville	
SUITABLE	H	Horotiu sandy loam	Mainly central city area and Hamilton East	Soil of the plain Generally suitable for soakage. **Initial site investigation is recommended.**
	Ha	Horotiu mottled sandy loam	Major areas between Kent Street, Frankton Railway and Bankwood	
	Hb	Horotiu sandy clay loam	Refer soil type H	
	Hs	Horotiu sand	Normally adjacent to soil type H	
	Hsg	Horotiu sand with gravels	Normally adjacent to soil type H	
	T	Te Rapa peaty loam	Frankton, Te Rapa and Ruakura	
	Tp	Te Rapa peaty sandy loam	Mainly west of Te Rapa	
	Ts	Te Rapa peaty sand	Near Sunshine Ave, west of the main trunk railway	
	Mh	Tamahere gravelly sand (on Horotiu soils)	Adjacent to Waikato river at Te Rapa, Chartwell. Smaller areas at Melville and south of Hillcrest	
	W	Waikato loamy sand, sand, and sandy loam	Adjacent to Waikato River	Soil of the low river terraces. Generally suitable for soakage. **Initial site investigation is recommended.**
	Mw	Tamahere gravelly sand (on Waikato soils)	Mainly near Chartwell and St Andrews	

This information is based on Soil Survey Report 31 published by New Zealand Soil Bureau in 1979. Please refer to it for the legend of soil types. To view the map, you can visit or contact Council's Building Control Unit phone: (07) 838 6699.

[4] http://www.waikatolass.co.nz/wp-content/uploads/2018/06/Regional-Infrastructure-Technical-Specification-V1.0-FINAL.pdf#page=285&zoom=100,0,76

[5] Hamilton Infrastructure Technical Specifications, Table 4-17.

[6] Refer to Waikato Stormwater Management Guideline for details https://www.waikatoregion.govt.nz/assets/WRC/Services/publications/technical-reports/2018/TR201801.pdf

Step 2: Undertake soil tests

Soil tests are required to confirm that the soil on your property can achieve the minimum percolation rate. The test should be conducted by a suitably qualified Engineer.

A step-by-step guide to do this test is available on the Department of Building and Housing website: www.building.dhb.govt.nz In the Building Code, Clause E1 Surface Water.

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 and this should be done where the soakage device is likely to be placed.

Exceptions to the above expectations for testing are:

- Extensions to car parking or paving of less than 50m^2 may use a rock filled trench along the lower edge of dimensions 0.5m wide and 0.5m deep.
- Soakage device for an impervious area less than 40m^2 can use nominal soak holes for Hamilton as described in Council's guidance '*Soak up your Stormwater*' which is available from Hamilton City Council.
- **Note: larger areas may not use multiples of these nominal designs.**

Generally, within Hamilton, soakage (with storage) will be expected to be utilised where soakage results are determined as per Table 3 below.

Table 3: Soakage Thresholds[7]

DETERMINATION METHOD	SOAKAGE THRESHOLD
Building Code E1 Method	> 150 mm/hr
Cambridge North Method	> 1.0 L/m2/min
Horslev Method	> 1.0 x 10-5 m/s

Soakage is allowed in soils with lower soakage however specific engineering design is required and for soils with low permeability rates, tests must be carried out by an IANZ (International Accreditation New Zealand) laboratory (refer IANZ's website for details www.ianz.govt.nz).

Step 3: Size the soakage system

The Building Code advises that soakage should be designed to accommodate a 60-minute storm of the size that might be expected once every 10 years. In Hamilton, this equates to a depth of 43.5mm over an hour (climate change adjusted).

Depending on site conditions you may need to consider additional requirements such as peat recharge and high ground water levels.

Recharging of peat: On peat soils it is important that stormwater management systems are designed to achieve the correct balance of soil recharge to mimic the pre-development soil moisture content. Council defines peat soil as those with more than 300mm of peat between 0.5m and 4.0m of the natural ground surface. Refer to the RITS for further details on how to manage peat soils.

[7] Hamilton Infrastructure Technical Specifications, Table 4-16.

3. SOAKAGE – RESIDENTIAL ON-LOT

The District Plan (rule 25.13.4.2A) requires that the first 10mm of runoff is retained on-lot. This is required to be achieved through a rainwater reuse tank which overflows to a soakage device. The soakage device also receives runoff from external impervious surfaces.

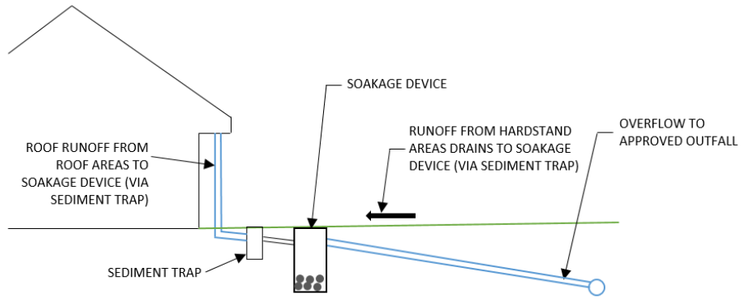

Figure 3: Schematic showing typical arrangement for soakage reduced device

3.1 Minimum design requirements

A soakage reduced device should be designed in accordance with the minimum design requirements and design procedure described above for the standard 10-year ARI soakage device and in accordance with the RITS, except the capacity of the device is sized differently, as outlined below:

1. Table 4 summarises the soakage volume requirements for residential applications.

   Table 4: Soakage Volumes ***in Addition to Reuse Tank***

Equivalent Lot Size	Required Soakage Volume
100 m2	700L*
200 m2	1,400L*
300 m2	2,100L
400 m2	2,800L
500 m2	3,500L

   ** Soakage for these lot sizes can also be achieved through pervious paving*

2. Refer to Section 2.1 Minimum design requirements for all other details.
3. Where site specific soakage testing indicates that soil soakage is less than 15 mm/hr, soakage is not considered to be an appropriate on-lot measure. High groundwater table may also lead to soakage being an inappropriate on-lot measure
4. Rainwater tank overflows are not required to be directed to the sediment trap, i.e. tank overflows should be piped directly to the soakage device.
5. It is important to ensure the soakage device is above the winter high water table, as per bullet point 'o' in Section 2.1 above.

4. SOAKAGE – REDUCED DEVICE (INDUSTRIAL/COMMERCIAL)

If there is a council approved downstream stormwater management device providing stormwater flow attenuation and stormwater quality treatment for your site, you can provide soakage on-lot designed as a reduced at-source measure only. This is referred to as a soakage reduced device.

4.1 Minimum design requirements

A soakage reduced device should be designed in accordance with the minimum design requirements and design procedure described above for the standard 10-year ARI soakage device and in accordance with the RITS, except the capacity of the device is sized differently, as outlined below:

1. If your site is located in the Mangakootukutuku Stream catchment, then the capacity of your soakage device needs to be adequate to cater for 10mm runoff from the maximum potential impermeable area draining to it.
2. If your site is **not** in the Mangakootukutuku Stream catchment, it is also recommended that the capacity of your soakage device is sized to be adequate to cater for retention of 10mm of runoff from the maximum potential impermeable area draining to it. At a minimum the soakage device should be sized to retain the site Initial Abstraction in accordance with the Waikato Regional Council Stormwater Management Guidelines.
3. The supplied standard drawing can be used as an indicative schematic of the typical arrangement for a soakage reduced device. The device is to be conservatively designed allowing for no infiltration and must consider void space within the media where applicable.
4. Refer to Section 2.1 Minimum design requirements for all other details.
5. Additional pre-treatment may be required based on expected contaminant load generation (particularly for industrial sites).
6. It is important to ensure the soakage device is above the winter high water table, as per bullet point 'o' in Section 2.1 above.

5.

5. SUMMARY OF PLANNING REQUIREMENTS

Your soakage system must be consented either as part of the whole site's building consent or as a separate building consent.

For details on building consents please contact Hamilton City Council's Building Control Unit phone (07) 838 6699.

Soakage systems sized for the 10-year ARI event are required to be designed by a suitably qualified person based on the guidance provided in this practice note, the RITS, and other best practice guidance.

As-laid plans, authorised by a registered drain layer, are required for your soakage system, and shall be provided to council.

If your soakage system is designed to be a reduced device, provided you comply with the minimum design requirements outlined in this practice note and the RITS, specific engineering design is not required for your soakage system. As-laid plans are still required for your soakage reduced device, authorised by a registered drain layer, and shall be provided to Council.