DESIGN RIGHT

Slowing the flow

On-site stormwater management for new developments is now a requirement in many jurisdictions. This is what you need to know about options such as detention and retention tanks, soak pits and pervious paving.

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NEW DEVELOPMENT places additional demands on existing stormwater systems, which increasingly do not have the capacity to handle further loads. When permeable surfaces like grass are replaced by houses, driveways, roads and decks, rainfall that used to soak through the soil or slowly drain over land runs off the land much faster.

Move to hydraulic neutrality

Both the volume of water and the peak flow are increased as a direct result of development. Many authorities now impose a requirement of hydraulic neutrality on new housing developments. In other words, stormwater must be managed on site to ensure the peak flow rate is the same or less than what it was prior to development.

Common management techniques include detention and retention tanks, soak pits, pervious paving and bioretention devices such as green roofs and rain gardens. All require active maintenance.

Detention tanks

Detention (sometimes known as attenuation) devices store stormwater temporarily, releasing it gradually to manage peak flows in the stormwater network. Options for large areas may include wetlands or ponds, but for a residential site, the detention device is usually a tank.

Stormwater detention tanks are designed to store rainwater run-off from roofs, driveways, paths and other impervious areas. The water discharges from the tank to the stormwater system through a small-diameter pipe at a controlled rate that the stormwater system can cope with (see Figure 1).

Underground retention and detention system. Photo courtesy of Hynds.

Common systems include below-ground tanks (typical storage capacity 2,000–5,000 L) and interlinked modules with smaller individual capacity that can be installed beneath floor slabs, decks, paving, driveways or even steps. The collection area of modular tanks may be limited – for example, 350 m² in Wellington.

Installation and flow

The inlet is from downpipes with a leaf diverter and silt trap to reduce sediment build-up within the tank.

The outlet is a small-diameter orifice – outlet pipe – at a specific height above flood level, regulating discharge to the stormwater network.

The overflow pipe capacity must equal or exceed the inflow capacity from downpipes and must discharge where flow is visible and does not cause a problem.

It is recommended that a mesh screen is installed over the silt trap and outlet pipes to prevent debris from entering and a first-flush diverter installed to reduce contaminants in the stormwater system.

Detention tanks should be installed by approved installers in accordance with the manufacturer's specifications.

Detention tanks:

- reduce the peak flow of stormwater leaving the site
- are useful in urban areas with reticulated stormwater
- ideally discharge by gravity but some sites may require a pump
- do not require seismic and wind restraints for in-ground tanks
- are not for storage – additional tanks are required for emergency water.

Retention tanks

Retention devices reduce the volume of run-off through disposal or reuse on site. Typical devices include tanks (with or without detention capability), soak pits, pervious paving and bioretention systems.

Choosing the right size

Establishing the appropriate device size is a function of several factors including the catchment area, rainfall intensity and, for soakpits, the soakage rate of the ground, which is determined by on-site testing.

Rainfall intensity curves are available for most areas from the building consent authority (BCA), tables in E1/AS1 or online from NIWA.

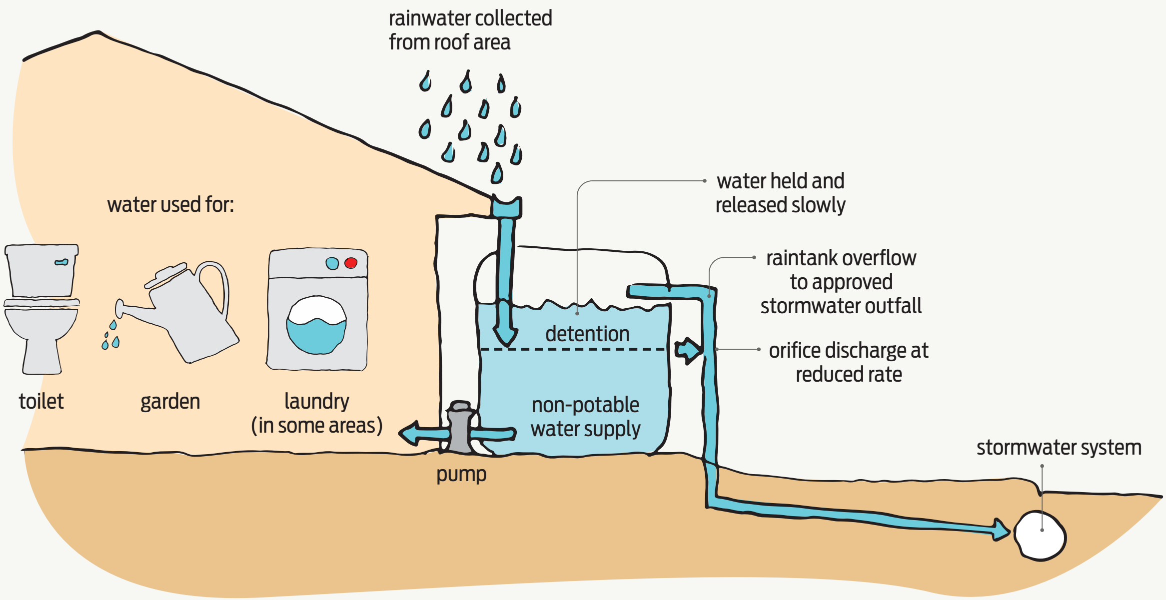

Figure 1 **Detention and retention system.**

Where differing design rainfall intensities are provided for a particular location, the most conservative rainfall intensity should be used. Design guidelines are available on some BCA websites, but the calculations are not simple and are best completed by someone with experience.

A resource consent will usually be required, and all tank designs and soak pits must comply with the requirements of the Building Code. Some installations also require a building consent – check with the BCA.

Installation and flow

Retention tanks are installed above ground in accordance with the manufacturer's specifications, including seismic and wind restraints:

- Inlet – from downpipes with a leaf diverter.
- Outlet – specific size and height above ground, connected to the stormwater network.
- Overflow pipe – capacity must equal or exceed the inflow capacity from downpipes and must discharge where flow is visible and does not cause nuisance.
- A first-flush diverter and mesh screen over the inlet and outlet pipes is recommended.

Retention tanks key points:

- Water is collected and must be used on site, often within a specified timeframe so the entire tank volume is available for the next rainfall event.
- Water is stored for use in the house for toilet flushing and in the garden, and some councils allow its use in the laundry. It can be used as an emergency water supply and must be boiled first.
- Useful to reduce demand on water supply and in areas without reticulated stormwater.
- The collection area may be limited – it is 400 m² in Wellington, for example.
- If used in the house, a pump is required. Backflow prevention may also be required.

Detention and retention tanks

Detention and retention tanks combine the benefits of both, reducing the peak flow of stormwater leaving the site and providing water storage for on-site use.

They are only suitable for water from the roof due to contaminants from areas such as driveways and are usually installed above ground with seismic and wind restraints.

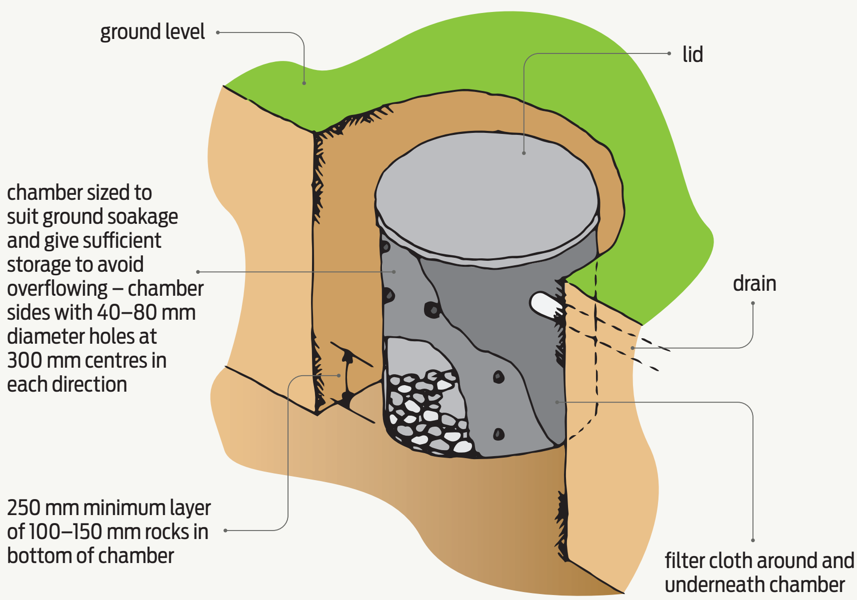

Figure 2 **Chamber soak pit.**

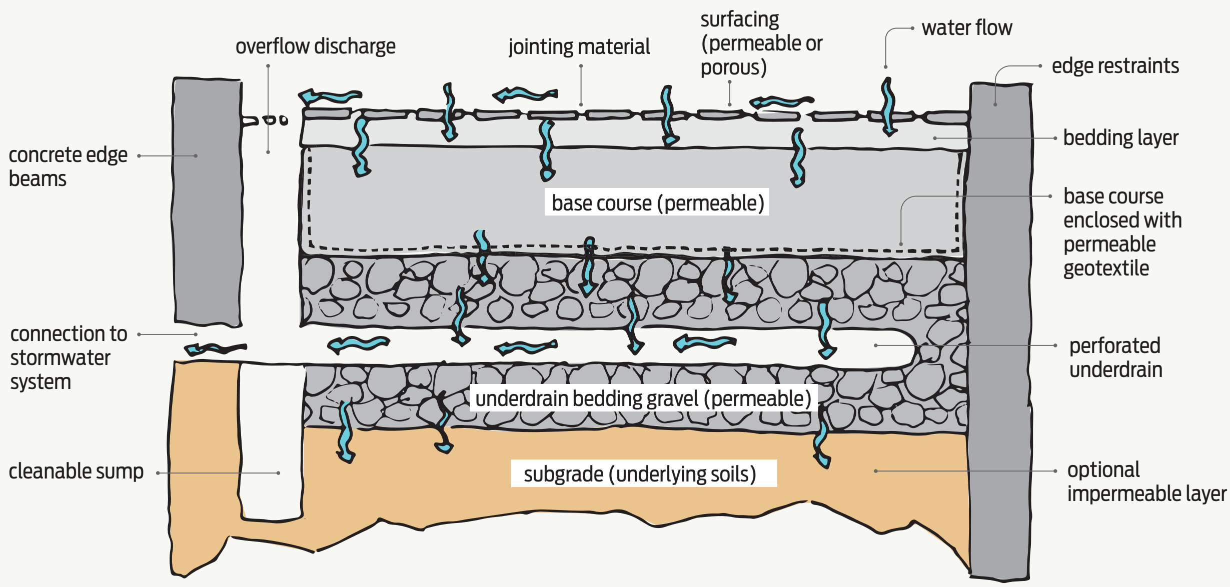

Figure 3 Schematic of pervious paving (adapted from Auckland Council drawing).

They have a small-diameter orifice part way up the side of the tank, allowing the slow release of roof run-off during and after rainfall. The volume below the orifice stores rainfall collected from roof areas for non-potable use within the building or garden.

These tanks require:

- a dead storage zone – typically 150 mm – at the bottom of the tank to allow sediment to settle
- installation by approved installers in accordance with the manufacturer's specifications.

Minimum tank maintenance

The minimum maintenance schedule for tanks is:

- 3 monthly – wash out leaf litter/debris diverters and first-flush diverters
- 6 monthly – inspect the roof gutters and clean off leaf litter, animal droppings, pollen, ash etc.
- annually – inspect and maintain mesh screens, orifice outlets, filters, seals, pipes and valves and silt traps for modular in-ground tanks
- 2–3 years – drain above-ground tank and remove any sediment and debris.

Soak pits

Soak pits collect and retain stormwater, allowing it to slowly soak into the earth. Soak pits are lined with a filter cloth and can be filled with rocks or be a solid chamber with porous sides and base (Figure 2).

Soak pit requirements:

- Water is collected and disposed of on site.
- Useful in areas without reticulated stormwater and with suitable ground conditions.
- Require careful design – New Zealand Building Code Verification Method E1/VM1.
- Plans must be carefully followed when the pit is constructed.
- Proprietary soak pits are also available.

Soak pit maintenance

Soak pits require maintenance to prevent them becoming blocked with silt, vegetation or other matter that may cause flooding problems. They must be cleaned and maintained annually by a specialist company.

Pervious paving

Pervious paving is a specially constructed hard surface that allows water to pass through to the underlying soil layers (see Figure 3). There are two distinct types of surface:

- Porous – water travels through the pavers into the underlying components.
- Permeable – water travels between impervious blocks into the underlying components.

Pervious paving can be used to reduce run-off and flooding and help to replenish groundwater. It is limited to flat and gentle slopes and has specific requirements:

- The pavers are installed on a permeable base course with a permeable geotextile beneath.
- Edge restraints are required around all edges to prevent displacement of pavers and geotextile.
- In soils with low infiltration, include a perforated underdrain in a permeable gravel sublayer connected to the stormwater system. The underdrain must be sized to suit site conditions.
- A specialised design and approval is required.
- A notice on land title may be required to inform the owner that maintenance is required.

Pervious paving maintenance

Pervious paving requires maintenance:

- after storms – inspect paving to check water drains away
- annually – sweep pavers with wet vacuum sweeper to prevent clogging with sediment, and check joint material and top up as necessary
- ongoing – where areas of paving settle, lift blocks, relevel bedding material and relay blocks.

Avoid using herbicides or high-pressure water blasters on pavers.

Bioretention devices

Devices such as green roofs and rain gardens require specialist design and are outside the scope of this article.