SAND FILTERS
Construction Guide

STORMWATER DEVICE INFORMATION SERIES

Auckland Council
Te Kaunihera o Tāmaki Makaurau

Pre-cast sand filter chambers being installed (Photo: Hynds Environmental Ltd)

Open sand filter constructed in-situ (Photo: NZTA)

What are sand filters?

Sand filters are holding tanks that collect and filter stormwater flowing off hard surfaces before it flows to the drainage system. Sand filters slow the amount of stormwater entering the drainage system as well as removing some contaminants. They are usually installed where stormwater runoff may collect high levels of contaminants, such as from roads, carparks and industrial areas.

Sand filters are designed to separate debris from the runoff, filtering the remaining flow. The most commonly used sand filters in Auckland are prefabricated sand filter units, fitted with components and predrilled for connections. These sand filters are usually buried underground, saving space in built-up areas.

Six key components of a sand filter (Washington sand filter)

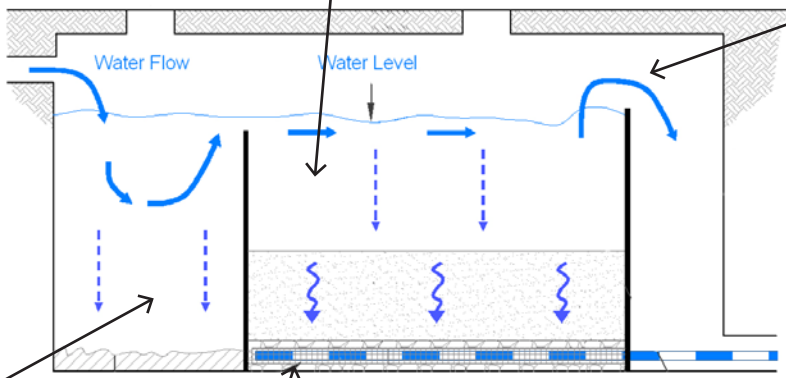
The six main elements of a sand filter vault are shown in the diagram below. Because sand filter vaults are the most common in Auckland, this type is illustrated. Other types of sand filter have similar elements set out to suit their design.

1. Inlet

Stormwater runoff enters the sand filter through a manhole inlet. A weir diverts heavy storm flows to bypass the sand filter.

3. Filtration chamber

Stormwater flows over a weir to enter the filtration chamber to seep through the sand mix. This mix may also have some compost, peat or other specialist material added to capture dissolved heavy metals. Some filters have a spreader channel to spread the flow across the filter bed.



5. Overflow system

Flows from larger storms or overflows are diverted to local drainage system via a weir or pipes set at a level higher than the normal operating level of the sand filter.

6. Outlet

Stormwater discharges from the sand filter to the local drainage systems such as pipes, stream or coast.

2. Sedimentation chamber

Runoff slows and large sediment settles on the bottom of the chamber. If included, plates in the chamber act as baffles to help sediment settle, and to trap litter and other floating material.

4. Under-drainage system

Filtered stormwater trickles down to perforated pipes beneath the filter bed, connected to the outlet.

TYPES OF SAND FILTER

There are three main sand filter types.

- **Sand Filter Vaults** (also known as Washington Sand Filter)

  The most common type used in Auckland. Generally these filters are installed where there is limited space. These are usually prefabricated concrete units supplied by manufacturers (Hynds Environmental or Humes) to treat areas of up to 10,000m^2. On larger sites more than one may be used, or constructed on site. Stormwater enters the Sand Filter via a semi-submerged sedimentation chamber before passing through a sand filter bed prior to discharge. These can be designed to work on-line or off-line.

- **Source Control Sand Filter** (also known as Delaware Sand Filters and Perimeter Sand Filters)

  Used on some fuel station forecourts or small carparks. These have two chambers. Stormwater enters through surface grates into the first settling chamber, then flows over a weir into the second chamber. Here, it drains down through sand to perforated pipes before discharging to the stormwater drainage system. Suitable for small, highly impervious flat areas with relatively low available head.

- **Austin Sand Filters – present on new motorways in Auckland.**

  Constructed on site. These have a wide inlet bay with a weir to slow runoff before flowing to covered sediment basin, and then passing through open sand filter before discharge. These filters are designed to receive runoff from larger drainage areas.

Construction Sequence

1. Excavate

- Set digger at least 1.5m from pegged position of sand filter to prevent slumping when excavating.
- Excavate for chambers and incoming inlet and outlet pipes to levels shown on construction plans, allowing for foundation fill.
- Where depth exceeds 1.5m, or soil is unstable, batter or shore side slopes.
- Stockpile excavated material at least 4m away or remove from site.
- Check material at base of excavation is firm and stable, (eg stiff clay, not waterlogged) and if not, consult site supervisor or engineer.
- Erect safety fencing around hole.

2. Dig foundations

- Lay and compact base course hardfill to150mm depth minimum to prevent chamber movement.
- Apply concrete blinding layer – generally 100mm depth minimum. Unstable soils may require reinforcing mesh and increased concrete strength and depth.
- Check levels match construction plans and finished surface is level.

3. Install chambers

- Check lifting machinery is certified to lift units – these can weigh several tonnes.
- Check prefabricated units have ladders, underdrain and inlet and outlet holes.
- Cut holes for inlet and outlet before pre-fabricated chambers are lifted into position.
- Clear and control area of all traffic and people during lifting.
- Check chambers are in position as shown in construction plans with outlets at correct ends. When more than one unit, connect as per unit design specifications.
- Apply waterproof sealant to all vertical, wall and floor joints, risers and connection pipes.

Fig.1 Excavation of chamber pit

Fig.2 Basecourse installation and compaction before sand filter installed on the pit

Fig.3 Sand filter chamber is lowered into the receiving pit.

Construction Sequence Cont...

4. Check Watertightness (optional)

- Check chambers are watertight as per design specifications.
- In general this involves plugging all chamber outlets, filling both chambers with water, and then measuring water loss after 24 hours. Greater than 5% loss of water volume shows leakages that will require sealing before continuing construction.

5. Connect

- When watertight, connect inlet and outlet pipes, and if specified, construct inlet and sediment tank weirs. Plug inlet and outlets during construction.
- If included in design, fit dewatering valve at finished level of filter material, draining to outlet.
- For units not prefabricated: install ladders as specified, and lay 100-150mm diameter perforated underdrain wrapped in geotextile into position shown on construction plans, connected to outlet.

6. Install filter materials

- Carefully backfill underdrain with 50mm minimum drainage material (gravel), avoiding filling, crushing or damaging pipe.
- Carefully place specified filter material in filtration chamber as detailed on construction plans. A variety of material types may be specified – layer as detailed.
- Ensure finished material is 400mm minimum depth, and levelled off.
- DO NOT compact material.

Fig.4 Showing filter media installation

7. Apply hydraulic compaction (Optional)

- Use hydraulic compaction to naturally settle filter material.
- This involves slowly filling sediment chamber with clean water until both sediment and filter chambers are full, to just below overflow.
- Let water completely drain through filter until flow from underdrain to outlet ceases.
- Wait at least 48 hours for filter to dry before topping up and levelling filter material.

8. Review levels

- Check all levels match construction plans before placing lids on units.

9. Complete & tidy up

- Install and seal lids with approved sealant.
- Fit access hatches and manholes to match position of ladders.
- Backfill around chambers and level to finished ground levels.
- Avoid tracking over or mounding excess material on top of chamber lids to prevent structural damage.
- Finish surfaces as specified in construction plans. If finish not specified, sow with grass.
- Remove erosion and sediment control devices (silt fences, catch pit protection) and safety fences.

Fig.5 Completed sand filter.
Blue lids show the access locations.

Quick checks

- ✓ Get approval by designer for all changes to original construction plans. Major changes need approval from the council.
- ✓ Check excavation levels and location match those on construction plans, and that the filter is level. Changes to levels may prevent the sand filter from functioning. Make sure sand filter sits on stable ground to prevent cracking or separation of units.
- ✓ Prevent soil and construction sediments entering the filter chambers and pipe work.
- ✓ Check levels of underdrain, weir, inlet, outlet and overflow, and use correct filter materials.
- ✓ Block or divert new or existing inlets and outlets during construction, and check inlet and outlets are unplugged before connecting to drainage system.
- ✓ Construction requirements may vary between local authorities. Confirm design specifications with the Council who approved resource consents for particular project before construction.
- ✓ Check sand filter media is same as the recommended media before filling.

Avoid

- ✗ DO NOT change levels of sand filter without direction from designer or Council.
- ✗ DO NOT begin construction or commission the sand filter until surrounding construction is complete.
- ✗ DO NOT compact filter material – only use hydraulic compaction.
- ✗ DO NOT drop gravel underdrain material from height as this will damage the under drainage system. Place gravel from a low level and spread manually.
- ✗ DO NOT enter the chambers once lid is in place without confined space training.