WASTEWATER RETICULATION

Each urban household's sewage is connected to an underground sewerage piping network (also known as sewerage or sanitary sewer or wastewater **reticulation** system). These pipes generally run beneath roads and footpaths. The existing Wairoa wastewater reticulation system consists of 40 km of pipes which are accessed by 745 manholes. Five pump stations help to get the wastewater through the reticulation system to the treatment plant.

Reticulation can be designed for either **gravity** flows (i.e. wastewater flows down through the pipes on a very gentle downhill slope) or **pressurised** flows (i.e. pumps push the wastewater into pipes with an uphill slope, often known as rising mains). Gravity reticulation is the most common design, as it avoids the need for pumps and expensive sealed and strengthened pipes with leak-proof connections and non-return valves (these valves stop wastewater going backwards into your home's pipelines).

Reticulation is designed like an underground version of a stream with a single large pipe at the final downstream end that is fed by incoming branches of large pipes (**mains**) that split upstream into more and more branches and sub-branches with smaller and smaller pipe diameters to match the smaller flow rates. Each area of reticulation that ultimately flows into a common main is called a **catchment**.

Drinking water and stormwater have separate reticulation systems, which gives rise to the terms **three waters**. It is important to keep each of these three reticulation systems separate so that cross-contamination is avoided, public and environmental health are protected, drinking water is not wasted, flooding from storms is controlled and minimised, and contaminated water is treated and discharged into the environment responsibly.

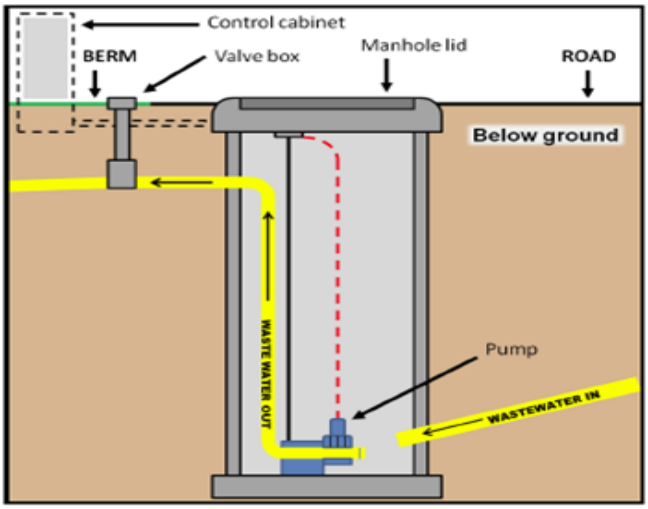
PUMPING AND PUMP STATIONS

As gravity pipes flow downhill, they become too deep underground to allow a single pipe to run all the way from the most upstream point within the wastewater reticulation catchment to the treatment plant. To overcome this, underground pump stations are strategically located to lift the wastewater from one catchment area to another section of gravity mains, and ultimately up to the treatment plant.

In the example above, the treatment plant is located on a low hill and therefore requires pumping to get the wastewater up to the plant from the main's lowest point below the road near the estuary.

The image below shows a typical pump station, where wastewater flows by gravity into the base of the pump station's **wet well.** When the wastewater reaches a specified level in the wet well pumps activate, lift the water and discharge it into a new pipe. This new pipe either flows by gravity down to the next pump station or is a pressurised pipeline to the treatment plant.

A wet well is designed to operate like a storage tank, which in some cases allows wastewater to drain out of the upstream network at a rate faster than the pump can pump it on to the next section of pipeline. In these cases, the wet well and some of the upstream pipeline fill up and store the wastewater until the pump manages to catch up with the accumulated volume. However, in some cases the inflow is greater than the pumps (or the pipes the pumps discharge into) can handle and the pump station storage is exceeded and a **pump station over flow** occurs. The wet wells can include an additional storage tank and/or an emergency overflow at the top to cater for some overflows but not all.

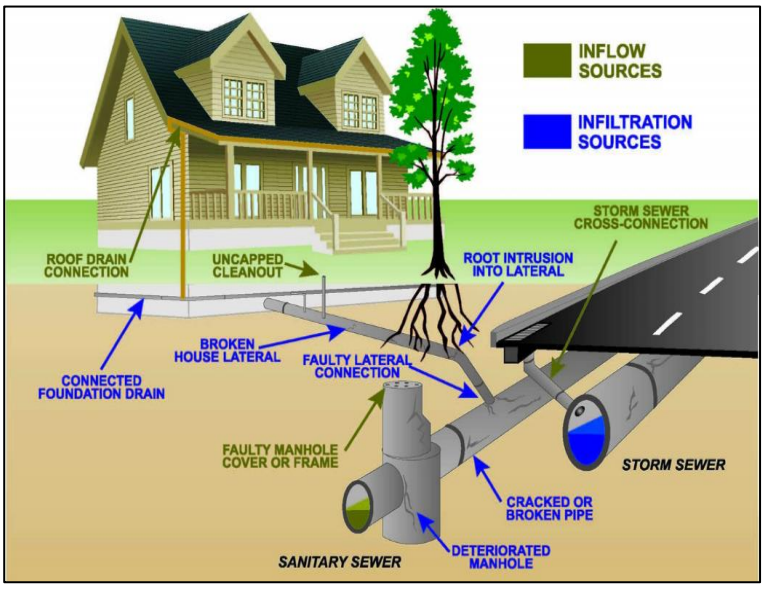


Wairoa's wastewater reticulation includes five pump stations that service different catchment areas of the wastewater reticulation network. Under extreme weather conditions (discussed below) the flow into some pump stations exceeds the ability for it to be discharged and pump station overflow occurs.

I & I

Groundwater infiltration and stormwater ingress (I & I) are common issues for sewerage reticulation networks, and are a significant concern for Wairoa. The figure below presents a schematic of the common sources and causes of I & I.

Groundwater infiltrates the wastewater reticulation network when the water table rises above the level of a faulty underground pipe. This is seasonal (mainly worst during winter) and increases during prolonged wet periods. Stormwater ingress only enters the wastewater reticulation network during and immediately after storm events, irrespective of whether the Wairoa River is flowing at high rates or not. Stormwater ingress is a result of water entering directly into house gully traps and around manhole lids.



I & I dilutes the wastewater and adds unnecessary flows which increase pumping costs (power and maintenance), overwhelms pumps and causes overflows of pump stations during large storms. It also forces an unnecessary treatment burden onto the treatment plant through extra flows, introduces grit and sand to the treatment plant which then settles in the plant's ponds (which leads to more frequent sludge removal from the ponds), reduces the wastewater treatment effectiveness (due to faster flow through the plant) and forces the previous days' wastewater flows to leave the treatment plant sooner than it might have. This means the discharge is less effectively treated than it would have been.

For all of these reasons, it is very important to minimise I & I flows into the wastewater reticulation. The most effective ways of reducing I & I are to ensure that all stormwater is directed to the separate stormwater system and to identify and then repair or replace all leaky wastewater reticulation pipes.