Case Study
Stormwater

Up-Flo™ Filter

Preserving One of New Zealand's National Treasures

Project Highlights

- Orakei Marina's development had to meet strict environmental requirements
- The shallow drainage system in a tidal zone required a low headloss system
- The restricted site area and tidal ground water conditions meant that all drainage construction work had to be completed quickly and effectively
- Three Up-Flo Filters were used to treat the stormwater runoff from 3 acres of parking lots
- The Up-Flo Filters were delivered to site in standard 4-ft manholes, ready to be quickly and easily installed
- With removal efficiencies > 90% for particles with a mean particle distribution of 20 microns, the Up-Flo Filters meet and exceed the ARC's permitting requirements

The Up-Flo Filter has a higher flow through capacity than traditional sand filters, making it a smaller and more economical alternative for stormwater treatment.

"[The development] was able to exceed the ARC's requirements for stormwater treatment of 75 percent of total suspended solids"

The Up-Flo Filter Keeps Development Runoff From Impacting the Pristine Hauraki Gulf

The Hauraki Gulf is an object of national pride and an economic hub for the Auckland region.

The Hauraki Gulf is an object of fiercely protected national pride in New Zealand. Held up as a national treasure, the Hauraki Gulf is one of the country's most precious conservation icons due to its vast diversity of birds, plants and aquatic life. Concern about the Gulf has been mounting since the 1990s due to increasing pressures from population growth, an expanding port and international events such as the America's Cup, which brought thousands of people to New Zealand.

Many companies had sought and failed to receive approval for development projects at Okahu Landing overlooking the Hauraki Gulf. Orakei Marina Development proposed the upgrade of 172 new berths and more than two acres of development consisting of a car park and gardens. To receive approval of the project, the firm needed to comply with strict environment requirements and overcome the challenges of working in tidal conditions.

The conversion of open space to impervious surfaces such as the car park proposed by Orakei Marina Development, would increase the volume of runoff and the risk of downstream flooding. Additionally, runoff from car park areas may contain high levels of pollutants, including trash and other debris, coarse and fine sediment, hydrocarbons, toxic trace metals, nutrients, pathogens, and other toxicants. Without proper storm water controls, oil and other materials dripped from cars would get swept directly into the marina when it rained. The stormwater drainage from critical areas such as large car parks has shown to have higher than average loading of pollutants. Thus, multiple treatment processes are typically needed to address the highly variable composition and pollution loading of stormwater runoff.

The marina also necessitated the use of a shallow drainage network across the site. During high tide, if the top of the drainage pipe is equal to the level of the water, sea water will back up into the drainage system. This would be a significant problem if it rained during high tide: Storm water wouldn't have any place to go, since the drainage pipe would already be filled with sea water. This would also cause troublesome surface flooding. Thus, the outfall pipe of the drainage system needs to be higher up in order to accommodate the tidal zone.

Stormwater filtration is known to be effective for controlling fine particulate and their associated pollutants. However, a common challenge with traditional surface filtration systems is a slow filtration rate (hence large footprint) and tendency to clog. With these conventional down flow filters, water flows down through a porous media filter that traps particles. If the particles are too large they will block the filter and reduce the surface area available for water to flow through. Often, developers try to overcome this by increasing the footprint of the filter to increase the amount of water being filtered at one time, but this takes up expensive real estate and involves considerably higher maintenance costs.

Surface filtration devices are generally not cost-effective for managing stormwater runoff because of the relatively high flow rates that occur during wet-weather events. The average one-acre parking lot, for example, can generate approximately 450 gallons of

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water per minute with average rainfall, yet typical down flow filters can only handle 2 to 5 gallons a minute. This is a particular concern in a region such as Auckland, which experiences high levels of rainfall almost year-round. Auckland experiences an average of about 4 feet of rain per year.

Maintenance of such large systems is also a consideration. Having a down flow system the size of a baseball field, for example, could require removal and replacement of the top 3 inches of the sand filter three to four times a year. Generally this requires a specialized truck for removal and disposal of this hazardous waste. In addition, the capital expense for these enormous filters is also cost prohibitive. Down flow filters have additional design flaws. For example, the filter media tends to stay submerged in water, creating an environment ripe for bacteria growth.

To tackle these challenges, Orakei Marina Development hired Hynds Environmental Systems Ltd., a New Zealand firm that helps companies meet environmental requirements through stormwater treatment, sewage treatment, flood protection, combined sewer overflow systems and other solutions. Hynds Environmental supplied three Hydro International Up-Flo™ Filter units to treat the storm water runoff from the marina's three acres of parking lots totaling 416,360 cubic feet (3.1 million gallons). The Up-Flo Filter was developed in the United States by Hydro International and is supplied in New Zealand by Hynds Environmental.

The low headloss of the Up-Flo Filter suited this shallow drainage system. Unlike traditional sand filters that can require up to 4 feet or more of headloss to operate efficiently, the Up-Flo Filter's combination of porous media, high flow-through rate and high treatment capacity allows for much lower headloss. At peak operational capacity, it only has approximately 29.5" of required headloss. The Up-Flo Filters were delivered to the site in standard 4-ft diameter manholes to make it easy to readily install the devices into the drainage network.

The filters Hynds Environmental supplied were designed differently from traditional down flow systems. The Up-Flo Filters employ multiple methods to treat runoff from critical source areas such as car parks. The sump captures coarse grit and gross debris, the chamber eliminates floatables and trash, the angled screen handles neutrally buoyant material, and the filter media screens out fine sediment, hydrocarbons, metals, organics such as pesticides and herbicides, and nutrients such as phosphorus.

In the Up-Flo Filter, water flows in an upward direction allowing particles to fall away from the filter media to prevent it from clogging. During a stormwater event, water enters the chamber within the device via an inlet pipe or overheat grate. Gross debris and sediment settle out in the sump. As water fills the chamber, flow is directed up through an angled screen and flow distribution media into the filter module. This way, the flow is evenly distributed across the media for maximum treatment. Treated flow exits the filter module via a conveyance channel to an outlet module. In systems utilizing up-flow technology, there is enough room inside for the filter media to swell and circulate through the device. The system is designed this way intentionally because the added room ensures a higher flow through capacity. In addition, a drain-down system keeps the media from staying submerged in between storms.

This alternative approach has been fully vetted by the Auckland Regional Council, which approved the Up-Flo filter for treatment of stormwater runoff.

As a result of using this advanced filtration system, Orakei Marina Development was able to exceed the Council's requirements for stormwater treatment of 75 percent of total suspended solids. The system removes more than 90 percent of particles with a mean particle distribution of 20 microns. Based on the success of the Orakei Marina project, other areas of the country now look to Auckland for guidance on the best treatment technologies for a particular job.

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