RIVER LAKE

# Whakatane Comprehensive Stormwater Consent Monitoring Plan: DRAFT

Prepared for:

**Whakatāne District Council**

RIVER LAKE

# Whakatane Comprehensive Stormwater Consent Monitoring Plan


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# 1 Introduction

## 1.1 Background

Whakatāne District Council (the Council) is seeking a Comprehensive Stormwater Consent (CSC) to authorise stormwater discharges from Whakatāne, Coastlands and The Hub.

This Draft Stormwater Monitoring Plan has been prepared to support the Stormwater Catchment Management Plan and resource consent process. It is intended that this Draft Stormwater Monitoring Plan is finalised by a suitably qualified person after resource consents are obtained.

The purpose of stormwater monitoring proposed in this plan is to confirm the quality of stormwater being discharged, assess its potential effects on the receiving environment and test compliance against the CSC.

## 1.2 Whakatāne stormwater network

The Whakatāne Urban Stormwater Catchment includes the Whakatāne Township and central business district (CBD), the coastal development of Coastlands/Piripai and the commercial and industrial areas of the Hub and Gateway Drive (Figure 1.1).

There are three main Stormwater Zones: Apanui (256 ha), Hinemoa (202 ha) and Whakatāne South (256 ha) and six smaller Stormwater Zones: Whitehorse/Melville/Wainui Te Whara (153 ha), Awatapu (45 ha), Mātaatua/Muriwai/Wairaka (59 ha); Coastlands (124 ha); Gateway Drive/The Hub (103 ha), and Wairere (306 ha including rural catchment);

For the purpose of the CSC application, the Whakatāne Urban Stormwater Catchment incorporates all the residential and commercial land in Whakatāne that drains indirectly or directly to the Whakatāne River. Natural waterbodies that receive stormwater discharges are as follows (with the number of stormwater discharge locations in brackets): Whakatāne River (19 downstream of Landing Road Bridge, 23 upstream of Landing Road Bridge), Wainui Te Whara Stream (11), Wairere Stream (2), Waiewe Stream, Awatapu Lagoon (19), Sullivan Lake and Kopeopeo Canal (1).

Natural and modified tributaries that enter the Whakatāne River within the urban boundaries of Whakatāne, include from downstream to upstream[1]: Wairere Stream, Waiewe Stream (McAlister Street pump station/gravity flapgate), Orini Canal and Kopeopeo Canal (TL), Hinemoa Street drain, Te Rahu Canal (TL), Wainui Te Whara Stream via Awatapu Lagoon, Waioho Stream (TL) and several unnamed tributaries near the southern urban boundary.

[1] TL = enters the Whakatāne River from the True Left side.

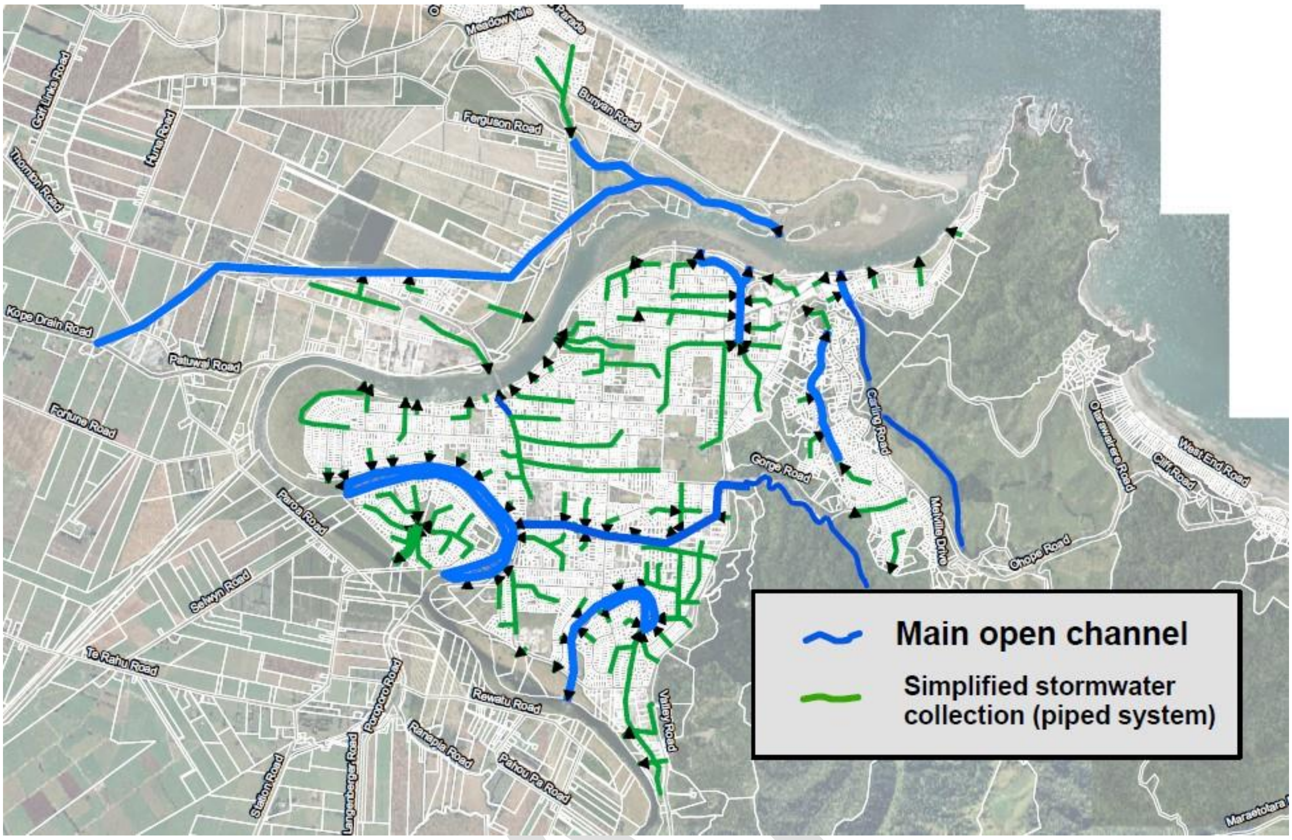


**Figure 2.1**: Whakatāne stormwater network showing simplified stormwater collection system and open waterways



## 1.3 Streams and the receiving environment

Ecological values of the stream receiving environment have been assessed in reports by Hamill (2015), Opus (2016), and Opus (2017). A summary of the ecological values of each of the receiving waters are provided below:

Whakatāne River has important ecological, recreational and cultural values. The salt marsh in the lower estuary provides important habitat for fish and birds. The lower section, downstream from Landing Rd bridge, is considered in Regional plans to be part of the Coastal Marine area. Daily water levels in this section of river are greatly affected by tidal fluctuations.

Wainui Te Whara Stream originates in the hill country around Mokourua, flows through the town and into Awatapu lagoon from which it enters the Whakatāne River via a fish friendly flap gate. It supports a range of native fish species.

Awatapu Lagoon is a man-made ox-bow lake that was isolated from the Whakatāne River as part of flood protection works in the 1970s. It is 7.7ha in size and on average 1.7m deep with a maximum depth of 4.3m. Water quality in the lagoon improves closer to the outlet where it is tidally connected to the Whakatāne River; overall the nutrient water quality is poor with frequent algae blooms and the presence of nuisance aquatic macrophytes such as parrots feather and hornwort. Awatapu Lagoon nevertheless provides valuable habitat for fish and birds.

Sullivan Lake is a shallow nutrient rich lake. Water quality is poor (classed as hypertrophic) and there are frequent nuisance algae blooms. It is valued as a habitat for waterfowl.

Wairere Stream drains farmland east of Hillcrest and receives only a small amount of urban stormwater.

Waiewe Stream has about 1 km of open stream channel along Waiewe Street, is piped down Hillcrest Road, flows as a waterfall and open stream beside the Hillcrest steps and is piped under the Strand to discharge near the paru flax drying area and connect with the Apanui Canal and McAlister Street pump station/gravity flapgate. Peak stormwater flows in this catchment are attenuated by a series of four small dams located in Waiewe Reserve

Apanui Canal enters the Whakatāne River via a gravity flap gate and pump stations at McAlister Street and in the Rose Gardens. It has a completely urban catchment. There is about 1 km of open channel downstream of Pyne Street. Waiewe Stream connects with Apanui canal at the downstream end via the paru flax dying wetland and ponding area. The lower end (downstream of the strand) of Apanui Canal is tidal due to the fish friendly flap gate (FFG) and this results in better water quality at the downstream end. Overall the water quality, habitat and ecological values of Apanui canal are poor, but it does support abundant shortfin eel (Opus 2017).

Hinemoa Street drain enters the Whakatāne River upstream of landing Road Bridge, via a gravity flap gate and pump station. It has a completely urban catchment and only about 360m of open channel. Overall the water quality, habitat and ecological values of Hinemoa Street drain are poor. Shortfin eel and galaxiid species are present but in low abundance (Opus 2017).

## 1.4 Stormwater consent monitoring

The Council holds the following resource consents for discharges of stormwater in Whakatāne that require monitoring:

- The Hub to Kopeopeo Canal (consent 63352)
- The Hub stormwater to Whakatāne River (consent 62713)
- Keepa Road pump station to Whakatāne River (consent 65604)
- Keepa Road settling pond to Orini Canal (RM20-0493-DC.01, formerly resource consent 66383)

Monitoring requirements at these sites are summarised in Table 1.1 and the summary results are in Table 1.2. Numerical limits in the consents are set for TSS (<150 mg/L), TPH (<15 mg/L) and pH (between pH 6 and 9).

**Table 1.1**: Summary of stormwater monitoring requirements on current stormwater consents for Whakatāne.

| Consent | Location | Variables | Type | Frequency | Limits |
|---|---|---|---|---|---|
| 63352 | The Hub to Kopeopeo Canal | TSS, PAH, COD | Four samples at 10 minute intervals per event | 4 times per year | TSS |
| 62713 | The Hub to Whakatāne River PS | TSS, PAH, COD | Four samples at 10 minute intervals per event | Quarterly | TSS |
| 62713 | The Hub Board Mill SW manhole | TSS, TPH | First flush | Annual | TSS, TPH |
| 65604 | Hub2 PS to Whakatāne River | TSS, TPH, pH | First flush (first 30 min) | 4 times per year/ 2 times per year | TSS, TPH |
| 66383 | Keepa Rd ponds to Orini Canal | TSS, TPH, pH, Dioxin, TP, TN, Pb, Zn, Cu | First flush (first 30 min) | 2 per year | TSS, TPH, pH |

**Note:** Conditions also require compliance with criteria in the RMA Sec 107.

**Table 1.2**: Summary results of Whakatāne stormwater consent monitoring (dataset for Keepa Road was missing data for 2017 and 2018). Some lab results had unusually high detection limits of total metals.

| Site | Statistic | n | pH | TSS | TPH | Dioxin WHO TEQ upper (pg/L) | PAH (mg/L) | COD (mg/L) | TP (mg/L) | TN (mg/L) | Total Lead | Total Zinc | Total Copper |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Guideline** | | | | **150** | **15** | **30** | | | | | **0.012** | **0.043** | **0.008** |
| Keepa Rd to Oreni, 66383 | Median | 6 | 6.6 | 6.3 | 0.7 | 4.69 | | | 0.0885 | 0.49 | 0.0009 | 0.006 | 0.0021 |
| Keepa Rd to Oreni, 66383 | Max. | 6 | 6.8 | 11 | 0.7 | 6.93 | | | 0.22 | 1.09 | <0.0011 | <0.021 | <0.053 |
| Hub to Kopeopeo Canal, 63352 | Median | 18 | | 28 | | | <0.00004 | 34 | | | | | |
| Hub to Kopeopeo Canal, 63352 | Max. | 18 | | 91 | | | 0.00047 | 200 | | | | | |
| Hub to Whak. PS, 62713 | Median | 28 | | 33.5 | | | 0.000018 | 25 | | | | | |
| Hub to Whak. PS, 62713 | Max. | 28 | | 179 | | | <0.01 | 230 | | | | | |

Guidelines: TSS in discharge of <150 mg/L (BOPRC). TPH <15 mg/L (MfE Environmental Guidelines for Water Discharges from Petroleum Industry Sites in NZ). Dioxin < 30 pg I-TEQ /L (USEPA). Total metal guidelines are ANZECC trigger for 80% protection in marine waters.

## 1.5 Stormwater investigations

Tozer (2016) developed a monitoring programme for Whakatāne stormwater, which consisted of eight sampling locations to reflect a range of land use types across the catchment. The following samples were collected:

- Water samples were collected from seventeen sites on four occasions during baseflow conditions. This included sampling from the Whakatāne River, Wainui Te Whara Stream, Wairere Stream, Hinemoa Stream, Apanui canal, Awatapu lagoon outlet, Sullivan Lake outlet and six stormwater outlets (Amber Grove, Coastlands, Gateway Drive, Sullivan Lake inlet, Te Tahi Street, and The Hub)
- Water samples were collected from four sites on four occasions during rain events, and
- Sediment samples were collected from eight sites on two occasions. This included sampling from the Whakatāne River (three sites), Wainui Te Whara Stream (two sites), Wairere Stream, Apanui canal and the Amber Grove stormwater).

The sampling results were reported in WSP Opus (2019) (Table 1.3 and Table 1.4). The key results were:

- *E. coli* bacteria concentrations were high during storm events. Faecal source tracking of samples from Amber Grove, Apanui Canal and Te Tahi Street found that the bacteria were not from a human source, instead the results indicated a wildfowl source and, at some sites, a possible ruminant source.

- Baseflow *E. coli* bacteria were above recreational bathing guidelines at Sullivan Lake and Hinemoa Stream.
- Total cadmium and mercury were within ANZECC Default Guideline Values (DGV) at all sites.
- Median total copper exceeded the ANZECC 80% protection level in baseflow stormwater discharges from Coastlands, Gateway Drive, and also at Amber Grove, Apanui canal and Te Tahi Street during rain events. In natural water bodies, total copper exceeded that 90% protection limit at Hinemoa Street, Wainui Te Whara and in the lower Whakatāne River.
- Median total zinc exceeded the ANZECC 80% protection level in baseflow stormwater discharges from Gateway Drive, and also at Amber Grove, Apanui canal and Te Tahi Street during rain events. The median zinc concentration at Gateway Drive was very high compared to other sites. In natural water bodies, total zinc exceeded that 90% species protection limit at Hinemoa Street and Apanui Stream.
- Median total chromium (III and IV) was within ANZECC 80% protection level at all sites (baseflow and rain event monitoring). In natural waterbodies total chromium was within the ANZECC 90% protection level at all sites. Note that chromium exceeded the ANZECC 95% protection trigger at all sites in part because the trigger level was lower than the laboratory detection limit.
- Median total lead was within the ANZECC DGV at all sites during baseflow conditions. However, the ANZECC 90% protection level was exceeded in stormwater from Te Tahi Street during rain events. pH was consistently within the trigger range.
- There were five (marginal) exceedances of the BOPRC 150 mg/L TSS trigger level. In the Wainui Te Whara Stream this was associated with dredging work occurring in the stream at the time.
- All hydrocarbons were below laboratory detection limits.
- Sediment from Apanui canal had Cu, Pb and Zn above the ANZECC DGV and Zn above the ANZECC DV-high. Sediment from Amber Grove had Zn above the ANZECC DGV (Table 1.4).
- High concentrations of total copper or zinc were often associated with high concentrations of suspended solids.
- In general, the highest concentration of total metals in baseflow stormwater was from Gateway Drive.

Key recommendations from WSP Opus (2019) included:

- Maintain *E. coli* monitoring at recreational sites on a quarterly basis. Undertake one-off faecal source tracking for Sullivan Lake and Hinemoa Stream
- Maintain monitoring of copper, chromium, lead and zinc, TSS, pH, NH4-N, nitrate, TPH on a quarterly basis. Less frequent monitoring might be appropriate for Wainui Te Whara upstream and Wairere Stream.
- Continue sediment sampling for copper, lead and zinc and consider additional inclusion of chromium, cadmium and organic carbon.
- Investigate the possible reasons for relatively high copper and zinc at Gateway Drive stormwater and high copper at Coastlands.
- Apply the ANZECC 90% protection trigger for water quality in natural water receiving environments.

Note that this monitoring programme has refined some of these recommendations to incorporate more recent methods, focus on stormwater effects, link to actions and integrate with existing monitoring programmes.

**Table 1.3:** Median water quality from baseflow and rain-event sampling by WSP Opus (2019). Shaded cells indicated exceedance of ANZECC guideline values as follows: >95% protection = blue, >90% protection = green, >80% protection = yellow. Site names in bold are natural waterbodies.

| Site Name | Count | Flow | TSS (g/m3) | Total Cadmium (g/m3) | Total Chromium (g/m3) | Total Copper (g/m3) | Total Lead (g/m3) | Total Mercury (g/m3) | Total Zinc (g/m3) | NH4-N (g/m3) | Nitrate-N (g/m3) | *E. coli* cfu/100ml |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Amber Grove | 4 | Base | 13 | 0.000053 | 0.00063 | 0.00075 | 0.00055 | 0.00008 | 0.01165 | 0.18 | 0.12 | 34 |
| Apanui Canal | 4 | Base | 5.5 | 0.000053 | 0.00058 | 0.000795 | 0.0003 | 0.00008 | 0.0186 | 0.27 | 0.21 | 27 |
| **Awatapu Outlet** | 4 | Base | 19 | 0.000053 | 0.00055 | 0.00124 | 0.0007 | 0.00008 | 0.0032 | 0.06 | 0.21 | 95 |
| Coastlands | 4 | Base | 4 | 0.000053 | 0.000635 | 0.0037 | 0.00067 | 0.00008 | 0.0063 | 0.03 | 0.01 | 60 |
| Gateway Drive | 4 | Base | 17.5 | 0.000053 | 0.00214 | 0.0043 | 0.00123 | 0.00008 | 0.3435 | 0.07 | 0.30 | 55 |
| **Hinemoa Stream** | 4 | Base | 3 | 0.000053 | 0.00053 | 0.00235 | 0.00065 | 0.00008 | 0.0465 | 0.21 | 1.08 | 685 |
| Sullivan Lake Inlet | 4 | Base | 13 | 0.000053 | 0.000825 | 0.00145 | 0.00065 | 0.00008 | 0.01455 | 0.05 | 0.23 | 780 |
| **Sullivan Lake Outlet** | 4 | Base | 10.5 | 0.000053 | 0.00053 | 0.001325 | 0.0006 | 0.00008 | 0.01105 | 0.010 | 0.05 | 225 |
| Te Tahi Street | 4 | Base | 3 | 0.000053 | 0.00053 | 0.00086 | 0.00026 | 0.00008 | 0.0166 | 0.04 | 0.30 | 40 |
| The Hub | 3 | Base | 33 | 0.00011 | 0.0011 | 0.0011 | 0.00021 | 0.00008 | 0.0094 | 0.12 | 0.15 | 10 |
| **Wairere Stream** | 4 | Base | 3 | 0.000053 | 0.00053 | 0.00053 | 0.00011 | 0.00008 | 0.0015 | 0.014 | 0.59 | 210 |
| **Wainui Te Whara Downstream** | 4 | Base | 59 | 0.000053 | 0.001345 | 0.001835 | 0.00177 | 0.00008 | 0.0069 | 0.014 | 0.40 | 75 |
| **Wainui Te Whara Upstream** | 4 | Base | 3 | 0.000053 | 0.00053 | 0.00053 | 0.00012 | 0.00008 | 0.0011 | 0.010 | 0.41 | 52 |
| **Whakatane River Downstream** | 4 | Base | 12.5 | 0.00021 | 0.0019 | 0.0019 | 0.0011 | 0.00008 | 0.0049 | 0.021 | 0.20 | 50 |
| **Whakatane River Bridge** | 4 | Base | 17.5 | 0.0000815 | 0.0011 | 0.0011 | 0.00077 | 0.00008 | 0.00325 | 0.020 | 0.20 | 55 |
| **Whakatane River Midway** | 4 | Base | 52 | 0.000053 | 0.00104 | 0.001515 | 0.00109 | 0.00008 | 0.00475 | 0.012 | 0.21 | 54.5 |
| **Whakatane River Upstream** | 4 | Base | 17 | 0.000053 | 0.00053 | 0.000595 | 0.00023 | 0.00008 | 0.00135 | 0.010 | 0.19 | 40.5 |
| Amber Grove | 4 | Rain | 17.5 | 0.000053 | 0.001545 | 0.0031 | 0.00355 | 0.00008 | 0.1095 | 0.07 | 0.14 | 3100 |
| Apanui Canal | 4 | Rain | 23 | 0.0000815 | 0.00244 | 0.01015 | 0.0054 | 0.00008 | 0.1435 | 0.07 | 0.09 | 3100 |
| Te Tahi Street | 4 | Rain | 83 | 0.000138 | 0.0079 | 0.0119 | 0.0084 | 0.00008 | 0.307 | 0.01 | 0.09 | 2850 |
| **Wainui Te Whara Downstream** | 3 | Rain | 17 | 0.000053 | 0.00077 | 0.00153 | 0.00074 | 0.00008 | 0.0127 | 0.01 | 0.09 | 500 |

**Table 1.4:** Sediment results from WSP Opus (2019) [2]

| Date | Site | Sediment fraction | Total Copper (mg/kg dw) | Total Lead (mg/kg dw) | Total Zinc (mg/kg dw) |
|---|---|---|---|---|---|
| 10/08/16 | Amber Grove | <2mm | 27 | 37 | **350** |
| 20/11/17 | Amber Grove | <63µm | 22 | 23 | 177 |
| 10/08/16 | Apanui Canal | <2mm | 42 | **62** | **400** |
| 20/11/17 | Apanui Canal | <63µm | **121** | **181** | **1180** |
| 20/11/17 | Waiewe Stream | <63µm | 15.2 | 25 | 164 |
| 20/11/17 | Wairere Stream | <63µm | 6.4 | 9.5 | 47 |
| 20/11/17 | Wainui Te Whara Downstream | <63µm | 10.2 | 12.3 | 76 |
| 10/08/16 | Whakatāne River Downstream | <2mm | 16.3 | 12 | 62 |
| 20/11/17 | Whakatāne River Downstream | <63µm | 15.1 | 9.9 | 61 |
| 10/08/16 | Whakatāne River Midway | <2mm | 11.6 | 8.3 | 44 |
| 20/11/17 | Whakatāne River Midway | <63µm | 16.2 | 11.5 | 63 |
| 10/08/16 | Whakatāne River Upstream | <2mm | 7.6 | 4.7 | 29 |
| 20/11/17 | Whakatāne River Upstream | <63µm | 15.7 | 10.3 | 60 |

[2] Bolded values are above the ANZG Default Guideline Value (DGV) of copper 65 mg/kg, lead of 50 mg/kg and zinc of 200 mg/kg

# 2 Monitoring programme

## 2.1 Introduction

The monitoring proposed in this draft Stormwater Monitoring Plan focuses on collecting stormwater samples, sediment samples and passive DGT samples (diffusive gradient in thin film) of dissolved metal. These are compared to guideline trigger value to determine whether additional management action is required.

## 2.2 Sites

The location of proposed sample sites are shown in Figure 2.1 and Table 1.1. The sampling focuses on key waterbodies (Whakatāne River, Wainui Te Whara/Awatapu, Sullivan Lake, Apanui Canal), areas with higher risk of stormwater contamination (i.e. the industrial zone near Te Tahi Street and Commercial area/CBD draining to Apanui Canal), and existing stormwater monitoring.

Apanui Canal is classified as an artificial waterway and Hinemoa Stream is classified as a stream, but in practice both waterways have very similar characteristics. Both have almost 100% urban stormwater catchment, are highly modified, have a tidal influence and support shortfin eel.

**Table 2.1**: Sample sites proposed for on-going monitoring

| ID | Site | Water type | Land use | Sample type | Frequency |
|---|---|---|---|---|---|
| Whakatāne South 11 | Te Tahi Street | Stormwater | Industrial | Stormwater, DGT | annual |
| | Te Tahi Street to Sullivan Lake | Stormwater | Industrial | DGT | annual |
| | Keepa Road to Orini Canal (Consent RM20-0493-DC.01) | Stormwater | Residential | Stormwater | annual |
| | Gateway Dr to Kopeopeo Canal | Stormwater | Industrial/ Commercial | Stormwater, DGT | annual |
| | Hub to Kopeopeo Canal (Consent 63352) | Stormwater | Industrial/ Commercial | Stormwater | annual |
| | Hub to Whakatāne River PS (Consent 62713) | Stormwater | Industrial/ Commercial | Stormwater | annual |
| Apanui 2 | Apanui Canal | Stormwater | Commercial /CBD | Sediment, DGT | annual |
| | Hinemoa Stream | River | Residential | Sediment, DGT | annual |
| | Wainui Te Whara before Awatapu Lagoon | River | Residential | Sediment, DGT | annual |
| | Whakatāne River Upstream | River | Rural | Sediment | annual |
| | Whakatāne River Downstream McAlister St | River | Rural/urban | Sediment | annual |

Note: the site Te Tahi Street to Sullivan Lake has not previously been sampled.

[To be added]

**Figure 2.1**: Location of monitoring sites

## 2.3 Timing and Frequency

### 2.3.1 Stormwater

Stormwater will be sampled at least annually during the first flush of a rain event. The samples shall be representative of the stormwater from the outlet and, where practicable, shall be collected within the first 30 minutes of a rain-event.

Stormwater quality can vary considerably during a rain-event, but generally the highest concentrations occur during a first flush and on a rising flow. Capturing the first flush of a rain event can be challenging and consideration will be given to using passive automatic sampling devices to collect samples at set water level(s) on the rising flow. The practicality of deploying these types of devices depends on the characteristics of individual stormwater outlets.

A long-term integrated sample of stormwater and baseflow events shall be collected using Diffusive Gradient in Thin-film (DGTs) devices (see below). DGTs (or equivalent) shall be deployed annually for a minimum three-week period during the summer/autumn (1 November to 30 May). The deployment period should include at least one /stormwater discharge event.

### 2.3.2 Sediment in rivers

A single, bulked, sediment sample shall be collected annually.

## 2.4 Methods

### 2.4.1 Stormwater grab samples

Samples shall be collected as grab samples from the stormwater drains or outlets. Samples shall be collected by a suitably experienced person. Gloves shall be worn to minimise the risk of sample contamination and to protect the field personnel. The grab sample collection method is described in Appendix B.

If samples are collected using a passive, automatic sampling device, then the devices shall be checked after each significant rain-event to ensure samples are collected from the devices within 24 hours of the event.

The sample shall be chilled, stored in a cool dark chill-bin and sent to the laboratory for analysis. Extra care should be taken of samples for analysis of faecal coliform bacteria. It is critical that these are stored in a cool, dark place and they should arrive at the laboratory for analysis within 24 hours of collection.

### 2.4.2 DGT sampling devices

DGT devices provide a cost-effective way to measure time-weighted average concentrations of dissolved metals in water. DGTs can be used for measuring concentrations of many metals including Al, As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb and Zn. They provide results comparable to bioavailable dissolved metal fraction. DGT measures all solution species that are labile (available to biota). They do not measure metals that are incorporated inside mineral particles and are therefore inert or unreactive.

DGTs can be deployed for long periods of time to capture average concentrations over the period. The longer the deployment times, the more metal accumulates and the lower the detection limits. The maximum concentration that can be measured depends on the capacity of the resin.

When deploying DGTs in receiving waters it is appropriate to compare the results with chronic guideline values (e.g. ANZECC guidelines). Procedures for deploying DGTs are described in Appendix B.

### 2.4.3 Sediment

Samples shall be collected by a suitably trained person. Gloves shall be worn to minimise the risk of sample contamination and to protect the field personnel.

The samples shall be collected from an area of fine sediment deposition in a pool or a run.

The sediment samples shall be collected from the **top 2 cm** of sediment only. Samples shall be collected from a known area using a sediment corer or plastic scoop. A minimum of six cores shall be collected and bulked into a single sample to obtain a sediment volume of about 800 mL. The cores shall be collected over an area covering at least 1 $m^2$.

After the sample has been placed in the sample container, any excess free water shall be decanted.

Samples shall be transported in a cool chilli-bin, chilled to 4°C and remain chilled during transport to the laboratory. Samples shall be transported to the laboratory promptly, in accordance with maximum holding times for relevant variables being tested. If sediment samples cannot be sent to the laboratory within 24 hours then they should be frozen.

The area of sediment sampled shall be recorded.

## 2.5 Variables to analyse

### 2.5.1 Water and stormwater

The water samples shall be analysed for: total suspended solids (TSS), hardness, chromium (Cr), copper (Cu), zinc (Zn), and lead (Pb). Note that hardness is important for assessing the bioavailability of metals in water samples (particularly Cr, Cu, Zn, and Pb). Water with more saline influence tend to be harder. Hardness may be removed from the analysis suite if a relatively consistent concentration is found after a minimum of six samples from a particular site.

Where DGTs are deployed they shall be analysed for Chromium (Cr), copper (Cu) and zinc (Zn).[3]

[3] WSP OPUS (2018) found that variables were more likely to exceed guideline values in Whakatāne stormwater.

At the time of sample collection field observations shall be made of any films of hydrocarbon on the water. Also, records shall be made of:

- the date and time of sampling,
- amount of rain that fell in the previous 1 hour,
- amount of rain that fell in the previous 24 hours, and
- conditions at the time of sampling.

The sample analysis shall be carried out by an IANZ accredited laboratory.

Some past and current stormwater discharge consents have included analyse of Total Petroleum Hydrocarbons (TPH) (Consent 66383) or Polycyclic Aromatic Hydrocarbons (PAH) (Consent 63352). TPH is general indicator of the level of contamination by a broad range of hydrocarbon compounds. MfE (1998) set guidelines for the maximum level of TPH allowable in stormwater averaged over an event as 15 mg/L. PAH are a class of semi Volatile Organic Compounds (VOC). It is not proposed to regularly test stormwater for these variables on a regular basis because TPH and PAH are strongly associated with sediment particles, are typically low in urban stormwater (Kennedy et al. 2016), and have been confirmed in past consent monitoring as being very low of Whakatāne stormwater.

The consent for the Keepa Road stormwater pond discharge to Orini Canal (Consent RM20-0493-DC.01) includes analysis for dioxins. The rational was, presumably, because the stormwater ponds is near a site known to be contaminated with dioxins from past dumping of wood waste. We proposed to continue to monitor dioxins from the stormwater for consistency with past monitoring, but note that dioxins from stormwater is considered a low risk because past monitoring has shown the dioxin concentration in the stormwater to be low, dioxins are strongly associated with sediment and the potential source of dioxins is from the capped contaminated site rather than the urban stormwater.

### 2.5.2 Sediment

The sediment samples shall be analysed for the following variables: total chromium (Cr), total copper (Cu), total lead (Pb), total zinc (Zn) and Polycyclic Aromatic Hydrocarbons (PAHs).

Sample analysis shall be carried out on the fraction of sediment <u>less than 63 microns</u> by an IANZ accredited laboratory. Prior to analysis the sediment samples shall be sieved through a 63 micron filter to remove coarse sands and gravels.

Consideration should be given to including the following additional analysis: organic carbon, dry matter (g/100g), density (g/mL) and wet weight (g). Analysis of dry matter is to allow a conversion from wet weight to dry weight and analysis of density is to convert to sample volume and allow a retrospection confirmation of average depth actually sampled.

## 2.6 Health and Safety

Samples shall be collected in accordance with the Council's health and safety procedures, including contact procedures and incident reporting. Contractors undertaking monitoring shall submit a Health and Safety plan for review by the Council prior to undertaking works.

Potential hazards shall be identified for each regular sample site and contractors undertaking sampling are provided with a copy of the sampling locations and know hazards and risk assessment. Any additional hazards identified during sampling should be recorded, actions taken to remedy these if required and the risk assessment updated accordingly.

Site specific risks may change due to factors such as time of day and weather conditions. Those undertaking sampling should take appropriate actions to address risks presented for sampling alone, night time sampling, or sampling in adverse weather conditions.

If samples cannot be collected safely than an alternative site (e.g. further upstream), alternative timing (during low flows) or an alternative method should be investigated in consultation with the project manager.

# 3 Reporting and Triggers

## 3.1 Triggers

Water quality guidelines have been set to trigger a response based on the monitoring results. The trigger values based on the DGVs indicate a level to trigger further analysis and monitoring to determine whether aquatic ecosystems are adequately protected. They are a prompt to investigate in more detail, rather than a standard that has to be met.

The triggers are based on the guideline values from ANZECC (2000), ANZG (2018), USEPA (2006) and BOPRC. Response trigger values have been tailored to reflect whether the sample is from a stormwater discharge or a natural waterway, the quality of the receiving environment and the type of sample as follows:

- For baseflow monitoring (i.e. outside of flood events) of streams and rivers the triggers have been set at the 80% protection level and the 95% protection level depending on the state of the waterbody. These triggers apply to the results from DGT devices in natural waters because the devices integrate results over the whole period of deployment (Table 3.1).
- Rain event monitoring of natural waters is not currently proposed, but if it were to occur the recommended trigger for metals would be the relevant USEPA Criteria Maximum Concentration (CMC) which protects against acute effects. Acute toxicity criteria are used as triggers for intermittent stormwater discharges because the events are generally of very short duration and have considerable dilution with the receiving environment (Table 3.1).
- For stormwater discharges during baseflow conditions, i.e. results of long-term deployment of DGT devices, the triggers have been set at ten times the relevant ANZECC guideline for the receiving water, on the assumption of there being at least ten times dilution. This is an arbitrary but likely conservative assumption for the small stormwater systems under consideration.
- For stormwater discharges during rain-events, the triggers are set at 10 times the USEPA acute CMC value. A response trigger value of 150 mg/L total suspend solids is also applied to stormwater monitoring results based on BOPRC guidelines. This trigger excludes extreme rain events greater than the 10% AEP.

- For sediment samples from natural systems after reasonable mixing (e.g. Whakatāne River) the trigger is set as the Default Guideline Value (DGV) from ANZG (2018).
- For sediment samples from stormwater systems (e.g. Apanui Canal) the trigger is set as the DGV-high from ANZG (2018) (Table 3.2). The GV-high has typically been used as the trigger in previous BOPRC Comprehensive Stormwater Consents (CSC).

The response trigger level for each monitoring site and sample type is shown in Table 3.3 (water quality) and Table 3.4 (sediment).

**Table 3.1**: Water quality trigger values for receiving water environments from ANZECC (2000) and USEPA (2006). Discharge values based on the US-EPA acute (CMC) assuming a hardness of 30 g/m$^3$.

| **Trigger values Metals** | **Freshwater (µg/L)** ANZECC Protection Level | | | **Marine water (µg/L)** ANZECC Protection Level | | | **Freshwater US-EPA acute** |
|---|---|---|---|---|---|---|---|
| | 95% | 90% | 80% | 95% | 90% | 80% | CMC |
| Chromium (CrVI) | 1 | 6 | 40 | 4.4 | 20 | 85 | 16 |
| Copper | 1.4 | 1.8 | 2.5 | 1.3 | 3 | 8 | 4.3 |
| Lead | 3.4 | 5.6 | 9.4 | 4.4 | 6.6 | 12 | 17 |
| Zinc | 8 | 15 | 31 | 15 | 23 | 43 | 42 |

***Notes***

- *Water trigger values for dissolved metals Cr, Cu, Pb, Zn, and Cd are based on the US-EPA acute (CMC) assuming a hardness of 30 g/m$^3$. The triggers should be adjusted for actual water hardness (USEPA 2006).*
- *Chromium (IV) is considerably more toxic than Cr (III), the trigger value provided relates to chromium (III) and so is conservative if total chromium is analysed.*

**Table 3.2**: Sediment trigger values receiving environments (ANZG 2018). Applicable to fine sediment fraction (<63um) and PAH normalised to 1% organic carbon within the limits of 0.2 to 10%.

| **Variable** | **GDV (mg/kg dry wt)** | **GV-high (mg/kg dry wt)** |
|---|---|---|
| Total cadmium | 1.5 | 10 |
| Total chromium | 80 | 370 |
| Total copper | 65 | 270 |
| Total lead | 50 | 220 |
| Total nickel | 21 | 52 |
| Total zinc | 200 | 410 |
| Polycyclic Aromatic Hydrocarbons (PAHs) | 10 | 50 |

**Table 3.2**: Water quality trigger values for each monitoring site and sample type.

| Site | | Cr (µg/L) | Cu (µg/L) | Pb (µg/L) | Zn (µg/L) | TSS (mg/L) | Trigger rational |
|---|---|---|---|---|---|---|---|
| **Stormwater** | | | | | | | |
| Te Tahi St (WHK south11) | Stormwater | 160 | 43 | 170 | 420 | 150 | 10x USEPA CMC |
| Te Tahi St (WHK south11) | DGT | 10 | 14 | 34 | 80 | 150 | 10x ANZECC 95% level |
| Te Tahi St to Sullivan Lake | DGT | 60 | 18 | 56 | 150 | 150 | 10x ANZECC 90% level |
| Keepa Rd to Orini Canal (Consent 66383) | Stormwater | 160 | 43 | 170 | 420 | 150 | 10x USEPA CMC |
| Gateway Dr to Kopeopeo Canal | Stormwater | 160 | 43 | 170 | 420 | 150 | 10x USEPA CMC |
| Gateway Dr to Kopeopeo Canal | DGT | 60 | 18 | 56 | 150 | 150 | 10x ANZECC 90% level |
| Hub to Kopeopeo Canal (Consent 63352) | Stormwater | 160 | 43 | 170 | 420 | 150 | 10x USEPA CMC |
| Hub to Whakatāne Rv PS (Consent 62713) | Stormwater | 160 | 43 | 170 | 420 | 150 | 10x USEPA CMC |
| **Streams/rivers** | | | | | | | |
| Apanui Canal | DGT | 40 | 2.5 | 9.4 | 31 | na | ANZECC 80% level |
| Hinemoa Stream | DGT | 40 | 2.5 | 9.4 | 31 | na | ANZECC 80% level |
| Wainui Te Whara before Awatapu Lagoon | DGT | 1 | 1.4 | 3.4 | 8 | na | ANZECC 95% level |

**Table 3.2**: Sediment trigger values for each monitoring site and sample type.

| Site | Cr (mg/kg) | Cu (mg/kg) | Pb (mg/kg) | Zn (mg/kg) | PAH (mg/kg) | Trigger rational |
|---|---|---|---|---|---|---|
| Apanui Canal | 370 | 270 | 220 | 410 | 50 | ANZG GV-High |
| Hinemoa Stream | 80 | 65 | 50 | 200 | 10 | ANZG GDV |
| Wainui Te Whara before Awatapu Lagoon | 80 | 65 | 50 | 200 | 10 | ANZG GDV |
| Whakatāne River Upstream | 80 | 65 | 50 | 200 | 10 | ANZG GDV |
| Whakatāne River Downstream McAlister St | 80 | 65 | 50 | 200 | 10 | ANZG GDV |

## 3.2 Response if triggers are exceeded

If the results of either stormwater or sediment samples exceed the trigger values[4], the permit holder shall initiate the actions set out in the Stormwater Management Plan. These actions shall include:

- Notification of BOPRC's compliance officer.
- Investigating potential causes of the exceedance. This may include undertaking contaminant source investigations to identify the source of contaminants.
- If the contamination is likely to be derived from the stormwater network, then initiating appropriate corrective actions to reduce the source of contaminants. These actions may include:

[4] Triggers to apply at any time except where the 10% Annual Exceedance Probability (AEP) design event is exceeded.

  - Reducing loads at source;
  - Reviewing district plan provisions.

- Re-testing of the discharge following implementation of the corrective actions.
- Reporting the result of any additional monitoring or contaminant source investigation to BOPRC's compliance officer.

## 3.3 Reporting

### 3.3.1 Annual reporting

The result of stormwater and sediment sampling shall be reported to the relevant compliance officer at Bay of Plenty Regional Council annually (or as required by the CSC consent). The report shall include:

- The location of sample site.
- The date and time of sampling or DGT deployment period.
- Rainfall in the 1-hour and 24-hour period prior to water sampling.
- Daily rainfall during DGT deployment period.
- Area of sediment sampled and depth sampled, size of corer and number of replicate cores. The actual depth sampled shall be check by using a calculation that divides wet weight by sediment density, and divides this by the sample area.
- Results of sample analysis.
- A comparison of the results with ANZECC guideline trigger values, ISQG-high, ISQG-low, and triggers set in the consent.
- An assessment of the quality of discharges and implications of the discharges on the receiving environment.

### 3.3.2 Six yearly review and reporting

The appropriateness of the stormwater monitoring programme shall be reviewed at least every six years[5] and sent to the Consents Compliance Manager, Bay of Plenty Regional Council. The review shall include:

- A summary of all previous stormwater monitoring data for the sites;
- A summary of any past exceedances and actions taken;
- Assessment of whether any trends or patterns are apparent;
- An assessment of the effectiveness of the monitoring method and recommendations for any changes to the monitoring methods, variables or sites.
- An assessment of the appropriateness of trigger values whether they need to be revised.
- An assessment of any at risk catchments and recommendations regarding potential mitigation or revision of the Catchment Management Plan.

[5] Six year reviews corresponds with the LTP process with the first review in 2024.

# References

ANZG 2018. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

ANZECC 2000. *Australian and New Zealand guidelines for fresh and marine water quality. Vol. 1 and 2. (2000):* Australian and New Zealand Environment and Conservation Council, Canberra, ACT, Australia.

Hamill K. 2015. *Wainui Te Whara Stream survey 2015*. Prepared for Whakatāne District Council by River Lake Ltd.

Kennedy, P., Allen, G and Wilson, N (2016). *The management of hydrocarbons in stormwater runoff: a literature review.* Prepared by Golder Associates (NZ) Limited for Auckland Council. Auckland Council technical report, TR 2016/010

MfE 1998. Environmental Guidelines for Water Discharges from Petroleum Industry Sites in New Zealand. Prepared by a Joint Working Group of the Ministry for the Environment, local authorities and petroleum marketing companies. ISBN 0-478-09047-1

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Opus 2017. *Whakatāne Stormwater Catchment Management Plan. Ecological values assessment Hinemoa Stream and Apanui Stream*. Prepared for Whakatāne District Council by P Deegan, Opus International Consultants.

Park S 2009. *Bay of Plenty Marine Sediment Contaminants Survey 2008*. Environment Bay of Plenty Environmental Publication 2009/01.

Tozer C 2016. *Comprehensive stormwater monitoring update*. Memo to Inka Krawczyk from Clive Tozer, Opus International Consultants, 14 November 2016.

USEPA 2006. *National recommended water quality criteria for toxic pollutants*. United States Environmental Protection Agency.

WSP Opus 2019. Stormwater monitoring report. Prepared for Whakatāne District Council by J. Gladwin, SWP Opus International Consultants, March 2019.

# Appendix 1: Stormwater discharge locations

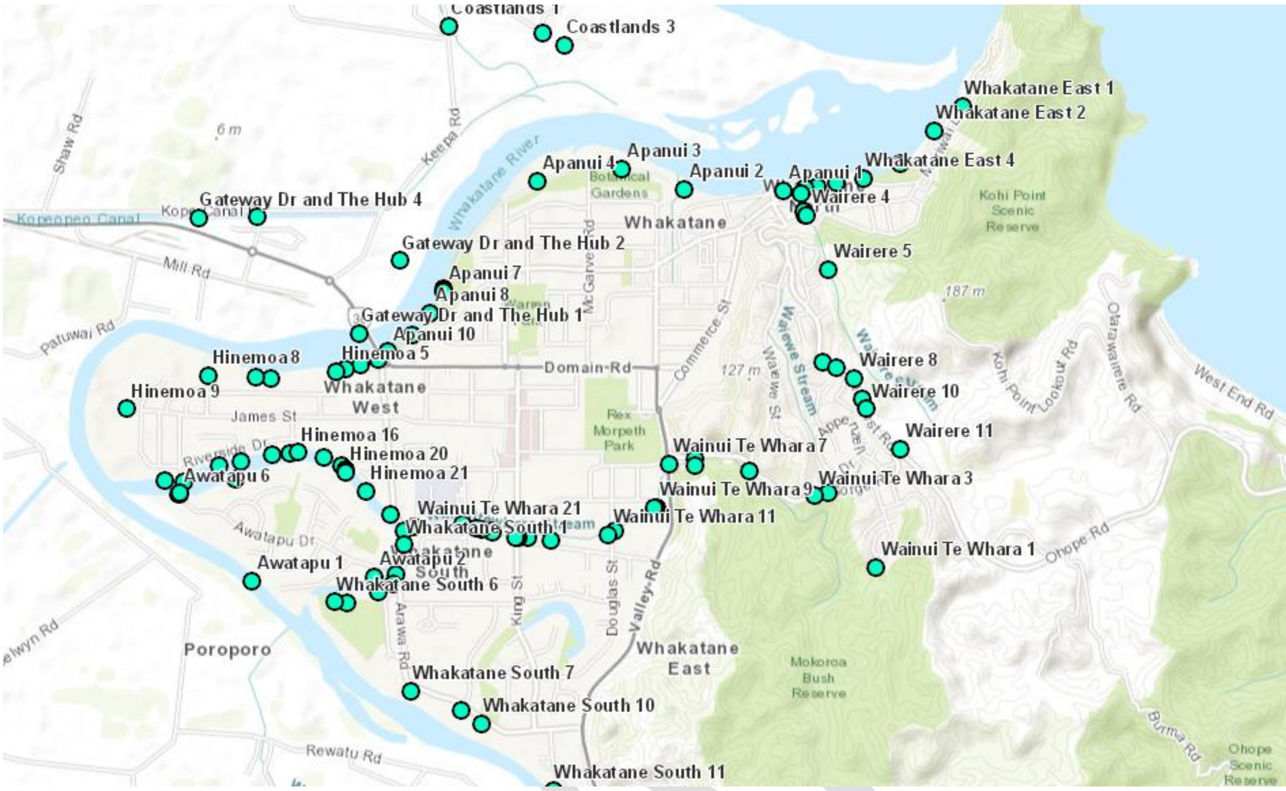


**Figure 1**: Whakatāne stormwater discharge locations

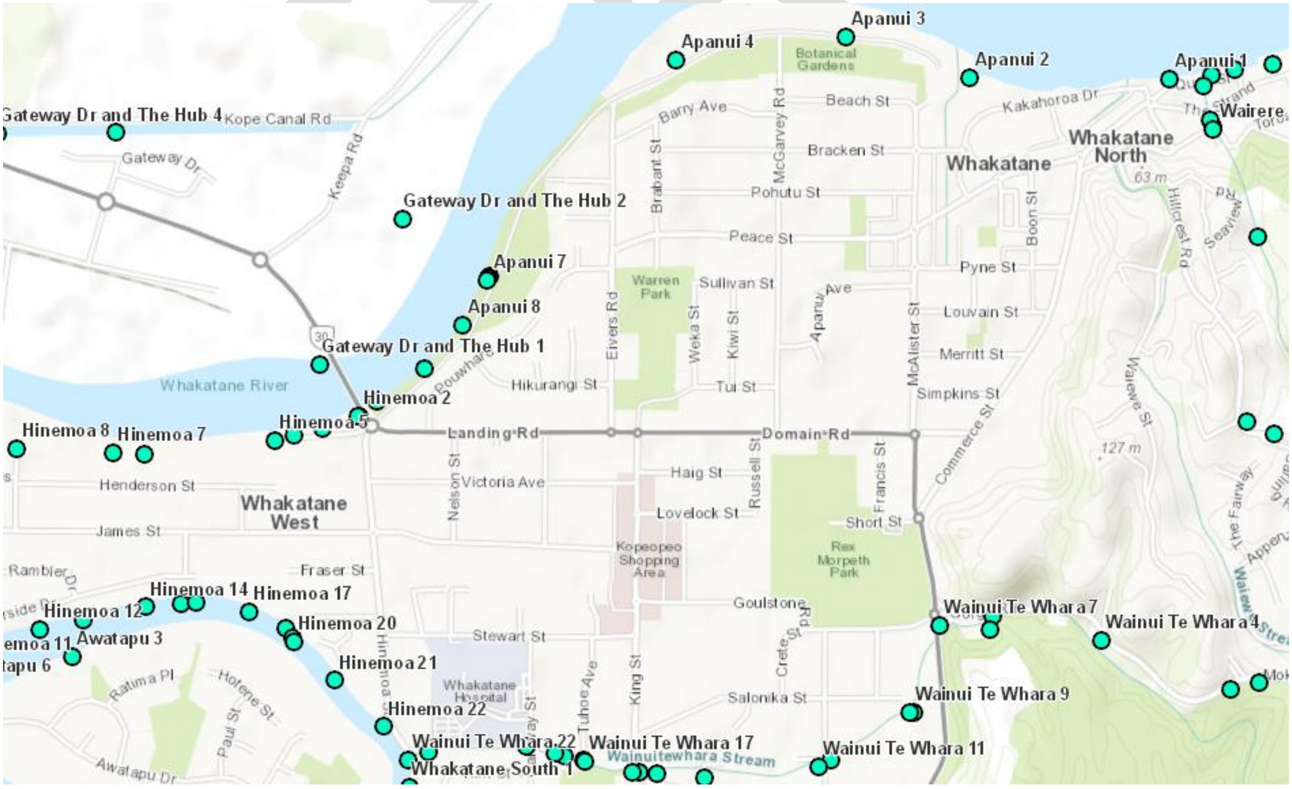


**Figure 2**: Whakatāne stormwater discharge locations, north.

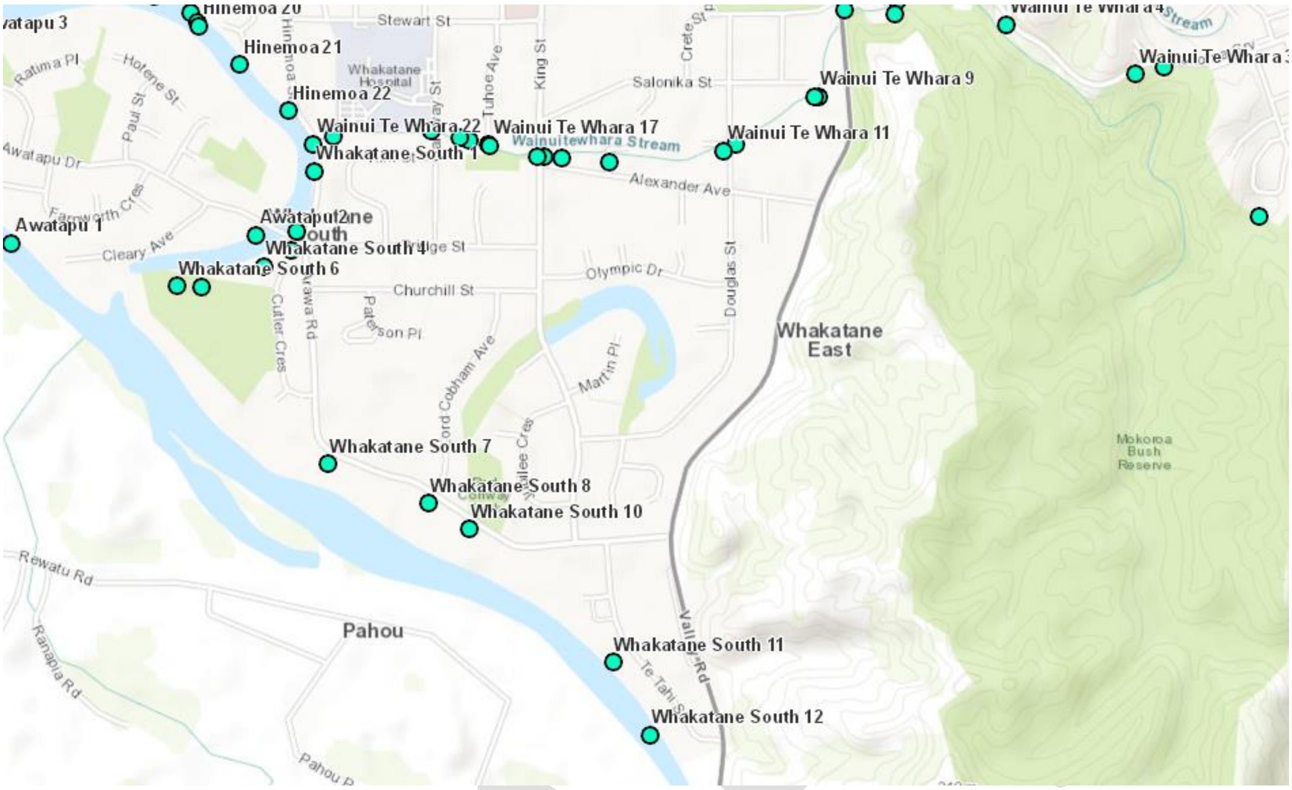


**Figure 3**: Whakatāne stormwater discharge locations, south.

# Appendix 2: Monitoring location site details

**Sample site:**

**Sub-catchment:**

**Site description and access:**

**Grid reference:**

**Hazards:**

**Water depth:** **Tidal influence:**

**Monitoring type:**

**Monitoring Frequency:**

Photo

**Sample site:**

**Sub-catchment:**

**Site description and access:**

**Grid reference:**

**Hazards:**

**Water depth:** **Tidal influence:**

**Monitoring type:**

**Monitoring Frequency:**

Photo

**Sample site:**

**Sub-catchment:**

**Site description and access:**

**Grid reference:**

**Hazards:**

**Water depth:** **Tidal influence:**

**Monitoring type:**

| | |
|---|---|
| **Monitoring Frequency:** | |

Photo

| | |
|---|---|
| **Sample site:** | |
| **Sub-catchment:** | |
| **Site description and access:** | |
| **Grid reference:** | |
| **Hazards:** | |
| **Water depth:** | **Tidal influence:** |
| **Monitoring type:** | |
| **Monitoring Frequency:** | |

Photo

| | |
|---|---|
| **Sample site:** | |
| **Sub-catchment:** | |
| **Site description and access:** | |
| **Grid reference:** | |
| **Hazards:** | |
| **Water depth:** | **Tidal influence:** |
| **Monitoring type:** | |
| **Monitoring Frequency:** | |

Photo

# Appendix 3: Field sampling methods

**Water quality grab samples**

Sample containers shall remain unopened until time of sampling. Lids shall be placed upright, and the inside of the bottle, including the lid, should not be touched to avoid the potential for contamination.

Samples shall be collected directly into the prescribed container. Sample containers should NOT be rinsed to ensure any preservatives (e.g. for metal analysis) are not washed out.

Surface water samples shall be collected from about 5cm below the water surface, utilising a suitable device able to recover samples from a designated depth and prevent ingress of surface water. Samples containing preservatives shall be filled to maximum capacity, those not containing preservatives filled to overflowing. Sampling for analysis of TPH shall comprise a sweep across the water surface.

Care is needed to avoid potential contamination of the sample during sample collection. Sample containers shall be held at the base, and the bottle neck plunged downward below the surface. The bottle shall be turned until the neck points slightly upward and the mouth is directed toward the current. If there is no current, a current is artificially created by pushing the bottle forward horizontally in a direction away from the hand. Care shall be taken to avoid contact or disturbance of the bank or stream bed as this may cause fouling of the water and sample..

If more than one sample is to be collected from the same watercourse (e.g. open drain, stream), sampling shall commence at the location furthest downstream, and work upstream in turn.

Samples shall be transported in a cool chilli-bin, chilled to 4°C and remain chilled during transport to the laboratory. Samples shall be transported to the laboratory promptly, in accordance with maximum holding times for relevant variables being tested.

**Passive Samplers (DGTs, diffusive gradient in thin film)**

Procedures from DGT Research (www.dgtresearch.com/guides-to-using-dgt/ )

*Handling*

- Store DGT units in a refrigerator prior to use and within a plastic bag. Ensure they remain in a moist environment.
- Do not remove from the sealed plastic bag until immediately (minutes) prior to deployment.
- Only get hold of the DGT unit with clean hands.
- Do not touch the white filter at the face of the unit and do not let it come into contact with anything else.

*Deployment*

- Having placed the DGT unit in its holder or attached it to any deployment device through the hole on the unit using any fishing line, deploy the unit immediately (minutes).
- Ensure the unit is deployed in flowing (or moving) water, but avoid excessive turbulence, particularly bubbles.
- Ensure that the white face of the DGT unit is fully immersed during the deployment period.
- Provide an accurate record to the nearest minute of the deployment time and the temperature of the water during the deployment time. If the variation is within + 2oC a mean (or start and end temperature) will suffice. If the variation is greater, ideally the mean temperature should be obtained from an integrated record of temperature (data logger or chart recorder).

*Retrieval*

- On retrieval of the holder remove the DGT unit immediately (minutes), taking care not to touch the face filter.
- Rinse the DGT unit with a wash bottle stream of distilled/deionised water and shake off obvious surface water (do not dry it).
- Place in the clean plastic bag provided and seal with minimum air space. Mark on the bag. Store it in a refrigerator.

# Appendix 4: Further trigger value explanation

**Sediment**

Filtering sediments according to particle size has an important effect on the metal concentration. The ANZG (2018) recommends applying the revised default guideline values for toxicants in sediment' to the <63 um sediment fraction.

Previously, the ANZECC (2000) guidelines applied to whole sediment fractions but particles >2mm (e.g. gravels) are usually not a source of bioavailable contaminants. The silt/clay fraction (<63 um) is more likely to absorb heavy metal contaminants. Because of this it is common to normalise contaminant analysis on the basis of the clay/silt fraction. Sieving is usually undertaken to remove unrepresentative particles greater than 1-2 mm in size (e.g. rocks, shells) that might distort the analyses. However, monitoring programmes differ as to whether they focus on the <2mm fraction, <500 micron fraction or the less than 63 micron fraction. BOPRC coastal estuarine surveys are based on the <500um sediment fraction (Park 2009).

ANZG (2018), in the 'revised default guideline values for toxicants in sediment', specifies a default guideline value (DGV) and a Guideline Value – High (GV-high). The GV-high represents the median value of the effects ranking while the DGV is based on a no-observed-effects level (NOEL). As such, GV-high could be considered as more likely to be associated with biological effects than the DGV but the extent of that impact is not necessarily known.

Thus, the GV-high is recommended for use as an indicator of potential high-level toxicity problems, and the DGV is recommended as a guideline value to ensure protection of ecosystems. If a DGV is exceeded than a multiple lines-of-evidence approach is recommended to better assess the risk to a sediment ecosystem.

**Table xx**: ANZG (2018) default guideline values for sediment quality. Applicable to fine sediment fraction (<63um) and normalised to 1% OC within the limits of 0.2 to 10%.

| Type of toxicant | Toxicant | DGV | GV-high |
|---|---|---|---|
| Metals (mg/kg dry weight)a | Antimony | 2 | 25 |
| | Cadmium | 1.5 | 10 |
| | Chromium | 80 | 370 |
| | Copper | 65 | 270 |
| | Lead | 50 | 220 |
| | Mercury | 0.15 | 1 |
| | Nickel | 21 | 52 |
| | Silver | 1 | 4 |
| | Zinc | 200 | 410 |

**Stormwater**

Regional water quality classification standards and criteria reference ANZECC water quality guidelines (2000) for assessing potential adverse effects on aquatic life. ANZECC guidelines are based around continuous, long-term (chronic) exposure conditions, as opposed to the intermittent, relatively short-term (acute) exposure conditions associated with storm events. Because stormwater events are intermittent, the use of chronic guidelines values for assessing the potential for stormwater toxicants on aquatic life will tend to be overly conservative (i.e. too cautious). This may result in implementing contaminant mitigation measures that are unnecessary from an effects basis.

The US EPA water quality criteria for toxicants provide guideline concentrations for both chronic and acute exposure events (US EPA 2002). Chronic and acute guideline concentrations are referred to as criterion continuous concentrations (CCC) and criterion maximum concentrations (CMC), respectively. The CMC provides a better indication of acute effects and are appropriate to compare with short term declines in water quality during stormwater events; while the CCC (or the ANZECC guideline values) provide a better indication of chronic effects and are appropriate to compare with average or baseline monitoring results.