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STORMWATER MONITORING PROGRAMME REVIEW

For Thames Coromandel District Council

May 2022

REPORT INFORMATION AND QUALITY CONTROL

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1 BACKGROUND

Thames-Coromandel District Council (TCDC obtained comprehensive stormwater discharge consent (CSDC) for eight urban areas within the Thames-Coromandel District from Waikato Regional Council (WRC) in 2011. The WRC resource consent reference and urban area that each consent relates to is listed in Table 1 and shown in Figure 1.

Table 1: TCDC Urban Stormwater Area

CSDC – Resource Consent Reference	Urban Area
105668	Thames Coast
122521	Thames
105661	Pauanui
105663	Coromandel
105664	Tairua
105665	Whitianga
105666	Onemana
105667	Whangamata

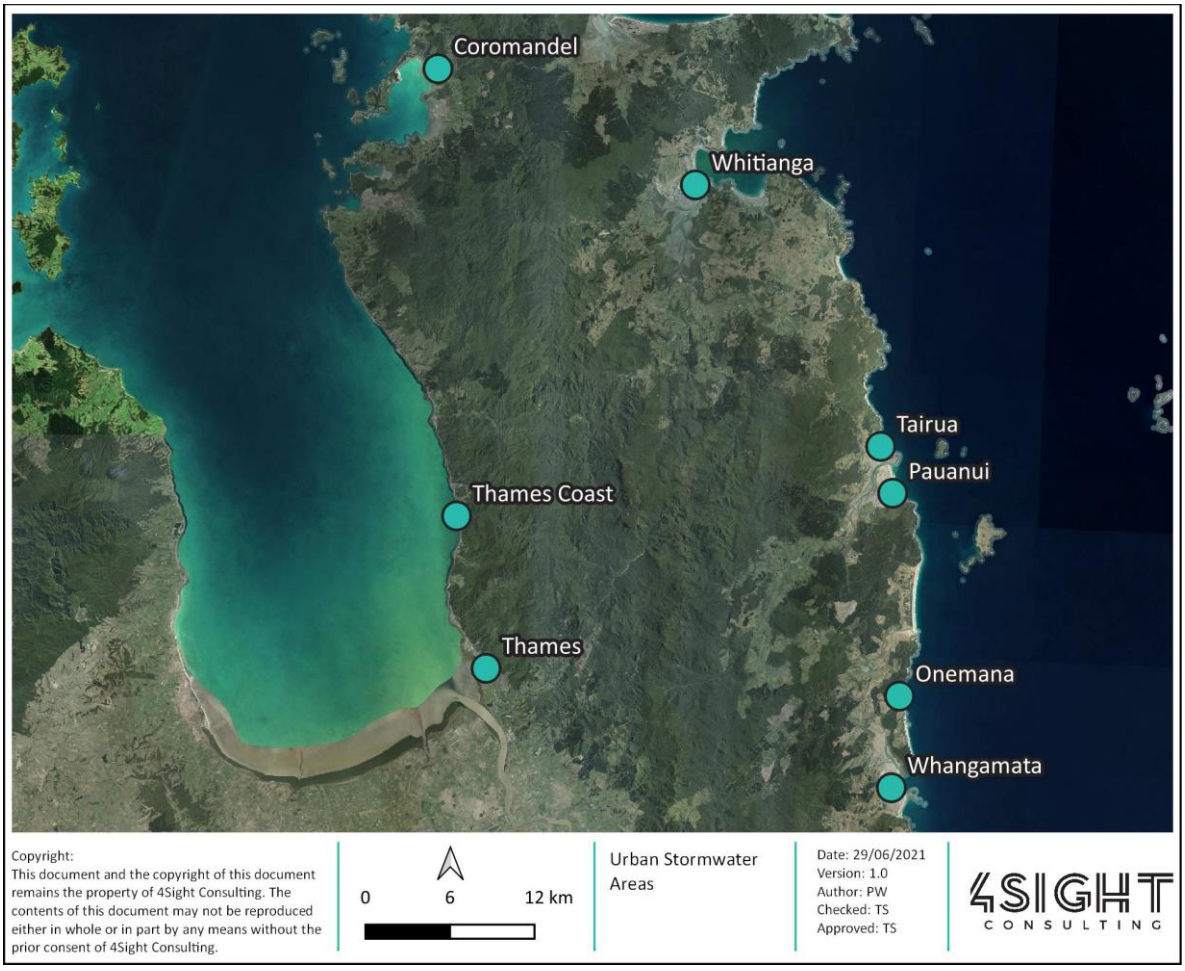

Figure 1: CSDC Urban Stormwater Locations.

The TCDC stormwater networks consist of approximately 278 km of stormwater pipes, approximately 3,900 manholes, four pump stations, stormwater inlet and outlet structures, and assorted minor drainage structures such as soakage pits, detention ponds, and stormwater treatment devices. Operation and maintenance of the stormwater network is carried out by TCDC through their contractors being Veolia Water (on behalf of the 3 Waters Business Unit) and Ventia (on behalf of the Roading Business Unit). Some of the findings from this review have included reporting from the respective contractors along with phone conversations to further understand monitoring, operation and maintenance activities.

The CSDC requires the development of a Stormwater Monitoring Programme capable of assessing the potential effects of the stormwater discharge on the receiving environment. The initial programme was developed and reported in 2013[1] and is now due for review.

1.1 Scope and Purpose

The scope of this work included a review the existing Stormwater Monitoring Programme as required by CSDC Consent Condition 4 (presented in Section 1.2). The review also considered whether the monitoring programme is fit for purpose as a tool to assess compliance with the conditions of the CSDC. This included the following:

- Review of monitoring data collected since implementation of the monitoring programme including ecological reporting;
- Review of visual monitoring completed by Veolia staff and associated annual reporting;
- Assessment of TCDC asset management practice against Consent Condition 4 to identify if there are any practices that may not be sufficiently addressed in the current Stormwater Monitoring Programme document;
- Review and commentary on best practice stormwater monitoring;
- Review and assessment of current and future monitoring drivers;
- Discussion with TCDC stormwater network and roading staff and Veolia staff as to interactions between the CSDC and stormwater network operations;
- Assessment of compliance with Condition 4; and
- Recommendations for updating the Stormwater Monitoring Programme document.

Implementation of the CSDC conditions to date was assessed based on the following key reports supplied by TCDC:

- Stormwater Monitoring Programme (2013)[1];
- Municipal Stormwater Network Operation Annual Report (2018)[2] ('the 2018 Annual Report');
- Draft Stormwater Management Plan (2020)[3] ('the SMP'); and
- CSDC Annual Report 2018-2020 (the 2020 Annual Report)[4].

The findings and recommendations of the review will be used to update the Stormwater Monitoring Programme document, which will then be submitted to WRC for approval in accordance with condition 4 before being implemented by TCDC.

[1] Baldwin, K., 2013. Stormwater Monitoring Programme: Thames-Coromandel Urban Areas. KTB Planning report prepared for Thames-Coromandel District Council.

[2] Olsen, C., 2018. Municipal Stormwater Network Operation Annual Report. Prepared by Veolia for Thames-Coromandel District Council.

[3] Gamble, K., 2020. Draft Stormwater Management Plan Thames Coromandel Areas September 2020. Thames-Coromandel District Council Report.

[4] TCDC, 2020. Annual Report: Comprehensive Stormwater Discharge Consents 2018-2020. Thames-Coromandel District Council Report.

1.2 Condition 4 - Consent Monitoring Requirements

Condition 4 of the CSDC sets out the requirements for the Stormwater Monitoring Programme, as follows.

Monitoring Programme

4) The Consent Holder shall retain appropriately qualified and experienced persons to prepare a Monitoring Programme. The objectives of the Monitoring Programme are to:

   - Investigate the actual and potential adverse effects of municipal stormwater diversion and discharge activities on the environment;
   - Provide information to refine Best Practicable Option stormwater management measures that assist the Consent Holder in avoiding, remedying or mitigating actual and potential adverse effects on the environment;
   - Assess the performance of utilised stormwater management devices to determine their overall effectiveness in managing and/or treating stormwater, and to guide the best practicable application of these devices in respective catchments;
   - Provide guidance on the ongoing and necessary changes to the Stormwater Management Plan to address any shortcomings with the operational procedures, management initiatives and implementation measures adopted by the Stormwater Management Plan;
   - Review the level of subdivision and development that is occurring in developing catchments, relative to the land use assumptions underlying the integrated catchment management approaches adopted by approved Catchment Management Plans;
   - Determine overall compliance with the conditions of the CSDC.

   As a minimum, the Monitoring Programme shall include:

   a) Monitoring to identify any adverse stormwater quantity and quality effects on aquatic ecosystems. This shall include stormwater receiving water body monitoring at targeted locations, and is likely to comprise one or more of the following activities:

      i) Visual assessments of general habitat quality and sensitivity to stormwater inputs,

      ii) Sediment quality sampling and analyses of key stormwater contaminants and sediment characteristics that aid data interpretation, and

      iii) Biological sampling and analyses of macroinvertebrate communities and fish populations;

   b) Monitoring to identify any visual signs of contaminants in stormwater (conspicuous oil or grease films, scums or foams, floatable suspended materials, conspicuous change in colour or visual clarity);

   c) Monitoring to identify any adverse scour, erosion and sediment deposition on land, property and the beds of stormwater receiving water bodies;

   d) Monitoring to identify any adverse flooding of land, property and stormwater receiving water bodies;

   e) Monitoring to identify any stormwater management structures that are impeding the upstream and downstream movement of fish;

   f) Monitoring to determine the performance of utilised stormwater management devices in managing and/or treating stormwater;

   g) Monitoring to gauge the level of subdivision and development that is occurring in developing catchments, relative to the land use assumptions underlying the integrated catchment management approaches adopted by approved Catchment Management Plans;

   h) Monitoring to ensure that all stormwater management devices are maintained in good working order, and providing best practicable stormwater management and/or treatment efficiency at all times;

i) Monitoring to determine best practicable street and stormwater catchpit cleaning operations to minimise the volume of stormwater contaminants entering the stormwater network and discharging to the receiving environment.

The Monitoring Programme shall be to a standard acceptable to the Waikato Regional Council and shall be submitted to the Waikato Regional Council for written approval in a technical certification capacity, by 31st March 2012 or such later date that may be approved in writing by the Waikato Regional Council in a technical certification capacity. Thereafter, the Monitoring Programme shall be reviewed, updated and submitted to the Waikato Regional Council for approval in a technical certification capacity, by 31st March every third year. The Waikato Regional Council will review and may alter the Monitoring Programme (in scale and/or method and/or location) after having had regard to the consistency and significance of the monitoring data collected, or any other information relating to the stormwater diversion and discharge activities authorised by the CSDC.

2 MONITORING PLAN REVIEW

The Stormwater Monitoring Programme (2013) is reviewed in this section, specifically focussing on the aspects of monitoring locations and monitoring parameters required by Condition 4(a).

2.1 Monitoring Locations

Monitoring locations and catchment descriptions are described in Section 1.3 of the Stormwater Monitoring Programme (2013). There are 15 locations in total located throughout the eight urban stormwater areas, including two control sites that are located at Thames (Moanatairi Beach foreshore) and Whangamata (Otahu Estuary).

The Thames control site was selected as there are known elevated levels of metals in sediments in the western Coromandel resulting from historic mining activities. The results from sediment monitoring near stormwater discharges in the western Coromandel should be interpreted in this context considering these historic elevated concentrations. We note that the Stormwater Monitoring Programme (2013) describes the Thames control site to be away from stormwater outlets, however, in the 2018 Kessels Ecology report, a photo is shown of a stormwater outlet controlled by a tide gate. It is unclear whether the correct location was sampled, or whether the location of the control site may be affected by stormwater discharges. If it is the latter, the control site may need to be relocated somewhere away from stormwater discharge.

The control site in Whangamata was selected because there are no industrial or commercial activities in the catchment other than some agricultural land use. Accordingly, sediment metal concentrations from eastern Coromandel locations should be interpreted considering the background metal concentrations measured at this location, which are typically lower than those measured in western Coromandel sediments.

The Stormwater Monitoring Programme (2013) does not include GPS coordinates for each monitoring location, which is highly recommended. The Kessels Ecology Reports attached to the 2018 and 2020 Annual Reports include a table of coordinates for the ecological monitoring sites; however, these appear to be incorrect locations (and geographical projection). Consequently, it is difficult to understand where each of the monitoring locations is from the annual and ecological reports. It is recommended that GPS coordinates are confirmed for each monitoring location and a map produced showing their locations.

Descriptions of the monitoring locations are provided in the Stormwater Monitoring Programme (2013), which were used in this review as a general guide to where the monitoring locations likely are.

The stormwater network has been expanded to accommodate urban growth in the Coromandel since the Stormwater Monitoring Programme was developed in 2013. Such changes are documented in Appendix 4 of the 2020 Annual Report. It is recommended that the location of monitoring sites is reassessed to ensure that these additional areas are captured by the current monitoring design. It is unlikely that substantial change to the monitoring location would be required as it appears that the majority of new areas drain to existing discharge points.

There are six sites allocated to Whangamata, which may be disproportionate to the potential level of effect or expected stormwater discharges. However, it appears that most of the sites in Whangamata are focussed on discharges with industrial activities in the catchment, which have the potential to contribute higher contaminant levels than other urban areas. Following a site visit, reallocation of monitoring sites may be warranted. Sites could be prioritised around

estimated stormwater volumes (provided in Appendix 4 of the 2020 Annual Report), catchment risk (described in the Stormwater Monitoring Programme (2013)), and the 'high risk outlets' (Appendix A of the Draft Stormwater Management Plan (September 2020)). Consideration may also be given to including monitoring locations at Thames Coast and Onemana, which form part of the CSDC but have no monitoring locations; however, these catchments are likely to be low risk as they are relatively small development areas and do not have industrial activities.

2.2 Monitoring Parameters

2.2.1 Sediment quality

The Stormwater Monitoring Programme (2013) lists the following parameters for sediment quality analysis:

- Heavy metals (As, Cd, Cr, Cu, Ni, Pb, Zn);
- Total organic carbon (TOC); and
- Polycyclic aromatic hydrocarbons (PAHs).

These parameters are still considered appropriate for monitoring the potential effects of urban stormwater on the receiving environment. Heavy metal analyses could be restricted to copper, lead, and zinc, as these are the most likely urban contaminants.

2.2.1.1 Sediment quality guideline values

In the Stormwater Monitoring Programme (2013), sediment quality guidelines values were taken from the ANZECC (2000) guidelines; specifically, the Interim Sediment Quality Guidelines (ISQG). These were the most appropriate source of sediment quality guideline values at the time this programme was developed. The ANZECC guidelines were revised and renamed in 2018 to the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018). The primary source of the most current guidelines is via the ANZG website (waterquality.gov.au).

The only guideline values that have changed since ANZECC (2000) are those for total PAHs; updated values are shown in Table 2. The updated guidelines values for PAHs have increased from their previous values (i.e., less conservative), most notably for the DGV (lower guideline value). A revised monitoring plan should include these new values.

Table 2: Recommended toxicant default guideline values for sediment quality. Note the only guideline values to be revised since ANZECC (2000) are those for total PAHs.

Parameter	ANZECC (2000)		ANZG (2018)	
	ISQG-Low	ISQG-High	DGV	GV-high
Total Recoverable Arsenic (mg/kg dry wt)	20	70	20	70
Total Recoverable Cadmium (mg/kg dry wt)	1.5	10	1.5	10
Total Recoverable Copper (mg/kg dry wt)	65	270	65	270
Total Recoverable Lead (mg/kg dry wt)	50	220	50	220
Total Recoverable Nickel (mg/kg dry wt)	21	52	21	52
Total Recoverable Zinc (mg/kg dry wt)	200	410	200	410
Total PAHs* (µg/kg dry wt)	4,000	45,000	10,000	50,000

* Normalised to 1% organic carbon within the limits of 0.2 to 10%.

2.2.2 Ecological assessment

The Stormwater Monitoring Programme (2013) states that ecological monitoring should be conducted generally following the methods used by Gerry Kessels & Associates June 2001, which were conducted to support the application for the CSDC, and in accordance with the Waikato Regional Council methodology used for the Regional Ecological Monitoring of Streams (REMS). In general, the approach is based on three ecological health indicators:

- Aquatic plant growth composition and percentage cover;

- Aquatic benthic macroinvertebrate diversity and distribution; and
- Identification of potential native freshwater fish habitat and potential barriers to fish migrations.

Aquatic plant growth

Visual assessments of aquatic vegetation were conducted by Kessels Ecology during the 2014 ecological monitoring. Percentage cover was reported in the monitoring report. This is considered to be an appropriate approach and is consistent with industry practice.

Benthic macroinvertebrates

Stormwater is discharged into freshwater and marine environments and each of these have different sampling techniques for macroinvertebrates. The monitoring programme only includes a description of methods for freshwater environments, which are generally in accordance with the protocols used at the time by Waikato Regional Council for their Regional Ecological Monitoring of Streams (REMS). Based on the Kessels Ecology Reports (2014 and 2018) a qualitative approach was taken (i.e., presence/absence and noting particularly abundant taxa), rather than a quantitative approach (identifying and counting all biota) that is used by regional councils. The information gathered using a the current (qualitative) approach could not be easily compared to regional council State of the Environment monitoring data, for example.

In 2001, the Ministry for the Environment released a protocol for sampling macroinvertebrates in wadeable streams.[5] Waikato Regional Council updated their field protocols and laboratory processing procedures for the REMS programme in 2002 to conform with these revised protocols. The updated protocols were followed by Kessels Ecology in their 2014 and 2018 ecological monitoring. A revised monitoring programme should be updated to include reference to these more recent protocols.

The 2014 and 2018 ecological monitoring conducted by Kessels Ecology assessed estuarine locations by inspecting epifauna (surface-dwelling fauna) that were visible on the surface or attached under rocks. This approach is similar to that used for freshwater sites (i.e., qualitative). Although this provides a high-level overview of larger organisms at the location, there is limited information available to compare these results to. Similar to the freshwater approach, results could not be compared to regional council State of the Environment data.

A standard approach to assess benthic ecological communities in marine environments is to take a sediment core of a known volume, sieve the sample to remove fine sediments, separate biota from the debris, and count and identify biota down to the lowest practicable taxonomic level. Sediment grain size should also be measured as this is a key explanatory variable for benthic macroinvertebrate communities. Results from this approach could be compared to State of the Environment monitoring conducted by Waikato Regional Council, where available. Such an approach could be considered in a revised monitoring programme.

Identifying and quantifying biota in freshwater and marine environments would provide a more robust indicator of the benthic communities, however, this approach requires experienced taxonomists at additional time and cost to the existing programme. Consideration should be given to whether such an approach is warranted when considering the relatively low level of effects identified by the monitoring to date.

Freshwater fish habitat and potential barriers to fish migrations

Freshwater fish habitat and passage at the stormwater outlets is described for each site in the Kessels Ecology (2018) report (Appendix 8 of the 2020 Annual Report). A high-level description is also provided that encompasses general observations across all monitoring sites. The approach and commentary are considered appropriate to assess the fish passage capability of stormwater network assets.

2.3 Gaps or Issues

- Confirm that the location of the Thames control site is not by a stormwater outlet.
- It is noted in the 2018 Annual Report, Appendix B, that sediment samples were collected at 4-yearly intervals (2014 and 2018) and results presented for heavy metals and TOC, but not for PAHs. It is not clear why PAHs were

[5] https://environment.govt.nz/publications/protocols-for-sampling-macroinvertebrates-in-wadeable-streams/

omitted from these tables, however, there is reference to 'Hydrocarbon results' in the Results Commentary and there are results for PAHs in the Laboratory Report, indicating that they were measured. It is recommended that PAH results are included in future reporting.

- Ecological monitoring currently does not include the most appropriate monitoring protocols for estuarine locations.
- Correct GPS coordinates are missing/incorrect for the monitoring locations.

3 REVIEW OF AVAILABLE DATA

This section summarises available data and information that has been reviewed, including discussions with TCDC and Veolia staff. The findings will inform how the Stormwater Monitoring Programme will be revised to align with the requirements of Condition 4. Notably, the requirements of Condition 4 (b) – (i) are not addressed in the 2013 Stormwater Monitoring Programme report and therefore should be addressed going forward.

3.1 Sediment Quality

Sediment quality results are presented for sampling conducted in 2014 and 2018 in the 2018 Annual Report (Appendix B). No conclusions can be made regarding trends from two years' data due to natural variability and a requirement for a higher number of data points to statistically identify trends.

In general, sites on the eastern Coromandel (Sites 5, 7–15) have lower concentrations of typical stormwater contaminants (copper, lead, and zinc) than at sites on the western Coromandel (Sites 1–4, 6). The highest exceedance of typical stormwater contaminants, however, was at site 12 – Whangamata: Aicken Rd, where lead was 7.5 times higher and zinc was 1.5 times higher than the respective ISQG-high guidelines in 2014. Results from the same locations in 2018 were both below the ISQG-low value and it is unclear why such high concentrations were measured in 2014.

Elevated levels (exceeding ISQG-high) of arsenic were measured at Site 3 – Thames: Burke St outlet and Site 9 – Whitianga: Moewai Road north – drain outlets in 2014. Arsenic is a known contaminant from historic mining activities, however, this may be unexpected at Site 9 in Whitianga. Arsenic concentrations at Site 9 – Whitianga were below ISQG-low in 2018. Again, it is unclear why such elevated concentrations were measured in 2014.

No summary was presented for PAHs in the 2018 Annual Report, however, the text description notes that there were some small exceedances of the ISQG-low guideline at some sites, and there was some variability between years. No sites were reported to exceed the ISQG-high value. Laboratory results for only 2018 are included in the 2020 Annual Report (Appendix 7) and so it could not be confirmed that PAHs were measured in 2014. The revised ANZG (2018) guideline values are less conservative than the ANZECC (2000) guidelines used in the reporting to date, so sites are likely to be similar or better when compared to the revised guideline values.

3.2 Ecological assessment

Aquatic macroinvertebrate assessments showed high variability among sites. This is not surprising considering the diverse range of habitats and discharging environments, ranging from small urban streams to large, well-flushed estuaries. The most common species identified at the sites were the tunnelling mud crab and mud snail, indicative of the muddy sediments at most locations.

There were no substantial differences in aquatic macroinvertebrates noted in the 2014 or 2018 Kessels Ecology reports regarding the control sites relative to the monitoring sites or notable changes between the sampling years. Identifying such differences or change with high variability will likely be very difficult. Further, assessing epifauna (surface-dwelling organisms) only in marine locations is likely to limit the ability to detect potential differences among locations or changes over years. Sampling within a few days of heavy rain is also unlikely to give freshwater locations sufficient time for macroinvertebrates communities to recolonise. Consideration is warranted as to whether this is an appropriate approach in the revised monitoring programme.

Green filamentous algae was identified at Sites 10 (Whangamata: Casement Road) and 13 (Whangamata: Lindsay Road); such algae can be an indicator of nutrient enrichment. Both locations are small, urban streams that are likely poorly flushed and will have warm water temperatures over the summer months. Such conditions are favourable for algal growth.

In general, there was little vegetation around the stormwater outlets and this is unlikely to provide more than occasional habitat for fish. Fish were observed during ecological sampling, however, indicating that they are present, at times. During high tides at estuarine sites, fish passage is likely to be freely accessible so long as flow speeds in the pipe are not too high; accessibility at low tide is likely to be difficult at most locations. The stormwater outlet is placed high relative to the water at Site 11 - Whangamata: Heatherington Road, which would prevent fish passage.

3.3 Visual observations

Overall, the visual monitoring shows a general improvement over time of the stormwater outlet locations. Notably, The Thames Wharf outlet has been broadened and had mangroves cleared to help reduce sedimentation.

There appears to be evidence of some sedimentation at many locations, but the contribution of sediment from urban-derived stormwater relative to upstream diffuse catchment-derived sources is unclear.

Site 5 - Pauanui: Shepard Avenue is the only site to have recorded erosion in the 2020 Annual Report. The drain at this location is higher than the sand, so will act as a groin and has the potential to inhibit sand movement along the beach.

In their 2018 Annual Report, Veolia checked for the presence of visual signs of contaminants in stormwater where generally no significant observations were noted. Some sites noted the presence of algae (Marquet Place), along with what is assumed to be iron bacteria (Casement Road, Meowai Road). Litter was observed at several outlets while an oil slick was present at Lindsay Road which in part serves industrial and commercial land uses. In addition to the Veolia observations, TCDC/Veolia responded to seven pollution incidents as reported in the 2020 Annual Report. Two of these were 'non-routine' (i.e., accidental or deliberate as defined in the SMP) discharge incidents comprising oil and water in a drain outside an automotive business in Thames and the washing of a concrete truck in a residential street in Thames. Appendix D of the SMP document outlined the Standard Operating Procedure for TCDC staff to refer to when responding to non-routine contaminant discharge incidents, including contacting WRC pollution staff.

3.4 Flooding

The 2020 Annual Report recorded the location of flooding events that occurred on private and public property. The SMP describes the service levels and performance measures for TCDC and contractor staff in responding to such incidents. It is assumed that the outcome of each incident (i.e., clean up and/or preventative works) was recorded at the time through the TCDC Pathways system. Asset management initiatives including flood mitigation are included in the SMP in line with the Service Levels and Performance Measures for Stormwater.

3.5 Fish Passage

The 2020 Annual Report discussed the findings from the ecological survey carried out by Kessels Ecology Limited in 2018. That survey noted that most of the survey sites were estuarine such that during high tide fish passage would be enabled. The 2018 Annual Report by Veolia notes that no stormwater management structures have been identified as a priority in terms of mitigating the effects of structures on fish movement. As noted in the section above, the current approach to monitoring fish passage from existing structures is considered fit for purpose. It is expected that new structures and assets should be designed in a manner to avoid barriers to fish passage.

3.6 Stormwater Management Devices

Condition 4 (f) and (h) relate to monitoring the performance of stormwater management devices and the maintenance of such devices. A list of the stormwater management device type and locations are listed in Appendix E of the SMP document along with the associated contractual maintenance responsibilities being fulfilled by 3 Waters (Veolia) or Roading (Ventia) contracts. The stormwater treatment devices are predominantly rain gardens, located in the Whitianga urban area, a selection of detention ponds along with several proprietary treatment devices such as Hynds First Defence (gross pollutants) and Hynds Upflo Filters. Notably, given the number of raingardens in the Whitianga area, maintenance practices are specifically detailed in the SMP document for implementation through the Roading Department and their contractor.

Direct monitoring of the performance of stormwater management/treatment devices as directed by condition 4(f) is, in our experience, uncommon. Gathering a statistically reliable dataset to assess against relevant stormwater

treatment guidelines or standards, for example, would have high cost and logistical requirements that are unlikely to be commensurate with the potential level of effect. Devices such as detention ponds generally operate by maintaining an operating volume that is discharged via specifically designed outlet structures where efficiency can be influenced by matters such as sediment accumulation and inlet/outlet blockage as well as contributing catchment assumptions. It may be anticipated that a stormwater management/treatment device is performing satisfactorily as long as an appropriate maintenance regime is maintained.

Further, by conducting appropriate monitoring in the receiving environment, the performance of the stormwater management/treatment devices can be inferred. For example, if the receiving environment is not increasing in stormwater-derived contaminants, ecological communities are similar to areas that are not affected by stormwater, there is no substantial scouring near the discharge location, and no flooding is occurring, it can be inferred that the stormwater devices are performing satisfactorily.

It is noted the performance outcome of the stormwater treatment or management device design in New Zealand, including the Waikato Region over the past 20–30 years has typically been informed by a recognised design guideline (e.g., ARC TP10[6]). Here an effluent quality outcome such as 75% TSS removal, or stormwater detention/attenuation for selected rainfall events is embedded to device design and construction. Using this guideline approach, device performance is generally accepted in coordination with scheduled inspection and maintenance protocols which align with the outcomes sought by Condition 4(f), namely understanding the performance of stormwater management devices. This approach appears to be validated in the district with respect to stormwater discharges from the urban areas and limited trends in adverse effects emerging in the receiving environment monitoring discussed above.

In conversation with TCDC staff[7], inspection and maintenance of stormwater treatment and management devices is carried out in accordance with the responsibilities outlined in the SMP document (Refer Sections F, G and H of the SMP). Notwithstanding, some clarification is recommended to the revised Stormwater Monitoring Programme to capture the implementation of Conditions 4 (f) and (h), which are currently being undertaken by TCDC and their contractors. This could include documented protocols or references for device inspection and maintenance (e.g., if this information is stored in the TCDC asset management system). Further, a gap analysis of the stormwater network and roading maintenance contracts and associated asset register could assist with confirming all management devices are subject to periodic inspections (if this does not already take place).

3.7 Monitoring of subdivision and development

Appendix D of the SMP outlines the administrative process for adopting new stormwater networks into the CSDC conditions. This has been documented in the 2020 TCDC Annual Report where it is understood the additional network has been approved by the Waikato Regional Council for the discharges to be authorised under the CSDC. A high-level review of the new network and associated land use concludes development type is predominantly residential with some single site industrial and industrial/commercial subdivision in Kopu and Thames.

A cross check of the new networks versus the locations of treatment devices listed in the SMP document indicates the application of stormwater treatment/management devices across the district are consistent with the management initiatives detailed in the SMP document. It is assumed that the SMP is equivalent to the 'Catchment Management Plan' terminology used in the CSDC. In terms of new stormwater network, reference in the Stormwater Monitoring Programme could include how new assets are vested and incorporated into inspection and maintenance schedules so that other monitoring requirements such as in Condition 4 (f) and (h) can continue to be implemented.

3.8 Street and catchpit cleaning

Street and catch pit cleaning frequencies are detailed in the SMP document under the responsibility of the roading maintenance contractor Ventia. This includes inspecting all stormwater structures (and cleaning if required) every six

[6] Stormwater Management Devices Design Guidelines Manual, Auckland Regional Council, 1992 and 2003.

[7] pers. Comm Ed Varley and Cliff Olsen

months. Inspection and cleaning frequency for urban streets and CBD streets (more frequent) is also outlined which includes removal of detritus and litter (gross pollutants).

4 CONDITION 4 ASSESSMENT

The following table summarises the requirements of Condition 4 along with the outcomes of the review discussed in the preceding sections of this report.

Table 3 Condition 4 Objectives

Condition 4 Objectives	Current approach	Comments
Investigate the actual and potential adverse effects of municipal stormwater diversion and discharge activities on the environment.	Addressed by a combination of visual assessment, sediment quality monitoring, and ecological assessments.	Current approach appropriate to assess the effects of stormwater network discharges throughout the district. Refer to recommendations in Section 5.2 detailing how the Monitoring Programme can be improved.
Provide information to refine Best Practicable Option stormwater management measures that assist the Consent Holder in avoiding, remedying or mitigating actual and potential adverse effects on the environment.	Receiving environment data coupled with current network management practices represent the current BPO while providing a framework for improvement as outlined through the various sections of the SMP.	Current approach appropriate.
Assess the performance of utilised stormwater management devices to determine their overall effectiveness in managing and/or treating stormwater, and to guide the best practicable application of these devices in respective catchments.	Given the stormwater management devices have predominantly been designed in accordance with a guideline document, performance is generally linked to inspection and clean out (where necessary) as is outlined in the SMP. Performance can also be inferred based on results from the receiving environment monitoring.	Current approach appropriate. A gap analysis of the maintenance contracts and associated asset register could assist with confirming all management devices are subject to periodic inspections (if this does not already take place).
Provide guidance on the ongoing and necessary changes to the Stormwater Management Plan to address any shortcomings with the operational procedures, management initiatives and implementation measures adopted by the Stormwater Management Plan.	Generally covered by the SMP document.	This condition appears to be implying an adaptive management approach. SMP could be updated to make this process clearer using various components already being implemented by TCDC/and or to be implemented.

Condition 4 Objectives	Current approach	Comments
Review the level of subdivision and development that is occurring in developing catchments, relative to the land use assumptions underlying the integrated catchment management approaches adopted by approved Catchment Management Plans.	Reported in the 2020 CSDC Annual Report. The underlying land use assumption has not been reviewed; however, it is assumed that development has generally occurred in accordance with District Plan zoning and /or operative resource consents. A high-level review of the new stormwater network concludes alignment with stormwater management outcomes detailed in the SMP.	Current approach appropriate.
Determine overall compliance with the conditions of the CSDC.	Reported in the 2020 CSDC Annual Report. Various commentary has also been included in this report.	

Table 4 Condition 4 Requirements

Condition 4 reference	Condition	Current approach	Comment
a	Monitoring to identify any adverse stormwater quantity and quality effects on aquatic ecosystems. This shall include stormwater receiving water body monitoring at targeted locations, and is likely to comprise one or more of the following activities:	See below.	
a i)	Visual assessments of general habitat quality and sensitivity to stormwater inputs.	Twice-yearly visual inspections, including photographs and site descriptions of vegetation, visible fauna, visible water quality attributes (e.g., foams, scums, algae, clarity). Four-yearly ecological assessments, including vegetation and fish habitat.	Current approach appropriate.

Condition 4 reference	Condition	Current approach	Comment
a ii)	Sediment quality sampling and analyses of key stormwater contaminants and sediment characteristics that aid data interpretation.	Four-yearly sampling approximately 1–3 m from stormwater outlet. Samples analysed for heavy metals, TOC, PAHs.	Sediment parameters and frequency appropriate. Could reduce metals to copper, lead, and zinc. PAH results not included in 2018 annual report [Appendix 7] but text description and laboratory reports indicate that it was completed. Potentially reassess monitoring locations considering urban growth areas.
a iii)	Biological sampling and analyses of macroinvertebrate communities and fish populations.	Four-yearly sampling for macroinvertebrates near the stormwater outlet. Currently a combination of freshwater and marine approaches. Primarily species absence/presence and noting particularly abundant species. Marine location only included surface-dwelling fauna (epifauna). Fish habitats were identified during sampling and opportunistic fish sightings were recorded.	The representativeness of sampling locations may need to be reassessed as a result of some urban growth since 2013. Site selection to be refined following a site visit. Absence/presence of epifauna in the marine environment may be sufficient, but could alternatively collect sediment cores and quantitatively assess benthic macroinvertebrates, in line with WRC estuarine monitoring. Methods for fish monitoring appropriate (opportunistic sightings during ecological surveys). More thorough fish surveys not recommended.

Condition 4 reference	Condition	Current approach	Comment
b)	Monitoring to identify any visual signs of contaminants in stormwater (conspicuous oil or grease films, scums or foams, floatable suspended materials, conspicuous change in colour or visual clarity).	Twice-yearly visual inspections, including photographs and site descriptions of vegetation, visible fauna, visible water quality attributes (e.g., foams, scums, algae, clarity).	Add this requirement to the revised Stormwater Monitoring Programme document. Adverse effects on water quality from a low-quality stormwater discharge are likely to revert to ambient conditions shortly (12–24 hours) after the low-quality discharge stops. Twice yearly observations are unlikely to capture such events. Possibly captured by community complaints/reports.
c)	Monitoring to identify any adverse scour, erosion and sediment deposition on land, property and the beds of stormwater receiving water bodies.	Twice-yearly visual inspections, including photographs and site descriptions.	Add this requirement to the revised Stormwater Monitoring Programme document. Current approach appropriate.
d)	Monitoring to identify any adverse flooding of land, property and stormwater receiving water bodies.	Documented in the SMP along with TCDC/contractor response protocols.	Add this requirement to the revised Stormwater Monitoring Programme document, including how flood complaints/event data is captured Captured by routine inspections and community complaints/report.
e)	Monitoring to identify any stormwater management structures that are impeding the upstream and downstream movement of fish.	Conducted during ecological surveys.	Add this requirement to the revised Stormwater Monitoring Programme document. Current approach appropriate.

Condition 4 reference	Condition	Current approach	Comment
f)	Monitoring to determine the performance of utilised stormwater management devices in managing and/or treating stormwater.	Inferred from a combination of the above monitoring and inspection and clean out protocols outlined in the SMP.	Add this requirement to the revised Stormwater Monitoring Programme document. Current approach appropriate. Also refer to commentary in the table above.
g)	Monitoring to gauge the level of subdivision and development that is occurring in developing catchments, relative to the land use assumptions underlying the integrated catchment management approaches adopted by approved Catchment Management Plans.	Refer to commentary above as similar text to condition objective above.	Current approach appropriate.
h)	Monitoring to ensure that all stormwater management devices are maintained in good working order, and providing best practicable stormwater management and/or treatment efficiency at all times.	Refer to commentary above as similar text to condition pre-amble.	Current approach appropriate.
i)	Monitoring to determine best practicable street and stormwater catchpit cleaning operations to minimise the volume of stormwater contaminants entering the stormwater network and discharging to the receiving environment.	Forms part of the SMP re street cleaning and catchpit cleaning protocols.	Current approach appropriate. Reporting on street cleaning practices by Ventia (e.g. in the annual report) would assist to confirm what has been done and where along with the provision for process improvement.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Review summary

The monitoring programme is generally satisfactory to infer receiving environment effects associated with stormwater discharges from the consented urban areas in the Thames Coromandel district. The recommendations below will further enable assessment of compliance with the conditions of the CSDC and the environmental outcomes anticipated when the consents were assessed.

5.2 Recommendations

The Stormwater Monitoring Programme was developed in 2013 and has not been reviewed until now. It is recommended that the monitoring programme is revised in line with the following recommendations:

- Reassess the representativeness of monitoring locations following a site visit.
- Confirm whether the Thames control site is located by a stormwater outlet or not.
- Consider including monitoring locations at Thames Coast and Onemana or providing explanation in the revised monitoring programme as to why it is considered appropriate to exclude these locations.
- Include GPS coordinates for all monitoring sites.
- Sediment quality results should include PAHs in the summary table.
- Sediment heavy metal analyses could be restricted to the most likely urban contaminants: copper, lead, and zinc.
- Sediment quality guidelines should be updated to the latest ANZG (2018) values.
- Ecological sampling protocols at freshwater sites updated to align with the most recent Ministry for the Environment 2001 protocol. Consider quantitative assessments and identification of all macroinvertebrates to makes results comparable to regional council State of the Environment data.
- Ecological sampling protocols at marine sites could be modified to include sampling of sediments for benthic macroinvertebrates to align with regional council State of the Environment estuarine monitoring.
- An update to the Stormwater Monitoring Programme is recommended to reference all subsections of Condition 4 (i.e., 4(b) – (i)) and the methods/procedures implemented by TCDC to assist with achieving compliance, which are not detailed in the current monitoring programme. This will result in the methods to implement Condition 4 being described in a single document and, while not duplicating information, will contain appropriate reference to how subsections of Condition 4 are being implemented.
- As a result of the various information resources reviewed for this project and the recommendations made for the Stormwater Monitoring Programme, subsequent edits to the SMP document may improve its implementation. For example, the role of the Stormwater Monitoring Programme is not currently discussed in the SMP and it may be of assistance to detail a process (for example through adaptive management), for the SMP to respond to Condition 4 monitoring results. This appears to be sought in the Condition 4 objectives and would provide a linkage between monitoring results and stormwater network management.