Municipal Storm water Network Operation Annual Report

August 2018

Written By: C Olsen
Reviewed By:

Introduction

The Thames-Coromandel District Council (TCDC) owns and maintains storm water networks within each urban area within the Thames-Coromandel District. The Council networks consist of approximately 231 km of storm water pipes, almost 8,300 manholes, four pump stations and assorted minor drainage structures such as soakage pits, detention ponds and storm water inlet and outlet structures. Some infrastructure dates back as far as the 1920's, however, condition assessments have shown infrastructure to be in good condition despite its age.

The Waikato Regional Council has issued Comprehensive Storm water Discharge Consent (CSDC) for eight urban areas in the Thames-Coromandel District. Condition 6 of the eight CSDC's requires TCDC to submit an annual report detailing the management and operation of the storm water networks for the year ending June 30th.

Summary of Storm water Network Management Provisions

The following table sets out the following:

- A summary of the operations procedure, management initiatives and implementation methods
- A summary of the main storm water infrastructure works
- A summary of the information gathered and analysed through the Monitoring Programme

Operational Procedures	Implementation Methods	Performance Measure	Summary Comments	Outcomes/Actions Taken
1. Storm-water Operation & Maintenance Services Contract (Utilities Contract)	Summary Report provided by TCDC Utilities Engineer that provides commentary on the following methods:	Summary Report provided?		
	a) Ensure that SW network maintenance is provided in Contract documents	a) Yes	Maintenance of storm water network is provided by in contract documents between TCDC and Veolia.	
	b) Monitoring of contract outcomes by TCDC staff to ensure SW network is functioning effectively	b) Yes	TCDC staff send through Request for Service (RFS's) in relation to the storm water network. Time periods for completion are stipulated and penalties are imposed where there is a failure to comply.	
	c) Ensure KPI's of contract documents are achieved	c) Yes	Veolia has its own KPI's for completion of RFSs, as well as those imposed in the contract. Penalties are imposed where there is failure to achieve KPI's. Achievement is reported monthly. Subject to Audit by Audit NZ	
	d) Provision by contractor of Annual Report on Storm water Network Operations and Maintenance (Utilities)	d) Annual Report written into contract No	No provision of a storm water annual report in contract documents. However a completed 2017-18 storm water activity log is attached to this report	

	e) Annual Report to identify the following works: • Major maintenance activities on SW network • Major upgrades to SW network • Spill response activities (if any) • Response to RFS re SW network	e) Annual report provided by contractor Yes	•	
2. Roading Contract	Summary Report provided by TCDC Utilities Engineer that provides commentary on the following methods:	Summary Report provided?		
	a) Ensure that SW network maintenance is provided in Contract documents	a) Yes/No	Road maintenance contract documents specify intervention criteria for roading storm water structure maintenance which is completed by the contractor as a cyclic activity.	
	b) Monitoring of contract outcomes by TCDC staff to ensure SW network is functioning effectively	b) Yes/No	Monthly cyclic inspections are carried out by Opus as Councils roading professional service provider which involves checking that the maintenance contractor is doing what they are contracted to do.	
	c) Ensure KPI's of contract documents are achieved	c) Yes/No	As above	
	d) Provision by contractor of Annual Report on Storm water Network Operations and Maintenance (Utilities)	d) Annual Report written into contract Yes/No	The road maintenance contractor is not required to provide an annual report, however they are required to provide an inspection report on a monthly basis	
	e) Annual Report to identify the following works: • Major maintenance activities on SW network	e) Annual report provided by contractor Yes/No	Maintenance procedures of roading storm water systems are detailed including intervention criteria in the road maintenance contract.	

	• Major upgrades to SW network • Spill response activities (if any) • Response to RFS re SW network			
3. Storm-water Monitoring Programme	Annual Report provided by TCDC Utilities Engineer that provides commentary on the following methods and outcomes of the Monitoring Programme:	Annual Report completed?		
	a) Visual Inspections (bi-annual report)	a) Bi-annual inspections Yes	Results of inspections contained in Appendix A.	
	b) Sediment testing (four yearly report)	b) Sediment testing Yes	Results of sediment testing and comparisons to ANZECC Guidelines contained in Appendix B.	
	c) Ecological Monitoring (four yearly report)	c) Ecological Yes	Ecological Assessment carried out by Kessels Ecology contained in Appendix C.	
	d) Observations and Outcomes	d) Do the outcomes improve SW quality or management – Yes/No	Action has not been considered in response to the findings	
		Have the monitoring results been utilised to determine appropriate management initiatives that	.	

		will be implemented through a revised SMP?		
4. Renewals and replacement of SW infrastructure	Summary Report provided by TCDC Utilities Engineer that provides commentary on the following implementation methods:	Summary Report provided?		
	a) Asset condition assessments and modeling programmes are used to plan the renewals and replacement programme (if any) of the Activity Management Plan	a) Yes/No	Yes. Failure rates are included to data applied to determining replacement programmes	
	b) Renewals and replacement to be identified in the Annual Plan	b) Yes/No	Yes	
	c) The renewals and replacement programme considers accepted best practice techniques and low impact engineering design (e.g. TP10) to ensure the continued effective operation of the network	c) Yes/No		
5. New Assets	Summary Report provided by TCDC Development Engineer or Utilities Engineer that provides commentary on the following methods:	Summary Report provided?		
	a) Subdivision and land use consents require compliance with Code of Practice and District Plan (where relevant)	a) Yes/No		

	b) District Plan and Code of Practice encourages low impact engineering design as set out in NZS4404:2010 and TP10	b) Yes/No		
	c) Engineering approval (e.g. s 224(c) RMA for subdivisions) encourages low impact engineering design as set out in NZS4404:2010 and TP10	c) Yes/No		
	d) New SW assets are included in asset management database	d) Yes/No		
	e) New SW assets are to be included in the SW Monitoring Programme where high risk catchments are identified	e) Yes/No		
6. Public Education Programme	Summary Report provided by TCDC Utilities Engineer that provides commentary on the following methods:	Annual Report provided?		
	a) General Education Programme – re-development and implementation	a) Yes	Builds upon a storm water education project first carried out by TCDC in the summer of 2000/2001. The programme will also include rates information mail outs in the form of pamphlets or articles in rating information. It is also suggested that storm water education information could be provided on the TCDC website.	
	b) Targeting Education Programme	b) Yes	Programmed aimed at high risk facilities or activities to encourage best practice storm water management within individual sites. It is	It is recommended that the targeted education

			anticipated that the programme will include regular site visits by Council staff to educate about the potential effects of storm water discharge. An additional information pamphlet with advising owners and operators of their responsibilities and best practice methods is considered an appropriate tool to improve storm water quality. This programme will also include information about the Standard Operating Procedures for responding to non-routine discharge incidents.	programme is developed and implemented, particularly in regards to high risk facilities in industrial areas of Whangamata and Whitianga.
	c) Town Centre Upgrades – educational information	c) Yes	Educational signs on storm water drains have been included in recent town centre upgrades (Thames and Whangamata).	This will continue to be promoted as part of future town centre upgrades and urban regeneration projects as these occur.
7. On-going staff training	Staff training for storm water management covering the following:	Staff training undertaken?		
	a) NZS4404:2010	a) Yes	Asset management staff who are responsible for managing the storm water network are continuing professional development and further education programmes.	
	b) Auckland Council TP10 Guidelines	b) Yes	Asset management staff who are responsible for managing the storm water network are continuing professional development and further education programmes.	
	c) Other	c) Yes	The consent holder will ensure that Standard Operating Procedures (SOP's) are	

			readily available to all customer service staff and that an appropriate level of in-house training has been provided to all new staff to ensure that the procedures are understood. TCDC response staff, such as the Area Managers and Monitoring and Enforcement Officers, will be given an appropriate level of training on the SOP's. Availability of spill response kits will be identified to ensure that the kits are available as soon as possible.	
8. Removal of illicit connections	Illicit connections identified and appropriate action taken to remove connection and/or undertake enforcement action if required	Illicit connections identified and removed (if any) Yes/No	There is currently no pro-active monitoring for illicit connections. Contractors, field reps and building inspectors are required to identify illicit connections and take appropriate steps to ensure their removal, once found.	

Details of Non-routine Contaminant Discharge Incidents

The following table provides a summary of all non-routine discharge events and a full schedule of the details of contaminant incidents including the outcomes of these events.

Date	Time	Description	Estimated Volume	Offender	Outcome	Officer	WRC Notified	Resolved

Summary of Level of Compliance with Conditions of Consent

The following table summaries the level of compliance achieved with the conditions of this consent, including any reasons for non-compliance or difficulties in achieving compliance.

Comprehensive Storm water Discharge Consent			
Conditions	**Compliance**	**Evidence of Compliance**	**Notes, Difficulties & Improvements**
General Conditions (Schedule A)	1. Design, structural integrity and maintenance of the storm water network		
	2. Changes to the storm water network		Included to the report in the storm water Activity log for 2017-18
	3. Best practicable option		
	4. Technical certification requirements for new storm water diversion and discharge activities		
	5. Consent Holder asset management activities		
	6. Adverse storm water quantity effects		Included to the report in the storm water Activity log for 2017-18
	7. Procedure for addressing adverse storm water quantity effects		
	8. Fish passage	No storm water management structures have been identified as a priority in terms of mitigating the effects of structures on fish movement.	
	9. Storm water management devices		
	10. Stream channel works		
	11. Floatable contaminants		
	12. Suspended solids		
	13. Hazardous substances		

	14. Micro-organisms		
	15. Adverse effects on aquatic ecosystems		
	16. Street and storm water catch pit cleaning operations		
	17. Storm water catch pits	Part of road maintenance activity	
	18. Storm water management devices		
	19. Illicit wastewater connections to the storm water network	Council staff and contractors lookout for illicit connections and take appropriate steps to ensure their removal, once found.	
	20. Routine contaminant discharges into the storm water network		
	21. Non-routine contaminant discharges into the storm water network	See SW activity log	
	22. New or replacement connections to the storm water network		
	23. Storm water quality improvement programme		
	24. Complaints registrar	TCDC has a Request for Service (RFS) procedure whereby public concerns or complaints are recorded in a system and responded to within a set timeframe.	Included to the report in the storm water Activity log for 2017-18
	25. Catchment management plans		
	26. Implementation of catchment management plans		
	27. Waikato Regional Council management plans		
	28. Low impact urban design measures and storm water management devices		
	29. Registrar of storm water management devices		
	30.Storm water management plan	Storm water Management Plan approved by TCDC in November 2013. All requirements set out in condition 30 are	

		included in the management plan.	
	31. Implementation of storm water management plan	The storm water Management Plan is currently being implemented by TCDC and its contractors.	
Conditions 2-6	2. Storm water diversion and discharge activities		
	3. Scope of storm water diversion and discharge activities authorised		
	4. Monitoring programme	Monitoring programme included in Storm water Management Plan	
	5. Monitoring programme	Monitoring programme carried out February/March and June 2018. Information collected through monitoring programme included in this report.	
	6. Annual Report	This report satisfies the requirements of this condition.	

Formal Complaints Summary

The following table provides a summary of all the formal complaints received, with regard to the storm water diversion and discharge activities, through Council's Requests for Service (RFS) system. This table summaries the compliance, or otherwise with condition 24 of Schedule A.

Date	Received from	Topic	TCDC Reference	Date of Completion	Response

Updated Catchment Drawings

Provide a list of all updated catchment drawings showing new storm water diversion and discharge activities which have been certified as authorised by Waikato Regional Council in accordance with condition 4 in Schedule A of this consent.

Summary of Storm water Measures Proposed to Remedy Non-compliance

Provide a summary of the actions and/or storm water management measures to be implemented over the coming year to remedy any non-compliance with the conditions of this consent.

Other Matters

Details of other matters considered relevant to this consent.

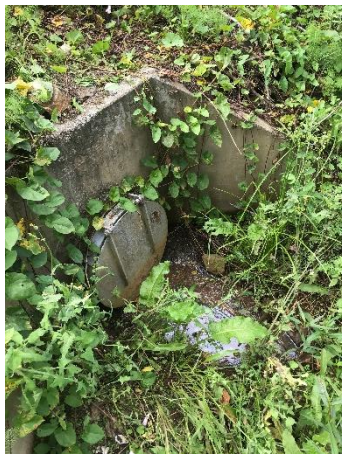
Appendix A: Visual Inspection of Receiving Waters at Storm water Outlets

Ref	Monitoring	**Observations and Actions** – (Photo on left side taken February 2018, photo on right taken June 2018)
01	Thames: Thames Marina	26/02/2018: Clear water, no scum, foam, oil slicks present. Aquatic life present in the mud (crabs), Presences of mangroves growing around outlet. Operation of the outlet hindered by heavy sediment build up and blocked by a boat. (Sediment removed May 2018) 12/07/2018: Small flow from outlet, clear water, no scum, foam, oil slicks present. Mangroves present around outlet. Outlet clear of sediment build up, small amount of aquatic life present in the mud.  
02	Thames: Sealey Street	26/02/2018: Small flow from outlet, clear water, no scum, foam, oil slicks present. Presences of algae growing in water and around the outlet. Small amount of rubbish around outlet. Outlet clear of sedimentation. 12/07/2018: Small flow from outlet, Clear water, algae present. Outlet clear of sedimentation and rubbish. No scum, foam, oil slicks present.  

03	*Thames: Burke Street outlet*	*26/02/2018: Clear water, no foam, scum, oil slicks present on water. Orangey brown tint to the surface of the mud. Small amount of sedimentation infront of outlet. Crab burrows present in mud. Mangroves growing around outlets.* *12/07/2018: Small flow from outlet, clear water. Orangey brown tint to mud surface, Strong mangrove presence around outlets. Crab burrows present.*  
04	**Thames Control Site:** Fergusson Drive – away from SW outlets	26/02/2018: No outlet present. Sandy sediment, organic debris present 12/07/2018: Same as above  

05	Pauanui: Sheppard Ave	27/02/2018: Clear water, no foam, scum, oil slicks present in water. Deep channel out from pipe. Aquatic life present in sand around outlet (crabs) 11/07/2018: Clear water, no foam, scum, oil slicks present. Deep channel still present beyond outlet. Build-up of woody debris on outlet pipe. Small build of sand on outlet, Channel filled with sea grass.  
06	Coromandel: Wharf Road	28/02/2018: Deep scouring on stream bed, 1 metre below outlet. No foam, scum, oil slick present. Murky water present. Aquatic life present around outlet (crabs). 11/07/2018: Deep scouring at outlet base, Small flow of water from outlet. Crab burrows present in mud. Clear water, no foam, scum, oil slicks present.  

07	Tairua: Marquet Place	27/02/2018: Minimal flow from outlet, clear water beyond outlet, no foam, scum, oil slicks present. Aquatic life present in mud surronding outlet. Small presence of algae. Thin layer of mud on the base of the wing wall. 11/07/2018: Clear water, no foam, scum, oil slicks present. Small build-up of gravel in channel. Crab burrows present in mud surrounding outlet. Small amount of organic debris in channel.  
08	Whitianga: Marina Hardstand	28/02/2018: No foam, scum, oil slicks present. Anti scour concrete amouring in place top prevent scouring at base of outlet. Small Amount of organic build-up on top of grill. 11/07/2018: Organic debris present on front of grill. Clear water flowing, no scum, foam, oil slicks present.  

09	Whitianga: Moewai Road north – drain outlets	28/02/2018: Slight orangey brown colour present, some orange scum present on top of water. Outlet very overgrown with vegetation. Outlet not affected by tide. 11/07/2018: Water is a lot clearer from outlet, some foam present on top of water. Outlet still overgrown with vegetation. Not affected by tide.  
10	Whangamata: Casement Road drain	28/02/2018: Clear water, Orangey brown scum present at the bottom of channel. No foam, oil slicks present. 11/07/2018: Scouring at base of outlet, Orangey brown scum still present in channel. Clear water, no foam, oil slicks present.  

11	Whangamata: Hetherington Road	28/02/2018: Rubbish around outlet (most likely from road not outlet), No foam, scum, oil slicks present 11/07/2018: Same as above  
12	Whangamata: Aitken Road	28/02/2018: Clear water, no foam, scum, oil slicks present. Heavy build-up of sediment in front of outlet pipe. Rubbish present in and around outlet. 11/07/2018: Water murky, no foam, scum, oil slicks present. Rubbish still present in channel. Heavy build-up of sediment in front of outlet pipe.  

13	Whangamata: Lindsay Road	28/02/2018: Oil slicks and small amounts of algae present, Scouring present beyond wing wall of outlet. 11/07/2018: Murky water with presents of slicks on top of the water. No foam or scum present. No rubbish present. Significant scouring present beyond outlet.  
14	Whangamata: Kotuku Street, SW outfall	28/02/2018: Significantly high flow from outlet, Concrete pad to prevent scouring. Clear water, no foam, scum, oil slicks present at outlet. 11/07/2018: High flow from outlet, Clear water, no foam, scum, oils slicks present. Small amount of organic debris surrounding outlet structure.  

15	**Whangamata Control Site:** Otahu Estuary – away from SW outlets	28/02/2018: Away from SW outlet. Sandy sediment. 11/07/2018: Same as above.  

Appendix B: Sediment Sampling Monitoring Results

Sediment Sampling Monitoring Results and comparison against ANZECC 2000 Interim Sediment Quality Guidelines (ISQG)

Individual Tests	Monitoring Location ISQG Low	ISQG High	1 Thames 3/2/14	2 Thames 3/2/14	3 Thames 3/2/14	4 Thames 3/2/14	5 Pauanui 5/2/14	6 Coro 12/2	7 Tairua 4/2/14	8 Whiti 12/2/14	9 Whiti 12/2/14	10 Whanga 13/2/14	11 Whanga 13/2/14	12 Whanga 13/2/14	13 Whanga 13/2/14	14 Whanga 13/2/14	15 Whanga 13/2/14
Environmental Solids	-	-															
Total Recoverable Digestion	-	-															
Total Organic Carbon (g/100g dry wt)	-	-	3.2	2.9	2.4	2.7	1.45	2.3	1.0	1.96	2.3	0.52	8.8	3.6	1.45	0.52	0.71
Dry Matter (Env) (g/100g as rcvd)	-	-	26	25	20	38	65	37	70	61	55	75	35	60	76	73	68
Heavy Metals (mg/kg dry wt)																	
Total Recoverable Arsenic	20	70	9.6	10.8	142	20	6	27	5.8	21	92	5.3	12.2	19.4	3.2	8.7	9.4
Total Recoverable Cadmium	1.5	10	0.151	0.151	0.153	0.46	0.027	0.074	0.029	0.071	4	0.018	0.001	0.82	0.055	0.025	0.016
Total Recoverable Chromium	80	370	31	33	32	224	6.4	28	7.5	16.4	75	6.1	12.9	14.6	6.2	6.8	9.3
Total Recoverable Copper	65	270	27	14.9	15.6	19	1.2	37	7.6	31	102	2.8	21	32	5.9	2.6	1.2
Total Recoverable Lead	50	220	40	41	39	38	2.8	27	13.6	14.5	23	4.1	18.1	1660	7.1	3.3	3.4
Total Recoverable Nickel	21	52	11.1	11.5	11.5	10.9	1.5	10.2	2.4	6.2	6.8	1.4	4.9	3.3	2.2	1.9	2
Total Recoverable Zinc	200	410	149	179	122	150	12.3	100	35	139	182	29	81	610	60	27	16.4

Between ISQG-Low and ISQG-High

Above ISQG-High

Individual Tests	Monitoring Location ISQG Low	ISQG High	1 Thames 26/2/18	2 Thames 26/2/18	3 Thames 26/2/18	4 Thames 26/2/18	5 Pauanui 5/2/14	6 Coro 12/2	7 Tairua 4/2/14	8 Whiti 12/2/14	9 Whiti 12/2/14	10 Whanga 13/2/14	11 Whanga 13/2/14	12 Whanga 13/2/14	13 Whanga 13/2/14	14 Whanga 13/2/14	15 Whanga 13/2/14
Environmental Solids	-	-															
Total Recoverable Digestion	-	-															
Total Organic Carbon (g/100g dry wt)	-	-	1.71	1.35	5.1	.66	0.16	1.45	.81	0.71	.38	0.41	14.8	.31	1.35	0.85	0.39
Dry Matter (Env) (g/100g as rcvd)	-	-	72	48	32	58	69	50	69	63	60	58	54	84	59	60	64
Heavy Metals (mg/kg dry wt)																	
Total Recoverable Arsenic	20	70	16.3	53	970	24	4.3	37	3.5	16.6	11.4	4.2	15.4	6.9	3.0	7.1	8.5
Total Recoverable Cadmium	1.5	10	.195	0.169	0.33	0.111	0.015	0.073	0.082	0.050	.111	0.010	0.143	0.066	0.051	0.017	0.016
Total Recoverable Chromium	80	370	26	21	34	15.1	5.2	21	7.1	12.8	11.5	5.6	19.8	11.5	5.9	5.5	9.7
Total Recoverable Copper	65	270	34	33	86	23	0.8	43	12.3	13.7	29	1.6	47	11.6	3.4	1.8	1.0
Total Recoverable Lead	50	220	55	65	80	23	2.5	41	7.6	10.2	14.4	4.7	22	9.1	10.1	3.4	3.6

Total Recoverable Nickel	21	52	13.3	9.4	22	5.7	1.3	8.1	5.7	3.9	4.9	1.3	6.1	6.2	2.1	1.5	1.7
Total Recoverable Zinc	200	410	400	390	270	94	14	103	161	106	85	25	196	94	26	31	16.6
		Between ISQG-Low and ISQG-High				Above ISQG-High											

Results commentary

In general terms the analysis for 2018 demonstrates little change from the 2014 results which are also included above. Hydrocarbon results are only marginally changed in all sites with none of the sites exceeding the ISGO upper range for Hydrocarbons and only a minor number at or above the ISQG lower level eg Fergusson Drive reference site

In terms of the metal analysis significant changes are evident in Whangamata where sites previously recorded with values above the ISQG low have returned results below the threshold. This is particularly the circumstance for site 12, Aicken road Whangamata where values for recoverable lead and zinc are now below the ISQG low level where as in 2014 they were above. All sites in Thames other than Burke demonstrate levels for Arsenic between the low and high ISQG levels, Burke street has an elevated Arsenic level which is not unexpected given the site is the outfall for the Moanataiari stream which drains the former epicenter for gold mining in Thames. Burke Street also demonstrates elevated levels of copper while all sites other than the Fergusson Drive reference site demonstrate slightly elevated levels for recoverable Nickel and Lead. The one site in Coromandel has levels for Arsenic above the ISQG low level this was also the case in 2014.

Appendix C: Ecological Assessment

THAMES COROMANDEL DISTRICT COUNCIL

VEOLIA WATER

Storm water Monitoring Programme: Ecological Assessment, Thames-Coromandel Urban Areas 2014

KesselsEcology
SURVEY, ASSESSMENT AND RESTORATION

Table of Contents

Prepared by: Dr Jennifer Price and Alicia Catlin
Reviewed by: Gerry Kessels

PWF Ref: VW.00212
Version: DRAFT I 280514

www.kessels-ecology.co.nz

Executive Summary

As part of their Comprehensive Storm water Discharge Consents, Thames-Coromandel District Council and Veolia Water are required to carry out a monitoring programme of storm water outlets, including an ecological assessment. Kessels Ecology was contracted to carry out the ecological assessment in 2014. The survey sites include 13 storm water outlets around the Coromandel area, as well as two control sites where no storm water is discharged. Most sites are situated in, or near, harbours, with one site (Site 9) in a freshwater stream.

The purpose of this study is to determine the general ecological health of the storm water discharge areas and assess general effects of storm water discharge. Monitoring is undertaken every four years.

This report should be read in conjunction with a report on sediment contaminant concentrations which has been produced by Veolia Water.

The general approach for the surveys is based on in-situ visual observation of three key biological indicators of ecological health. These three indicators are as follows:

- Aquatic plant growth composition and percentage cover;
- Benthic macroinvertebrate diversity and distribution; and
- Identification of potential native freshwater fish habitat and potential barriers to fish migrations.

Many storm water outlets surveyed showed poor water quality during low tide, as shown by low dissolved oxygen levels and high temperatures that would make the habitats inhospitable for more sensitive species. Water quality at the time of sampling was more likely to be related to tides and channel depth, rather than storm water quality. Temperature and dissolved oxygen are likely to improve at high tide and during times when storm water is flowing through the channels.

Macroinvertebrates mainly consisted of a core group of commonly found organisms that were found across most sites. In these mainly estuarine habitats, the invertebrate fauna present at a particular site is greatly dependent on the substrate and exposure to water currents, e.g. whether the site is mainly muddy and sheltered or sandy/rocky and exposed. Only very severe changes in benthic fauna would be likely to be detected using the current survey technique.

Aquatic plant coverage was low at the time of sampling, perhaps due to very dry conditions in the previous weeks. Mangroves were common at the muddier estuarine sites, and filamentous green algae were only found at 2 sites. No effects of the storm water discharges on aquatic plants were evident at the time of sampling.

It is recommended that future sampling takes place following several millimetres of rainfall if possible so that any ecological effects of storm water discharge will be more obvious.

1 Introduction

As part of their Comprehensive Storm water Discharge Consents, Thames-Coromandel District Council and Veolia Water are required to carry out a monitoring programme of storm water outlets, including an ecological assessment. Kessels Ecology was contracted to carry out this assessment in 2014. The survey sites include 13 storm water outlets around the Coromandel area, as well as two control sites where no storm water is discharged. Most sites are situated in, or near, harbours, with one site (Site 9) in a freshwater stream.

The purpose of this study is to determine the general ecological health of the storm water discharge areas and assess general effects of storm water discharge. Monitoring is undertaken every four years.

This report should be read in conjunction with a report on sediment contaminant concentrations which has been produced by Veolia Water.

2 Methodology

2.1 General Approach

The general approach for the surveys is based on the visual observation of three key biological indicators of ecological health. These three indicators are as follows:

- Aquatic plant growth composition and percentage cover;
- Benthic macroinvertebrate diversity and distribution; and
- Identification of potential native freshwater fish habitat and potential barriers to fish migrations.

2.2 Survey Sites

Fifteen sample sites were found within Coromandel and nearby communities or immediately upstream of the majority of the urban areas. Sites were investigated on 25 and 26 February 2014. Coordinates of the sample sites are given in Table 1. The sites are as follows (site descriptions from Baldwin 2013):

Site 1: Thames Marina. High risk catchment with commercial and industrial activities occurring, making it susceptible to the build up of contaminants in the sediments. Outlet flows into an area of mangroves.

Site 2: Sealey St South of Goldfields shopping centre – Thames. High risk catchment with commercial activities. Close to SH25. Outlet flows into a narrow channel which flows into the harbour.

Site 3: Burke St outlet – Thames. High risk catchment with commercial and industrial activities and close to SH25.

Site 4: **Control site**, Fergusson Dr – Moanatairi, away from SW outlets - Thames. Residential catchment associated with historical mine catchments. A floodgate controls storm water flow at this site.

Site 5: Sheppard Avenue, Pauanui harbour – Pauanui. High risk catchment, storm water flows directly into the estuary.

Site 6: Wharf Road, Whangarahi Stream – Coromandel. High risk catchment which envelops most of the CBD.

Site 7: Marquet place, Tairua harbour – Tairua. High risk catchment which envelops most of the CBD. Storm water outlet flows directly into the harbour.

Site 8: Marina hardstand – Whitianga. High risk catchment which envelops most of the CBD. The storm water outlet flows into the marina where channels have been constructed.

Site 9: Moewai Road north, drain outlets – Whitianga. High risk catchment with commercial and industrial activities. SH25 is also close. The storm water outlet at this site flows into a freshwater stream.

Site 10: Casement Rd drain Moana Anu Anu River – Whangamata. High risk catchment with commercial and industrial activities. At this site the storm water outlet flows into a channel which flows into the harbor.

Site 11: Hetherington Rd, south of marina – Whangamata. High risk catchment with commercial and industrial activities. The storm water outlet flows directly into the harbor.

Site 12: Aicken Rd – Whangamata. High risk catchment with commercial and industrial activities. At this site the storm water outlet flows into a channel which flows into the harbor.

Site 13: Lindsay Rd – Whangamata. High risk catchment with commercial and industrial activities. Similar to site 10 and 12 the storm water outlet flows into a channel which flows into the harbour.

Site 14: Kotuku St SW outfall, Otahu Estuary Kotuku Street – Whangamata. This site is considered to be in a low risk residential area. The storm water outlet flows into a raised concrete pond before flowing to the estuary.

Site 15: **Control site**, Otahu estuary, away from SW outlets – Whangamata. The site is situated in a residential catchment, as it is a control site no storm water outlet is present.

Table 1: New Zealand Transverse Mercator (NZTM2000) coordinates for the storm water stream sampling sites, February 2014.

Site	Easting	Northing
1 – Thames	175.324259	-37.84802
2 – Thames	175.322644	-37.82414
3 – Thames	175.315976	-37.75009
4 – Thames (Control)	175.314992	-37.73042
5 – Pauanui	175.511939	-37.1264
6 – Coromandel	175.294266	-36.453979
7 – Tairua	175.504958	-37.0508
8 – Whitianga	175.422053	-36.501537
9 – Whitianga	175.402005	-36.495468
10 – Whangamata	175.515725	-37.12133
11 – Whangamata	175.515860	-37.115899
12 – Whangamata	175.515398	-37.12400
13 – Whangamata	175.515222	-37.12768
14 – Whangamata	175.522067	-37.133112
15 – Whangamata (Control)	175.522529	-37.133356

2.3 Water Quality

Standard physicochemical water parameters including temperature, dissolved oxygen, electrical conductivity and pH were recorded at each site during each survey using a YSI Pro-plus field meter. Water quality measurements were taken prior to any other sampling which may have disturbed the substrate.

2.4 Aquatic Macroinvertebrates

Where possible, aquatic macroinvertebrate samples were collected in accordance with Environment Waikato's regional guidelines (Collier and Kelly 2005), which are based on protocols developed for the Ministry for the Environment by Stark et al. (2001). However, due to the estuarine and marine habitat present at most sites, this method was not always appropriate as it was designed for freshwater streams. At estuarine sites, a thorough search was carried out for all fauna species on the sediment surface and under rocks and logs etc. Samples were assessed for presence or absence of taxa and particularly abundant taxa were noted.

3 Results & Discussion

3.1 Site Descriptions

3.1.1 Site 1: Thames Marina

This outlet flows into an area of mangroves. Several mangrove seedlings were present in the channel (coverage at high tide would be 50% of channel). A moderate amount of large woody debris was present in the channel, covering approximately 50% of the bottom. Multiple crab burrows were observed. The substrate was muddy and the anoxic layer was within a centimetre or two of the surface. Fauna present in the samples included high abundances of the Oligochaete (earthworm), mud crab *Helice crassa*, mud snail *Amphibola crenata*, true fly Tanypodinae (a freshwater species) as well as isopods and amphipods.

Photo 1. Site 1: Thames Marina.

3.1.2 Site 2: Sealey St– Thames

This outlet flows into a narrow channel which flows into the harbour. Mangrove seedlings were present. The water level was very low and several crab burrows were present near the water's

edge. Woody debris covered approximately 5% of the channel, with some litter also present. The flow rate was approximately 0.25 m/s, and the substrate was muddy and anoxic. Fauna present included the highly abundant mudsnail *Potamopyrgus antipodarum*, true fly *Chironomus zealandicus*, earthworms (oligochaetes), various paddleworms and an estuarine mud snail *Amphibola crenata*.

Photo 2. Site 2: Sealey St, Thames.

3.1.3 Site 3: Burke St outlet – Thames

Mangrove seedlings would cover 70% of the channel at high tide at this site. A very small amount of marine green alga was present. Some small woody debris was present but only covered around 1% of the stream bed. Flow was very low at 0 m/s at the time of sampling. The anoxic layer was very close to the sediment surface. A brown scummy film was present on the water's surface. Fauna present include the mud snail *Potamopyrgus antipodarum*, true fly *Chironomus zealandicus*, cockle *Austrovenus stutchburyi* and oligochaetes, paddleworms and amphipods.

Photo 3. Site 3: Burke St outlet, Thames

3.1.4 Site 4: Control site, Fergusson Dr – Thames

A floodgate controls storm water flow at this site; no storm water flow was present at the time of sampling. The outlet flows directly into the harbour onto a boulder substrate with sandy mud underneath. Fauna present included marine species such as oyster *Crassostrea glomerata*,

barnacle *Austrominius modestus*, cockle *Austrovenus stutchburyi*, whelk *Cominella glandiformis*, crab *Helice crassa*, pipi *Paphies australis*, little black mussel *Xenostrobus pulex*, and polychaete worms (though only the dead shells of cockles and pipis were seen). No aquatic plants were present at the site.

Photo 4. Site 4: Fergusson Dr, Thames

3.1.5 Site 5: Sheppard Avenue, Pauanui harbour – Pauanui

The outlet near Sheppard St in Pauanui flows directly into the estuary. Fauna species noted included oyster *Crassostrea glomerata*, barnacle *Austrominius modestus*, cockle *Austrovenus stutchburyi*, whelk *Cominella glandiformis*, crab *Helice crassa*, pipi *Paphies australis,* and an amphipod. Seagrass fragments were present at the site but had likely been washed there as they were not attached to the substrate. The substrate at this site was sandy.

Photo 5. Site 5: Sheppard Ave, Pauanui.

3.1.6 Site 6: Wharf Road, Whangarahi Stream – Coromandel

This outlet consists of a pipe entering a wide tidal channel approximately 1 m above the bottom. Many crab burrows were present on the banks. The substrate consisted of large cobbles and boulders covered in fine muddy sediment. Little cover was present for fish or

invertebrates. Woody debris covered approximately 1% of the stream bed. Fauna present include the mud snail *Potamopyrgus antipodarum,* cockle *Austrovenus stutchburyi,* shrimp *Paratya curvirostris* and other taxa including amphipods and oligochaetes. No aquatic plants were present at the site.

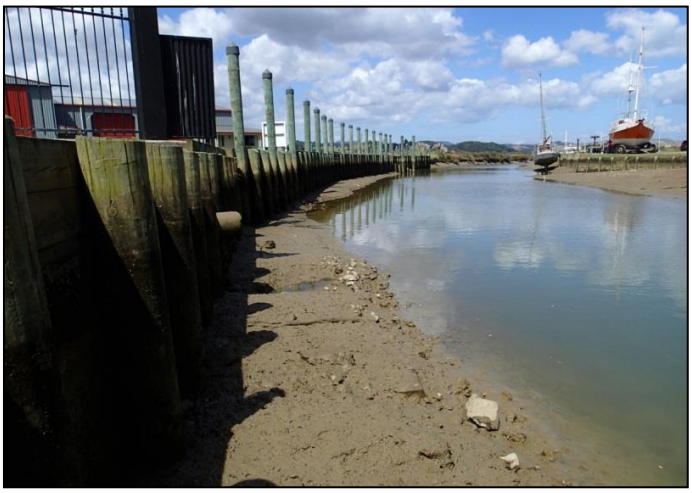


Photo 6. Site 6: Wharf Rd, Coromandel.

3.1.7 Site 7: Marquet place, Tairua harbour – Tairua

This outlet flows directly out into the harbour. Several shrimp *Paratya curvirostris* and crab burrows were observed at this site. A small number of mangrove seedlings were present. The substrate at this site was made up of concrete blocks with several *Juncus* sp. plants on the banks. The substrate was muddy sand with the anoxic layer evident very close to the surface. Several whelks *Cominella glandiformis* were seen, and a shortfin eel approximately 25 cm long was caught when collecting invertebrates. Fauna present in the sample included the shrimp *Paratya curvirostri*s, mud snails *Potamopyrgus antipodarum, Amphibola crenata* and *Zeacumantus subcarinatus,* mud crab *Helice crassa*, true fly Orthocladiinae and periwinkle *Nodilittorina antipodum*.

Photo 7. Site 7: Marquet Place, Tairua Harbour.

3.1.8 Site 8: Marina hardstand – Whitianga

This outlet flows out into the marina area where channels have been constructed. The substrate at this site was riprap with fine sediment covering deeper areas. No plant material or

woody debris was present. Shrimp *Paratya curvirostris*, yellow eye mullet and cockabullies were seen at the site. Other organisms included little black mussels, topshell *Nerita melanotragus*, mudflat topshell *Diloma subrostrata*, sea slug *Onchidella nigricans*, barnacle *Austrominius modestus*, and oysters *Crassostrea glomerata*.

Photo 8. Site 8: Marina hardstand, Whitianga.

3.1.9 Site 9: Moewai Road north– Whitianga.

The outlet at Moewai Rd flows into a freshwater stream. Dense grass and *Convolvulus* covered the banks, and other plants on the riparian margins included blackberry, pine, flax, tutu and *Juncus* sp. The stream bed was completely covered in coarse woody debris and iron floc, a byproduct of iron-metabolising bacteria that is not harmful to stream fauna. Fauna present included the highly abundant mud snail *Potamopyrgus antipodarum,* cockle *Austrovenus stutchburyi,* mollusc Sphaeriidae, true fly Tanytarsini and seed shrimp Ostracoda.

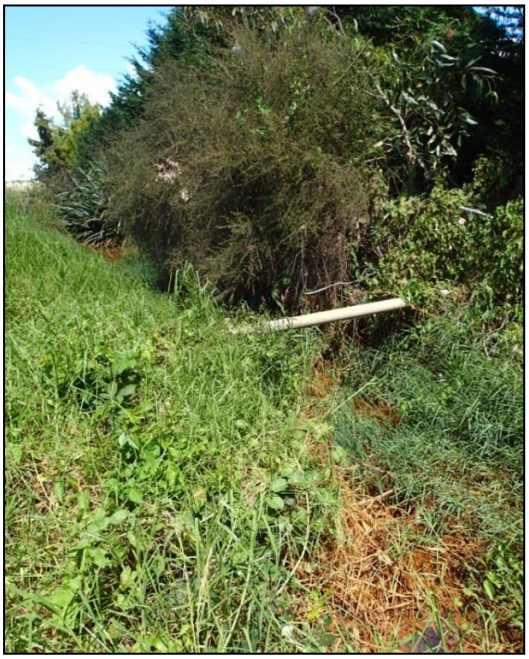


Photo 9. Site 9: Moewai Rd, Whitianga.

3.1.10 Site 10: Casement Rd drain, Moana Anu Anu River – Whangamata

At Casement Rd, the storm water outlet flows into a channel which then flows into the harbour. Near the harbour, the substrate was sandy and several rushes were present. No flow was present; the water in the drain was stagnant at the time of sampling. Woody debris covered approximately 30% of the substrate, and several mangrove seedlings were present. Several crab burrows and mudflat snails *Amphibola crenata* were present. Fauna present included the highly abundant mud snail *Potamopyrgus antipodarum,* true fly Muscidae, shrimp *Paratya curvirostris* and crustaceans Ostracoda and Amphipoda.

Photo 10. Site 10: Casement Rd, Whangamata.

3.1.11 Site 11: Hetherington Rd – Whangamata.

The outlet at Hetherington Rd is a pipe that runs directly into the harbour. The sediment surrounding the outlet was densely vegetated with *Juncus* sp. The site was completely dry at the time of sampling with no water flowing from the storm water network. Mudflat snails *Amphibola crenata* and whelks *Cominella glandiformis* were present.

Photo 11. Site 11: Hetherington Rd, Whangamata.

3.1.12 Site 12: Aicken Rd – Whangamata.

Similar to Site 10, the Aicken Rd storm water outlet flows into a channel which then flows into the harbour. No water was flowing at the time of sampling and an oily film was present on the water's surface. Litter was present in the drain. Leafy debris covered approximately 25% of the channel, and the substrate was soft and muddy.

Near the harbour, the channel was lined with rushes and pampas grass, with occasional manuka trees. The substrate was soft and muddy, with woody debris covering approximately 10% of the channel. Fauna present included the mud snail *Potamopyrgus antipodarum,* mud crab *Helice crassa,* true fly Ephydridae and oligochaete worms. No aquatic plants were present within the channel.

Photo 12. Site 12: Aicken Rd, Whangamata.

3.1.13 Site 13: Lindsay Rd – Whangamata

Similar to Sites 10 and 12, the Lindsay Rd storm water outlet flows into a channel which then flows into the harbour. No water was flowing at the time of sampling. The outlet flows into a large pool with a maximum depth of 0.8 m at the time of sampling. The substrate was rocky with a covering of fine sediment. An oily film was present on the surface of the water. Fine filamentous green algae and shrimp *Paratya* were seen. Fauna present included the snails *Potamopyrgus antipodarum* and *Physa acuta*.

Photo 13. Site 13: Lindsay Rd, Whangamata.

3.1.14 Site 14: Kotuku St – Whangamata.

This outlet flows into a raised concrete pond before flowing into the estuary. Flow from the outlet was very low at the time of sampling. Substrate was made up of concrete blocks covered in sand. Organisms included topshell *Nerita melanotragus*, mudflat topshell *Diloma subrostrata*, barnacle *Austrominius modestus*, oysters *Crassostrea glomerata*, cockle *Austrovenus stutchburyi*, whelk *Cominella glandiformis*, amphipod, pipi *Paphies australis,* limpet and shrimp *Paratya.* No aquatic plants or algae were present at the outlet.

Photo 14. Site 14: Kotuku St, Whangamata.

3.1.15 Site 15: Control site, Otahu estuary – Whangamata.

Site 15 is the estuary control site, with no storm water outlet present. The substrate at this site was sandy. Fauna present included cockle *Austrovenus stutchburyi*, whelk *Cominella glandiformis*, amphipod, pipi *Paphies australis,* mudflat topshell *Diloma subrostrata* and shrimp *Paratya.* No aquatic plants or algae were present.

Photo 15. Site 15: Otahu Estuary, Whangamata.

3.2 Water Quality

Site temperatures varied from 18 to 25°C at the sites surveyed (Table 2). A daily maximum of 20°C is recommended as guideline for sensitive organisms including macroinvertebrates (Richardson et al. 1994, NIWA 2004). Native fish are generally more tolerant of high water temperatures, and a temperature threshold of 26°C is considered appropriate for these species (NIWA 2004). Temperatures were measured mid-morning to early afternoon, meaning that temperature probably exceeds the measured values when it reaches a maximum in the late afternoon.

Conductivity was highly variable, with no evidence of a consistent pattern between sites. High conductivity indicates saltwater intrusion which is reflected in the proximity of the sites to the harbour and/or estuarine areas.

Dissolved oxygen was also highly variable between sites, generally with low measurements apart from Site 15, a control site showing high oxygen saturation (Table 2). Habitat for aquatic biota is considered impaired at DO concentrations below 6 mg/L (Franklin 2010). A minimum threshold of 80% saturation is also recognised as a guideline standard for ecological protection by the Waikato Regional Council (Tulagi 2013) and Resource Management Act[1]. Low storm water flows from the catchment and low tides were likely a contributing factor to these low DO concentrations. Sites 1, 9, 10 and 12 showed particularly low dissolved oxygen; likely because these sites were all small tidal channels that had no flow at the time of sampling.

No consistent differences in pH were observed between the storm water sites (Table 2).

Sites 4 and 11 had no water present at the time of survey so water quality measurements could not be taken (Table 2). As Site 4 is a control site, water quality data could be important as a reference for the other sites.

[1] Third Schedule, classes AE, F and FS

Table 2 Water quality parameters measured at storm water sites in the Coromandel area, February 2014.

Site	Dissolved oxygen (%)	Dissolved oxygen (mg/L)	Specific conductivity (µS/cm)	pH	Salinity (PSU)	Temperature (ºC)
1 – Thames	0.4	0.04	35739	6.99	22.27	21.5
2 – Thames	45.0	3.89	429.0	8.2	0.21	22.2
3 – Thames	68.9	5.66	5200	7.25	0.66	22.8
4 – Thames (Control) *						
5 – Pauanui	69.0	5.36	43286	8.07	27.90	19.3
6 – Coromandel	72.8	6.04	38700	7.42	22.50	21.9
7 – Tairua	58.0	4.65	42576	7.83	27.42	19.2
8 – Whitianga	74.5	4.75	44548	8.14	28.76	25.1
9 – Whitianga	14.1	1.27	677	7.23	0.33	20.9
10 – outlet Whangamata	10.5	0.83	29889	7.33	16.6	19.6
10 – near harbour Whangamata	26.4	2.38	187.1	8.10	0.11	21.6
11 – Whangamata*						
12 – outlet Whangamata	0	0	295.0	7.36	0.14	23.0
12 – near harbour Whangamata	11.2	0.81	40589	7.08	24.56	18.6
13 – Whangamata	33.3	2.53	45975	7.8	29.75	21.8
14 – Whangamata	83.0	7.51	6051	7.62	4.81	19.1
15 – Whangamata (Control)	93.3	7.0	36660	8.05	22.9	23.8

* - No water was present at time of survey

3.3 Aquatic Macroinvertebrates

Aquatic macroinvertebrate communities showed variability among sampling sites, potentially related to the amount of salt water intrusion. Molluscs (dominated by the New Zealand mudsnails *Potamopyrgus antipodarum* and *Amphibola crenata*) were highly abundant at a majority of the sites along with the cockle, *Autrovenus stuchburyi* and the crustacean shrimp *Parayta curvirostris.* Generally there were few observed differences in diversity and abundance between sites, with the same taxa of molluscs, crustacea, worms and true flies occurring at each of the 15 sites. Diversity and abundance of invertebrates was likely affected by the dry and warm conditions at the time of sampling, with only tolerant species able to survive in the shallow water habitats near the outlets.

3.4 Aquatic Plants

Aquatic plant cover was low overall at the storm water outlets and mainly consisted of mangroves and mangrove seedlings at the sites with muddier substrates, including sites 1, 2, 3, 7 and 10. The control sites had sandier substrates and would not be expected to support mangroves. Green filamentous algae was present at Site 13 and in small amounts at site 3; large amounts of such algae can signal nutrient enrichment.

3.5 Fish Habitat

As most sites surveyed were estuarine, they would be freely accessible to fish at high tide and likely to support common estuarine fish species, such as cockabullies *Fosterigion nigripenne*

and yellow eye mullet *Aldrichetta forsteri*. Tolerant freshwater species such as gambusia *Gambusia affinis* and shortfin eel *Anguilla australis* are also likely to be present at some sites, particularly Site 9 which was a freshwater stream. These fish would be likely to vacate the small tidal channels at low tide due to low dissolved oxygen, high temperatures and low water levels. Most sites had little cover or habitat (i.e. woody debris, stones or other hard structures) and would not be expected to provide more than occasional habitat for fish.

4 Conclusions

Many storm water outlets surveyed showed poor water quality during low tide, as shown by low dissolved oxygen levels and high temperatures that would make the habitats inhospitable for more sensitive species. Water quality at the time of sampling was more likely to be related to tides and channel depth, rather than storm water quality. Temperature and dissolved oxygen are likely to improve at high tide and during times when storm water is flowing through the channels.

Macroinvertebrates mainly consisted of a core group of commonly found organisms that were found across most sites. In these mainly estuarine habitats, the invertebrate fauna is greatly dependent on the substrate and exposure to water currents, e.g. whether the site is mainly muddy and sheltered or sandy/rocky and exposed. Only severe changes in benthic fauna would be likely to be detected using the current survey technique.

Aquatic plant coverage was low at the time of sampling, perhaps due to very dry conditions in the previous weeks. Mangroves were common at the muddier estuarine sites, and filamentous green algae were only found at 2 sites. No effects of the storm water discharges on aquatic plants were evident at the time of sampling.

It is recommended that future sampling takes place following at least 10-50 mm of rainfall so that any ecological effects of storm water discharge will be more obvious.

References & Bibliography

ANZECC (Australian and New Zealand Environment and Conservation Council). 2000. Australian and New Zealand guidelines for fresh and marine water quality. Volume 1 - The Guidelines. Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand.

Baldwin, C. 2013. Storm water Monitoring Programme: Thames-Coromandel Urban Areas, November 2013. Prepared for Thames-Coromandel District Council by KTB Planning.

Collier, K. J., and J. Kelly. 2005. Regional Guidelines for Ecological Assessments of Freshwater Environments: Macroinvertebrate Sampling in Wadeable Streams. Environment Waikato Technical Report TR2005/02.

Collier, K. J., and M. J. Winterbourn. 2000. New Zealand Stream Invertebrates: Ecology and Implications for Management. New Zealand Limnological Society.

Franklin, P. 2010. *Dissolved oxygen criteria for fish and the determination of ecological flows*. NIWA Internal Report 146, National Institute of Water and Atmospheric Research.

NIWA. 2004. *WAIORA Version 2.0*. National Institute of Water and Atmospheric Research.

Richardson, Jody , Boubée, Jacques A. T. and West, David W.1994. Thermal tolerance and preference of some native New Zealand freshwater fish. New Zealand Journal of Marine and Freshwater Research 28: 399–407

Stark, J. D., I. K. G. Boothroyd, J. S. Harding, J. R. Maxted, and M. R. Scarsbrook. 2001. Protocols for sampling macroinvertebrates in wadeable streams. Ministry for the Environment.

Tulagi, A. 2013. Regional Rivers Water Quality Monitoring Programme: Data Report 2012. Waikato Regional Council Technical Report 2013/13.