BEFORE THE HEARINGS PANEL SOUTHLAND REGIONAL COUNCIL

IN THE MATTER	of the Resource Management Act 1991
AND	of an Application for Resource Consent to Discharge from Stormwater Network
BY	**INVERCARGILL CITY COUNCIL** **APP-201668843**
	Applicant

BRIEF OF EVIDENCE OF ADRIAN PAUL COCKER

Dated 25 July 2017

Filed by
Invercargill City Council
Civic Administration Building
101 Esk Street
Private Bag 90104
Invercargill 9840
Ph: (03) 211 1777
Solicitor Acting: M D Morris
e: Michael.Morris@icc.govt.nz

I, Adrian Paul Cocker state:

BACKGROUND

1. My name is Adrian Paul Cocker. I am employed as 3 Water Operations Technologist for the Invercargill City Council (ICC). I have held that position for the past 2 years, having previously been employed as the ICC Laboratory Manager 11 years. I have worked for the ICC since 1980, firstly as a Lab Technician and progressing to Senior Lab Technician. I am responsible as the Laboratory Manager for the ICC. I am responsible for Trade Waste consenting for the ICC and drafted the last 2 updates to the ICC Trade Waste Bylaw. I am responsible to oversee the operation (technical) of both the ICC Water Treatment Plant and the ICC waste treatment Plants. I am responsible to ensure procedures are in place such that the drinking water quality and systems comply with the Health (Drinking Water) Amendment Act 2007. I hold a NZCS (Biology – Microbiology) and Diploma for Graduates (Biotechnology) from Otago University.

SCOPE OF EVIDENCE

2. Monitoring programme undertaken over the last 5 years:
    - Design of programme to characterise the discharges impact on water quality
    - Identify why the specific discharge locations were identified and what they represent in terms of nature of catchment.
    - Detailed description of individual sample sites
        - Clifton Channel, Consent 206940
        - Kingswell Creek, Consent 206939
        - Otepuni Stream, Consent 206938
        - Waihopai River, Consent 206936
        - Waikiwi Stream, Consent 206937
    - Brief Synopsis of Routine Sampling for Discharge Consents
        - Clifton Channel, Consent 206940
        - Kingswell Creek, Consent 206939
        - Otepuni Stream, Consent 206938
        - Waihopai River, Consent 206936
        - Waikiwi Stream, Consent 206937
    - Routine Discharge Consent Testing Costs
3. Procedure and Findings of Industrial Audits conducted over the last five years
4. Investigations of sewage contamination

- Investigations as stated condition of Waihopai discharge consent (with estimated costs)
- Investigations triggered by Condition 6 of discharge consent (with estimated costs)
  - Brief review of Investigations
- Proposed Methodology for identifying sewage under new consents

5. Issues addressed by new proposed consent

MONITORING PROGRAMME UNDERTAKEN OVER THE LAST 5 YEARS

Design of programme

6. In Decision of Commissioners November 2011:

6.1 ES established that contaminants in the stormwater principally arise from management of land services, but other sources may include leaks or connections from wastewater lines, or flushing of contaminant into the stormwater system.

6.2 ES stated that at present (2011) there is little stormwater or receiving water quality information available.

6.3 The conditions of the December 2011 discharge consents specified for monitoring for an initial period followed by provision for annual programmes.

6.4 ES stated that sewage in stormwater is almost certainly a plumbing issue.

6.5 ES stated that they believed in most cases sewage will have been mistakenly connected to the stormwater system in a building, or a cross-connection between the ICC sewerage and stormwater system exists.

6.6 ES considered that monitoring and maintenance of the sewerage and stormwater system networks was necessary.

6.7 ES stated that parts of the network were expected to last more than a century.

7. Due to acceptance by ICC of the deficiency of discharge and receiving water quality data, an extensive water quality data accumulation programme was included in each of the five stormwater discharge to freshwater consents.

8. Each of the five stormwater discharges to freshwater consents had a sampling programme that was customised to each receiving water catchment.

9. Routine sampling programmes were included for the following:

   9.1 Dry Weather Conditions Receiving Water

   9.2 Storm Conditions Receiving Water

   9.3 Dry Weather Conditions Stormwater Discharges

   9.4 Storm Conditions Stormwater Discharges

   9.5 Receiving Waters Sediments

   9.6 Receiving Water Macroinvertebrates Communities.

10. Trigger sampling/investigation programmes were included that were to be started when receiving or discharges exceeded trigger limits.

11. The Waihopai River Consent 206936 included a programme to identify and remove human sewage contamination from stormwater system drains at 274 Talbot Street, at Prestonville and at Russell Street.

12. The discharges consents included a receiving water zone of reasonable mixing extending 50m downstream from the outfall of each discharge.

13. The discharges consents included a sediment zone of reasonable mixing of 1m from the outfall of each discharge.

14. MWH along with ICC conducted investigations and research to identify suitable sample locations that would be capable of supplying the water quality data necessary to evaluate the discharges

15. **Receiving Water Sample Sites**. For the receiving waters sample sites were chosen along the length of the stream as it travelled through the Invercargill reticulated stormwater system. A control site was chosen for each of the 5 receiving waters. The control site was upstream of the first ICC stormwater discharge to the receiving waters. Another site was chosen downstream of the last ICC stormwater discharge to the receiving waters. Where it was deemed necessary or useful, further sites were chosen that were within the zone of ICC discharges to the receiving water.

16. **Discharge Sample Sites**. - Discharge sample sites were identified to cover a range of different catchments within the Invercargill City. Different sites

were identified on the following basis. Residential, Commercial, Industrial, or a mix of the above. Where possible, sample sites were also chosen that would reflect the age and type of materials used for the stormwater infrastructure.

17. **Sediment Samples Sites** – Sediment sample sites were chosen that would best reflect any environmental impact that the stormwater discharges may have. For the larger streams sites were chosen above the influence of ICC stormwater discharges. Sites were chosen at all receiving waters downstream of the last ICC stormwater discharge to the receiving waters. Where it was deemed necessary or useful, further sites were chosen that were within the zone of ICC discharges to the receiving water.

18. **Macroinvertebrate Samples Sites** – Initially sites were established on the three larger streams only. In the latter macroinvertebrate sampling round, two sites were added from the Waikiwi Stream as it was felt that there was a lack of data in this stream. Generally, the sample sites reflected the receiving water sample sites with, where deemed necessary, the addition of further sites at the mouth or freshwater boundary with the coastal marine area.

Detailed description of individual sample sites

19. The overall catchment maps are provided as Attachment 1 of Mr Loan's evidence. Individual maps of stormwater and sewer assets in the catchment of each discharge sample points described can be found in Appendix B of Appendix A of the application.

Clifton Channel, Consent 206940

20. The Clifton Channel is approximately 3 km in length extending from Avon Road to discharge at the New River Estuary. It is a small highly modified watercourse that largely flows through farmland. Discharge to the New River Estuary is by way of flood gates located beside the Clifton Wastewater Treatment Plant tertiary treated effluent discharge. There were no discharge sampling sites included in this consent due to the relatively small catchment area of the consent and the Clifton Channel traveling for most of the City through relatively low impact and relatively undeveloped land.

21. Receiving Water Sites

    21.1 Bain Street – A control receiving water site upstream of ICC discharges to the receiving waters.

21.2 Wicklow Street – A site mid distance from the channel entering the City to the discharge of the Clifton Channel to the New River Estuary.

21.3 Downstream of Bluff Industrial Line Railway. – This site is at the lower extent of the reticulated stormwater network downstream of the last ICC stormwater discharge.

22. Sediment Sample Site

22.1 Downstream of Bluff Industrial Line Railway. – This site is at the lower extent of the reticulated stormwater network.

Kingswell Creek, Consent 206939

23. The Kingswell Creek is approximately 9 km in length extending from about Seaward Bush to a flood protection dam on the outskirt of urban Invercargill and discharge at the New River Estuary. Upstream from Invercargill the land is largely farm land. The discharge to the New River Estuary is located about 1km north of the Clifton Wastewater Treatment Plant tertiary treated effluent discharge and about 1km south of the Invercargill Closed Landfill lagoon inlet/outlet. The Creek is subject to tidal influences to about Elles Road and as such, receiving water samples were generally taken close to slack water low conditions.

24. Receiving Water Sites

24.1 Chesney Street – A control receiving water site upstream of ICC discharges to the receiving waters.

24.2 Upstream of Bluff Highway – This site is at the lower extent of the reticulated stormwater network downstream of the last ICC stormwater discharge.

25. Stormwater Discharge Sites

25.1 Brown Street North Drain West at Bridge – This sample site encompasses an area of approximately 10 City blocks. The area is predominantly residential. About 2/3 of the stormwater network was installed pre 1949 with improvement/replacements of the remaining in the period 1950 to 1999. About 2/3 of the foulsewer network was installed between pre 1949 with improvement/replacements of the remaining carried out in the period 1950 to 1969.

25.2 Elles Road Bridge Drain Northwest side of the river - This sample site encompasses an area of approximately 15 City blocks. The area is predominantly residential with a small commercial zone of about one City Block. About 1/2 of the stormwater network was installed pre 1949 with improvement/replacement/installation of the remaining in the period 1950 to 1989. About 1/2 of the foulsewer network was installed between pre 1949 with improvement/replacement/installation of the remaining carried out in the period 1950 to 1989.

25.3 Drain Outfall upstream of Bluff Road Bridge - This sample site encompasses an area of approximately 3 City blocks. The area is residential. The initial 10% of the stormwater network was installed 1950-1959 with extensions to the network in each of the decades 1960-1969, 1970-1979 and 1980-1989. About 1/2 of the foulsewer network was installed between 1960-1969, with the remaining installed in the period 1970 to 1979.

26. Sediment Sample Site

26.1 150m West of Bluff Highway – This site is at the lower extent of the reticulated stormwater network downstream of the last ICC stormwater discharge at about discharge to the New River Estuary.

27. Macroinvertebrate Communities Site.

27.1 Chesney Street – A control receiving water site upstream of ICC discharges to the receiving waters.

27.2 50m downstream of Elles Road bridge– A site downstream of the 2 largest stormwater discharges to the Kingswell Creek but out of the zone of the Creek that may be influenced by stormwater discharge from the Southern District Health Board.

Otepuni Stream, Consent 206938

28. The Otepuni Stream is approximately 15 km in length extending from about Longbush South Road to a flood protection dam on the outskirts of urban Invercargill and to discharge at the Coastal Marine zone of the Waihopai River. Upstream of the City the land is largely farmland. The stream is subject to tidal influences to about Elles Road and as such, receiving water samples were generally taken close to slack water low conditions. The discharge to the Waihopai River is about 500m north of the Stead Street

Bridge. The Stream travels though the City bounded by mainly industrial/commercial areas but also having significant residential run-off.

29. Receiving Water Sites

29.1 20mUpstream Rockdale Road – A control receiving water site upstream of ICC discharges to the receiving waters.

29.2 40m Downstream of Lindisfarne Street Bridge – This site at the midpoint of the reticulated stormwater network.

29.3 Upstream of the Mersey Street Bridge – This site at about 200m upstream of the discharge of the Otepuni Stream to the Coastal Marine reach of the Waihopai River. This site is downstream of the Invercargill KiwiRail Station and as such will at times contain stormwater and associated contaminants emanating from there (does not form part of the ICC reticulated Stormwater system).

30. Stormwater Discharge Sites

30.1 Drain at 34 Onslow Street – This sample site is a manhole prior to the discharge of stormwater to the Otepuni Stream. This sample site encompasses an area of about 18 blocks and is zoned residential. About 90% of the stormwater network was installed 1960-1969 with the remaining in the period 1970 to 1989 (apart from about 60m of pipeline installed 1950-1959. About 90% of the foulsewer network was installed 1960-1969 with the remaining in the period 1970 to 1989.

30.2 Drain at 16 Onslow Street – This sample site is a manhole prior to the discharge of stormwater to the Otepuni Stream. This sample site encompasses most of Onslow Street, commercial/industrial, and also about 8 City blocks of residential. The commercial stormwater network is dated 1970-1999 with the residential 1960-1969 with improvements/installations 1980-2009. The foulsewer in the commercial/industrial was installed 1970-1979 with the residential installed 1960-1969.

30.3 Drain at Southwest Lindisfarne Street Bridge – This sample site is an outfall of stormwater to the Otepuni Stream. This sample site encompasses about 20 City blocks and is residential. The stormwater network was established pre 1949 with about 80% of that original network still in place. The remaining has been subject to renewals during the period 1990 to 2019. The foulsewer network

was established pre 1949 with about 70% of the network still in place. The remaining was subject to renewals in the period 1960-1969 and 1990-1999.

30.4 Drain at Camden Street – This sample site is a manhole prior to the discharge of stormwater to the Otepuni Stream. This sample site encompasses about 12 City blocks and is residential. The stormwater network was established pre 1949 with about 60% of that original network still in place. The remaining has been subject to renewals during the period 1980 to 1999. The foulsewer network was established pre 1949 with about 95% of the network still in place. The remaining was subject to renewals in the period 1950-1959 and 2000-2009.

30.5 Drain at Southwest side of Ythan Street Bridge – This sample site is a manhole one block before the discharge of stormwater to the Otepuni Stream. This sample site encompasses about 3 City blocks and is about 70% residential with the remaining commercial/industrial. The stormwater network was established pre 1949 with about 50% of that original network still in place. The remaining has been subject to renewals during the period 1970 to 1979 and 2000-2009. The foulsewer network was established pre 1949 with about 70% of the network still in place. The remaining was subject to renewals in the period 2000-2009.

30.6 Drain at Northwest side of Levin Street Bridge – This sample site is an outfall of stormwater to the Otepuni Stream. The outfall is semi submerged at all times and can be completely submerged at high tide. This sample site encompasses about 18 City blocks and is completely commercial encompassing a major part of the CBD. The stormwater network was established pre 1949 with about 40% of that original network still in place. The remaining has been subject to renewals during the periods 1950 to 1959, 1960-1969, 1970-1979, 1980-1989, 1990-1999, 2000-2009 and 2010-2019. The foulsewer network was established pre 1949 with about 90% of the network still in place. The remaining was subject to renewals in the period 2000-2009 and 2010-2019.

31. Sediment Sample Sites

31.1 Same three sites as the receiving water sites, plus

31.2 At mouth of Otepuni Stream - A site at the mouth of the Otepuni Stream consisting of a mud bottom.

32. Macroinvertebrate Communities Sites

32.1 20m Upstream Rockdale Road – same as the control receiving water site upstream of ICC discharges to the receiving waters.

32.2 40m Downstream of Lindisfarne Street Bridge – This site at the midpoint of the reticulated stormwater network, as per the receiving water site.

32.3 At mouth of Otepuni Stream - A site at the mouth of the Otepuni Stream consisting of a mud bottom.

Waihopai River, Consent 206936

33. The Waihopai is approximately 40 km in length extending from about Ota Creek Road to a flood protection dam on the outskirts of urban Invercargill and to discharge at the New River Estuary at the Stead Street bridge. There are some industrial activities at Kennington and Mortain Mains but the catchment is largely farmland above Invercargill. The fresh water section of the Waihopai River extends to the Ohai Industrial Line Railway, with the section of river below this being coastal. The coastal marine section contains two large stormwater outfalls that are not subject to this consent. The River is subject to tidal influences to about 200m upstream of the Queens Drive Bridge and as such, receiving water samples were generally taken close to slack water low conditions. The Waihopai River is the largest tributary to run through Invercargill and is subject to the larger part of recreational use of such tributaries. Recreational activities include fishing, whitebaiting and some canoe/kayak use.

34. Receiving Water Sites

34.1 50m Upstream Racecourse Road – A control receiving water site upstream of ICC discharges to the receiving waters.

34.2 50m downstream Queens Drive Bridge– A water site about halfway between outskirts of City and start of coastal marine section.

34.3 50m upstream of Prestonville Discharge - A water site just above the stormwater outfall from the Prestonville ponding area. This sample could be considered as a control site for the next downstream sample.

34.4 70m downstream of Prestonville Discharge - A water site just below the stormwater outfall from the Prestonville ponding area. This

sample can be used to assess the influence of Prestonville discharge on the receiving waters.

34.5 Downstream of North Road Bridge - A water sample site at the lower extent of the receiving waters just before the change to coastal marine.

35. Stormwater Discharge Sites

35.1 Drain at 274 Talbot Street – This sample site is an outfall to a ditch which then discharges to the Waihopai River. It is a site that was identified by DOC in 2011 as being subject to potential human effluent. This sample site encompasses an area of about 4 blocks and is zoned residential. About 60% of the stormwater network was installed 1950-1959 with the remaining in the period 1960 to 1969 (apart from about 50m of ditch installed prior to 1949). About 30% of the foulsewer network was installed 1950-1959 with the remaining in the period 1960 to 1969.

35.2 Drain at 61 Rosewood Drive – This sample site is manhole prior to discharge to the Waihopai River. This sample site encompasses an area of about 5 blocks and is zoned residential. Although the catchment is reasonably new, the stormwater network was established over 5 separate decades from 1950 to 2009. The foulsewer network was installed in three separate decades1950-1959, 1970-1979 and 2000-2009.

35.3 Drain ‘3’ 8m upstream of Queens Drive Bridge, South side – This sample site is at a manhole prior to discharge to the Waihopai River due to the outfall being submerged at all times. This sample site encompasses an area of about 9 blocks and is zoned residential although it contains some small areas of commercial at the Herbert Street extent of the catchment. The stormwater network was established pre 1949 with about 25% of the original network still in use. The rest of the network had been upgraded/replaced in the decades 1950-1959, 1970-1979, 1980-1989, 1990-1999 and 2010 to 2019. The foulsewer network was installed pre 1949 with upgrade/replacements 1950-1959, and 1960-1969.

35.4 Stormwater drain discharging to backwater in Thomsons Bush- This sample site is at discharge to a backwater in Thomsons Bush. The backwater is periodically pumped to the Waihopai River downstream of the North Road Bridge. This sample site encompasses an area of about 4 blocks and is zoned residential

along with a large area of developed farmland. The stormwater network was developed over 4 separate decades, pre 1949, 1970-1979, 1980-1989, and 1990-1999. The foulsewer network was established in 1970 to 1979 with a 50m section 1960-1969.

35.5 Drain at 126 Gladstone Terrace – This sample site is at a manhole prior to discharge to the Waihopai River due to the outfall being submerged at all but extremely low flows. This sample site encompasses an area of about 3 blocks and is zoned residential. The stormwater network was installed 1960-1969. The foulsewer was installed 1960-1969 with a small extension 1970-1979.

35.6 Prestonville Drain – This sample site is a pumped outfall to the Waihopai River. The site has a ponding area which acts as a settlement zone. Water from the bottom or the top of the pond is not pumped to the River. It is a site that was identified by in 2011 as being subject to potential human effluent contamination. This sample site encompasses an area of about 9 blocks residential and 4 blocks commercial/industrial. The catchment is split between 2 areas about equal in size. About 60% of the stormwater network was installed 1960-1969 with the remaining in the period 1970 to 2019 About 60% of the foulsewer network was installed 1960-1969 with the remaining in the period 1970 to 1989.

35.7 Russell Street Drain – This sample site is an outfall to a ditch prior to discharge to the Waihopai River. This sample site encompasses an area of about 20 City blocks and is zoned residential. The stormwater network was established pre 1949 with about 50% of the original network still in use. The rest of the network had been upgraded/replaced in the decades 1950-1959 1980-1989, 1990-1999 and 2000 to 2009. The foulsewer network was installed pre 1949 with about 70% still in use with the remaining upgrade/replacements 1950-1959, and 1960-1969.

36. Sediment Sample Sites

36.1 Same sites as the receiving water sites, plus:

36.2 20m above Ohai Industrial Line Railway- A site at the lower extent of the Waihopai River just east of the freshwater marine coastal boundary zone consisting of a mud bottom.

37. Macroinvertebrate Communities Sites

    37.1 50m Upstream Racecourse Road – same as the control receiving water site upstream of ICC discharges to the receiving waters.

    37.2 Queens Drive Bridge– same as the water site about halfway between outskirts of City and start of coastal marine section.

    37.3 20m above Ohai Industrial Line Railway- A site at the lower extent of the Waihopai River freshwater zone Stream consisting of a mud bottom.

Waikiwi Stream, Consent 206937

38. The Waikiwi Stream is approximately 40 km in length extending from about Cross Road Dacre to discharge to the Oreti River. The stream is used for fishing and whitebaiting.

39. Receiving Water Sites

    39.1 Upstream West Plains Road Stormwater Outfall – A control receiving water site upstream of ICC discharges to the receiving waters.

    39.2 Downstream West Plains Road Outfall above West Plains Road Bridge. – A water site about 150m downstream of the West Plains Road stormwater outfall. This site is considered to show any direct effect of the stormwater discharge to the receiving environment.

40. Stormwater Discharge Site

    40.1 Discharge – This sample site is an artificial drain that discharges to the Waikiwi Stream. The drain is not part of the ICC stormwater network. This sample site encompasses an area of about 16 City blocks and is zoned mostly residential. There is a parcel of land that is commercial /industrial and contains a timber milling and processing site. About 90% of the stormwater network was installed 1960-1969 with the remaining in the period 1970 to 1979. About 60% of the foulsewer network was installed 1960-1969 with the remaining in the period 1970 to 2009 (apart from a small section of sewer established pre 1949).

41. Sediment Sample Sites

    41.1 Within 20m West Plains Road Bridge – A sediment site that should show effects from the West Plains Road stormwater discharge.

42. Macroinvertebrate Communities Sites

    42.1 300m Upstream West Plains Road Bridge – A control site about 150m upstream of ICC discharge to the receiving waters.

    42.2 10m Downstream West Plains Road Bridge – A site about 150m downstream of ICC discharge to the receiving waters.

Brief Synopsis of Routine Sampling for Discharge Consents

43. The following is a brief synopsis of the results of the ICC monitoring programme. This summary is from the 2017 Annual Report for the existing consent, which has not yet been submitted to Environment Southland. This includes more recent information on sampling at selected outfalls and 2017 sediment sampling that has been gathered subsequent to the application which is included as Attachment A to my evidence.

Clifton Channel– Consent 206940

44. Water quality in the Clifton Channel were monitored periodically during dry and storm weather conditions. The channel has been monitored as per the schedule 17 times during dry conditions and 4 times during storm conditions. Sediment testing from the bed of the Clifton Channel was tested 6 times once for the 12 month period.

Clifton Channel - Trends and Adverse Effects - Based on observations of median results dry weather sampling:

45. Dissolved Oxygen: Trend toward lower DO downstream from Bain Street at Wicklow.

46. Suspended Solids: Trend toward slightly lower solids downstream from Bain Street.

47. Phosphorus: Trend lower downstream from Bain Street.

48. Nitrogen: Trend toward lower ammonia downstream from Bain Street. .

49. E. coli: Trend lower from Bain Street downstream.

50. Clarity: Very slight trend to increase in clarity from Bain Street.

51. Metals: Slight trend up of zinc from Bain Street. Trend down from Bain Street for Chromium and copper.

52. There was no analysis of trends for storm or wet weather sampling due to the low number of samples in the dataset. However, bacterial levels are elevated under such conditions. Nitrate levels appeared slightly decreased at the Bluff Highway West sample point. Phosphorus levels appeared to show a decrease from the Bain Street site. The suspended solids were slightly elevated during storm conditions.

Concentrations that Consistently (>50% of samples) Exceed ANZECC Lowland River Trigger Values (Dry Weather)				
	ANZECC Trigger	Bain Street	Wicklow Street	Bluff Highway West
Dissolved Reactive P	0.010mg/l	Yes	Yes	Yes
Total P	0.033mg/l	Yes	Yes	Yes
Total Ammoniacal N	0.9mg/l @ pH 8	No	No	No
Total Oxidised N	0.444mg/l	Yes	Yes	Yes
Total N	0.614mg/l	Yes	Yes	Yes

Concentrations that Consistently (>50% of samples) Exceed ANZECC Freshwater 95% Level of Protection (Dry Weather)				
	ANZECC Trigger	Bain Street	Wicklow Street	Bluff Highway West
Arsenic	0.024mg/l	No	No	No
Cadmium	0.0002mg/l	No	No	No
Chromium	0.001mg/l	No	No	No
Copper	0.0014mg/l	Yes	Yes	Yes
Lead	0.0034mg/l	No	No	No
Nickel	0.011mg/l	No	No	No
Zinc	0.008mg/l	Yes	Yes	Yes

Clifton Channel Sediment - Trends and Adverse Effects

53. Sediment sampling was first carried out in March 2012 and then repeated in March 2013, March 2014, March 2015 and April 2016 and May 2017. There appeared to be no trends between the 6 samples taken at this site.

54. The zinc level was four times measured above the ISQG-Low and once on the limit, but well below the ISQG-High. This represents a possible-effects

range within which effects would occasionally occur (Long 1995). Other metals were consistently below the ISQG-Low.

Sediment Metal Concentrations that Consistently Exceed ANZECC ISQG Trigger			
	ANZECC Trigger Low	ANZECC Trigger High	Clifton Channel
Arsenic	20mg/kg	70mg/kg	No
Cadmium	1.5mg/kg	10mg/kg	No
Chromium	80mg/kg	370mg/kg	No
Copper	65mg/kg	270mg/kg	No
Lead	50mg/kg	220mg/kg	No
Mercury	0.15mg/kg	1mg/kg	No
Nickel	21mg/kg	52mg/kg	No
Silver	1mg/kg	3.7mg/kg	No
Tin	5mg/kg	70mg/kg	No
Zinc	200mg/kg	410mg/kg	Low

Sediment PAH Concentrations that Consistently Exceed ANZECC ISQG Trigger			
	ANZECC Trigger Low	ANZECC Trigger High	Bluff Road
	mg/kg dry wt.		
Acenaphthene	0.016	0.5	No
Acenaphthylene	0.044	0.64	No
Anthracene	0.085	1.1	No
Benzo(a)anthracene	0.261	1.6	No
Benzo(a)pyrene (BAP)	0.43	1.6	No
Dibenzo(a,h)anthracene	0.063	0.26	No
Fluoranthene	0.6	5.1	No
Fluorene	0.019	0.54	No
Naphthalene dry wt	0.16	2.1	No
Phenanthrene	0.24	1.5	No
Pyrene	0.665	2.6	No
Low MW PAH	0.552	3.16	Low
High MW PAH	1.7	9.6	No

Kingswell Creek Discharge Permit – Consent 206939

55. Water quality in the Kingswell Creek and Stormwater Discharges were required to be monitored periodically during dry and storm weather conditions. The river and drains have been monitored as per the schedule 19 times during dry flow and 4 times during wet flows Sediment testing from the bed of the Kingswell Creek was tested 6 times once for each 12 month

period. Macroinvertebrate testing was carried out during March 2012 and April 2016.

Kingswell Creek -Trends and Adverse Effects- Based on observations of median results dry weather sampling

56. There was no analysis of trends for storm due to the low number of samples in the dataset. However, bacterial levels are very much elevated under such conditions. The ammonia level appeared slightly elevated. Nitrate levels appeared slightly decreased at the Bluff Road sample point. Phosphorus levels may have shown a slight increase. The suspended solids were slightly elevated during storm conditions but not wet weather conditions.

57. Dissolved Oxygen: Trend toward higher DO downstream from Chesney Street.

58. Suspended Solids: No trend downstream.

59. Phosphorus: Slight trend down in Total Phosphorus from Chesney Street to Bluff Road.

60. Nitrogen: No trend downstream.

61. E. coli: Slight trend down from Chesney Street to Bluff Road.

62. Clarity: No significant trend downstream.

63. Metals: Trend up of lead and zinc from Chesney Street. Very slight trend up of copper from Chesney Street.

64. There do not appear to be any long term trends in concentrations of the analytes measured at both the Chesney Street and Bluff Road sites (medians).

Concentrations that Consistently (>50% of Samples) Exceed ANZECC Lowland River Trigger Values (Dry Weather)			
	ANZECC Trigger	Chesney Street	Bluff Road
Dissolved Reactive P	0.010mg/l	Yes	Yes
Total P	0.033mg/l	Yes	Yes
Total Ammoniacal N	0.9mg/l @ pH 8	No	No
Total Oxidised N	0.444mg/l	Yes	Yes
Total N	0.614mg/l	Yes	Yes

Concentrations that Consistently (>50% of Samples) Exceed ANZECC Freshwater 95% Level of Protection (Dry Weather)			
	ANZECC Trigger	Chesney Street	Bluff Road
Arsenic	0.024mg/l	No	No
Cadmium	0.0002mg/l	No	No
Chromium	0.001mg/l	No	No
Copper	0.0014mg/l	Yes	Yes
Lead	0.0034mg/l	No	No
Nickel	0.011mg/l	No	No
Zinc	0.008mg/l	Yes	Yes

Kingswell Discharge Trends and Adverse Effects

65. There were no long term trends observed with the discharge dataset for the Elles Road and Brown Street discharges. These two sites show consistent faecal contamination. At the Bluff Road South discharge there has been a trend to higher *E. coli* concentrations over the last reporting period. However this slight trend may be skewed by the highest *E. coli* count occurring on the dry conditions with elevated flow. The *E. coli* concentrations at the Bluff Road South discharge are still well below 1000MPN/100ml. There were no noticeable effects from the Kingswell stormwater discharges on the receiving waters.

Brown Street	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Poor
Residential	100	65	65	35	35	0	0	
Commercial Industrial	0							

Elles Road	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		S	FS	SW	FS	SW	FS	Poor
Residential	100	50	50	50	50	0	0	
Commercial Industrial	0							

Upstream Bluff Road Bridge	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Good
Residential	100	0	0	100	100	0	0	
Commercial Industrial	0							

Kingswell Discharge Storm Event Monitoring

66. An automatic sampler was set up at single locations with the intent of capturing a weather event. Samples were taken at 20 minute intervals with 3 samples composited for each hour of sampling.

67. *Brown Street Outfall to Kingswell Creek* – This is a site that is residential with predominantly older infrastructure. Trends throughout the Storm event are as follows:

Brown Street Storm Water Storm Event Monitoring	
E.coli	Elevated soon after rain with prolonged return to background levels.
Ammoniacal Nitrogen	Slight Elevation Soon after rain with return to background levels
Nitrate Nitrogen	Decrease after rain with prolonged return to background levels
Dissolved Reactive Phosphorus	Slight Elevation Soon after rain with return to background levels
Total Phosphorus	Slight Elevation Soon after rain with return to background levels
Suspended Solids	Elevated soon after rain with prolonged return to background levels.
Total Arsenic	Slight Elevation Soon after rain with return to background levels
Total Cadmium	No change throughout events
Total Chromium	Elevated soon after rain with prolonged return to background levels.
Total Copper	No change throughout events
Total Lead	Slight Elevation Soon after rain with return to background levels
Total Nickel	Slight Elevation Soon after rain with return to background levels
Total Zinc	No change throughout events

Kingswell Creek Sediment - Trends and Adverse Effects

68. Sediment sampling was first carried out in March/April 2012 and then repeated in March 2013, March 2014, March 2015, April 2016 and May 2017.

69. *Bluff Road* - There appeared no trends between the 5 samples taken at the Bluff Road Site. All metals have been consistently below the ISQG-Low.

Sediment Metal Concentrations that Consistently (>50% of samples) Exceed ANZECC ISQG Trigger			
	ANZECC Trigger Low	ANZECC Trigger High	Bluff Road
Arsenic	20mg/kg	70mg/kg	No
Cadmium	1.5mg/kg	10mg/kg	No
Chromium	80mg/kg	370mg/kg	No
Copper	65mg/kg	270mg/kg	No
Lead	50mg/kg	220mg/kg	No
Mercury	0.15mg/kg	1mg/kg	No
Nickel	21mg/kg	52mg/kg	No
Silver	1mg/kg	3.7mg/kg	No
Tin	5mg/kg	70mg/kg	No
Zinc	200mg/kg	410mg/kg	No

Sediment PAH Concentrations that Consistently (> 50% of samples) Exceed ANZECC ISQG Trigger			
	ANZECC Trigger Low	ANZECC Trigger High	Bluff Road
	mg/kg dry wt.		
Acenaphthene	0.016	0.5	No
Acenaphthylene	0.044	0.64	No
Anthracene	0.085	1.1	No
Benzo(a)anthracene	0.261	1.6	No
Benzo(a)pyrene (BAP)	0.43	1.6	No
Dibenzo(a,h)anthracene	0.063	0.26	No
Fluoranthene	0.6	5.1	No
Fluorene	0.019	0.54	No
Naphthalene dry wt	0.16	2.1	No
Phenanthrene	0.24	1.5	No
Pyrene	0.665	2.6	No
Low MW PAH	0.552	3.16	No
High MW PAH	1.7	9.6	No

Otepuni Stream Discharge Permit – Consent 206938

70. Water quality in the Otepuni Stream and Stormwater Discharges are required to be monitored periodically during dry and storm weather conditions. The river and drains have been monitored as per the schedule 19 times during dry conditions and 4 times during wet conditions. There were also storm sample events captured by automatic sampler at the Lindisfarne Street discharge site. Sediment testing from the bed of the Otepuni Stream was tested 6 times, once for the 12 month period. Macroinvertebrate testing was carried out during March 2012 and April 2016.

Otepuni Stream - Trends and Adverse Effects- Based on observations of median results dry weather sampling

71. Dissolved Oxygen: No obvious trend downstream.

72. Suspended Solids: Lindisfarne tends to be lower than Rockdale and Mersey Street

73. Phosphorus: No consistent trend downstream.

74. Nitrogen: No consistent trend downstream.

75. E. coli: No consistent trend downstream.

76. Clarity: No trend downstream

77. Metals: There was a slight trend for increases in lead and zinc downstream. Other metals remained relatively stable as the stream travelled through the City.

78. There was no analysis of trends for storm or wet weather sampling due to the only being four samples in the dataset. However, bacterial levels are elevated under such conditions. Nutrient levels remained about constant apart from Total Phosphorus which increased downstream. Suspended solids were very elevated downstream from the Rockdale Road site. There do not appear to be any long term trends in concentrations of the analytes measured from Upstream to Downstream sites (medians).

Concentrations that Consistently (>50% of samples) Exceed ANZECC Lowland River Trigger Values (Dry Weather)				
	ANZECC Trigger	Rockdale Road	Lindisfarne Street	Mersey Street
Dissolved Reactive P	0.010mg/l	Yes	Yes	Yes
Total P	0.033mg/l	Yes	Yes	Yes
Total Ammoniacal N	0.9mg/l @ pH 8	No	No	No
Total Oxidised N	0.444mg/l	Yes	Yes	Yes
Total N	0.614mg/l	Yes	Yes	Yes

Concentrations that Consistently (>50% of samples) Exceed ANZECC Freshwater 95% Level of Protection (Dry Weather)				
	ANZECC Trigger	Rockdale Road	Lindisfarne Street	Mersey Street
Arsenic	0.024mg/l	No	No	No
Cadmium	0.0002mg/l	No	No	No
Chromium	0.001mg/l	No	No	No
Copper	0.0014mg/l	Yes	Yes	Yes
Lead	0.0034mg/l	No	No	No
Nickel	0.011mg/l	No	No	No
Zinc	0.008mg/l	Yes	Yes	Yes

Otepuni Discharge Trends and Adverse Effects

79. The *E. coli* concentration at the 34 Onslow Street site has tended to trend downward from the levels of 2012 and 2013. Zinc and lead levels at Lindisfarne Street have trended slightly down. However faecal contamination is still very evident at the Lindisfarne Street site. Zinc has trended down at Camden Street but high faecal contamination is evident through the E. coli and Ammonia concentrations. Zinc and lead levels at Ythan Street have trended slightly down. There were no noticeable effects from the Otepuni stormwater discharges on the receiving waters tested.

34 Onslow Street	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Generally Good
Residential	100	0	0	100	100	0	0	
Commercial Industrial	0							

16 Onslow Street	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Occasionally Poor
Residential	50	5	0	85	100	10	0	
Commercial Industrial	50							

Lindisfarne Street	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Poor
Residential	100	80	70	10	30	10	0	
Commercial Industrial	-							

Camden Street	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Poor
Residential	100	60	95	40	3	0	2	

Commercial Industrial	-							
Ythan Street	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Good
Residential	70	50	70	25	0	25	30	
Commercial Industrial	30							

Levin Street	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Occasionally Poor
Residential	0	40	90	40	0	20	10	
Commercial Industrial	100							

Otepuni Discharge Storm Event Monitoring

80. An automatic sampler was set up at single locations with the intent of capturing a weather event. Samples were taken at 20 minute intervals with 3 samples composited for each hour of sampling.

81. *Lindisfarne Street Outfall to Otepuni* -This is a site that is residential with predominantly older infrastructure. Trends throughout the event are as follows:

Lindisfarne Street Storm Water Storm Event Monitoring	
E.coli	Elevated soon after rain with prolonged return to background levels.
Ammoniacal Nitrogen	No change throughout events
Nitrate Nitrogen	Decrease after rain with prolonged return to background levels
Dissolved Reactive Phosphorus	Slight Elevation Soon after rain with return to background levels

Lindisfarne Street Storm Water Storm Event Monitoring	
Total Phosphorus	Elevated soon after rain with prolonged return to background levels.
Suspended Solids	Elevated soon after rain with prolonged return to background levels.
Total Arsenic	Slight Elevation Soon after rain with return to background levels
Total Cadmium	No change throughout events
Total Chromium	Slight Elevation Soon after rain with return to background levels
Total Copper	Slight Elevation Soon after rain with return to background levels
Total Lead	Slight Elevation Soon after rain with return to background levels
Total Nickel	Slight Elevation Soon after rain with return to background levels
Total Zinc	Elevated soon after rain with prolonged return to background levels.

Otepuni Stream Sediment - Trends and Adverse Effects

82. Sediment sampling was first carried out in April/May 2012 and then repeated in February/March 2013, March 2014, March 2015,April 2016 and May 2017. The metal and PAH levels in the sediment samples taken inside the City are higher than at the sample taken outside the City (Rockdale Road). The concentration of these parameters is elevated at the Mersey Street Site.

83. Rockdale Road - There were no trends between the 6 samples taken at the Rockdale Road Site. All metals were consistently below the ISQG-Low level. PAH testing for most species gave results below detection limit.

84. Lindisfarne Street - There appeared to be no trends between the 6 samples taken at the stream Lindisfarne Street Site to 2017, discounting sample outliers from 2016.

85. Mersey Street - There appeared to be no trends between the 6 samples taken at the stream Mersey Street Site to 2017.

86. Outfall - There appeared to be no trends between the 6 samples taken at the stream Outfall Site to 2017.

Sediment Metal Concentrations that Consistently (>50% of samples) Exceed ANZECC ISQG Trigger						
	ANZECC Trigger Low	ANZECC Trigger High	Rockdale Road	Lindisfarne Street	Mersey Street	Outfall
Arsenic	20mg/kg	70mg/kg	No	No	No	No
Cadmium	1.5mg/kg	10mg/kg	No	No	No	No
Chromium	80mg/kg	370mg/kg	No	No	No	No
Copper	65mg/kg	270mg/kg	No	No	No	No
Lead	50mg/kg	220mg/kg	No	No	Low	No
Mercury	0.15mg/kg	1mg/kg	No	No	No	No
Nickel	21mg/kg	52mg/kg	No	No	Low	Low
Silver	1mg/kg	3.7mg/kg	No	No	No	No
Tin	5mg/kg	70mg/kg	No	No	No	No
Zinc	200mg/kg	410mg/kg	No	No	Low	Low

87. PAH concentrations are generally below ANZECC ISQG low trigger values before the City at Rockdale Road but increase as the stream travels through the City. The highest PAH levels have been at the Mersey and the Outfall sites.

Sediment PAH Concentrations that Consistently (>50% of samples) Exceed ANZECC ISQG Trigger						
	ANZECC Trigger Low	ANZECC Trigger High	Rockdale Road	Lindisfarne Street	Mersey Street	Outfall
	mg/kg dry wt.					
Acenaphthene	0.016	0.5	No	No	No	No
Acenaphthylene	0.044	0.64	No	No	No	No
Anthracene	0.085	1.1	No	No	No	No
Benzo(a)anthracene	0.261	1.6	No	Low	Low	No
Benzo(a)pyrene (BAP)	0.43	1.6	No	Low	Low	No
Dibenzo(a,h)anthracene	0.063	0.26	No	No	No	No
Fluoranthene	0.6	5.1	No	No	Low	No
Fluorene	0.019	0.54	No	No	No	No
Naphthalene dry wt	0.16	2.1	No	No	No	No
Phenanthrene	0.24	1.5	No	Low	Low	No
Pyrene	0.665	2.6	No	Low	Low	No
Low MW PAH	0.552	3.16	No	Low	Low	Low
High MW PAH	1.7	9.6	No	Low	Low	No

Waihopai River Discharge Permit – Consent 206936

88. Water quality in the Waihopai River and Stormwater Discharges are required to be monitored periodically during dry and storm weather conditions. The river and drains have been monitored as per the schedule 19 times during dry flow and 5 times during wet conditions. There were also several storm sample events captured by automatic sampler at 2 discharge sites – Prestonville and Russell Street. Sediment testing from the bed of the Waihopai River was 6 times, tested once for each 12 month period. Macroinvertebrate testing was carried out during March 2012 and April 2016.

Waihopai River - Trends and Adverse Effects - Based on observations of median results dry weather sampling 2012 to 2016

89. Dissolved Oxygen: Slight trend downwards to downstream North Road.

90. Suspended Solids : No trend downstream to Prestonville Samples, but then a trend to higher at the North Road sample site. River-bed is muddy closer to the coastal marine boundary.

91. Phosphorus :No consistent trend downstream.

92. Nitrogen: No consistent trend downstream.

93. E. coli :No trend downstream to North Road, but, appears higher at Queens drive Site but recovers by next sample site at Prestonville.

94. Clarity :No trend downstream

95. Metals: There is a trend for increases in copper, nickel and zinc downstream. Lead was stable downstream to Prestonville but appears to trend up at North Road.

96. There was no analysis of trends for storm or wet weather sampling due to the small number of samples in the dataset. However, bacterial levels are elevated under such conditions. Nutrient levels remained about constant apart from Total Phosphorus which increased downstream. Suspended solids were slightly elevated downstream from the Racecourse Road site. There do not appear to be any long term trends in concentrations of the analytes measured at receiving water sample sites.

Concentrations that Consistently (>50%) of samples) Exceed ANZECC Lowland River Trigger Values (Dry Weather)						
	ANZECC Trigger	Racecourse Road	Queens Drive	Prestonville Up	Prestonville Down	North Road
Dissolved Reactive P	0.010mg/l	Yes	Yes	Yes	Yes	No
Total P	0.033mg/l	No	No	No	No	Yes
Total Ammoniacal N	0.9mg/l @ pH 8	No	No	No	No	No
Total Oxidised N	0.444mg/l	Yes	Yes	Yes	Yes	Yes
Total N	0.614mg/l	Yes	Yes	Yes	Yes	Yes

Concentrations that Consistently (>50% of samples) Exceed ANZECC Freshwater 95% Level of Protection (Dry Weather)						
	ANZECC Trigger	Racecourse Road	Queens Drive	Prestonville Up	Prestonville Down	North Road
Arsenic	0.024mg/l	No	No	No	No	No
Cadmium	0.0002mg/l	No	No	No	No	No
Chromium	0.001mg/l	No	No	No	No	No
Copper	0.0014mg/l	No	Yes	Yes	No	Yes
Lead	0.0034mg/l	No	No	No	No	No
Nickel	0.011mg/l	No	No	No	No	No
Zinc	0.008mg/l	No	No	No	No	Yes

Waihopai Discharge Trends and Adverse Effects

97. There are no medium to long term trends noticed in this dataset from sampling that commenced in March 2012. Elevated E.coli and Nutrient levels are noted in the Queens Drive manhole. This is due to presumed faecal contamination in that part of the network. The Invercargill City Council have engaged a drain-layer with previous experience in the City's sewer and stormwater network to investigate this catchment for possible sources of contamination.

274 Talbot Street	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Good
Residential	100	0	0	100	100	0	0	
Commercial Industrial	0							

61 Rosewood Drive	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Good
Residential	100	5	0	95	50	0	50	
Commercial Industrial	0							

Drain 3 Queens Drive	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Poor
Residential	95	25	60	72	40	3	0	
Commercial Industrial	5							

Thomsons Bush	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Good
Residential	100	0	0	100	100	0	0-	
Commercial Industrial	0							

126 Gladstone Terrace	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Good
Residential	100	0	0	100	100	0	0	
Commercial Industrial	0							

Prestonville	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Occasionally Poor
Residential	50	0	0	97	100	3	0	
Commercial Industrial	50							

Russell Street	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Poor
Residential	100	50	70	47	30	3	0	
Commercial Industrial	500							

Waihopai Discharge Storm Event Monitoring

98. An automatic sampler was set up at single locations with the intent of capturing a weather event. Samples were taken at 20 minute intervals with 3 samples composited for each hour of sampling.

99. *Prestonville Pump Station Inlet Flume to Pond* –2 storm events have been captured at this sample point. This is a site that is half residential and half commercial/industrial. Trends throughout the events are as follows:

Prestonville Pump Station Storm Water Storm Event Monitoring	
E.coli	Elevated soon after rain with prolonged return to background levels.
Ammoniacal Nitrogen	Elevated soon after rain with prolonged return to background levels.
Nitrate Nitrogen	Decrease after rain with prolonged return to background levels
Dissolved Reactive Phosphorus	Elevated soon after rain with prolonged return to background levels.
Total Phosphorus	Elevated soon after rain with prolonged return to background levels.
Suspended Solids	Elevated soon after rain with prolonged return to background levels.
Total Arsenic	Slight Elevation Soon after rain with return to background levels
Total Cadmium	No change throughout events
Total Chromium	Elevated soon after rain with prolonged return to background levels.
Total Copper	No change throughout events

Total Lead	Elevated soon after rain with prolonged return to background levels.
Total Nickel	Elevated soon after rain with prolonged return to background levels.
Total Zinc	Elevated soon after rain with prolonged return to background levels.

100. *Russell Street Manhole at Albert Intersection* – A storm event has been captured at this sample point. This is a site that is residential with predominantly older infrastructure Trends throughout the event are as follows:

Russell Street Storm Water Storm Event Monitoring	
E.coli	Elevated soon after rain with prolonged return to background levels.
Ammoniacal Nitrogen	Elevated soon after rain with prolonged return to background levels.
Nitrate Nitrogen	Decrease after rain with prolonged return to background levels
Dissolved Reactive Phosphorus	Elevated soon after rain with prolonged return to background levels.
Total Phosphorus	Elevated soon after rain with prolonged return to background levels.
Suspended Solids	Elevated soon after rain with prolonged return to background levels.
Total Arsenic	No change throughout events
Total Cadmium	No change throughout events
Total Chromium	No change throughout events
Total Copper	Elevated soon after rain with prolonged return to background levels.
Total Lead	Elevated soon after rain with prolonged return to background levels.
Total Nickel	No change throughout events
Total Zinc	Elevated soon after rain with prolonged return to background levels.

101. *Rosewood Drive Manhole* – A storm event has been captured at this sample point. This is a site that is residential with predominantly newer infrastructure. Trends throughout the event are as follows:

Rosewood Drive Storm Water Storm Event Monitoring	
E.coli	Elevated soon after rain with prolonged return to background levels.
Ammoniacal Nitrogen	Elevated soon after rain with prolonged return to background levels.

Rosewood Drive Storm Water Storm Event Monitoring	
Nitrate Nitrogen	Decrease after rain with prolonged return to background levels
Dissolved Reactive Phosphorus	Elevated soon after rain with prolonged return to background levels.
Total Phosphorus	Elevated soon after rain with prolonged return to background levels.
Suspended Solids	Elevated soon after rain with prolonged return to background levels.
Total Arsenic	Elevated soon after rain with prolonged return to background levels.
Total Cadmium	No change throughout events
Total Chromium	Elevated soon after rain with prolonged return to background levels.
Total Copper	Elevated soon after rain with prolonged return to background levels.
Total Lead	Elevated soon after rain with prolonged return to background levels.
Total Nickel	Elevated soon after rain with prolonged return to background levels.
Total Zinc	Elevated soon after rain with prolonged return to background levels.

Waihopai River Sediment - Trends and Adverse Effects

102. Sediment sampling was first carried out during April/May 2012 and then repeated in February 2013, March 2014, March 2015 and April 2016 and May 2017. In general, the metal and PAH levels in the sediment samples taken inside the City are higher than at the sample taken outside the City (Racecourse Road). The accumulation of these contaminants seems to be site specific with trends not noticed from up to downstream.

103. *Racecourse Road* - There appeared no trends between the 6 samples taken at the Racecourse Road Site. All metals were consistently below the ISQG-Low. PAH testing for most species gave results below detection limit. There were no occasions of PAH levels above ISQG-Low

104. *Queens Drive* - There is not an accumulation of sediment at this site with most of the river bed being fine to course gravels. A site near the side of the true left bank under the bridge has been used for the six samples (taken each year). There appeared no trends between the 6 samples taken at the Queens Drive site.

105. *Prestonville Upstream* - There is no apparent trend for the metals or PAH species at the Prestonville Up Site. All metals are consistently below the ISQG-Low guideline value.

106. Prestonville Downstream - There is no apparent trend for the metals or PAH species at the Prestonville Down Site. All metals are consistently below the ISQG-Low guideline value.

107. North Road - Over the six years of testing metal levels tend to trending down of this site. Possibly PAH levels may be trending downwards but it cannot be determined as most species are below detection limits.

108. Railway Bridge - There is no apparent trend for the metals or PAH species at the railway Bridge Site. All metals are consistently below the ISQG-Low guideline value.

Sediment Metal Concentrations that Consistently (>50% of samples) Exceed ANZECC ISQG Trigger								
	ANZECC Trigger Low	ANZECC Trigger High	Racecourse Road	Queens Drive	Prestonville Up	Prestonville Down	North Road	Railway Bridge
Arsenic	20mg/kg	70mg/kg	No	No	No	No	No	No
Cadmium	1.5mg/kg	10mg/kg	No	No	No	No	No	No
Chromium	80mg/kg	370mg/kg	No	No	No	No	No	No
Copper	65mg/kg	270mg/kg	No	No	No	No	No	No
Lead	50mg/kg	220mg/kg	No	No	No	No	No	No
Mercury	0.15mg/kg	1mg/kg	No	No	No	No	No	No
Nickel	21mg/kg	52mg/kg	No	No	No	No	Low	Low
Silver	1mg/kg	3.7mg/kg	No	No	No	No	No	No
Tin	5mg/kg	70mg/kg	No	No	No	No	No	No
Zinc	200mg/kg	410mg/kg	No	No	No	No	No	Low

Sediment PAH Concentrations that Consistently (>50% of samples)Exceed ANZECC ISQG Trigger								
	ANZECC Trigger Low	ANZECC Trigger High	Racecourse Road	Queens Drive	Prestonville Up	Prestonville Down	North Road	Railway Bridge
	mg/kg dry wt.							
Acenaphthene	0.016	0.5	No	No	No	No	No	No
Acenaphthylene	0.044	0.64	No	No	No	No	No	No
Anthracene	0.085	1.1	No	No	No	No	No	No
Benzo(a)anthracene	0.261	1.6	No	No	No	No	No	No
Benzo(a)pyrene (BAP)	0.43	1.6	No	No	No	No	No	No
Dibenzo(a,h)anthracene	0.063	0.26	No	No	No	No	No	No
Fluoranthene	0.6	5.1	No	No	No	No	No	No
Fluorene	0.019	0.54	No	No	No	No	No	No
Naphthalene dry wt	0.16	2.1	No	No	No	No	No	No
Phenanthrene	0.24	1.5	No	No	No	No	No	No
Pyrene	0.665	2.6	No	No	No	No	No	No
Low MW PAH	0.552	3.16	No	No	No	No	Low	Low
High MW PAH	1.7	9.6	No	No	No	No	No	No

Waikiwi Stream Discharge Permit – Consent 206937

109. Water quality in the Waikiwi Stream and Stormwater Discharges are required to be monitored periodically during dry and storm weather conditions. The river and drains have been monitored as per the schedule 16 times during dry flow and 4 times during wet conditions. Sediment testing from the bed of the Waikiwi Stream was tested s6 times, once for each 12 month period. Macroinvertebrate testing was carried out during April 2016.

Waikiwi Stream - Trends and Adverse Effects- Based on observations of median results dry weather sampling

110. Dissolved Oxygen: No trend from above to below stormwater discharge.

111. Suspended Solids: No trend from above to below stormwater discharge.

112. Phosphorus: No trend from above to below stormwater discharge.

113. Nitrogen: No trend from above to below stormwater discharge.

114. E. coli: No trend from above to below stormwater discharge.

115. Clarity: No trend from above to below stormwater discharge.

116. Metals: No trend from above to below stormwater discharge.

117. There was no analysis of trends for storm weather sampling due to the low number of samples in the dataset.

118. There do not appear to be any long term trends in concentrations of the analytes measured at both Upstream and Downstream sites.

Concentrations that Consistently (>50% of samples)Exceed ANZECC Lowland River Trigger Values (Dry Weather)			
	ANZECC Trigger	Upstream of Discharge	Downstream of Discharge
Dissolved Reactive P	0.010mg/l	Yes	No
Total P	0.033mg/l	Yes	Yes
Total Ammoniacal N	0.9mg/l @ pH 8	No	No
Total Oxidised N	0.444mg/l	Yes	Yes
Total N	0.614mg/l	Yes	Yes

Concentrations that Consistently (>50% of samples) Exceed ANZECC Freshwater 95% Level of Protection (Dry Weather)			
	ANZECC Trigger	Upstream of Discharge	Downstream of Discharge
Arsenic	0.024mg/l	No	No
Cadmium	0.0002mg/l	No	No
Chromium	0.001mg/l	No	No
Copper	0.0014mg/l	No	No
Lead	0.0034mg/l	No	No
Nickel	0.011mg/l	No	No
Zinc	0.008mg/l	No	No

Waikiwi Discharge Trends and Adverse Effects

119. There are no seasonal trends observed with the discharge dataset. Samples from the Upstream and Downstream receiving waters were not distinguishable from each other (in individual sampling rounds). There were no noticeable effects from the Waikiwi stormwater discharge under dry weather conditions.

West Plains Road Discharge	%	Age of Network (percent)						Summary of Catchment Discharge Water Quality
		Pre 1949		1950 to 1999		2000 to 2019		
		SW	FS	SW	FS	SW	FS	Good
Residential	80	0	0	100	97	0	3	
Commercial Industrial	20							

Waikiwi Stream Sediment - Trends and Adverse Effects

120. Sediment sampling was first carried out in May 2012 and then repeated in March 2013, March 2014, March 2015, April 20106 and May 2017. There appeared to be no trends between the 5 samples taken at this site. All metals were consistently below the ISQG-Low.

Sediment Metal Concentrations that Consistently (>50% of samples) Exceed ANZECC ISQG Trigger			
	ANZECCTrigger Low	ANZECC Trigger High	Downstream of Discharge
Arsenic	20mg/kg	70mg/kg	No
Cadmium	1.5mg/kg	10mg/kg	No
Chromium	80mg/kg	370mg/kg	No
Copper	65mg/kg	270mg/kg	No
Lead	50mg/kg	220mg/kg	No
Mercury	0.15mg/kg	1mg/kg	No
Nickel	21mg/kg	52mg/kg	No
Silver	1mg/kg	3.7mg/kg	No
Tin	5mg/kg	70mg/kg	No
Zinc	200mg/kg	410mg/kg	No

Sediment PAH Concentrations that Consistently (>50% of samples) Exceed ANZECC ISQG Trigger			
	ANZECC Trigger Low	ANZECC Trigger High	Downstream of Discharge
	mg/kg dry wt.		
Acenaphthene	0.016	0.5	No
Acenaphthylene	0.044	0.64	No
Anthracene	0.085	1.1	No
Benzo(a)anthracene	0.261	1.6	No
Benzo(a)pyrene (BAP)	0.43	1.6	No
Dibenzo(a,h)anthracene	0.063	0.26	No
Fluoranthene	0.6	5.1	No
Fluorene	0.019	0.54	No
Naphthalene dry wt	0.16	2.1	No
Phenanthrene	0.24	1.5	No
Pyrene	0.665	2.6	No
Low MW PAH	0.552	3.16	No
High MW PAH	1.7	9.6	No

Routine Discharge Consent Testing Costs

121. The following table summarises routine testing costs over the period of the current discharge consents. Costs for administration of the consents are not included. Costs for investigations, as a result of trigger sampling are outlined in the investigations for sewage contamination section of this evidence.

	Clifton	Kingswell	Otepuni	Waihopai	Waikiwi	Totals
Receiving Water	$16,099	$12,214	$19,596	$37,058	$10,906	$95,873
Discharge Water	$0	$24,752	$51,985	$66,386	$10,260	$153,383
Sediment Testing	$1,867	$2,806	$7,468	$11,202	$1,867	$25,210
Macroinver--tebrates	$0.00	$4,333	$6,500	$6,500	$2,364	$19,697
Sampling (@ $50/hr)	$2,200	$2,300	$5,750	$6,250	$1,000	$17,500
Total Exc. GST						$311,663

PROCEDURE AND FINDINGS OF INDUSTRIAL AUDITS

122. As a condition of each of the five stormwater discharge consents there was a requirement for the ICC to undertake audits of Industrial and Commercial sites that store, handle or use hazardous substances or other materials that have the potential to enter the reticulated stormwater networks.

123. The ICC developed a list of Industrial and Commercial sites that stored or handled hazardous substances and had connections to the reticulated stormwater system. Generally all sites have some connection to the stormwater system.

124. Field audits were to be carried out at a rate of 20% per year until all sites had been audited.

125. Sites previously audited by ES Pollution Prevention Officer since 1 January 2009 could be excluded from further field audits.

126. The site audits identified sites that required improvements to hazardous storage and handling areas to ensure they are excluded from stormwater discharge catchments and sites that required improvements to stormwater treatment.

127. Table 2.6 (page 18) of the application summarises the audits that have been undertaken during the consent period. The Percentage Audited to Date in that table refers to the percentage of the number of properties identified at the start of the audit procedure. For some catchments further properties have been identified and thus audited resulting in percentages greater than 100. In the Otepuni Catchment, the properties audited in the 2014/15 include many in areas which drain to CMA.

128. Industrial Audits showed about 80% compliance with good practice. These premises had no issues apparent to the auditor (ICC Environmental Health Officer).

129. Most issues of non-compliance were considered minor. In these cases cleaner production was discussed with the owner occupier at the time.

130. Some of the audited premises had issues that were related to waste material storage. In some cases the owner/occupier was referred to the ICC Waste Minimisation Officer.

131. Some of the audited premises had issues that were related to wash down areas or drainage layout. Education or use of dedicated wash down pads that drained to interceptors was encouraged

132. Premises that as part of their normal trade, produce liquid waste, are required where possible, or necessary, to have a trade waste consent to direct such waste to the sewerage system.

133. Premises that have a Trade Waste Consent for discharge of effluent to sewer were generally very compliant. This may be in part due to cleaner production practises and correct storage of hazardous waste that are part of the trade waste agreement.

134. Premises that have a Trade Waste Consent are subject to periodic inspection by the ICC Trade Waste Officer.

INVESTIGATIONS OF SEWAGE CONTAMINATION

Investigations as Stated condition of Waihopai discharge consent (with estimated costs)

135. As per Condition 3 (e)(ii) of Waihopai River Stormwater Discharge Consent 206936 the ICC were required to commence a programme to identify and remove human sewage contamination from 3 specified drains. The reticulated stormwater system drain at 274 Talbot Street, the reticulated stormwater system drain at Prestonville, and the reticulated stormwater drain at Russell Street.

274 Talbot Street Discharge Jan 2012 to Aug 2016

136. This site was identified by DOC as having signs of human sewage contamination based on a visual inspection of the site.

137. The ICC laboratory sampled and tested the site to establish any extent of faecal contamination that was at the site. Regular visual inspections and testing for E. coli was carried out.

138. This discharge site has been tested for E. coli concentration on a total of 64 occasions (42 check samples, 16 dry weather, 3 storm conditions and 3 wet weather). On no sampling occasions was there any sign of human sewage at the site. In total, the median E. coli /100ml was 34; the average was 116 E. coli /100ml, and the 95th percentile was 571 E. coli /100ml (including wet weather and storm sampling). Results obtained for the period do not indicate to the ICC that human sewage contamination was present in the discharge. There has still been no sign of any reported faecal material and FWA results (historical) have been on, or below detection limit. Further occasional check monitoring is undertaken and summarised in our interim reports.

Prestonville Inflow Jan 2012 to present day

139. This site was identified by the Environment Southland Report Living Streams Project as having human sewage contamination

140. The ICC laboratory sampled and tested the site to establish any extent of faecal contamination that was at the site. Regular visual inspections and testing for E. coli was carried out. Camera and Dye testing have also been used as tools to identify problems in this catchment. A cross connection was discovered at a vehicle workshop with the drain being re-directed to the sewer from stormwater. However it is unlikely that this was the source of any faecal contamination.

141. This discharge site has been tested for E. coli concentration on a total of 55 occasions (32 check samples, 17 dry weather, 3 storm conditions and 3 wet weather). In total, the median E. coli /100ml was 461, the average was 2401 E. coli /100ml, and the 95th percentile was 20691 E. coli /100ml (including wet weather and storm sampling). The results to date continue to confirm that intermittent high faecal counts may still be obtained during dry weather with elevated counts during storm and wet weather conditions. In all 169 check samples have been taken in the Prestonville catchment. An automatic sampler has been placed at the Prestonville Inflow site twice during storm events. Contamination levels at this site is intermittent with most samples having E.coli levels below the 1000/100ml trigger level. Further investigation work in this catchment is still underway.

Russell Street Discharge Jan 2012 to present day

142. This site was identified by the Environment Southland Report Living Streams Project as having human sewage contamination

143. The ICC laboratory sampled and tested the site to establish any extent of faecal contamination that was at the site. Regular visual inspections and testing for E. coli was carried out. Dye testing and cameras have also been used by ICC drainage staff or contractors. Results tend to indicate that there is intermittent faecal contamination to this sample site. Problems including partially blocked foulsewer (roots), blocked gully traps, broken gully traps have been identified. In all these cases the problems were not part of the ICC stormwater network as they were situated in the plumbing of private properties.

144. It is estimated that there is at least the same length of stormwater network that forms part of the drainage on private properties. Smaller pipes are more subject to damage or blockage that larger pipes. Some blocked stormwater mains have been identified and are waiting for maintenance contractor to clear.

145. To about 1960 it was common for the sewers and stormwater drains of land owners to be constructed of butted tile pipes. These may be in good condition but still allow some seepage to and from each other.

146. This discharge site has been tested for E. coli concentration on a total of 38 occasions (14 check samples, 18 dry weather, 3 storm conditions and 3 wet weather). In total, the median E. coli /100ml was 1472 However the average was 10393 E. coli /100ml, and the 95th percentile was 61512 E. coli /100ml (including wet weather and storm sampling). FWA results (historical) have ranged from detection limit to a very strong indication of the presence of laundry waste. The results to date confirm that intermittent high faecal counts are possible during dry weather. A total of 57 check samples have been taken in this catchment. There are indications that some of the streets in the catchment will require a thorough investigation including dye testing and camera investigations. The catchment appears to be very susceptible to the influence of rain such that reliable investigative results are restricted to dry/low water table conditions. An automatic sampler was placed at a manhole just upstream from the Russell Street Discharge on 2 separate occasions; once during a no rain event and the other during a period where there were 2 minor rain events. The ICC lab staff are continuing to investigate this catchment as part of routine investigations.

147. Since the employment of an Investigations Officer there have been further investigations into this catchment. 8 problem areas have been identified and are pending remediation.

148. Cost of Investigations to date (estimate)

	Sampling	Lab Testing	Dye/Camera/Labour	Total
274 Talbot	$1,600	$1,800	$0	$3,400
Prestonville	$5,500	$3,000	$4,500	$13,000
Russell Street	$3,800	$3,000	$3,500	$10,300
Russell Street	Investigations Officer			$5,600
Total				$32,300

Investigations triggered by Condition 6 of discharge consent (with estimated costs)

149. Condition 6 of each of the five Stormwater Discharge Consents outline trigger levels of contaminant that must initialise an investigation.

147.1 Condition 6

If monitoring of the receiving waters or dry weather stormwater discharge monitoring indicates the presence of human sewage by elevated E.coli counts and/or the presence of whitening agents or other wash-water indicator(s), the consent holder shall:

(i) notify Public Health south and Southland Regional Council's Compliance Manager upon receipt of the monitoring results that indicate sewage contamination

(ii) within 30 days, commence investigations to source and eliminate the sewage contamination and shall

(iii) provide monthly reports to Southland Regional Council's Compliance Manager on progress towards finding and removing sewage contamination of the stormwater network. These repairs shall cease once the source of the contamination has been eliminated or it has been confirmed that the effect in the receiving waters was not due to a discharge from the consent holder's stormwater network

(b) For the purposes of this condition, an elevated E.coli count shall be:

(i) more than 1000 E. coli/100ml in the dry weather stormwater discharge and/or

(ii) an increase between the most upstream and most downstream receiving waters monitoring sites of more than 1000 E. coli/100ml

150. Over the period of the discharge consents there have been:

150.1 no investigations triggered by an increase in E. coli concentration in the receiving waters,

150.2 no investigations triggered in the Waikiwi or Clifton waterways,

150.3 several investigations triggered by an increase in E. coli concentration in the discharge waters.

151. In the Kingswell Creek investigations have been triggered by elevated E. coli in the Brown Street and Elles Road sites. In the Otepuni Stream investigations have been triggered by elevated E. coli in the 16 Onslow Street, Lindisfarne Street, Camden Street and the Levin Street sites. In the Waihopai River investigations have been triggered by elevated E. coli in the Queens Drive, Prestonville and Russell Street sites.

152. I discussed earlier the investigations for the 274 Talbot Street, Prestonville and Russell Street sites which were required by Condition 2 of the Waihopai Stormwater Discharge Consent.

153. If not for Condition 2 of the Waihopai Stormwater Discharge Consent, there would have been no investigation triggered for the 274 Talbot street site, as the trigger values were not exceeded.

154. In Decision of Commissioners November 2011 the Commissioners acknowledged that due to the lack of previous investigation work they believed that the trigger for investigation (into probable sewage contamination) of 1000 E. coli/100ml was not unreasonable. The Commissioners limited the number of dry weather investigations for each catchment to three per year.

155. Over the period of investigations it has proved difficult to isolate the point source of suspected faecal contamination and thus eliminate the contamination.

156. The ICC employed a drain layer (Investigations Officer) in 2016 that was very familiar with the ICC sewer and stormwater networks (having been a maintenance worker on the networks for several years). The drain layer was employed solely to carry out investigations into faecal contamination of the stormwater network. The intention was that the investigation process would rapidly accelerate.

Brief review of Investigations

157. *Camden Street Oct. 2012-to Aug 2016 (Islington Street Investigation)* - One of the first investigations triggered was by the visual appearance of laundry

wash water in a discharge from Islington Street A bench top survey was completed and the micro catchment from Islington Street mapped. This was a relatively small area encompassing only 2 City blocks. Repeated sampling and testing for *E. coli* was able to eliminate the top 250m of the stormwater network. Dye testing was carried out on several occasions to isolate any point source contamination. Results from the dye testing did not identify any problems. Further *E. coli* testing was carried out with results similar to earlier test results. Camera use in the stormwater and sewer pipelines did not identify any physical problems with the condition of either pipeline. Further *E. coli* testing was carried out with results similar to earlier test results. The primary test source for the stormwater is from manholes. In this case it was decided to install a further manhole to be used solely for sampling and testing. The extra manhole appeared to isolate the point source contamination to about 3 household. Plumbing and drainage inspections of the properties were carried out with no identified problems. Further dye testing was carried out at the properties with no identified problems. A further sampling manhole (temporary) was installed. With still no identified problem the temporary manhole was taken out. A small sampling tube was installed on the shared stormwater discharge from 2 properties and flush testing of the properties was carried out. There was still no identification of any point source contamination. Periodic continued *E. coli* testing has shown results similar to those samples taken at the start of the investigation. Costs for investigation have been significant and are estimated below.

Sampling (66 occasions)	$4,950
Lab Testing (212 samples)	$4,250
Dye Testing (6 occasions)	$960
Camera Testing (4 occasions)	$1,200
Manhole Installation and other Infrastructure	$12,000
Other Labour/Administration	$1,600
Total	$24,960

158. *Drain 3 Queens Drive Jun 2010 to present* - This investigation was initiated by laboratory staff in January 2013. As per the Camden Street investigation a bench top survey was completed and the micro catchment from Islington Street mapped. This established that the catchment covered about 9 City blocks. Initially E. coli sampling and testing was repeated several times to establish areas of possible faecal contamination. The laboratory has sampled the network on 60 occasions. The Investigations Officer has sampled from 166 manholes and carried out dye testing on 19 occasions. Camera testing has been carried out on about 5 occasions. A sampling

manhole was installed in an un-accessible section of network on Herbert Street. To date there have been 14 problems identified that may cause faecal contamination to the stormwater network. Most problems have been found on the private parts of the drains owner by the households. These problems are with broken boundary traps and broken gully traps that are repaired at the cost of the owner. In 3 cases the foulsewer connection was blocked with some overflow to the stormwater system. Some of the problems are still pending and the network has not yet been cleared of faecal contamination. As was noted, in several of the cases problems were with maintenance of the private drainage network on privately owned properties. Costs to date are estimated below.

Sampling (60 occasions)	$4,500
Lab Testing (408 samples)	$8,160
Dye Testing (9 occasions)	$1,440
Camera Testing (5 occasions)	$1,500
Manhole Installation and other Infrastructure	$12,000
Other Labour/Administration	$16,800
Total	$44,400

159. *Lindisfarne Street Jan 2017 to present* - This investigation was initiated by the Investigations Officer in January 2017. The catchment was established to be in excess of 20 city blocks. The network has been sampled and tested on 42 occasions. It has been dye tested intermittently by the Investigations Officer. As a direct result of the Investigations 7 problems that may cause faecal contamination to the stormwater system have been identified. Most have been remedied but some are repairs are still pending. As in the previous catchment most (all in this case) have been problems identified on the part of the drainage network on private property.

160. Although not strictly the Lindisfarne catchment a cross connection was established from a cross leased property on Centre Street. It appears that the sewer and stormwater networks had been connected incorrectly at the time of construction some 30 years ago. The problem was remedied at ICC cost. Costs to date are estimated below:

Lab Testing (42 samples)	$840
Dye Testing (intermittent)	$1,000
Camera Testing (1 occasions)	$300
Infrastructure	$2,000
Other Labour/Administration	$16,800
Total	$20,940

161. *Brown Street Sep 2013 to present* - This investigation was initiated by the Laboratory in September 2013. The catchment was established to be about 18 city blocks. The network has been sampled and tested on 48 occasions. It has been dye tested 4 times by the Investigations Officer n and other ICC staff. As a direct result of the Investigations 2 problems that may cause faecal contamination to the stormwater were identified. In both circumstances boundary traps on the properties were at fault. In one of these cases there was probable spill-over of sewage to the stormwater network. There is significant ongoing work to be done in this catchment. Costs to date are estimated below:

Sampling (48 occasions)	$3,600
Lab Testing (85 samples)	$1,700
Dye Testing (4 occasions)	$640
Manhole Installation and other Infrastructure	$1,000
Other Labour/Administration	$3,000
Total	$9,940

162. *Russel Street, Prestonville, 174 Talbot Street Jan 2012 – present*
Investigations as described above. Investigations into Russell Street and Prestonville are ongoing.

163. *Elles Road, Leven Street, 16 Onslow Street*
Investigation are yet to be initiated.

Proposed Methodology for identifying sewage under new consents

164. In the proposed discharge consent Condition 8 refers to the identification of sewage contamination in the stormwater discharges.
Condition 8
If the monitoring undertaken in accordance with Condition 7 identifies that the "indicator Programme' trigger level values listed in Condition 4 are exceeded at any discharge on more than one occasion, the consent holder shall undertake the following as appropriate.
a) The consent holder shall commence an investigation into the catchment of the identified discharge to determine if any sources of untreated human sewage to the stormwater network can be located within the catchment of this discharge, unless such an investigation is already occurring for this discharge location.
b) Once complete or at six monthly intervals, whichever is sooner, the consent holder shall provide a report to the Consent Authority that includes:

i. A description of the methodology for the investigation undertaken

ii. Maps which show the locations at which samples, inspections or other activities were undertaken; and

iii. A summary of the results of the investigations, including any mitigation measures that have been or are intended to be undertaken to remove the sewage and the timetable for implementing those measures

c) Include a summary of the results and any mitigation measures implemented, in the annual report.

165. It is envisioned that in the circumstance of such an investigation the following steps shall be taken:

165.1 A benchtop exercise to establish the extent of the catchment with mapping of stormwater and foulsewer networks including the location of manholes or any other such sampling point.

165.2 An on-site investigation of the sewer network to look for obvious damage and establish that it is functioning as intended. In the case that there is an obvious fault with the system, the problem shall be remedied and the investigation re-evaluated. In the case of a catchment that has built in sewer overflows to the stormwater network the overflows shall be checked and where there is evidence that the overflow has operated the operation shall be investigated to ensure and establish if the overflow was necessary.

165.3 An on-site investigation of the stormwater network to look for obvious damage and establish that it is functioning as intended. In the case that there is an obvious fault with the system, the problem shall be remedied and the investigation re-evaluated.

165.4 Institute a programme of *E. coli* testing to attempt to isolate areas of the catchment that may be a problem. *E. coli* testing will probably form a part of any further steps as outlined below.

165.5 Consider and where completely necessary undertake infrastructure upgrades that may include the installation of further sampling sites.

165.6 Consider camera testing of both the foulsewer and stormwater networks

165.7 Institute dye tracing to isolate point sources of contamination.

165.8 Consider the use of FWA analysis to isolate point sources of contamination.

165.9 Consider the use of faecal source tracking to establish the likely source of contamination.

166. It is likely that a dedicated Investigations Officer may be required to oversee and carry out such investigations.

ISSUES ADDRESSED BY NEW PROPOSED CONSENT

167. The proposed consent is very complex and will involve a significant workload for several parties within the ICC. This is an acknowledgement from the ICC that they are serious about improving the state of our stormwater network and associated receiving waters.

168. Data gathered from the five short term stormwater consents has been beneficial to the design and thus the complexity of the proposed discharge consents. Concepts that were tested over the term of the current consents have generally been expanded such that the conditions of the proposed new consent give the ICC a realistic chance of success toward achieving an improvement in the operation and maintenance of the stormwater network along with the foulsewer network.

169. Investigations carried out under the current consents have shown that a significant number of stormwater discharge contamination issues arise in the drainage and associated plumbing not owned or maintained by the ICC. However ICC accepts that, while private, these still constitute a source of contamination that is present in some of the discharges to receiving waters.

170. It was theorised during the previous consent hearing that most of the contamination issues that were present in the stormwater network were due to illegal connections or exchange between the networks via constructed overflows. Investigations that have taken place have shown this not to be the situation in most circumstances.

171. Investigations carried out over the term of the current consents have also highlighted the constantly changing nature of the contamination. In several cases contamination that had been isolated to a small area was often not present when further work was scheduled. This is likely due to intermittent partial blockages or breakdowns in the drainage network possibly in both the private and ICC networks. For most of these intermittent problems the land/property owner or ICC will not be aware that there may have been an issue.

172. Because of the problems that are bought about by these contamination issues the proposed new consent outlines a robust process for dealing with the identification and removal of sewage contamination. See “Flow charts of the proposed condition of consent”, which are attached to Ms Bennett’s evidence.

173. The industrial audits that were instituted in the current consents have been beneficial and been responsible for many businesses becoming more aware of their obligations to isolate or remove potential sources of contamination from their worksite. The proposed new consent continues with the requirements of the industrial audits.

174. Spill and Contamination Management has been slightly expanded from the current consent. It is not realistic, or probably possible, to avoid occasional contamination of the stormwater system from blockages and spills that will occur in or from the foulsewer network. What is important is that the ICC through their current reticulated networks maintenance contractor is fully aware and prepared to act quickly when there is such an occurrence. The proposed new consent makes it an obligation to ensure that such spills or contamination are acted upon in an efficient and prompt manner.

175. Routine sampling of the receiving waters in the proposed new consent allows for an effective mechanism to gauge environmental effects of the stormwater discharges (Dry Weather Programme). Beyond this the programme allows for triggers (or alerts) to possible contamination that may be sourced from the stormwater outfalls. As a result of contaminant level triggers the sampling programme expands to either a Surveillance or Indicator Programme. Unlike the current consents, which only specify specific discharges, the proposed new consent makes every stormwater discharge important. It allows a mechanism such that all of the discharges are now subject to an investigation. This will give the proposed new consent the ability to actually monitor the whole of the stormwater network (through the triggering of relatively low contamination levels).

176. Wet weather monitoring is customised to assess the effects of stormwater discharged during wet weather on the receiving waters and environment.

177. Sediment sampling is continued in the proposed new consent with specific analytes that have been identified through the course of the current consents

178. A special programme is included with the purpose of a Reduction in Metal Loads. This has the potential to give real and measurable improvements to the discharges resulting in a reduction in toxicity of sediment and thus a higher range of bio-diversity in our receiving environment. This programme is to be instituted almost immediately so that the potential improvements will be in the short term.

179. A new and vital condition of the proposed new consent is the introduction of a Working Party will facilitate a closer working relationship with ICC and

other affected parties. It will give a formal platform for problems to be aired or issues raised. It also gives all parties ownership of the issues that arise and realistic opportunity for problems to be discussed openly and hopefully, solved.

Dated: 25 July 2017

……..

Adrian Cocker

3 Waters Operations Technologist

Attachment 1: Additional Monitoring Data Collected subsequent to the Application Document

Clifton Channel Sediment Testing 2017

Sample	Clifton Channel @ Lake Street	*ANZECC ISQG-Low*	*ANZECC ISQG-High*
Date	04-May-17		
Time	15:30		
Sampled	A. Cocker (ICC)		
Dry Matter as received g/100g	70		
Total Organic Carbon g/100g dry wt	1.39		
Total Zinc mg/kg dry wt	220	*200*	*410*
Total Copper mg/kg dry wt	9	*65*	*270*
Total Lead mg/kg dry wt	20	*50*	*220*
Total Arsenic mg/kg dry wt	5	*20*	*70*
Total Nickel mg/kg dry wt	11	*21*	*52*
Total Cadmium mg/kg dry wt	<0.10	*1.5*	*10*
Total Chromium mg/kg dry wt	9	*80*	*370*
Total Tin mg/kg dry wt	<1	*5*	*70*
Total Silver mg/kg dry wt	<0.4	*1*	*3.7*
Total Selenium mg/kg dry wt	<20		
Total Mercury mg/kg dry wt	<0.10	*0.15*	*1*
Acenaphthene mg/kg dry wt	<0.04	*0.016*	*0.5*
Acenaphthylene mg/kg dry wt	<0.04	*0.044*	*0.64*
Anthracene mg/kg dry wt	<0.04	*0.085*	*1.1*
Benzo(a)anthracene mg/kg dry wt	0.12	*0.261*	*1.6*
Benzo(a)pyrene (BAP) mg/kg dry wt	0.16	*0.43*	*1.6*
Benzo(b)fluoranthene + Benzo(j)fluoranthene mg/kg dry wt	0.23		
Benzo(g,h,i)perylene mg/kg dry wt	0.16		
Benzo(k)fluoranthene mg/kg dry wt	0.08		
Chrysene mg/kg dry wt	0.15	*0.384*	*0.28*
Dibenzo(a,h)anthracene mg/kg dry wt	<0.04	*0.063*	*0.26*
Fluoranthene mg/kg dry wt	0.26	*0.6*	*5.1*
Fluorene mg/kg dry wt	<0.04	*0.019*	*0.64*
Indeno(1,2,3-c,d)pyrene mg/kg dry wt	0.12		
2-Methyl napthalene	No Test	*0.07*	*0.67*
Naphthalene mg/kg dry wt	<0.16	*0.16*	*2.1*
Phenanthrene mg/kg dry wt	0.09	*0.24*	*1.5*
Pyrene mg/kg dry wt	0.27	*0.665*	*2.6*
Low Molecular weight PAHs (2-Methyl napthalene not tested)	<0.68	*0.552*	*3.16*
High Molecular weight PAHs	1	*1.7*	*9.6*
Above ISQG-Low			

Kingswell Creek Sediment Testing 2017

Sample	Kingswell Creek 150m West of Bluff Road @ Walking Track Bridge	*ANZECC ISQG-Low*	*ANZECC ISQG-High*
Date	04-May-17		
Time	15:20		
Sampled	APC		
Dry Matter as received g/100g	0:00		
Total Organic Carbon g/100g dry wt	0.95		
Total Zinc mg/kg dry wt	53	*200*	*410*
Total Copper mg/kg dry wt	9	*65*	*270*
Total Lead mg/kg dry wt	11.1	*50*	*220*
Total Arsenic mg/kg dry wt	3	*20*	*70*
Total Nickel mg/kg dry wt	10	*21*	*52*
Total Cadmium mg/kg dry wt	<0.10	*1.5*	*10*
Total Chromium mg/kg dry wt	9	*80*	*370*
Total Tin mg/kg dry wt	<1.0	*5*	*70*
Total Silver mg/kg dry wt	<0.4	*1*	*3.7*
Total Selenium mg/kg dry wt	<20		
Total Mercury mg/kg dry wt	<0.10	*0.15*	*1*
Acenaphthene mg/kg dry wt	<0.04	*0.016*	*0.5*
Acenaphthylene mg/kg dry wt	<0.04	*0.044*	*0.64*
Anthracene mg/kg dry wt	<0.04	*0.085*	*1.1*
Benzo(a)anthracene mg/kg dry wt	<0.04	*0.261*	*1.6*
Benzo(a)pyrene (BAP) mg/kg dry wt	<0.04	*0.43*	*1.6*
Benzo(b)fluoranthene + Benzo(j)fluoranthene mg/kg dry wt	0.04		
Benzo(g,h,i)perylene mg/kg dry wt	<0.04		
Benzo(k)fluoranthene mg/kg dry wt	<0.04		
Chrysene mg/kg dry wt	<0.04	*0.384*	*0.28*
Dibenzo(a,h)anthracene mg/kg dry wt	<0.04	*0.063*	*0.26*
Fluoranthene mg/kg dry wt	0.06	*0.6*	*5.1*
Fluorene mg/kg dry wt	<0.04	*0.019*	*0.64*
Indeno(1,2,3-c,d)pyrene mg/kg dry wt	<0.04		
2-Methyl napthalene		*0.07*	*0.67*
Naphthalene mg/kg dry wt	<0.16	*0.16*	*2.1*
Phenanthrene mg/kg dry wt	<0.04	*0.24*	*1.5*
Pyrene mg/kg dry wt	0.06	*0.665*	*2.6*
Low Molecular weight PAHs (2-Methyl napthalene not tested)	<0.36	*0.552*	*3.16*
High Molecular weight PAHs	<0.28	*1.7*	*9.6*
Above ISQG-Low			

Otepuni Stream Sediment Testing 2017

Sample	Otepuni Upstream of Rockdale Road	Otepuni Downstream of Lindisfarne Bridge	Otepuni Upstream of Mersey Street Bridge	Otepuni Outfall to Waihopai River	*ANZECC ISQG-Low*	*ANZECC ISQG-High*
Date	02-May-17	02-May-17	02-May-17	02-May-17		
Time	16:10	14:40	14:30	14:25		
Sampled	RLA	RLA	RLA	RLA		
Dry Matter as received g/100g	0:00	0:00	0:00	0:00		
Total Organic Carbon g/100g dry wt	0	1	3.6	3		
Total Zinc mg/kg dry wt	14	79	270	187	*200*	*410*
Total Copper mg/kg dry wt	4	9	35	29	*65*	*270*
Total Lead mg/kg dry wt	2.3	13.8	50	20	*50*	*220*
Total Arsenic mg/kg dry wt	<2	<2	9	11	*20*	*70*
Total Nickel mg/kg dry wt	3	10	44	35	*21*	*52*
Total Cadmium mg/kg dry wt	<0.10	0.12	0.2	0.2	*1.5*	*10*
Total Chromium mg/kg dry wt	4	9	29	38	*80*	*370*
Total Tin mg/kg dry wt	<1.0	<1.0	3.2	1.4	*5*	*70*
Total Silver mg/kg dry wt	<0.4	<0.4	0.5	<0.14	*1*	*3.7*
Total Selenium mg/kg dry wt	<20	<20	<20	<20		
Total Mercury mg/kg dry wt	<0.10	<0.10	0.42	<0.10	*0.15*	*1*
Acenaphthene mg/kg dry wt	<0.03	<0.04	0.05	<0.06	*0.016*	*0.5*
Acenaphthylene mg/kg dry wt	<0.03	<0.04	<0.05	<0.06	*0.044*	*0.64*
Anthracene mg/kg dry wt	<0.03	<0.04	0.2	<0.06	*0.085*	*1.1*
Benzo(a)anthracene mg/kg dry wt	<0.03	0.09	0.51	<0.06	*0.261*	*1.6*
Benzo(a)pyrene (BAP) mg/kg dry wt	<0.03	0.10	0.61	<0.06	*0.43*	*1.6*
Benzo(b)fluoranthene + Benzo(j)fluoranthene mg/kg dry wt	<0.03	0.12	0.65	<0.06		
Benzo(g,h,i)perylene mg/kg dry wt	<0.03	0.07	0.45	<0.06		
Benzo(k)fluoranthene mg/kg dry wt	<0.03	0.05	0.29	<0.06		
Chrysene mg/kg dry wt	<0.03	0.09	0.48	<0.06	*0.384*	*0.28*
Dibenzo(a,h)anthracene mg/kg dry wt	<0.03	<0.04	0.08	<0.06	*0.063*	*0.26*
Fluoranthene mg/kg dry wt	<0.03	0.17	1.37	0.05	*0.6*	*5.1*
Fluorene mg/kg dry wt	<0.03	<0.04	0.07	<0.06	*0.019*	*0.64*
Indeno(1,2,3-c,d)pyrene mg/kg dry wt	<0.03	0.09	0.47	<0.06		
2-Methyl napthalene	No Test	No Test	No Test	No Test	*0.07*	*0.67*
Naphthalene mg/kg dry wt	<0.14	<0.17	<0.3	<0.3	*0.16*	*2.1*
Phenanthrene mg/kg dry wt	<0.03	0.05	0.98	<0.06	*0.24*	*1.5*
Pyrene mg/kg dry wt	<0.03	0.19	1.43	0.06	*0.665*	*2.6*
Low Molecular weight PAHs (2-Methyl napthalene not tested)	0.29	0.38	1.65	0.6	*0.552*	*3.16*
High Molecular weight PAHs	0.18	0.63	4.48	0.35	*1.7*	*9.6*
Above ISQG-Low						

Waikiwi Stream Sediment Testing 2017

Sample	Waikiwi West Plains Road Bridge	*ANZECC ISQG-Low*	*ANZECC ISQG-High*
Date	08-May-17		
Time	9:15		
Sampled	RLA		
Dry Matter as received g/100g	47		
Total Organic Carbon g/100g dry wt	3.4		
Total Zinc mg/kg dry wt	75	*200*	*410*
Total Copper mg/kg dry wt	12	*65*	*270*
Total Lead mg/kg dry wt	9.6	*50*	*220*
Total Arsenic mg/kg dry wt	5	*20*	*70*
Total Nickel mg/kg dry wt	12	*21*	*52*
Total Cadmium mg/kg dry wt	0.31	*1.5*	*10*
Total Chromium mg/kg dry wt	15	*80*	*370*
Total Tin mg/kg dry wt	<1.0	*5*	*70*
Total Silver mg/kg dry wt	<0.4	*1*	*3.7*
Total Selenium mg/kg dry wt	<20		
Total Mercury mg/kg dry wt	<0.10	*0.15*	*1*
Acenaphthene mg/kg dry wt	<0.05	*0.016*	*0.5*
Acenaphthylene mg/kg dry wt	<0.05	*0.044*	*0.64*
Anthracene mg/kg dry wt	<0.05	*0.085*	*1.1*
Benzo(a)anthracene mg/kg dry wt	<0.05	*0.261*	*1.6*
Benzo(a)pyrene (BAP) mg/kg dry wt	<0.05	*0.43*	*1.6*
Benzo(b)fluoranthene + Benzo(j)fluoranthene mg/kg dry wt	<0.05		
Benzo(g,h,i)perylene mg/kg dry wt	<0.05		
Benzo(k)fluoranthene mg/kg dry wt	<0.05		
Chrysene mg/kg dry wt	<0.05	*0.384*	*0.28*
Dibenzo(a,h)anthracene mg/kg dry wt	<0.05	*0.063*	*0.26*
Fluoranthene mg/kg dry wt	<0.05	*0.6*	*5.1*
Fluorene mg/kg dry wt	<0.05	*0.019*	*0.64*
Indeno(1,2,3-c,d)pyrene mg/kg dry wt	<0.05		
2-Methyl napthalene		*0.07*	*0.67*
Naphthalene mg/kg dry wt	<0.3	*0.16*	*2.1*
Phenanthrene mg/kg dry wt	<0.05	*0.24*	*1.5*
Pyrene mg/kg dry wt	<0.05	*0.665*	*2.6*
Low Molecular weight PAHs (2-Methyl napthalene not tested)	0.55	*0.552*	*3.16*
High Molecular weight PAHs	0.3	*1.7*	*9.6*
Above ISQG-Low			

Waihopai River Sediment Testing 2017

Sample	Waihopai Upstream of Racecourse Road	Waihopai Downstream Queens Drive Bridge	Waihopai Upstream of Prestonville	Waihopai Downstream of Prestonville	Waihopai Downstream of North Road	Waihopai 20 metres above Railway Bridge	*ANZECC ISQG-Low*	*ANZECC ISQG-High*
Date	02-May-17	02-May-17	02-May-17	02-May-17	02-May-17	02-May-17		
Time	16:00	15:50	14:50	15:00	15:30	15:45		
Sampled	RLA	RLA	RLA	RLA	RLA	RLA		
Dry Matter as received g/100g	78	74	45	65	71	37		
Total Organic Carbon g/100g dry wt	0.35	0.19	3.0	0.91	0.62	3.2		
Total Zinc mg/kg dry wt	18	19	113	48	88	220	*200*	*410*
Total Copper mg/kg dry wt	4	3	16	12	17	33	*65*	*270*
Total Lead mg/kg dry wt	3.0	2.8	12.1	6.2	21	23	*50*	*220*
Total Arsenic mg/kg dry wt	<2	<2	3	8	4	11	*20*	*70*
Total Nickel mg/kg dry wt	4	4	18	19	11	39	*21*	*52*
Total Cadmium mg/kg dry wt	<0.10	<0.10	0.29	<0.10	0.16	0.26	*1.5*	*10*
Total Chromium mg/kg dry wt	4	3	16	24	10	41	*80*	*370*
Total Tin mg/kg dry wt	<1.0	<1.0	<1.0	<1.0	2.6	1.3	*5*	*70*
Total Silver mg/kg dry wt	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	*1*	*3.7*
Total Selenium mg/kg dry wt	<20	<20	<20	<20	<20	<20		
Total Mercury mg/kg dry wt	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	*0.15*	*1*
Acenaphthene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	<0.03	<0.06	*0.016*	*0.5*
Acenaphthylene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	<0.03	<0.06	*0.044*	*0.64*
Anthracene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	<0.03	<0.06	*0.085*	*1.1*
Benzo(a)anthracene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	0.04	<0.06	*0.261*	*1.6*
Benzo(a)pyrene (BAP) mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	0.06	<0.06	*0.43*	*1.6*
Benzo(b)fluoranthene + Benzo(j)fluoranthene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	0.06	<0.06		
Benzo(g,h,i)perylene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	0.04	<0.06		
Benzo(k)fluoranthene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	<0.03	<0.06		
Chrysene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	0.06	<0.06	*0.384*	*0.28*
Dibenzo(a,h)anthracene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	<0.03	<0.06	*0.063*	*0.26*
Fluoranthene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	0.10	<0.06	*0.6*	*5.1*
Fluorene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	<0.03	<0.06	*0.019*	*0.64*
Indeno(1,2,3-c,d)pyrene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	0.05	<0.06		
2-Methyl napthalene							*0.07*	*0.67*
Naphthalene mg/kg dry wt	<0.15	<0.16	<0.3	<0.17	<0.15	<0.3	*0.16*	*2.1*
Phenanthrene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	0.04	<0.06	*0.24*	*1.5*
Pyrene mg/kg dry wt	<0.03	<0.04	<0.05	<0.04	0.12	<0.06	*0.665*	*2.6*
Low Molecular weight PAHs (2-Methyl napthalene not tested)	0.3	0.36	0.55	0.37	0.3	0.6	*0.552*	*3.16*
High Molecular weight PAHs	0.18	0.24	0.3	0.24	0.34	0.36	*1.7*	*9.6*
Above ISQG-Low								

Prestonville Pump Station Inlet Flume to Pond - Storm Event 25-26 October 2016

Time	Rainfall In This Sample Time mm	*Escherichia coli* MPN/100ml
25/10/2016 17:40	0	100
25/10/2016 18:40	0.5	300
25/10/2016 19:40	3.5	17000
25/10/2016 20:40	0.5	3200
25/10/2016 21:40	0	1000
25/10/2016 22:40	0	2900
25/10/2016 23:40	0	4100
25/10/2016 0:40	0	1100
25/10/2016 1:40	0.5	1000
26/10/2016 2:40	0.5	800

Above ANZECC Default Trigger NZ

Exceeds 1000MPN/100ml

Time	Rainfall In This Sample Time mm	Ammonia mg/litre as N	Nitrate mg/litre as N	Dissolved Reactive Phosphorus mg/litre	Total Phosphorus mg/litre
25/10/2016 17:40	0	0.23	2.06	0.022	0.067
25/10/2016 18:40	0.5	0.21	1.88	0.029	0.07
25/10/2016 19:40	3.5	0.31	0.46	0.096	0.129
25/10/2016 20:40	0.5	0.26	0.32	0.087	0.123
25/10/2016 21:40	0	0.2	0.72	0.058	0.12
25/10/2016 22:40	0	0.26	1.04	0.067	0.12
25/10/2016 23:40	0	0.27	1.11	0.06	0.105
25/10/2016 0:40	0	0.21	1.27	0.051	0.105
25/10/2016 1:40	0.5	0.2	1.74	0.036	0.108
26/10/2016 2:40	0.5	0.23	1.33	0.022	0.091

Prestonville Pump Station Inlet Flume to Pond - Storm Event 25-26 October 2016

Time	Rainfall In This Sample Time mm	Total Arsenic mg/litre	Total Cadmium mg/litre	Total Chromium mg/litre	Total Copper mg/litre	Total Iron mg/litre	Total Lead mg/litre	Total Nickel mg/litre	Total Zinc mg/litre
25/10/2016 17:40	0	0.00097	<0.00005	0.00056	0.014	4.0	0.00042	0.0042	0.052
25/10/2016 18:40	0.5	0.0012	<0.00005	0.0014	0.0077	4.3	0.0025	0.061	0.081
25/10/2016 19:40	3.5	0.0013	<0.00005	0.0019	0.010	0.097	0.0021	0.0036	0.089
25/10/2016 20:40	0.5	0.0017	<0.00005	0.0029	0.012	2.0	0.0030	0.0055	0.12
25/10/2016 21:40	0								
25/10/2016 22:40	0	0.0015	<0.00005	0.0017	0.011	2.2	0.0015	0.0038	0.14
25/10/2016 23:40	0								
25/10/2016 0:40	0	0.0011	<0.00005	0.0012	0.0091	2.5	0.00092	0.0034	0.13
25/10/2016 1:40	0.5								
26/10/2016 2:40	0.5	0.0012	<0.00005	0.0013	0.0061	3.6	0.0013	0.0043	0.099

Time	Rainfall In This Sample Time mm	Suspended Solids mg/litre	pH	Conductivity mS/cm
25/10/2016 17:40	0	13.2	6.58	0.326
25/10/2016 18:40	0.5	55.8	6.65	0.299
25/10/2016 19:40	3.5	189.4	6.92	0.062
25/10/2016 20:40	0.5	23.1	6.87	0.081
25/10/2016 21:40	0	24	6.74	0.137
25/10/2016 22:40	0	10	6.67	0.167
25/10/2016 23:40	0	7.8	6.67	0.163
25/10/2016 0:40	0	7.2	6.63	0.19
25/10/2016 1:40	0.5	7.5	6.6	0.215
26/10/2016 2:40	0.5	5.45	6.56	0.255

Above ANZECC Default Trigger NZ

126 Gladstone Terrace Manhole - Dry Event 16 August 2016

Time	Rainfall In This Sample Time mm	*Escherichia coli* MPN/100ml
15/08/2016 16:00	0	0
15/08/2016 19:00	0	0
15/08/2016 22:00	0	1
15/08/2016 1:00	0	0
16/08/2016 4:00	0	1
16/08/2016 7:00	0	2

Above ANZECC Default Trigger NZ

Exceeds 1000MPN/100ml

Time	Rainfall In This Sample Time mm	Ammonia mg/litre as N	Nitrate mg/litre as N	Dissolved Reactive Phosphorus mg/litre	Total Phosphorus mg/litre
15/08/2016 16:00	0	0.01	1.73	0.009	0.022
15/08/2016 19:00	0	0.01	0.70	0.007	0.016
15/08/2016 22:00	0	0.01	1.40	0.005	0.016
15/08/2016 1:00	0	0.01	1.01	0.005	0.008
16/08/2016 4:00	0	0.01	1.42	0.005	0.008
16/08/2016 7:00	0	0.01	1.38	0.005	0.005

126 Gladstone Terrace Manhole - Dry Event 16 August 2016

Time	Rainfall In This Sample Time mm	Total Arsenic mg/litre	Total Cadmium mg/litre	Total Chromium mg/litre	Total Copper mg/litre	Total Iron mg/litre	Total Lead mg/litre	Total Nickel mg/litre	Total Zinc mg/litre
15/08/2016 16:00	0	<0.2	<0.001	<0.01	0.017	<0.2	<0.002	<0.01	0.033
15/08/2016 19:00	0	<0.2	<0.001	<0.01	0.013	<0.2	<0.002	<0.01	0.029
15/08/2016 22:00	0	<0.2	<0.001	<0.01	<0.01	<0.2	<0.002	<0.01	0.022
15/08/2016 1:00	0	<0.2	<0.001	<0.01	<0.01	<0.2	<0.002	<0.01	0.021
16/08/2016 4:00	0	<0.2	<0.001	<0.01	<0.01	<0.2	<0.002	<0.01	0.021
16/08/2016 7:00	0	<0.2	<0.001	<0.01	<0.01	<0.2	<0.002	<0.01	0.02

Time	Rainfall In This Sample Time mm	Suspended Solids mg/litre	pH	Conductivity mS/cm
15/08/2016 16:00	0	6.3	6.67	0.263
15/08/2016 19:00	0	7	6.65	0.261
15/08/2016 22:00	0	4.4	6.63	0.261
15/08/2016 1:00	0	4.8	6.57	0.265
16/08/2016 4:00	0	2.8	6.54	0.267
16/08/2016 7:00	0	3.5	6.5	0.261

Above ANZECC Default Trigger NZ

61 Rosewood Drive Manhole - Storm Event

Time	Rainfall In This Sample Time mm	*Escherichia coli* MPN/100ml
4/07/2016 15:00	1	23
4/07/2016 16:00	1.5	104
4/07/2016 17:00	0.5	275
4/07/2016 18:00	0.5	107
5/07/2016 1:00	0.5	16
5/07/2016 2:00	1	35
5/07/2016 3:00	0.5	147
5/07/2016 4:00	0.5	39
5/07/2016 5:00	0	37
5/07/2016 6:00	0.5	26
5/07/2016 7:00	0	32
5/07/2016 8:00	0	6
5/07/2016 9:00	0	6

Above ANZECC Default Trigger NZ

Exceeds 1000MPN/100ml

Time	Rainfall In This Sample Time mm	Ammonia mg/litre as N	Nitrate mg/litre as N	Dissolved Reactive Phosphorus mg/litre	Total Phosphorus mg/litre
4/07/2016 15:00	1	0.08	3.98	0.016	0.028
4/07/2016 16:00	1.5	0.08	0.14	0.010	0.057
4/07/2016 17:00	0.5	0.13	0.34	0.013	0.068
4/07/2016 18:00	0.5	0.04	1.08	0.016	0.024
5/07/2016 1:00	0.5	0.04	4.50	0.021	0.100
5/07/2016 2:00	1	0.04	1.56	0.032	0.077
5/07/2016 3:00	0.5	0.05	0.81	0.036	0.077
5/07/2016 4:00	0.5	0.03	2.06	0.019	0.090
5/07/2016 5:00	0	0.03	1.15	0.026	0.081
5/07/2016 6:00	0.5	0.03	1.51	0.039	0.034
5/07/2016 7:00	0	0.04	0.47	0.013	0.015
5/07/2016 8:00	0	0.03	2.69	0.003	0.017
5/07/2016 9:00	0	0.03	2.42	0.011	0.017

61 Rosewood Drive Manhole - Storm Event

Time	Rainfall In This Sample Time mm	Total Arsenic mg/litre	Total Cadmium mg/litre	Total Chromium mg/litre	Total Copper mg/litre	Total Iron mg/litre	Total Lead mg/litre	Total Nickel mg/litre	Total Zinc mg/litre
4/07/2016 15:00	1								
4/07/2016 16:00	1.5								
4/07/2016 17:00	0.5	0.0026	0.000054	0.0035	0.014	4.3	0.011	0.0046	0.44
4/07/2016 18:00	0.5								
5/07/2016 1:00	0.5								
5/07/2016 2:00	1								
5/07/2016 3:00	0.5	0.00053	<0.00005	0.0017	0.0032	0.45	0.0016	0.0013	0.24
5/07/2016 4:00	0.5								
5/07/2016 5:00	0								
5/07/2016 6:00	0.5								
5/07/2016 7:00	0								
5/07/2016 8:00	0								
5/07/2016 9:00	0	0.00010	<0.00005	0.00064	0.0045	0.010	<0.0001	0.00090	0.069

Time	Rainfall In This Sample Time mm	Suspended Solids mg/litre	pH	Conductivity mS/cm
4/07/2016 15:00	1	5.4	7.07	0.234
4/07/2016 16:00	1.5	13.3	7.12	0.074
4/07/2016 17:00	0.5	2294*	6.97	0.072
4/07/2016 18:00	0.5	12.3	6.96	0.111
5/07/2016 1:00	0.5	77.5	7.47	0.260
5/07/2016 2:00	1	21.5	7.26	0.198
5/07/2016 3:00	0.5	142*	7.09	0.119
5/07/2016 4:00	0.5	8.7	7.20	0.188
42556.20833	0	391*	6.94	0.189
5/07/2016 6:00	0.5	7	7.04	0.171
5/07/2016 7:00	0	1.8	7.04	0.145
5/07/2016 8:00	0	1.7	7.02	0.212
5/07/2016 9:00	0	0.9	7.06	0.244

Above ANZECC Default Trigger NZ

* High suspended solids appeared to be bark - runoff from garden?

True left bank 10m West Lindisfarne Bridge - Storm Event 31-1 Feb 2016

Time	Rainfall In This Sample Time mm	*Escherichia coli* MPN/100ml
31/01/2017 13:30	3	3400
31/01/2017 14:30	2	3400
31/01/2017 15:30	0.5	3500
31/01/2017 16:30	2	2600
31/01/2017 17:30	4	1900
31/01/2017 18:30	5	2000
31/01/2017 19:30	4	6700
31/01/2017 20:30	0.5	6500
31/01/2017 21:30	0.5	9700
31/01/2017 22:30	0	10500
31/01/2017 23:30	0	8100
1/02/2017 0:30	0	6100
1/02/2017 1:30	0	6400
1/02/2017 2:30	0	5900

Above ANZECC Default Trigger NZ

Exceeds 1000MPN/100ml

Time	Rainfall In This Sample Time mm	Ammonia mg/litre as N	Nitrate mg/litre	Dissolved Reactive Phosphorus mg/litre	Total Phosphorus mg/litre
31/01/2017 13:30	3	0.04	2.26	0.050	0.073
31/01/2017 14:30	2	0.04	0.48	0.038	0.062
31/01/2017 15:30	0.5	0.04	0.19	0.041	0.065
31/01/2017 16:30	2	0.03	0.16	0.036	0.054
31/01/2017 17:30	4	0.03	0.87	0.038	0.049
31/01/2017 18:30	5	0.04	0.19	0.034	0.052
31/01/2017 19:30	4	0.04	0.22	0.041	0.062
31/01/2017 20:30	0.5	0.04	0.69	0.062	0.092
31/01/2017 21:30	0.5	0.04	1.19	0.062	0.079
31/01/2017 22:30	0	0.02	1.65	0.058	0.082
31/01/2017 23:30	0	0.01	2.08	0.053	0.082
1/02/2017 0:30	0	0.01	2.23	0.053	0.076
1/02/2017 1:30	0	0.01	2.48	0.041	0.065
1/02/2017 2:30	0	0.01	2.20	0.038	0.062

True left bank 10m West Lindisfarne Bridge - Storm Event 31-1 Feb 2016

Time	Rainfall In This Sample Time mm	Total Arsenic mg/litre	Total Cadmium mg/litre	Total Chromium mg/litre	Total Copper mg/litre	Total Iron mg/litre	Total Lead mg/litre	Total Nickel mg/litre	Total Zinc mg/litre
31/01/2017 13:30	3	0.00098	0.000068	0.0018	0.023	1.4	0.0057	0.0032	0.12
31/01/2017 14:30	2	0.00018	0.000098	0.0023	0.031	2	0.010	0.0041	0.15
31/01/2017 15:30	0.5								
31/01/2017 16:30	2								
31/01/2017 17:30	4	0.00097	<0.00005	0.0019	0.012	0.74	0.0039	0.0029	0.15
31/01/2017 18:30	5								
31/01/2017 19:30	4								
31/01/2017 20:30	0.5	0.0022	0.000051	0.0015	0.010	0.48	0.0030	0.0013	0.15
31/01/2017 21:30	0.5								
31/01/2017 22:30	0								
31/01/2017 23:30	0	0.0018	0.000079	0.0018	0.018	0.54	0.0019	0.0016	0.17
1/02/2017 0:30	0								
1/02/2017 1:30	0								
1/02/2017 2:30	0	0.0013	0.000055	0.0019	0.011	0.58	0.0017	0.0015	0.14

Time	Rainfall In This Sample Time mm	Suspended Solids mg/litre	pH	Conductivity mS/cm
31/01/2017 13:30	3	23	7.29	0.261
31/01/2017 14:30	2	82	6.61	0.056
31/01/2017 15:30	0.5	18.5	6.73	0.05
31/01/2017 16:30	2	7.5	6.74	0.07
31/01/2017 17:30	4	21	6.93	0.076
31/01/2017 18:30	5	26.5	6.99	0.034
31/01/2017 19:30	4	29.5	6.99	0.041
31/01/2017 20:30	0.5	11	6.89	0.098
31/01/2017 21:30	0.5	11	6.73	0.145
31/01/2017 22:30	0	7	6.94	0.202
31/01/2017 23:30	0	8.4	7.01	0.241
1/02/2017 0:30	0	8.5	7.05	0.259
1/02/2017 1:30	0	6	7.07	0.269
1/02/2017 2:30	0	5	7.09	0.275

Above ANZECC Default Trigger NZ

Stormwater Outfall at True Right Bank 3m West Brown Street Bridge - Storm Event 12-13 June 2017

Time	Rainfall In This Sample Time mm	*Escherichia coli* MPN/100ml
12/06/2017 12:00	0	12000
12/06/2017 12:20	1	3900
12/06/2017 13:20	2	2300
12/06/2017 14:20	0	3000
12/06/2017 15:20	1	3500
12/06/2017 16:20	4.5	3000
12/06/2017 17:20	3	2500
12/06/2017 18:20	5.5	4300
12/06/2017 19:20	0.5	17000
12/06/2017 20:20	1	8100
12/06/2017 21:20	0	8200
12/06/2017 22:20	0	5900
12/06/2017 23:20	0	4000
13/06/2017 0:20	1	4300
13/06/2017 1:20	0	2800
13/06/2017 2:20	0	1200
13/06/2017 3:20	0	3500
13/06/2017 4:20	0	1200

Above ANZECC Default Trigger NZ

Exceeds 1000MPN/100ml

Time	Rainfall In This Sample Time mm	Ammonia mg/litre as N	Nitrate mg/litre as N	Dissolved Reactive Phosphorus mg/litre	Total Phosphorus mg/litre
12/06/2017 12:00	0	0.22	0.58	0.035	0.057
12/06/2017 12:20	1	0.03	0.16	0.019	0.024
12/06/2017 13:20	2	0.03	0.07	0.038	0.063
12/06/2017 14:20	0	0.02	0.23	0.035	0.076
12/06/2017 15:20	1	0.04	0.2	0.043	0.043
12/06/2017 16:20	4.5	0.03	0.09	0.024	0.046
12/06/2017 17:20	3	0.06	0.08	0.043	0.057
12/06/2017 18:20	5.5	0.04	0.08	0.046	0.091
12/06/2017 19:20	0.5	0.08	0.37	0.053	0.072
12/06/2017 20:20	1	0.1	0.66	0.076	0.076
12/06/2017 21:20	0	0.12	0.5	0.065	0.078
12/06/2017 22:20	0	0.15	0.44	0.038	0.083
12/06/2017 23:20	0	0.07	0.57	0.045	0.043
13/06/2017 0:20	1	0.11	0.68	0.045	0.078
13/06/2017 1:20	0	0.09	0.6	0.045	0.091
13/06/2017 2:20	0	0.15	0.62	0.024	0.067
13/06/2017 3:20	0	0.09	0.62	0.032	0.079
13/06/2017 4:20	0	0.14	0.54	0.045	0.067

Stormwater Outfall at True Right Bank 3m West Brown Street Bridge - Storm Event 12-13 June 2017

Time	Rainfall In This Sample Time mm	Total Arsenic mg/litre	Total Cadmium mg/litre	Total Chromium mg/litre	Total Copper mg/litre	Total Iron mg/litre	Total Lead mg/litre	Total Nickel mg/litre	Total Zinc mg/litre
12/06/2017 12:00	0	0.00094	0.000066	0.0022	0.018	1.2	0.0029	0.0024	0.19
12/06/2017 12:20	1	0.0021	<0.00005	0.0031	0.017	2.2	0.0061	0.0052	0.27
12/06/2017 13:20	2	0.0019	<0.00005	0.0022	0.015	1.2	0.0039	0.0030	0.22
12/06/2017 14:20	0	0.0018	<0.00005	0.0024	0.014	1.4	0.0030	0.0027	0.2
12/06/2017 15:20	1								
12/06/2017 16:20	4.5	0.0027	<0.00005	0.0031	0.014	2.1	0.0067	0.0049	0.18
12/06/2017 17:20	3								
12/06/2017 18:20	5.5	0.0032	<0.00005	0.0031	0.0092	1.6	0.0074	0.0047	0.14
12/06/2017 19:20	0.5								
12/06/2017 20:20	1								
12/06/2017 21:20	0	0.0024	<0.00005	0.0020	0.0090	0.95	0.00032	0.0019	0.19
12/06/2017 22:20	0								
12/06/2017 23:20	0								
13/06/2017 0:20	1	0.0014	<0.00005	0.0019	0.011	0.75	0.0015	0.0013	0.15
13/06/2017 1:20	0								
13/06/2017 2:20	0								
13/06/2017 3:20	0	0.011	<0.00005	0.0018	0.0075	0.81	0.0028	0.0013	0.13
13/06/2017 4:20	0								

Time	Rainfall In This Sample Time mm	Suspended Solids mg/litre	pH	Conductivity mS/cm
12/06/2017 12:00	0	86	6.98	0.263
12/06/2017 12:20	1	173	6.61	0.096
12/06/2017 13:20	2	83	6.58	0.088
12/06/2017 14:20	0	115	6.6	0.122
12/06/2017 15:20	1	150	6.6	0.097
12/06/2017 16:20	4.5	123	6.5	0.049
12/06/2017 17:20	3	50	6.4	0.045
12/06/2017 18:20	5.5	68	6.44	0.051
12/06/2017 19:20	0.5	34.3	6.59	0.144
12/06/2017 20:20	1	23.4	6.72	0.218
12/06/2017 21:20	0	28.7	6.69	0.201
12/06/2017 22:20	0	13.6	6.7	0.206
12/06/2017 23:20	0	17.6	6.7	0.247
13/06/2017 0:20	1	8	6.78	0.264
13/06/2017 1:20	0	8.5	6.8	0.271
13/06/2017 2:20	0	6.3	6.77	0.276
13/06/2017 3:20	0	8.7	6.72	0.278
13/06/2017 4:20	0	6.8	6.71	0.279

Above ANZECC Default Trigger NZ