Dunedin City Council

Stormwater Monitoring

July 2019 – June 2020

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July 2019 to June 2020

Prepared for Dunedin City Council

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Executive Summary

Dunedin City Council operates the Dunedin stormwater system. Monitoring of stormwater and the receiving environments is required by Otago Regional Council resource consents (RM11.313.01 - RM11.313.10). Between July 2019 and June 2020, required monitoring included stormwater quality during dry and wet weather conditions, harbour water quality during dry and wet weather conditions, and harbour sediments. However, sampling was restricted by weather/tidal conditions not being met, and/or restrictions on sampling due to the COVID-19 lockdown.

Dry weather sampling of stormwater found variable levels of faecal contamination. However, there were no outfalls with consistently high results for both FWAs and *E. coli* and therefore no outfalls require immediate further investigation.

Automated sampling of stormwater was not undertaken during rainfall events in the Mason Street catchment due to conditions not being met and/or restrictions on sampling. Only two rainfall events have been captured in the Mason Street catchment, however moving the sampler to the Halsey Street catchment could be considered.

Harbour sediment contaminant concentrations were low in 2019 and well below the resource consent trigger levels. PAH concentrations, in particular, at some sites were much lower in 2019 than in previous results. Reductions in contaminant inputs to the harbour in recent years have contributed to a decline in contaminant concentrations in harbour sediments.

1. Introduction

Dunedin City Council (DCC) operates the Dunedin stormwater system which comprises a network of gutters, open channels, pipes, mud tanks, and outfalls. The principal coastal receiving water environments for Dunedin's reticulated stormwater are the upper basin of Otago Harbour, Port Chalmers, and, on the open coast, Second Beach and St. Clair Beach. Otago Regional Council (ORC) resource consents (RM11.313.01 - RM11.313.10) authorise the discharge of stormwater from ten stormwater catchments to these receiving environments (Figure 1). Conditions of the consents require monitoring of stormwater quality during dry and wet weather conditions, harbour water quality during dry and wet weather conditions, harbour sediments, and, on a biennial basis, harbour biological communities.

DCC engaged Ryder Environmental to undertake the required monitoring in 2019-20. This report summarises the monitoring undertaken between July 2019 and June 2020.

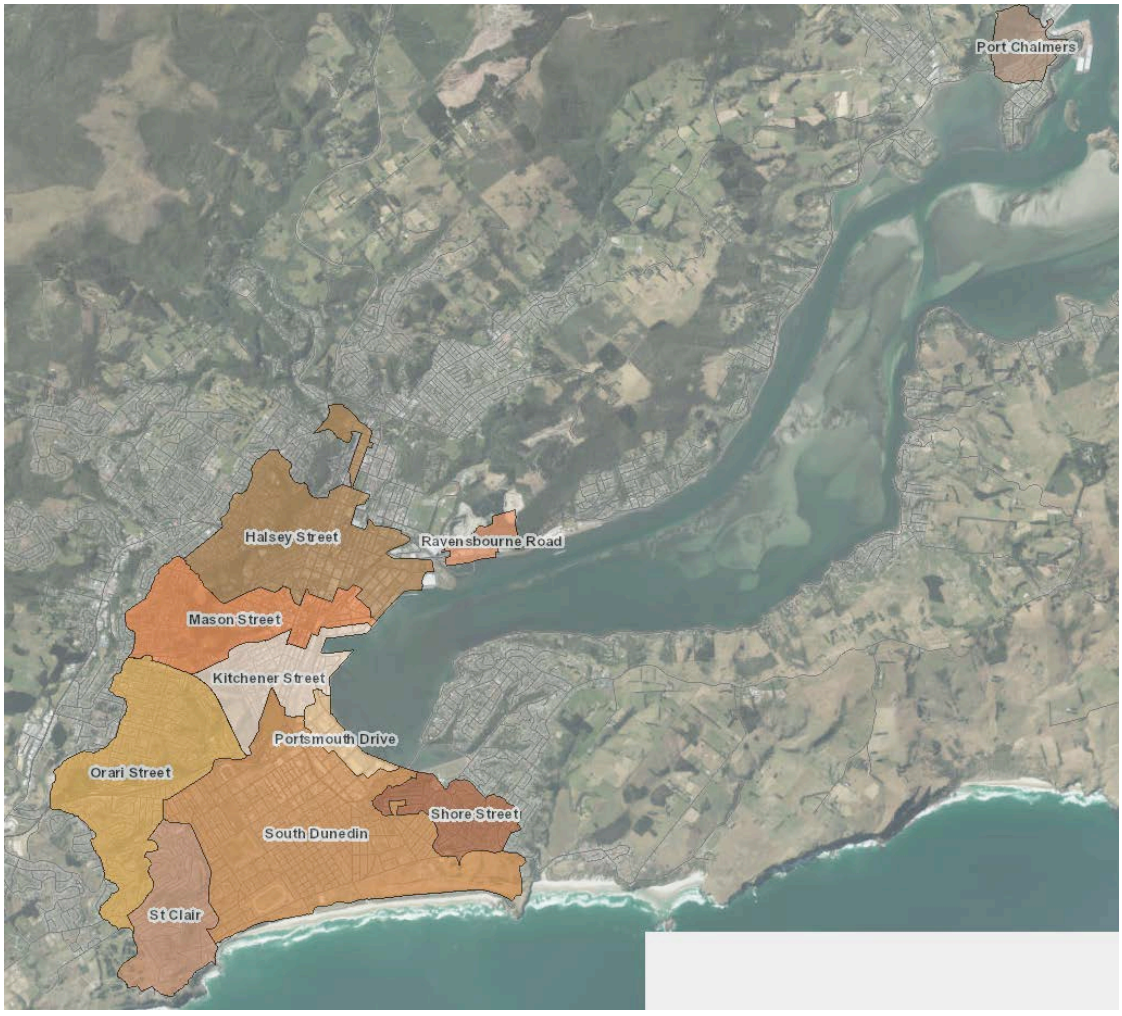

Figure 1. Dunedin stormwater catchments. From DCC webpage.

2. Methods

2.1 Stormwater outfalls

Monitoring of stormwater quality is required at 14 larger outfalls and many smaller outfalls where Dunedin's stormwater discharges to receiving environments (Figure 2). Many of Dunedin's outfalls have long histories dating back to the early settlement of the city. A number of the outfalls do not have outfall structures or are inaccessible for sampling. It is therefore neither practical nor possible to sample all 33 outfalls at the discharge point to the receiving environment. However, access at many sites is available via manholes a short distance upstream from the outfall.

2.2 Stormwater – Dry weather

Dry weather sampling is required at stormwater outfalls (Figure 2) at low tide (to avoid seawater contamination) during dry weather that includes an antecedent dry period of at least 72 hours. Samples are collected for laboratory analysis (Eurofins) for *Escherichia coli* (*E. coli*), which is a type of bacteria commonly found in the guts of warm-blooded mammals (including people) and birds, and is used as an indicator of faecal contamination in freshwater. The indicator bacteria themselves do not pose a significant risk to human health, but rather indicate the likely presence of faecal material which contains disease-causing pathogens. Sources of *E. coli* bacteria include untreated wastewater and faecal deposition by birds and other animals (e.g., dogs). Samples are also collected and analysed on site for fluorescent whitening agents (FWAs) using an *AquaFluor* Handheld Fluorometer/Turbidimeter. FWAs are used in laundry detergents and, as household plumbing mixes effluent from toilets with washing machine 'grey water', FWAs are usually associated with human faecal contamination and indicate possible wastewater infiltration to the stormwater system (Petch 1996, Gilpin *et al.* 2004). Dry weather sampling allows the determination of background contaminant levels entering the receiving environments via stormwater outfalls, and can indicate possible cross-connections between stormwater and wastewater systems. Where human wastewater is present, both elevated *E. coli* concentrations and FWA levels are expected. At some outfalls where indicators of human wastewater have not been detected or there is generally no flow, sampling is only required six-monthly, while sampling at other outfalls is required monthly (when all conditions for sampling are met) (see Appendix One).

2.3 Stormwater – Wet weather

Wet weather sampling is required at ten major stormwater outfalls at low tide within one hour of the commencement of a rain event (more than 2.5 mm of rain), following an

antecedent dry period of at least 72 hours. Sampling under these conditions is undertaken in an endeavour to sample the first flush, which is likely to contain the highest concentration of contaminants. Samples are collected for laboratory analysis (Eurofins) for arsenic, cadmium, chromium, copper, nickel, lead, zinc, oil and grease, suspended solids, pH, polycyclic aromatic hydrocarbons (PAH), and *E. coli* (the freshwater faecal indicator bacteria).

Figure 2. Dunedin stormwater outfalls. Monthly dry weather sampling sites (blue circles) and six-monthly dry weather sites (green circles). See Appendix One for outfall information. Aerial photo from Google Earth.

Figure 2 continued. Dunedin stormwater outfalls. Monthly dry weather sampling sites (blue circles) and six-monthly dry weather sites (green circles). See Appendix One for outfall information. Aerial photo from Google Earth.

2.4 Automated sampler – Wet weather

The ISCO automated sampler is used to target specific stormwater outfalls during wet weather and is located within stormwater catchments as required by the resource consent. Since February 2018, the automated sampler has been located near Toitu Museum, approximately 600 m up-pipe of the Mason Street stormwater outfall (Figure

3). The automated sampler has been programmed to collect samples over the first two-hour period of a rain event (more than 2.5 mm of rain) that coincides with low tide, following an antecedent dry period of at least 72 hours. When the automated sampler is triggered successfully under the correct conditions, samples are collected for laboratory analysis (Eurofins) for arsenic, cadmium, chromium, copper, nickel, lead, zinc, oil and grease, suspended solids, pH, polycyclic aromatic hydrocarbons (PAH), and *E. coli* (the freshwater faecal indicator bacteria).

Figure 3. The location of the ISCO automated sampler, near Toitu, sampling the Mason Street catchment. Mason Street stormwater outfall indicated by green circle. Aerial photo from Google Earth.

2.5 Harbour water

Monitoring of harbour water quality is required at six sites in the upper harbour (Figure 4). Sampling of harbour water quality is required on four occasions, targeting one rainfall event and one dry period. Sampling for a rainfall event is required within three hours of the commencement of a rain event (more than 2 mm of rain) following an antecedent dry period of at least 72 hours, while sampling for a dry period is following an antecedent dry period of at least 72 hours. Samples are to be collected at mid-flood tide and mid-ebb tide on each occasion (two sampling occasions per tide cycle). Dry weather sampling allows the determination of background contaminant levels in harbour water, while wet weather sampling assesses the contribution of contaminants from stormwater inputs into

the harbour. Ebb tides (outgoing tides) are likely to move contaminants down harbour while flood tides (incoming tides) may lead to higher concentrations of contaminants in the upper harbour. It must be noted, however, that inputs from the Water of Leith can complicate contaminant levels, especially during flood tides. Samples are collected for laboratory analysis (Eurofins) for cadmium, copper, lead, zinc, and enterococci. Enterococci is a type of bacteria commonly found in the guts of warm-blooded mammals (including people) and birds, and is used as an indicator of faecal contamination in marine water; enterococci have been identified as having the best relationship with health effects in marine waters (Ministry for the Environment (MfE) 2003). The indicator bacteria themselves do not pose a significant risk to human health, instead they indicate the presence of faecal material which contains disease-causing pathogens. Sources of enterococci bacteria include untreated wastewater and faecal deposition by birds and other animals (e.g., dogs).

2.6 Harbour sediment

Monitoring of harbour sediment quality is required at four sites in the upper harbour (Figure 4). Sediments are a potential source and sink for dissolved contaminants, and assessing sediment quality can identify where contaminant concentrations could result in adverse effects on ecological communities. Sampling of harbour sediment quality involves the collection of the uppermost 20 mm of sediment. At the Orari Street and Shore Street sites, samples are collected directly from the substrate by scraping the top 20 mm into a collection jar. At the Halsey Street and Kitchener Street sites, sampling is required in deep water (approximately 3-7 m deep) and sediment is subsequently collected using a petit ponar grab with a subsample obtained from the uppermost 20 mm of the contents of the grab. Samples are collected for laboratory analysis (Eurofins) for arsenic, cadmium, chromium, copper, nickel, mercury, lead, zinc, weak acid extractable copper, total petroleum hydrocarbons (TPH), organochlorine pesticides, and polycyclic aromatic hydrocarbons (PAH).

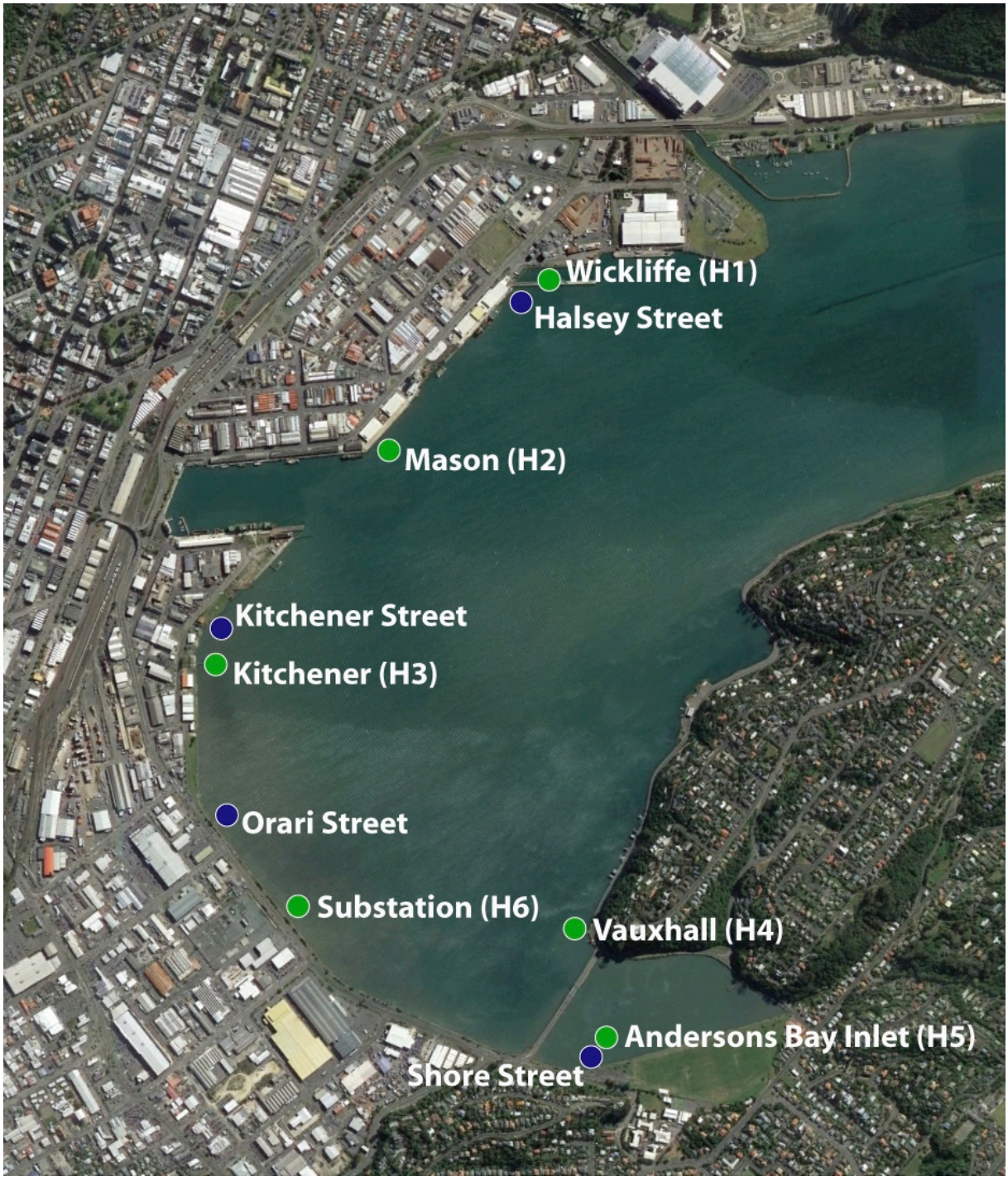

Figure 4. Otago Harbour water quality sampling sites (green circles) and sediment sampling sites (blue circles). Aerial photo from Google Earth.

3. Results and Discussion

3.1 Stormwater – Dry weather

Dry weather sampling of stormwater outfalls was undertaken under the required weather and tidal conditions in July and September 2019, and January, February, and June 2020 (Table 1). Dry weather sampling could not be undertaken in the months of April and May 2020 due to restrictions on field work during the COVID-19 lockdown, and in other months between July 2019 and June 2020 due to weather conditions not being suitable (e.g., no antecedent dry period of at least 72 hours) and/or tidal conditions not being suitable for sampling (e.g., low tide in the middle of the night).

Dry weather sampling at the stormwater outfalls is undertaken to determine background contaminant levels. High faecal indicator concentrations under dry conditions could be due to stormwater and wastewater systems cross-connections, but can also be influenced by surface runoff from surrounding land (e.g., dog faeces, bird droppings). To understand potential sources of contaminants, looking at both the FWA levels (which indicate possible wastewater infiltration) and the *E. coli* concentrations (which can come from a variety of sources) for each sample is important. If FWA levels remain low but *E. coli* concentrations are high, the result may indicate contamination from, for instance, surface runoff. If both FWA levels and *E. coli* concentrations are high, the result may indicate possible wastewater contamination.

Sampling at outfall 1 (St Clair catchment) revealed *E. coli* concentrations were elevated and above the trigger level (550 cfu/100mL) several times, but FWA levels only exceeded trigger levels once, in January 2020. Sampling at outfall 3 (Shore Stream catchment) found elevated *E. coli* concentrations and FWA levels once, in February 2020, while outfall 5 (Portsmouth Drive catchment) had elevated *E. coli* concentrations and FWA levels in both January and February 2020. Catchments with three consecutive sampling occasions with both elevated *E. coli* and FWAs are subject to further investigation. However, there was no sampling in March (due to conditions not being met) or April and May (due to COVID-19 lockdown), and the next sampling, in June 2020, found only elevated FWA levels.

Outfalls 10 (Kitchener Street catchment), 24, 25, and 27 (Halsey Street catchment), and 33 (Port Chalmers catchment) had elevated *E. coli* concentrations on most or all sampling occasions (outfall 10 was not elevated in July 2019, and outfall 25 was not elevated in September 2019). Outfall 25 had particularly high *E. coli* concentrations (above 100,000 cfu/100mL) twice. Overall, three of the six Halsey Street catchment outfalls had elevated *E. coli* concentrations on most/all sampling occasions. However, FWA levels were not elevated at any of these outfalls on any of the sampling occasions in 2019-20.

Outfalls 30 (Ravensbourne catchment) and 32 (Port Chalmers catchment) had elevated FWA levels on all occasions except July 2019. However, *E. coli* concentrations at these outfalls were not elevated on any of the sampling occasions.

Sampling at outfalls not discussed above found variable levels for FWAs and/or *E. coli* in 2019-20. Variable results at different outfalls have also been found during previous years of monitoring.

Overall, between July 2019 and June 2020, no outfalls had consistently high results for both FWAs and *E. coli*, and therefore no further investigations are required.

Table 1. FWA levels and* E. coli *concentrations from dry weather sampling between July 2019 and June 2020. Outfalls marked with grey cells are sampled six-monthly. Orange cells indicate values exceed trigger levels: FWA level of 0.1 (recommended by B. Gilpin in personal communication to B. Stewart),* E. coli *trigger level of 550 cfu/100mL (MfE (2003) action (red) limit). NS = not sampled; NF = no flow; No Access = access to outfall restricted.

Outfall	3 July 2019		4 September 2019		16 January 2020		12 February 2020		11 June 2020	
	FWA	*E. coli* (cfu/100mL)	FWA	*E. coli* (cfu/100mL)	FWA	*E. coli* (cfu/100mL)	FWA	*E. coli* (cfu/100mL)	FWA	*E. coli* (cfu/100mL)
1	0.037	390	0.057	16,000	0.103	39,000	0.082	7,700	0.064	1,000
2	NS	NS			NS	NS				
3	0.064	64	0.108	120	0.080	350	0.108	630	0.093	220
4	0.031	69	0.012	<4	0.073	<4	0.114	130	0.055	48
5	0.092	520	0.130	40	0.129	5,300	0.133	3,700	0.161	240
6	0.091	420	0.077	48	0.124	120	0.106	170	0.101	140
7	NF	NF	NF	NF	0.073	84	0.106	240	0.095	11,000
8	0.066	2,600	0.075	510	0.085	220	0.093	530	0.081	1,600
9	0.089	16			0.084	180				
10	0.036	420	0.045	15,000	0.050	2,300	0.040	600	0.040	900
11	0.019	<4			0.100	220				
12	NF	NF	0.035	<4	NF	NF	0.032	31	0.060	<4
13	No Access	No Access			No Access	No Access				
14	No Access	No Access			No Access	No Access				
15	No Access	No Access			No Access	No Access				
16	No Access	No Access			No Access	No Access				

Table 1 cont. FWA levels and* E. coli *concentrations from dry weather sampling between July 2019 and June 2020. Outfalls marked with grey cells are sampled six-monthly. Orange cells indicate values exceed trigger levels: FWA level of 0.1 (recommended by B. Gilpin in personal communication to B. Stewart),* E. coli *trigger level of 550 cfu/100mL (MfE (2003) action (red) limit). NS = not sampled; NF = no flow; No Access = access to outfall restricted.

Outfall	3 July 2019		4 September 2019		16 January 2020		12 February 2020		11 June 2020	
	FWA	*E. coli* (cfu/100mL)	FWA	*E. coli* (cfu/100mL)	FWA	*E. coli* (cfu/100mL)	FWA	*E. coli* (cfu/100mL)	FWA	*E. coli* (cfu/100mL)
17	No Access	No Access			No Access	No Access				
18	No Access	No Access			No Access	No Access				
19	No Access	No Access			No Access	No Access				
20	No Access	No Access			No Access	No Access				
21	No Access	No Access			No Access	No Access				
22	No Access	No Access			No Access	No Access				
23	0.027	130	0.033	6,600	0.029	250	0.033	7,900	0.020	36
24	0.026	3,200	0.029	12,000	0.024	6,700	0.032	16,000	0.024	7,000
25	0.039	240,000	0.057	68	0.057	440,000	0.062	99,000	0.047	37,000
26	NF	NF	NF	NF	NF	NF	NF	NF	0.022	8
27	0.061	16,000	0.056	4,200	0.053	3,600	0.044	5,300	0.065	88,000
28	0.077	<4			0.066	200				
29	0.102	24			0.089	1,500				
30	0.087	12	0.103	110	0.104	44	0.107	320	0.151	12
31	0.065	850			0.060	8,500				
32	0.067	<4	0.143	<4	0.122	16	0.112	16	0.124	88
33	0.053	8,900	0.066	2,100	0.044	600	0.075	5,300	0.064	3,000

3.2 Stormwater – Wet weather

Between July 2019 and June 2020 the conditions required to undertake wet weather sampling at stormwater outfalls (i.e., at low tide, within one hour of the commencement of a rain event (more than 2.5 mm of rain), following an antecedent dry period of at least 72 hours) were not met within daylight hours (required for safety reasons), and no wet weather sampling was therefore able to completed in 2019-20. Conditions were not monitored during the months of April and May 2020 due to restrictions on field work during the COVID-19 lockdown.

3.3 Automated sampler – Wet weather

Sampling of stormwater during a wet weather event was not undertaken by the automated sampler between July 2019 and June 2020. The ISCO automated sampler, located at a Mason Street catchment site, was not triggered successfully under correct conditions for any rain events in 2019-20. The ISCO automated sampler was triggered on one occasion between April and May 2020. However, due to restrictions on field work during the COVID-19 lockdown, the sampler was not able to be checked or emptied. This event therefore is recorded as a false alarm.

The automated sampler was incorrectly triggered (i.e., false alarm) on one occasion in June 2020. False alarms can be due to a range of causes, including the sampler being triggered when insufficient total rain falls during an event, the sampler incorrectly filling all bottles, the sampler being triggered but tidal conditions resulting in potential for saltwater intrusion (depending on the site of the sampler in the catchment), and/or a malfunction or maintenance issue with the sampler (e.g., perforated tubing within the sampler, flat battery).

The ISCO automated sampler was to remain at its current location until one further rainfall event was successfully sampled (two rainfall events have been captured in this catchment, and the automated sampler must be used to sample three storm events a year). However, as the period required to sample the third rainfall event is now prolonged (i.e., a two-year period), moving the sampler to the next catchment (Halsey Street catchment) could be considered.

3.4 Harbour water

Sampling of harbour water quality is required on four occasions, targeting one rainfall event and one dry period. Between July 2019 and June 2020, however, the weather (i.e., following an antecedent dry period, within three hours of the commencement of a rain event (more than 2 mm of rain)) and tidal (i.e., mid-flood tide and mid-ebb tide at times

when sampling can be completed safely) conditions required for sampling a rainfall event did not coincide, and therefore no rainfall events were able to be sampled.

As harbour water sampling is used to determine the effects of stormwater discharges on water quality in Otago Harbour, sampling both a rain event and a dry period each year allows comparison of results. However, in 2019-20 there were no rain events under suitable conditions for sampling, and therefore no dry weather event was sampled. It should be noted that conditions were not monitored during the months of April and May 2020 due to restrictions on field work during the COVID-19 lockdown.

3.5 Harbour sediment

Sampling of harbour sediment quality was undertaken at the four upper harbour sites (see Figure 4) in January 2020 (Halsey Street site) and March 2020 (Kitchener Street, Orari Street, and Shore Street sites). As found during previous sampling, surface sediments (where visible) were generally clean with little surface detritus.

Contaminant concentrations in harbour sediments at all sites were well below the 2013 trigger levels listed in the resource consent (Table 2). However, the ANZECC (2000) interim sediment quality (ISQG) Low guideline levels for lead, mercury, zinc and PAH were exceeded at some sites. The ISQG-Low represents the threshold for potential effects to occur, while the ISQG-High represents a point where a high probability of effects is possible.

Lead concentrations at Kitchener Street and Shore Street were slightly above the ISQG-Low value but were considerably lower than both the ISQG-High value and the 2013 trigger level. Similarly, mercury concentrations at Kitchener Street were slightly above the ISQG-Low value but well below the ISQG-High value. Zinc concentrations at Kitchener Street were above the ISQG-Low value but below the ISQG-High value and were considerably lower than the 2013 trigger level. PAH concentrations at Kitchener Street and Shore Street were slightly above the ISQG-Low value but well below the ISQG-High value and were considerably lower than the 2013 trigger level.

Overall, contaminant concentrations were generally highest at the Kitchener Street site, as is often the case. However, exceedances of the ISQG-Low values were generally at the low end of the range between the Low and High guidelines, and therefore indicate low probability of potential effects.

Some contaminants do not have trigger or guideline levels listed in the consent, such as weak acid extractable copper (WAE copper), organochlorine pesticides (OCP), and total petroleum hydrocarbons (TPH) (Table 2). Of these contaminants, concentrations of WAE copper were similar to standard copper at each site and were highest at the Kitchener and Shore Street sites, while OCP concentrations were low at all four sites and below all

laboratory detection limits at the Halsey and Shore Street sites. TPH concentrations, however, were considerably higher at the Orari and Shore Street sites than at the other sites. Guideline values proposed for TPH are 280 mg/kg (Low) and 550 mg/kg (High) (Simpson *et al.* 2013). TPH concentrations at Orari Street were below both proposed levels, but concentrations at Shore Street were slightly above the 'Low' level but well below the 'High' level, indicating low probability of potential effects.

Contaminant concentrations in sediments in recent years have been considerably lower than at some historic sites. The Kitchener Street site has historically been influenced by a scrap metal yard and a now defunct sandblasting operation, with high values of metal contaminants, while South Dunedin (Portobello Road) sites have had high PAH concentrations due to historic contamination from stormwater, especially from the old gas works. However, improvements in wastewater/stormwater connections and the cessation of many industrial activities have reduced contaminant input to the harbour.

Sediment sampling in 2018-19 and 2019-20 found low PAH concentrations at all sites (generally well less than 5 mg/kg), whereas concentrations in other years have been considerably higher. For instance, sampling in 2018 at Orari Street found PAH concentration of 142.82 mg/kg. This variation can be influenced by movement of sediments, as contaminated sediment can be remediated naturally when fresh sediments, able to support viable biological populations, settle on top of them (ANZECC 2000). However, future variability is to be expected, and elevated concentrations at some sites should not be cause for alarm in subsequent sampling. It is also possible that extreme weather events in the future could disturb and redistribute some of the contaminated sediments along the harbour foreshore.

Table 2. Harbour sediment contaminant concentrations, 30 January 2020 (Halsey Street) and 11 March 2020 (Kitchener Street, Orari Street, and Shore Street). Trigger and guideline values are specified in resource consents.

	Arsenic (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	WAE Copper[1] (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Nickel (mg/kg)	Zinc (mg/kg)	PAH[2] (mg/kg)	TPH[3] (mg/kg)	OCP[4] (mg/kg)
2013 trigger levels	19	1.7	80	-	122	209	-	21	902	183	-	-
ANZECC (2000) ISQG-Low[5]	20	1.5	80	-	65	50	0.15	21	200	4	-	-
ANZECC (2000) ISQG-High[5]	70	10	370	-	270	220	1	52	410	45	-	-
Halsey Street	11.7	0.22	33.8	16.6	26.1	27.9	0.1	18.7	125.0	<0.75	22	<0.6
Kitchener Street	15.2	0.25	30.1	41.0	33.4	55.6	0.2	12.6	286.0	4.07-4.27	66	0.06-0.74
Orari Street	3.4	0.07	7.6	18.4	5.4	8.8	<0.1	3.4	47.9	0.73-1.03	239	0.02-0.7
Shore Street	7.0	0.19	18.0	37.0	21.6	53.0	<0.1	10.9	196	14.51-14.61	330	<0.7

1. WAE copper = Weak-acid extractable copper.

2. PAH = polycyclic aromatic hydrocarbons. Concentration ranges are between known concentrations and the maximum possible concentrations (as some samples below laboratory detection limits). '< value' indicates all concentrations below laboratory detection limits.

3. TPH = total petroleum hydrocarbons – maximum content.

4. OCP = organochlorine pesticides. Concentration ranges are between known concentrations and the maximum possible concentrations (as some samples below laboratory detection limits). '< value' indicates all concentrations below laboratory detection limits.

5. ANZECC (2000) interim sediment quality (ISQG) guideline values, as listed in the resource consent.

4. Conclusion

General

Monitoring of Dunedin's stormwater discharges and receiving environments (Otago Harbour) was undertaken between July 2019 and June 2020. Sampling only included stormwater quality during dry weather conditions and harbour sediments. Sampling of stormwater quality during wet weather conditions, automated sampling of stormwater quality during wet weather conditions, and harbour water quality during dry/wet weather conditions was not undertaken due to the required weather/tidal conditions not being met, and/or sampling was restricted due to the COVID-19 lockdown.

The results of the 2019-20 monitoring can assist with identifying areas where improvements and/or remediation may be required, such as outfalls where results indicate possible cross-connections between stormwater and wastewater systems.

Stormwater – Dry weather

Dry weather sampling of stormwater outfalls in 2019-20 found contaminant concentrations were variable at many outfalls, with high concentrations of faecal indicators (which can be from multiple sources) or high levels of FWAs (usually associated with human faecal contamination). However, only outfall 5 (Portsmouth Drive catchment) had both elevated *E. coli* concentrations and FWA levels on multiple occasions. Two consecutive rounds of sampling, in January and February 2020, found elevated *E. coli* and FWAs at this outfall, but the next sampling round, in June 2020, found only elevated FWAs. As catchments with three consecutive sampling occasions with both elevated *E. coli* and FWAs are subject to further investigation, based on the 2019-20 sampling, no further investigations of any outfalls are required. However, due to restrictions on sampling in 2019-20, and the absence of sampling during March-May 2020, further sampling of these outfalls will be closely reviewed to identify any potential issues.

Automated sampler – Wet weather

Wet weather sampling of stormwater by the automated sampler was not able to be successfully undertaken in 2019-20 in the Mason Street catchment. The ISCO automated sampler was to remain at its current location until a third rainfall event was successfully sampled (two events were captured in 2018-19) and was then be moved to the next catchment. However, the sampler has now been in the Mason Street catchment site for two years, and the next catchment to be sampled is the Halsey Street catchment. Dry weather sampling in the Halsey Street catchment revealed elevated *E. coli* concentrations at several outfalls, and sampling this catchment would be useful to determine inputs to

the harbour from this catchment during wet weather. The possibility of moving the automated sampler to the Halsey Street catchment, despite only two rainfall events being captured in the Mason Street catchment, could be considered.

Harbour sediment

Contaminant concentrations in harbour sediments were low in 2019-20, and were all well below trigger levels specified in the resource consent. Concentrations of some contaminants were above the 'low' guidelines but were well below the 'high' guidelines (ANZECC 2000). Contaminants with historically high concentrations, such as PAH, had much lower concentrations than found in previous years (e.g., PAH at Orari Street was 142.82 mg/kg in 2018, <0.75 mg/kg in 2019, and 0.73-1.03 mg/kg in 2020). Contaminated sediments will continue to be flushed out of the upper harbour, but may also be remediated naturally as fresh sediments settle on top of them. Movement of sediments during extreme weather events could, however, disturb and redistribute, or expose historically contaminated sediment.

Summary

This report has summarised the July 2019 to June 2020 monitoring of Dunedin's stormwater and receiving environments, as required of DCC by ORC resource consents. Results from this monitoring period have not indicated any stormwater outfalls with possible cross-connections between stormwater and wastewater systems, however several outfalls had elevated concentrations at times, and will continue to be monitored for future indications of cross-connections. Based on the sampling in 2019-20, no sites require further investigation.

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Appendix One: Stormwater outfalls

Table A1.1. Dunedin stormwater outfall information.

Outfall	DCC reference	Resource consent	Location	Catchment	Frequency of dry weather sampling
1	SWX03979	RM11.313.10	Second Beach	St Clair	Monthly
2	SWX00011 & SWX00012	RM11.313.10	St Clair Beach	St Clair	Six monthly
3	SWX04625	RM11.313.04	Shore Street	Shore Street	Monthly
4	SWX03649	RM11.313.09	Portobello Road	South Dunedin	Monthly
5	SWX03644	RM11.313.07	Teviot Street	Portsmouth Drive	Monthly
6	SWX03640	RM11.313.07	Midland Street	Portsmouth Drive	Monthly
7	SWX03631	RM11.313.07	Orari Street	Portsmouth Drive	Monthly
8	SWX03635 & SWX70740	RM11.313.08	Orari Street	Orari Street	Monthly
9	SWX03579	RM11.313.07	Kitchener Street	Portsmouth Drive	Six monthly
10	SWX03568	RM11.313.06	Kitchener Street	Kitchener Street	Monthly
11	SWX70102	RM11.313.06	French Street	Kitchener Street	Six monthly
12	SWX03547	RM11.313.06	Kitchener Street	Kitchener Street	Monthly
13	SWX03562	RM11.313.06	Birch Street	Kitchener Street	Six monthly
14	SWX03556	RM11.313.06	Birch Street	Kitchener Street	Six monthly
15	SWX03559	RM11.313.06	Wharf Street	Kitchener Street	Six monthly
16	SWZ70569	RM11.313.06	Fryatt Street	Kitchener Street	Six monthly
17	SWX03540	RM11.313.06	Fryatt Street	Kitchener Street	Six monthly
18	SWX03536	RM11.313.06	Fryatt Street	Kitchener Street	Six monthly
19	SWX03532	RM11.313.06	Fryatt Street	Kitchener Street	Six monthly
20	SWX70370	RM11.313.06	Fryatt Street	Kitchener Street	Six monthly
21	SWX03489	RM11.313.05	Mason Street	Mason Street	Six monthly
22	SWX03506	RM11.313.03	Bauchop Street	Halsey Street	Six monthly
23	SWX03466	RM11.313.03	Bauchop Street	Halsey Street	Monthly
24	SWX03455	RM11.313.03	Halsey Street	Halsey Street	Monthly
25	SWX03450	RM11.313.03	Halsey Street	Halsey Street	Monthly
26	SWX03472	RM11.313.03	Halsey Street	Halsey Street	Monthly
27	SWX03718	RM11.313.03	Wickliffe Street	Halsey Street	Monthly
28	SWX02628	RM11.313.02	Magnet Street	Ravensbourne	Six monthly
29	SWX02623	RM11.313.02	Magnet Street	Ravensbourne	Six monthly
30	SPN02502	RM11.313.02	Ravensbourne Road	Ravensbourne	Monthly
31	SWX12941	RM11.313.01	George Street /SH88	Port Chalmers	Six monthly
32	SWX12994	RM11.313.01	Sawyers Bay, Watson Park	Port Chalmers	Monthly
33	SWX12879	RM11.313.01	George Street (Port Otago)	Port Chalmers	Monthly