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Summary of compliance biomonitoring results for the 2019-2020 monitoring year in conjunction with time-trend analysis of the full dataset

Introduction

The Taranaki Regional Council in addition to state of the environment (SEM) macroinvertebrate biomonitoring, also conducts a significant number of macroinvertebrate biomonitoring surveys on behalf of consent holders, to ensure compliance with consent conditions and to assess impacts of various activities on stream health. Examples of activities that could impact on stream health include direct discharges to a stream of treated wastewater or abstraction of water.

The results of the compliance monitoring are analysed and individual reports produced annually detailing the results of those surveys. However, no overall analysis of the compliance monitoring data occurs. As there are over double the number of compliance monitoring sites as there are SEM sites it was considered a potentially useful undertaking to examine the results together and produce a short memo detailing the results of the compliance monitoring in its entirety.

The amount of information that has been collected from all the compliance biomonitoring is very substantial with monitoring of some sites being undertaken over more than 20 years. Therefore, in order to make summarising more efficient and effective only one macroinvertebrate variable, the macroinvertebrate community index (MCI), was analysed. The MCI has been used as a surrogate for stream health and is the variable that is focused on for SEM reporting. The results presented in this memo look at the 2019-2020 monitoring year, and changes over time.

Methods

Compliance macroinvertebrate biomonitoring data was collated in an excel spreadsheet and the degree of downstream change in the MCI was calculated for all relevant sites for spring (typically October to December) 2019 and summer (typically February to March) 2020 results. The freshwater biologist responsible for a particular compliance programme then briefly commented where significant deterioration was observed.

Macroinvertebrate data was then analysed for trends over time. MCI data was statistically analysed for trends over time using the Mann-Kendall test followed by FDR analysis for sites. The significance of a site's trend (i.e. the strength of the trend) was calculated according to the statistical probability of occurrence (p-value). A Kendall tau coefficient was also produced which indicated whether the trend was positive or negative and the magnitude of the trend. The FDR was applied to the results to increase confidence in the results by eliminating apparent trends that are the results of co-incidence and random distributions rather than genuine change. Only sites with at least ten surveys were included in the analysis.

Results and discussion

Biomonitoring was conducted for 35 compliance monitoring programmes at 145 sites in the 2019-2020 monitoring year (see #2575695 for specific details about each site). Of the 145 sites there were 43 upstream 'control' sites while the remainder were 'impact' sites. Of the 145 sites, 30 sites were either in 'very poor' or 'poor' health for spring 2019 surveys and 47 were either in 'very poor' or 'poor' health for summer 2020 surveys (Table 1). Typically, lower MCI scores are found in summer conditions (average of 3 units difference according to SEM data) due to lower flows, longer time between freshes, lower dissolved oxygen, higher temperatures and more periphyton.

Table 1 Number and percentage of sites, including potentially impacted downstream (DS) sites, that fall into the macroinvertebrate health categories based on MCI ranges which has been adapted for Taranaki streams and rivers from Stark's classification for Spring 2019 (105 sites) and Summer 2020 (142 sites)

TRC Grading	MCI	Spring 2019				Summer 2020			
		No. DS sites	% DS	No. sites	% sites	No. DS sites	% DS	No. sites	% sites
Excellent	≥140	0	0	0	0	0	0	0	0
Very Good	120-139	8	62	13	12	3	33	9	6
Good	100-119	17	65	26	25	28	72	39	27
Fair	80-99	26	72	36	34	32	68	47	33
Poor	60-79	21	78	27	26	33	79	42	30
Very Poor	<60	3	100	3	3	5	100	5	4

Compliance monitoring sites with 'very poor' or 'poor' health were typically either in small, probably modified, waterways (e.g. a tributary of the Parahaki Stream) or in industrial catchments though these were also small, modified waterways (e.g. Mangati and Mangaone Streams) (Table 2). Therefore, habitat was the main factor determining macroinvertebrate health.

Table 2 Compliance monitoring programmes with sites with either 'very poor' or 'poor' macroinvertebrate health (* denotes control sites and ^ downstream impact sites)

Compliance programme	Waterway	Spring Survey		Summer Survey	
		Site code	MCI	Site code	MCI
Boyd Surrey Road Stockpiling Facility	Unnamed Tributary of the Mangatangehu Stream	MTH000062^	76		
Central Landfill	Unnamed Tributaries of the Waingongoro River	WGG000647*	77	WGG000648^	76
		WGG000649^	70		
		WGG000654^	76		
Colson Rd Landfill	Puremu Stream	PMU000110^	73	PMU000104*	74
		PMU000113^	73	PMU000113^	73
				PMU000108^	74
				MNH000260^	74
Contact Energy Stratford	Patea River			PAT000357^	74
				PAT000360^	77
Eltham WWTP	Mangawhero Stream			MWH000380*	78
Fonterra Whareroa	Tawhiti Tributary			TWH000479^	68
	Tangahoe Tributary			TNH000470^	70
Inglewood closed landfill	Unnamed Tributary of Awai Stream (smaller)	AWY000105^	70	AWY000105^	56
	Unnamed Tributary of Awai Stream (larger)			AWY000107^	70
		AWY000115^	70	AWY000115^	74

Compliance programme	Waterway	Spring Survey		Summer Survey	
		Site code	MCI	Site code	MCI
Kaimiro Production Station	Unnamed tributaries of the Mangaoraka Stream			MRK000198 [^]	76
				MRK000207 [^]	78
Mangati Stream; Bell Block Industrial Area	Mangati Stream	MGT000491 [^]	73	MGT000488*	62
		MGT000497 [^]	69	MGT000490 [^]	67
		MGT000500 [^]	68	MGT000491 [^]	67
		MGT000512 [^]	67	MGT000497 [^]	63
		MGT000520 [^]	65	MGT000500 [^]	53
		MGT000550 [^]	68	MGT000512 [^]	53
		MGT000550 [^]	68	MGT000520 [^]	69
		MGT000550 [^]	62		
Mangorei HEPS	Waiwhakaiho River			WKH000655 [^]	78
Maui Production Station	Ngapirau Stream	NPR000100*	75		
		NPR000190 [^]	68		
McKechnie Aluminium Solutions Ltd - Bell Block Plant	Mangaone Stream	MGO000031 [^]	78		
McKee Production Station	Mangahewa Stream	MHW000060*	76		
		MHW000065 [^]	78	MHW000065 [^]	75
Oaonui Weir	Oaonui Stream			OAN000280 [^]	76
Omata Tank Farm	Herekawe Stream			HRK000094 [^]	76
Remediation NZ Uruti	Haehanga Stream			HHG000093*	71
				HHG000100 [^]	67
				HHG000115 [^]	68
				HHG000150 [^]	66
				HHG000190 [^]	70
Stratford WWTP	Patea River			PAT000350 [^]	76
				PAT000351 [^]	70
Turangi Production Station (Turangi-A)	Unnamed tributary of the Parahaki Stream	PRH000020*	61	PRH000020*	67
		PRH000022 [^]	65	PRH000022 [^]	72
		PRH000024 [^]	57	PRH000024 [^]	58
Waihapa Production Station	Ngaere Stream			NGR000498 [^]	79
Lower Waiwhakaiho Catchment	Waiwhakaiho River Mangaone	MGO000050*	75	WKH000920*	71
		MGO000054 [^]	79	MGO000050*	71
		MGO000150 [^]	63	MGO000054 [^]	68
		MGO000155 [^]	68	MGO000150 [^]	66
		MGO000190 [^]	60	MGO000155 [^]	58
		MGO000190 [^]	63		
Waverly WWTP	Wairoa Stream	WRO000069*	62	WRO000069*	69
		WRO000073 [^]	58	WRO000073 [^]	64
		WRO000077 [^]	60	WRO000077 [^]	62

Because of the complexities and uniqueness of each compliance monitoring programme, a significant deterioration in MCI score (>10.8 MCI units) does not necessarily indicate significant impacts from the consent holder. Ten compliance

programmes at a total of 15 sites recorded a significant deterioration where compliance activities possibly contributed or caused the significant deterioration. Table 3 outlines the programmes that had significant deteriorations, the degree of deterioration and a brief comment including any action taken about each one.

Table 3 Impact sites recording significantly lower MCI scores in comparison to 'control' site or baseline MCI scores, in relation to biomonitoring carried out in the 2019-2020 monitoring year

Compliance programme	Spring or Summer Survey	Site no. and Site code	MCI 'impact' site	MCI unit difference from upstream	Report reference FRODO number and comments
Boyd Surrey Road Stockpiling Facility	Spring and Summer	Site 2 MTH000062	76 and 80	24 and 17	#2502795 and #2533269 Results suggest that a harmful discharge associated with stockpiling activities has possibly entered the unnamed tributary of the Mangatengehu Stream between sites 1 and 2. Appropriate enforcement action was taken by the job manager in response to these results.
Cold Creek Water Supply Scheme	Summer	Site 3 CLD000180	109	17	#2658713 Results indicated no immediate impacts of the scheme's water abstraction, however were indicative of localised impacts from the backwash and supernatant discharge over a short reach of the Cold Stream. Physicochemical monitoring will coincide with biological monitoring in 2020-2021 in response to these results.
Colson Road Landfill	Summer	Site 3 PMU000113	60	22	#2397458 The extent to which discharges have affected the macroinvertebrate communities at this site could not be determined, due to the upstream concrete products site and to the minor stock damage observed at the site.
Fonterra Whareroa	Summer	Site 1 TNH000470	70	23	#2567017 Results indicated that stormwater discharges had contributed to a decline in macroinvertebrate health at site 1 (70 MCI units), although effects were localised with recovery evident at site 3 (93 MCI units). Monitoring will be increased in the 2020-2021 year in response to these results.
Inglewood closed landfill	Summer	Site 3 AWY000115	74	16	#2574206 Results were indicative of some evidence of potential impacts from the Inglewood Landfill leachate, particularly at site 3. However habitat influences are also likely. A recommendation was made to carry out biological and physicochemical sampling

Compliance programme	Spring or Summer Survey	Site no. and Site code	MCI 'impact' site	MCI unit difference from upstream	Report reference FRODO number and comments
					simultaneously in the 2020-2021 year.
Oaonui Weir	Summer	Site 2 OAN000280	76	12	#2486344 Water abstraction may have exacerbated the impacts of low flows at the downstream site. However, due to similar community composition at the two sites, it was concluded that overall there were no significant impacts. An additional downstream site has been added in response to these results.
Fonterra Kapuni	Summer	Site D WKR000650	110	27	#2538060 Given that this survey is measuring the impacts of discharge to land over a large area, and the monitoring sites are consequently several kilometres apart, there is insufficient evidence to conclude that this decline is related to the land disposal of Fonterra Kapuni factory waste and not concurrent land use. Additionally habitat differences between sites may contribute to the observed decline. A recommendation was made to investigate whether suitable intermediate sites could be added to the survey as well as reviewing the suitability of the current sites.
Mangati Stream; Bell Block Industrial Area	Spring	Site A3 MGT000497, Site B MGT000500, Site D2 MGT000512, Site E MGT000520, Site F MGT000550	63 63 60 58 70	22 22 25 27 15	#2503272 There are many inputs into this stream from several industries and the decline observed is likely due to a combination of discharges that caused an additive effect in a downstream direction. To compound the issue, it was more than 2 months since the last fresh. It is difficult to discern the exact cause of the decline, however, it is likely due discharges by multiple consent holders in this reach of the Mangati.
Lower Waiwhakaiho Catchment	Spring	Site 13 WKH000950	91	14	#2473058 The Waiwhakaiho is a large river that has many influences. There are many inputs into the river between the control site and the furthest downstream site including several large drains coming from urbanized and industrial areas as well as the Mangaone Stream, which has a significant industrial

Compliance programme	Spring or Summer Survey	Site no. and Site code	MCI 'impact' site	MCI unit difference from upstream	Report reference FRODO number and comments
					storm water loading. There is also often a large colony of seabirds (sometimes 500+ birds) that roost 100 m upstream of the last sampling site that may also be contributing to the low score. It is difficult to discern the cause of the drop in MCI at this site due to the number of variables that contribute to river health and water quality.
Stratford WWTP	Spring and Summer	Site 3a PAT000350 and Site 4 PAT000351	107 and 101, for spring and 76 and 70 for summer	14 and 20 for spring and 31 and 37 for summer	#2555665 and #2495746 Results indicated that there was a highly significant decline in macroinvertebrate health in the Patea River. This was indicative of chronic nutrient enrichment between sites 2 and 3a, coincident with discharges from the Stratford WWTP. The consent has recently been renewed with more stringent controls on nutrients.

**Significant decreases at impact sites in comparison to 'control' sites were not included if decline was not associated with the activities being monitored i.e. due to habitat variation.*

The timetrend analysis found that out of a total of 128 sites where sufficient data existed for analysis to be performed, there were 38 sites (30%) with statistically significant improvements after application of the FDR (Table 4) and 92 sites in total that had a positive trend. There were no sites that had a statistically significant decline after FDR though there were five sites that had significant p-values before the application of FDR. There were 36 sites in total that had a negative trend. Trend analysis was not undertaken at 17 of the monitored sites due to insufficient data.

The majority of sites showed a positive trend which was congruent with the SEM macroinvertebrate data and indicates that in general macroinvertebrate health as indicated by MCI has generally improved in the Taranaki Region. Furthermore, it suggests that consented discharges, water abstractions and other potential impacts have not led to longterm deterioration in macroinvertebrate health. However, caution needs to be used regarding this interpretation as some activities may have caused step change deteriorations in MCI scores preceding the implementation of monitoring.

Table 4 Summary of compliance monitoring programmes with indication of significant site improvements (* denotes control sites and ^ downstream impact sites)

Compliance Programme	River or stream monitored with number of sites (*)	Sites with significant positive time-trends after FDR analysis
Ample Group Ltd	Kahouri Stream (3)	None
ANZCO	Waingongoro River (3)	WGG000500*, WGG000540^
Boyd Surrey Road Stockpiling Facility	Mangatengehu Stream- Unnamed Tributary (4)	None
Taranaki By-Products	Inaha Stream (5) Inaha Stream- Unnamed Tributary (3)	INH000400^, INH000420^, INH000430^ INH000440^
Central Landfill	Waingongoro River- Unnamed Tributaries (5)	None
Cold Creek Water Supply Scheme	Cold Stream (4) Taungatara Stream (4)	None None
Colson Road Landfill	Puremu Stream (3) Puremu Stream- Unnamed Tributary (1) Manganaha Stream (2)	None None None
Contact Energy Stratford	Patea River (5) Kahouri Stream (2)	None KHI000457*, KHI000480^
Eltham WWTP	Mangawhero Stream (2) Waingongoro River (1)	MWH000380*, MWH000490^ WGG000665^
Fonterra Kapuni	Kaupokonui Stream (5) Waiokura Stream (2)	KPK000655*, KPK000679^, KPK000685^ KPK000660^ WKR000500*
Fonterra Whareroa	Tawhiti Stream- Unnamed Tributary (2) Tangahoe River- Unnamed tributary (3) Unnamed Coastal Stream (1)	TWH000479^ None UND001340^
Inglewood Landfill	Awai Stream- Unnamed Tributaries (4)	None
Inglewood Metal Ltd	Kurapete Stream (3)	KRP000980^
Kaimiro Production Station	Mangaoraka Stream- Unnamed Tributaries (4)	None
Kaponga WWTP	Kaupokonui Stream (3)	KPK000500*, KPK000520^, KPK000550^
Kapuni Production Station	Kapuni Stream (2)	KPN000285*, KPN000289^
Kapuni Water Treatment Plant	Kapuni Stream (2)	KPN000300*
Kupe Production Station	Kapuni Stream (3)	None
Mangati Stream [integrated]	Mangati Stream (8)	MGT000520^, MGT000550^
Mangorei HEPS	Waiwhakaiho River (4)	None
Maui Production Station	Ngapirau Stream (2)	NPR000190^
McKechnie Aluminium Solutions Ltd	Mangaone Stream (2)	MGO000031^
McKee Production Station	Mangahewa Stream (3)	MHW000060*
Motukawa HEPS	Manganui River (4)	MGN000300*

NPDC Inglewood Wastewater Treatment Plant	Kurapete Stream (2)	KRP000300*, KRP000660^
Oaonui weir	Oaonui Stream (2)	None
Omata Tank Farm	Herakawe catchment (2)	HRK000085*
Remediation NZ Uruti	Haehanga Stream (5)	None
	Haehanga Stream- Unnamed Tributary (2)	None
Stratford WWTP	Patea River (4)	PAT000330*
Turangi Production Station	Parahaki Stream- Unnamed Tributary (3)	None
Opunake WTP	Waiaua River (3)	WAA000402
Waihapa Production Station	Ngaere Stream (3)	NGR000480*, NGR000498^
Waimate West Water Supply	Mangawheroiti Stream (4)	None
Waiwhakaiho Catchment + SEM	Waiwhakaiho River (3)	None
	Mangaone Stream (5)	None
Waverley WWTP	Wairoa River (3)	Insufficient data

Conclusions

In terms of impacts of compliance monitoring activities on waterways there was not a particularly strong correlation between sites in 'very poor' or 'poor' condition and downstream changes in MCI score between 'control' and 'impact' sites. This was because habitat and likely cumulative impacts were the main cause of low MCI scores at compliance monitoring sites, rather than specific, consented impacts. Compliance programmes with sites that did show a significant difference between the 'control' and the 'impact' site represented a range of activities including water abstraction, landfills and wastewater treatment plant discharges with no particularly activity appearing to be prone to cause significant impacts to macroinvertebrate health.

Timetrend analysis either showed significant positive trends or non-significant trends which indicated that since biomonitoring started there were no major longterm declines in macroinvertebrate health at any of the compliance monitoring sites.