Agenda Memorandum

Date 31 January 2017

Memorandum to
Chairperson and Members
Policy and Planning Committee

Subject: Regional freshwater ecological quality: 2015-2016 results from state of the environment monitoring

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Document: 1803519

Purpose

This memorandum presents an update to the Committee on the latest results of the Council's state of the environment monitoring programme for fresh water ecological health (macroinvertebrate monitoring).

A full report is available upon request, *Freshwater Macroinvertebrate Fauna Biological Monitoring Programme Annual State of the Environment Monitoring Report 2015-2016* providing the details of the monitoring of the Council's SEM macroinvertebrate monitoring sites in the 2015-2016 year, and including analysis of trends in this data since 1995. This memorandum summarises the report's data and findings, and includes the Executive Summary and the Recommendations from the report as an appendix.

A presentation on the report will be made at the meeting.

Executive summary

The Council's 'Regional Freshwater Plan for Taranaki' (October 2001) states as two of its objectives for the region, 'to maintain and enhance the quality of the surface water resources of Taranaki by avoiding, remedying or mitigating the adverse effects of contaminants discharged to land and water from point-sources.... and diffuse sources' (Objectives 6.2.1 and 6.3.1). In doing so, the Council and community seek to provide for the values associated with surface water, and to ensure the maintenance of aquatic ecosystems (Environmental Results Anticipated ER1).

In order to ascertain the successful adoption and application or otherwise of the Council's policies and methods of implementation, the Council conducts 'state of the environment' (SEM) monitoring to obtain up to date robust information for parameters that characterise the region's environment and resources. The results and findings of the SEM programme for the region's freshwater systems can be interrogated to determine trends and changes in trends in the quality of the region's freshwater resources, alongside the information on the current 'state' of the region's in-stream ecological health parameters that SEM generates.

With SEM established in 1995, the database is extensive enough to allow regular robust statistical trend analysis, conducted according to recognised and nationally adopted methodologies, to inform such reviews.

The latest results describing the state of and trends in the state of the macroinvertebrate communities of the region's waterways are presented herein for the information of the Council.

In 2015-2016, two new sites were added to the 57 sites already in the programme, in order to ensure good coverage of stream health within the Council's proposed Freshwater Management Units. For the first time, trend analysis was undertaken based on the latest ten year period, in addition to analysis for the full 21 year record. Using the data record from a shorter, more recent period sacrifices some certainty in the output results for the sake of identifying current rather than long-term trends.

The results continue to be overall as encouraging as in similar reports in the last few years and even more encouraging than those from earlier periods, with positive trends that had become markedly better with each year that passes continuing to be maintained in the 2015-2016 year.

In terms of Macroinvertebrate Community Index (MCI), the specific measure of the health of in-stream ecological communities, the study shows that in 2015-2016, spring survey MCI scores were generally higher than typical (overall 5 MCI units higher than the long-term medians, compared with 4 MCI units higher than longterm median in spring 2014); but in summer under drier low flow conditions were on average almost identical to long-term medians, at the 57 representative sites. Eleven sites scored their highest MCI values ever during the 2015-2016 monitoring period, while one site produced a new minimum score.

As is typical, summer scores were lower overall than spring scores in 2015-2016, but the seasonal difference was similar to that in preceding years.

The updated trend analysis shows that at 46 of the 53 sites for which trends can be determined (87%), MCI scores appear to be improving. This is the highest percentage of sites showing an indication of ecological improvement of any degree found to date. Surprisingly and pleasingly, the number of sites showing improvement continues to be maintained at the high levels of recent years, rather than begin to decrease as might generally be expected once rates of improvement begin to flatten out.

Changes in the indicative and in the statistically significant trends are summarised below.

Progressive changes in significant and highly significant trends in MCI scores (57 sites)

Year	Number of sites with +ve, very sig trend (p<0.01, FDR)	Number of sites with +ve, sig trend (p<0.05 but not highly sig)	**Total number of sites with positive trends of any significance**	Number of sites with negative trend of any significance	Sites with positive	Sites with negative
1995-2016	16	14	**30**	1	46	7
1995-2015	22	7	**29**	0	44	8
1995-2014	21	9	**30**	0	44	8
1995-2013	21	5	**26**	0	44	8
1995-2012	15	10	**25**	1	42	10

1995-2011	9	14	**23**	0	40	12
1995-2010	7	11	**18**	0	40	12
1995-2009	7	9	**16**	0	38	14
1995-2008	5	8	**13**	0	38	13

That is, the proportion of sites in the region showing indications of an improvement of any extent continues to exceed the proportion of sites showing declines, in an ever-increasing ratio (the ratio is now at 6.6:1, up from 5.5:1 during the last three years and up from 2.9:1 in 2008).

Applying a more rigorous statistical evaluation to the long-term trend data, there are 30 sites in one of the two categories showing strongly or very strongly significant improving trends. This continues the pattern evident in the past two years, that the region now has the highest number of sites showing statistically significant ecological improvement ever recorded. There are more than double the number of sites showing strong or very strong improvement as there were eight years ago. On the other hand, within this grouping there has been a reduction in the number of sites where the statistical test of certainty (confidence) around the positive trend is strongest.

There is one ecological monitoring site in Taranaki showing a significant negative trend, a site in the upper Katikara Stream that has been affected by natural headwater erosion events in the recent past on the mountain.

As noted above, for the first time an analysis of the trends at each site over the last ten years has also been undertaken. As a general rule, using a smaller record mans a loss of confidence in detecting trends, and also means that natural variability at each site makes it harder to detect trends. Notwithstanding these caveats, the analysis shows that over the last ten years there are 39 sites showing indications of improvement while 12 show indications of deterioration. Statistically significant changes over the last ten years are found at 12 sites; of these, 11 are clearly showing improvement, while only one is deteriorating. Sites showing recent definite improvement are the upper Waiongana, lower Maketawa, lower Mangati, lower Punehu, lower Mangaehu (a mid altitude site), mid Waingongoro, lower Mangahewa, mid Kapoaiaia, and mid and lower Kurapete streams and rivers. The lower Katikara Stream site is deteriorating.

In terms of the question 'what is the state of the ecological health of our streams?', predictive scores have been developed for ring plain sites that are based on either the altitude of each site, or alternatively on its distance below the National Park boundary. The predictive modelling indicates for each site what the MCI 'should' be, if the site were as good as could be reasonably achieved. A summary for all results for the 2015-2016 year is provided below, by percentage allocation into 'significantly lower', 'no significant difference', or 'significantly higher' scores than expected.

Season	**Spring 2015**			**Summer 2016**		
Actual vs Prediction	> 10 units lower	± 10 units	> 10 units higher	> 10 units lower	± 10 units	> 10 units higher
Altitude	0	55	45	8	68	24
Distance	5	58	34	8	71	21

This analysis shows that in the 2015-2016 year, there were somewhat different patterns between the two survey seasons, but in both periods sites regionally showed better scores

that might otherwise have been expected. This was even more evident during the spring surveys than in summer.

In the spring surveys, well over a third of all sites had MCI scores that were much better than could have been reasonably anticipated based on typical quality for equivalent sites, and extremely few sites (which were found in short, small ring plain streams) had MCI scores that were much worse than is usually the case. In the summer surveys results were more balanced between scores lower and higher than predicted, but there were still about three times as many sites with better scores than expected, than there were with scores below expectations.

In terms of the sites showing the most improvement in their ecological condition over the 21 years of monitoring, they are:

- the mid reaches of the Kaupokonui Stream
- Mangaehu River at Raupuha Road
- lower Punehu Stream
- the upper and mid Kapoaiaia Stream
- the lower Mangati Stream.

Thus, the findings of the macroinvertebrate monitoring programme demonstrate that the Council and regional community are meeting the Long Term Plan (LTP) target, to maintain and enhance water quality in the region, even more robustly as each year goes by. The greatest proportion of the improving sites are located in mid to lower/mid-catchment reaches; significant improvement at the lowest sites is now evident, indicating that habitat improvement is occurring and drivers of cumulative adverse effects are being reduced throughout each catchment.

The cause of the positive trends is multi faceted and complex. The maturing and extension of the riparian programme with planting and stock exclusion, continuing reductions in the number and improvements in the quality of discharges into waterways, and compliance regimes will all be playing a role. With the continuation of these programmes further consequential gains in water quality and in in-stream ecological health across the region and in particular extending into the lowest reaches of the region's streams and rivers should occur.

The report makes recommendations to continue the freshwater macroinvertebrate ('MCI') component of the SEM programme in a similar format and to update the trend analysis reports following analysis at the end of the 2016-2017 year.

The National Policy Statement for Freshwater (2014) includes national objectives and policies that the Council must give effect to over time. Implicit within this policy framework is the concept of ecosystem health, so the Council's long term regional freshwater ecosystem quality monitoring provides good foundational data for setting appropriate limits and methods of implementation, and for assessment purposes.

Further, it is noted to Members, that the Ministry for the Environment has previously released proposals for amending the National Policy Statement on Fresh Water (2014), to include a compulsory requirement upon councils to monitor the ecological condition of surface waters using macroinvertebrate indicators. This proposal continues to be debated at national level. However, this Council would be well-placed if such an obligation were to be introduced, whilst noting that many aspects of any usage of macroinvertebrates as a

compulsory attribute with assigned numeric attribute states would be scientifically problematic.

The value of this monitoring and analytical work lies in the advantage of up-to-date feedback to the Council and regional community on the consequences of land use and water quality management initiatives adopted in the region.

Recommendations

That the Taranaki Regional Council:

1. receives this memorandum noting the preparation of a report into the state of and trends in regional in-stream macroinvertebrate community health data for Taranaki, for 2015-2016 and over the period 1995-2016
2. notes the findings of the SEM programme
3. adopts the specific recommendations therein.

Background

This Committee has been regularly informed of the findings that emerge from the Council's various freshwater 'state of the environment' monitoring programmes. These programmes are important as indicators of the effectiveness of the Council's and community's interventions and resource management initiatives addressing freshwater quality and in-stream health in the region. Members will be aware that there is a high level of interest nationally in the state and management of the country's fresh water resources.

The *Regional Fresh Water Plan for Taranaki* contains objectives to manage the state of the region's surface freshwater. Objective 6.2.1 requires the Council and region 'to maintain and enhance the quality of the surface water resources of Taranaki by avoiding, remedying or mitigating the adverse effects of contaminants discharged to land and water from point sources', while Objective 6.3.1 is an equivalent objective for diffuse sources of contaminants. In Section 10.3 of the Plan, the Council commits to continued monitoring, research and investigations related to fresh water quality, to provide information on the state of freshwater in the region and the effectiveness of the Plan.

The Council's 2012-2022 LTP has, under the 'Levels of service' specified for resource management, a commitment to the '*protection of the life-supporting capacity of water, in-stream uses and values*'. The measure for this activity is: '*Macroinvertebrate Community Index (MCI) values (a measure of freshwater community richness and composition) at 50 regionally representative sites*.' The target throughout the duration of the LTP is that '*the proportion of sites showing a trend (whether significant or indicative) of improvements in MCI against a base year of 1995 to exceed the proportion showing decline over the same period*.'

Staff have, and have been trained in, the software and methodology used by NIWA for trend analysis of data related to freshwater systems, to ensure that data and analysis provided to the Council and the public of Taranaki is robust, defensible, and consistent with analyses delivered at a national level. In this way timely and reliable feedback on the quality and health of the region's streams and the effectiveness of water quality management in the region can be generated and utilised.

Discussion

One of the Council's 'State of the Environment' monitoring programmes measures the abundance and composition of macroinvertebrate communities on streambeds, as an indicator of stream ecological health. This programme has been delivered by the Council for 20 years to date, i.e. since 1995. Staff have now reported the data for the 2015-2016 year, including an analysis of trends in stream ecological health for Taranaki both over the period 1995-2016 (the entire record) and over the last ten years.

The Executive Summary for the report is attached. In particular it notes that 59 sites were surveyed, from 26 rivers and streams, and explains the representative significance of each site. Each site and water course is chosen for location, representativeness, regional variation in river environment, position within a catchment, and surrounding land use, and with regard to evaluating the effects of riparian management.

MCI values were generally higher than is usual in the spring surveys, but were more characteristic in the summer surveys in 2015-2016. MCI scores were lower at sites located lower in catchments (as is usual- the consequence of more open and exposed stream beds, lower flows, higher temperatures, sedimentation on stream beds, and cumulatively higher levels of some contaminants, resulting in a shift in the proportion of more sensitive taxa). The sites located lower in the reaches of catchments showed a typical but ecologically insignificant reduction in MCI values from spring to summer (8 MCI units), unlike the summer of 2012-2013 when such sites showed a reduction of 10 units between spring and summer. The usual reduction between spring to summer for sites low in catchments is of 5 units: thus, the 2015-2016 year was quite typical in this regard.

Eleven of the 59 sites recorded new maximum MCI values in one or other of the two surveys, compared with three such results in the last period. The highest MCI scores in the 2015-2016 year were found at the upper Timaru Stream (146 in spring and 144 in summer) and upper Waingongoro River (144 in summer). Lowest MCI scores were found in the uppermost sites in the Mangawhero and Mangati streams (MCIs of 72 in summer), and thus represent 'natural' more than degraded conditions. MCI scores increased in both streams further down in their catchments, and notably these higher scores were below reaches where there have been or are significant discharges regulated by the Council.

In the spring survey, 91% of the sites had MCI values that were similar to or significantly better than historical medians. Of these, six (mainly mid-reach) sites had scores significantly higher than usual. In summer, 95% of the sites had MCI values that were similar to or significantly better than historical medians, and significantly lower scores were found at only 3 sites.

In terms of the Council's LTP commitment to the '*Protection of the life-supporting capacity of water, in-stream uses and values*', the measure for this activity is: '*Macroinvertebrate Community Index (MCI) values (a measure of freshwater community richness and composition) at at least 50 regionally representative sites*', and the target is '*the proportion of sites showing a trend (whether significant or indicative) of improvement in MCI against a base year of 1995 to exceed the proportion of sites showing decline over the same period*'.

The updated trend analysis shows that at 46 of the 53 sites (87%) for which trends can be calculated, MCI scores are improving. Surprisingly and pleasingly, the number of sites showing improvement continues to be maintained at the high levels that have been attained

over recent years instead of beginning to decrease as might otherwise generally be expected once the benefits of interventions begin to become a matter of history.

In trend analysis to 2010, 38 sites were showing improvement; in trend analysis to 2011, 40 showed improvement; in 2012, the number increased to 42.

Seven sites are showing an indication of a degree of deterioration. The number of sites showing deterioration continues to reduce- in trend analysis to 2012, 10 sites were showing deterioration, down from 13 when trend analysis began in 2008. That is, the proportion of sites in the region showing a trend of improvement continues to exceed the proportion of sites showing declines, in an ever-increasing ratio (the ratio is now at 6.6:1, the highest it has ever been and up from less than 3:1 five years ago). In most cases where an apparent deterioration is indicated, the cause can be identified as natural headwater erosion events in the recent past on the mountain. Recovery of ecological conditions in such circumstances in the most recent surveys is now becoming apparent (eg upper Manganui, upper Maketawa, and upper Katikara streams).

Applying a more rigorous statistical evaluation of trend data, the number of sites with a 'positive and very significant' trend since 1995 is 16, and there are a further 14 sites with a 'positive significant' trend, giving 30 sites now in either of the two positive categories of strong or very strong improving trends. Going back to the first trend analysis (2006-2007), it was found that 'only' 13 sites were showing strong or very strong improving trends in ecological health at the time.

The latest result for the number of sites showing a highly significant improvement is the best result ever recorded. That is, the number of sites in the Taranaki region with a statistically strong or very strong improvement evident is continuing to be maintained at record high levels. There are more than double the number of sites showing strong or very strong improvement as there were eight years ago. On the other hand, within this grouping there has been a reduction in the latest results of the number of sites where the statistical test of certainty (confidence) around the positive trend is strongest.

Reviewing the locations of sites showing improvement (Figure 1 below, which reproduces Figure 179 from the report), 2 of 9 upper catchment sites (22%), 15 of 25 mid catchment sites (60%) and 13 of 25 lower catchment sites (52%) are showing statistically significant improvement. Given that upper catchment sites, by virtue of their location, are subject to relatively little intervention activities that could improve their stream health, that particular result is not unexpected. However, what is encouraging from the perspectives of the Council and regional community, is the extent to which improvements in in-stream ecological health are becoming apparent throughout the full lengths of the region's catchments. This could be considered to be associated with the progressive implementation of programmes such as riparian management across the ring plain.

The analysis set out above relates to the 'direction of travel' for the region's streams and rivers. The associated question is that of how good (in terms of a comparison with how good a site could ever be reasonably expected to become) the current ecological status of each site is. In terms of the question 'what is the state of the ecological health of our streams?', the Council has developed means of calculating predictive scores for ringplain sites that are based on each of the altitude of each site, and/or its distance below the National Park boundary.

As noted above, as a stream descends, there are a range of influences (natural and human) that cause a reduction to some degree of MCI scores. The predictive modelling indicates for each site what the MCI 'should' be, if the site were to be as good as could be reasonably achieved.

A summary for all results for the 2015-2016 year is provided below, by percentage allocation into 'significantly lower', 'no significant difference', or 'significantly higher' scores than expected.

Season	Spring 2015			Summer 2016		
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Altitude	0	55	45	8	68	24
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This analysis shows that in the 2015-2016 year, there were somewhat different patterns between the two survey periods, but in both periods sites regionally showed a distribution of scores better than might otherwise have been expected.

This was even more evident during the spring surveys than in summer. In the spring surveys, well over a third of all sites had MCI scores that were much better than could have been reasonably anticipated based on typical quality for equivalent sites, and extremely few sites (which were found in short, small ring plain streams) had MCI scores that were much worse than predictable. In the summer surveys, results were somewhat more balanced between scores lower and higher than predicted, but there were still about three times as many sites with better scores than expected, than there were with scores below expectations. Well over 90% of all sites had scores as good as or better than those that could otherwise be expected.

The streams and rivers with both the strongest statistical evidence of improvement ('there definitely is an improvement') and the greatest change in ecological state ('there is a definite improvement', of 20 MCI units or more) are:

- Kaupokonui Stream upstream of the Fonterra Kapuni factory
- Kaupokonui Stream upstream of STDC Kaponga WWTP
- Punehu Stream at SH45 (lower catchment)
- Kapoaiaia Stream at Wiremu Road
- Kapoaiaia Stream at Wataroa Road
- Mangati Stream within residential area, Bell Block.

Four of these sites have illustrated particularly strong improvements over the most recent ten year period (the Kaupokonui Stream sites continue to show further improvement but not so strongly). Other sites also showing a large increase in MCI scores include the lower Waitara River, Mangaehu River, lower Timaru stream, and lower Waiongana stream.

Three of the 6 Waingongoro sites are showing statistically significant positive trends, but the two sites simultaneously showing the greatest improvement in ecological condition are both located below the township. A review in each case of their patterns of change show periods of strong improvement after 2002 (coincident with the substantial removal of the effluent discharge from the Riverlands meatworks into the river) and again after 2009 (which is coincident with the removal of the discharge from the STDC Eltham wastewater treatment plant).

Conclusions

In simple terms, the latest results of SEM MCI monitoring have seen an on-going firming of the trend of improvements being found regionally in respect of the LTP target of maintaining or enhancing regional in-stream ecological health (Figure 1). Over the long term, additional measures such as more complete stock exclusion from waterways, the maturing and extension of riparian planting, and continuing reductions in the number and improvements in the quality of discharges into waterways, should see further consequential gains in water quality and in in-stream ecological health across the region and in particular extending into the lowest reaches of the region's streams and rivers.

Decision-making considerations

Part 6 (Planning, decision-making and accountability) of the *Local Government Act 2002* has been considered and documented in the preparation of this agenda item. The recommendations made in this item comply with the decision-making obligations of the *Act*.

Financial considerations—LTP/Annual plan

This memorandum and the associated recommendations are consistent with the Council's adopted Long-Term Plan and estimates. Any financial information included in this memorandum has been prepared in accordance with generally accepted accounting practice.

Policy considerations

This memorandum and the associated recommendations are consistent with the policy documents and positions adopted by this Council under various legislative frameworks including, but not restricted to, the *Local Government Act 2002*, the *Resource Management Act 1991* and the *Local Government Official Information and Meetings Act 1987*.

Legal considerations

This memorandum and the associated recommendations comply with the appropriate statutory requirements imposed upon the Council.

Appendices/Attachments

Document 1716915: *Freshwater Macroinvertebrate Fauna Biological Monitoring Programme Annual State of the Environment Monitoring Report 2015-2016* (excerpts).

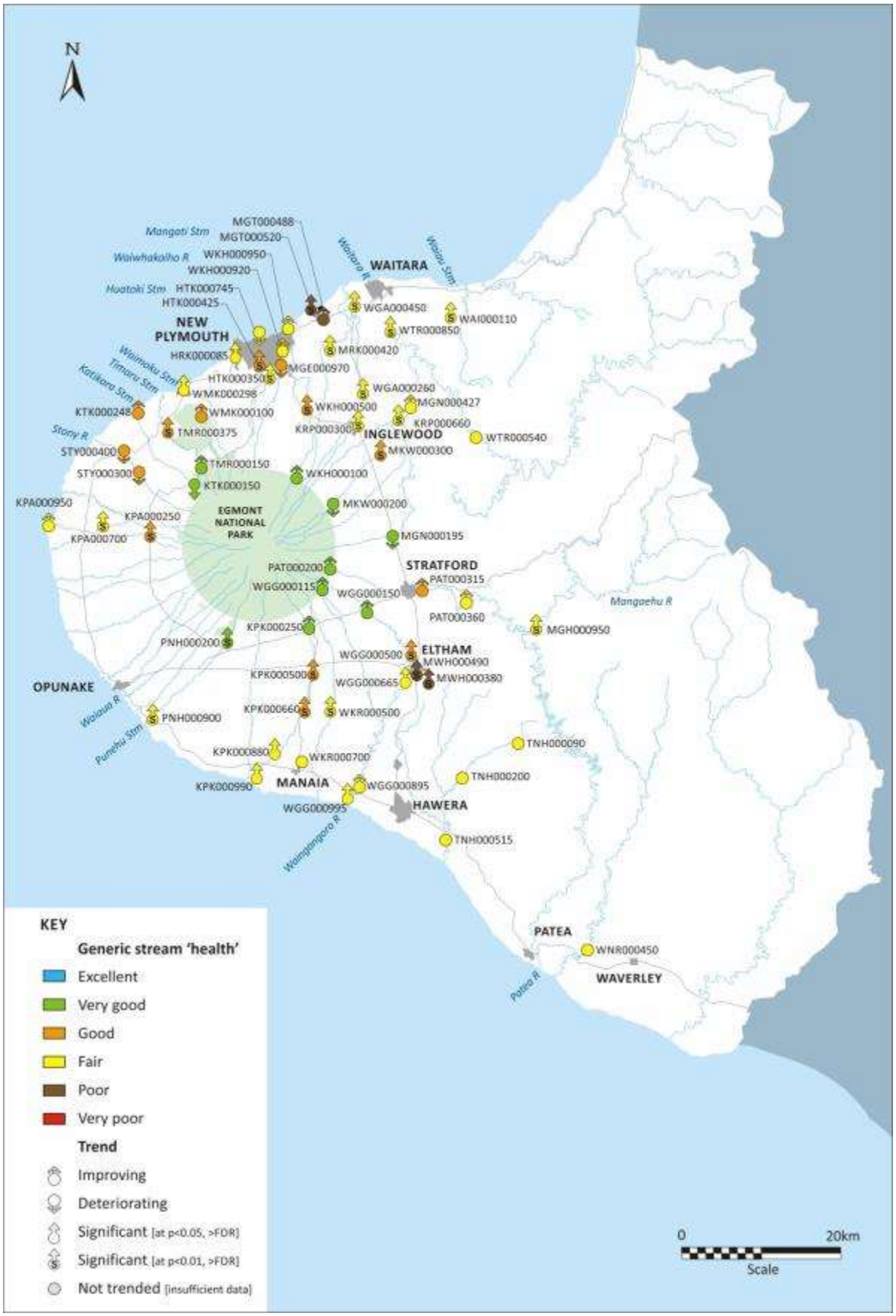

Figure 1: Generic biological 'health' (median MCIs) and trends in biological quality for SEM sites, 1995-2016

Executive summary

Section 35 of the Resource Management Act requires local authorities to undertake monitoring of the region's environment, including land, air, and fresh and marine water quality. The Taranaki Regional Council initiated the freshwater biological component of the State of Environment Monitoring (SEM) programme for Taranaki in the 1995-96 monitoring year. The macroinvertebrate component was separated from the microfloral component in the 2002-03 year. The latter programme was broadened to incorporate recently-developed techniques and is reported separately.

This report covers the 2015-2016 monitoring year. Biological surveys were performed in spring (October 2015 mainly through to November 2015 with some wet weather delay extending through to December 2015) and summer (February to March 2016). Each seasonal survey assessed the macroinvertebrate communities at 59 sites in 26 rivers and streams. Two new sites were added in the 2015-2016 year, in the upper Waitara River and in the lower Whenuakura River, because of the need for the Council put in place adequate representative monitoring of the region's proposed Freshwater Management Units (as required by the National Policy Statement on Fresh Water).

The Hangatahua (Stony) River was selected as a river with high conservation value and the Maketawa Stream was selected having been identified in the Regional Freshwater Plan for its regionally important recreational value. The Waitara, Manganui, Patea, Waiwhakaiho and the Mangaehu Rivers were chosen as examples of waterways with large catchments and multiple human impacts, arising in either the Egmont National Park or the eastern hill country. The Waingongoro River was included in the programme as a river under intensive usage with more recent wastes diversions out of the river, and the Waiongana Stream as a stream from which there is a major water abstraction (although not currently exercised). The Timaru, Mangaoraka, Waiokura (added in 2007) and Punehu Streams were included as streams within primary agricultural catchments. The Kaupokonui River, Mangorei Stream and Waimoku Stream were selected to monitor the progress of riparian planting in these catchments. These catchments had been targeted in management policies for riparian planting initiatives. The Katikara and Kapoaiaia streams are western Taranaki streams also targeted for riparian planting initiatives, which have been part of the monitoring programme since 2000. The Tangahoe River was included in 2007 to monitor land use changes in an eastern hill country catchment. The Kurapete Stream was added to the programme as an example of a small seepage ringplain stream where significant improvements to a major point source discharge have been implemented. The Waiau Stream is an example of a northern lowland catchment. The Mangawhero and Mangati Streams were selected as examples of small, degraded streams. The Huatoki Stream was selected as an example of a stream influenced by urbanisation and also in part by riparian vegetation while the Herekawe Stream, on the western outskirts of the New Plymouth urban area (with a lengthy consent monitoring record), has been added in order to monitor the impact of relatively recent community walkway planting initiatives. The Whenuakura River was selected as a large river draining the eastern hill country.

For sites located in lower catchments the proportion of 'sensitive' taxa in the macroinvertebrate communities generally have been lower in summer than in spring, coincident with lower flows, higher water temperatures, less scouring, and increased smothering of habitats by more widespread algal growth within rivers and streams in summer. During the 2015-2016 period, the median spring score (104 units) was eight units

higher than the median summer score (96 units) but the seasonal difference in scores was not statistically significant. As is typical in catchments worldwide, the proportion of 'sensitive' taxa in the macroinvertebrate communities decreased down the length of the waterways, which was reflected in the deterioration in generic stream 'health' from 'very good' in the upper reaches though 'good' in mid-reaches to 'fair' to 'good' in the lower reaches.

A large number of sites (11 sites with historical data) recorded new historical maximum MCI scores, while one decrease in historical minimum score was recorded (in the lower reaches of the Tangahoe River), in the 2015-2016 period.

Evaluations of generic stream 'health' have also been performed and assessments of current scores compared with predictive measures based on altitude and distance for ringplain streams arising from within the National Park and for all sites in relation to River Environment Classification (REC) predictions.

The trends through time have been evaluated and will continue to be assessed on an annual basis as the SEM programme continues. Only ten of the fifty-nine sites monitored have shown any indications of deterioration over the full 21 year period of monitoring, with only one site having a statistically significant deterioration in MCI scores (a result of headwater erosion effects inside the National Park). On the other hand, thirty sites have shown statistically significant improvements, all but five of which were of ecological importance. Roughly equal numbers of these sites were located in the lower reaches of ringplain catchments as in mid catchment reaches. Generally, in lower catchment sites the macroinvertebrate communities tend to be very 'tolerant' of the cumulative impacts of organic enrichment. Significant improvement of (predominantly 'fair') biological stream 'health' at the lowest sites is unlikely to be detected until habitat improvements occur by way of substantial catchment-wide initiatives such as riparian planting and diversion of point source surface water dairy treatment ponds systems wastes discharges to land irrigation. Notably, the data now shows that the proportion of lower catchment sites showing significant improvement over 21 years (52%) is almost the same as the proportion of mid catchment sites (60%).

For the first time, trends in the most recent ten years of data were also calculated. Eleven of 51 sites still showed statistically significant improvement over this shorter period (with one showing deterioration), and three sites still showed statistically significant improvements after FDR adjustment (the most rigorous test for determining whether a trend is statistically significant) using this more limited dataset. These results can be compared with, respectively, 30 and 16 sites with trends with the same degrees of significance across the entire history of record. This appears to be due to three reasons. Firstly, trends at several sites appear to have plateaued recently, which is only to be expected if interventions such as riparian management have already been completed or have been largely paused for several years. Furthermore, substrate instability and sedimentation caused by extensive headwater erosion events in recent years have affected the macroinvertebrate communities at upper sites in the Stony River (in particular), Katikara Stream, Maketawa Stream, Waiwhakaiho River, and Timaru Stream on occasions within this period. Most of these sites did continue to show recovery from these impacts during the 2015–2016 period. Finally, the smaller dataset has less power to detect statistically significant differences within a background of natural fluctuations even if real ecological improvements are occurring.

The recommendations for the 2016-2017 monitoring year provide for the freshwater biological component of the SEM monitoring to be maintained by way of the same

macroinvertebrate faunal programme and for time trend reporting on the full data set and the most recent ten year dataset (to detect recent trends) to be performed annually.

Recommendations

It is recommended for 2016-2017:-

1. THAT the freshwater biological macroinvertebrate fauna component of the SEM programme be maintained in the 2016-2017 monitoring year by means of the same programme to that undertaken in 2015-2016;

2. THAT temporal trending of the macroinvertebrate faunal data continues to be updated on an annual basis.