PredatorFree Hawke's Bay
Whakaorangia Te Matau-a-Māui

Maraetōtara river quality trends

Milestone: Complete detailed 5-year review of water quality trend data

Introduction

The Maraetōtara River flows into the Pacific Ocean to the north of Cape Kidnappers, at Te Awanga. The river is a spring fed system with moderate water velocities that are usually dominated by cobble/gravel substrate with periphyton communities. During low flow periods aquatic macrophytes increase their coverage from the stream edges and can form mats in slower velocity areas of the streams.

This report has been created from Hawke's Bay Regional Council's State of the Environment reporting. For more information on sampling methods please see the full report at www.hbrc.govt.nz/environment/state-of-the-environment/soe-five-yearly/

Cape to City and the Maraetōtara River

The Maraetōtara River flows through the length of the Cape to City footprint. The river has a long history of riparian planting, fencing, and willow removal which began in 2002 initially with a partnership between HBRC and the Maraetōtara Tree Trust (MTT) with a goal of planting the entire river length. The Department of Conservation have provided considerable support MTT through their Community Fund. The Cape to City project was able to contribute significantly to this endeavor with over 240 000 stems planted, the majority which were along the riparian margins of the river.

Where planting has occurred, Esplanade Strip agreements have been created protecting planting sites in perpetuity.

Water quality and ecological indicators

Water quality and ecological indicators monitored as part of the SOE monitoring programme may be considered in the following groups:

1. Microbiological water quality indicators, such as *Escherichia coli* (*E. coli)*, which provides an indication of the level of health risk to recreational users of the water,
2. Basic physical-chemical indicators, such as temperature, dissolved oxygen and pH,
3. Indicators associated with the visual appearance of the water, such as water clarity and turbidity,
4. Toxicants, such as nitrate-nitrogen and ammoniacal nitrogen,

5. Nutrients, such as nitrogen and phosphorus, as controlling factors, or indicators of risk of eutrophication (excessive plant/algae growth),
6. Biological indicators of eutrophication (periphyton CHLAs) and ecological health (macroinvertebrate communities).

Maraetōtara water quality and ecological indicators

The various water quality and ecological indicators were compared with environmental guidelines and trigger values to provide an indication of the state of water quality. Statistical analyses of trends through time were performed to determine whether the various water quality indicators have been improving or degrading over time. For the relevant indicators available, data were compared with the Regional Plan (RRMP) Guidelines, and with the National Policy Statement for Freshwater management (NPSFM) (2014) Attribute States. Monitoring data collected during the 2013-2018 period indicate the following:

- Nitrogen enrichment was high at the Maraetōtara River at Waimarama Rd potentially an artefact of high leaching in the upper catchment due to the limestone geology
    - Both TN and DIN had reduced significantly at the downstream Maraetōtara at Te Awanga site, suggesting assimilation by macrophyte and periphyton communities
    - Both sites displayed decreasing (improving) trends for TN, DIN and nitrate
- Phosphorus levels in the Maraetōtara River were moderate
    - Both sites showed increasing (deteriorating) DRP trend
- Swimability scores were poor at the Maraetōtara River at Te Awanga which failed to meet the national bottom line and fell into the 'D' band. The Maraetōtara River at Waimarama Rd was better, falling into the 'B" band.

The Maraetōtara River site is classified as warm dry, low elevation, soft sedimentary pastoral stream and supports many native fish species, including: longfin eel, shortfin eel, inanga, common smelt, patiki (black flounder), torrent fish, Cran's bully, common bully, blue gill bully, giant bully and redfin bully. The river also supports healthy rainbow and brown trout fisheries, and an eel fishery.

The lower reaches of the Maraetōtara River are used for swimming and are monitored for water quality during the bathing beach season (1 November to 31 March) each year. The river has a history of riparian retirement and fencing, and in reaches where this has occurred habitat values are higher.

The upper catchment of the Maraetōtara River features limestone geology, which can be prone to leaching. This may explain the elevated TN and DIN levels seen at the Waimarama Rd site, both of which exceeded the lowland ANZECC trigger values. Further, down the catchment at Te Awanga, median TN and DIN concentrations reduced by 48.8 and 60% respectively, indicating either instream attenuation by macrophyte and periphyton growth, both of which are present in the stream. Both sites showed decreasing trends for nitrogen, with 6.2 and 6.1 % decreases for TN, 9.0 and 5.9 % decreases for DIN, and 7.4 and 5.87 % annual decreases in nitrate for Waimarama Rd and Te Awanga, respectively. Both sites had median TP concentrations below upland ANZECC trigger value but exceeded lowland trigger values for DRP. In addition,

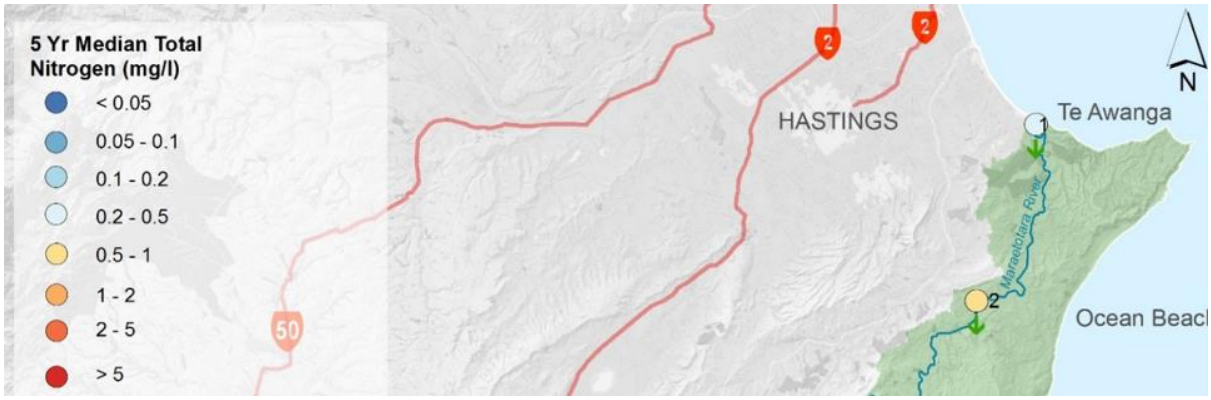
both sites showed increasing trends for DRP, with 10.0 and 19.1% annual increases at Waimarama Rd and Te Awanga respectively. At Waimarama Rd, The Maraetōtara River fell into the 'B' NPS-FM category, but further downstream at Te Awanga, 95th percentile concentrations exceeded 1200 cfu/100mL, failing the national bottom line.

Total Nutrients

Nitrogen (N) and phosphorus (P) are key growth limiting nutrients that influence the growth rate and biomass of algae (or periphyton) and aquatic plants. Low availability of these two nutrients often limits plant biomass development (Mathieson, Quinn et al. 2012).

Maraetōtara River (at Te Awanga) (0.43mg/l) had the lowest median TN concentrations of all 8 sites, and were largely better than the lowland ANZECC trigger value.

The Maraetōtara River (at Waimarama Rd) (0.87mg/L) had elevated median TN concentrations.



5 year median and trends in total nitrogen (TN) concentrations

5 year median total phosphorus (TP) concentrations at SOE monitoring sites

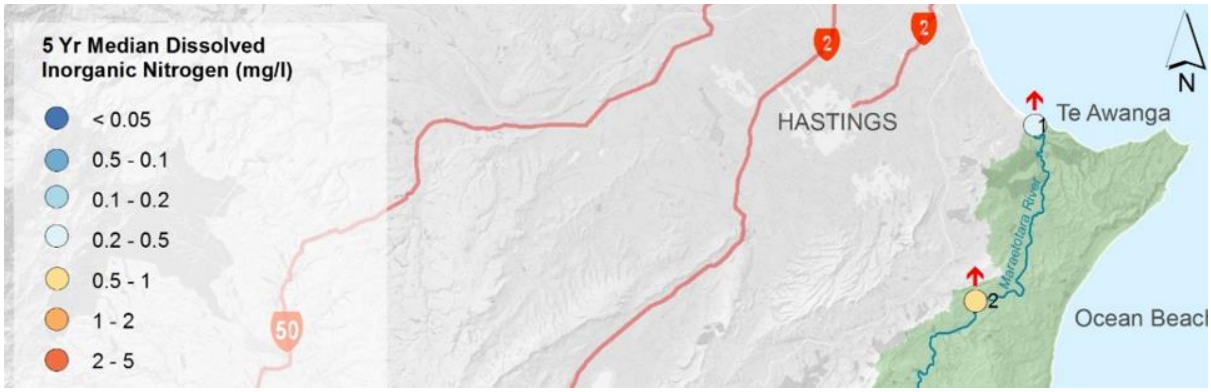
Dissolved Nutrients

Dissolved inorganic nitrogen (DIN) and dissolved reactive phosphorus (DRP) concentrations were also examined at SOE monitoring sites. The Maraetōtara (at Te Awanga) and the Pouhokio Stream were more elevated, but still fell into the 'B' state. The median DIN concentrations for the Maraetōtara River at Waimarama Rd was more than twice that of the Te Awanga site, and fell into the 'C' band. The lower

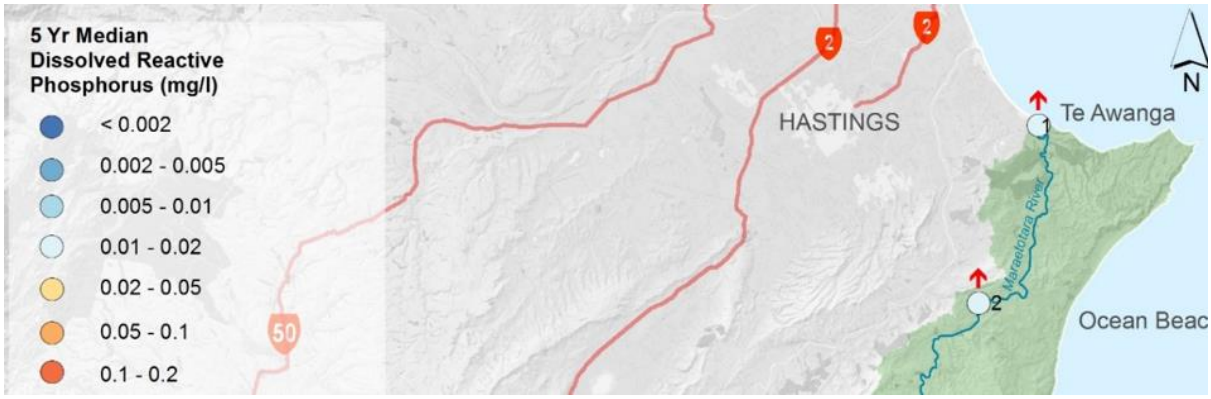
concentration at the downstream sites suggests DIN is being attenuated by macrophyte and periphyton communities.

DIN concentrations decreased (improved) at the Maraetōtara River (at Te Awanga) (5.99%). Both sites on the Maraetōtara River fell into the 'B' band showing slight enrichment.

Increases in DRP concentrations were identified for the Waingongoro Stream (4.91%) and the Maraetōtara River at Waimarama Rd (10.03%) and at Te Awanga (19.12%).



5 year median and trends in dissolved inorganic nitrogen (DIN) concentrations at SOE monitoring sites



5 year median and trends in dissolved reactive phosphorus (DRP) concentrations at SOE monitoring sites.

Nitrate-nitrogen and ammonia-nitrogen toxicity

Nitrate and ammonia are toxicants that can cause lethal or sub-lethal (e.g. reducing growth rates or reproductive success) effects to aquatic species. These effects can occur as a result of short-term (hours to days) or long-term (weeks, months, years) exposure to nitrate or ammonia.

Both Maraetōtara sites fell into the 'A' attribute state for ammonia toxicity for median values, however fell into the 'B' state for maximum values.

5 year median and trends in nitrate-nitrogen (NO3-N) concentrations at SOE monitoring sites

Water Clarity – Black Disc and Turbidity

Water clarity is measured as the proportion of light transmitted through water. The concept includes two important aspects, which are (1) visual clarity (sighting range for humans and aquatic animals), and (2) light penetration for growth of aquatic plants (Davies-Colley and Smith 2001, Davies-Colley, Vant et al. 2003).

Sites on the Maraetōtara River at Waimarama Rd and Te Awanga had median black disc sighting distances of 2.85m and 3.05m respectively, although these are below the recommended minimum 3.5 m for 'significant trout fisheries'. Trend analyses of these SOE monitoring sites shows improvements in median black disc values, with increases of 14.7% and 10.99% at Waimarama Rd and Te Awanga respectively.

Turbidity is a measurement of the degree of light scattering of the water and is caused by suspended particles present in the water column. As the number of suspended particles increases, the turbidity increases. There is a direct relationship between water clarity, as measured using a black disc, and turbidity - the higher the turbidity, the lower the water clarity.

Neither site exceeded the lowland ANZECC trigger value for turbidity. Median turbidities in the Maraetōtara River were the lowest for the Southern Catchment sites tested, with 1.12 NTU and 1.18NTU at Waimarama Rd and Te Awanga respectively. The Maraetōtara River (at Waimarama Rd) was the only site where a trend was detected, with an annual decrease (improvement) in median turbidity of 8.61%.

5 year median and trends in Black Disc (BD) water clarity at SOE monitoring sites

Microbiological Water Quality Indicators – *E. coli*

Escherichia coli (commonly abbreviated as E. coli) concentrations have been routinely monitored throughout the Porangahau and Southern catchments as an indicator of microbiological water quality. E. coli is a bacterium commonly found in the lower intestine of warm-blooded animals and is an important indicator of the presence of pathogens of faecal origin in the water. E. coli is used to assess the level of health risk to water users having direct contact with water. The Maraetōtara River (at Waimarama Rd) ranked in the top 40%, of all Hawke's Bay regional sites.

5 year median E. coli concentrations at SOE monitoring sites including trend direction.

The E. coli attribute table has five categories, or attribute states (i.e. A, B, C, D and E). Each attribute state has four criteria, or 'statistical tests', that need to be satisfied for water quality to be in that attribute state. Higher attribute states provide lower levels of infection risk for each activity type. All four criteria are necessary to establish an attribute state. If one or more criteria can't be satisfied, a lower attribute state must apply.

Site	n	Median	% exceedances >260	% exceedances >540	95th Percentile	Category
Maraetōtara Rv at Te Awanga	56	A	B	B	D	D
Maraetōtara Rv at Waimarama Rd	56	A	A	B	B	B

Biological Indicators – Macroinvertebrate Community Index

Benthic macroinvertebrate communities are the assemblages of insects, crustaceans, worms and molluscs that live on the bottom of streams and rivers. Macroinvertebrate communities are commonly used as state indicators of water quality and ecosystem health. The macroinvertebrate community of a stream adjusts to conditions in the aquatic environment, including naturally induced changes and stressors affecting ecosystem health. The macroinvertebrates collected at a site are exposed to changes in conditions at that site for periods of months, to a year or even several years, depending on their life cycle. When under stress, the community composition changes as sensitive species are lost, and more tolerant species appear, which leads to a community dominated by more tolerant species. Both human activities and natural changes such as drought and floods, or natural variations in stream bed substrate type and water temperature may affect macroinvertebrate communities. Assessing the composition of macroinvertebrate communities provides a long-term and integrated view of stream ecological health.

5 year median Macroinvertebrate Community Index (MCI) scores at SOE monitoring sites.

Physical Habitat

Physical habitat is the living space of aquatic flora and fauna, and it is a critical component of good stream health (Shields et. al. 2006; Clapcott et. al. 2018). In general, a more diverse habitat will support a more diverse range of flora and fauna (Benton et. al. 2003). Waterways around New Zealand, and the world, have been subjected to various modifications that have simplified habitat structure and reduced habitat quality (Maddock 1999). This includes activities such as channel straightening and deepening, piping, removal of riparian vegetation and the reduction of riparian buffer widths, damage caused by livestock access and sedimentation resulting from bank and broader catchment erosion processes (Maddock 1999; Scarsbrook and Halliday 1999; Shields et. al. 2008). In urban areas, the use of concrete and other artificial materials can result in stream channels that have little connection left with the natural world, with extreme examples involving large proportions of waterways flowing through underground pipes (Reid et. al. 2008). The cumulative degradation of habitat often results in waterways being treated like ‘drains’ instead of being recognised as a living space for aquatic flora and fauna. This physical degradation has been widespread in rural and urban areas alike (Reid et. al. 2008; Quinn et. al. 2010).

Physical habitat quality can be considered at a broad range of scales, from the entire catchment down, right down to a minute and sub-reach scale (Frissell et. al. 1986). For the purpose of SOE reporting, we have focused on a rapid habitat assessment method that has been standardised for use by all regional councils in New Zealand (Clapcott et. al. 2015). The rapid habitat assessment method visually evaluates ten habitat parameters at a site scale (≈100m) and assigns each a score between 1 and 10. Individual scores are summed to produce an overall rapid habitat assessment score (RHA). Both Maraetōtara River sites scored in between the median and upper quartile.

Periphyton Biomass

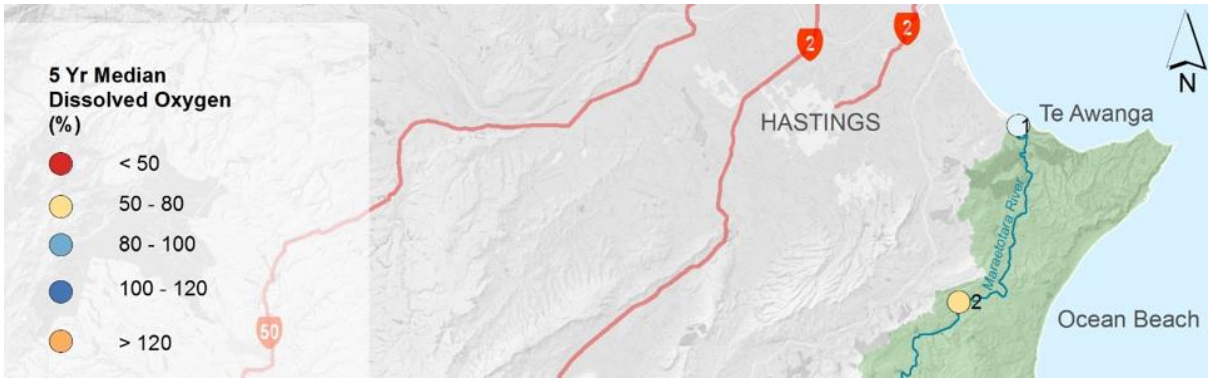
Algae are found in many locations in rivers. They may drift in the water column in both rivers and lakes, but they are called periphyton when they are attached to objects underwater such as the streambed gravel, rocks, logs, branches or any other stable material. Low levels of algal growth occur naturally in healthy riverine ecosystems. Algae are the main primary producers in streams and rivers, and are fundamental to the functioning of aquatic ecosystems (Biggs 2000). They support invertebrate and fish productivity and diversity. But when periphyton cover grows too thickly, it can detrimentally affect ecosystem health and recreational values. Algal growth is controlled by several biotic and abiotic factors. Biotic factors include grazing by invertebrates and abiotic factors are nutrient availability, available light, and the time available for algae to grow between flood flows that scour algae off the river bed (known as the ‘accrual’ period).

The Maraetōtara River sites had slightly higher growths, at 43.63 and 40.44% for Waimarama Rd and Te Awanga respectively.

Dissolved Oxygen

Dissolved oxygen is an important element of the life supporting capacity of freshwater ecosystems. Humans absorb oxygen from the air through their lungs, while aquatic organisms absorb oxygen from the water through their gills. Fish, invertebrates and other organisms are stressed when insufficient oxygen is dissolved in the water.

The ANZECC (1992) guidelines recommend a minimum DO concentration of 6 mg/l and 80% saturation. Hay, Hayes et al. (2006) suggests these limits should be seen as short-term exposure levels (i.e. occurring only for a few days), as data suggests that long-term exposure to DO levels of 6 mg/l can impair the growth of salmoniids, which include trout species (CCME 1997).



5 year median dissolved oxygen % saturation levels at SOE monitoring sites

5 year median dissolved oxygen concentration levels at SOE monitoring sites.

Summary and Conclusions

Over the last five years, the Maraetotara River has shown decreasing trends for nitrogen (TN and DIN) and nitrate. However there is detectable annual increases in dissolved reactive phosphorous. At Waimarama Rd, The Maraetōtara River fell into the ‘B’ NPS-FM category, and further downstream at Te Awanga, 95th percentile concentrations exceeded 1200 cfu/100mL, failing the national bottom line.

It is likely too early to tell whether planting is making a measurable difference to water quality along the Maraetotara. HBRC will continue this monitoring programme long term, so any changes will be detected. The long term goal is for riparian planting and fencing along the entire river, and annual planting will continue driven by the Maraetotara Tree Trust.