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TAURIKO WEST WATER QUALITY ASSESSMENT

Tauranga City Council

City Waters Planning

February 2024

REPORT INFORMATION AND QUALITY CONTROL

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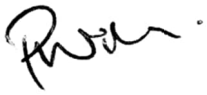
Authors:	Dr Pete Wilson Principal Water Quality Scientist	
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1 INTRODUCTION

Tauranga City Council (TCC) is preparing an application for the Tauriko West Urban Growth Area (Tauriko West) Comprehensive Stormwater Consent (CSC), as required by the Bay of Plenty Regional Natural Resources Plan (RNRP). The CSC will authorise the discharge of stormwater from the fully development area, but not construction related discharges (which will be addressed by the developers/landowners in conjunction with earthworks consents). Tauriko West is an approximately 330 hectare (ha) greenfield site situated between State Highway 29 and the Wairoa River in Tauranga (Figure 1).

The potential changes in water quality resulting from developing the growth area have been modelled by Morphum Environmental[1] (the Morphum Report) using TCC's Freshwater Management Tool (FWMT). A number of scenarios were modelled using the FWMT and the ones relevant to this study are the current baseline (i.e., the current quantity and quality of stormwater discharged from the undeveloped area) and a future scenario[2], which incorporates mitigations according to the stormwater management plan prepared for the Tauriko west Growth Area[3] (i.e., the potential quantity and quality of stormwater of the developed area).

4Sight Consulting – Part of SLR (4Sight) has been engaged by Tauranga City Council (TCC) to conduct a water quality assessment to support the CSC application. This assessment focuses on how stormwater discharges from Tauriko West may influence the water quality of the Wairoa River based on the findings from the FWMT.

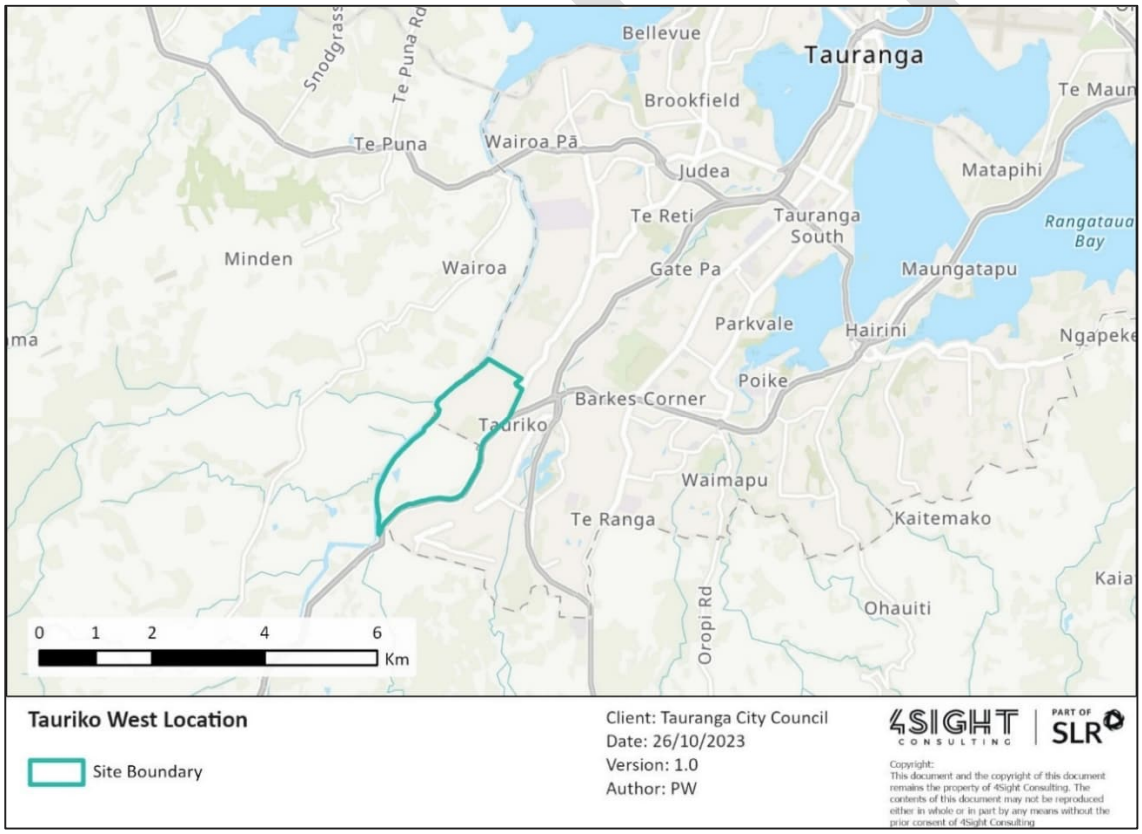

Figure 1: Location of the proposed Tauriko West development area.

[1] Rayman. L., Saecker-Battley. P., Clarke. C. (2024). Tauriko West Study Report (P04082) Morphum Environmental Limited. Report prepared for Tauranga City Council.

[2] Referred to in the Morphum Report and this report as Scenario 3 or S3.

[3] Tauriko West Urban Growth Area - Stormwater Management Plan. Report 3-AWD05.46 17 November 2023. Prepared by WSP for Tauranga City Council

2 APPROACH

The water quality assessment is focussed on key water quality parameters that are measured both in the Wairoa River and modelled by the FWMT. The approaches used to assess the current state of the Wairoa River, the undeveloped Tauriko West area, and the predicted changes to stormwater quality resulting from the developed Tauriko West area are described in this section.

2.1 Current state

This section outlines the current state of the Wairoa River and the water quality of runoff from the undeveloped Tauriko West area.

2.1.1 Wairoa River

Information on the current state of the Wairoa River water quality was obtained from Bay of Plenty Regional Council's (BOPRC) state of the environment (SOE) monitoring data. The nearest site downstream of Tauriko West is the Wairoa @ SH2 site, approximately 4 km downstream from the northern corner of the growth area. The Wairoa River catchment is around 2,132 km^2 in total and predominantly comprises pasture (45%) and indigenous forest (44%)[4].

Data summaries were also used from LAWA for 5-year water quality medians and trends.

2.1.2 Tauriko West development area

Water quality and runoff from the current, undeveloped Tauriko West area was derived from daily mean outputs from the FWMT, which was run using the rainfall time series from 1 January 2016 to 31 December 2020.

The Morphum Report provides details about the model and modelling methodology, and the sub-catchments that comprise the Tauriko West area. Of particular relevance here is sub-catchment 1010 (Figure 2) as it changes in the current scenario and the fully developed scenario (Scenario 3). The TCC FWMT has pre-defined sub-catchments and, for the baseline scenario (not shown in Figure 2), sub-catchment 1010 extends substantially further north past the northern boundary of the Tauriko West area; that is, the baseline scenario modelled sub-catchment 1010 with a total area of 194 ha, but only 36 ha of that is within the development area. To accommodate this, flow outputs from this sub-catchment were scaled down.[5] Average contaminant concentrations from this sub-catchment remained the same as in the larger area (as these are not affected by catchment size). It is acknowledged that the average concentrations will be influenced by the land use in areas outside of the development area, however, the rural land use is reasonably consistent across the pre-development catchment 1010 and hence the effect of this is minor.

To calculate overall flows and contaminant concentrations for the Tauriko West area, the daily mean outputs (flows and contaminant concentrations) from each modelled sub-catchment in the FWMT were combined. To achieve this, flows from all sub-catchments were added together and concentrations from all sub-catchments were calculated using a flow-weighted average, where concentrations were weighted based on the median flow of that sub-catchment. The median flow was used rather than the sub-catchment size as the hydrological characteristics among sub-catchments differed and this was considered a better representation of the total flow and contaminant concentrations.

Once compiled, summary statistics were calculated for the whole Tauriko West area from the daily means. This simple approach treats all stormwater discharge from Tauriko West as a single point discharge – essentially representing the total contribution of the Tauriko West area at its most downstream point.

[4] https://www.lawa.org.nz/explore-data/bay-of-plenty-region/river-quality/wairoa/

[5] Flows from sub-catchment 1010 were multiplied by 36/194 [0.1856] to account for the reduced area.

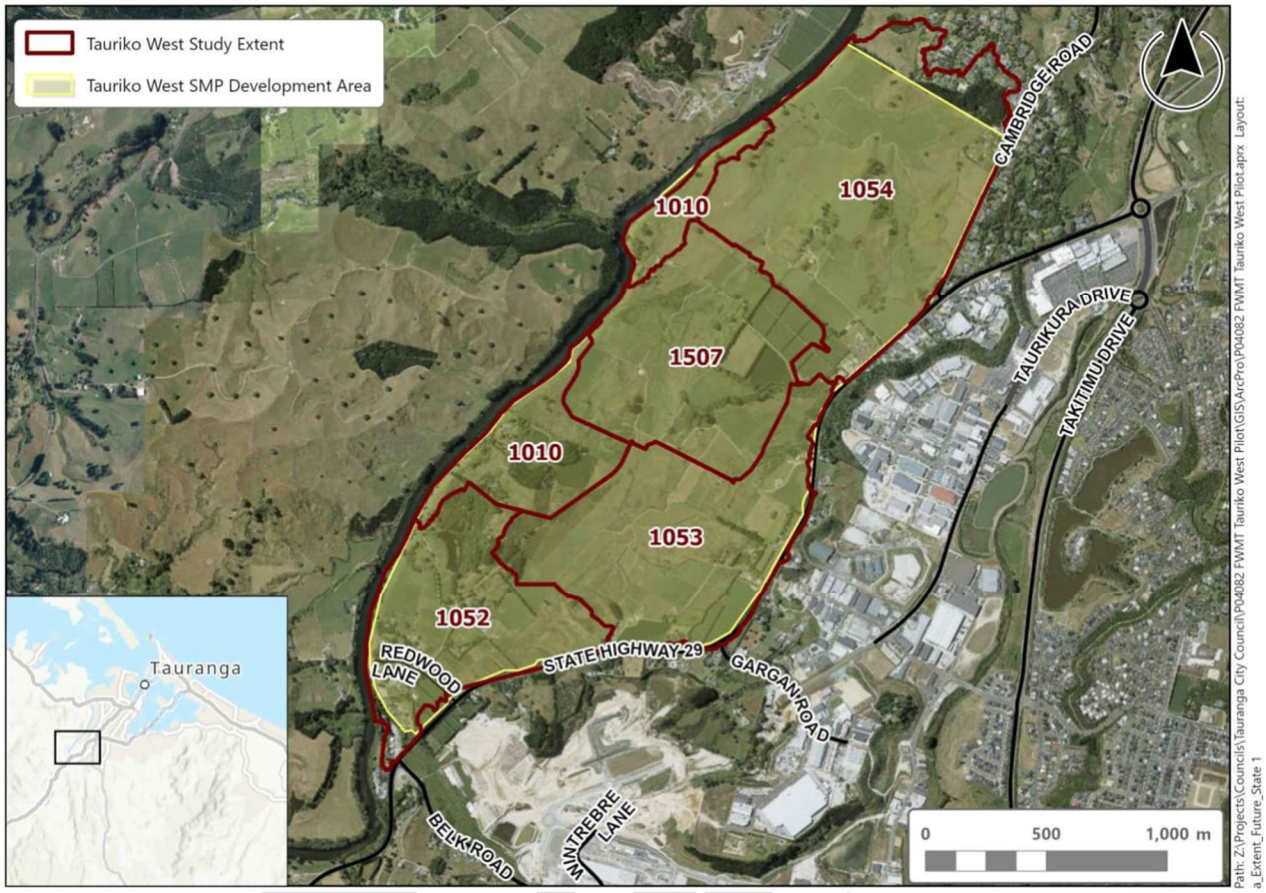

Figure 2: Tauriko West area modelled using the FWTM and the sub-catchments within the area.

Source: Rayman, et al. (2023).

2.1.3 Guideline values

To place water quality results in context, they are assessed against relevant guidelines from the NPS-FM (2020)[6] and ANZG (2018)[7] (

[6] National Policy Statement for Freshwater Management 2020 - Amended February 2023.

[7] ANZG 2018. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines

Table 1). ANZG guideline values are specific to the climate and topography river environment classification. In this instance, the Wairoa River adjacent to Tauriko West has an environment classification of 'warm and wet hill'.

Table 1: Guideline values and their sources used to assess the quality of stormwater discharges.

Parameter	Guideline value	Source
E. coli	540 *E.coli*/100 mL	NPS-FM (2020) *E. coli* primary contact sites. 'Fair' estimated risk. To be assessed against 95th percentile of data.
Total nitrogen	179 µg/L	ANZG (2018) physical and chemical stressors for warm wet hill River Environment Classification. To be assessed against 80th percentile of data.
Total phosphorus	17 µg/L	
Total suspended solids	4.2 mg/L	
Copper	1.4 µg/L	ANZG (2018) default guidelines values (DGVs) for toxicants in freshwater. 95% level of species protection. (note these are developed for dissolved metal concentrations, rather than total)
Zinc	8 µg/L	

2.2 Assessment of effects

This section outlines the approach used to describe the quality of stormwater discharges from the proposed developed Tauriko West area and the effects it has on the Wairoa River after mixing.

2.2.1 Developed Tauriko West area

The quality of stormwater discharges from the developed Tauriko West area was derived in a similar manner to that of the current, undeveloped area. That is, daily mean outputs from the FWMT for Scenario 3 were used. The flows from all sub-catchments were summed and average contaminant concentrations were calculated using a flow-weighted average. In the FWMT modelling of the future development scenario, sub-catchment 1010 reflected the development area so scaling of flows was not required (in contrast to the baseline pre-development scenario).

2.2.2 Differences between summary statistics

To provide an initial assessment of the differences between the stormwater quality of the undeveloped and developed Tauriko West area, the summary statistics from scenario 3 were subtracted from the equivalent statistics from the baseline scenario.[8] In this instance, a negative number indicates a lower concentration (i.e., improved water quality) relative to the baseline conditions. This provides an indication of which water quality parameters are predicted to increase, and which are predicted to decrease, following the transition from the current land use to a fully developed urban land use (including a range of stormwater mitigation measures as proposed in the SMP).

2.2.3 Effects on the Wairoa River after mixing

Effects of the stormwater discharge from the baseline and developed scenarios on the Wairoa River were then calculated using a mass balance model. This was calculated for each parameter for each daily mean output from the model.

To achieve this, daily mean flows for the Wairoa River were required over the same period as the FWMT model, and these were obtained from the BOPRC data portal. The nearest flow measurements on the Wairoa River are approximately 7 km upstream from the Tauriko West area at the Wairoa @ Below Ruahihi Power Station site.

[8] Note this gives a slightly different result than if differences were calculated for each daily mean output by the FWMT.

Flows were adjusted (scaled) based on the upstream catchment area at Tauriko West and the Wairoa @ Below Ruahihi Power Station site [from NIWA river maps].[9]

For each day, the concentration of each contaminant was calculated taking into consideration the concentration and flow of the stormwater and the flow of the Wairoa River. For this assessment, the contaminant concentration in the Wairoa River was set to 'zero' – this means that concentrations after mixing show the *increase (or decrease)* in the Wairoa River from the stormwater discharge relative to background levels of the Wairoa River. That is, the assessment shows the change in water quality, not the absolute water quality, to provide an indication of the effect of the Tauriko West development – as the absolute water quality is dominated by the large upstream river catchment.

3 EXISTING ENVIRONMENT

The existing environment for the Wairoa River and the undeveloped Tauriko West area are described in this section. This was prepared using existing information from key information sources including LAWA[10], the Bay of Plenty Environment Data Portal[11], and outputs from the FWMT.

3.1 Wairoa River

The Wairoa River is one of the main freshwater sources to the Tauranga Harbour. The closest BOPRC SOE site to Tauriko West, named Wairoa @ SH2, is located approximately 4 km downstream from Tauriko West at the mouth of the river according to the Bay of Plenty Regional Coastal Environment Plan. Being a distance downstream of Tauriko West, there will be other catchment-derived sources that influence the water quality at this location; however, it is still considered an appropriate point of reference to describe the general water quality of the Wairoa River as it passes the Tauriko West area.

Flow metrics of the Wairoa River adjacent to Tauriko West are presented below as taken from NIWA river maps:[12]

- Mean annual low flow (MALF): 6.5 m^3/s
- Median annual flow: 11.75 m^3/s

Based on the last five years of data, LAWA summarises that the Wairoa River @ SH2 has elevated nutrients (nitrogen and phosphorus) and *E. coli*, placing it in the worst 50% or 25% of similar rivers in New Zealand (Table 2). The data indicate, however, that water quality is likely improving at this location.

[9] That is, flows measured at Wairoa @ Below Ruahihi Power Station were multiplied by 1.45 to estimate daily mean flows adjacent to Tauriko West taking into account the additional catchment area of the downstream location.

[10] https://www.lawa.org.nz/

[11] https://envdata.boprc.govt.nz/

[12] Whitehead, A.L., Booker, D.J. (2020). NZ River Maps: An interactive online tool for mapping predicted freshwater variables across New Zealand. NIWA, Christchurch. https://shiny.niwa.co.nz/nzrivermaps/

Table 2: Selected water quality summary data from LAWA.

(State and trends using the latest five years of data. Comparisons are to other lowland forest sites in New Zealand)

Parameter	Median	State Comparison	State	Trend
Total nitrogen	0.555 mg/L	In the worst 25% of all lowland forest sites	N/A	Likely improving
Total phosphorus	0.027 mg/L	In the worst 50% of all lowland forest sites	N/A	Very likely improving
E. coli	130 cfu/100 mL	In the worst 50% of all lowland forest sites	D	Likely improving

Further summary statistics are presented below for parameters that overlap with those modelled by the FWMT for comparison (Table 3). Note that LAWA does not include measurements of heavy metals, so these are not included. In general, the summary statistics show that, at times, concentrations can be highly elevated, which coincide with heavy rainfall events (i.e., 95th percentile and maximum values that are orders of magnitude higher than the median concentration).

Table 3: Summary of selected results from the Wairoa at SH2 site (October 2018 to October 2023)

Parameter	Minimum	5th %ile	20th %ile	Median	80th %ile	95th %ile	Maximum
E. coli (MPN/100 mL)	1	21.65	57.3	170	477	2800	13800
Total nitrogen (mg/L)	0.377	0.453	0.513	0.563	0.634	0.942	1.164
Total phosphorus (mg/L)	0.006	0.012	0.018	0.024	0.036	0.097	0.135
Total suspended solids (mg/L)	2.6	3.5	4.8	8.6	19.4	38.8	86.0

Overall, water sampling results from the latest five years (2018 to 2023) at the Wairoa @ SH2 site showed elevated concentrations of nitrogen and to a lesser extent, phosphorus. *E. coli* concentrations are also elevated and are in the NPS-FM band D. It is important to note that while the current Tauriko West area will contribute to elevated contaminant levels in the river, water quality will be predominantly influenced by the large upstream catchment.

3.2 Current Tauriko West catchment

The existing Tauriko West area predominantly comprises pasture and horticultural land use. Runoff from this land use was modelled by the FWMT and summaries of the outputs presented in the Morphum Report. Summary statistics from daily means are presented in

Table 4, below. It should be noted that the modelled results are for the 2016 to 2020 period, whereas the Wairoa River summary is from the most recent five years (2018-2023). However, this difference is unlikely to be material.

The median modelled contaminant concentrations in runoff from the undeveloped Tauriko West area, prior to mixing with the Wairoa River, are higher than median concentrations measured at the SOE site downstream in the Wairoa River from Tauriko West during 2018-2023. The higher concentrations of *E. coli* and nutrients in runoff from the Tauriko West area (compared to that of the Wairoa River) are likely to reflect the primarily pastoral and horticultural land uses within this sub-area, when compared to a large proportion of indigenous forest in the upper Wairoa River catchment.

Although representing slightly different time periods, this is still a useful comparison and shows how the current discharges from Tauriko West contribute to, but do not dominate, the water quality of the Wairoa River due to the small proportion of runoff relative to the large catchment area and substantial flow of the Wairoa River (noting that the median flow of the Wairoa River is three orders of magnitude (one thousand times) greater than the median discharge flow from Tauriko West.

Table 4: Summary of selected outputs from the FWMT baseline scenario (2016–2020) for Tauriko West.

Parameter	Minimum	5th %ile	20th %ile	Median	80th %ile	95th %ile	Maximum
E. coli (MPN/100 mL)	667	696	723	769	1102	5482	51120
Total nitrogen (mg/L)	0.674	0.745	0.792	0.873	1.110	9.413	41.481
Total phosphorus (mg/L)	0.037	0.040	0.040	0.041	0.043	0.537	7.983
Total suspended solids (mg/L)	0.8	0.9	1.1	1.3	3.0	34.6	481.9
Copper (total; mg/L)	0.0009	0.0010	0.0010	0.0010	0.0011	0.0017	0.0113
Zinc (total; mg/L)	0.0028	0.0032	0.0033	0.0034	0.0040	0.0067	0.0342

Assessment of the quality of the discharge from the undeveloped Tauriko West area against relevant guideline values shows that levels of *E. coli*, total nitrogen, and total phosphorus are elevated (Table 5). Notably, *E. coli* and total nitrogen are an order of magnitude higher than their respective guideline values. TSS, copper, and zinc are below their respective guideline values.

Table 5: Discharge quality from the existing Tauriko West area compared to guideline values

(Results exceeding the guideline value are highlighted in teal - note guideline value units have been converted from Table 1 to match the parameter unit used in Table 4

Table 4*)*

Parameter	Assessment unit	Result / Concentration	Guideline value
E. coli (MPN/100 mL)	95th %ile	5482	540
Total nitrogen (mg/L)	80th %ile	1.110	0.179
Total phosphorus (mg/L)		0.043	0.017
Total suspended solids (mg/L)		3.0	4.2
Copper (mg/L)	Median	0.0010	0.0014
Zinc (mg/L)		0.0034	0.008

4 ASSESSMENT OF EFFECTS

This section presents the assessment of water quality from the developed Tauriko West area as predicted by the FWMT. Results from the developed scenario are compared to those for the undeveloped scenario (Section 3.2) to show where the quality and quantity of the stormwater discharge from this area is likely to change (either an improvement or decline).

The Morphum Report summarised the following predicted changes in surface stormwater quantity and contaminant yield per hectare for Scenario 3 based on the results of the FWTM, relative to the baseline (current land use) scenario:[13]

- 202% increase in stormwater volume
- 75% decrease in sediment yield
- 83% decrease in total nitrogen yield
- 91% decrease in total phosphorus yield
- 13% increase in total zinc yield

[13] Rayman, et al. (2024), Table 13, page 43.

- 50% decrease in total copper yield
- 79% decrease in *E. coli* yield

These changes are further explored in the following sections, with a focus on concentrations rather than loads/yields.

4.1 Stormwater quality of the future developed area

A summary of the quality of stormwater discharges from the developed Tauriko West area (following the generation of contaminants from the developed land use and their reduction/mitigation through devices and other measures as described in the SMP) prior to mixing with the Wairoa River is presented in Table 6, below. The parameters, time period, and summary metrics used are the same as presented for the baseline scenario (Table 4). The majority of parameters show reduced concentrations relative to the baseline scenario. The notable exceptions to this are for total nitrogen and zinc. The differences between the two scenarios are discussed further in Section 4.1.1.

Table 6: Summary of selected outputs from the FWMT Scenario 3 (mitigated future state; 2016–2020)

(Values that are higher than in the baseline scenario are highlighted in teal)

Parameter	Minimum	5th %ile	20th %ile	Median	80th %ile	95th %ile	Maximum
E. coli (MPN/100 mL)	232	374	419	485	603	1025	20606
Total nitrogen (mg/L)	0.565	0.911	1.209	1.438	1.653	2.007	12.096
Total phosphorus (mg/L)	0.008	0.019	0.025	0.028	0.032	0.044	1.510
Total suspended solids (mg/L)	0.6	0.7	0.7	0.9	2.4	6.3	355.8
Copper (total; mg/L)	0.0003	0.0006	0.0010	0.0010	0.0011	0.0018	0.0049
Zinc (total; mg/L)	0.0012	0.0028	0.0036	0.0039	0.0060	0.0142	0.0436

Assessment of the quality of the discharge from the developed Tauriko West area against relevant guideline values shows that levels of *E. coli*, total nitrogen, and total phosphorus are likely to remain elevated, similar to the baseline scenario (Table 7). *E. coli* and total nitrogen remain an order of magnitude higher than their respective guideline values even though *E. coli* concentrations are about five times lower than for the existing undeveloped area. Similarly to the baseline scenario, TSS, copper, and zinc are below their respective guideline values (although zinc concentrations increase slightly following development consistent with the transition to an urban environment).

Table 7: Stormwater discharge quality from the developed Tauriko West area (Table 6)

(Results exceeding the guideline value are highlighted in teal. [note guideline value units have been converted from Table 1 to match the parameter unit used in Table 6])

Parameter	Assessment unit	Result / Concentration	Guideline value
E. coli (MPN/100 mL)	95th %ile	1025	540
Total nitrogen (mg/L)	80th %ile	1.653	0.179
Total phosphorus (mg/L)		0.032	0.017
Total suspended solids (mg/L)		2.4	4.2
Copper (mg/L)	Median	0.0010	0.0014
Zinc (mg/L)		0.0039	0.008

4.1.1 Change in stormwater quality relative to baseline

To readily see the stormwater discharge quality changes predicted between the baseline scenario and Scenario 3 from the FWMT, the difference in summary statistics between the two scenarios was calculated (i.e., scenario 3 minus baseline; Table 8).

Table 8: Differences in water quality parameter outputs between baseline and Scenario 3

(i.e., Table 6 minus Table 4). A negative value indicates a decreased concentration in the future development relative to baseline. Increases from baseline are highlighted in teal.

Parameter	Minimum	5th %ile	20th %ile	Median	80th %ile	95th %ile	Maximum
E. coli (MPN/100 mL)	-435	-323	-304	-284	-499	-4457	-30514
Total nitrogen (mg/L)	-0.109	0.166	0.417	0.565	0.543	-7.406	-29.384
Total phosphorus (mg/L)	-0.029	-0.021	-0.015	-0.013	-0.011	-0.493	-6.474
Total suspended solids (mg/L)	-0.2	-0.3	-0.3	-0.4	-0.7	-28.2	-126.1
Copper (total; mg/L)	-0.0006	-0.0004	0	0	0	0.0001	-0.0064
Zinc (total; mg/L)	-0.0016	-0.0004	0.0004	0.0006	0.0020	0.0075	0.0095

Overall, there is a decrease (improvement) in most concentrations due to the land change from rural to urban and the ability to divert stormwater in the developed area through treatment devices.

Total nitrogen concentrations for the 5th, 20th, 80th percentile and median statistics are higher in scenario 3 than in the baseline scenario. This appears contrary to the 83% decrease in total nitrogen yield predicted by the FWMT; however, further exploration of the data shows that the model predicts an increased minimum nitrogen concentration in runoff in general but the maximum concentrations, especially during large rainfall events, are substantially reduced in scenario 3 – for example the 95th%ile concentration reduces significantly. This is consistent with the assessment undertaken in the Morphum Report[14]. For example, the median contaminant grade for total organic nitrogen (TON) under scenario 3 for sub-catchment 1507, is 'B-grade' compared to the baseline (undeveloped) case A-grade (Table 15). However, as indicated in Table 16 of that report, this doesn't not change the overall grade for this sub-catchment. Hence, in this case, the median concentration is higher in scenario 3 relative to the baseline but the total yield and average concentration of nitrogen is less.

Not surprisingly, zinc concentrations are estimated to be higher in the stormwater discharges from the developed area for the 20th percentiles through to the maximum, reflecting that urban land use is a known greater source of zinc than rural land use. Although zinc concentrations in the stormwater discharge are predicted to be higher from the developed area relative to the current, undeveloped area, concentrations are still predicted to be below the conservative 95% species protection guideline value (Table 7) and, therefore, be of low risk to aquatic organisms. This indicates the benefit of the measures and mitigations that are applied through the SMP, including low impact design and a 'treatment-train' approach.

4.2 Receiving environment concentrations

As noted earlier in this report, stormwater discharges from Tauriko West contribute to but do not dominate the water quality of the Wairoa River due to their small volume relative to the flow of the river. This section presents the assessment of the effects of the stormwater from Tauriko West on the Wairoa River after mixing.

Figure 3 following provides an example of the change in contaminant concentrations in the Wairoa River as a result of the development of the Tauriko West area. It is presented as a time series as this provides a better overall appreciation of the changes in contaminant concentrations associated with Scenario 3 when compared to the baseline state.

[14] Rayman, et al. (2024), Table 15, page 45 and Table 16, page 46.

The upper panel shows the daily mean flow in the Wairoa River, adjacent to the Tauriko West area during the same period that the FWMT was run. This is the flow of the water that stormwater discharges from the site would have been mixed with. The mid and lower panels show the daily mean difference between the effect of stormwater from Tauriko West baseline and developed scenarios using a mass balance approach; that is, it is the difference between the baseline and developed scenarios of the concentration of TSS and TN in the stormwater after mixing with the Wairoa River. A negative value indicates that the TSS or TN concentration is lower after mixing with the Wairoa River for the developed area than it was in its current, undeveloped state.

In general, when river flows (and, therefore rainfall) are low, the predicted TSS and TN concentrations in the developed Tauriko West scenario are similar to those of the current, undeveloped Tauriko West area, having a value in the lower plot close to zero. During rainfall events, when river flows are also higher, TSS and TN concentrations in the stormwater are typically predicted to be less in the developed Tauriko West than in the current, undeveloped Tauriko West. This is a due to the change in land use from pastoral/horticultural to urban and the proposed stormwater management resulting in water attenuation and sediment retention.

Similar plots for phosphorus, *E. coli*, copper and zinc are shown on the following pages (Figures 4 and 5), with only the results from zinc showing any increase. However, as indicated in the notes for that plot, the changes are very small in magnitude and are below the analytical level of detection.

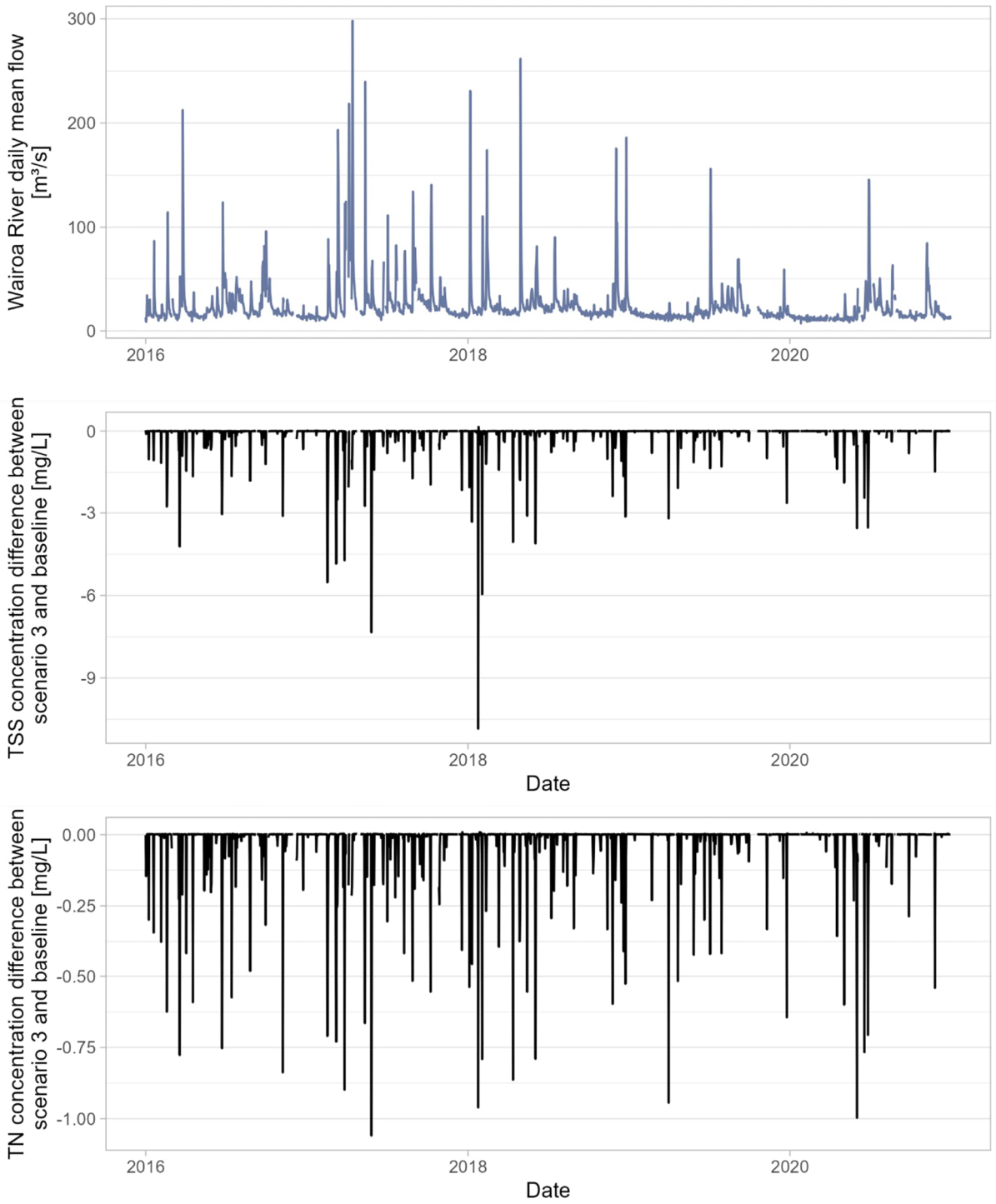

Figure 3: Mean daily flow in the Wairoa River (upper) and predicted change in TSS (mid) and TN (lower) following development

(A negative value indicates a decreased concentration for the development scenario relative to the baseline scenario)

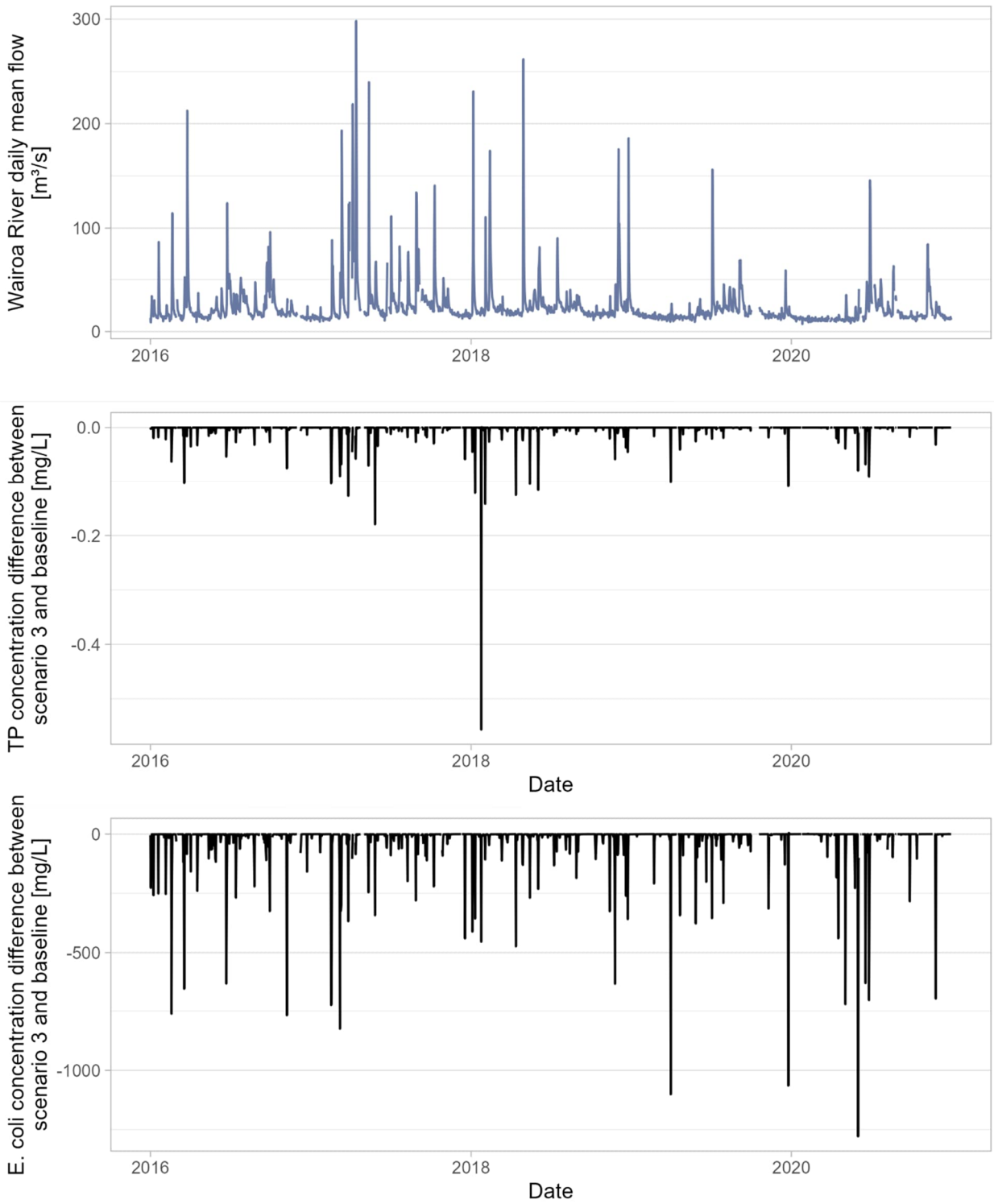

Figure 4: Timeseries plots showing mean daily flow in the Wairoa River (upper) and the predicted change in TP (mid) and *E. coli* (lower) concentrations in the Wairoa River following development.

(A negative value indicates a decreased concentration for the development scenario relative to the baseline scenario)

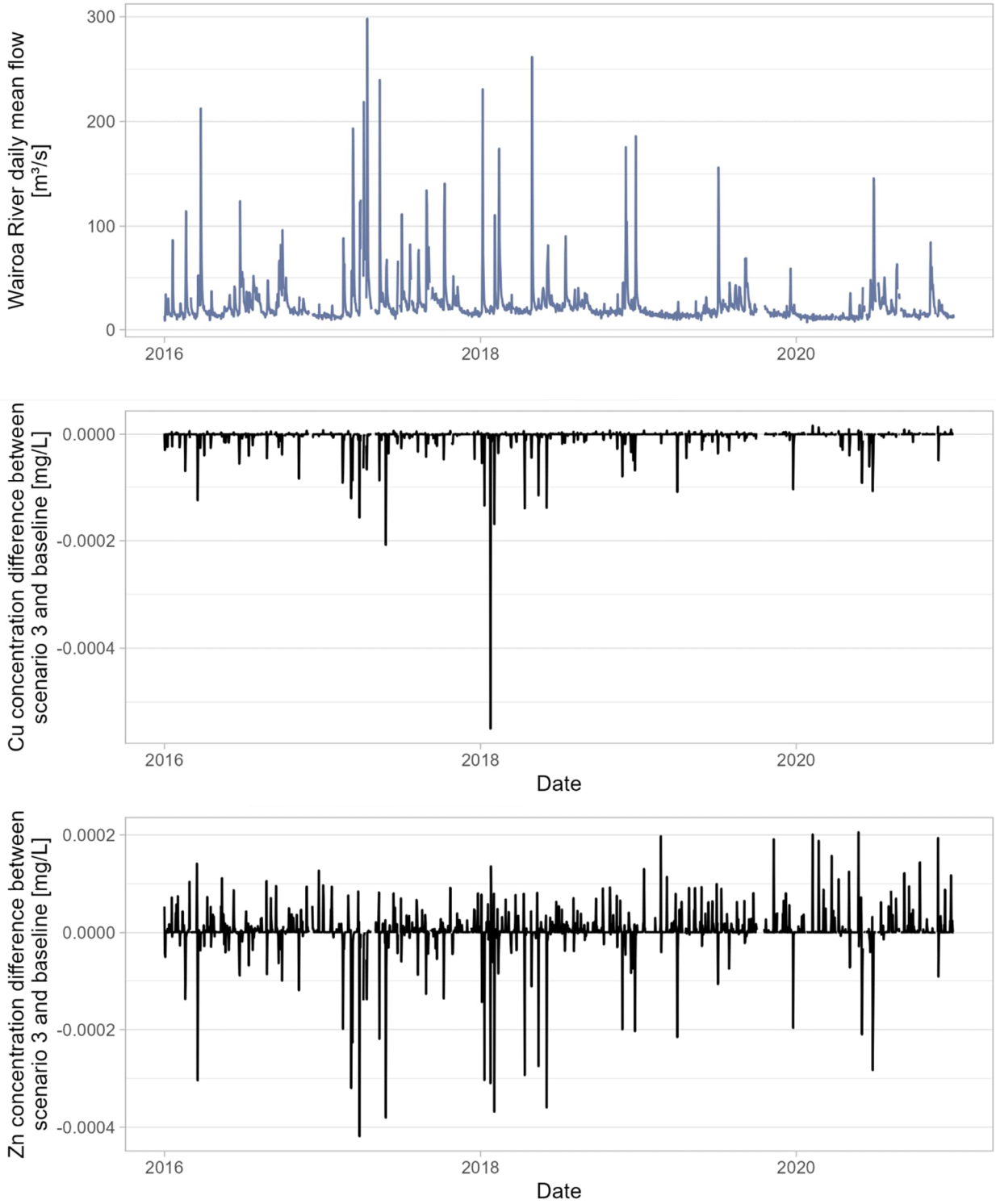

Figure 5: Timeseries plots showing mean daily flow in the Wairoa River (upper) and the predicted change in copper (mid) and zinc (lower) concentrations in the Wairoa River following development.

(A negative value indicates a decreased concentration for the development scenario relative to the baseline scenario) For reference, the laboratory detection limits for copper and zinc are 0.001 and 0.004 mg/L respectively. The changes shown here are at least an order or magnitude less than this.

Data used to create the preceding plots were summarised and tabulated to demonstrate the predicted water quality changes in the Wairoa River resulting from the proposed development area (Table 9). That is, they represent contaminant concentrations in the Wairoa River contributed by the undeveloped and developed Tauriko West area after mixing. Absolute concentrations in the Wairoa River are predominantly influenced by the upstream catchment and would be in addition to the concentrations presented here.

Data were summarised by the assessment unit associated with the appropriate guideline value; that is, *E. coli* was summarised by the 95th percentile, nutrients and TSS by the 80th percentile, and metals by the median. The guideline value for each parameter is shown for context to indicate whether the predicted changes are large or small relative to a meaningful threshold.

The difference in contaminant concentrations when looking at an appropriate percentile better aligns with the predicted improvements of the FWMT listed at the beginning of Section 4 of this report. Relative to the undeveloped scenario, the developed state is predicted to have lower contaminant concentrations (water quality improvements) for all parameters other than metals.

No change is predicted with copper, which differs to the prediction by the FWMT outputs, and is likely due to the use of aggregated daily mean data provided rather than 15-minute increments calculated by the model. The small increase in zinc is as expected by urban development and the model predictions.

Table 9: Contaminant concentrations in the Wairoa River resulting from the stormwater discharges

(after mixing for the baseline and developed scenarios and assuming an upstream concentration of zero (mass balance approach))

Parameter	Assessment unit	Baseline concentration (after mixing)	Developed state concentration (after mixing)	Difference	Guideline value
E. coli (MPN/100 mL)	95th %ile	111	21	-90	540
Total nitrogen (mg/L)	80th %ile	0.0066	0.0064	-0.0002	0.179
Total phosphorus (mg/L)		0.0003	0.0001	-0.0001	0.017
Total suspended solids (mg/L)		0.0179	0.0135	-0.0044	4.2
Copper (total; mg/L)	Median	0.000003	0.000003	0	0.0014
Zinc (total; mg/L)		0.000008	0.000010	0.000002	0.008

4.3 Conclusions

Overall, the FWMT predicts an increase (202%) in surface stormwater volume for the developed Tauriko West area relative to the current, undeveloped area. The change of land use from rural to urban and the proposed stormwater treatment and mitigation measures for the developed area are predicted to result in substantial decreases in key catchment-derived contaminants, including *E. coli*, nutrients, TSS, and copper.

The small effect from Tauriko West stormwater discharges to water quality in the Wairoa River are unlikely to result in changes to water quality state or classifications (e.g., NPS bands for toxicity or ecosystem health) but will contribute to overall improvements in water quality. *E. coli* may be an exception to this, with a potentially measurable decrease of its 95th percentile value by 90 MPN/100 mL. As noted throughout the report the absolute concentrations in the Wairoa River are dominated by upstream sources. The predicted increased zinc concentration in the Wairoa River resulting from the stormwater discharges after mixing is very small (three orders of magnitude/1000 times smaller) than its respective guideline value and highly unlikely to be measurable or detectable above natural variation.