

Whaitua Te Whanganui-a-Tara Expert Panel

Proxy Modelling Catchment Assessment: Addendum

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Purpose:

To provide context to the Expert Panel on the changes in water quality from Transmission Gully (TG) and Petone to Grenada (PTG) highways during Business as Usual, Improved and Water Sensitive Scenarios, for the two selected proxy catchments and their relevant Expert Panel Assessment Units (EPAU):

1. Porirua at Mouth - Groundwater/surface water fed predominantly urban streams and surface water fed predominantly urban streams
2. Horokiri and Motukaraka at Mouth ('Horokiri Mouth') - Mixed rural and Mangaroa/Pakuratahi Valleys.

This builds on the document "Proxy Modelling Catchment Memo RevC_Final" (Blyth 2020), herein referred to as 'Proxy Catchments Memo'.

Overview of Porirua Whaitua reporting and proxy catchments:

Figure 1 (below) presents the Porirua Whaitua modelling catchments, with the two selected proxy catchments highlighted. Model results were reported at a range of catchments (for example, three large subcatchments with their own tributaries were reported on within Porirua at Mouth). The highways (TG and PTG) run through many of the reporting catchments in Porirua, however their impacts on water quality can often be isolated to a few parameters.

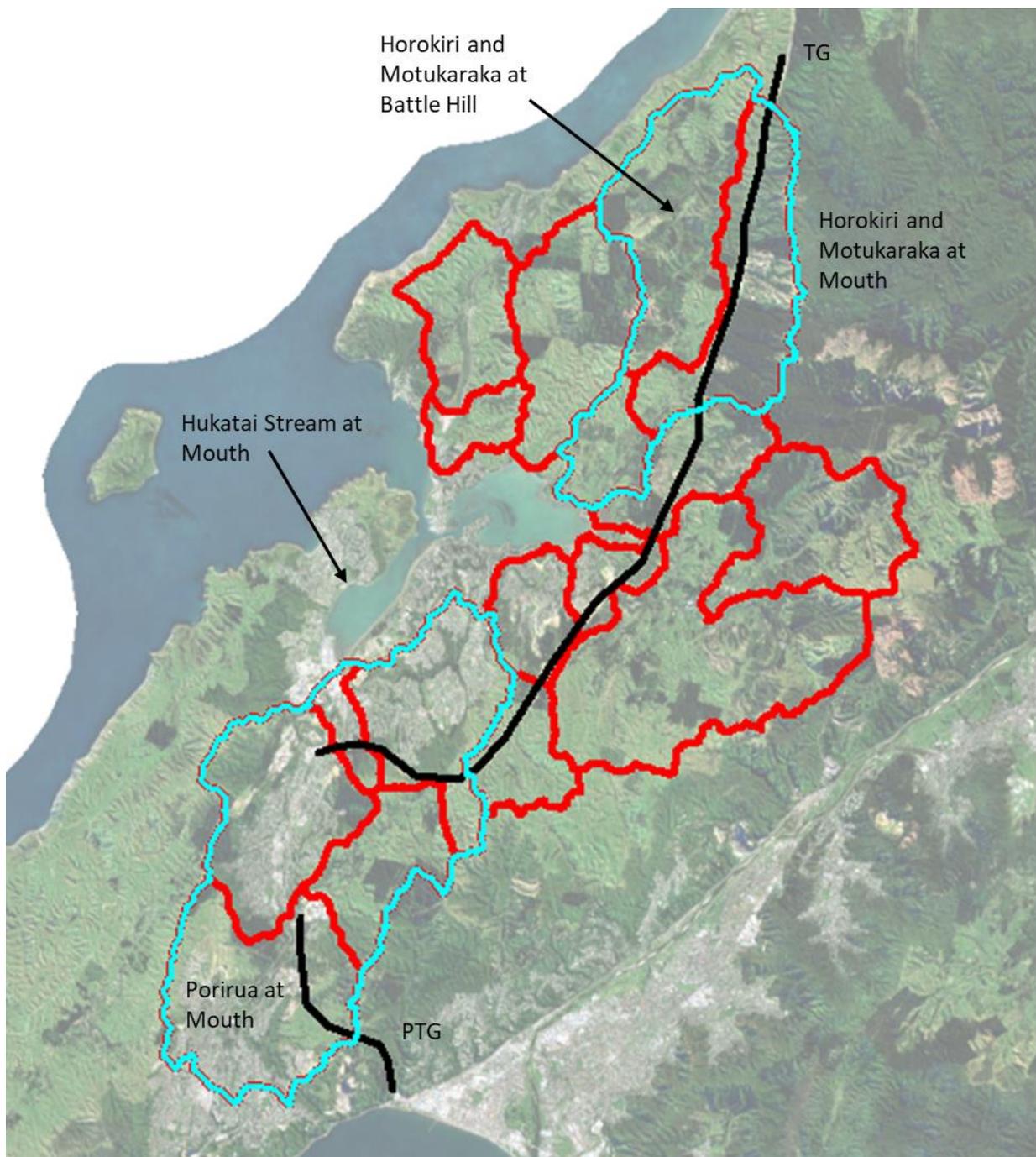


Figure 1. Overview of some of Porirua modelling catchments (red) and selected proxy modelling catchments. TG and PTG approximate locations are presented as black lines. Catchments <5 km² are excluded in this figure.

Horokiri and Motukaraka at Mouth - Mixed rural and Mangaroa/Pakuratahi Valleys.

As documented in the Proxy Catchment Memo (Table A3-1), TG results in a 0.7% increase in the roading landuse within this 33.2 km² catchment.

The primary impacts of TG in this rural catchment are:

1. Increases in Copper and Zinc concentrations through BAU, Improved and WS scenarios. Road treatment mitigations reduce the load through Improved and WS scenarios, however copper remains net positive despite these reductions.
2. Minor increase in runoff from impervious road area (however hard to discern as buffered by mitigations such as pole planting and retirement in the greater catchment. See Table A3-2).
3. No discernible effects on Nitrogen and Phosphorus (and their various species), or suspended sediment concentrations
4. No discernible effects on *E.coli* concentrations.

Horokiri and Motukaraka at Battle Hill ('Battle Hill') is a subcatchment within this proxy catchment (see Figure 1). TG has no impact on this subcatchment, however Improved and WS mitigations such as pole planting and retirement do occur in greater proportions compared to the subcatchment to the east of TG (see Jacobs 2019 Scenario Modelling Report).

Battle Hill results have been presented in Tables 1 to 3 for Copper, Zinc and flow (noting that retirement and pole planting will have affected flow through scenarios in Battle Hill subcatchment). While copper and zinc concentrations do increase because of TG, the attribute state remains as an 'A' under all scenarios.

Table 1. Horokiri/Motukaraka Stream copper concentrations and relative change (%) at 'Battle Hill' subcatchment and 'Horokiri Mouth' proxy catchment through scenarios.

Catchment	Baseline		BAU		Improved		WSUD		BAU		Improved		WSUD	
	Cu median	Cu 95th percentile	% change median	% change 95th percentile	% change median	% change 95th percentile	% change median	% change 95th percentile						
Battle Hill	0.00003	0.00012	0.00003	0.00012	0.00003	0.00011	0.00003	0.00011	0%	0%	0%	-8%	0%	-8%
Mouth	0.00004	0.00013	0.00012	0.00091	0.0001	0.00069	0.00006	0.00032	200%	600%	150%	431%	50%	146%

Table 2. Horokiri/Motukaraka Stream zinc concentrations and relative change (%) at 'Battle Hill' subcatchment and 'Horokiri Mouth' proxy catchment through scenarios.

Catchment	Baseline		BAU		Improved		WSUD		BAU		Improved		WSUD	
	Zn median	Zn 95th percentile	% change median	% change 95th percentile	% change median	% change 95th percentile	% change median	% change 95th percentile						
Battle Hill	0.00007	0.00024	0.00007	0.00024	0.00007	0.00022	0.00006	0.00021	0%	0%	0%	-8%	-14%	-13%
Mouth	0.00008	0.0003	0.00021	0.00158	0.00018	0.0012	0.00011	0.00056	163%	427%	125%	300%	38%	87%

Table 3. Horokiri/Motukaraka hydrological changes (%) from the baseline model, at 'Battle Hill' subcatchment and 'Horokiri Mouth' proxy catchment through scenarios

Catchment	BAU % change						Improved % change						WSUD % change					
	MALF (% change)	Median (% change)	95th Percentile (% change)	99.8th Percentile (% change)	Mean Annual Discharge (% change)	FRE3 Frequency (events per year exceeding FRE3 (% change))	MALF (% change)	Median (% change)	95th Percentile (% change)	99.8th Percentile (% change)	Mean Annual Discharge (% change)	FRE3 Frequency (events per year exceeding FRE3 (% change))	MALF (% change)	Median (% change)	95th Percentile (% change)	99.8th Percentile (% change)	Mean Annual Discharge (% change)	FRE3 Frequency (events per year exceeding FRE3 (% change))
Battle Hill	0%	0%	0%	0%	0%	0%	-5%	-2%	-3%	-4%	-3%	-1%	-5%	-2%	-5%	-7%	-4%	1%
Mouth	2%	1%	0%	0%	1%	0%	0%	0%	-2%	-2%	-1%	-1%	0%	-1%	-4%	-4%	-2%	-1%

Porirua at Mouth - Mixed rural and Mangaroa/Pakuratahi Valleys.

TG and PTG increases in land area for the Porirua at Mouth catchment has been presented in Table 4. This is adapted from Table A2-2 in the Proxy Catchment Memo. The remaining road area increase in this urban catchment is due to infill and greenfield developments (see Table A2-3).

Table 4. Relative (%) change from the baseline landuse for Porirua at Mouth roads, with vehicles per day exceeding 5000.

Roads (vehicles per day)	Relative change (%)	Relative Area increase (ha)
5,000 - 20,000	0.02%	1.1
20,000 - 50,000	0.22%	12
>50,000	0.06%	3.3

Figure 1 shows that both highways impact a large number of the model reporting catchments in Porirua Whaitua, including all of the urban catchments >5km² (smaller than this was excluded from the proxy catchment assessment). The impacts of the highways are similar to the Horokiri and Motukaraka at Mouth proxy catchment, and include:

1. Increases in Copper and Zinc concentrations through BAU, Improved and WS scenarios. Road treatment mitigations reduce the load through Improved and WS.
2. Minor increase in runoff from impervious road area (more significant for greenfield and infill roads due to their larger area than PTG and TG)
3. No discernible effects on Nitrogen and Phosphorus (and their various species), or suspended sediment concentrations.
4. No discernible effects on *E.coli* concentrations.

Trying to discern the impacts of the highways on contaminant concentrations and flows is difficult, as while selecting another urban reporting catchment is possible, their smaller area (than Porirua at Mouth) means the impact on loads from road development is greater, and also harder to tease out amongst the effects of infill and greenfield roads. This was part of the reason Porirua at Mouth was selected, as the large catchment area buffered the effects of highway development in results.

Whilst not included within the proxy assessment work, Hukatai Stream at Mouth (located in Titahi Bay, draining into Porirua Harbour) is a 98 ha small urban catchment that has some minor infill development through scenarios (no greenfield development). This is reporting point 11 in Jacobs 2019 scenario modelling report. This site is not impacted from any highways. The changes in concentrations through scenarios for copper, zinc and flow have been presented for this catchment in Tables 5 to 7 and compared with Porirua at Mouth. This information is presented as a rough guide only, and each panel member should use their own judgement to determine its appropriateness when considering highway impacts.

Table 5. Porirua at Mouth and Hukatai Stream at Mouth copper concentrations and relative change (%) through scenarios.

Catchment	Baseline		BAU		Improved		WSUD		BAU		Improved		WSUD	
	Cu median	Cu 95th percentile	% change median	% change 95th percentile	% change median	% change 95th percentile	% change median	% change 95th percentile						
Porirua	0.00109	0.00477	0.0012	0.00479	0.00116	0.00404	0.00089	0.00371	10%	0%	6%	-15%	-18%	-22%
Hukatai	0.00076	0.00376	0.00079	0.00392	0.00079	0.00384	0.00078	0.0039	4%	4%	4%	2%	3%	4%

Table 6. Porirua at Mouth and Hukatai Stream at Mouth zinc concentrations and relative change (%) through scenarios.

Catchment	Baseline		BAU		Improved		WSUD		BAU		Improved		WSUD	
	Zn median	Zn 95th percentile	% change median	% change 95th percentile	% change median	% change 95th percentile	% change median	% change 95th percentile						
Porirua	0.00808	0.03623	0.00779	0.03338	0.00453	0.01925	0.00164	0.00695	-4%	-8%	-44%	-47%	-80%	-81%
Hukatai	0.00259	0.01298	0.00264	0.01323	0.00203	0.01006	0.00142	0.00712	2%	2%	-22%	-22%	-45%	-45%

Table 7. Porirua at Mouth and Hukatai Stream at Mouth hydrological change (%) through scenarios.

Catchment	BAU % change						Improved % change						WSUD % change					
	MALF (% change)	Median (% change)	95th Percentile (% change)	99.8th Percentile (% change)	Mean Annual Discharge (% change)	FRE3 Frequency (events per year exceeding FRE3 (% change))	MALF (% change)	Median (% change)	95th Percentile (% change)	99.8th Percentile (% change)	Mean Annual Discharge (% change)	FRE3 Frequency (events per year exceeding FRE3 (% change))	MALF (% change)	Median (% change)	95th Percentile (% change)	99.8th Percentile (% change)	Mean Annual Discharge (% change)	FRE3 Frequency (events per year exceeding FRE3 (% change))
Porirua	6%	3%	2%	4%	4%	5%	5%	2%	1%	3%	2%	-2%	-3%	-5%	-6%	-4%	-4%	6%
Hukatai	0%	0%	0%	0%	0.01%	0.81%	0%	0%	0%	0%	-0.03%	0.81%	0%	0%	-2%	-1.4%	-2.3%	-0.8%