WAKA KOTAHI WELLINGTON STATE HIGHWAY STORMWATER MONITORING PLAN

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ABSTRACT

There are ~808 km of state highway across the Wellington Region. This includes five operational State Highways and a mix of both old and newly operational sections of highways. The Greater Wellington Regional Council (GWRC) introduced a two-stage consenting regime for the discharge of stormwater from the state highway network. The regime requires a 'global' approach for stormwater discharges from state highways.

In a first for New Zealand, GWRC granted a global discharge consent (October 2022) to Waka Kotahi that authorizes the discharge of stormwater from routine operational use of the state highway network across the Wellington region. This excludes discharges from construction and maintenance activities, and associated with slips and accidents).

Stage one (5-year duration) is largely an information gathering phase to fill knowledge gaps. It requires the monitoring of the quality of stormwater discharging from the state highway network to fresh and/or coastal waters. It does not consider hydrological impacts.

Stage two of the consenting regime requires the development of a long-term strategy for managing the effects of operational discharges, taking account of wider policy drivers set out in the PNRP. The aim is to develop catchment specific stormwater management plans that address the management of cumulative effects (on aquatic ecosystem health, mahinga kai, contact recreation, and Māori customary use).

The intention behind the two-stage consenting regime is that monitoring undertaken during Stage one will inform the development of a prioritised programme for improvements in the Stormwater Management Strategy (SMS) required by Stage two.

The paper describes the method for selecting priority sites for monitoring operational stormwater discharges from Wellington Region's state highway network. It considers the logistics of site access since the target zones are subject to vehicles travelling at high speed. It has applied information from a range of databases to identify priority catchments and monitoring sites. This includes state highway stormwater assets from the Waka Kotahi, current monitoring and consents across the catchments, relevant schedules for ecological and cultural significance and sensitivities, hydrological processes of the sub-catchments, and a simple contaminant load model (using vehicle telemetry data).

Data were arranged in a spatial webmap to identify key interactions, and to assist in developing a prioritization framework for selecting representative monitoring sites.

More difficult and complex issues needed to be integrated into the SMP. These included the opening of the new sections of the SH1 network e.g., Transmission Gully Motorway and the Mackays to Peka Peka and Peka Peka to Ōtaki Expressways. With the older sections of SH1 pending revocation, the SMP has incorporated both the new and old sections of the SH network.

KEYWORDS

Wellington State Highway Network, Contaminant Load Model, Wellington Proposed Natural Resources Plan, Adaptive Management

PRESENTER PROFILE

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1 INTRODUCTION

Waka Kotahi NZ Transport Agency (Waka Kotahi) is a New Zealand Crown entity tasked with promoting safe and functional transport by land, including the responsibility for driver and vehicle licensing, and administering the New Zealand State highway network. Waka Kotahi operate and manage the state highway roading network within the region and are responsible for the discharge of stormwater from the state highway network.

Waka Kotahi was granted a global stormwater consent (GSC) in October 2022 under the new generation stormwater policy framework administered by the Greater Wellington Regional Council (GWRC). This consent forms the Stage One consent of the framework, and is effective for a five year period, under Rule R50 of the proposed Natural Resources Plan (PNRP). PNRP Rule R50 requires monitoring of stormwater discharges and reporting on the quality of the discharges authorised under that rule. At a high level, the purpose of the monitoring under Rule R50 is to:

1. Gather data to understand the actual and potential effects of stormwater discharges on the various receiving environments; and
2. Develop information to support the creation of a draft Stormwater Management Strategy (SMS). This draft SMS will be required to support the second stage application for resource consent that will be approximately 5 years in the future.

The five-year term of the Stage One GSC is considered an appropriate term to enable sufficient monitoring of stormwater discharges to inform a Stage Two consent application with the purpose of developing a Stormwater Management Strategy (SMS). The Stage 2 consent is intended for a longer period, and requires the implementation of strategic measures to be identified and implemented to ensure improved outcomes for freshwater quality.

Although the state highway network comprises an established series of highways throughout the country, it is not a static network. Existing sections of state highway are modified and upgraded, new portions of highway are created, and some stretches of highway are decommissioned or transferred to local authorities (also referred to as revocation). The nature of the state highway network therefore changes over time. This is the case in the Wellington Region, with significant new parts of the network having been recently commissioned (Figure 1). These new portions of state highway include Transmission Gully and Peka Peka to Ōtaki. Similarly, some current sections of the state highway will be revoked, and Waka Kotahi will hand over responsibility to the local council authority (this will occur with a portion of 'old' State Highway 1 now superseded by the new MacKays to Peka Peka (M2PP) section of State Highway 1).

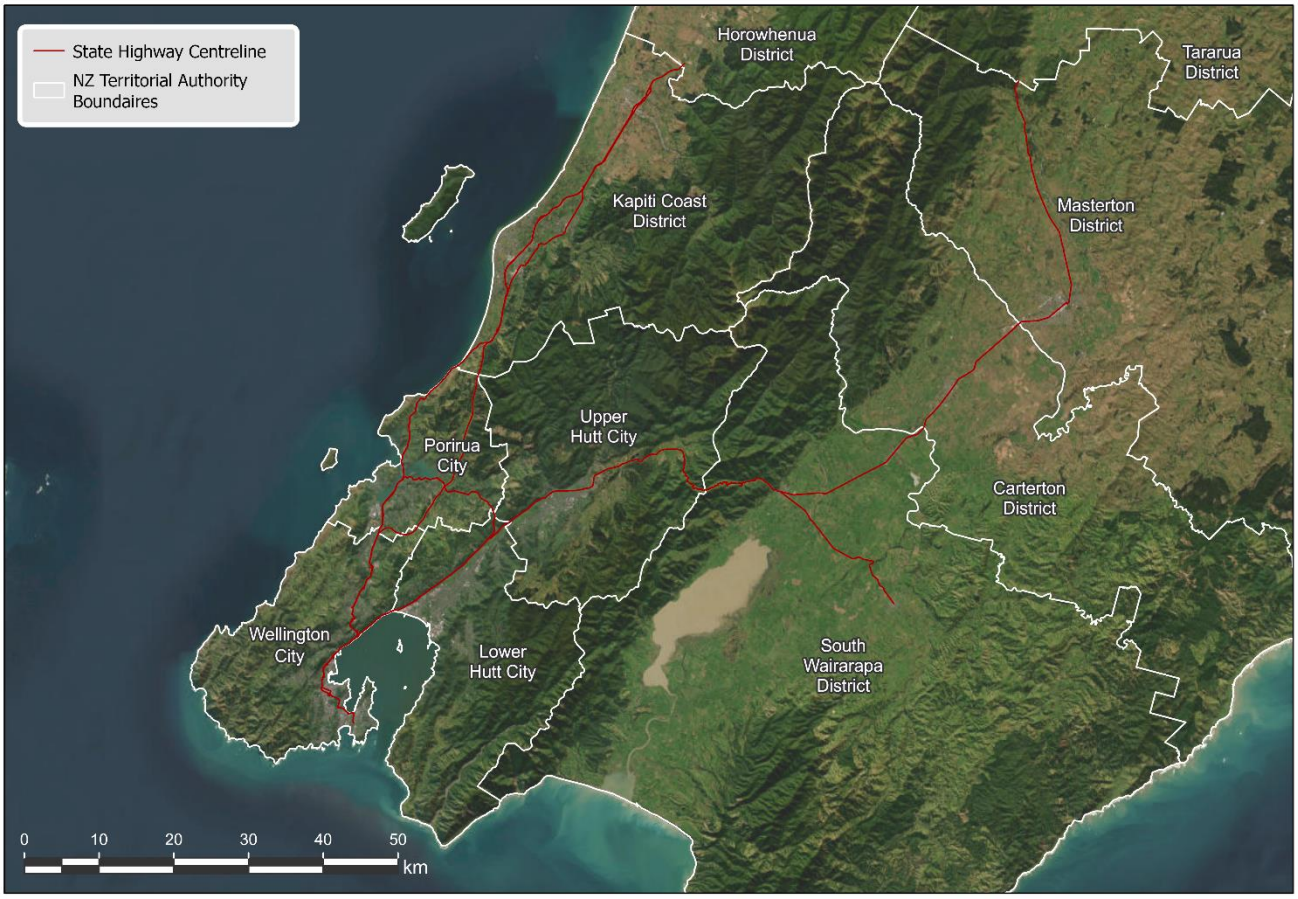


Figure 1 Overview of the State Highway Network in the Greater Wellington Region

Both Transmission Gully (TG) and Peka Peka to Ōtaki (PP2O) have their own stormwater management regimes, approvals and monitoring plans. However, they have not to date been consented pursuant to Rule R50 of the PNRP. Given they are ultimately just part of a wider network, the GWRC (as consenting authority) considered it appropriate to include these portions of state highway in the global SMP. In effect, the existing management/monitoring plans will be wrapped within the scope of the global consent and not require different approvals under another rule.

Stormwater is defined in the PNRP as "Runoff that has been intercepted, channeled, diverted, intensified or accelerated by human modification of a land surface, or runoff from the external surface of any structure, as a result of precipitation and include any contaminants contained therein."

Stormwater Network is defined in the PNRP as "the network of devices designed to capture, detain, treat, transport and discharge stormwater, including but not limited to kerbs, intake structures, pipes, soak pits, sumps, swales and constructed ponds and wetlands, and that serve more than one property."

The discharge of stormwater from the operation of the state highway network includes discharges during the day-to-day operation from all areas of the network. These include discharges direct to land, direct to surface water or discharge to a piped stormwater network managed by territorial authorities. For simplicity throughout this paper, the term 'receiving environment' has been applied to describe the land, surface water body, or council piped network to which stormwater from the state highway is discharged. It is recognised the term 'receiving environment' is generally used in a broader context to

describe wider catchments areas, but for this paper the intent is to distinguish between the three main receptors for stormwater originating from the state highway.

Depending on the proximity of these receiving environments to the state highway discharge point(s), potential contaminants[1] associated with discharge can be transported and attenuated via various pathways:

- Discharge to land, such as to swales and verges, will enhance soakage of stormwater to land;
- Discharge to surface water bodies – such as via direct discharge, or overland flow entering a surface water body, will undergo dilution in the water column, dispersion to downstream environments, and potentially deposition of sediment/particulate bound contaminants in depositional prone areas if present;
- Discharge to a piped network of a local council authority is assumed, for the purpose of this consent application, to be an authorised discharge under existing or pending council held global stormwater discharge consents.

1.1 CURRENT STORMWATER MANAGEMENT AND EXISTING MANAGEMENT

Waka Kotahi have developed a stormwater treatment standard (Waka Kotahi 2010) for the state highways to help meet their commitments to water resources. It is also the primary design guideline for the operation and maintenance of stormwater treatment infrastructure and devices.

Stormwater is managed under the BOI direction across TG, M2PP, PP2O. This given the current schedules and contractual arrangements in place, these processes are recognized under the 'umbrella' of the global consent process, and are not re-litigated for the purpose of the SMP. Rather, at the completion of those programmes, any available monitoring data will be compiled with that collated under the parallel consent process.

1.2 THE CONSENT

Under consent WGN220179[38030] & [38031], Condition 2 requires a detailed stormwater monitoring plan to be submitted within six months of the consent being granted. Condition 3 (see box 1) sets out the requirements of the consent.

Information garnered during the short-term, five-year Stage One consent process is intended to fill any information gaps required for setting out the Stage Two, long term SMS, noting here that there are specific information requirements for the Stage Two specified in Schedule N of the PNRP. This Schedule also includes, by reference, any Whaitua specific requirements that have been identified during the course of NPSFM implementation, and subsequent plan changes.

[1] For this monitoring plan, key stormwater indicator contaminants are total suspended sediment, total copper, total zinc, and total petroleum hydrocarbons.

Box 1

Resource Consent WGN220179[38030][38031],

Condition 3

The purpose of the SMP is to set out the monitoring and other information-gathering necessary to inform the development of the long term Stormwater Management Strategy for the State Highway Network required by Condition 8.

The SMP shall include at a minimum the following detail:

a) Monitoring objectives;

b) Stormwater discharge, freshwater and coastal receiving water and soil sampling locations, and methodology and frequency for each proposed location including:

i) Rationale for the selection of each site, that includes a desktop assessment of traffic volumes/counts along stretches of the state highways to determine likely contaminant hot spots across the entire state highway network location within Wellington Region. This assessment shall include, for each site selected, estimated traffic volumes/counts along the section of state highway located in the upstream contributing catchment.

Note: Traffic volumes are one of a number of factors which will be considered during site selection. Other factors such as health and safety considerations and corridor topography will also be considered.

ii) Identification, where practicable, of at least two sites where autosamplers shall be used for stormwater discharge monitoring (allowing flow weighted event mean concentrations/mass calculation) and details of sampling events. In the event the consent holder cannot identify two or more sites where autosamplers are to be used they shall provide a site assessment report that includes a list of surveyed sites, their exact location as well as photos and the reasons why the use of autosamplers are not appropriate for each site.

Note 1: as opportunities to use autosamplers are limited in a state highway environment, the consent holder shall consider opportunities for their use based on the following criteria:

- *highway corridor environment including TTM requirements, speed zone and volume of vehicles etc*
- *site accessibility*
- *safety (for workers and customers)*
- *cost and resource implications*
- *its relevance (i.e. if there are any other alternative options which could provide a similar result)*

Note 2: The consent holder should aim to monitor 4 stormwater discharge sites with at least 6 storm events monitored at each site.

iii) Engagement with iwi across the Wellington Region to confirm any sampling sites of cultural significance, including mahinga kai, guided but not limited by, locations identified in Schedule C of the Proposed Natural Resources Plan and how iwi will be involved

Note 1: The requirements of condition 6 will need to be complied with in regard to anyone undertaking monitoring.

Note 2: At the time of granting this consent the consent holder had agreed with Ātiawa ki Whakarongotai Charitable Trust and Nga Hapu o Otaki that they will be involved in monitoring under this consent.

Note 3: Any commitment of the consent holder to resourcing iwi's involvement in monitoring under this consent is a matter to be agreed between the consent holder and the relevant iwi.

ed in monitoring (where this has been agreed to).

c) Water quality, and sediment quality parameters and associated in-situ measurement and laboratory test methods;

d) Key metadata and other supporting information that is to be collected, including weather conditions, field observations and photographs;

e) A copy of any final Stormwater Management Plans (as required by the Board of Inquiry consents) for Transmission Gully and Peka Peka to Otaki Expressway (once operational).

Note: Separate monitoring requirements for the purposes of this consent will be developed for Transmission Gully and Peka Peka to Otaki (once operational) and included in the SMP required under condition 2. The management plans to be provided under 2(e) are for information purposes only and their certification is not required under this consent.

f) Linkages with other existing resource consents and/or monitoring programmes and details of how the consent holder will engage with stakeholders and consent holders to discuss opportunities for linkages with other existing resource consents and/or monitoring programmes;

g) A schedule of proposed monitoring for year 1 of the consent term and an indicative schedule of proposed

2 APPROACH TO IDENTIFYING MONITORING SITES

The focus for the development of the SMP is on the discharges to surface water bodies. These receiving waters represent the areas susceptible to the highest potential chronic risk of adverse effects of contaminants discharged from state highway runoff. Whilst discharge to land has been assessed as receiving a relatively high proportion of the theoretical annual average contaminant load (see below), available evidence demonstrates that for large sections of state highway receiving road drainage discharging to roadside drains, contaminant attenuation and load reduction is significantly enhanced by vegetated swales and roadside drains (by up to 70-90%). Any subsequent discharge of contaminants to water, following discharge to land, are either retained in the stormwater treatment device or roadside drain, or undergo significant attenuation that is variable both temporally and spatially. Interspersed with upper catchment effects, indirect effects of contaminants discharged from state highway runoff on groundwater systems are difficult to separate out from the influence of upper catchment sources.

A process to identify potential hot-spots of stormwater contaminants discharging to sensitive surface water bodies was developed. This was to ensure the key criteria in meeting the information requirements in Schedule N could be addressed, including alignments with the requirements to report on water quality that may impact on attributes both in the GWRC Water Objectives as well as the NPSFM NOF attribute requirements.

2.1 WEBMAP DEVELOPMENT

A Wellington Region basemap was constructed to include a series of data sources as follows:

- GWRC NRP Scheduled sites with focus on Category 1 surface water bodies[2], as well as Schedule A (outstanding water bodies), Schedule C (sites with significant mana whenua values), Schedule F (ecosystems and habitats with significant indigenous biodiversity values);
- GWRC environmental monitoring data sites, rivers and streams, SLUR sites, and catchment boundaries;
- Local council stormwater asset data; (KCDC, WWL, MDC, SWDC);
- Sub-catchment boundary data (i.e. same spatial scales for sub-catchments applied across other global stormier consents in the Wellington Region); and
- Waka Kotahi RAMM stormwater asset data.

Sub-catchments were on the same (for Kāpiti Coast and Wellington Water GSC) or similar (MDC) spatial scale as those catchments used for the local council GSCs. For areas where these sub-catchments had not been identified (Soth Wairarapa District Council, SWDC) or were by spatial comparison too difference (Carterton District Council, CDC), the urban footprint of the townships themselves was used as the sub-catchment.

[2] Under the PNRP, Category 1 surface water bodies includes, and is limited to the following parts of a surface water body or the coastal marine area:
(a) outstanding water bodies identified in Schedule A (outstanding water bodies), and
(b) sites with significant mana whenua values identified in Schedule C (mana whenua), and
(c) inanga spawning habitat identified in Schedule F1b (inanga spawning habitats), and
(d) habitats for indigenous birds in rivers identified in Schedule F2a (birds-rivers), and
(e) significant natural wetlands identified in Schedule F3 (identified significant natural wetlands), and
(f) estuaries identified in Schedule F4 (coastal sites), and
(g) within 1,000m upstream of a surface water abstraction site for a community drinking water supply shown on Map 39.

Waka Kotahi provided their in-house stormwater asset data associated with the operation of the national state highway network. This data set was regarded as 'interim' given there are recognized gaps in the data base that will take time to resolve.

Data were supplied as follows:

- Drainage lines (stormwater pipes, culverts, drains, 'other' features);
- Sumps/manholes/catchpits/soak pits/culverts;
- Drainage ponds (constructed treatment wetlands, drainage pads etc installed for new sections of the state highway);
- Surface water channels; and
- Carriage width.

2.2 DECISION CRITERIA (DRAINAGE, CLM & NRP DATA)

To assist in the identification of priority sites, several additional data layers were created. These included the development of a 'receiving environment', whereby the likely drainage of the stormwater from the state highway was assigned a category. This data layer was combined with outputs of a simplified contaminant load model (CLM) for the purpose of identifying specific areas of the sub-catchment receiving potentially higher contaminant loads. This data was then overlayed with information about the sensitivities across the catchments to identify monitoring priorities.

2.2.1 RECEIVING ENVIRONMENT OF STORMAWATER

A data layer representing categories that receive any stormwater draining from the state highway network was created. This was to facilitate the process to distinguish where stormwater was likely to discharge to a surface water body (thus identifying the highest priority), versus where it would likely discharge to a council pipe (and thus be managed under that respective council's GSC), or where the stormwater probably discharged to land (where it would undergo attenuation, and potentially migrate to groundwater over time).

For Waka Kotahi's Road Asset and maintenance Management (RAMM) data, interactions with other features (surface water courses, council pipes) and indications of drainage to intersecting features were assessed on a manual basis to assign a category across the state highway to which the stormwater was likely to drain to. For simplicity, only three categories were identified, given the main purpose of this step was to identify where discharge was likely to occur to a surface water body. It was also important for the following step in identification of contaminant 'hot spots', as drainage to a council pipe meant that the stormwater was accounted for under that council's GSC, and any drainage to land was not considered as high a priority for monitoring.

Categories assigned across the state highway were:

- Discharge to a surface water body (blue colour coded)
- Discharge to a council piped network (green colour coded)
- Discharge to land (yellow colour coded)

Figure 2 displays the state highway categorization across the entire network. Figure 3 displays a close up for the Ngauranga sub-catchment in the Wellington City region, showing the assignment of the SH1 and SH2 across the Ngauranga interchange, based on the interaction of the RAMM data with WCC piped network, and the discharge to the coastal marine area.

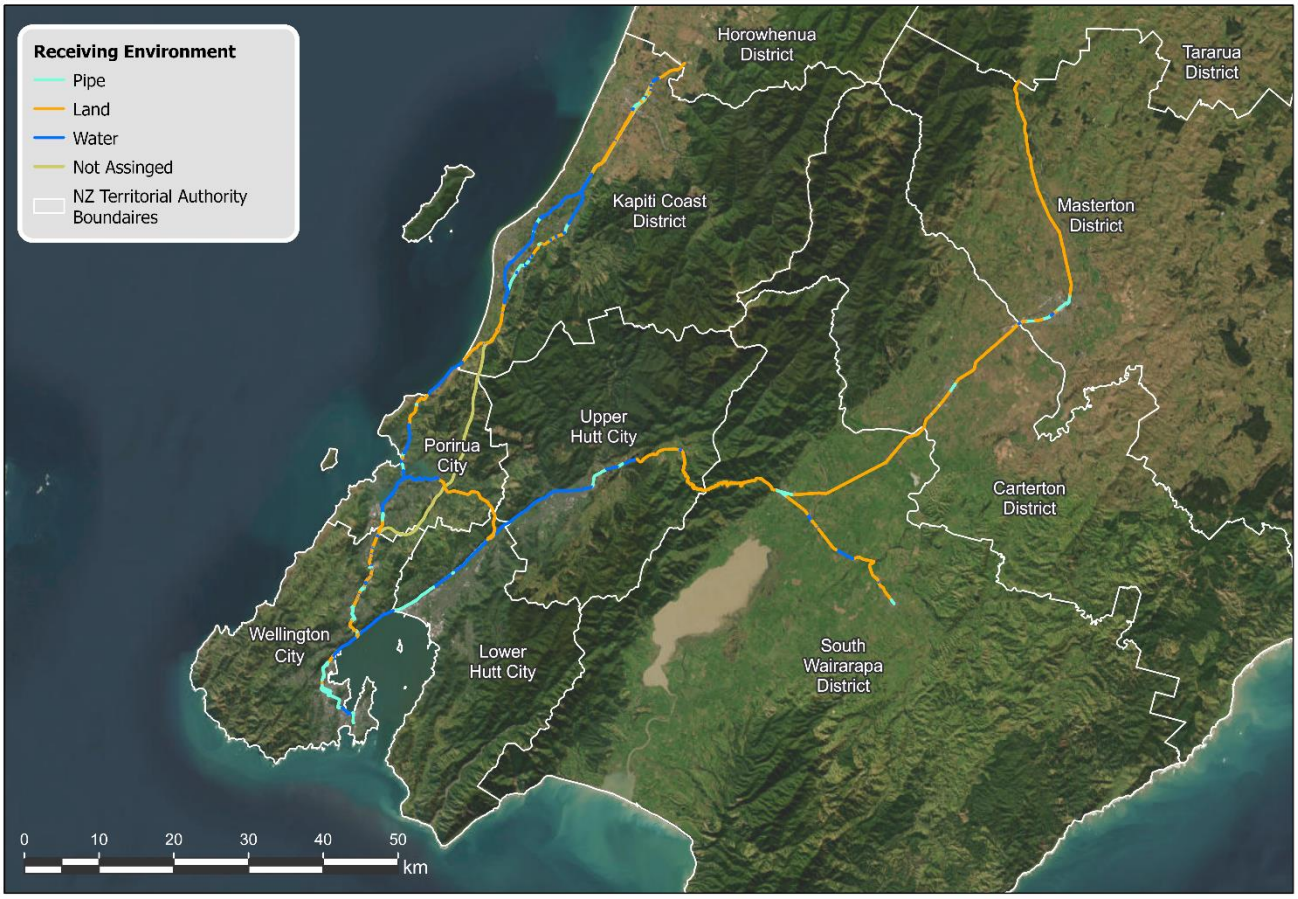
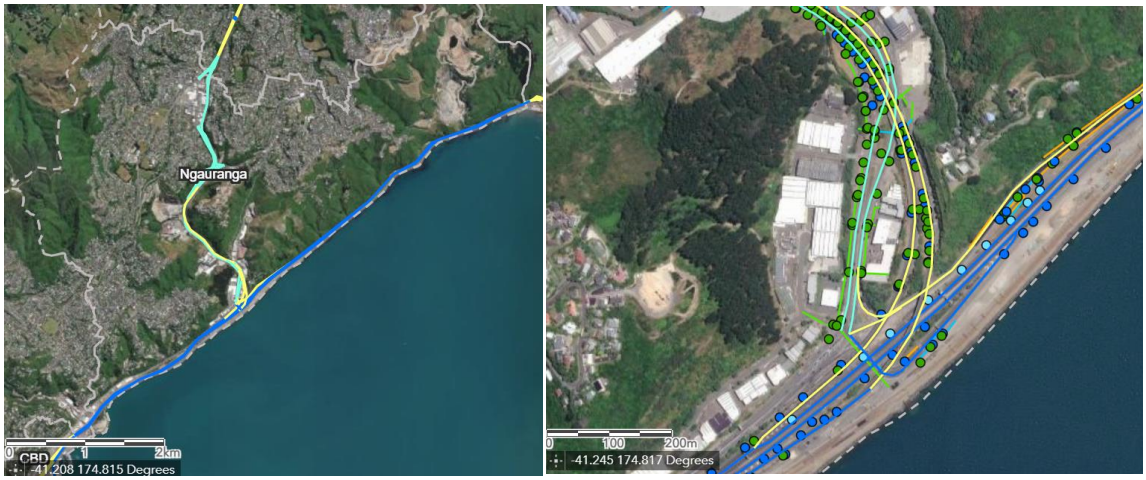


Figure 2 State Highway Network categorized into 'receiving environment' type. Note Transmission Gully categorization is in progress and will be updated for the final SMP.



A B

Figure 3 Webmap screen shot of the Ngauranga sub-catchment in the Wellington City region A: showing a mix of stormwater discharge to land (yellow), council piped network (green), and discharge to a surface water course (blue), and B: individual centrelines and associated stormwater asset features of the network. Screenshot from Waka Kotahi / SLR webmap.

2.2.2 CONTAMINANT LOAD MODEL

A simplified approach to assigning contaminant load bandings and identifying potential 'hot spots' of stormwater contaminants was applied using the Auckland Council's Contaminant Load Model (CLM)(ARC 2010). The use of the CLM was for the identification of key areas of the state highway network contributing to overall sub-catchment contaminant loads. It was not intended that the data is indicative of the *net* amount reaching and surface water body or council asset, given other aspects of the model such as stormwater treatment device, and contaminant attenuation, were not evaluated. It is also acknowledged that more complex risk-based models (e.g. NIWAs Road Stormwater Screening Model) are available for the purpose of identifying specific risk areas by combining catchment land use, and factoring in pathway attenuation, traffic congestion and non-road pollution sources. Given the scope of the Rule R50, a more simplistic approach was considered appropriate for the intent to inform the SMP.

For the purpose of representing the contaminant load across the spatial area of interest of the sub-catchment, the impervious area of the state highway network is accounted for in the load calculations, to generate a yield factor per unit area. Contaminant export coefficients for total suspended sediment (TSS), total zinc (TZn), total copper (TCu) and total petroleum hydrocarbons (TPH) were obtained from the CLM (2006, v2), and applied to the state highway data.

By the nature of the CLM, load (kg/year) is driven by the area/footprint of the carriage way, combined with the vehicle per day (VPD) count data. Thus to 'normalise' sub-catchment loads to comparable areas only reveals the catchment contaminant yields on a per unit area. Given the spatial area of interest are the potentially sensitive receiving environments, the contaminant yields were aggregated initially on a sub-catchment basis to assist in the prioritization process, and later on a road segment basis to identify and confirm potential 'hot-spots' within a sub-catchment itself.

Annual average contaminant loads represented as percentile bands (as categorized from the total annual contaminant loads kg/year) for each section of the state highway within each sub-catchment are shown in Figure 4.

Contaminants discharging to each identified receiving environment type (assigned as discharge to land, surface water, or council pipe) was also calculated, and are listed as proportional discharge of the calculated raw contaminant loads (annual average) in Table 1.

Figure 4 Relative proportion of contaminant loads across the State Highway Network, represented as 20th percentile bands. Screenshot from Waka Kotahi / SLR webmap. Note – at the time of preparation does not include Transmission Gully or current PP2O as AADT is not yet available, to be updated pending data updates.

Table 1: Proportion (%) of contaminant load discharging to land, council pipe, or surface water body across eight local councils in the Wellington Region.

Council	Load to Land (kg/y)	Load to Pipe (kg/y)	Load to Water (kg/y)	Total Load (kg/y)
Carterton	1.7	0.2		1.9
Hutt	1.0	5.5	7.2	13.7
Kāpiti	8.3	2.3	7.3	18.0
Masterton	3.0	1.1	0.1	4.2
Porirua	13.6	2.3	9.7	25.7
SWDC*	6.2	0.6	0.2	7.0
Upper Hutt	3.9	1.2	0.4	5.5
Wellington	3.7	10.1	10.2	24.0
Total Proportional Discharged	**41.4**	**23.4**	**35.2**	**100**
Total Suspended Sediment (kg/year)	**25,527**	**4,538**	**18,102**	**48,166**
Total Copper (kg/year)	**64**	**36.2**	**54.4**	**154.6**

Council	Load to Land (kg/y)	Load to Pipe (kg/y)	Load to Water (kg/y)	Total Load (kg/y)
Total Zinc (kg/year)	**192.2**	**108.4**	**163.2**	**463.8**
Total Petroleum Hydrocarbons (kg/year)	**1454.4**	**820.5**	**1234.5**	**3509.4**

*SWDC is currently the only council that does not have a global stormwater consent in place (noting this is now managed by Wellington Water Ltd). Hutt, Upper Hutt, Porirua and Wellington are managed under the current WWL GSC, Kapiti holds its own GSC, MDC and CDC were recently granted GSC.

Discharge to land was found to represent the highest proportional discharge of contaminants, followed by surface water receiving environments, then council pipes. Across the council areas, Porirua represents the area receiving the highest proportional contaminant load (prior to attenuation or treatment). Similarly, across the receiving environment categories, discharge to water was highest across the Wellington City region, closely followed by Porirua. Council areas across the Wairarapa, as well as Upper Hutt, received proportionally lower contaminant loads compared with other councils.

2.2.3 INTERSECTIONS WITH SENSITIVE RECEIVING ENVIRONMENTS

For the initial stage of identification of sensitive receiving environments that intersect with potentially higher contaminants across a sub-catchment, data were sorted based on the sub-catchment basis as follows:

- Sub-catchments identified where sites contained a Schedule site of key interest (and noting what the Schedule site of interest was) that intersected with the state highway, or where the Schedule site was identified as in close proximity down gradient of the state highway;
- For sub catchments were ranked for areas with the highest proportional contaminant loads discharging to a surface water body;
- Data from the first two steps above were combined to identify sub-catchments where surface water received proportionally higher contaminant loads, and where this intersected with a Schedule site of significance.

Receiving environment priorities were determined by assessing the priorities for the SMP as high, medium, low, which combined the outputs of the CLM with a qualitative assessment about the representativeness of the sub-catchments and overlapping sensitivities as identified against the PNRP schedules. For sub-catchments that were identified as proportionally lower range of contaminant load, but where the state highway was in proximity or intersected with a Category 1 Surface water Body, this was assessed as a medium to high priority on the basis of the significance of the water body.

3 PRIORITIES FOR MONITORING

The outcomes of the prioritization process are listed in Table 2. This indicates that sub-catchments were also identified that had comparatively lower contaminant load bandings, but where the state highway intersected with sensitive receiving environments (in particular Category 1 surface water bodies) was identified.

Table 2: Proportion (%) of contaminant load discharging to land, council pipe, or surface water body across eight local councils in the Wellington Region.

Catchment name	Load Banding (Quartile)	Priority for Monitoring
Porirua		

Catchment name	Load Banding (Quartile)	Priority for Monitoring
Duck (SH58 and TG)	1	**High priority** – SH58 is a lower contaminant load generating section of the SH, but is downgradient of TG, and is adjacent to Schedule A Water Body / Salt marsh area. Options to include coordinating sampling at Duck Creek/Browns Bay with the existing GSC which currently includes metals (Cu, Zn) , as well as TG monitoring. Rain Gauge: Duck Creek at James Cook Reservoir
Pauatahanui (SH 57 and TG)	2	**High priority** – lower to medium contaminant load band for the section of the SH58, but as with the Duck Creek catchment, it is intersected by the TG motorway,a nd is adjacent to Category 1 surface water body. Targeted grab or Nalgene bottle sampling area is the Pauatahanui Stream down gradient of the main roundabout. Coordinate with TG treatment device locations to identify site for autosampler to be installed.
Kakaho (SH59)	3	**High priority** – medium contaminant loads, but is adjacent to Category 1 surface water body at Pauatahanui Inlet. Currently no relevant other GSC sites. Target sampling along coastal discharge outlets at Paremata Beach is possible at outlets draining the SH, with the use of Nalgene samplers
Porirua Harbour / Aotea (SH59)	3	**High priority** - medium contaminant load, but multiple interactions with a range of Scheduled sites of significance including Porirua Stream Mouth, Okowai (Papakowhai) Lagoon are adjacent to SH. SNW (Romesdale Lagoon, Papakowhai Bush) are also adjacent to SH SNW lagoon sites. Option to coordinate Porirua Stream site(s) with existing GSC. Rain Gauge options: Met Station at Porirua Elsdon Park AWS, Porirua Stream at Tawa Junction
Taupo (SH59)	3	**High priority** – medium contaminant load, but adjacent to Taupo Swamp Complex, a Category 1 surface water body. Currently no relevant GSC sites Option to assess an upper and lower Taupo Swamp Complex site to assess gradient along Taupo Stream. Identification of drainage pipes to the swamp complex to confirm if suitable for Nalgene first flush samplers to be installed. Rain Gauge: Taupo Stream at Whenua Tapu
Kāpiti		
Mazengarb Stream	2	**Medium priority** – medium contaminant load, but of high interest and significance for iwi. SNWs are not adjacent to SH, but catchment includes both the SH59 and SH1 (M2PP). No relevant current with KCDC GSC (historic site only) Noted that Mazengarb Stream is impacted by various catchment activities – including Otaihanga Landfill and urban runoff. Options for culvert/catchpit sampling to be investigated. Coordination with iwi for cultural monitoring are being investigated
Waimeha River	1	**Medium priority** – low contaminant load, but adjacent to SNW, Category 1 surface water body. No current KCDC GSC sites Option to include Waimeha Stream crossing (north boundary of sub-catchment), El Rancho Mānuka Wetland.
Wharemauku Stream Catchment	2	**Medium priority** – discharges to Wharemauku Stream, No relevant GWRC RWQE sites or KCDC GSC sites Freshwater sites only to be targeted.
Waikanae River	3	**High priority** – adjacent to SNW on the border with Waimeha River Catchment, Waikanae River discharges to Waikanae Saltmarsh and Estuary. Options to include site on the Waikanae River downstream of new SH1, and use the existing GWRC RWQE (SOE) site as upstream reference site (RS10, Waikanae Stream at Greenaway Rd, which currently monitors for Cu, Zn)

Catchment name	Load Banding (Quartile)	Priority for Monitoring
		Up to two sample site to be selected from proposed locations
Kāpiti Coast District (Other) SH1, M2PP, PP2O	4	**High priority** – North of Waimeha River Catchment adjacent to SNW, and north of Waitohu catchment , adjacent to Category 1 surface water body /SNW No current relevant sites under KCDC GSC. Options to include Mangaone Stream at SH (upstream of current GWRC RWQE site RS07), Otaki River at SH, Ngarara Road Wetland D Wetland sites potentially suitable for PSD deployment (DGT, Nalgene samplers), if culverts to wetlands present options to include an autosampler to characterise event-based discharge
Hutt City		
Hutt (SH2)	4	**High priority** – SH2 runs adjacent to long stretches of Hutt River, and Category 2 surface water body. Downstream receiving environment is the Hutt Estuary which is a Category 1 sites. Piped discharges to the Hutt River potentially suitable for Nalgene first flush samplers. Options to include GWRC RWQE sites: Hutt River Opposite Manor Park Golf Club (RS21), Hutt River at Boulcott (RS22) which currently monitor for Cu, Zn Hutt Estuary is subject to significant influence from Waiwhetu Catchment, whilst of high interest, may be too confounded by wider catchment influences
Wellington City		
Kaiwharawhara (SH1)	2	**High priority** – downstream of SH, adjacent to Schedule F site Option to include GWRC RWQE SOE Site (upstream of SH). Downstream of SH is the Kaiwharawhara Estuary (coastal site). One sample site to be selected from proposed locations
Ngauranga (SH1, SH2)	4	**Medium priority** – representative of high use SH1/SH2 with the main interchange, adjacent to Wellington Harbour. There are no interactions with key PNRP Schedules, but likely that discharges to the Harbour will be of high interest. Coordinate with WWL GSC, options to include Nalgene samplers identified upgradient of the interchange for discharges from the SH1 to the tributary.

SNW – Significant Natural Wetland

3.1 INTEGRATION OF CULTURAL MONITORING

An ongoing consultation process has been established across the region to facilitate opportunities for incorporation of sites identified by mana whenua as holding cultural significance. Specific sites for incorporation into the SMP are being identified across the Kapiti area, and where feasible and safe, members of local iwi will be able to undertake a range of monitoring activities across sites with the intent of information and data contributing to the knowledge of specific sites.

3.2 CORRIDOR ACCESS RESTRICTIONS

A key feature of the state highway network is the physical environment being a carriaheway for fast moving vehicles. Long listed sites across priority catchments were discussed with Waka Kotahi's Corridor Access Team, and assessed against the Corridor Access Risk Register (CARR) to determine on a case-by-case basis if sites required additional risk control measures to be applied. Specifically, any site that was identified as a high priority, but required a specific Traffic Management Plan (TMP) was excluded from progressing through the site selection process.

Sites that were identified as being accessible via a legal carparking space (including legal carparking on the main highway itself) does not require a permit or special access.

Sites that were identified as only being accessible via the state highway designation, but not from a legal carpark, and are off the main corridor itself were assessed as not requiring a TMP, but require the presence of a certified Traffic Inspector Control to accompany any field sampling personnel.

4 CONCLUSIONS

Despite the linear nature of the SH network and the comparatively small footprint of the land occupied by the road corridor, the requirements for monitoring under the PNRP framework are complex. Sources of complexity arise from:

- Multiple sub-catchments (and landuse) the SH traverses;
- Mixture of old and new SH sections; and
- Logistics of identifying appropriate monitoring sites, taking into accounts the requirements of the consent as well as safe access to sites.

4.1 RECOGNISING COMPLEXITY WITH ADAPTIVE MONITORING AND MANAGEMENT

Integral to the effective implementation of the SMS is the overarching principle of Adaptive Management. The ANZG (2018) defines the process of adaptive management as:

> *'a continuous cycle of improvement based on setting goals and priorities, developing strategies, taking action and measuring results, and then feeding the results of monitoring back into new goals, priorities, strategies and actions'*

The effectiveness of an adaptive-monitoring approach relies on the support of appropriately designed monitoring tools to ensure the sufficient level of information is captured, and to inform a requirement to alter or adapt an approach if these information requirements are not being met. For the SH network, this allows for the following:

- Refine or improve system understanding of the quality of stormwater discharging from the state highway network;
- Improved conceptual understanding of the potential effects and risks to the receiving environment of the discharges of stormwater from the state highway network;
- Confirm if established appropriate indicators of stormwater quality are robustly characterised for discharges from the network;
- Compare the physio-chemical characteristics of the network derived stormwater against other regional data (where available), and available water/sediment quality guideline data (where applicable);
- Assess water/sediment quality against relevant water/sediment quality objectives for the sub-catchments; and
- Identify appropriate levels of information required to inform management actions / mitigations that may be developed as part of the long-term water quality management response objectives for the purpose of informing the SMS.

Sampling stormwater is inherently complex, and the first 12 months of the programme will use a combination of grab sampling, first flush sampling (Nalgene stage samplers), autosampler at a select site(s) and targeted sediment sampling across selected catchpits (prior to maintenance), as well as immediately downstream of any discharge points to the receiving environment. If any monitoring methods are assessed as not meeting the objectives, a process to review and implement alternative methods will be developed.

4.2 FUTURE MONITORING NEEDS

The SMP is iterative and will be refined following subsequent review and evaluation of the logistics of implementation after each annual cycle. Ongoing consultation with iwi and GWRC will be required to ensure integration of catchment specific requirements where there is interest in the contribution of stormwater from the state highway at specific sites. Furthermore, it is understood GWRC are planning to develop a regional contaminant load model. With the total area occupied by the state highway network amounting to ~0.04% of the total land area, the contribution of data from the state highway GSC will form a small but important data gap for this modelling process.

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