Technical Report 25

Contaminant Load Assessment

NZ TRANSPORT AGENCY
WAKA KOTAHI

1 MacKays to Peka Peka Expressway

Revision History

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Executive Summary

A contaminant load assessment was undertaken for the four catchments through which the proposed MacKays to Peka Peka Expressway (the Expressway) passes. The contaminant load model (CLM) process was used to assess the relative effects of the proposed Expressway against the existing (without the proposed Expressway) land use scenario. The process also provided a means of assessing the effectiveness of the proposed Expressway's stormwater treatment by comparison of the mitigated and unmitigated contaminant loads.

For each existing and future land use scenarios, a CLM model was developed for the following catchment areas:

- Whareroa Stream
- Wharemauku Stream
- Waikanae River
- Ngarara Stream

The Ngarara Stream is further divided into three sub-catchments being:

- Waimeha Stream
- Te Harakeke Wetland
- Kakariki Stream

The results of the CLM assessment showed that when fully operational and with no stormwater treatment, the proposed Expressway in 2031 is likely to lead to an overall improvement in the contaminant loads (sediment, zinc, copper and total petroleum hydrocarbons (TPH)) discharging to the receiving environment from most catchments modelled relative to the existing situation. With stormwater treatment, the fully operational proposed Expressway is likely to lead to an overall reduction in contaminant loads generated from all catchments relative to the existing scenario except for the Wharemauku and Waimeha stream catchments. The sediment load is likely to reduce by < 2% in all catchments with a corresponding reduction of between 1 and 6% for zinc, 2 and 12% for copper and 1 and 21% for TPH relative to a no stormwater treatment scenario. The contaminant loads generated from the Wharemauku Stream catchment and Waimeha Stream sub-catchments for the stormwater treated future scenario are likely to increase relative to the existing land use scenario.

1. Introduction

A contaminant load assessment was undertaken for the four catchment areas through which the proposed Expressway passes. The Auckland Regional Council's (ARC) Contaminant Load Model (Version MAY06) (CLM) was used for the assessment (Appendix 25.A). The following scenarios were modelled:

- Existing scenario (2011)
- Future scenario (2031) with the proposed Expressway without stormwater treatment
- Future scenario (2031) with the proposed Expressway with stormwater treatment

The model assessment provides a basis whereby the effects of the proposed Expressway can be considered against the existing (without the proposed Expressway) land use scenario. It deals with the effects of stormwater contaminants from the operational phase of the proposed Expressway, not the construction phase. The model also provides a means for assessing the effectiveness of any proposed stormwater mitigation (e.g. stormwater treatment) by comparison of the proposed mitigated and unmitigated contaminant loads.

The model calculates the annual contaminant loads of sediment, zinc, copper and TPH (primarily oil and grease) within a defined catchment area based on the areas of different contaminant sources in the catchment and their contaminant yields (g m^{-2} y^{-1}). The total suspended solids (TSS), zinc, copper and TPH are estimated as bottom of outfall loads and the average concentration of zinc, copper and TPH per unit of sediment. The contaminant concentration in the sediment (mg/kg) is the contaminant load (mg) as a function of the sediment load (kg) at the outfall.

The model requires input for the total area of the catchment including roof, roads and paved surfaces for each urban land use class (residential, commercial and industrial), as well as the area of exotic production forest, stable bush, farmed pasture, retired pasture and horticulture. The type of impervious surface and land use is important since different surfaces and activities generate different levels of contaminants. In particular, the road area information is complemented with existing (2011) and predicted (2031) traffic volumes (both with and without the proposed Expressway).

1.1. Issues Identified with the proposed Expressway

Full operation of the proposed Expressway will see a change from predominantly pastoral to road land use in the footprint of the proposed Alignment. This will lead to an increase in the amount of impervious surface area within the footprint of the proposed route, resulting in higher runoff volumes, peak flow rates and a subsequent change in the quantity and quality of stormwater runoff. The potential effects on the environment from operation of the proposed Expressway include:

- Increased sediment loads with the potential for detrimental effects on the ecology in receiving waters.
- Generation of long-term stormwater runoff containing vehicle pollutants leading to poor water quality and heavy metal accumulation in sediments in the receiving environment.
- Changes in runoff volume and higher rates of erosion

These effects can be mitigated through long-term stormwater management (stormwater quality, quantity and receiving environment protection).

1.2. Stormwater Management

To mitigate stormwater quality effects on the downstream receiving environment, runoff from the road area of the proposed Expressway will be treated prior to discharge. Stormwater runoff from the proposed Expressway will be treated by either swales or constructed wetlands. Where it is considered that downstream receptors are particularly sensitive, a treatment train approach comprising a combination of both swales and wetlands (in series) may be used.

1.3. The Study Area

For each of the existing and future land use scenarios, a CLM model was developed for the following catchment and sub catchment areas across the Project extent (Figure 1, Technical Report Appendices, Report 25, Volume 5):

- Whareroa Stream
- Wharemauku Stream
- Waikanae River
- Ngarara Stream

The Ngarara Stream is further divided into three sub-catchments being:

- Waimeha
- Te Harakeke Wetland
- Kakariki Stream

The Whareroa, Wharemauku and Ngarara stream catchments discharge to outfall locations along the Kāpiti coast. The Waikanae River catchment discharges to the coast by way of the Waikanae Estuary. Both the Kakariki and Waimeha stream sub-catchments discharge to their respective streams approximately 100m downstream of the proposed Expressway Alignment. These sub-catchments have been modelled to assess the potential effects of the proposed Expressway on the stream at these downstream locations.

The Te Harakeke Wetland sub-catchment is also located within the Ngarara Stream catchment. The Te Harakeke Wetland is the largest wetland across the Project extent and is of particular ecological significance. As such, a CLM assessment was undertaken for the wetland in order to assess the change in the potential contaminant load during operation of the proposed Expressway. See Figure 1 (Technical Report Appendices, Report 25, Volume 5).

2. Methodology

2.1. Overview

The CLM was used to estimate the contaminant loads generated from each catchment area for the existing and future land use scenarios. The following scenarios were modelled:

- Existing scenario (Year 2011)
- Future scenario (Year 2031) with full operation of the proposed Expressway (without stormwater treatment)
- Future scenario (Year 2031) with full operation of the proposed Expressway (with stormwater treatment)

The year 2031 was selected as the basis for the future land use scenario to align with the modelled future traffic counts. Specific information required for input into the CLM includes the following land use types:

- Roof area (e.g. coloursteel, galvanised, painted etc.)
- Paved surfaces (other than roads) associated each residential, commercial and industrial land use area
- Road lengths within different traffic count categories (vehicles/day)
- Urban grass lands (includes parks, golf courses, reserves etc.)
- Exotic production forest (categorised based on land slope)
- Stable bush (categorised based on land slope)
- Farmed pasture (categorised based on land slope)
- Horticulture (categorised based on land slope)

The future developed land use scenario (year 2031) considers only the proposed Expressway and associated changes to the road network. Note that the contaminant loads generated during construction of the proposed Expressway were not considered in this assessment. The methodology and assumptions used to calculate the inputs to the model are provided in the following sections.

2.2. Contributing Land Use Areas for the Existing (2010) Scenario

The contributing land use area for each catchment modelled was compiled by GIS from both the Ministry for the Environment's (MFE) Land Cover Database (LCDB2) (2004) and urban zoning information as given in the District Plan. These were combined and reclassified into a new "land-use layer" (single data set) which was used throughout the CLM process. From this, an estimate of the areas within the rural land use classes (e.g. exotic production forest, stable bush, farmed pasture etc.) was obtained as well as the areas currently zoned for residential, commercial and industrial land use purposes (Figure 2, Technical Report Appendices, Report 25, Volume 5). The area of each major land use class within each catchment used in the existing CLM scenario is summarised in Table 1.

Table 1: Summary of Existing Land Use Areas (ha)

Catchment	Whareroa Stream	Wharemauku Stream	Waikanae River	Ngarara Stream
Total Area	1617	1499	15144	2114
Roof	9	88	111	68
Road	29	86	132	90
Paved Surfaces	22	284	166	156
Urban Grasslands	35	319	287	295
Exotic Forest	210	259	560	195
Stable Bush	334	157	9288	497
Farmed Pasture	978	306	4589	810
Horticulture	-	-	11	3

Sub-catchment	Te Harakeke Wetland	Kakariki Stream	Waimeha Stream
Total Area	1824	698	207
Roof	46	22	18
Road	66	26	16
Paved Surfaces	107	78	39
Urban Grasslands	172	96	69
Exotic Forest	191	5	3
Stable Bush	476	264	17
Farmed Pasture	762	207	45
Horticulture	3	-	-

2.2.1. Roof Area

In each catchment, the total roof area for each residential, commercial, industrial and rural land use area was provided by Kāpiti Coast District Council (KCDC). KCDC provided the building footprint layer as well as the zoning data. The area of each roof type was estimated using the CLM guidance notes for dwellings built before 1995. For those buildings in 'open space' and rural areas (i.e. not zoned residential, commercial or industrial), the proportion of each roof type was assumed to be consistent with residential roof types.

2.2.2. Paved Surfaces (other than roads)

Paved surfaces (other than roads) include footpaths, private driveways and car parks. The amount of paved surface area associated with residential land use was assumed to be 50% of the total zoned area less the area as roof and road. For the industrial and commercial land use areas, paved surfaces were assumed to be the total corresponding zoned area, less the area as roof, road and urban grasslands (see 'Urban Grass Lands' below).

2.2.3. Roading Network

In the CLM, the contaminant load generated from roads requires input of the length of all roads within the catchment. This input requirement is further refined such that the road input is categorised according to the road's actual or predicted daily traffic counts.[1] These categories vary in their contaminant yield. The traffic count classifications and respective contaminant yield assumptions are shown below in Table 2.

[1] Predicted daily traffic information has been traffic modelling assessment in the Assessment of Transport Effects (Technical Report 32, Volume 3).

The road lengths in each catchment were calculated using GIS and the LINZ CRS (Core Record System) road centreline dataset. The road lengths are entered into the model within the corresponding traffic count category. The CLM assumes a relationship between the volume of traffic and the number of lanes with < 20,000 vpd as 2-lane roads, 20,000 – 50,000 vpd as 3-lane roads, 50,000 – 100,000 vpd as 4-lane roads and > 100,000 vpd as 6-lane roads. The road area is then calculated from assumed road widths as follows:

- 2-lane roads = 17m
- 3-lane roads = 20.5m
- 4-lane roads = 24m
- 6-lane roads – 31m

The contaminant loads are estimated from the road area and the corresponding contaminant yields. Note that the road widths are based on 3.5 m per lane with a total verge width of 10m.

Table 2: Road classification and contaminant yield assumptions for various contaminants

Road Classification	Sediment Yield	Zinc Yield	Copper Yield	Hydrocarbon Yield
Vehicles/Day	$g/m^2/annum$	$g/m^2/annum$	$g/m^2/annum$	$g/m^2/annum$
<1000	4	0.021	0.0070	0.11
1000 - 5000	30	0.107	0.0349	0.54
5000 - 20000	150	0.537	0.1744	2.68
20000 - 50000	299	1.068	0.3472	5.34
50000 - 100000	300	2.281	0.7414	11.41
>100000	300	3.532	1.1480	17.66

Except for State Highway 1 (the existing SH1), almost all roads across the Project extent are 2-lane roads with traffic counts of < 20,000 vehicles per day. The traffic count data as provided by the Assessment of Transport Effects (Technical Report 32, Volume 3) is provided in Appendix 25.B. The total road lengths within each traffic count category (vehicles per day) are converted to an area using the road widths as described above.

Currently, the existing SH1 is the major road across the Project area with traffic counts of between 20,000 and 50,000 vehicles per day (Appendix 25.B). The existing SH1 comprises between 2 and 4-lanes across the Project extent. On the basis of this traffic count, the model would assume that the existing SH1 is entirely a 3-lane road. It would therefore appear that for those sections of the existing SH1 which are 2 or 4-lanes, the model would either over or underestimate the contaminant load due to the difference in the road pavement area from that of a 3-lane road. While this is true for sediment, for zinc, copper and TPH the contaminant load generated from a road area is directly dependent on the traffic volume and road length (not road area) i.e. for a fixed number of vehicles, the contaminant load generated from a specific length of road is the same whether or not that road is two, three or four lanes. As such, for these contaminants, no adjustment is necessary for any difference any in the number of lanes (road width). The road length is then entered into the model within the appropriate traffic count category. Note that the methodology used to input the roading network into the model was undertaken in consultation with Mike Timperly who developed the CLM for the ARC.

Unlike zinc, copper and TPH, the sediment yield is a function of both traffic volume and road surface area. The latter dependence on road surface area is to allow for natural (i.e. non-vehicular) erosion from the road pavement[2]. Therefore the sediment load will be over or underestimated if consideration is not given to any difference in the number of lanes from those given within the model.

In the 5,000 – 20,000 vpd traffic count category, the sediment load from natural sources is much less than half the vehicle load within that traffic count category[3]. Therefore for those parts of the existing SH1 which comprise 4-lanes, and are entered into the CLM within the 5,000 – 20,000 vpd traffic count category, the model would underestimate the sediment load due to natural sources by 71% (the ratio between the road widths (17m/24m). In total, this is much less than the approximately ±30% error inherent in the CLM and therefore no adjustment has been made to the modelling approach.

2.2.4. Urban Grass Lands

Urban grass land includes open space such as parks and reserves, and other grassed areas such as lawns and verges associated with residential, commercial and industrial land use. The total area of urban grass lands was assumed to comprise those areas zoned ‘open space’ in the District Plan as well as pervious areas in each of the zoned residential, commercial and industrial areas. The amount of urban grass lands associated with residential land use was assumed to be 50% of the total zoned area, less the corresponding area as roof and road. For the industrial and commercial land use areas, urban grass land was assumed to consist of the pervious land cover of 28% and 15% respectively (taken from Connell Wagner, 2001). It was assumed that all urban grass land comprised a slope of < 10º.

2.2.5. Additional Assumptions

The following additional assumptions were made:

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[2] Based on personal communication with Mike Timperly.

[3] Based on personal communication with Mike Timperly.

- There are several major wetlands in the catchments across the Project area. The CLM makes no allowance for wetlands and as such, these areas were input into the model as stable bush. This was considered a conservative approach as while wetlands generate some contaminants they also provide a stormwater treatment function.
- The sediment load associated with construction of the proposed Expressway has not been evaluated in this study.
- The surface area as runway and paved surfaces (other than roads) associated with the Paraparaumu airport was included as industrial and residential paved surfaces respectively in the CLM.

2.3. Contributing Land Use for the Future (2031) Scenario

The future land use scenario (year 2031) would see construction of the proposed Expressway and associated changes to the roading network. For each catchment, the area of each major land use class modelled in the future (year 2031) scenario is given in Table 3.

Note that no other land use change other than those associated with the roading network has been included in the future (2031) modelled scenario. There are currently approved/consented areas for redevelopment in the Wharemauku Stream and Waikanae River catchments. In most cases, these areas are small in terms of the overall catchment area and therefore, there is likely to be only a minimal effect on contaminant yields across each catchment area modelled. In addition to these, there is likely to be an approximate 280ha development north of the Project area within the Ngarara Stream catchment. Due to construction of the proposed Expressway, the structure plan for this proposed land use change has since been withdrawn and as such, the extent and type of development is unknown.

2.3.1. Future Roading Network

In the CLM, the sediment and contaminant loads generated from roads are estimated from the lengths of the roads within each daily traffic count and the type of stormwater treatment. The future scenario (year 2031) land use scenario includes the proposed Expressway and subsequent changes to the roading network. The future (2031) traffic counts throughout the Project extent were obtained from the Assessment of Transport Effects (Technical Report 32, Volume 3), which are contained in Appendix 25.B. The current volume of traffic on the existing SH1 falls within the 20,000 to 50,000 vehicles/day classification. When fully operational, the proposed Expressway in year 2031 will have a predicted traffic count of between 5,000 – 20,000 vehicles per day. At this time, a similar volume of traffic is predicted to use the existing SH1 route.

The proposed Expressway will be a 4-lane road while the existing SH1 has between 2 and 4-lanes. With traffic counts of between 5,000 – 20,000 vpd, the model would then assume that both the proposed Expressway and SH1 are 2-lane roads. See Section 2.2.3 for an explanation of the approach taken to model roads with a different number of lanes than that assumed by the model.

Stormwater Treatment

For each catchment modelled, the CLM requires the proportion of each land use class (e.g. roofs, roads, paved surfaces etc.) draining to a specified treatment device (or treatment train arrangement). Stormwater runoff from the proposed Expressway will be treated by swales and/or constructed wetlands. In the Whareroa Stream catchment, 100% of the road runoff from the proposed Expressway area will be treated by swales. The existing southbound lanes in this catchment will not be treated. In the Waimeha Stream sub-catchment, runoff from the proposed Expressway road surface will be directed to constructed wetlands. In all remaining catchments and sub-catchments, road runoff will be treated with a combination of both swales and wetlands.

Table 3: Summary of Future Land Use Areas (ha)

Catchment	Whareroa Stream	Wharemauku Stream	Waikanae River	Ngarara Stream
Total Area	1,617	1,499	15,144	2,114
Roof	9	88	111	68
Road	31	96	137	100
Paved Surfaces	21	276	165	156
Urban Grasslands GrasGrasslands	35	319	287	295
Exotic Forest	210	259	557	194
Stable Bush	334	156	9289	496
Farmed Pasture	977	306	4588	802
Horticulture	0	0	10	3

Sub-catchment	Te Harakeke Wetland	Kakariki Stream	Waimeha Stream
Total Area	1,824	698	207
Roof	46	22	18
Road	75	28	18
Paved Surfaces	142	79	39
Urban Grasslands	138	96	69
Exotic Forest	190	5	3
Stable Bush	476	264	17
Farmed Pasture	755	205	44
Horticulture	3	0	0

For the proposed Expressway, the proportion of the road area draining to the stormwater treatment system in each traffic-count classification (e.g. < 1000 vehicles per day, 1,000 – 5,000 vehicles per day etc.) is a required input to the model. However, only one treatment device (or one treatment train arrangement) can be specified for each traffic-count classification. As such, where stormwater runoff from the proposed Expressway road area drains to both swales and wetlands, swales have been considered the primary treatment device for the purposes of the CLM process. This is considered the most conservative approach as these are the least efficient in terms of treatment for three of the four contaminants of interest (Table 4). Therefore, for each catchment modelled, the proportion of total stormwater runoff draining to the designated stormwater treatment device was estimated from the treated stormwater runoff from the proposed Expressway as a fraction of the total road area within the 5,000 – 20,000 v/d traffic-count classification. The proportion of road runoff draining to each treatment device is shown in Table 5.

Table 4: Contaminant Load Reduction Factors for Swales and Constructed Wetlands as given in the CLM (Version: May 2006)

Contaminant	Swale	Constructed Wetland
Sediment	0.75	0.77
Zinc	0.47	0.54
Copper	0.57	0.69
TPH	0.47	0.10

Table 5: Area (m²) and Proportion (%) of Stormwater Runoff from the proposed Expressway Road Surface Area Draining to Constructed Wetlands and Swales

Treatment Device		Constructed Wetlands		Swales	
Catchment / Sub-catchment	Total Expressway Road Area (m²)	Road Area Treated (m²)	Road Area Treated (%)	Road Area Treated (m²)	Road Area Treated (%)
Whareroa Stream	138,800	0	0	138,800	100
Waikanae River	442,820	412,820	93	30,000	7
Wharemauku Stream	403,630	348,000	86	55,630	14
Ngarara Stream	806,850	427,460	53	379,390	47
Te Harakeke Wetland	578,560	243,260	42	335,300	58
Kakariki Stream	130,290	104,200	80	26,090	20
Waimeha Stream	98,000	80,000	82	18,000	18

For TPH, the CLM specifies a load reduction of 10% for constructed wetlands and 47% for swales. A review of stormwater treatment devices in the United States found that most devices can remove the majority of petroleum hydrocarbons from stormwater (CWP, 2000). Swales were reported to have a removal efficiency of about 62% while for wetlands, the performance lies between 80 – 90% (CWP, 2000). Therefore the CLM process is likely to underestimate the TPH removal. As such, representative estimates of the likely reduction in TPH was also modelled separately at the higher load reduction factor of 70% as given for biomedia filtration devices[4].

Note that runoff from the proposed Expressway is assumed to be the only road area across the Project extent which is treated. While there are several additional roads which may also drain to one of the above treatment devices, these were considered minor for the purposes of the CLM assessment undertaken in this study.

3. Results

In this section, the results of the CLM for the existing and future (2031) land use scenarios are given for each catchment. For the future scenario, the model was run both with, and without, stormwater

[4] Based on personal communication with Mike Timperly.

treatment. The results are given as both the annual contaminant loads discharging from the catchment area and as contaminant concentrations in the sediment at the outfall location. The CLM spreadsheets are provided in Appendix 25.C to 25.I of this Report.

3.1. Waikanae River Catchment

The results in Table 6 show that 31,004 tonnes of sediment currently discharges annually from the Waikanae catchment to the receiving estuary. In 2031, during operation of the proposed Expressway, an unmitigated load of 30,987 tonnes per year is expected to discharge to the estuary, a slight reduction of < 1% from the existing (Table 13).

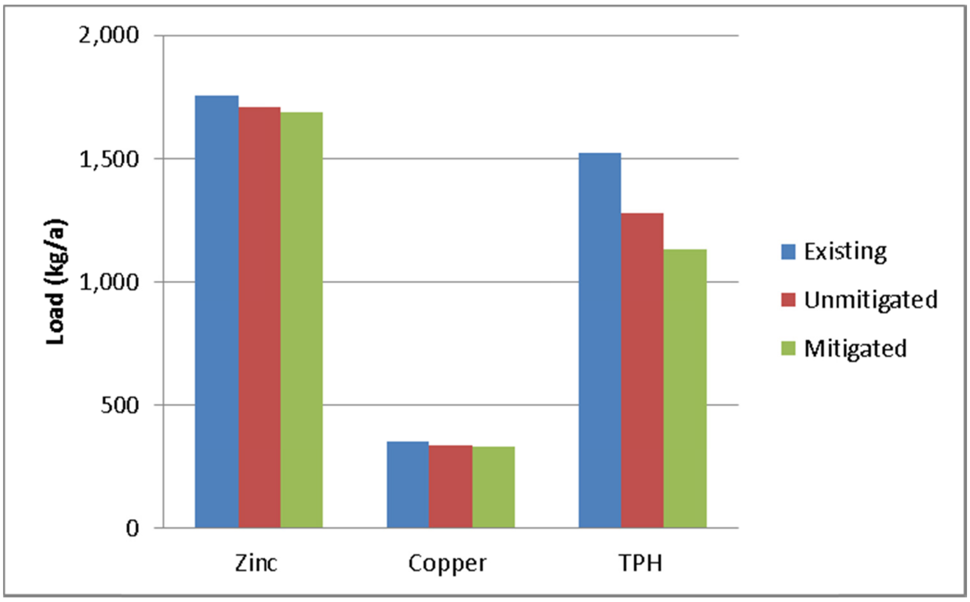
The existing load of zinc, copper and TPH currently discharging to the Waikanae Estuary is predicted to be 1,758, 352 and 1,519 kg/a respectively. In 2031, the unmitigated loads are predicted to be 1,708, 336 and 1,278 kg/a for zinc, copper and TPH respectively. These equate to an approximate reduction of 3% for zinc, 5% for copper and 16% for TPH (Table 13 and Figure 3).

There is little predicted change in the contaminant concentrations in the sediment between the existing and unmitigated future land use scenarios. The zinc concentration in the sediment showed a decrease of approximately 4% to 55 mg/kg and TPH, 16% to 41 mg/kg. There is no corresponding future change in the sediment concentration for copper.

Table 6: Estimated total annual contaminant loads (mass load/annum) discharging to the outfall of the Waikanae River Catchment and the contaminant concentrations in the sediment (mg/kg) at the outfall location

Contaminant	Unit	Existing	Future (2031) Unmitigated	Future (2031) Mitigated
Sediment	t/a	31,004	30,987	30,979
Zinc	kg/a	1,758	1,708	1,689
	mg/kg	57	55	55
Copper	kg/a	352	336	328
	mg/kg	11	11	11
TPH	kg/a	1,519	1,278	1133
	mg/kg	49	41	37

Figure 3: Zinc, Copper and TPH Loads discharging from the Waikanae River catchment



The future loads, with stormwater treatment, were predicted to be 1,689, 328 and 1,133 kg/a for zinc, copper and TPH respectively. This is a reduction of 1% for zinc, 2% for copper and 11% for TPH relative to the unmitigated stormwater loads (Table 15). Subsequently, with stormwater treatment, there is a minor reduction predicted in the contaminant concentrations in the sediment relative to the future unmitigated scenario. Thus, the concentrations in the sediment are predicted to be lower by approximately <1% for zinc and copper and 10% for TPH.

3.2. Wharemauku Stream Catchment

The results in Table 7 show that the existing load of sediment that discharges from the Wharemauku Stream catchment to the coastal receiving environment is 2,300 tonnes per year. Without stormwater treatment, this is predicted to increase by < 1% in year 2031 to 2,308 tonnes annually.

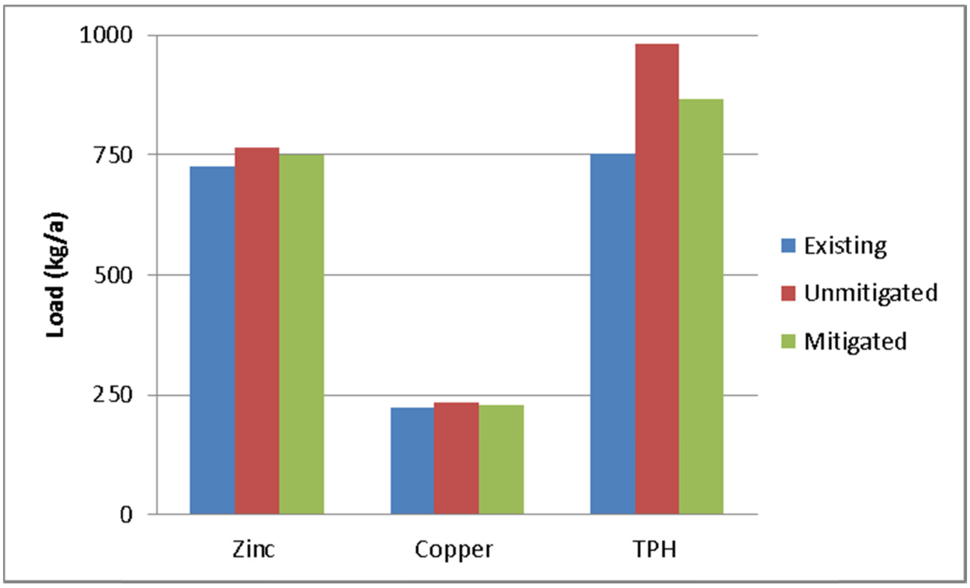
The predicted unmitigated load of zinc, copper and TPH in year 2031 is 765, 235 and 982 kg/a respectively (Figure 4). This is an increase over existing loads of approximately 5% for zinc, 4% for copper and 30% TPH respectively. Similarly, the unmitigated concentration of each contaminant in the sediment is predicted to increase in year 2031 during operation of the proposed Expressway relative to existing levels (Figure 4). The zinc concentration in the sediment increased from 316 mg/kg to 332 mg/kg, copper from 98 mg/kg to 102 mg/kg and TPH from 328 to 426 mg/kg. These equate to relative increases of 5%, 4% and 30% respectively.

Table 7: Estimated total annual contaminant loads (mass load/annum) discharging to the outfall of the Wharemauku Catchment and the contaminant concentrations in the sediment (mg/kg) at the outfall location

Contaminant	Unit	Existing	Future (2031) Unmitigated	Future (2031) Mitigated
Sediment	t/a	2,300	2,308	2,301
Zinc	kg/a	726	765	750
	mg/kg	316	332	326
Copper	kg/a	225	235	229
	mg/kg	98	102	99
TPH	kg/a	753	982	866
	mg/kg	328	426	376

With stormwater treatment, the future sediment load is predicted to be lower by < 1% relative to the unmitigated load. The mitigated loads of zinc, copper and TPH are predicted to be 750, 229 and 866 kg/a, a decrease of 2, 3 and 12% respectively, relative to the unmitigated results. The zinc, copper and TPH concentrations corresponding to the sediment with stormwater treatment are likely to reduce to 326, 99 and 376 mg/kg for respectively, a decrease of approximately 2%, 3% and 12% compared to the unmitigated levels.

Figure 4: Zinc, Copper and TPH Loads discharging from the Wharemauku Stream catchment



3.3. Ngarara Stream Catchment

The results of the CLM (Table 8) showed that 1,792 tonnes of sediment discharges annually to the coastal receiving environment from the Ngarara Stream catchment. In year 2031 and without stormwater treatment, the load is predicted to reduce < 1% to 1,785 t/a.

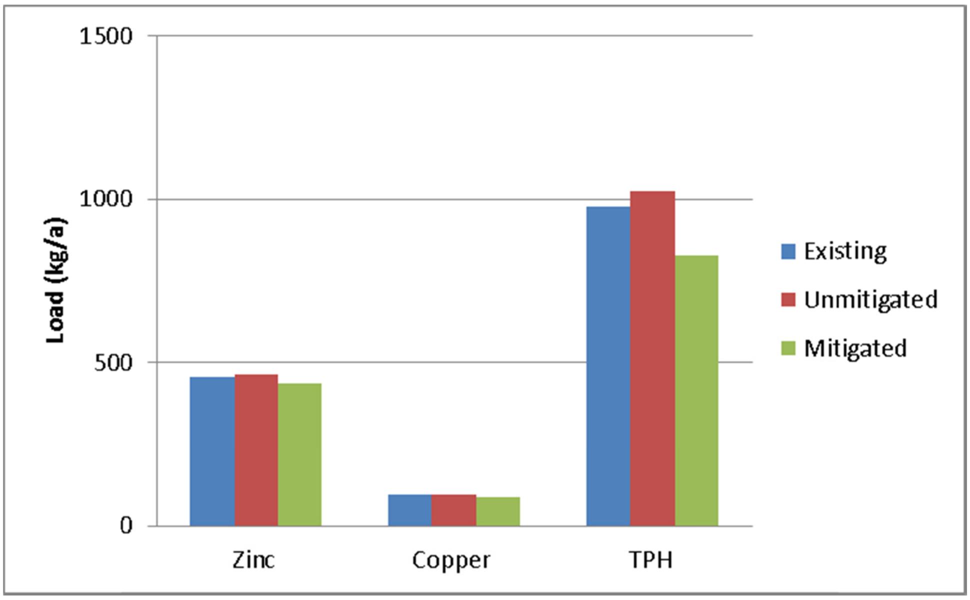
Table 8: Estimated total annual contaminant loads (mass load/annum) discharging to the outfall of the Ngarara Stream Catchment and the contaminant concentrations in the sediment (mg/kg) at the outfall location

Contaminant	Unit	Existing	Future (2031) Unmitigated	Future (2031) Mitigated
Sediment	t/a	1,792	1,785	1,774
Zinc	kg/a	454	463	437
	mg/kg	253	259	246
Copper	kg/a	93	96	86
	mg/kg	52	54	48
TPH	kg/a	976	1,023	829
	mg/kg	545	573	467

The unmitigated load of zinc, copper and TPH discharging to the coastal environment from the Ngarara catchment in year 2031 is predicted to be 463, 96 and 1,023 kg/a respectively. This is a relative increase of < 5% over an existing load of 454 kg/a for zinc, 93 kg/a for copper and 976 kg/a for TPH (Figure 5). Subsequently, without stormwater treatment, there is a slight increase in the contaminant concentrations in the sediment in year 2031, with zinc increasing from 253 mg/kg to 259 mg/kg, copper from 52 mg/kg to 54 mg/kg and TPH from 545 to 573 mg/kg.

With stormwater treatment, the future sediment load is predicted to be 1,774 tonnes per year, lower by < 1% relative to the unmitigated load. The load of zinc, copper and TPH are predicted to reduce by 6% (437 kg/a), 10% (86 kg/a) and 19% (829 kg/a) respectively, with stormwater treatment relative to the unmitigated results. Subsequently, this resulted in a predicted decrease in the contaminant concentrations in the sediment of 5% (246 mg/kg) for zinc, 11% (48 mg/kg) for copper and 18% (467 mg/kg) for TPH.

Figure 5: Zinc, Copper and TPH Loads discharging from the Ngarara Stream catchment



3.3.1. Whareroa Stream Catchment

The CLM results for the Whareroa Stream catchment are shown in Table 9. The results showed that 4,814 tonnes of sediment discharges annually from the Whareroa catchment to the coastal receiving environment. In comparison, an unmitigated load of 4,806 tonnes of sediment is expected to discharge from the catchment in year 2031, a slight reduction (< 1%) from the existing load.

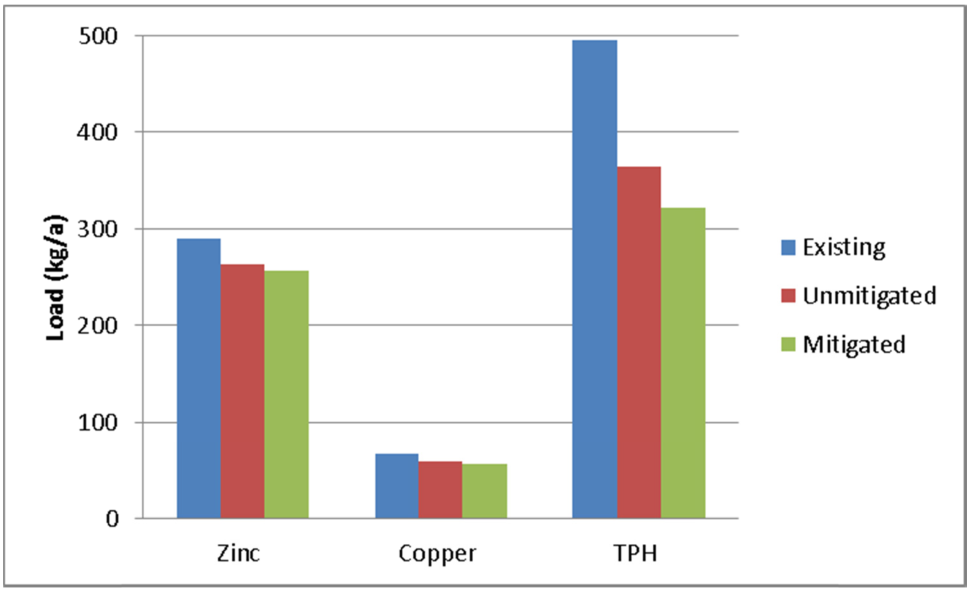
Table 9: Estimated total annual contaminant loads (mass load/annum) discharging to the outfall of the Whareroa Catchment and the contaminant concentrations in the sediment (mg/kg) at the outfall location

Contaminant	Unit	Existing	Future (2031) Unmitigated	Future (2031) Mitigated
Sediment	t/a	4,814	4,806	4,803
Zinc	kg/a	290	263	257
	mg/kg	60	55	54
Copper	kg/a	68	59	57
	mg/kg	14	12	12
TPH	kg/a	495	364	321
	mg/kg	103	76	67

The predicted existing load of zinc, copper and TPH currently discharging from the Whareroa catchment is 290, 68 and 495 kg/a respectively (Figure 6). In the future land use scenario without stormwater treatment (year 2031), the loads were predicted to reduce by 9% for zinc (263 kg/a), 13% for copper (59 kg/a) and 27% for TPH (364 kg/a) (Figure 6). Consequently, the change in the zinc, copper and TPH concentrations in the sediment between the existing and unmitigated future land use scenarios is 8%, 14% and 26% respectively.

The sediment load discharging from the Whareroa Stream catchment with stormwater treatment is predicted to be 4,803 t/a, a minor decrease of < 1% relative to the unmitigated future load. The mitigated load of zinc, copper and TPH were predicted to be 257, 57 and 321 kg/a respectively, equivalent to a decrease of 2%, 3% and 12% over the unmitigated results. The zinc concentration in the sediment decreased from 55 mg/kg to 54 mg/kg and TPH from 76 to 67 mg/kg. These equate to a relative decrease of 2% and 12% respectively. There was no change in the copper concentrations in the sediment.

Figure 6: Zinc, Copper and TPH Loads discharging from the Whareroa Stream catchment



3.4. Te Harakeke Wetland Sub-Catchment

The results in Table 10 show that 1,680 tonnes of sediment currently discharges from the wider catchment area to the Te Harakeke wetland. During future operation of the proposed Expressway, an unmitigated load of 1,665 t/a is predicted to discharge to the wetland, a reduction of < 1% from the existing load.

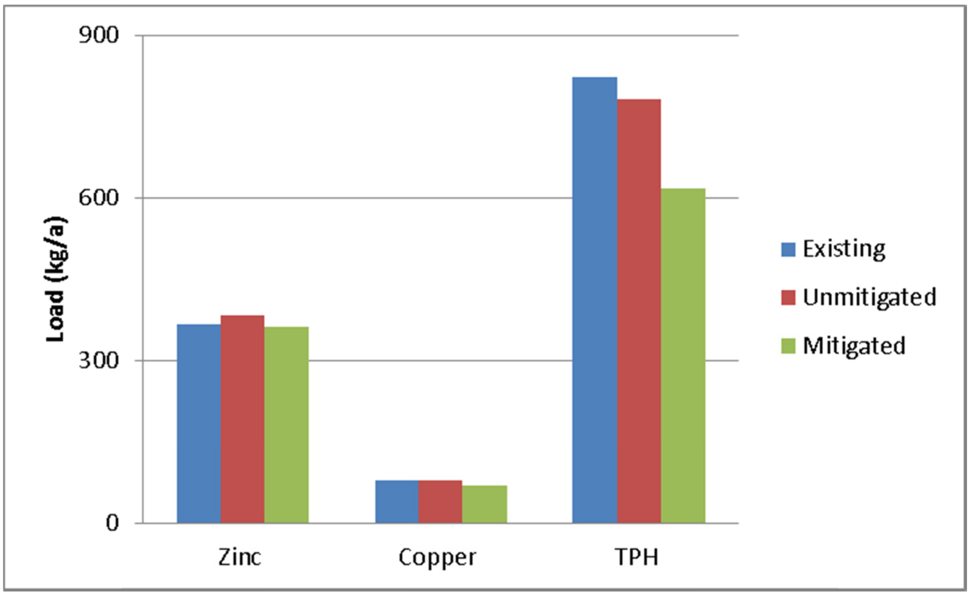
Table 10: Estimated total annual contaminant loads (mass load/annum) discharging to the outfall of the Te Harakeke Wetland catchment and the contaminant concentrations in the sediment (mg/kg) at the outfall location

Contaminant	Unit	Existing	Future (2031) Unmitigated	Future (2031) Mitigated
Sediment	t/a	1,680	1,665	1,655
Zinc	kg/a	367	383	361
	mg/kg	219	230	218
Copper	kg/a	77	78	69
	mg/kg	46	47	42
TPH	kg/a	823	783	617
	mg/kg	490	471	372

The existing load of zinc, copper and TPH currently discharging to the wetland is predicted to be 367, 77 and 823 kg/a respectively. The unmitigated loads in year 2031, are predicted to change by <5% for all contaminants with future loads of 383 kg/a for zinc, 78 kg/a for copper and 783 kg/a for TPH respectively (Figure 7). Consequently, there is little predicted change in the contaminant concentrations in the sediment between the existing and unmitigated future land use scenarios. The future unmitigated concentration of zinc, copper and TPH in the sediment are 230 mg/kg for zinc, 47 mg/kg for copper and 471 mg/kg for TPH.

The sediment load discharging to the Te Harakeke Wetland with stormwater treatment is predicted to be < 1% lower (1,655 t/a) relative to the modelled load without stormwater treatment. The predicted loads with stormwater treatment for zinc, copper and TPH are predicted to be 361 kg/a, 69 kg/a and 617 kg/a respectively, a relative reduction of approximately 6, 12 and 21% against the unmitigated loads. The mitigated sediment concentrations are expected to decrease by 5% (218 mg/kg), 11% (42 mg/kg) and 21% (372 mg/kg) over the unmitigated results for zinc, copper and TPH respectively.

Figure 7: Zinc, Copper and TPH Loads discharging to the Te Harakeke Wetland



3.5. Kakariki Stream Sub-Catchment

The results (Table 11) show that 588 tonnes of sediment currently discharges annually to the Kakariki Stream at a location of approximately 100m downstream of the proposed Alignment. In year 2031 and without stormwater treatment, this is expected to decrease by approximately 1% to 581 t/a.

Table 11: Estimated total annual contaminant loads (mass load/annum) discharging to the Kakariki Stream (approximately 100m downstream of the proposed Expressway) and the contaminant concentrations in the sediment (mg/kg) at the outfall location

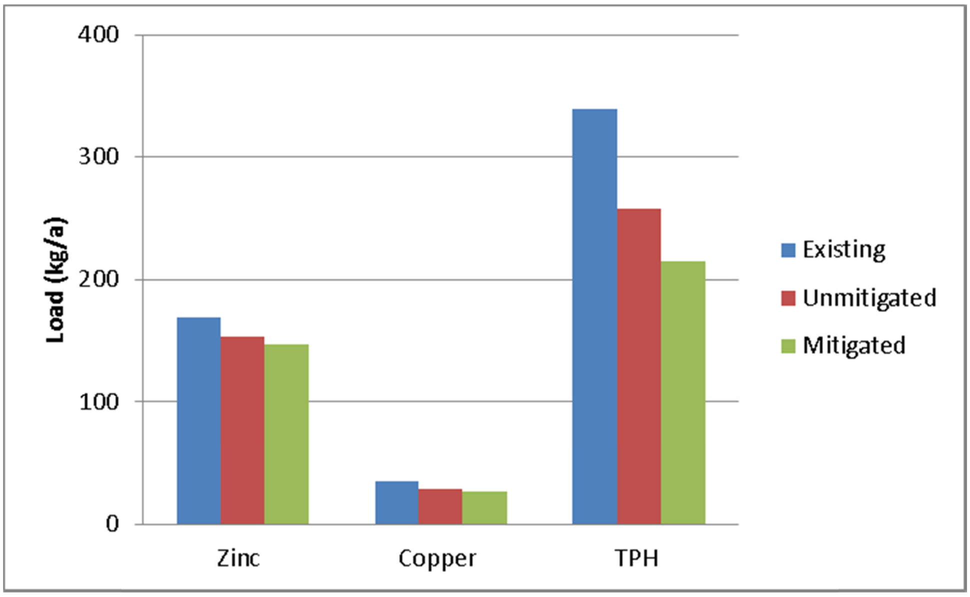
Contaminant	Unit	Existing	Future (2031) Unmitigated	Future (2031) Mitigated
Sediment	t/a	588	581	579
Zinc	kg/a	169	153	147
	mg/kg	288	263	255
Copper	kg/a	35	29	27
	mg/kg	59	50	47
TPH	kg/a	340	258	215
	mg/kg	578	443	371

The unmitigated annual loads of zinc, copper and TPH discharging to the Kakariki Stream are predicted to decrease during operation of the proposed Expressway in year 2031 relative to the existing scenario (Figure 8). The future unmitigated loads of zinc, copper and TPH are 153, 29 and

258 kg/a respectively, a relative decrease over existing levels of approximately 9%, 17% and 24%. Subsequently, the future unmitigated zinc, copper and TPH concentrations in the sediment are 263, 50 and 443 mg/kg, a relative reduction of approximately 9%, 15% and 24% from existing levels.

With stormwater treatment, the future sediment load is predicted to be lower by < 1% relative to the unmitigated load. The mitigated load of zinc, copper and TPH are predicted to be 147, 27 and 215 kg/a respectively. This is a decrease of approximately 4% for zinc, 7% for copper and 17% for TPH over the unmitigated results. With stormwater treatment, the contaminant concentrations in the sediment are 255, 47 and 371 mg/kg for zinc, copper and TPH respectively, reductions of 3%, 6% and 16% over the unmitigated results.

Figure 8: Zinc, Copper and TPH Loads discharging to the Kakariki Stream



3.6. Waimeha Stream Sub-Catchment

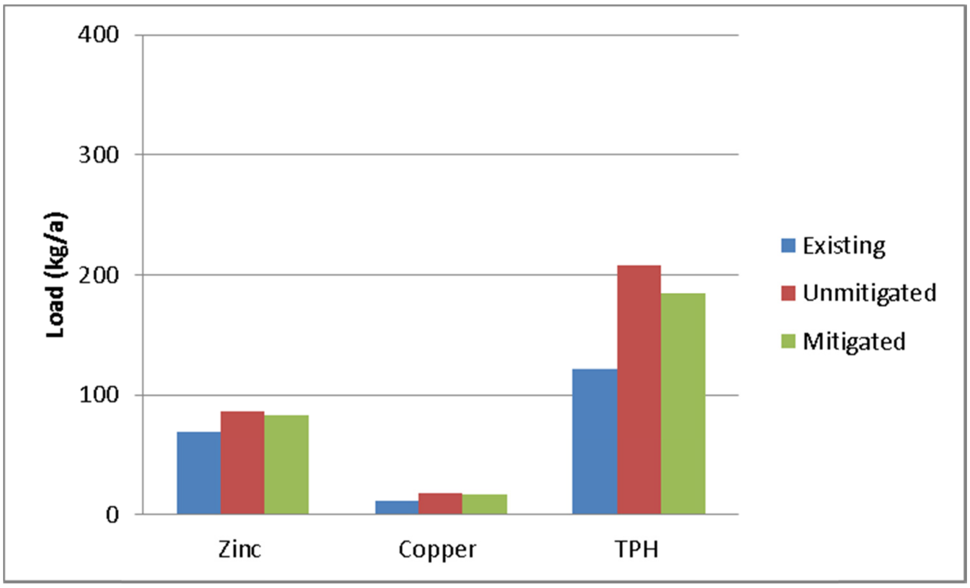
The results in Table 12 showed that the existing load of sediment discharging to the Waimeha stream approximately 100m downstream of the proposed Alignment is 86 t/a. The unmitigated load in year 2031 is predicted to increase slightly over the existing level to 90 t/a.

Table 12: Estimated total annual contaminant loads (mass load/annum) discharging to the Waimeha Stream (approximately 100m downstream of the proposed Alignment) and the contaminant concentrations in the sediment (mg/kg) at the outfall location

Contaminant	Unit	Existing	Future (2031) Unmitigated	Future (2031) Mitigated
Sediment	t/a	86	90	88
Zinc	kg/a	69	86	83
	mg/kg	802	961	935
Copper	kg/a	12	18	17
	mg/kg	144	201	187
TPH	kg/a	121	208	184
	mg/kg	1410	2316	2083

The future (2031) unmitigated annual load of zinc, copper and TPH discharging to the Waimeha Stream is predicted to be 86, 18 and 208 kg/a respectively. This is an increase of approximately 25% for zinc, 50% for copper and 72% for TPH over existing levels (Figure 9). Likewise, the predicted future unmitigated zinc, copper and TPH concentrations in the sediment are 961, 201 and 2316 mg/kg, an increase in concentration of approximately 20% for zinc, 40% for copper and 64% from existing levels.

Figure 9: Zinc, Copper and TPH Loads discharging to the Waimeha Stream



The future sediment load with stormwater treatment is predicted to be 88 t/a, lower by 2% relative to the unmitigated load. With stormwater treatment, the contaminant loads in year 2031 are predicted to be lower by <20% relative to the unmitigated results with future loads of 83 kg/a for zinc, 17 kg/a for copper and 184 kg/a for TPH respectively. Consequently, there is a < 20% change in each contaminant concentration in the sediment between the unmitigated and mitigated future land use scenarios.

3.7. Roading Network

The existing and future (Year 2031) contaminant loads generated from the roading network in the catchment and sub-catchment areas across the Project extent are shown in Figures 10 to 14. The results show that the roading network within five of these areas is expected to generate lower loads with the fully operational proposed Expressway relative to existing levels. This is in part, due to diversion of traffic from existing roads to the proposed Expressway with a consequential reduction in contaminant yield and stormwater treatment. The contaminant loads generated from the future roading network for the two remaining catchments are likely to be higher than existing levels.

Figure 10: Change between the existing and future (Year 2031) stormwater treated sediment load generated from the roading network for the catchments and sub-catchments across the Project extent

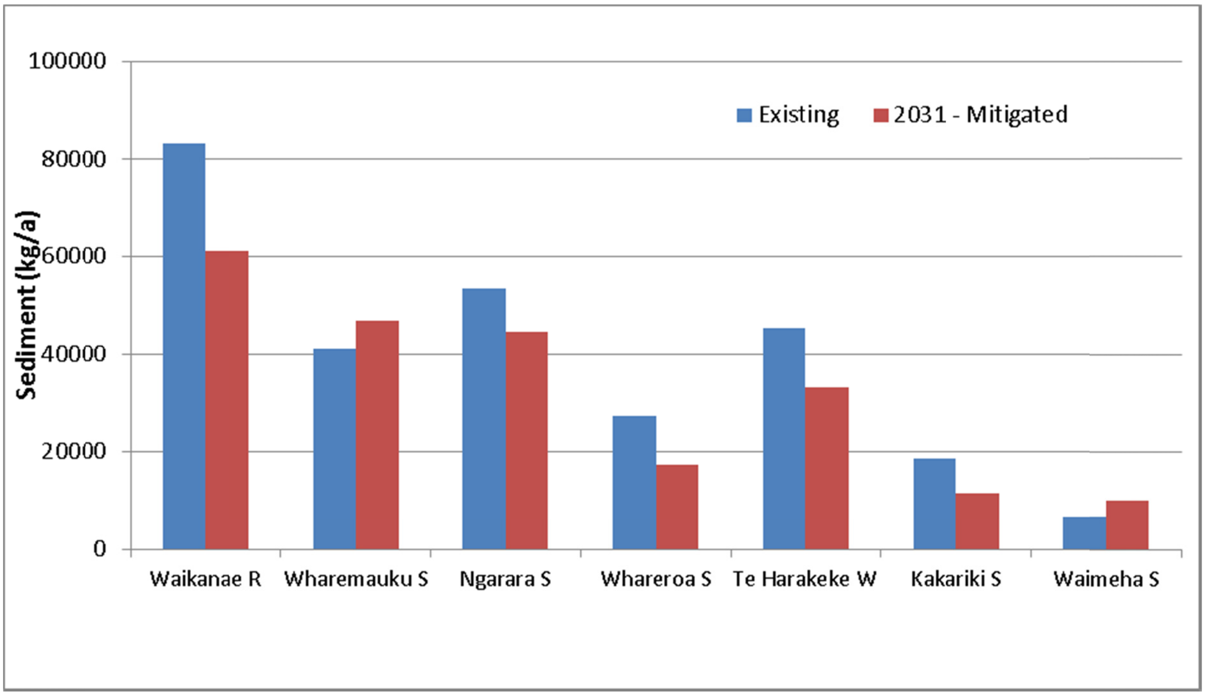


Figure 11: Change between the existing and future (Year 2031) stormwater treated zinc load generated from the roading network for the catchments and sub-catchments across the Project extent

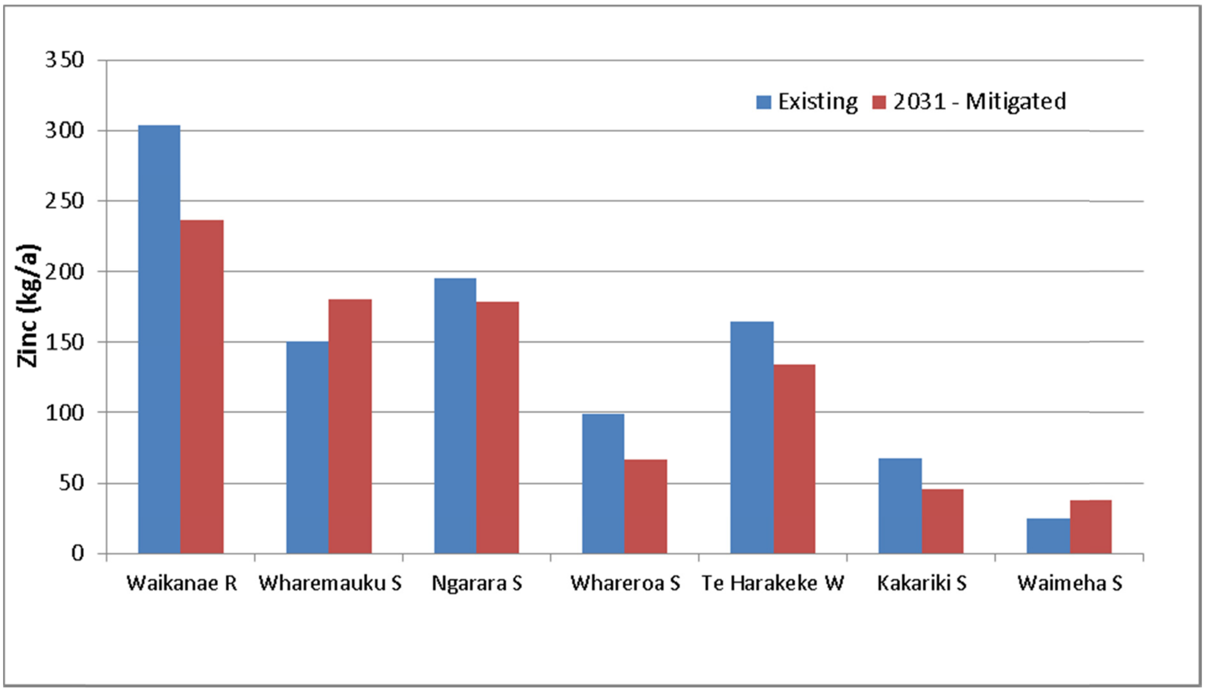


Figure 12: Change between the existing and future (Year 2031) stormwater treated copper load generated from the roading network for the catchments and sub-catchments across the Project extent

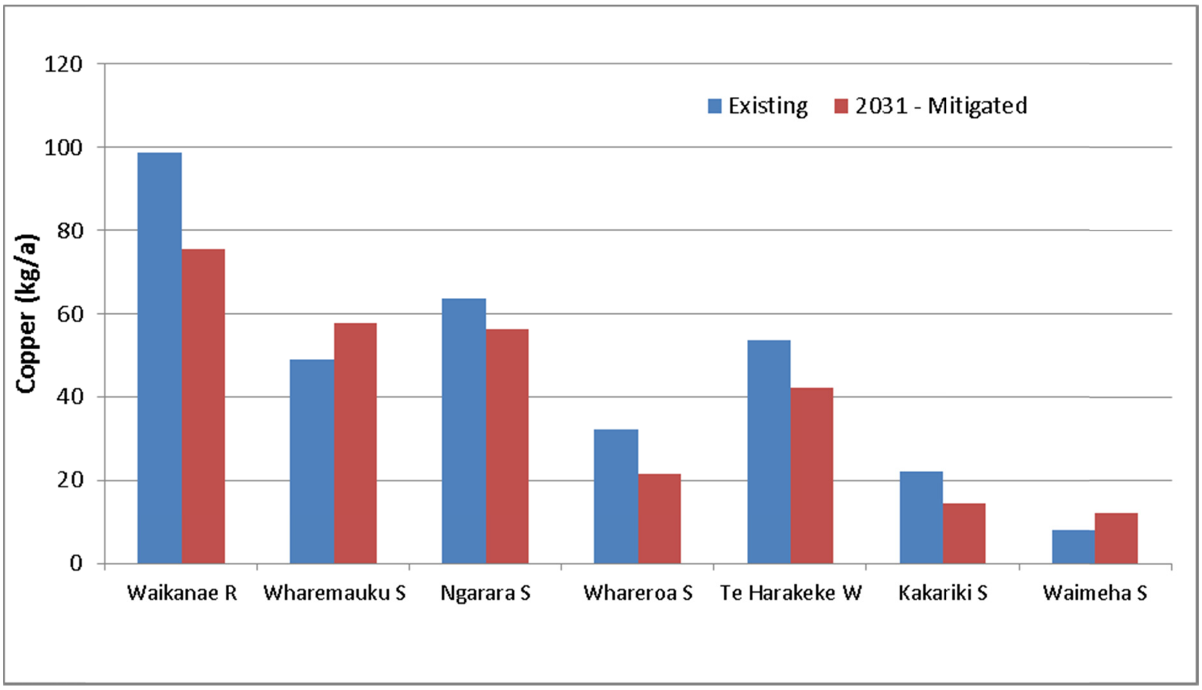
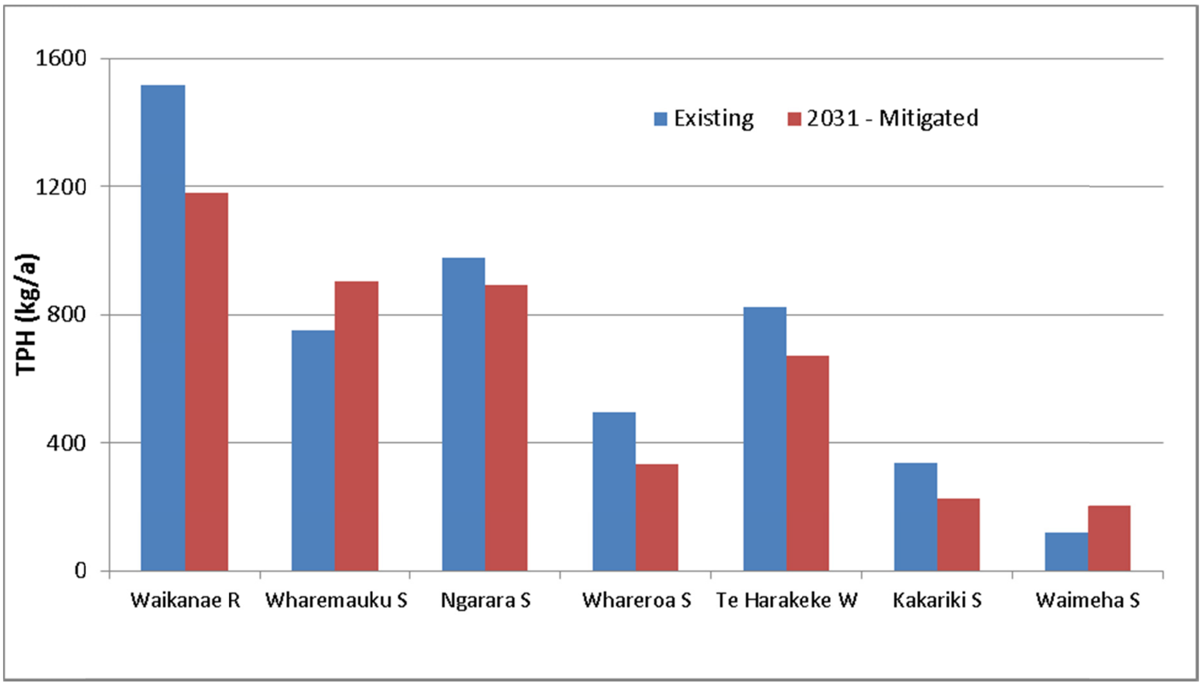


Figure 13: Change between the existing and future (Year 2031) stormwater treated TPH load generated from the roading network for the catchments and subcatchments across the Project extent



The contaminant load modelling has been undertaken assuming swales as the primary stormwater treatment device in all catchments modelled. As discussed in Section 2.3.1, swales in the CLM have a load reduction factor of 0.47 which is likely to underestimate the reduction of TPH. The TPH was modelled separately using the higher load reduction factor given for biomedia filtration devices to obtain a more representative estimate of the TPH reduction across the roading network within the Waikanae River and Wharemauku Stream.

3.8. Summary

An overall summary of the CLM results are shown below in Table 13 to 16.

Table 13: Change (%) in the future (year 2031) contaminant loads relative to existing levels, without stormwater treatment (unmitigated)

Catchment / Sub-catchment	Sediment	Zinc	Copper	TPH
Waikanae River	< 1	-3	- 5	-16
Wharemauku Stream	< 1	5	4	30
Ngarara Stream	< 1	2	3	5
Whareroa Stream	< 1	-9	-13	-26
Te Harakeke Wetland	< 1	4	1	-5
Kakariki Stream	-1	-9	-17	-24
Waimeha Stream	5	25	50	72

Note: the negative values correspond to a decrease in the future contaminant loads relative to the existing load while positive percentages indicate a corresponding load increase·

Table 14: Change (%) in the future (year 2031) contaminant loads relative to existing levels, with stormwater treatment (mitigated)

Catchment / Sub-catchment	Sediment	Zinc	Copper	TPH
Waikanae River	< 1	-4	-7	-25
Wharemauku Stream	< 1	3	2	15
Ngarara Stream	-1	-4	-8	-15
Whareroa Stream	< 1	-11	-16	-35
Te Harakeke Wetland	< 1	-2	-10	-25
Kakariki Stream	-2	-13	-23	-37
Waimeha Stream	2	20	42	52

Note: the negative values correspond to a decrease in the future contaminant loads relative to the existing load while positive percentages indicate a corresponding load increase·

Table 15: Decrease (%) in the future contaminant loads with stormwater treatment relative to the predicted future loads without stormwater treatment

Catchment / Sub-catchment	Sediment	Zinc	Copper	TPH
Waikanae River	< 1	1	2	11
Wharemauku Stream	< 1	2	3	12
Ngarara Stream	< 1	6	10	19
Whareroa Stream	< 1	2	3	12
Te Harakeke Wetland	< 1	6	12	21
Kakariki Stream	< 1	4	7	17
Waimeha Stream	2	3	6	12

Table 16: Existing and Future Predicted Contaminant Concentrations (mg/kg) in the Sediment of the Catchments along the Project Extent with Stormwater Treatment

Catchment / Sub-catchment	Zinc		Copper		TPH	
	Existing	Future	Existing	Future	Existing	Future
Waikanae River	57	55	11	11	49	37
Wharemauku Stream	316	326	98	99	328	376
Ngarara Stream	253	246	52	48	545	467
Whareroa Stream	60	54	14	12	103	67
Te Harakeke Wetland	219	218	46	42	490	372
Kakariki Stream	288	255	59	47	578	371
Waimeha Stream	802	935	144	187	1410	2083

4. Discussion

4.1. Effects of the proposed Expressway without Stormwater Treatment

The results of the CLM assessment show that there is likely to be a small relative reduction in the sediment loads generated from most catchments across the Project extent in 2031 with full operation of the proposed Expressway (without stormwater treatment) relative to existing levels. A decrease in the sediment loads occurs when farmed pasture and other high sediment-yielding land uses are converted to urban areas (i.e. roofs, roads) where the sediment yields are often lower.

The predicted zinc, copper and TPH loads generated from three catchments (Wharemauku, Waimeha and Ngarara) in the future (2031) scenario (without stormwater treatment) are expected to increase relative to existing levels. The remaining catchments show a corresponding decrease in the contaminant loads. The overall predicted change in the contaminant loads appears to be mostly due to redistribution of traffic between the lower and higher traffic count classifications. For example, the model assumes a sediment yield of 150 $gm^{-2}a^{-1}$ from a road in the 5,000 to 20,000 vehicles/day classification and a sediment yield of 299 $gm^{-2}a^{-1}$ from a road in the 20,000 to 50,000 vehicles/day classification. The full suite of contaminant yields from the road classifications is shown in Table 5.

Note that traffic counts across the proposed Expressway and SH1 in the future 2031 scenario will be greater than the traffic counts on the existing SH1 (Appendix 25.B). However, the traffic will be spread over two roads (the proposed Expressway and SH) rather than one road (SH1). As such, traffic will be less congested and more free-flowing along the proposed Expressway and SH1 compared to the existing scenario.

4.2. Efficiency of Stormwater Treatment

For all catchments modelled in this study, the fully operational proposed Expressway with stormwater treatment, is likely to lead to a < 2% reduction in the sediment load relative to the scenario without stormwater treatment. The corresponding load reduction for zinc, copper and TPH are between 1% and 6% for zinc, 2% and 12% for copper and between 1% and 21% for TPH.

The contaminant with the smallest predicted relative change in load between the existing and future (with the proposed Expressway) modelled land use scenarios is sediment. Sediment is largely derived from rural-based land use activities. As the surface area of the proposed Expressway is small relative to the size of the predominantly rural-based catchments being modelled, the change in sediment load is typically small.

In comparison, the largest relative change occurred for TPH. Roads are generally the primary source of TPH and therefore, the proposed Expressway has the largest influence on the predicted loads between the land use scenarios modelled. In comparison, zinc and copper are derived from numerous urban catchment sources.

4.3. Effects of the proposed Expressway with Stormwater Treatment

The fully operational proposed Expressway is likely to lead to an overall improvement in the contaminant loads discharging from most catchments along the Project extent. The results of the CLM process showed that during the operational phase, with stormwater treatment, the contaminant loads discharging from the outfall of each catchment are likely to be lower than without stormwater treatment. In addition, for all but two catchments (Wharemauku and Waimeha streams), the contaminant loads predicted for the future stormwater-treated land use scenario, will be lower than the existing land use scenario (without the proposed Expressway). This is partly a result of the change in the roading network, where traffic is conveyed from roads without stormwater treatment to the proposed Expressway, with stormwater treatment. For the Wharemauku and Waimeha stream catchments, the predicted contaminant loads during operation of the proposed Expressway with stormwater treatment, are likely to be above existing loads. For the Wharemauku Stream catchment, this is mostly due to an increase in the traffic counts on Kāpiti Road in the future 2031 land use scenario. For the Waimeha Stream catchment, the increase in the contaminant loads is due to addition of the proposed Expressway through this catchment (SH1 does not pass through the catchment). Note that implications and effects from increased contaminant loads on water quality and ecology in the receiving environment are not discussed in this report. These are discussed in Technical Reports 22, 26 and 30, Volume 3.

4.4. Future Development along the Kāpiti Coast

The Kāpiti Coast will likely undergo further development prior to year 2031 and therefore the contaminant loads given in this assessment are not representative of the actual loads in year 2031. Nevertheless, the CLM process provides a means where the relative change in the expected contaminant loads generated during the operational phase of the proposed Expressway can be assessed.

5. Summary

The results of the CLM assessment can be summarised as follow:

- Development of the proposed Expressway, with stormwater treatment, is likely to lead to an overall improvement in the contaminant (sediment, zinc, copper and TPH) loads discharging to the receiving environment from almost all catchments (except the Wharemauku and Waimeha stream catchments) along the Project extent relative to existing levels. This is largely due to a change in the roading network where traffic is conveyed from roads without stormwater treatment to the proposed Expressway, with stormwater treatment and a reduction in the contaminant yields from lesser trafficked roads. Conversely, the contaminant loads generated from the Wharemauku Stream catchment and Waimeha Stream sub-catchment are likely to increase relative to the existing land use levels.
- With stormwater treatment, the sediment load is likely to reduce by < 2% in all catchments modelled in this study, relative to a no-stormwater treatment scenario. The corresponding reductions for zinc, copper and TPH are likely to range between 1 and 6% for zinc, 2 and 12% for copper and 1 and 21% for TPH.

5.1. Limitations

The following limitations apply to the CLM process as undertaken in this study.

- The CLM (ARC, Version 06) was developed from studies undertaken in the Auckland region. The applicability of the model to the Wellington region is discussed in Appendix 25.A.
- The CLM makes no specific allowance for natural processes such as natural small-scale ponds, wetland areas and other such areas which may retard or mitigate the true contaminant load discharging from the catchment.
- Only one treatment device type (or treatment train arrangement) can be specified for each land use class for each catchment modelled. Swales have been used as the designated treatment device in those catchments where stormwater runoff is treated by way of a combination of both swales and wetlands. This is a conservative approach which likely underestimates the contaminant loads in those cases where the predominant treatment device is constructed wetlands. For most contaminants, constructed wetlands have a higher load reduction factor than swales.
- The CLM does not provide for those processes occurring in the receiving environment such as remobilisation, mixing, deposition and dispersion. As such, it most likely overestimates the contaminant concentrations in the sediment at the outfall.
- The future (2031) land use scenario would see construction of the proposed Expressway with some small areas of residential and commercial/industrial development. It is likely that any redevelopment within the urban areas would include some targeted stormwater management. These have not been expressly allowed for in the CLM process.

References

Center for Watershed Protection (CWP), 2000. National Pollutant Removal Performance Database for Stormwater Treatment Practices 2nd Edition. For EPA Office of Science and Technology. http://www.stormwatercenter.net/Library/STP-Pollutant-Removal-Database.pdf

Connell Wagner, 2001. Isohyet Based Calculation of Design Peakflows. Isohyet Guidelines and Charts. http://www.kapiticoast.govt.nz/Documents/Downloads/Isohyet-Guidelines-and-Charts.pdf

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Appendix 25.A

Contaminant Load Model (CLM)

Contaminant Load Model (CLM) Version 2006 (ARC)

The Auckland Regional Council's (ARC) Contaminant Load Model (Version MAY06) (CLM) was used for this assessment. The CLM model was developed from data obtained from three key projects in the Auckland region which quantified different sources of metal contaminants in urban catchments. These were:

- Stormwater quality and quantity in Auckland City (NIWA)
- Vehicle contributions of metals to road run-off reaching urban stormwater networks (NIWA)
- Roof run-off quality (Diffuse Sources Ltd and Kingett Mitchell Ltd, 2005).

The CLM spreadsheet model has been developed to simplify the calculation of how much sediment, zinc, copper and petroleum hydrocarbons is produced within a given land area. The model brings together the best data presently available for contaminant yields (the amount of contaminant produced per given source area in a given time e.g. g m^2/a) and the efficiencies of various management options for reducing the amounts of contaminants leaving a site.

For TSS, zinc, copper and TPH the spreadsheet calculates the expected bottom of site outfall loads, annual average yields and the average concentration of zinc, copper and TPH per unit of sediment. The proposed different management options (wetlands and proprietary devices) can then be applied to model the expected reduction in contaminant loads.

The model allows for the selection of up to three contaminant management options in series e.g. a stormwater treatment train, but note that the overall retention efficiencies of most such trains have never been measured.

Model Input

The spreadsheet model allows input for the total site area, the length of each category of roads, the areas of other contaminant sources, the contaminant management options for each source and for the whole site, and the fractions of the source and sites areas draining to the management option trains. The optional input data are the management options for each source and for the site (Bottom of Site). These options include painting roofs, stabilising stream banks and stormwater treatment.

Model Outputs

When all the source areas and any management options have been entered, the source contaminant yields, overall management option load reduction efficiencies and the raw (unmanaged) and reduced (managed) loads are given. Providing a sum for the urban parts of the site enables the sediment load reduction to be compared with design removal efficiencies required by local and regional rules.

Application of the Contaminant Load Model to the Wellington Region

Due to the time constraints of the study, the CLM model was not validated or assessed in terms of its applicability to the Wellington region.

The CLM was developed from studies undertaken in the Auckland region and as such, there may be factors which limit the model in terms of its applicability to the Wellington region. These include such factors as soil type and topography. The suitability of the model to the Wellington region was assessed as part of the environmental effects assessment undertaken by NZTA as part of the Transmission Gully project (Transmission Gully Project *Assessment of Water Quality Effects*, Technical Report 15, 2011). From this assessment, it was concluded that it was appropriate to use the ARC CLM to model the estimated contaminant loads from the Transmission Gully Project. The Transmission Gully route lies south of the proposed M2PP route with predominantly rural land use. As such, the model is therefore likely to be appropriate for use in the catchments along the M2PP extent.

The ARC CLM was also validated as part of NZTA's Transmission Gully project. The study concluded that appropriate use of the data was in assessment of the relative change between the scenarios, both with and without the Project. A similar assessment approach has been used in this study. As the assessment is based on the relative change in the contaminant levels, any change in the output of the model due to geographical differences is likely to be negligible.

Appendix 25.B

Traffic Count Data

Traffic Count Data

2010

Road Name	Count
AMOHIA STREET	3673
ARAWHATA ROAD	6831
ELIZABETH STREET	8106
FIELD WAY	2445
GUILDFORD DRIVE	4431
IHAKARA STREET	3454
KAPITI ROAD	19591
MARAE LANE	1856
MATAI ROAD	2430
MAZENGARB ROAD	5680
MILNE DRIVE	3531
NGAIO ROAD	6539
NGARARA ROAD	2174
OTAIHANGA ROAD	6544
PAETAWA ROAD	876
PARK AVENUE	2603
PEKA PEKA ROAD	1133
POPLAR AVENUE	2940
RATANUI ROAD	7236
RAUMATI ROAD	7733
REALM DRIVE	2947
RIMU ROAD	14428
SH 1	22712
TE MOANA ROAD	8467
TE ROTO DRIVE	10260
WALTON ROAD	162

2031

Road Name	Count
AMOHIA STREET	8618
ARAWHATA ROAD	7828
ELIZABETH STREET	9975
FIELD WAY	3641
GUILDFORD DRIVE	4215
HILLCREST ROAD	482
IHAKARA STREET	11313
KAPITI ROAD	23587
MARAE LANE	1684
MATAI ROAD	3267
MAZENGARB ROAD	7180
MILNE DRIVE	3628
NGAIO ROAD	8801
NGARARA ROAD	4283
OTAIHANGA ROAD	5658
PAETAWA ROAD	1247
PARK AVENUE	15702
PEKA PEKA ROAD	3882
POPLAR AVENUE	13402
RATANUI ROAD	4898
RAUMATI ROAD	10385
REALM DRIVE	3564
RIMU ROAD	14082
SH 1	14126
TE MOANA ROAD	8608
TE ROTO DRIVE	12053
WALTON ROAD	482
Expressway	16801
Peka Peka Interchange	3310
Poplar Interchange	6536
IHAKARA ROAD EXT	4779

Appendix 25.C

Waikanae River Catchment CLM Spread Sheets

Refer to Technical Report Appendices, Report 25, Volume 5

Appendix 25.D

Wharemauku Stream CLM Spread Sheets

Refer to Technical Report Appendices, Report 25, Volume 5

Appendix 25.E

Ngarara Stream Catchment CLM Spread Sheets

Refer to Technical Report Appendices, Report 25, Volume 5

Appendix 25.F

Whareroa Stream CLM Spread Sheets

Refer to Technical Report Appendices, Report 25, Volume 5

Appendix 25.G

Te Harakeke Wetland CLM Spread Sheets

Refer to Technical Report Appendices, Report 25, Volume 5

Appendix 25.H

Kakariki Stream Sub-Catchment CLM Spread Sheets

Refer to Technical Report Appendices, Report 25, Volume 5

Appendix 25.I

Waimeha Stream Sub-Catchment CLM Spread Sheets

Refer to Technical Report Appendices, Report 25, Volume 5