TRANSMISSION GULLY PROJECT

Proposed Ecological Management & Monitoring Plan

August 2011

Boffa Miskell

Front Cover Photo:

TOP LEFT: Perched culverts in the main stem of Duck Creek which will be re-graded as part of mitigation for this project to allow the return of some species of native fish to the upper reaches of this stream.

TOP RIGHT: Boulderfields common on the steep eroding slopes of the upper Te Puka and Horokiri valleys. They provide habitat for lizards and insects. Reinstatement of lost boulderfields will be required as part of the mitigation package.

BOTTOM LEFT: Early retirement and planting along the designation began in 2002. This has lead to revegetation of 40 ha of land adjacent to key streams which will provide protection from erosion and improved upstream cover for native fish species during construction.

BOTTOM RIGHT: Extensive monitoring of freshwater and marine habitats will be required throughout the construction process. Baseline sampling will be necessary to establish thresholds of acceptable change which will guide adaptive management of the construction site.

Bibliographic reference:
Boffa Miskell, 2011: Transmission Gully Project: Proposed Ecological Management and Monitoring Plan. Prepared for NZ Transport Agency and Porirua City Council by Boffa Miskell Limited. Report No: W09034G. 95 p.

Prepared by:	Stephen Fuller	Associate Director	BML
	Dr Vaughan Keesing	Principal Ecologist	BML
	Dr Sharon De Luca	Principal Ecologist	BML
Reviewed by:	M Kennedy	NZTA	

Document Status: Draft
Version: V.2. 30 July 2011

TABLE OF CONTENTS

A. Introduction

1 BACKGROUND

This plan outlines an array of guidelines and programmes for the mitigation and monitoring of effects of the proposed Transmission Gully Road project. These are intended to inform both the Environmental Management Plans that will be prepared for construction, and to provide information that will inform the detailed design process of stream diversions, culverts and protection of vegetation, habitats and indigenous fauna.

The report addresses freshwater, terrestrial and marine issues. The body starts by summarising the range of ecological values and potential adverse and positive effects, summarises the proposed mitigation actions and then provides general approaches to their management and monitoring.

Later sections contain a number of indicative revegetation and monitoring programmes referred to in the body of the document. Some of these are fully developed plans (such as the aquatic monitoring plan and revegetation programme), others guidelines such as for the installation of culverts and riparian revegetation or an array of site specific information to guide engineers in developing the future plans (the diversion reach appendices).

The sediment and erosion and stormwater sections while very pertinent to the aquatic ecology of the area are programmes managed by the construction engineers, and the establishment of these is addressed by them at the appropriate stage. The Ecological Impact Assessment (EcIA) however, addresses the estimations made by those experts and the following report highlights the ecological aspects of these potential effects and how in essence significant adverse effects will be avoided.

2 CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

This Ecological Management Plan (ECOMP), forms part of a comprehensive suite of environmental controls within the Construction Environmental Management Plan (CEMP) for the construction phase of the Transmission Gully Project. The ecological components of this plan are listed in the table below.

The ECOMP addresses all aspects of the Projects ecological monitoring and management initiatives. The purpose of the ECOMP is to detail the ecological monitoring and management programme so consent agencies, design engineers, and contractors know how the ecological effects of the Transmission Gully Project will be measured and managed.

In addition, ecological input will be important in the development of Site Specific Environmental Management Plans (SSEMP).

The monitoring component of this plan includes qualitative and quantitative monitoring of the effects of construction phase activities on the terrestrial, freshwater and marine ecosystems within the wider project area. The focus of the monitoring is to identify potential adverse environmental effects from construction and to trigger implementation of appropriate systems and controls to avoid, remedy or mitigate these effects.

The ECOMP will be updated throughout the course of the Project to reflect material changes associated with changes to construction techniques or the natural environment. Approval from the Greater Wellington Regional Council and the Department of Conservation will be required, for any relevant revisions of a material nature to the ECOMP or sub-plans, for which these authorities have jurisdiction.

An overarching principle of the ECOMP is avoidance through the design process, and where this is not possible then minimisation, remediation and mitigation of adverse effects on ecological values.

3 SUMMARY OF ECOLOGICAL VALUES

The main alignment of Transmission Gully and the three link roads traverse a wide range of habitats from improved pasture, plantation forestry, shrublands, and scrub, to forest remnants. It ranges from sea level to 280m in altitude.

Terrestrial Vegetation

While much of the landscape along the Project route has been highly modified by farming, the proposed alignment will potentially affect many areas of vegetation of ecological value including protected and unprotected forest remnants and areas of secondary regeneration. The scale of effects will vary for each site. For some, small areas of marginal vegetation may be removed. Some sites will be permanently affected, losing vegetation beneath the road footprint. Other sites will be affected during the construction period but there will be opportunities for restoration following completion of works.

Terrestrial Fauna

Terrestrial fauna has been affected by a long history of land clearance and farming with native lizards present in low numbers and a low diversity. The key habitats identified for both lizards and Peripatus are the mature forests of the Akatarawa Forests at the Wainui Summit, and the colluvial boulder fields found on steep slopes within the Te Puka, upper Horokiri, and Duck Creek.

Avi-fauna

Of the range of native birds present most are common within pastoral landscapes. The few uncommon or threatened bird species are typically associated with key habitats. High numbers of native birds were observed in and around the mature indigenous forest in the headwaters of the Te Puka and Horokiri catchments had a high diversity and abundance of more common native forest passerines such as kereru and tui. There was good though lesser abundance of native forest species in the regenerating and mature forests of Cannons Creek and Porirua Park Bush. Finally the saltmarsh and tidal flats of Pauatahanui Estuary are known for the presence of uncommon and rare birds including international migrants.

Native Bats

The only vegetation of sufficient size and maturity to sustain a population of native bats is the mature forests of the Akatarawa Forests. An unconfirmed bat vocalisation was recorded at Wainui Saddle on the margins of this forest during this study. This observation needs to be confirmed.

Streams Aquatic Habitat

The Transmission Gully alignment crosses eight catchments, seven of which discharge to Porirua Harbour, a nationally significant estuary. Porirua Harbour contains two shallow tidal inlets: the Onepoto Arm and the Pauatahanui Inlet. Four streams (Horokiri, Ration, Pauatahanui, Duck) discharge into the Pauatahanui arm, while two (Kenepuru/Cannons and Porirua) discharge into the Onepoto Arm of the harbour. The eighth catchment (Wainui/Te Puka) discharges to the Kapiti Coast north of Paekakariki. The waterways include permanently flowing streams and rivers as well as intermittent and ephemeral headwaters.

Freshwater Fauna

Each of the streams that lie along the Transmission Gully route has high natural and fisheries value. Significant lengths of stream habitat will be lost due to culverting and fill sites. Similar lengths of the stream will suffer from temporary or permanent diversion. In particular Duck, Horokiri and Te Puka systems are considered to be regionally significant. The lower reaches of Ration and Pauatahanui are also considered to be of high value despite their modifications as they retain

important fauna species. The Kenepuru, Porirua tributary and Cannons systems are of lower value although they still support an array of values, notably components of the macroinvertebrate fauna.

Porirua Harbour (Pauatahanui Inlet and Onepoto Inlet)

Porirua harbour and its associated reserves and wildlife refuges are identified in the Regional Policy Statement as 'Sites of National or Regional Significance for Indigenous Vegetation or Significant Habitats for Indigenous Fauna'. Porirua Harbour is also identified in the Regional Policy Statement as a 'Landscape and Seascape of National or Regional Significance'. The Department of Conservation considers Pauatahanui Inlet to be of international significance given our obligations to the RAMSAR Convention on Wetlands, and the Bonn Convention on Migratory Species.

The major concern identified for construction of this route is the risk of sediment discharge to the Harbour during construction and the long term discharge of contaminants from the road surface once operational. This potential impact will be an area where high levels of control are expected to be required as Conditions of the Resource Consents. The level of risk has not previously been quantified.

Protected & Identified Natural Areas

The proposed designation crosses nine protected natural areas (reserves, covenants, Regional Parks) and three wetland reserves lie downstream of works. The designation also crosses 13 unprotected sites which have been identified by PNA surveys as having conservation value.

The proposed Transmission Gully route passes through two of the five regional parks, Battle Hill Farm Forest Park and Belmont Regional Park. GWRC has prepared management plans for both Parks. Both plans are currently being reviewed. The management plans recognize the reality of the Transmission Gully Project and that the impacts will be significant. Both of the management plans also state that the impacts need to be mitigated.

4 SUMMARY OF POTENTIAL ADVERSE EFFECTS

4.1 Direct Impacts of Construction

A number of areas of vegetation and habitats of indigenous fauna have been identified that will be lost beneath the project Footprint and this effect will need to be mitigated.

The key effects during construction are:

- Permanent loss of 40 ha of indigenous vegetation (wetlands, shrublands and scrub, seral forest, and mature or maturing forest) and habitat beneath the road footprint;
- Temporary loss or modification to a further 85 ha of indigenous vegetation due to earthworks and construction activities within the wider designation;
- Permanent loss of 5,100 m of freshwater habitat, riparian margins, and resident populations of freshwater flora and fauna, due to culverting, diversion and associated stream shortening;
- Modifications to a further 5,200 m of freshwater habitat and riparian margins through bridge construction and diversion;
- Potential loss of sedentary species (e.g. lizards) when their habitat is removed;
- Disturbance and displacement of mobile species (e.g. birds) by construction activity; and
- Potential impact on the movement of migratory fish by streambed modifications and culverts.

4.2 Indirect Impacts of Construction

The key indirect effects during construction are:

- Increase of sediment within stream habitats above baseline levels with potential impacts on streams and freshwater fauna; and
- Increase of sediment discharging to harbours above baseline levels with potential impacts on habitats, vegetation and species reliant on these waterbodies.

4.3 Operation Impacts

The key effects during operation are:

- Potential discharge of contaminated stormwater from the road surface to local streams, with potential impacts on water and habitat quality, and effects on sensitive taxa;
- Potential increase of stormwater and contaminant discharge to Porirua Harbour with potential impacts on habitats and sensitive fauna; and
- Potential effects of road operation on sensitive bird and/or bat populations.

5 SUMMARY OF PROPOSED MITIGATION

5.4 RECOMMENDED MITIGATION

A number of proposed mitigation and management measures have been proposed to avoid, remedy and / or mitigate for the potential adverse effects of the project. Note that mitigation is proposed through detailed design, careful management of works, monitoring and adaptive management where effects are identified, and through the retirement and revegetation of land to mitigate for loss or modification to important habitat.

Mitigation for Direct Impacts of Construction

- In total it has been calculated that 250 ha of land needs to be retired and revegetated to mitigate for the permanent loss or modification of 120 ha of terrestrial habitat.
- Mitigation sites have been located along the alignment with a total area of 425 ha. Within these sites 270 ha of revegetation or enrichment planting is proposed. This meets the requirements for vegetation mitigation.
- These blocks combined with the other 9 early retirement sites (already protected), and the retrofitting of culverts in Duck Creek, provide a quantity of stream types (30.9km). This land will be treated in a variety of ways to achieve the riparian enhancements required by the SEV analysis.
- Within these sites, a range of mitigation measures are proposed including revegetation, enrichment planting, land retirement, the remediation of damaged stream bed, innovative fish passage design, and detailed design of stream diversions to match the habitat that is being replaced.
- Attention is required during detailed design where opportunities exist to further avoid areas of vegetation and habitat.
- In addition attention is required in the design and construction of culverts and stream diversions to avoid or remedy potential effects on fauna and habitat quality.
- A number of recommendations are made with regard to fish passage and the capture and transfer of fish during construction of culverts and diversions. The creation of boulderfields

at the toe of fill batters in the Te Puka and Horokiri can mitigate for loss of lizard and insect habitat.

- Each of these activities requires careful monitoring to ensure the required outcomes are achieved.

Indirect Impacts of Construction

- A range of measures are proposed for the management of erosion, and the capture and treatment of sediment during construction. Treatment devices have been designed to exceed regional guidelines (Greater Wellington Regional Council; Erosion and Sediment Control Guidelines for the Wellington Region June 2006). Some discharge of sediment will however, occur and the effects of this on the aquatic and marine receiving environments requires monitoring.

Operation Impacts

- The Project design requires the use stormwater treatment wetlands where possible and proprietary treatment devices elsewhere. Combined, these devices are expected to perform such that the levels of contaminants in stormwater discharging to streams and the Porirua Harbour will not increase. Some discharge of stormwater contaminants will however, occur and the effects of this on the aquatic and marine receiving environments requires monitoring.

6 SUMMARY OF POTENTIAL POSITIVE EFFECTS

The retirement and revegetation required in mitigation for the loss of terrestrial and freshwater habitat, and the methods of stormwater management, will have a number additional positive environmental outcomes. They are:

- **A green corridor**: There is an opportunity through retirement and revegetation along sections of the route (as part of both ecological and landscape mitigation), to provide a series of habitat "stepping stones" along the alignment, and connect existing bush areas. This will have ecological benefits for both terrestrial fauna and native birdlife as well as providing landscape and amenity benefits.
- **A blue corridor**: There is an opportunity through retirement and revegetation of sections of stream within the Te Puka Stream, Horokiri Stream, and Duck Creek (as part of both ecological and landscape mitigation), to create sections of aquatic habitat with greater habitat values than are currently present in these largely rural landscapes. This will have long term ecological benefits.
- **Reductions in long term erosion**: The land retirement proposed in the Te Puka and upper Horokiri will lead to long term reductions in erosion within these sections of catchment with the benefit of reduced sediment transport to the lower reaches of these streams and to the coast (Wainui stream mouth) and harbours (Pauatahanui Inlet).
- **Distribution & abundance of native fish:** Existing stream crossings and culverts along the route have been confirmed as native fish barriers. The recommended replacement of these barriers as offset mitigation for habitat loss will open up large areas of these catchments to native fish species that have declined or disappeared due to these barriers.

- **New wetlands:** The current Project design uses 5 treatment wetlands for the capture and removal of contaminants from stormwater. These wetlands, if designed and managed properly, will also provide additional benefit for native flora and fauna.
- **Research:** this Project will result in a range of ecological investigations that will provide public good in terms of increasing local conservation knowledge, and will potentially involve new science around stream diversions and rehabilitation, and modelling of effects on the estuary. This knowledge and science can be fed directly into management of adjoining areas under control of other agencies.

Each of these activities requires monitoring to ensure the required outcomes are achieved.

7 SUMMARY OF MONITORING REQUIREMENTS

Baseline, construction and post construction monitoring of sensitive environments, water quality, culvert installation, earthworks, discharges to the harbour, and mitigation will be critical to achieving the outcome discussed above.

We strongly recommend a process of adaptive management for dealing with erosion and sediment control, and for the design and installation of culverts and diversions. Adaptive management would require detailed monitoring, the results of which feedback into the design and ongoing management.

This includes monitoring of:

- Revegetation
- Species Translocations
- Habitat development
- Fish passage
- Diversion design and habitat restoration
- Culvert installation and fish passage
- Erosion and sediment management
- Stormwater treatment
- The potential positive effects of the mitigation measures.

8 TABULATED SUMMARY OF ECOLOGICAL MANAGEMENT AND MONITORING REQUIREMENTS

Actual or potential environmental effect	Mitigation Recommended	Monitoring Recommended	Condition required	Report name/reference
TERRESTRIAL & AQUATIC ECOLOGY				
Construction effects - Direct				
Terrestrial vegetation loss	▪ Conservative approach to calculating mitigation requirements. ▪ Best endeavours to avoid identified sites within designation through detailed design. ▪ 250ha of revegetation as mitigation for loss of 120 ha of native vegetation (sites identified & include existing and total 426ha of which 270 ha of revegetation). ▪ Mitigation sites to be legally protected. ▪ Landscape planting along the route for landscape and visual mitigation will provide additional benefit.	▪ Ecological involvement and advice during detailed design. ▪ Landscape and restoration plan for each mitigation site. ▪ Contractual monitoring of planting for a minimum 3 years with quarterly report year 1, annually thereafter. ▪ Ecological monitoring of habitat recreation.	**Y**	SSEMP (identify issue & locations) Landscape and Revegetation Plan to provide detail
Species Loss – plants	▪ Ensure stormwater treatment wetland development provides habitat for rare plant. ▪ 5 stormwater treatment ponds proposed along the site will provide additional wetland habitat along the route as mitigation for any minor effect on this site.	▪ Contractual monitoring of planting for a minimum 3 years with quarterly report year 1, annually thereafter. ▪ Additional rare plant monitoring 1 & 3 yrs after construction.	**Y**	SSEMP (identify issue & locations) Detailed Design for Stormwater Ponds provide detail.
Species Loss – lizards, Peripatus	▪ Capture and translocation prior to earthworks where habitat found. ▪ Re-create scree / boulderfield habitat at toe of fill batters for lizards.	▪ Permit required for translocation. Will require monitoring of populations for a fixed period. ▪ Monitoring of formed scree for a fixed period to ensure stable and in use by target species. ▪ Ecological involvement and advice during detailed installation.	**Y**	SSEMP DoC Permit required.
FW habitat loss & modification	▪ Conservative approach to calculating mitigation requirements. ▪ Best endeavours to avoid streams not directly affected by stream works. ▪ Temporary culverts installed on all temporary construction access tracks to minimise trafficking through stream beds. ▪ Protection and restoration of 26km of stream as mitigation for loss or modification of 10.5 km of stream bed. (sites identified and total 30 km of stream to be protected).	▪ Ecological involvement and advice during detailed design and installation of culverts. ▪ Monitoring of diversions to ensure velocities are acceptable and the appropriate habitat mix is achieved. ▪ Monitoring of culverts to ensure fish passage is maintained. ▪ Monitoring of ecological enhancement in stream, and revegetation, land retirement	**Y**	SSEMP Diversion Design Guide including ecological design principles (EcIA). Culvert Design Guide including ecological design principles (EcIA). Detailed construction and staging plan for each diversion.

Actual or potential environmental effect	Mitigation Recommended	Monitoring Recommended	Condition required	Report name/reference
	▪ Mitigation sites to be legally protected. ▪ Replacement of perched culverts in Duck creek will provide additional benefit (8.5 km available to fish.)	and protection to ensure that predicted benefits are achieved. ▪ Monitoring of upper Duck Creek to ensure improved fish passage is providing anticipated benefits. ▪ Monitoring of down stream benthic communities to ensure communities remain stable		
Species Loss – FW species loss / disturbance – river works	▪ Capture and translocation of fish prior diversion or culverting. ▪ Timing of works to avoid peak fish migrations (1 Oct to 30 Dec, & 1 Apr to 30 May) ▪ Innovative culvert design.	▪ Monitoring of diversions for at least two spring migrations following completion to ensure communities of fish and macro-invertebrates re-establish.	**Y**	SSEMP DoC Permit required.
Disturbance avifauna – falcon / kaka / pied shag / black shag	▪ Revegetation of Te Puka and upper Horokiri, together with formation of stormwater treatment ponds will more than mitigate for any minor effects on these species.	▪ N/A	**N**	NIL
Disturbance bats	▪ NIL required	▪ Additional study required to confirm presence, species and population characteristics.	**Y**	Avifauna Monitoring Plan (See EcIA)
Construction Effects – Indirect				
Dust	▪ NIL – goal to avoid through monitoring and management.	▪ Monitoring of dust and appropriate controls.	**Y**	Part of CEMP
Fire	▪ NIL – goal to avoid through monitoring and targeted management.	▪ Comprehensive fire plan. ▪ Monitoring of fire risk. ▪ No smoking work site. ▪ Controls or halt on hot works during high risk periods, monitoring of vehicle / equipment exhausts. ▪ Relationship with Rural Fire including on-site training.	**Y**	Part of CEMP
Weeds	▪ NIL - goal to avoid through monitoring and targeted management.	▪ Weed monitoring during works and at the conclusion. ▪ Vehicle washing. ▪ Controls on sourcing of aggregate and topsoil if required.	**Y**	Part of CEMP
Sediment to Streams & Harbour	▪ Establishment of high target for management of erosion and pond treatment efficiency. ▪ Use of innovative sediment capture devices. ▪ Construction staging to minimise risk during a storm event. ▪ Agreed maximum area of open (unstabilised) earthworks within	▪ Adaptive management of erosion and sediment control devices. ▪ Continuous water quality monitoring. ▪ Event based aquatic habitat monitoring. ▪ Calendar monitoring of down stream benthic communities	**Y**	SSEMPs provide detailed guidance. Water quality and Aquatic health monitoring plan basis of adaptive management (See EcIA).

Actual or potential environmental effect	Mitigation Recommended	Monitoring Recommended	Condition required	Report name/reference
	Pauatahanui Inlet at any one time to minimise risk during a storm event. ▪ Sediment ponds design capacity 1:10 yr storm.	to ensure communities remain stable. ▪ Early warning system for potential storm events.		
Contaminant from worksite to Streams & Harbour	▪ NIL - goal to avoid through monitoring and targeted management.	▪ Plans for response to any potential discharge of contaminants to streams or adjacent land, fuel, lubricant, cement. ▪ Truck washes bunded and dirty water captured. ▪ Dedicated vehicle service sites bunded. ▪ Risk management plan and on site pollution kits and training.	**Y**	Part of CEMP
Operational effects				
Stormwater to streams and harbour	▪ Use of treatment wetlands and proprietary in-road filter devices. ▪ Establishment of high target for treatment efficiency. ▪ Retirement of erosion prone land in Te Puka and Horokiri. ▪ Transfer of traffic from SH58 & Grays road (discharge to inlet without treatment) to TG (treated) will provide some benefit. ▪	▪ Annual monitoring of stormwater treatment devices to ensure they continue to meet design efficiencies. ▪ Longer term monitoring of downstream benthic communities to ensure communities remain stable	**N**	To form part of ongoing road monitoring work programme.
Disturbance avifauna – bats	▪ Adaptive management	▪ Assuming present monitoring is required.	**Y**	Monitoring plan to be developed.
Disturbance avifauna – pipit	▪ Nil proposed.	▪ N/A	**N**	N/A
Disturbance avifauna – others	▪ NIL required.	▪ N/A	**N**	N/A
Fish Passage	▪ Adaptive management.	▪ Annual monitoring of culverts and in-stream structures to ensure that fish passage is continuing to be provided.	**Y**	To form part of ongoing road monitoring work programme.

B. General Approach to Ecological Management

1 TRAINING

Environmental training for all staff will be undertaken as part of the site induction programme as described in section 4.4 of the CEMP. This requires all new staff to go through an induction training session when they commence work and then as part of regular refresher courses.

Environmental Induction will include information on the following aspects of this plan:

- Information about the activities and stages of construction that may cause impact to ecological features and values;
- Bird roosting areas and behaviours, lizard species, fish species, significant trees and valued vegetation, and waterways within and surrounding the construction area;
- The values and sensitivity of Pauatahanui Inlet and the Onepoto Arm of Porirua Harbour.
- Consent and designation requirements;
- Ecological monitoring and management procedures.

Section x.x of the ESCP outlines the induction and training requirements for management of erosion and sediment control which is vital for minimising the Project's impact on marine and freshwater ecology.

2 ROLES & RESPONSIBILITY

Section 4.1.1 of the CEMP details roles and responsibilities associated with managing environmental factors from construction of the Project. The contractor Environmental Manager has the responsibility for supporting the implementation of all required ecological monitoring and mitigation, and leading the review of results with appropriate communication of issues to the Project Management Team and the NZTA.

Ecological specialists will be nominated to monitor the effects of construction on the ecology. In some instances the specialists can train the environmental team to carry out the ecological monitoring. Specialists include:

- Botanist
- Freshwater ecologist
- Marine ecologist
- Ornithologist
- Herpetologist

Permits to capture and move species will be required, specifically permits from the Ministry of fisheries to release fish species within the same stream they are captured in and the DOC where species are proposed to be released in a different water body. DOC permits will also need to be attained to translocation reptiles and, in theory, the Peripatus too.

All personnel working on the Project including contractor employees and subcontractors have the responsibility for following the requirements of this Plan and responsibilities pertaining to the management of erosion and sediment control outlined in section x.x of the ESCP are vital for managing effects on marine and freshwater ecology.

3 VEGETATION MANAGEMENT

Environmental management through the construction period is required to minimise disturbance to vegetation that is to be retained and to minimise risks associated with vegetation removal.

3.1 VEGETATION REMOVAL

Mitigation measures in Table 1 will be implemented by the contractor to maintain existing botanical values and to minimise impacts associated with vegetation removal.

Table 1 Mitigation measures for vegetation removal

Effect	Mitigation Measures
Minimise ground disturbance and subsequent sedimentaiton of watercourses	▪ Careful selection of appropriate machinery to minimise disturbance ▪ Minimise exposed ground and re-stabilise areas as soon as possible using ESCP methods. ▪ Install erosion and sediment controls in accordance with ESCP
Minimise organic contaminants entering waterways	▪ Stockpile bark mulch away from watercourses and overland flow paths ▪ Direct output of chippers away from watercourses ▪ Minimise duration of vegetation stockpiling, either removing from site or mulching as soon as possible.
Avoid loss of plants of biological value	▪ Restrict vegetation clearance, tree felling and scrub clearance to a minimum required for the works footprint. ▪ Work vegetation clearance activities in with environmental management mitigation requirements ▪ Minimise damage to vegeattion outside those areas to be cleared, by clearly defining clearance boundaries with marker tape or by marking perimieter trees.

3.2 VALUED VEGETATION

There will be some opportunities during detailed design to minimise effects on a number of high value areas of mature forest (coastal kohekohe, lowland podocarp/tawa, or montane podocarp hardwood forest that falls within the designation but not the Project Footprint. The sites where opportunities exist for further avoidance may be achievable are:

- Rowans Bush (139) in the Wainui Catchment.
- The various coastal kohekohe remnants in the Te Puka Catchment (KCDC Ecosites K223-229)
- The Akatarawa - Whakatikei Regional Forest Park
- TG Riparian Area (PCC Ecosite 199).
- Tawa remnants within Cannons Creek Bush (PP12) in the vicinity of the Cannons Creek Bridge
- Porirua Park Bush (PCC76)

In addition, where possible attempts should be made to avoid seral scrub and forest (kanuka scrub and forest, mahoe dominated scrub and low forest) particularly where it is found as riparian cover. This includes:

- Gullies crossed by the TG alignment on the western slopes of Te Puka and Horokiri catchments.
- Scoresby Grove Kanuka (PCC Ecosite 196).
- James Cook Drive Bush (PCC Ecosite 33).
- Whitby Bush (PCC Ecosite 155b).

- Exploration Drive Kanuka (PCC 190).
- Cannons Creek Bush (PCC 12).
- Roberts Bush (PCC88).

Where these sites can be avoided or effects minimised fencing will be established to demarcate the Projects footprint boundary. Contractors working in these areas should be advised that the fence demarcates work boundaries that should not be breached.

Where they cannot be avoided all practicable steps will be taken to minimise the areas of this vegetation that are removed.

Where mature native trees are to be removed the process will involve discussion with the project ecologist who may wish to be present as part of lizard recovery (B.5), avifauna (B.7) or bat (B.8) monitoring and management.

Where any of these forests cannot be avoided, mitigation needs to be provided that takes into account their value and maturity. These sites are shown in Figure 1.

3.3 PLANT PEST MANAGEMENT

Disturbed and bared soils often lead to weed invasion. The purpose of a weed survey is to determine whether efforts to prevent spread of weeds over earthworked sites have been effective, and in particular to determine if any weeds have been:

- Introduced by vehicle arrivals from other sites; or
- Carried into the site within imported materials such as soils, gravels and hydro-mulch mixes; or
- Spread across the site through the presence of large open earthworked areas.

The survey focus should primarily be on invasive weed species not currently present or which are highly localised within the site. The types of weeds of particular concern are:

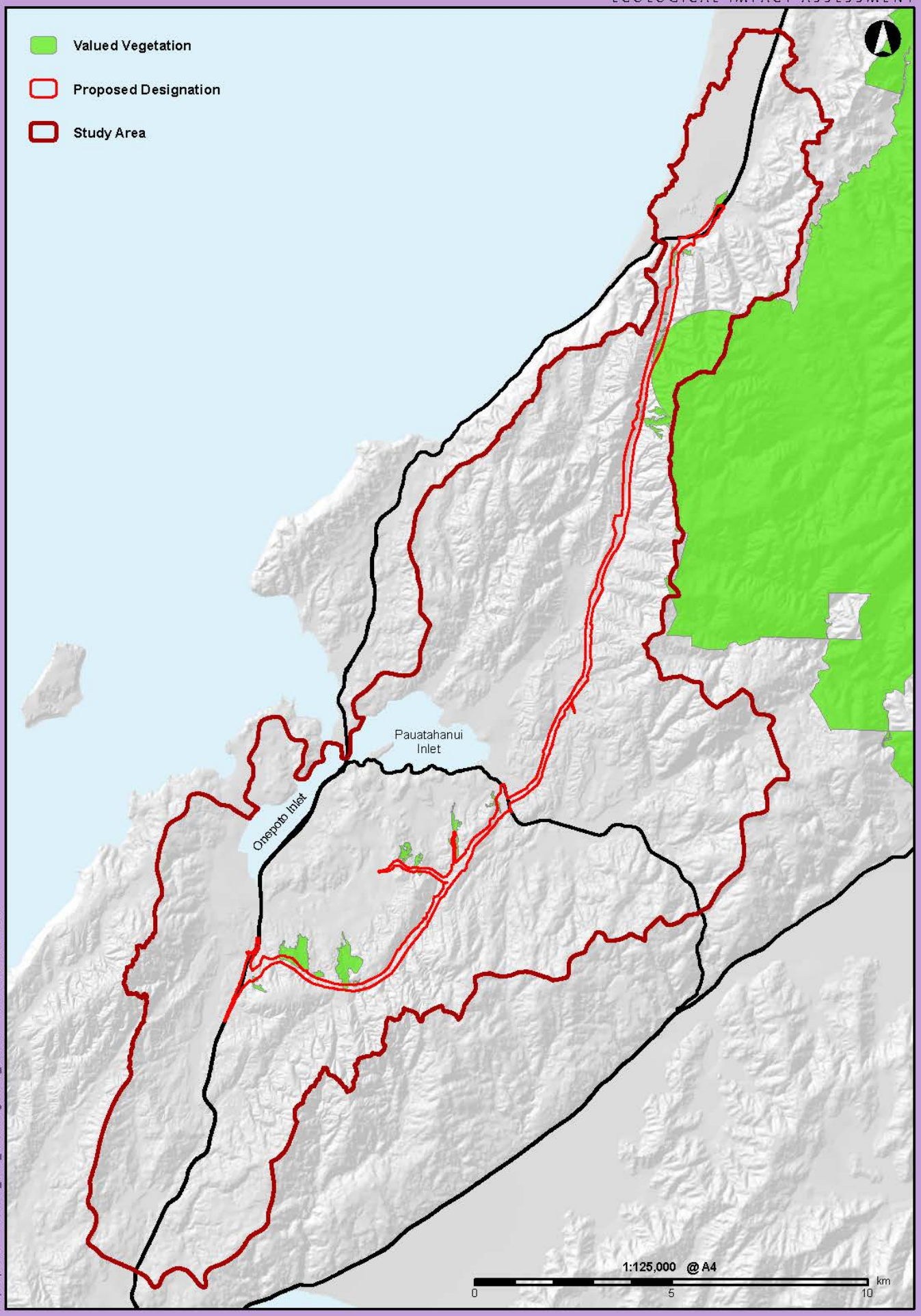
- Vines such as blackberry, japanese honeysuckle, climbing asparagus, cathedral bells, the various ivy's, old man's beard, and convolvulus;
- Invasive shrub weeds such as inkweed, boneseed, tutsan, Himalayan honeysuckle, buddleia, and barberry; and
- Invasive weeds of wetlands, stream banks and wet places such as pampas grass.

Non-ecological weeds (e.g. ragwort, thistle or gorse) may be noted but are not of ecological concern and should not trigger weed issues.

A survey should be undertaken at a time when all bulk earthworks had been completed, and when all disposal sites are finished, and stabilisation has been well advanced. Since the works are done in sections, each section, as it is closed and stabilised, should then receive an initial weed survey. This survey should be followed up by another in one year and a final survey two years post earthworks stabilisation.

The survey should include all haul road and main road edges, all batter slopes, all spoil areas, all diversion reaches, all laid down and storage sites and all sediment control ponds and all stream riparian zones and diversion channels.

The survey should record species, GPS location, description of terrain and a measure of the abundance of the weed as well as any complicating management issues, e.g. growing amongst native regeneration.



Boffa Miskell

NZ TRANSPORT AGENCY WAKA KOTAHI

DRAFT

VALUED VEGETATION

TRANSMISSION GULLY

2

4 LAND RETIREMENT AND REVEGETATION

A total of 40ha of native vegetation will be lost beneath the project footprint and a further 80ha of native vegetation lies within the designation and will be affected in part or in whole during construction. In total it has been calculated that 250 ha of land needs to be retired and revegetated to mitigate for this effect. In addition, a total of 26,500 m of stream needs to be restored to mitigate for the permanent loss or modification of 10,400 m of stream habitat.

Eleven sites have been located along the alignment with a total area of 425 ha. These sites have been chosen because they provide the greatest range of benefits for flora and fauna. These sites contain a mix of pasture, shrubland and forest as well as 13,000 m of stream habitat. It is proposed that 270 ha of revegetation or enrichment planting will be carried out.

Note that the identified retirement sites include 41 ha of land that has already been retired and replanted as required under earlier conditions associated with the current designation. Within these early retirements sites 1.6 ha of riparian planting has been carried out along 1,960 m of stream.

In the long term retirement and revegetation of land in the Te Puka, Horokiri, Duck and Kenepuru catchments will create corridors of riparian communities and stream habitat of increased value, providing both more habitat and blue corridor along parts of the route. This goal should form part of the mitigation vision.

4.4 Planting Plan

A planting plan will be prepared, setting out the site work needed to restore and enhance the biodiversity and amenity values of the eleven revegetation sites, both the riparian and wider slopes and gullies.

The goals of the restoration are:

- Conserve the existing shrubland and secondary forest in both Te Puka and Horokiri;
- Remove existing weed issues;
- Increase the overall extent of riparian cover and associated habitat quality;
- Reintroduce kahikatea, swamp maire and other relevant final canopy species (matai, totara and rimu) to the site;
- Increase the presence of the species that are now locally uncommon;
- Provide improved habitat for flora and fauna including locally uncommon plant species (e.g. Plagianthus), uncommon lizards and macro-invertebrates, birds and bats.

4.5 Proposed Restoration Treatments

Within the restoration sites four broad restoration treatments are proposed. They are:

- **Terrestrial Revegetation**: standard mass planting, typically in pasture, and using native pioneer species (e.g. tauhinu, cottonwood, *Coprosma*, *Hebe*, kanuka, *Pittosporum's*, ngaio), with some future canopy species interspersed.
- **Riparian Revegetation**: mass planting of robust species adapted to riparian conditions including flood flows and temporary inundation. Typically streams in pasture or rushland, and using native species (e.g. flax, toetoe, ribbonwood), with some future canopy species interspersed (kahikatea, pukatea, totara).

- **Enrichment planting**: typically where there is already regeneration of open shrublands that can provide a nursery. Without enrichment many current successions progress to a persistent monoculture dominated by mahoe. Planting will be of future canopy species (e.g. rewarewa, titoki, kohekohe, pigeonwood, tawa, and podocarps).
- **Retirement**: typically where natural regeneration has progressed to the point that additional planting is not required. The activities associated with this are fencing and pest control.

The total areas of each treatment are:

Table 2 Total Areas of each proposed Planting Treatment

Type of Mitigation (Required EC of 162 ha)	Retirement Area (ha)
Existing Benefit (early retirement planting)	31
Revegetation Area (proposed)	53
Enrichment Area (proposed)	187
Retirement and Protection (proposed)	155
TOTAL	**426**

4.6 Riparian Vegetation

The riparian planting is a fundamental part of the aquatic mitigation. Given the shape of the banks, their height and width and the profile of the wider catchment the riparian revegetation should occupy an area 20m wide in the main stems of Te Puka and Horokiri, through to 10m wide on the less steep and open lands from chainage 8500 to 11500. It is noted that the wider forest revegetation merges with the riparian zone, but in the first instance the following plants are specific to the riparian zone.

Table 3 Recommended Riparian Species & Growth Rates

	Common name	Botanical name	Growth rate	Mature Height (m)	Height at 5 years	Height at 10 years	Height at 20 years (m)
RIPARIAN WET							
Initial planting (stream bank erosion protection)	Toetoe	Cortaderia toetoe	Fast	3	n/a	n/a	overtopped
	Lowland flax	Phormium tenax	Fast	3	n/a	n/a	overtopped
	Umbrella sedge	Cyperus ustulatus	Fast	1.5	n/a	n/a	overtopped
	Sedge	Carex geminata	Fast	1.5	n/a	n/a	overtopped
	Cabbage tree	Cordyline australis	Fast	15	3.75	7.5	15
Initial planting (wet terraces)	Koromiko	Hebe stricta var. stricta	Fast	4	3.75	7.5	overtopped
	Karamu	Coprosma robusta	Fast	5	3.75	5	overtopped
	Kowhai	Sophora microphylla	Fast	8	3.75	8	overtopped
	Kotukutuku (tree fuchsia)	Fuchsia excorticata	Fast	10	3.75	7.5	10
	Fivefinger	Pseudopanax arboreus	Fast	10	3.75	7.5	10
	Houhere (narrow-leaved lacebark)	Hoheria angustifolia	Fast	10	3.75	7.5	10
	Tarata (lemonwood)	Pittosporum eugenioides	Fast	10	3.75	7.5	10
	Manatu (lowland ribbonwood)	Plagianthus betulinus	Fast	15	3.75	7.5	15
Year 3 enrichment	Putaputaweta	Carpodetus serratus	Slow	10	1.25	2.5	5
	Turepo	Streblus heterophyllus	Slow	12	1.25	2.5	5
	Swamp maire	Syzygium maire	Slow	15	1.25	2.5	5
Year 5 - 8	Pukatea	Laurelia novae-zelandiae	Slow	30	1.25	2.5	5

enrichment	Kahikatea	Dacrycarpus dacrydioides	Slow	40	1.25	2.5	5
RIPARIAN DRY							
Initial planting	Rangiora	Brachyglottis repanda	Fast	6	3.75	7.5	overtopped
	Karamu	Coprosma robusta	Fast	5	3.75	7.5	overtopped
	Koromiko	Hebe stricta var. stricta	Fast	4	3.75	7.5	overtopped
	Makomako (wineberry)	Aristotelia serrata	Fast	8	3.75	7.5	overtopped
	Ngaio	Myoporum laetum	Fast	8	3.75	7.5	overtopped
	Houhere (lacebark)	Hoheria sexstylosa	Fast	8	3.75	7.5	overtopped
	Kohuhu	Pittosporum tenuifolium	Moderate	10	2.5	5	10
	Kanuka	Kunzea ericoides	Moderate	15	2.5	5	10
Year 3 enrichment	Fivefinger	Pseudopanax arboreus	Fast	10	3.75	7.5	10
	Mahoe	Melicytus ramiflorus	Moderate	10	2.5	5	10
	Broadleaf (kapuka)	Griselinia littoralis	Moderate	15	2.5	5	10
	Heketara	Olearia rani	Slow	8	1.25	2.5	5
	Pigeonwood	Hedycarya arborea	Slow	8	1.25	2.5	5
Year 5 - 8 enrichment	Titoki	Alectryon excelsa	Slow	15	1.25	2.5	5
	Nikau	Rhopalostylis sapida	Slow	10	1.25	2.5	5
	Hinau	Elaeocarpus dentatus	Slow	20	1.25	2.5	5
	Tawa	Beilschmiedia tawa	Slow	25	1.25	2.5	5

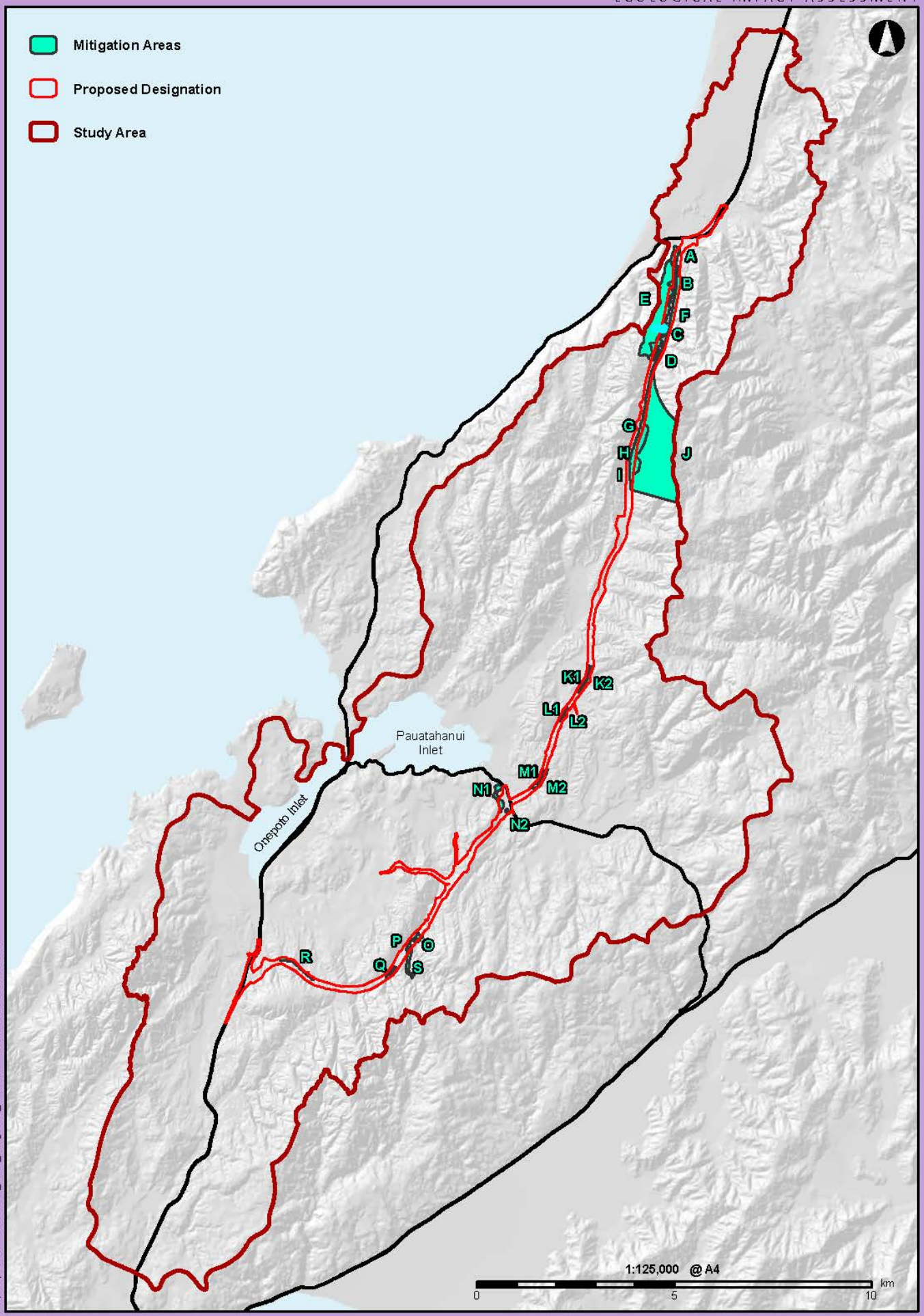
4.7 REVEGETATION GUIDELINES

The following is a set of Principles that the restoration should follow:

Natural recovery or regeneration is the preferred method in those areas that are suitable and can sustain this such as the upper eastern Horokiri slopes, but the natural recovery will be assisted by planting of:

- The planting strategy for the lowlands outside of the riparian area is to plant nodes of trees (islands) in the open pasture areas, amongst potential natural regeneration, and to promote natural spread. All these will have a focus of helping natural seed dispersal, and natural colonisation and spread of indigenous vegetation.
- A target of “total revegetation with forest” is the ultimate goal except in areas associated with the wetlands and access tracks.
- The proposed time frame for intensive management activities should be 10 years; successes, management issues, ecological succession and self sustainability should be reviewed at that time;
- Ongoing annual maintenance work will include monitoring and operations addressing pests and weeds (i.e. possum, rabbits and weeds, which threaten ecological succession). (Wasps and hares may also be a problem.)
- Gorse, broom and hawthorn will be viewed as assisting ecological succession unless monitoring shows otherwise.
- Plant material will be sourced locally where possible; otherwise from as close as possible to the site.
- Species historically present, but currently absent, will be reintroduced when conditions permit.
- Plants are to be hardened off and mulched so that no irrigation is required.

Standard conditions of maintenance and monitoring by the contractor are assumed.



Boffa Miskell

NZ TRANSPORT AGENCY WAKA KOTAHI

DRAFT

MITIGATION AREAS

TRANSMISSION GULLY

1

5 LIZARDS

Important lizard habitat is found within the Te Puka and Horokiri Valleys. In some areas this habitat will be lost beneath the project footprint. Protection of resident lizard populations will be required through trapping and capture of individuals and implementation of appropriate relocation strategies.

5.8 ENABLING WORKS

The following actions are required to enable translocations:

- Permits to capture and move species will be required, including a project plan;
- Identification of habitat immediately adjacent to works that need to be protected;
- Confirmation of sites to be searched;
- Confirming translocation sites;
- Catching the taxa and providing temporary storage for them, and release; and
- Monitoring success.

5.9 RESCUE SITE

Site Identification

Habitats where good numbers of lizards are likely to be found will be identified a minimum of two months in advance of vegetation clearance. Artificial cover objects will be located in the habitat no less than six weeks before capture.

Fencing

Where lizard habitat can be avoided fencing will be established to demarcate the Project's footprint boundary. Contractors working in these areas should be advised that the fence demarcates work boundaries that should not be breached.

Where they cannot be avoided all practicable steps will be taken to minimise the areas of this habitat that affected.

Pre-clearance trapping

Immediately prior to works commencing pre-clearance trapping and searching, including destructive searches of low vegetation and boulderfields, will be carried out by DOC permitted ecologists.

Captured lizards will be placed immediately into holding boxes with secure mesh lids to allow ventilation. Vegetation, soil and leaf litter from the capture site will be placed in the box to provide cover and protection from desiccation during containment.

Vegetation clearance

Once pre-clearance trapping has been completed, controlled vegetation clearance can commence under the guidance of DOC permitted ecologists. The vegetation clearance will involve the removal of all remaining vegetation via heavy machinery and support for ecologists salvaging any remaining lizards within taller vegetation such as felled trees.

5.10 RELEASE SITES

Wherever possible translocation will be to similar nearby unaffected habitat. While this may cause short term local habitat over-allocation over time the lizards will re-distribute themselves. If equivalent sites cannot be found nearby, alternative release sites must be agreed.

Salvaged lizards must be released from captivity not more than 24 hours after capture.

Lizards should not be released into sites where herbicides have been used.

5.11 HABITAT ENHANCEMENT

Following completion of earthworks areas of scree and boulder field type habitat are to be formed at the toe of fill batters in Te Puka and Horokiri catchments. The locations for these are to be determined by the project ecologist once works have been stabilised and are to be formed in concert with the revegetation programme for these areas.

Appropriate boulders and logs (from harvested native trees) are to be stockpiled during earthworks for this work.

The scree fields are to mirror the typical dimensions currently present, which are approximating 20 to 30m wide by 50 long. These boulderfields are to be left to naturally re-populate.

5.12 PEST CONTROL

If this operation secures a significant population of threatened lizards (Pacific gecko, Wellington green gecko, spotted skink, ornate skink) pest control will be required over the period of capture and release and for a period following (See Section C.3.4).

Pest control will involve the use of rodent bait stations throughout the translocation sites commencing one month prior to release of captured lizards. Pest control operations should be maintained on a monthly basis by refreshing bait blocks in stations for a period of twelve months by which time the rescued lizards will have become established.

6 TERRESTRIAL MACRO-INVERTEBRATES (Peripatus)

Important habitat for *Peripatus novaezealandia* is found within the Te Puka and Horokiri Valleys. In some areas this habitat will be lost beneath the project footprint. Protection of this invertebrate populations will be required transfer of individuals to appropriate relocation sites.

6.13 ENABLING WORKS

The following actions are required to enable translocations:

- Permits to capture and move species will be required, including a project plan;
- Confirmation of sites to be searched;
- Confirming translocation sites;
- Catching the taxa and providing temporary storage for them, and release; and
- Monitoring success.

6.14 RESCUE SITE

For *Peripatus* translocation is a simple matter of collecting and moving the logs and wood debris that they shelter under to nearby safe habitats. Care is required that the Peripatus are not shaken out of the wood but transfer can be as simple as movement of the log/wood feature to the edge of the existing bush outside of any disturbance required.

Transfer should be carried out during daylight hours to ensure the *Peripatus* are presence in the feature.

6.15 RELEASE SITE

Wherever possible translocation will be similar to nearby unaffected habitat. If equivalent sites cannot be found nearby, alternative release sites must be agreed.

6.16 HABITAT ENHANCEMENT

The re-creation of scree and boulder field type habitat described above will also provide habitat for Peripatus.

6.17 PEST CONTROL

None required.

7 AVIFAUNA (BIRDS)

Important habitat for *native birds* is found within the Te Puka and Horokiri Valleys and on the forested hillsides from Cannons Creek to Gillies Bush above Ranui Heights. In some areas construction activities occur in close proximity to this habitat, and at Cannons Creek some of this habitat will be lost beneath the project footprint.

7.18 Management of Construction Effects

During construction in the vicinity of Wainui Saddle, project ecologists will monitor breeding of threatened native birds (bush falcon and kaka) and ensure that there is no disturbance by construction activity.

The animal pest control that will be carried out in this location as part of the lizard release and protection of revegetation, will provide additional benefits to the avifauna of the area.

The protection of vegetation important to native birds is discussed in B.3.2 above.

7.19 Management of Operational Effects

Native birds are considered to be at risk of collision with transparent road barriers. No transparent barriers are to be installed near key habitat of nationally threatened or locally uncommon native birds. This includes the upper Te Puka and Wainui Valleys and Wainui Saddle, and from Cannons Creek to Porirua Park Bush.

8 BATS

There is a possibility a population of native bars are present in the Akatarawa Forests to the east of Wainui Saddle.

8.20 Investigations

Prior to commencement of construction a study will be carried out to determine if native bats are present along the Transmission Gully Alignment in the vicinity of Wainui Saddle.

9 IN-STREAM WORKS

A range of activities are proposed within watercourses and will have effects that ranging from permanent to temporary.

Diversions

Around 5 kilometres of stream diversion will be required over the Project largely within the Horokiri and Te Puka stream systems. These diversions will typically remove in their entirety those sections of the stream affected and all aquatic values are removed. All major diversion are in high value streams and are important in terms of aquatic habitat and connectivity.

The diversions around these affected filled in stream sections are in difficult terrain with spatial constraints and pose substantial engineering challenge. Nevertheless with the understandings of the parameters required to recreate good aquatic habitat (see Attachment 1) those diversion reaches can in most situations be made to match current in-stream habitat and in some situations potentially offer better and more diverse aquatic habitat than that which currently occurs.

The basics of meander, depth, substrate and velocities are the critical aspects of the channel recreation. Riparian revegetation along with wider catchment land use changes mean that the end product for both Te Puka and Horokiri in its middle and upper reaches will be very significantly better quality habitat than currently exists. The mitigation requirements have been developed on the assumption that this can be achieved.

To achieve this result will require detailed design and considerable care during construction, and in some cases, ongoing monitoring and maintenance.

Culverts

A range of temporary and permanent culverts will be installed. The permanent culverts will have a combined length of over 5.1 km leading to the loss of aquatic habitat and potential problems for fish passage.

In addition the mitigation model requires the benefit that will be achieved through removal of fish barriers in Duck Creek. These barriers relate to current farm access roading. With their removal up to 8.5 km of stream habitat can be made available to native fish species which are currently excluded or in very low numbers due to poor recruitment.

Guidelines

The following guidelines and monitoring plans have been developed to assist in this work.

- Diversion Design Guide - requiring restoration as close as possible to the condition of the original stream bed.
- Culvert Design Guide with principles for habitat maintenance and fish passage.
- Monitoring plans to establish proof of the limit of adverse effects and to measure the success of the mitigation package proposed.
- Post Construction Fish Passage monitoring plan (culvert passage).

9.21 TIMING

Unless allowed by consent condition, timing of works in stream beds will normally be timed to avoid peak fish movements (Spring Migration 1 Oct -30 Dec; Autumn Migration 1 April – 30 May).

The exception to this will be the Te Puka stream. During the period of construction of this section of the Transmission Gully alignment, the stream will be diverted to temporary diversions where fish

passage will not be possible. For the times that these works overlap inland fish migrations (1 October – 30 December) any whitebait that reach the lower extent of works, will be captured and transferred upstream to a safe location above works as per the guidelines described below (Section B.10).

9.22 DESIGN

A suitably qualified ecologist will be involved in the design and staging of all in-stream works including temporary and permanent culverts, temporary and permanent fords, diversions and weirs.

The design of all in stream works will comply with guidelines presented in 0. They will consider as a matter of course the following issues:

- Water velocity and Flow rates
- Appropriate water course width and depth
- Habitat and geomorphological
- Substrate
- Fish passage
- Removal and remediation of temporary structures.

9.23 VALUED RIPARIAN HABITAT

There is an expectation of best endeavours to avoid wherever possible native riparian vegetation and aquatic systems outside the construction footprint.

Where they can be avoided or effects minimised fencing or other markers will be established to demarcate the Projects footprint boundary. Contractors working in these areas should be advised that the signage fence demarcates work boundaries that should not be breached.

Where they cannot be avoided all practicable steps will be taken to minimise the areas of vegetation and the extent of in-stream habitat that is impacted.

9.24 DIVERSION CHANNEL DESIGN PRINCIPALS

The diversion reach must both convey water as well as provide new and appropriate aquatic habitat. This means the velocities and flow paths must be of a similar nature (it cannot be a straight, plain, drain), the substrate must be similar, the depths also similar (hyporheic zone), the banks as stable and the array of physical water habitat types (riffle, cascade etc) comparable. Correct diversion construction can mitigate, over time, for the diversion loss.

The aim of the diversions in each case is to mimic the habitat being lost and, where feasible and sensible, create added habitat opportunities. This is particularly the case in the middle-upper Te Puka were the existing habitat is restricted to a rather uniform riffle-stepped riffle situation with the similar depth, substrate and velocity profiles over large linear distances. Sampling showed a reduced fish fauna in these reaches as opposed to the lower “gorge” reaches and upper native bush reaches.

In the Horokiri and Te Puka streams, long diversions will utilize weirs/cascades to maintain velocities, flows and depths where the diversions have led to a reduction in stream length. These cascades will be designed to act as “staircases” to allow fish such as eel, koaro and banded kokopu to traverse. The design of each cascade needs to include pools top and bottom for quiet water in which fish can rest before moving on.

Attachment 1 provides guidelines on for the final design of diversion channels in each key catchment, in particular in setting the substrate, meander, habitat hypes, depths and velocity goals.

9.25 CULVERTS DESIGN PRINCIPLES

A total of nineteen low gradient culverts will be installed which must be designed to ensure swimming-fish passage. Twenty four culverts will be installed in high velocity streams and must be designed to ensure climbing-fish passage.

Low gradient stream culverts

Main stem culverts of all streams must facilitate the passage of juvenile and adults of whitebait of several fish species that are relatively poor climbers including *Galaxias argenteus* (Giant kokopu) and *G. maculatus* (Inanga).

For the movement of fish identified in these streams any culvert or stream diversion needs to have the following design criteria:

- A velocity at or around 0.5 m/s (but certainly less than 1 m/s);
- A water depth of at least 0.1m but preferably 0.2 m;
- The base needs to be roughened and with velocity abatement devices;
- The invert (both in and out) must be below the stream invert and the structures conducive to gravel movement into and along the culvert.
- Where culvert length exceeds 6o m, and water velocity is greater than 0.4 m/s, rest areas will need to be installed.

High gradient stream culverts

Investigations have identified the need for design features that take into account the steep fall on tributary streams, while providing a surface for climbing fish. Culverts in these streams must facilitate the passage of juvenile and adults of whitebait of native fish that are excellent climbers including *G. brevipinnis* (Koaro) and *G. fasciatus* (Banded kokopu) as well as both eel species.

Innovative solutions to fish passage may be required in these culverts. Design through adaptive management is recommended.

9.26 DUCK CREEK PERCHED CULVERTS

Six perched culverts within Duck Creek will be either replaced or retrofitted to renew fish passage. It has been calculated this will re-open 8.5 km of stream where fish numbers are affected.

9.27 CONSTRUCTION MONITORING

At each milestone in the formation and landscaping of diversion channels, the livening of the new channel and the reclamation of the existing channel, site visits will be carried out by a suitably qualified ecologist to ensure the design principals have been followed and to provide advice where necessary on changes or improvements that are required.

10 FRESHWATER FISH TRANSLOCATIONS

In a number of situations associated primarily with culvert installation and diversion sites section of stream will be reclaimed. In these reaches fish will need to be collected, housed and moved to safe locations.

Prior to and during the permanent diversion of streams, all practicable steps shall be taken to capture and relocate fish from the affected reaches of stream. All practicable steps include, but are not limited to netting with minnow traps and electric fishing.

10.28 ENABLING WORKS

The following actions are required to enable translocations:

- Permits to capture and move species will be required, specifically permits from the Ministry of fisheries to release fish species within the same stream they are captured in and the DOC where species are proposed to be released in a different water body. DOC permits will also need to be attained to translocation reptiles and, in theory, the peripatus too. Permits will require preparation of a project plan.
- Confirmation of sites to be searched and timing of works;
- Confirming translocation sites;
- Catching the taxa, providing temporary storage, and release; and
- Monitoring success.

10.29 RESCUE SITE

Temporary Diversion

Hours before the time of the diversion the upstream and downstream extents of the diversion should be block netted. The catch and transfer should have two stages.

- **Stage 1:** This involves an initial electric fish of the site just prior to final installation of the dam and dewatering of the reach. A downstream channel closing net should first be installed at the water reintroduction point. That process should involve a downstream to upstream electric fishing run with nets to trap and retain all fish. Three electric catch sweeps of the affected reach should be undertaken.
- **Stage 2:** As the dewatering occurs, a search should be made of the substrate and particularly the bank edges to retrieve stranded fish not caught by the electric fishing machine (EFM) – this is typically eel that where “buried” in the banks. These fish should also then be moved.

10.30 RELEASE SITES

Where ever possible all fish will be released in the same stream they have been captured.

Diversion & Reclamation

Where the stream works involve diversion to a new channel the fish should be held in sufficiently large containers until water has been diverted to the new channel and it is running clear. Fish can then be reintroduced to the new channel.

Culverting

Where the stream is to be diverted to a bypass pipe or to a culvert the fish need to be transferred into a nearby main stem or tributaries. The decision on appropriate release site should take into

account the quantity of aquatic habitat present and the species of fish that have been captured. Where possible releases should be upstream of works.

10.31 OTHER

- All fish netting and relocation shall be completed by a suitably qualified ecologist.
- All fish collected shall be relocated upstream of the diversion.
- The Manager, Environmental Regulation, Wellington Regional Council shall be advised when the relocation of fish has been completed.

It is impractical and possibly unnecessary to attempt to capture and move the aquatic invertebrate species (koura aside). However, in recycling the substrates of the diversion reaches for relaying in the new diversion, a substantive number and abundance of aquatic invertebrate species may be relocated to the new diversion by such a process.

10.32 INSPECTIONS

Immediately following formation of diversions and prior to livening of the new channel an appropriately qualified ecologist will inspect and confirm that any structures within the diversion will provide fish passage for all native species currently known to occur or reasonably likely to occur within this stream.

An advisory note will be prepared and forwarded to the Manager, Environmental Regulation, Wellington Regional Council, confirming all culverts have been installed as required under condition, prior to the diversion of water through the pipes.

11 AQUATIC AND MARINE ECOLOGY AND SEDIMENTATION

Controlling the impact of construction activities on marine ecological values is a function of minimising the amount of stream flushed sediments derived from road construction earthworks. Control measures within sub-plans have been developed for construction phase stormwater ESCP, contaminated soil, and management of bulk earthworks.

The current array of erosion and sediment control, stormwater treatment and other sediment management devices and systems avoids, to a large extent, the discharge of the Project's earthworks derived sediment. However, during higher return period rain events these measures cannot guarantee to limit the discharge to a "less than minor" or "acceptable" effect.

If as a result of a large rainfall event, sediment deposition within the Porirua Harbour occurs in a sensitive area and at a depth and exposure period that is likely to cause adverse effects, the options for remedial measures or mitigation are limited. Removal of the deposited sediment is difficult without causing additional and potentially greater adverse effects. Thus, the focus throughout this Project has been on avoidance of the discharge of sediment to the harbour through management systems, and the use of adaptive management to refine systems and processes where issues have arisen.

11.33 MONITORING AND ADAPTIVE MANAGEMENT

The primary opportunity for management of risk of sediment discharge to valued streams and the marine environment rests with monitoring and adaptive management of the site, systems for erosion control, the capture and treatment of sediment laden water, and its discharge.

Attachment 2 provides an indicative freshwater aquatic monitoring plan, which uses baseline data to establish triggers for changes to turbidity, sediment deposition and aquatic health and guidance for how the results of this monitoring will feed into an adaptive management processes.

Appendix 3 provides and indicative marine monitoring plan which uses baseline data to establish triggers for changes to sediment deposition and the health of the marine environment and guidance for how the results of this monitoring will feed into an adaptive management processes.

11.34 EARLY WARNING STORM PLAN

These plans also establish an early warning process for identification of approaching storms that have the potential to exceed design capacities for erosion and sediment control systems. This early warning system is intended to provide up to several days for stabilisation of earthworks, removal of equipment from stream beds and floodplains, cleaning and upgrading of sediment control structures. It follows the following stages:

PREPARATION

1) Establish relationship and project objectives with forecasters;
2) Establish "event" decision tree with forecasters (Will be iterative -see 14 below)
3) Establish contractor "event" teams and roles (Will be iterative -see 14 below)
4) Establish stockpile of gear, hay bales, silt fences, fabric mats, flock blocks, geotubes, etc. (Will be iterative -see 14 below)

EVENT NOTIFICATION

5) Early identification, and monitoring of storm fronts;
6) Notification of Councils
7) Step by step earthworks shutdown, halt to refuelling;
8) Step by step checks of bunds, ponds, cut off drains, grit traps, silt fences, etc, etc;
9) Emergency stabilisation of key areas using mulch;
10) Movement of machinery away from streams and out of floodplains;
11) Sediment pond and stream monitoring teams on standby;

POST EVENT

12) Site tidy up and repair
13) Event review / debrief
14) Adaptive management of systems
15) Reporting: Internal / External

C. Ecological Monitoring

1 OVERALL APPROACH

Baseline information on ecological values and features potentially affected by the project will be collected before works commence. Ecological monitoring of lizards, birds, vegetation, fish, aquatic and marine ecology shall be undertaken before, during and after construction works are completed.

The main objectives of the ecological monitoring programme will be to verify that:

- The proposed measures to avoid adverse ecological effects have been installed / implemented, are being maintained appropriately, and are working effectively; and
- The proposed ecological mitigation and/or management initiatives have been installed / implemented, are being maintained appropriately, and are working effectively; and
- Any unavoidable adverse ecological effects are local, minimal, and of limited duration, or are otherwise appropriately and sufficiently mitigated.

2 VEGETATION MONITORING

2.1 Valued Vegetation

Prior to works commencing an assessment should be undertaken to produce an updated condition of the valued vegetation identified in Figure 1. This assessment will be used as a baseline data set to monitor changes in the condition of these areas of the valued vegetation throughout the construction process. A photographic record of each area of Valued Vegetation will be collected before during and after works are complete.

Monitoring will be required fortnightly during bulk earthworks. Monitoring reports will be produced as required. They will include the date of the visit, condition of the valued vegetation, condition of protective fencing, works undertaken in the vicinity of the vegetation and any actions required.

2.2 Pest Plants

Monitoring of pest plant species is essential to trigger the planning and implementation of pest plant management.

During the construction phase of the Project, monitoring for pest plants will take place in areas of open earthworks at least every six months (spring and autumn). The aim of this survey is to identify areas that have been recently colonised by pest plants, and areas that contain the potential for infestation. The contractor will walk the site, not the location and type of pest plant species, and identify appropriate control methods.

Monitoring of pest plants will focus on areas along riparian zones, areas that were cleared/disturbed during the construction phase and areas of revegetation.

2.3 Planting

Each area of planting, be it general, riparian or enrichment will require the standard care and monitoring programme typically afforded revegetation projects. Standard is a system of monthly leading to biannual maintenance actions and monitoring of all planted species and weeds and herbivore pests over a period of three years. Such a programme will be established with the revegetation plans.

Generally areas that have been planted will fall under a defects liability period lasting a minimum of three years. It is the responsibility of the landscape contractor to monitor and maintain these areas. The monitoring process is presented in the indicative planting plan (Attachment 4)

In addition to measuring the success of planting will be requirements to ensure habitat is forming and that will require the monitoring of natural indigenous species seedling colonisation and vegetation cover increase (canopy closure). While there are a range of other habitat aspects the above to act as good proxies for the satisfactory development into the future of habitat.

Three year review.

At the completion of the three year maintenance period a full review of the success of the revegetation will be carried out to ensure it has met the mitigation requirements. It will include:

- Counting and measuring the progress of the restoration
- Success of weed clearance and weed maintenance
- The success of the animal pest management
- Assessing the progress against desired outcome
- Reviewing management programme to realign with outcome (if needed)
- Reviewing outcome

Ten year review.

A 10 year review currently appears appropriate to measure the progress (success) of the various strategies be reviewed:

- The survival and growth rate of the planted specimens
- The extent of indigenous seed dispersal and development
- The site coverage of indigenous canopy.
- The need for enrichment planting.

These factors will enable managers to determine the success of the "natural re-colonisation with assistance" strategy, the self sustaining capability of the site and what, if any, further management actions are required.

3 TERRESTRIAL FAUNA & AVIFAUNA

3.4 Lizard Monitoring

Post-release lizard monitoring will be required if a significant population of threatened lizards (Pacific gecko, Wellington green gecko, spotted skink, ornate skink) are salvaged from the development site. In this instance, post-release monitoring would be conducted the following year and annually, to determine whether efforts to mitigate the impacts of the project are successful, and if further management is necessary.

Post-release monitoring aims to indicate the survivorship of skinks and geckos, and determine if breeding is occurring (via the detection of gravid females and/or juveniles) within release sites and revegetated areas. Monitoring will continue on an annual basis (e.g. in summer and spring) until these criteria are met.

If criteria are not met at five years' post-release, the relocation would be deemed unsuccessful and a report detailing the outcome and potential reasons would be prepare for NZTA and DOC. Post release monitoring must be conducted by DOC permitted ecologists.

Monitoring will determine whether animal pest management (rodents) can be relaxed or intensified, and whether areas of habitat enhancement are being utilised.

3.5 Peripatus

Checks for Peripatus in release areas can be conducted at the same time as lizard monitoring.

3.6 Birds

Avifauna Monitoring at Wainui Saddle and Porirua Park Bush will continue through construction. If no effects on falcon or kaka is observed it may stop as soon as construction is complete.

3.7 Bats

If the presence of bats is confirmed at this site, monitoring for bat mortality at Wainui Saddle will commence as soon as the road is opened to traffic and continue for a minimum of two summer seasons.

If no mortalities are observed within this time, a concluding report, summarising search effort and methodology, will be prepared and monitoring may cease.

If mortalities are observed a report detailing the outcome and potential reasons would be prepare for NZTA and DOC. The report will provide recommendations for additional study or mitigation if required.

4 AQUATIC HABITAT & FRESHWATER FAUNA

A series of monitoring plans are required for both testing effects (specifically water quality and biotic community quality of receiving aquatic habitats) and for determining the success of mitigation actions, specifically fish passage through culverts, diversion re-colonisation, and riparian revegetation success.

An effects test plan relates specifically to conditions xx which require preparation of a Stream Quality Monitoring Methodology (SQMM) and associated Stream Quality Monitoring Reports (SQMR).

Attachment 2 provides an indicative aquatic monitoring plan which covers: fish passage, habitat recovery, restoration, water quality, and benthic macroinvertebrate community monitoring.

4.8 Diversions

A brief report will be prepared at each milestone associated with diversion formation, confirming the issues discussed, describing any actions taken, and providing sign-off for that stage and agreement for the contractor to commence the next phase of work.

Baseline studies will be repeated bi-annually (Autumn & Spring) at all sample sites until all bulk earthworks are complete and the site is stabilised.

A statistical assessment will be made following each study comparing against the baseline results. If a significant difference in any of the measures (fish, macro-invertebrate, or sediment deposition) is identified this will trigger the adaptive management process described in C.6 and shown in Figure 3.

The results of this study will be included in a bi-annual reporting, unless there is a significant issue requiring immediate action.

4.9 Culverts

A brief report will be prepared at each milestone associated with installation of culverts in streams where native fish are present. The report will confirm the design is appropriate for the fish species present, any retrofitting of fish passage devices has been completed and will provide sign-off for that stage and agreement for the contractor to commence the next phase of work.

4.10 Fish Translocations

A brief report will be prepared following each fish translocation, describing the number and species of fish captured, the location of their release, and any issues that arose during the operation.

4.11 Fish Passage

Baseline sampling will confirm the range of species present in the locations of all in-stream structures.

Sampling will be carried out in the spring following the installation of each device and will be repeated for a total of three years.

Where sampling determines that fish passage has been obstructed the contractor will recommend remedial action.

5 SEDIMENT & EROSION CONTROL

Monitoring of both the water quality and the stream habitats and plant/animal community health will be required throughout the earthworks and at least two years beyond

Monitoring of treatment devices and methods falls under the Erosion and Sediment Control Plan (ESCP). Monitoring of water quality and stream health is the responsibility of this plan.

In general, monitoring assessments based on the whole community rather than particular indicator species are more desirable (Haskell *et al*., 1992; Norris and Norris, 1995). Multivariate statistical approaches such as noted by Wright (1995) and Reynoldson *et al*. (1995) using benthic macroinvertebrate communities (RIVPACS and BEAST) or PERMANOA are preferred.

- Stream and estuarine water quality and aquatic habitat monitoring plan during construction, with a focus on adaptive management.
- Storm event disaster plan during construction
- Consent conditions to measure effect and enforce additional protective or mitigation actions.

5.12 STREAM MONITORING

Monitoring of the stream habitats and plant/animal community health will be required throughout the earthworks and at least 2 years beyond, alongside vigilant monitoring of treatment devices and methods.

A Monitoring programme has been drafted and is included as Appendix 2. It includes a series of habitat and benthic aquatic invertebrate samplings involving replicated sampling, coupled with the continuation of the turbidity loggers and storm-related grab samples.

Monitoring data should be in a form that allows a community response measure such as the use of a PERMANOVA analysis along with a QMCI indication system. Monitoring should also continue for the duration of construction and two years beyond. Fish migration success will also need to be monitored (in addition to culvert passage) to ensure no water quality cues inhibit up stream migration patterns.

Attached (Section D.3) is a template of the required Aquatic monitoring plan.

5.13 HARBOUR MONITORING

Monitoring of sediment deposition and marine ecological values spatially and temporally, through routine and event based data collection will be required in order to confirm the conclusions drawn in the assessment of effects.

Attached (Section D.4.) is a template of the required Estuarine monitoring plan.

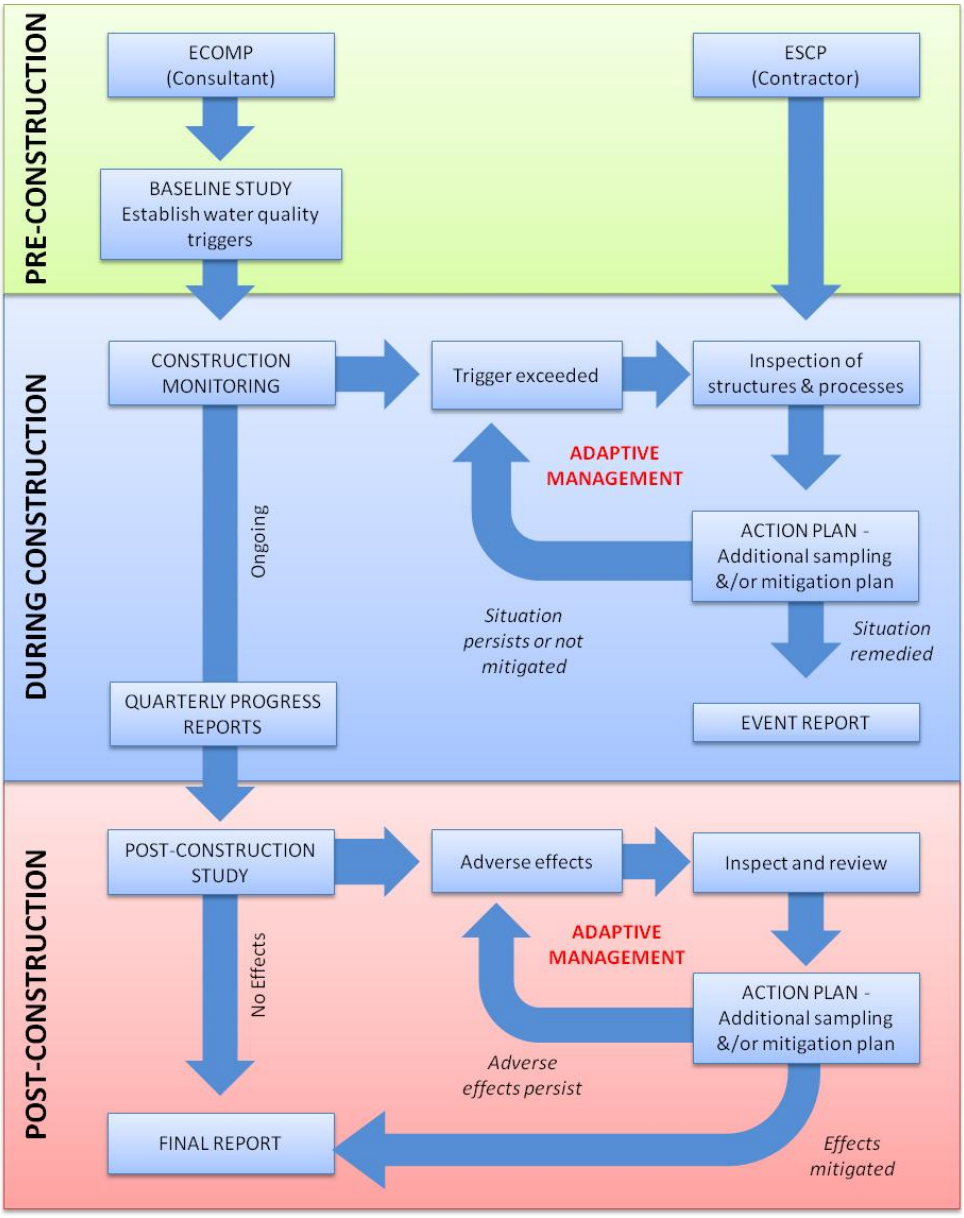
6 RESPONSE TO INDICATORS OF SIGNIFICANT EFFECTS

6.14 ADAPTIVE MANAGEMENT

Adaptive management requires monitoring, research and review. Once monitoring has occurred, the assessment of monitoring results will lead to 'adapted' development and operation, either to anticipate potential problems identified by the monitoring, or to ensure any effects of the existing activity are reduced to acceptable levels. Review conditions provide flexibility to either expand or cut back activity should the research suggest it is necessary.

Figure 3 provides an indicative process for monitoring, management and reporting related to marine and aquatic habitat monitoring. A key component is the establishment of pre construction baseline conditions against which to measure change. Monitoring through construction provides continual feedback to the contractor on the effectiveness of environmental management methods. Monitoring post construction establishes processes for remediation and/or mitigation if effects could not be avoided.

Figure 3 Adaptive Management Flow Chart



6.15 RESPONSE TO OBSERVED EFFECT

In the event that adverse impacts on terrestrial, in-stream or marine communities are detected by the monitoring programme, an adaptive management process will be triggered. An example of this process is shown in Figure 3 taken from the Stream Quality Monitoring Plan (See Attachment 2).

The process aims to ensure a link between the Stream Quality Monitoring Methodology (SQMM) and the Erosion and Sediment Control Monitoring (ESCP). Baseline studies (and existing local studies) will produce an event trigger value. If the trigger value is exceeded it starts an adaptive management process that continues until the situation causing the trigger is remedied.

Should a link between the adverse effect and on-site practices be established then alterations to the operational methods (including modifications to environmental devices) will be investigated as a first order response. The Wellington Regional Council will be consulted on any proposed changes to the on-site practices. Further monitoring would then be used to assess the effectiveness of the alterations.

Factors to be assessed in the decision chain relating to the above include:

- The assessed likely cause(s) of the effect
- Whether the effect is ongoing
- The magnitude of the effect
- The sensitivity of the receiving environment
- The need for, and nature of, any remedial action.

If any remedial action is deemed to be necessary (by the Regional Council) then the contractor shall be responsible for the appropriate rectification or mitigation of the adverse effects detected. The Regional Council will be consulted during this process.

However, should no such linkages be established between the Project work practices and the adverse environmental effects observed, then the contractor shall not be liable for any remediation or mitigation works over and above those already required by the conditions of consent and the designation.

7 REPORTING

Monthly compliance reports will be forwarded to Greater Wellington Regional Council and Project Engineer by the contractor responsible for monitoring.

Devices monitoring

- Covered by the ESCP

Ecological habitat monitoring

- Terrestrial Habitat Monitoring within two months after completion of each survey
- Freshwater Habitat Monitoring within two months after completion of each survey
- Marine Habitat Monitoring within two months after completion of each survey

8 ECOMP REVIEW

The ECOMP will be reviewed by the contractor after confirmation of the resource consent and designation conditions and will be revised in accordance with those conditions. The ECOMP will be updated, with the necessary approval, throughout the course of the Project to reflect material changes associated with changes to construction technical or the natural environment. Approval from Greater Wellington Regional Council and/or the Department of Conservation will be required for any relevant revisions of a material nature to the ECOMP.

A management review of the ECOMP will be undertaken at least annually by the Project Management Team and the NZTA Environmental Representative. The management review will be organised by the Environmental Manager, and the Project team will be informed of any changes to this plan through the regular Project communication process. The review will take into consideration:

- Any significant changes to construction activities or methods
- Any significant change in the related sub plans (including the ESCP, CEMP, SSEMP)
- Key changes to the roles and responsibilities within the Project
- Changes to industry best practice standards
- Changes in legal or other requirements (social and environmental legal requirements, NZTA objectives and relevant policies, plants, standards, specifications, and guidelines)
- Results of inspection and maintenance programmes, and logs of incidents, corrective actions, internal or external assessments.
- Public complaints

Reasons for making changes to the ECOMP will be documented. A copy of the original ECOMP document and subsequent versions will be kept for the Project records, and marked as obsolete. Each new/updated versions of the ECOMP documentation will be issued with a version number and date to eliminate obsolete ECOMP documents in use.

D. Indicative Ecological Management and Monitoring Plans

1: Stream Diversion Guidelines; Staging, Physical Design Parameters & Adaptive Management Plan DRAFT FOR DISCUSSION

2: Stream Quality Monitoring Methodology & Adaptive Management Plan. DRAFT FOR DISCUSSION

3: Estuarine Quality Monitoring Methodology & Adaptive Management Plan. DRAFT FOR DISCUSSION

4: Planting Plan: Early Retirement Site 6; Ration Stream.

STREAM DIVERSION GUIDELINES
TRANSMISSION GULLY

Diversion Staging
Physical Design Parameters
& Adaptive Management

DRAFT FOR DISCUSSION

Submitted to
NZ Transport Agency

By
Boffa Miskell Ltd

Report Number W09034
July 2011

STREAM DIVERSION GUIDELINES

DIVERSION GUIDELINES (DRAFT)

The purpose of this information is to guide the establishment of the final design of the diversion channel in particular in setting the substrate, meander, habitat hypes, depths and velocity goals.

The information for these diversion design guidelines comes from the stream sampling carried out by Boffa Miskell as part of the Transmission Gully investigations together with reference material provided by published works such as Richardson Jowett (1996) on fish species requirements. It is discussed in detail in Technical Report #9 Freshwater Habitat & Species.

The aim of most stream diversions is to mimic the aquatic habitat being lost (meaning largely the substrate and flow dynamics) and, where feasible and sensible, create added habitat opportunity.

Matching these parameters as closely as possible will ensure that the diversion retains the diversity of morphology, hydrology, substrate, and habitats of the current channel, and will include a number of additional enhancements such as inanga spawning,

Physical Parameters

Technical Report 9 provides detailed descriptions of the physical parameters of the two streams in which most diversions will occur. They are summarised here to provide context to the following guidelines.

Habitat Proportions

In terms of lengths of each habitat to recreate, and accepting that there will be construction limitations, the data from the sites shows that stepped riffles in the Te Puka and upper Horokiri are the longest habitat types, with riffles also occupying substantive linear lengths between 14 and 24 m. Waterfalls, chutes and cascades are generally short at less than 5m.

Table 1 Habitat type proportions (%) in the diversion reaches of the Horokiri and Te Puka.

	Run	Riffle	Pool	Stepped riffle	Cascade	Water Fall	Stepped Pools	Chute	Stepped run	Braid
Te Puka		35	9	12	12		22		2	8
Horokiri upper	8	24	22	2	14	2	12	4	12	
Horokiri middle	26	44	30							

Substrate Composition

Table 2 shows that the most common substrate type in the Te Puka is cobble, medium sized is ubiquitous but large cobble is also common. Gravels sand and pebble are also frequently present and therefore a wide substrate type is available. The upper Horokiri includes some bed rock and boulders, but is dominated by large cobble whereas lower down the catchment (the middle Horokiri) medium cobble dominant and sand and pebbles are common.

Table 2 Average % cover of the different substrate types.

	Large Cobble	Medium Cobble	Small Cobble	Gravel	Sand	Boulder	Pebble	Bedrock
Horokiri middle	59.3%	85.2%	59.3%	33.3%	48.1%	7.4%	59.3%	

Horokiri upper	75.0%	50.0%	41.7%		16.7%	25.0%	33.3%	8.3%
Te Puka	30.0%	100.0%	70.0%	30.0%	20.0%		30.0%	

Water Velocity

Table three shows the average water velocities experienced in the three streams. High velocities not only affect fish passage but also the ability of fish to become resident and utilise the habitat.

Table 3 Average velocity by habitat type

Average velocity (m/s)	Horokiri middle	Horokiri upper	Te Puka
Run	0.4	0.2	0.3
riffle	0.7		
pool	0.4	0.3	
cascade		0.4	
Step/Riflle			0.3
Run/Riffle			0.5

Stream width and depth

These parameters affect the total area of habitat that can be utilised, as well as the volumes of water that will be carried during normal flows.

Table 4 Average depth and wetted width by primary habitat type

Micro-habitat	Average depth (m)	Max depth (m)	Proportion wet (%)	Wetted Total (m)
Middle Horokiri				
Run	0.11	0.24	36.20%	3.22
riffle	0.10	0.16	44.99%	2.60
pool	0.39	0.67	49.78%	2.13
Upper Horokiri				
Run	0.14	0.09	44.65%	1.7
pool	0.35	0.25	55.26%	2.1
cascade	0.17	0.05	91.18%	3.1
Te Puka				
Step/Riffle	0.19	0.11	41.11%	3.7
Run/Riffle	0.11	0.06	45.19%	6.1
Run	0.12	0.06	31.67%	1.9

SUMMARY GUIDELINES

Channel Length & Meander

- Wherever possible diversions will seek to create small meanders
- The meander should be planned and pegged out on site.
- The Meander is vital for providing habitat diversity, channel complexity, and velocity reduction.

Channel complexity

To mirror as closely as possible the diversity shown in table 1 with an emphasis on the four types contributing the largest component of each stream, e.g.

- 35% Riffle
- 25% Step pool
- 15% Run
- 15% Boulder cascade

Channel Habitat Diversity

Diversity will increase over time as the new stream channel 'matures'. Ongoing monitoring will be important.

- Cobble riffle
- Run – Pool
- Boulder - bedrock Cascade
- Root mat (from riparian vegetation)
- Undercut (bank)
- Boulder

Width of wetted bed

(Between banks & including gravel bars) to match as closely as possible current as seen in table 4, taking into account the different widths, depths and velocities of different channel types

Water Depth

To match as closely as possible current seen in table 4

Generally depths of all features other than pools should fall within a target a range of 0.05 and 0.3. Riffle depths should aim to be 0.05-0.15, cascade depths range from 0.0.05, Runs should range from 0.05-0.3 m. Target depth for pools should be 0.25 to 0.5.

Velocity

To match as closely as possible current seen in table 3.

Velocities of the diversion reaches therefore should be contained below 0.5 ms-1 and preferably 0.2 to 0.4 ms-1, and drop structures preferred to move down the catchment rather than steep reaches of fast runs or riffles. In attaining these velocities small waterfalls and chutes are recommended to be constructed with a climbing fish surface focus.

Bed material

To match as closely as current situation as seen in table 2.

The placement of these different sized bed materials needs to be monitored and size will be determined by velocity and desired habitat.

Consent conditions xx require ecological instruction and guidance during this process.

Hyporheic Zone

When forming the diversion channel, where the excavation is in clay or similar, the bed is to be cut down 1m below final bed depth and filled with coarse material to form a deep gravel / cobble bed and functioning Hyporheic zone. If the excavation falls in river gravels this will not be necessary.

Shading

- Currently 40% based on overhanging banks, blackberry weedlands, and weedy aquatic macrophyte

- To attain a minimum (with revegetation) of 80% based on canopy of small trees, marginal grasslands.

Spawning Habitat

- Currently limited to small sand bars within stream channel
- Increase with landscaping to 50% of stream margin and extending 5-10m inland.

Planting

Planting to achieve the following

- Erosion control immediately following earthworks – hydro-seed with inter-planting
- Riparian cover and stream shading
- Weed control – elimination

Diversion Staging / Indicative Methodology

1) Build the new stream alignment off line and maintain existing stream quality;
2) Establish the new stream bed and substrate with space for a hyporheic zone (at least 1 m deep);
3) Provide sufficient space to add old bed substrate material on top;
4) Create channel depth profile (noting above requirements) to mimic existing stream, in terms of final water depths, width and so velocities;
5) Establish the flood terrace (The terrace as well as assisting in the management of flood waters, also supplies the opportunity to develop filtering vegetation, riparian native vegetation and additional filter systems for discharging storm water);
6) Form stream banks as near as possible to the slope and material of the natural bank condition (use riprap baskets as armouring at meander curves where required;
7) Ensure sufficient meanders are present;
8) Store and dispose of excavated material so that it does not contaminate either waterway;
9) Provide clean appropriately sized hard substrates (see above) in correct proportions as well as new larger substrate were cascade sections (drops) are needed and ensure water does not fall (as in water fall) such that fish passage is threatened;
10) Plant the immediate riparian vegetation prior to or as soon after as practicable the re connection;
11) Plant out the rest of the flood terrace (especially for stabilisation);
12) Ensure no rain events at the time of reconnection;
13) Prior to diversion of water, fish out and transfer eel and all fish caught. Use a holding tank while diversion to new stream is enacted. Release the fish into the stream either below or above the new connection, after re-connection;
14) Trap and release of fish ideally should be in the same day;
15) Immediately following fish removal break lower connection and then make and redirect stream in to new diversion;
16) Search and capture eel and fish on the ebbing water in the diverted reach;
17) Prior to infilling the old channel and immediately following loss of surface water, salvage some of the cobble material for transfer into the upper half of the new reach (for purposes of inoculation of algae, periphyton and some invertebrate);

18) Infill old channel with appropriate clean fill and excavated stream material, ensure diversion "wall" water proofed.
19) Monitor sediment discharge at the downstream end of the new diversion over the period of several days and in at least two rain fall events;
20) Monitor benthic community return (primarily periphyton species and cover and aquatic invertebrates : *Coloburiscus*, *Deleatidium*, *Aoteapsyche*, *Hydrobiosis*, *Psilochorema* and *Elmidae*) over the period of two years, biannually (4 surveys).

AQUATIC MONITORING PROGRAMME
TRANSMISSION GULLY

Stream Quality Monitoring Methodology
& Adaptive Management Plan

DRAFT FOR DISCUSSION

Submitted to
NZ Transport Agency

By
Boffa Miskell Ltd

Report Number W09034
July 2011

INTRODUCTION

This monitoring plan has been prepared to meet conditions in relation to Resource Consent Approvals: WGNxxx [xxx] [xxx] to undertake earthworks, divert, reclaim and place structures in the main stems and tributaries of the Te Puka, Horokiri, Ration, Pauatahanui, Duck Creek, Kenepuru (Cannons) and Porirua aquatic systems associated with the development of Transmission Gully roadway.

This plan relates specifically to Consents xxx (fish passage during stream diversion), and xxx (water quality and preparation of an Environmental Monitoring Plan [EMP], for the monitoring and adaptive management of sediment discharge), and xxxx (habitat recreation success in new diversion channels).

The conditions require that the EMP detail the methods for monitoring stream water quality, the health of the aquatic environment, and provide an adaptive management framework whereby the results of water quality monitoring trigger appropriate responses by contractors and their staff to respond to and mitigate any events that have the potential to cause direct adverse effects and indirect adverse effects on the downstream receiving environments. These conditions can be summarised as follows:

Consent [xxx] Construction Monitoring – Water Quality

- Baseline Water Quality Monitoring (Condition xxx)
- Construction Monitoring plan approval (Condition xxx)
- Construction Monitoring of water quality (Condition xxx)
- Reporting (Condition xxx).

Consent [xxx] Construction Monitoring - Aquatic & Estuarine Ecology

- Baseline Aquatic Monitoring Plan (Condition xxx)
- Construction Monitoring plan approval (Condition xxx)
- Construction Monitoring of Aquatic and Estuarine health (Condition xxx)
- Reporting (Condition xxx).

Consent [xxx] Fish Relocation

- Fish relocation -during permanent diversion (Condition xxx)
- Fish passage - diversions (Condition xxx)
- Fish passage - culverts (Conditions xxx)

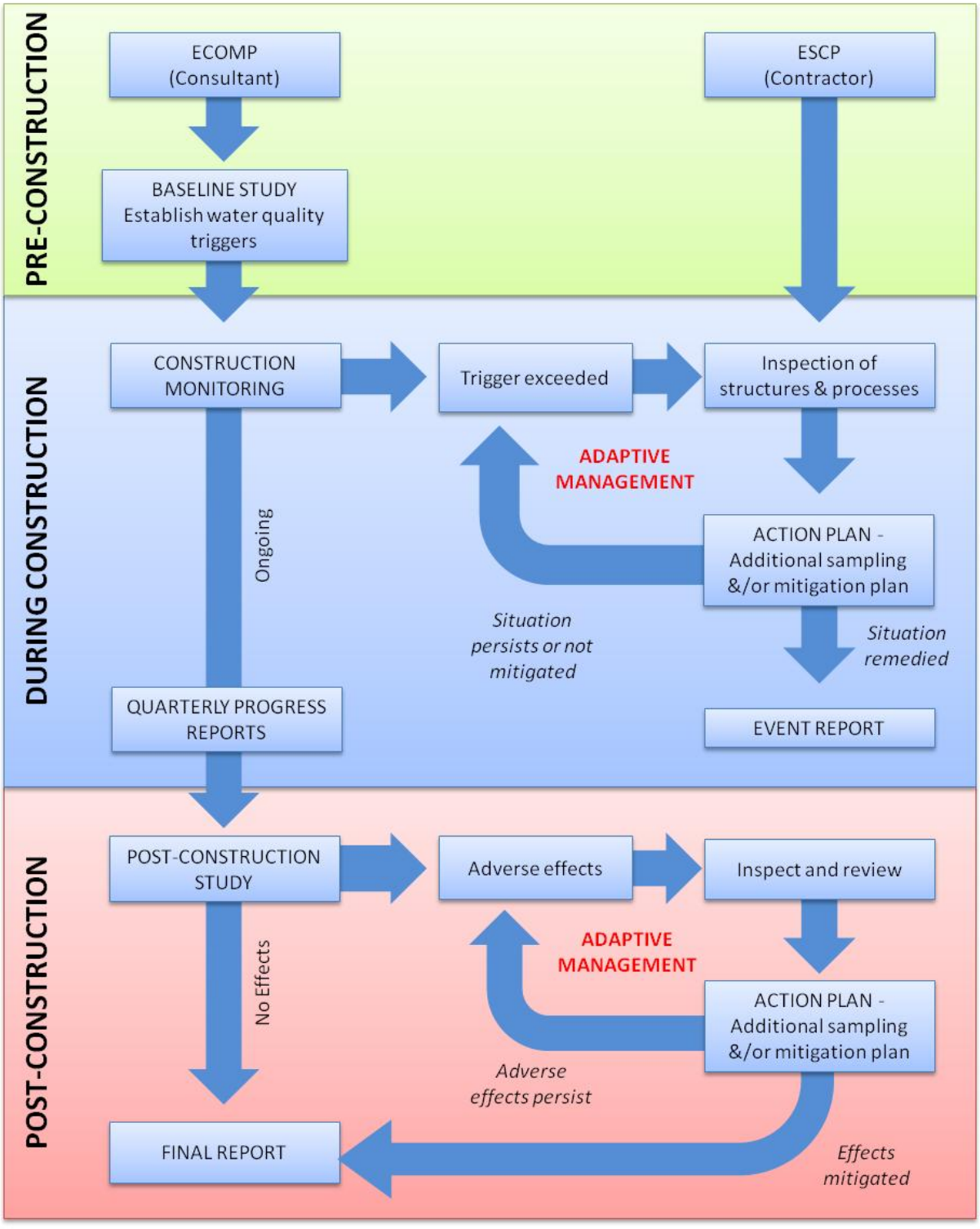
Consent [xxx] In-Stream Works

- Diversion Design (Condition xxx)
- Staff training
- Construction monitoring

ADAPTIVE MANAGEMENT PROCESS

The general process that this plan follows is shown in Figure 1. It aims to ensure a link between the Stream Quality Monitoring Methodology (SQMM) and the Erosion and Sediment Control Monitoring (ESCP). Baseline studies (and existing local studies) will produce an event trigger value. If the trigger value is exceeded it starts an adaptive management process that continues until the situation causing the trigger is remedied.

Figure 1: Adaptive Management Flow Chart



MONITORING SITE SELECTION

Monitoring will be carried out at four study reaches which will include 18 "impact" sites and three "control" or reference sites. The proposed study reaches are centred on the locations shown in Figure 2, and described in Table 1.

Table 1: Monitoring sites and monitoring activities at each site

Site	Description	Measures	Provisional Location Lat Long & NZMG
Impacted sites			
01	Te Puka Stream above SH1 culvert	F, AI, S, Trb,	
02	Te Puka lower Diversion channel	AI, PHA, S, F.	
03	Te Puka upper Diversion channel	AI, PHA, S, F.	
04	Whareroa/Wainui Stream	F, S.	
05	Horokiri upper main stem	AI, S.	
06	Horokriri upper Diversion	AI, PHA, S.	
07	Horokriri lower Diversion	AI, PHA, S.	
08	Horokiri below terrace wetland	AI, F, S, Trb	
09	Horokiri east branch confluence	AI, S, Trb.	
10	Horokiri lower main stem	AI, S.	
11	Ration lower mainstem	AI, F, S, Trb.	
12	Pauatahanui lower main stem	AI, F, S, Trb	
13	Duck Creek lower main stem	AI, F, S, Trb	
14	Duck creek XX crossing main stem	AI,F, S	
15	Duck Creek True right Tributary	AI,F,S.	
16	Duck Creek upper main stem	F.	
17	Cannon Creek middle reach (above ponds)	AI,F,S.	
18	Porirua Tributary	S.	
Control sites			
19	Te Puka Upper Forest Tributary	AI, F, S.	
20	Horokiri upper True left tributary	AI, F, S.	
21	Horokiri west branch	AI, S, Trb	

Code – AI = Aquatic macroinvertebrate (kick net), F = fish (EFM), PHA = Physical habitat assessment (scores), S = sediment deposition, Trb = turbidity logger

The location of sites for measurement has been guided by the estimation of the end of a "zone of reasonable mixing". This zone has been guided by the GWRC practice of 70m downstream of the last discharge point. Other sites have been chosen to be directly within diversion zones or at potential fish passage issues sites.

The final locations may be subject to refinement to ensure security of monitoring equipment, unrestricted access, and safe access during rainfall events.

Figure 2: Proposed Location of Study Reaches

SAMPLING REGIME & TIMING

Sampling and analysis is often done progressively through the construction and earthworks periods of a large project. However, the baseline aside, the programme we recommend for this project given that there could be 3 fronts over a period of 3 years with a further 3 years for the last front, is that an annual October-November prescribed sampling regime should be followed such that there are two annual full sampling data sets pre-earthworks, three or four annual measures through the process and two annual data sets collected post conclusion of the earthworks and any other sediment releasing activities. Throughout all of this time the Turbidity data loggers will operate (along with the rain gauges) continuous (being serviced once a month each month) while storm event related grab samples may be collected as circumstances require.

Other sampling will occur as triggered by issues and events, in particular spot fish passage surveys relative to season and stream fresh observations against completion of culvert installations, or physical habitat checks following completion of diversion channels.

Table 2: Summary of Programmed Sampling Regime

		Fauna		**Habitat**	**Water Turbidity**	
		Fish (Oct-Nov & again in March-April)	**Macro-invert (November through to February)**	**Visual Assessment**	**Logger (NTU)**	**Sediment deposition**
Historic 2009-2010		✓	✓	✓	✓	
Pre Construction Baseline 2009		✓	✓	✓	✓	
Pre Construction Baseline 2010		✓	✓	✓	✓	
Pre Construction Baseline 2011			✓		✓	✓
Construction Horokiri 2012			✓		✓	✓
Construction Horokiri 2013			✓		✓	✓
Construction Horokiri 2014		✓	✓	✓	✓	✓
Construction Cannons Creek 2012			✓		✓	✓
Construction Cannons Creek 2013			✓		✓	✓
Construction Cannons Creek 2014		✓	✓	✓	✓	✓
Construction Pauatahanui 2012			✓		✓	✓
Construction Pauatahanui 2013			✓		✓	✓
Construction Pauatahanui 2014		✓	✓	✓	✓	✓
Construction TePuka 2015			✓		✓	✓
Construction TePuka 2016			✓		✓	✓
Construction TePuka 2016		✓	✓	✓	✓	✓
Post Construction	Horokiri to Cannon 2015	✓	✓	✓	✓	✓
Post Construction	Horokiri to Cannon 2016	✓	✓	✓	✓	✓
Post Construction	TePuka 2017	✓	✓	✓	✓	✓
Post Construction	Horokiri to Cannon 2018	✓	✓	✓	✓	✓

PRE-CONSTRUCTION BASELINE

The objectives of the baseline water quality monitoring are:

- To establish a range of stream turbidity levels associated with representative rainfall events which if exceeded during construction will trigger an adaptive management and reporting response (See Figure 1).
- To establish both impact and control sites in appropriate locations so that it is possible to determine whether any recorded changes to water quality, in-stream biota, or habitat quality are attributable to this project or are the result of other activities within the Pauatahanui, Porirua or Wainui catchments.
- To accurately describe existing in-stream biota and habitat quality, so that any changes during and at the completion of construction can be identified and appropriate strategies put in place to remedy or mitigate.

FAUNA

Prior to commencement of construction existing populations of fish and macroinvertebrates will be determined at the 21 monitoring reaches using two methods.

FISH

- Initial baseline fish surveys have been conducted in either spring 2009 or late summer/Autumn 2010. Sampling was (and will be post construction) carried out by NIWA certified operators using a Kainga 300 backpack electro-fishing machine.
- Sampling at each of the study reaches will consist of 10 runs targeting cover features. Each run will be 4 x 1 metres, double pass, and separated by at least 5-6 metres of un-fished stream. Fish will be captured by scoop net and downstream stop net and transferred to a bucket. Fish will be identified, measured, and returned to their habitats.
- Post Construction. At the end of earthworks and construction that potentially could result in sediment discharge and following the installation of all culverts, diversions and other potential fish passage barriers, repeated EFM sampling (as per method above) during October-November will be carried out to identify up-stream moving eel and galaxids and again in March April to establish passage success.

FRESHWATER MACRO-INVERTEBRATES

- Sampling will be undertaken in the months of October to November annually.
- Communities of freshwater macroinvertebrates will be sampled following a period of stable flow of no less than 1 week. The sampling technique will generally follow the national standard protocol C1 (hard-bottomed, semi-quantitative) (Stark, Boothroyd, Harding, Maxted, & Scarsbrook, 2001).
- At each of the 21 study reaches, 3 habitat hot-spot focused and 2 random 0.1m^2 macro-invertebrate samples will be collected using a, 0.5 mm mesh Suber sampler. Samples will not be taken within electric fishing runs.
- Species will be identified to MCI level and abundance will be full count.

DEPOSITED SEDIMENTS

Prior to commencement of construction existing levels of deposited sediment will be determined at the 19 of the monitoring reaches using two methods. Anchored astro-turf plate surface accumulation and visual assessment. Sampling will provide a quantitative measure of suspended

sediment for programmed sampling. Visual estimates of sediment deposition will provide a rapid means of assessing change following a specific triggered event.

VISUAL ESTIMATE OF % COVER OF FINE SEDIMENTS

- Visual estimation of % cover of fine sediment (grain size < 2 mm) on the streambed will be carried out at 10 locations within each of the four study reaches. The viewing locations will be located on five equidistant transects distributed down the length of the sample reach. Estimates will be taken at two random locations per transect. The % cover of fine sediment recorded for each study reach will be the average of the 10 estimates (Wagenhoff, 2009).

PLATE TURF ACCUMULATION

- Use of a 3 X 0.25m2 long-grass astro-turf blocks positioned in the stream bed at suspected deposition zones. These blocks will be used to entrap sediments, mimicking macrophyte entrapment (Apt, Clary & Thornton 1994), and then allow the collection and weighing of those sediments. Given the accumulation rate within the turf of the blocks will initially be unknown the blocks will be trialled in the first year, and measured every month when the loggers are maintained and the data downloaded. These measures will determine if an annual measure for the blocks will be applicable.
- Blocks are inverted into a collection tray and entrapped sediment washed into the tray and collected and strained for a wet weight measurement.

BASELINE AND ONGOING WATER TURBIDITY SAMPLING

NTU LOGGER

In total seven turbidity loggers (Greenspan TS-3000 Turbidity Sensor/Logger; 0-3,000 NTU, or equivalent) will be installed. Four loggers are currently installed (Western & Eastern Horokiri, arms, lower Puatahanui and lower Duck). A further three one to cover the Te Puka at the SH, one in the lower Ration and one further logger in the middle Horokiri. One site only is a control site (the western Horokiri). The loggers are superficially to provide the median and mean back ground sediment in suspension loads of the various waterways. Spikes due to storms are of less importance to establishing effects and subtle changes to back ground suspended sediments.

The turbidity loggers have been run for XXX years prior to commencement of the construction. They will then run continuously for the entire earthworks and construction period of the roading and then for two years post construction.

From the results of the baseline sampling a turbidity trigger level will be established for the impact logger that is equivalent to 2 Standard Deviations of the difference between upstream and downstream loggers, of the turbidity at the baseline logger on that day. Exceedence of this level during construction will trigger an adaptive management response as shown in Figure 1 and detailed below.

GRAB SAMPLING

In addition to the use of NTU data loggers, grab samples will be taken for analysis of Total Suspended Solids (TSS) and to ensure accurate calibration of the NTU loggers. All sampling will be undertaken at least 1 metre from the bank. Where rivers are less than 2 metres wide the mid point will be used. The sampling point shall be in open free flowing water.

A target of at least 10 rainfall events will be recorded between now and commencement of earthworks and all large rainfall events (i.e. over 15 mm) through bulk earthworks will be sampled.

Sampling will be undertaken as soon as possible after 15 mm of continuous rainfall has been recorded. If rainfall persists for more than 24 hours, sampling will be repeated daily.

Rainfall will be tracked from a combination of hourly data updated every 30 minutes at http://www.metservice.co.nz/public/localWeather/wellington.html and local data taken from a GWRC weather station at Seton Nossiter Park which provides rainfall data from the Porirua Catchment upstream of Westchester drive, updated every 3 to 4 hours, (see http://www.gw.govt.nz/Seton-Nossiter-Park) and also from a weather station in the Stebbings Stream catchment, upstream of the works.

STORM MONITORING

Construction monitoring will include both scheduled checks (Oct-Nov every year) and event based responses to rainfall causing discharges that create exceedences measured by the construction contractors monitoring their sediment control devices.

PREPARATION

- Establish relationship and project objectives with forecasters (NIWA, NZ Meteorological Service);
- Establish "event" decision tree with forecasters (will be iterative – see (c) iii below)
- Establish contractor "event" teams and roles (will be iterative – see (c) iii below)
- Establish stockpile of gear, hay bales, silt fences, fabric mats, flock blocks, geotubes, etc (will be iterative – see (c) iii below)

EVENT

- Early identification, and monitoring of storm fronts;
- Notification of Councils of event
- Step by step earthworks shutdown, halt to refuelling;
- Step by step checks of bunds, ponds, cut off drains, grit traps, silt fences, etc, etc;
- Emergency stabilisation of key areas;
- Movement of machinery away from streams;
- Sediment pond and stream monitoring teams on standby;

POST EVENT

- Site tidy up and repair
- Event review / debrief
- Adaptive management of systems
- Reporting: Internal / External

5.1.1 RAIN EVENTS

Identification of a rainfall trigger has been developed during baseline aquatic monitoring of xx rainfall events over an xx period as described in the Baseline Aquatic Monitoring Plan.

A xx mm/hr rainfall event will trigger stream sampling.

xxx will subscribe to the telemetered rainfall warning system at xxx rain gauge. xxx will be alerted by text when an event of xx mm/hr has occurred providing time to anticipate a xx mm trigger event, and prepare for a site visit if required.

SITE RECORDS

Throughout the monitoring record sheets will be completed on each sampling visit. This will record include the following:

Date and time,	Weather conditions,
Nature of flow,	Any conspicuous change in colour or visual clarity,
Presence of any conspicuous oil or grease films, scums or foams or floatable or suspended material,	Presence of any existing emission of objectionable odour,
Presence of anything existing that makes the water unsuitable for human or animal consumption.	Presence of any existing significant adverse effect on aquatic life.

A photograph of the streams at the sampling points will also be taken at the time of sampling. This photograph along with notes on the river's appearance will be used to comment on any changes in colour and visual clarity. These photos can be used to compare different sampling locations including control and impact sites.

EXCEEDENCE OF TRIGGER LEVELS

An exceedence may relate to either of the two different sampling regimes.

WATER TURBIDITY

Turbidity monitoring via the loggers and by grab samples being triggered by particular sized rain events provides an early identification of an issue and is the primary monitoring tool. The purpose of the trigger level is to instigate an immediate response by the construction and ecological team, and if there has been a failure of structures or systems, to develop an action plan and allocate responsibilities for remedy.

SUSPENDED SEDIMENT TRIGGER LEVELS

Trigger levels for exceedence of Total Suspended Sediments (TSS) and Turbidity (NTU) will be calculated from the baseline investigations and will include triggers for both rainfall events and baseline flows. A breach of a trigger level does not mean that ecological damage has occurred, but that the risk of such damage has substantively increased.

EXCEEDENCE (SUSPENDED SEDIMENTS)

- Where device field measurement or rain intensity field triggered sampling shows a trigger level has been exceeded the following action will be taken: A sampling run (TSS grab samples) will be completed and values across all monitoring locations within the affected catchment will be compared to determine if there is a pattern of exceedence.
- Where suspended sediments exceed the trigger level at one or more of the sites, an inspection will be undertaken upstream of the monitoring point.
- The inspection will look for a source or cause for an elevated reading, including looking at erosion and sediment control structures to determine if they are operating correctly.
- Where an erosion or sediment control structure is found not to be operating correctly the Project Environmental Manager or Duty Manager and Greater Wellington Regional Council will be notified as quickly as practical. An action plan for remedy will be immediately prepared and tasks allocated.

- If discharge causes visible changes to the character of the stream in the location of the discharge a decision will be made regarding additional biological study to determine if mitigation is required.
- Where no satisfactory explanation can be determined for the exceedence; additional investigation outside of storm events may be undertaken provided that work will stop immediately if the difference in turbidity between the downstream and upstream logger exceeded the mean plus 2 times the standard error of the difference between the two loggers recorded prior to any work.

Note that exceedence of a trigger level does not necessarily mean that there has been a discharge from the worksite. It may relate to upstream activities, or to a rainfall event and associated turbidity levels that are significantly greater than were captured during the baselines study. These will be taken into account during the trigger response.

FAUNA AND HABITATS

Statistical analysis of periodic sampling against the pre-construction baseline will determine if there has been (or is occurring) a significant change in indicator species, or community composition, or habitat quality. Analysis will include Permutational Multivariate Analysis of Variance.

TRIGGER LEVELS

Trigger levels for changes in stream health will be developed as part of the baseline investigations and will include triggers for both biotic change and habitat change and involve QMCI changes, community diversity changes, and community composition changes.

EXCEEDENCE REMEDIAL ACTIONS

Where periodic sampling shows a trigger level has been exceeded the following action will be taken.

- A meeting will be called with the client and Project Environmental Manager or Duty Manager to describe the exceedence and its implications.
- Greater Wellington Regional Council will be informed of the exceedence and the actions being undertaken to locate the source.
- Where erosion or sediment control structures are found not to be operating correctly an action plan for remedy will be immediately prepared and tasks allocated.
- A decision will be made regarding additional ongoing biological study to determine if the situation has been remedied or whether mitigation measures are required.
- Where no satisfactory explanation can be determined for the exceedence; additional investigation may be required to be undertaken.

POST CONSTRUCTION COMPARISON

Following completion of all construction activities

- Monitoring will continue until all earth worked surfaces have been stabilised.
- A repetition of the baseline monitoring programme will be completed in the first October-November period following completion of site works.
- At this point statistical comparisons will be undertaken between pre – during - post samples to determine the cumulative scale of any effects over the course of the project, if any.

- This information will be included in the final project report which will summarise all the sampling undertaken, trends in stream health, confirmation of any effects and recommendations for remedial work if necessary.
- Based upon the results of this assessment further work maybe undertaken.

IN-STREAM WORKS

STAFF TRAINING (Condition xxx)

Prior to the commencement of earthworks all contractors likely to be involved in the construction of the diversions, or other in-stream works will be briefed on the values of Duck Creek, the objectives of the stream design, the requirements of native fish for fish passage, and the sensitivity of the receiving environment to sediment discharge.

CONSTRUCTION MILESTONEES (Condition xxx)

At each milestone in the formation and landscaping of diversion channels, the livening of the new channel and the reclamation of the existing channel, site visits will be carried out by a suitably qualified ecologist to ensure the design principals have been followed and to provide advice where necessary on changes or improvements that are required.

CONSTRUCTION MONITORING (Condition xxx)

Baseline studies will be repeated bi-annually (Autumn & Spring) at all sample sites until all bulk earthworks are complete and the site is stabilised.

A statistical assessment will be made following each study comparing against the baseline results. If a significant difference in any of the measures (fish, macro-invertebrate, or sediment deposition) is identified this will trigger the adaptive management process described in Section 2 and shown in Figure 1.

The results of this study will be included in a bi-annual reporting, unless there is a significant issue requiring immediate action.

REPORTING (Condition xxx)

A brief report will be prepared at each milestone associated with diversion formation, confirming the issues discussed, describing any actions taken, providing sign-off for that stage and agreement for the contractor to commence the next phase of work.

FISH PASSAGE

FISH RELOCATION (Condition xxx)

Prior to and during the permanent diversion of streams, all practicable steps shall be taken to capture and relocate fish from the affected reaches of stream. All practicable steps include, but are not limited to netting with minnow traps and electric fishing.

- All fish netting and relocation shall be completed by a suitably qualified ecologist.
- All fish collected shall be relocated upstream of the diversion.
- The Manager, Environmental Regulation, Wellington Regional Council shall be advised when the relocation of fish has been completed.
- An advisory note will be prepared and forwarded to The Manager, Environmental Regulation, Wellington Regional Council, when the relocation of fish has been completed.

FISH PASSAGE - DIVERSIONS (Condition xxx)

Immediately following formation of diversions and prior to livening of the new channel xxx will inspect and confirm that any structures within the diversion will provide fish passage for all native species currently known to occur or reasonably likely to occur within this stream.

An advisory note will be prepared and forwarded to the Manager, Environmental Regulation, Wellington Regional Council, confirming all culverts have been installed as required under condition xx, prior to the diversion of water through the pipes.

FISH PASSAGE CULVERTS (Condition xxx)

Immediately following formation of the culverts xxx will inspect the structures and confirm that they have been installed in accordance with the relevant guidelines to provide fish passage for all native species currently known to occur or reasonably likely to occur within this stream.

An advisory note will be prepared and forwarded to the Manager, Environmental Regulation, Wellington Regional Council, confirming all culverts have been installed as required under condition xx, prior to the diversion of water through the pipes.

POST CONSTRUCTION MONITORING

All baseline aquatic fauna and habitat sampling will be repeated in the spring following completion of works and again the following spring.

It will be carried out in spring or early summer following winter rains, and when fish movement within the stream will be at their peak.

At this point statistical comparisons will be undertaken between pre–during–post samples to determine the scale of any effects that have occurred, if any.

This information will be included in the final project report which will summarise all the sampling undertaken, trends in stream health, confirmation of any effects and recommendations for remedial work if necessary.

The report shall include, but not be limited to:

- Results of all construction and post construction monitoring;
- Discussion of any exceedences and their effects on aquatic ecology;
- Identification of any impediments to fish passage;
- Recommendations for any remedial measures;
- Timeframe for implementing treatments.
- Proposals for ongoing monitoring if required;

REPORTING

In summary the reporting regime will be as follows:

Baseline Study Report: Completed at least one month prior to commencement of earthworks.

Bi-Annual progress reports: summarising the results of all sampling and site inspections and providing recommendations to remedy or mitigate any significant adverse effects that have occurred or to avoid foreseen significant adverse effects. This may include, but not be limited to:

- Changes in the management or implementation of erosion and sediment control measures;
- Methods to remedy the significant adverse effects;
- Mitigation measures to offset the significant adverse effects; and
- All raw data collected on site including raw macro-invertebrate data, clarity and sediment deposition.

Diversion Staging Reports: following each agreed milestone associated with diversion formation, confirming the design meets the agreed guidelines, providing sign-off for that stage and agreement for the contractor to commence the next phase of work

Event Reports: prepared as required for each monitored event, summarising the results of all sampling and site inspections and providing recommendations to remedy or mitigate any significant adverse effects that have occurred or to avoid foreseen significant adverse effects. This may include, but not be limited to:

- Changes in the management or implementation of erosion and sediment control measures;
- Methods to remedy any adverse effects;
- Additional ecological investigations.

Concluding Report: following completion of all site works and at least 9 months following site stabilisation. It will include:

- Water quality results;
- Aquatic Habitat results & recommendations;
- Fish Passage results & recommendations.

All reports will be provided to the consenting authority within the timeframes described above, and will be copied to the NZTA.

REFERENCES CITED

Apt, R.S.; Clary, W.P.; Thornton, C.I. 1994. Sediment deposition and entrapment in stream bed vegetation. Journal of Irrigation and Drainage Engineering vol 120, no. 6 pp 1098-1111

Hamer, ,M. 2007. The Freshwater fish spawning and migration Calander Report. Environment Waikato Technical Report 2007/11. www.ew.govt.nz

Jowett, I., & Richardson, J. (2003). Fish Communities in New Zealand rivers and their relationships to environmental variables. *NZJournal of Marine and Freshwater Research.* , Vol. 37: 347-366.

NIWA. (2007). *www.niwa.cri.nz/ncwr/tools/quorer*. Retrieved from Quorer: a simple method for estimating deposited fine sediment.

Stark, J., Boothroyd, I., Harding, J., Maxted, J., & Scarsbrook, M. (2001). *Protocols for sampling macroinvertebrates in wadeable streams.* New Zealand Macroinvertebrate Working Group Report No. 1. Prepared for the Ministry for the Environment, Sustainable Management Fund Project No. 5103. 57p.

Wagenhoff, A. M. (2009). *Multiple-stressor effects on stream health in Southland streams and rivers. A report provided to Environment Southland in fulfilment of ENVIROLINK medium advice grant 488-ESRC211.* Department of Zoology, University of Otago

ESTUARINE AND COASTAL MONITORING PROGRAMME: TRANSMISSION GULLY

Estuarine Quality Monitoring Methodology
& Adaptive Management Plan

DRAFT FOR DISCUSSION

Submitted to
NZ Transport Agency

By
Boffa Miskell Ltd

Report Number W09034
July 2011

INTRODUCTION

This monitoring plan has been prepared to meet conditions in relation to Resource Consent Approvals: WGNxxx [xxx] [xxx] to undertake earthworks and discharges from the main stem and tributaries of the Te Puka, Horokiri, Ration, Pauatahanui, Duck Creek, Kenepuru (Cannons) and Porirua aquatic systems associated with the development of Transmission Gully roadway and their discharge to the Porirua harbour.

This plan relates specifically to Consents xxx (xxx (water quality and preparation of an Environmental Monitoring Plan [EMP], for the monitoring and adaptive management of sediment discharge to the Pauatahanui inlet and Onepoto arm of the Porirua harbour).

The conditions require that the EMP detail the methods for managing and monitoring stream water quality, the health of the estuarine benthic environment, and provide an adaptive management framework whereby the results of water quality monitoring trigger appropriate responses by contractors and their staff to respond to and mitigate any events that have the potential to cause direct adverse effects and indirect adverse effects on the estuarine receiving environments. These conditions can be summarised as follows:

Consent [xxx] Construction Monitoring – Water Quality

- Baseline Water Quality Monitoring (Condition xxx)
- Construction Monitoring plan approval (Condition xxx)
- Construction Monitoring of water quality (Condition xxx)
- Reporting (Condition xxx).

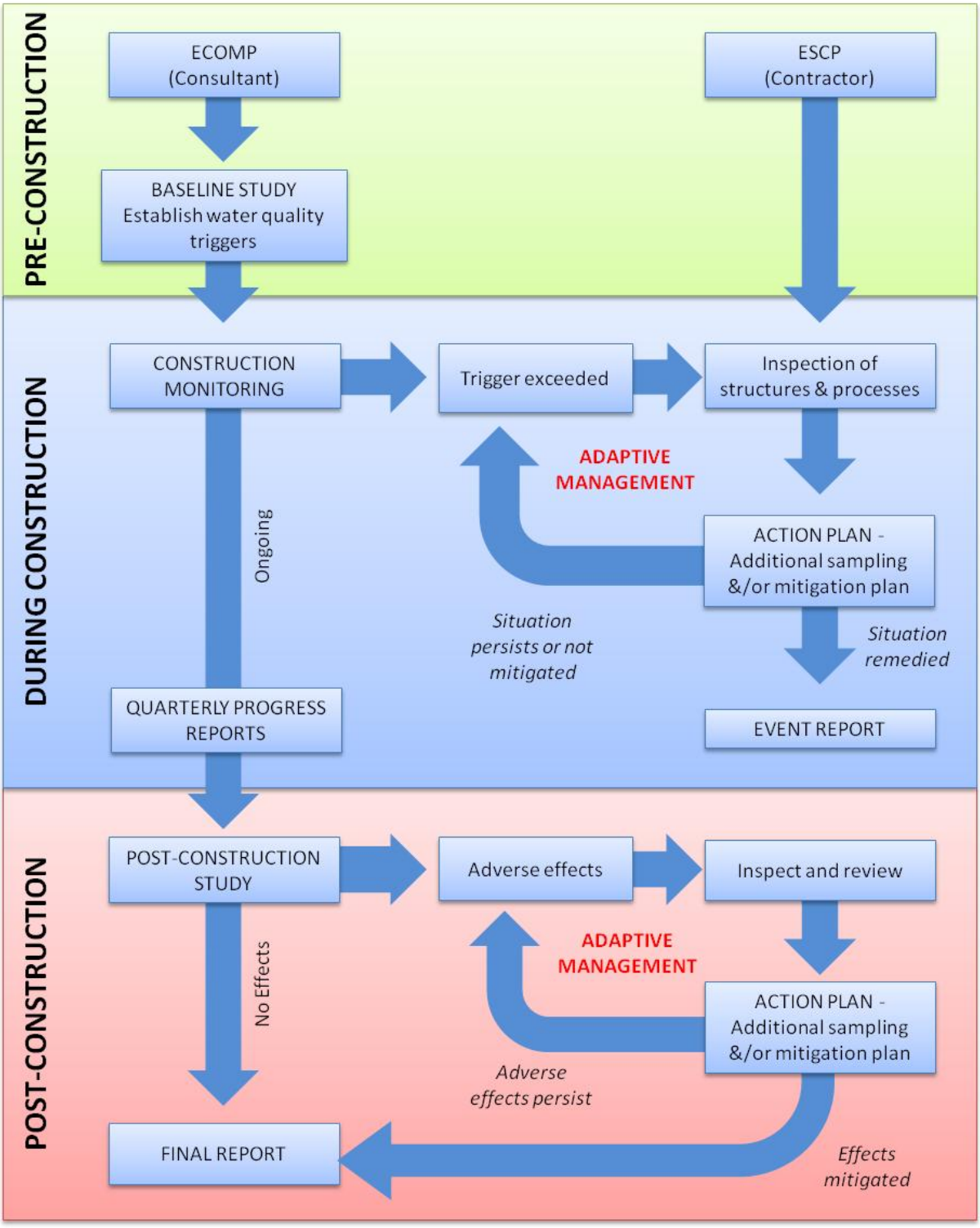
Consent [xxx] Construction Monitoring - Estuarine Ecology

- Baseline Estuarine Monitoring Plan (Condition xxx)
- Construction Monitoring plan approval (Condition xxx)
- Construction Monitoring of Estuarine biota health (Condition xxx)
- Reporting (Condition xxx).

ADAPTIVE MANAGEMENT PROCESS

The general process that this plan follows is shown in Figure 1 It aims to ensure a link between the Estuarine Quality Monitoring Methodology (EQMM) undertaken and the Erosion and Sediment Control Monitoring (ESCP) up stream. Baseline studies (and ongoing local studies) will produce an event trigger value. If the trigger value is exceeded it starts an adaptive management process that continues until the situation causing the trigger is remedied.

Figure 1 Adaptive Management Flow Chart – this flow chart needs to be altered for estuarine



MONITORING SITE SELECTION

Monitoring will be carried out at nine intertidal and 18 subtidal study sites. The proposed study locations are described in Table 1 and shown in Figure 2 below.

Table 1: Monitoring sites and monitoring activities at each site

Site No.	Site Description	Provisional Location (NZMG)	
Intertidal		Northing	Easting
IP1	West of Kakaho Stream mouth	5449820.87	1758904.74
IP2	Adjacent to Kakako Stream mouth	5449660.79	1759088.06
IP3	Adjacent to Horokiri Stream mouth	5448934.61	1759922.53
IP4	Adjacent to Ration Stream	5448447.54	1760558.98
IP5	Adjacent to Pauatahanui Stream	5448120.82	1760372.34
IP6	Adjacent to Duck Creek	5447803.46	1759634.80
IP7	Adjacent to Browns Stream	5447848.17	1758033.18
OP1	Adjacent to Porirua Stream	5445178.58	1754616.58
OP2	West of Porirua Stream	5445629.67	1754531.64
Subtidal			
P1	Adjacent to Horokiri Stream mouth	5448808.73	1759732.05
P2	Adjacent to Duck Creek mouth	5447969.76	1759707.97
P3	East of Kakaho Stream mouth	5449398.76	1759266.12
P4	West of Kakaho Stream mouth	5449528.99	1758095.73
P5	Adjacent to Pautahanui Stream mouth	5448288.71	1760103.99
P6	Central subtidal basin	5448525.79	1759138.04
P7	Between Horokiri Stream mouth and Ration Stream mouth	5448647.07	1760029.29
P8	Adjacent to Kakaho Stream mouth	5449500.61	1758937.48
P9	Central subtidal basin	5448307.00	1759757.00
P12	Central subtidal basin	5448809.00	1759312.00
P16	Central subtidal basin	5449372.00	1759008.00
P17	Central subtidal basin	5447870.09	1759457.16
P18	Central subtidal basin	5447926.39	1759305.21
O1	Adjacent to Porirua Stream mouth	5445584.27	1754849.93
O2	Adjacent to Porirua Stream mouth	5445776.14	1754339.01
O3	Adjacent to Porirua Stream mouth	5445726.28	1754673.96
O4	Mid Onepoto Arm	5447065.11	1756058.02

The location of sites for measurement has been guided by the estimation of deposition zones coupled with where the valued fauna and habitat persists.

The final locations may be subject to refinement to ensure safe access during rainfall events, tidal conditions and any observations of deposition change.

Figures 2: Proposed Intertidal and Subtidal Monitoring Locations

SAMPLING REGIME & TIMING

SCHEDULED INTERTIDAL SAMPLING

At each intertidal location a 50m x 30m grid (subdivided into 10 15m x 10m smaller grids should be established (following the initial study methodologies) using GIS prior to entering the field. Then these 10 sub-grids should be subdivided into six 5m x 5m grids. Sampling should then be undertaken at one of the randomly selected 5m x 5m grids within each 15m x 10m grids. Thus, a total of ten samples per grid location per sampling event will be collected. The sampling design is based on the Estuarine Environmental Assessment and Monitoring National Protocol (Cawthron, 2002).

In each small grid the following data must be collected:

- A core sediment sample (15cm deep x 13cm diameter) for infaunal invertebrate analysis. The core of sediment is sieved through a 0.5mm mesh and the retained material preserved using >60% ETOH with 1-2% glyoxal. Macroinvertebrates are later extracted from the retained material, identified and counted.
- A 0.50m x 0.5m quadrat is used to collect epifauna and macroalgae data (quadrats are to be photographed) in the field. Macroinvertebrates are identified and counted (including an estimation of mud crab density through counting crab burrow holes), and percentage cover of macroalgae within the quadrat is estimated.
- A redox discontinuity layer (RDL) (i.e. depth of anoxic sediment) sample is to be collected using a 60mm diameter cylinder (to a depth of 8-10cm). The depth of the start of the anoxic sediment is measured using a rule in the field and the sediment sample is replaced.
- For the baseline and post-construction measures a surface sediment (top 2cm) sample is to be collected for contaminant and nutrient analyses and sediment grain size analyses.

SCHEDULED SUBTIDAL MONITORING

Subtidal surveys should comprise physical and biological habitat description, infaunal and epifauna invertebrate sampling, and the collection of sediment samples for grain size analyses and contaminant analyses (baseline and post-construction only). Subtidal survey techniques are based on Kingsford & Battershill (1998).

At each sampling site the following should be undertaken:

- a general assessment of the habitat focusing on the nature of the surficial sediment type(s);
- classify physical habitat complexity;
- classify biological habitat type;
- collection of 3 replicate sediment cores for assessment of infaunal invertebrate community;
- assessment of epifaunal invertebrate community and macroalgal cover (three replicate 0.25m² quadrats) where visibility permits;
- collection of a composite surficial sediment samples for sediment grain size analyses;
- collection of composite surficial sediment samples for sediment contaminant analyses;
- three replicate measurements of depth below the sediment surface of the start of anoxic sediment;
- depth of water measured.

TIMING OF SCHEDULED SAMPLING

Sampling and analysis is typically carried out progressively through the earthworks and construction periods of a large project. The programme we recommend for this project given that there could be three construction fronts occurring over a period of three years with a further three years for the last front, is that a two year baseline be established (sampling occurring in March-April and October-November each year), followed by biannual sampling during the same periods (March-April and October-November) during construction and for three years post-construction to ensure closure of effects.

Table 2: Summary of Scheduled Sampling Regime

(Dates are indicative only)		Fauna		Habitat	Sediment	
		Infauna	Epifauna	Redox layer	Grain Size	Contaminants
Historic 2009-2011		✓	✓	✓	✓	✓
Pre Construction Porirua Baseline March 2012		✓	✓	✓	✓	✓
Pre Construction Porirua Baseline November 2012		✓	✓	✓	✓	✓
Pre Construction Porirua Baseline March 2013		✓	✓	✓	✓	✓
Pre Construction Porirua Baseline November 2013		✓	✓	✓	✓	✓
Construction Porirua year 1- March 2014		✓	✓	✓	✓	
Construction Porirua year 1 November 2014		✓	✓	✓	✓	
Construction Porirua year 2- March 2015		✓	✓	✓	✓	
Construction Porirua year 2 November 2015		✓	✓	✓	✓	
Construction Porirua year 3- March 2016		✓	✓	✓	✓	
Construction Porirua year 3 November 2016		✓	✓	✓	✓	
Construction TePuka/Wainui March 2017		✓	✓	✓	✓	
Construction TePuka/Wainui November 2017		✓	✓	✓	✓	
Construction TePuka/Wainui March 2018		✓	✓	✓	✓	
Construction TePuka/Wainui November 2018		✓	✓	✓	✓	
Post Construction	Pauatahanui (2017-2020)	✓	✓	✓	✓	✓
Post Construction	Onepoto (2014-2017)	✓	✓	✓	✓	✓
Post Construction	TePuka (2018-2021)	✓	✓	✓	✓	✓

TRIGGERED MONITORING

Monitoring of specific sites will be triggered by certain rainfall events, exceedance of turbidity discharge standards, spills or accidents that may affect the marine habitat. The trigger levels will be developed in association with the appropriate consenting authority staff at a later date??

Throughout the entire pre-construction to post-construction period, turbidity data loggers will also be in operation (along with the rain gauges) as described in the freshwater monitoring programme (SQMM) and are an essential trigger monitoring protocol. Turbidity loggers will also be in operation at the discharge point of erosion and sediment control ponds.

Other sampling will occur as triggered by issues and events.

SITE RECORDS

Throughout the period of monitoring record sheets will be completed on each sampling visit at each site. This will record include the following, where relevant:

- Date, time of survey, time of low tide/high tide, weather conditions (including three days previous);
- Nature of flow at stream mouth;
- Observation of any sediment deposition, including physical nature of sediment, GPS location, extent, depth measurements;
- Survey methodology used and samples collected;
- Any anomalies or other disturbances to the site.

A photograph of the sampling points will also be taken at the time of sampling. This photograph along with notes on the substrate appearance will be used to comment on any changes in sediment characteristics. These photos can be used to compare different sampling locations including control and impact sites.

PRE-CONSTRUCTION BASELINE

The objectives of the baseline monitoring are:

- To establish the intertidal and subtidal benthic faunal communities present and predicted areas of sediment deposition during storm events (during the construction period), and to associate these communities with existing sediment characteristics and contaminant loadings.
-
- To accurately describe existing estuarine biota and habitat quality, so that any changes during and at the completion of construction can be identified and appropriate strategies put in place to remedy or mitigate.

INTERTIDAL SAMPLING

FAUNA & SEDIMENT

- The intertidal sites surveyed for the effects assessment (i.e. adjacent to the mouths of the Porirua, Duck, Pauatahanui, Ration, Horokiri and Wainui Streams) will continue to be monitored in the pre-construction monitoring (see Figures 2a-c).
- Additional sites to the west of Porirua Stream mouth, adjacent to Browns Stream and to the west of Kakaho Stream mouth will also be monitored, based on the outcomes of the hydrodynamic/sediment modelling results (Figures 2a-c).
- Sampling will be carried out as per the methodology described in section x.x above.

SUBTIDAL SAMPLING

- Subtidal sites that will be surveyed include a subset of those surveyed to support the effects assessment because the invertebrate and sediment data indicated that the central subtidal basin areas had relatively homogenous characteristics. Further, as the hydrodynamic modelling results indicated that it was largely the outer edges of the subtidal basin areas that may receive additional sediment during the construction phase of the project, a small number of the central subtidal sites could be omitted from the proposed baseline sampling regime.
- The sites are shown in Figures 2a-b. No subtidal surveys will be carried out adjacent to the Wainui Stream, given the low risk of adverse effects on marine ecological values due to high energy nature of the ultimate receiving environment.

REPORTING

- A report documenting the location, access instructions, the physical characteristics of each sampling sites and the results of the work will be prepared in advance of construction monitoring sampling commencing. This is to ensure that the sampling can be replicated by another party.
- All relevant assessment measures and sampling results (e.g. species diversity and abundances) will be entered in a spreadsheet that will be regularly updated and made available on request to the consenting authority and NZTA.
- A report summarising the results of baseline sampling will be prepared prior to commencement of earthworks and shall include trigger values for Construction monitoring. The report shall be supplied to NZ Transport Agency and The regulatory authority who is responsible for the consents.

CONSTRUCTION MONITORING

Construction monitoring will include both the ongoing scheduled monitoring (in March/April and October/November each year) of the sites included in the pre-construction monitoring and triggered or event-based responses to rainfall, device failures or spills causing discharges that create exceedences measured by the construction contractors monitoring their sediment control devices. Monitoring of exceedences will involve specific sampling sites, not necessarily all of the scheduled intertidal and subtidal monitoring sites.

EVENT MONITORING & PREPARATION

FRONT END

- Establish relationship with Contractors operating sediment control devices such that exceedences and triggered events are communicated directly to the monitoring team/company, within agreed timeframes.
- Trigger levels for changes marine ecological values will be developed as part of the baseline investigations and will include triggers for both biotic change and habitat change and involve community diversity and composition changes, in addition to changes to the nature of the benthic sediment.

EVENT

- Notify the appropriate Council staff that triggered monitoring being undertaken.
- Participate and inform the response team operating and managing the sediment devices.
- Carry out monitoring of the sampling sites that may be affected.
- Report findings to NZTA and appropriate Council staff, including any recommendations for further monitoring, alterations to site management practices or trigger alerts.

POST EVENT

- Continue to monitor sites where effects were identified.
- Report further findings to NZTA and appropriate Council staff.

DATA ANALYSIS

Statistical analysis of data will be undertaken in order to determine if there has been (or is occurring) a significant change in invertebrate community composition or diversity, or habitat quality (e.g. sediment grain size):

- data collected during triggered monitoring against scheduled monitoring and baseline data;
- scheduled monitoring data against baseline pre-construction data.

Data analysis may include Permutational Multivariate Analysis of Variance in addition to univariate analyses.

EXCEEDENCE REMEDIAL ACTIONS

Where scheduled sampling shows a trigger level has been exceeded further investigatory work will be undertaken in order to determine whether there is a cause and effect relationship between the ecological effect and construction of the Project. If remedial or mitigation measures are required, these will be agreed with the relevant Council staff and other affected parties.

POST CONSTRUCTION COMPARISON

Following completion of all construction activities

- A repetition of the baseline monitoring programme will be completed in the first March or November period following completion of site works and the once again the following year.
- At this point statistical comparisons will be undertaken between pre – during - post sampling data in order to determine any cumulative effects over the course of the project.
- This information will be included in the final project report which will summarise all the sampling undertaken, trends in marine and estuarine health, confirmation of any effects and recommendations for remedial work or mitigation, if necessary.
- Based upon the results of this assessment further monitoring maybe undertaken, extending to a maximum of three years post construction.

REPORTING

Estuarine monitoring reporting requirements are specified in Schedule xxx, condition xxx.

- In summary the reporting regime will be as follows:
  - **Baseline Study Report:** at least one month prior to commencement of earthworks;
  - **Annual Progress Reports:** summarising the results of all sampling and site inspections;
  - **Triggered/Event Reports:** prepared as required and submitted within a timeframe to be agreed;
  - **Concluding Report:** following completion of all site works and at least two seasonal post construction monitoring events following site stabilisation.

All reports will be provided to the consenting authority within the timeframes described above, and will be copied to the NZTA.

MITIGATION PLANTING PLAN
TRANSMISSION GULLY

RETIREMENT SITE 6

Submitted to
NZ Transport Agency

By
Boffa Miskell Ltd

Report Number W09034
July 2011

▪ report

Retirement Area No 6 (Ration Stream Catchment) Ecological Mitigation Land Requirement and Planting Implementation Plan

Prepared for
Transit New Zealand

By
Beca Carter Hollings & Ferner Ltd

July 2002

2809133/75 Final ▪ W2:79306

Table of Contents

1 Introduction

1.1 Purpose

The purpose of this Implementation Plan is to provide site-specific information pertaining to the planting and long term maintenance, monitoring and management of Retirement Area No. 6. This report has been prepared in accordance with the general principles outlined in the Management Plan prepared by Beca Carter Hollings & Ferner Ltd. This report together with the Management Plan is intended to meet the Commissioners recommendations for the designation requirements of the proposed inland motorway through Transmission Gully.

Advice from John Campbell (ERANZ) regarding the planting areas and objectives and John Hudson (Promised Land Ltd) regarding planting specifications and ongoing plant management has been sought and is incorporated into this document.

1.2 Retirement Area No. 6

Evidence provided by Stephen Fuller during the hearings identified nine stream sites and two steep hill sides for early retirement and revegetation prior to the commencement of any works. Retirement Area No. 6 was on of the stream sites identified as requiring early retirement and revegetation.

Retirement Area No. 6 is located within the Ration Stream catchment and covers an area of 3.5 ha. An unnamed tributary of Ration Stream traverses the site in an east – west direction. The tributary has a number of arms on the eastern side of the motorway footprint.

2 Retirement Area Description

Retirement area No. 6 straddles an entrenched stream system that flows from east to west and drains into Ration Stream in nearby pine forest. Several small tributaries that originate within the eastern and northern ends of the retirement area feed into the main stream. This stream has down-cut by approximately 20-30 m which has resulted in steep-sided banks and narrow stream terraces in the valley bottom. Except at the northern end of the retirement area, where regenerating native forest dominated by kanuka and mahoe is present, the area is farmed and is in pasture.

2.1.1 Animal Pest Issues

Rabbits, hares and possums are expected to be the most common animal pests in the area.

2.1.2 Pest Plant Issues

Currently the majority of the site is grazed and clear of pest plants. Pockets of gorse (*Ulex europaeus*) are present in some areas of the site. Wellington Regional Council have advised that although not currently present on the site, the following plants are found in the surrounding area and can spread easily.

- Nodding Thistle (*Carduus nutans*)
- Darwins Barberry (*Berberis darwinii*)
- Banana Passionfruit (*Passiflora mollissima/mixta*)
- Snakefeather (*Asparagus scandens*)

2.2 Land Access

Access to Retirement Area No. 6 is via Flighty's Road and a farm track across the Walsh property (refer to Figure 1).

Photo 1 – View of Retirement Area No. 6

3 Planting Treatment Objectives

A site visit of Retirement Area No. 6 was carried out by Alex Gray (Beca), John Campbell (ecologist) and John Hudson (landscape architect) on 11 July 2001. During this site visit the suitability of the sites for the various planting treatments described in the Management Plan was assessed.

It was determined that a combination of sediment control, runoff control, flora and fauna corridor and stream margin shade planting would be most suitable for the three retirement areas. Additional sediment control planting is proposed downstream of the retirement area. The proposed planting areas are shown in Figures CK16. Land in these areas is characterised as:

- Seasonally moist alluvial valley bottom;
- Seasonally moist alluvial stream margins; and
- Seasonally dry ridge.

In addition to the retirement area it is recommended that a small area of land located downstream of the designation footprint be planted for the purpose of sediment control. This area is foreseen as being beneficial for the control and treatment of sediment runoff during the construction of Transmission Gully Motorway. The retirement and planting of this area may be possible because this land is likely to be acquired as part of the severed property acquisition arrangements.

4 Planting Specifications

4.1 General

Figure CK16 shows the planting treatment to be applied to the various sections of the retirement area. Initial planting is expected to commence in Winter 2002 and may continue through to 2003 depending on plant availability. Replacement planting will be carried out for a period of three years following initial planting. This will ensure that planted areas become well established.

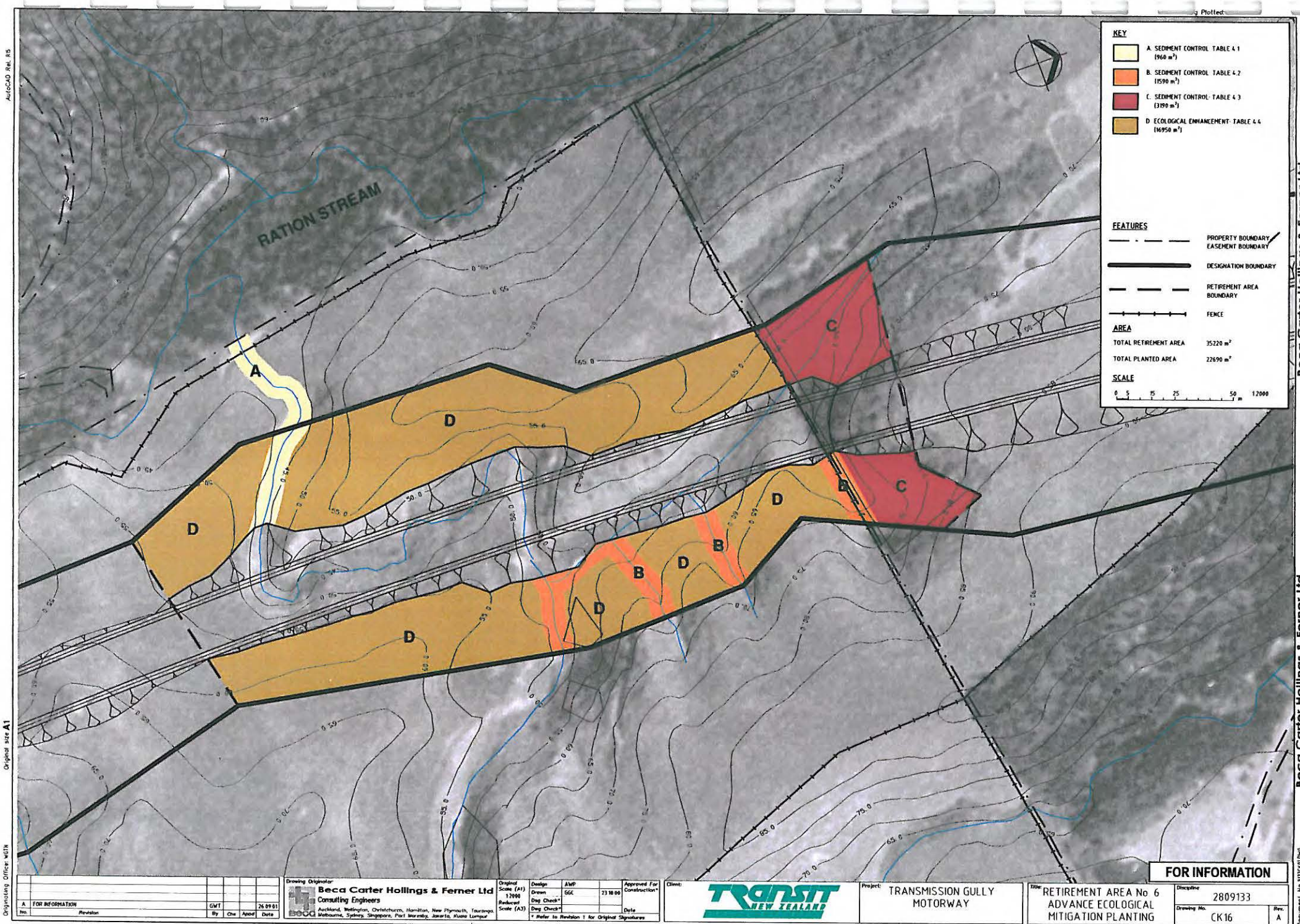
Subsequent planting will be carried out to fill any gaps to create an average matrix of 1m centres within the planting area. Planting or this purpose should be carried out after completion of construction.

The following specifications apply to all planting:

- Planting should be ideally commence in June/July
- Spot spray existing grass with appropriate weedicide complying with manufacturer's killing grass within a 300mm diameter circle.
- A stand-down period in accordance with manufacturer's recommendations shall occur following spraying and prior to any planting.
- Plant all plants within centre of sprayed circle.
- All personnel undertaking application of agrichemicals shall be Growsafe Certified. The Engineers representative shall be contacted immediately in the event of a chemical/hazardous substance spillage.
- Interplant into existing vegetation.
- Gorse shall be removed by hand cutting immediately below ground level and removing plants from the site.
- Exposure of bare ground should be minimised.
- Add 12 month slow release Osmocote fertiliser (granules) to the hole for each plant. Apply fertiliser at the recommended rate for the plant size.
- Place SYNTEX SYN 108 fabric vegetation suppression matting cut to circles 300mm in diameter around each plant, pegging firmly with at least four pegs.
- Keep the mats and the plants clear of grass, gorse and weeds for 36 months from planting.
- Apply slow release Osmocote fertiliser (granules) as per manufacturer's instructions to plants at the end of year 1 and year 2.

4.2 Planting Zone A

Planting treatment for this area generally follows Table 5.2 of the Management Plan. This planting treatment is to be applied to that area along the stream, downstream of the



AutoCAD Rel. 15

Original size A1

Originating Officer WGTN

Beca Carter Hollings & Ferner Ltd

Beca Carter Hollings & Ferner Ltd

Document No. 1132601Dwg

No.	Revision	By	Chk	Apprd	Date
A	FOR INFORMATION	GWT			26 09 01

Drawing Originator:
Beca Carter Hollings & Ferner Ltd
Consulting Engineers
Auckland, Wellington, Christchurch, Hamilton, New Plymouth, Tauranga, Melbourne, Sydney, Singapore, Port Moresby, Jakarta, Kuala Lumpur

Original Scale (A1) 1:2000
Reduced Scale (A3)

Design	AWP		Approved For Construction*
Drawn	GGC	23 10 00	
Dsg Check*			
Dwg Check*			Date

* Refer to Revision 1 for Original Signatures

Client: TRANSIT NEW ZEALAND

Project: TRANSMISSION GULLY MOTORWAY

Title: RETIREMENT AREA No 6 ADVANCE ECOLOGICAL MITIGATION PLANTING

FOR INFORMATION

Discipline: 2809133

Drawing No.: CK16

Rev.: A

DO NOT SCALE

IF IN DOUBT ASK

motorway footprint. This area is located partly within and outside of the proposed designation. The primary purpose of planting within this area is to enhance the performance of other sediment control mechanisms.

The total area subject to this planting treatment is 960m².

Table 4.1

Zone A Planting Treatment

Initial Planting	No. of plants	Subsequent Planting	% of Planting
Group 1 Plants		*Pseudopanax arboreus* (Fivefinger)	30
Cortaderia toetoe (Toetoe)	240	*Melicytus ramiflorus* (Mahoe)	15
Phormium tenax (Harakeke)	48	*Coprosma grandifolia* (Kanono)	15
Group 2 Plants		*Schefflera digitata* (Pate)	15
Leptospermum scoparium (Manuka)	288	*Rhopalostylis sapida* (Nikau)	5
Coprosma robusta (Karamu)	192	*Dacrycarpus dacrydioides* (Kahikatea)	5
Fuchsia excorticata (Tree Fuchsia)	29		
Griselinia littoralis (Broadleaf)	29	*Prumnopytis taxifolia* (Matai)	5
Plagianthus regius (Lowland Ribbonwood)	29	*Dacrydium cupressinum* (Rimu)	5
Pseudopanax arboreus (Fivefinger)	29	*Beilschmiedia tawa* (Tawa)	5
Melicytus ramiflorus (Mahoe)	29		
Coprosma grandifolia (Kanono)	29		
Group 3 Plants			
Metrosideros robusta (Northern Rata)	19		

Initial Planting

- Plants to have an average spacing of 1m,
- Mixture of Group 1 plants to be planted in downslope areas of site,
- Mixture of Group 2 plants to be planted in upslope areas of site, and
- Group 3 plants to be planted in groups in drier areas of site.

Subsequent Planting

- Subsequent planting should fill any gaps to create a matrix with an average spacing of 1m, and
- Plants (planted during the initial planting stage) may require removal to ensure that no fewer than 10 plants from the subsequent list are planted.

4.3 Planting Zone B

Planting treatment for this area generally follows Table 5.7 of the Management Plan. The area subject to this planting treatment is located along the watercourses located to the east of the motorway alignment. The total area subject to this planting treatment is 1590m².

The primary purpose of this planting treatment is to provide stream shade and runoff control.

Table 4.2

Zone B Planting Treatment

Initial Planting	No. of plants	Subsequent Planting	% of Planting
Group 1 Plants		*Pseudopanax arboreus* (Fivefinger)	30
Leptospermum scoparium (Manuka)	398	*Rhopalostylis sapida* (Nikau)	15
Kunzea ericoides (Kanuka)	159	*Weinmannia racemosa* (Kamahi)	15
Cortaderia toetoe (Toetoe)	318	*Fuchsia excorticata* (Tree Fuchsia)	10
Phormium tenax (Harakeke)	48	*Dacrycarpus dacrydioides* (Kahikatea)	5
Cordyline australis (Cabbage Tree)	318		
Group 2 Plants		*Dacrydium cupressinum* (Rimu)	5
Coprosma grandifolia (Kanono)	325	*Metrosideros robusta* (Northern Rata)	5
Coprosma robusta (Karamu)		*Podocarpus totara* (Totara)	5
Pseudopanax arboreus (fivefinger)		*Prumnopytis taxifolia* (Matai)	5
Hebe stricta var. atkinsonii (Koromiko)		*Knightia excelsa* (Rewarewa)	5
Melicytus ramiflorus (Mahoe)			
Aristotelia serrata (Wineberry)			
Carpodetus serratus (Putaputaweta)			
Solanum aviculare (Poroporo)			
Coriaria arborea (Tutu)			
Griselinia littoralis (Broadleaf)			
Pennantia corymbosa (Kaikomako)			
Plagianthus regius (Lowland Ribbonwood)			
Schefflera digitata (Pate)			
Group 3 Plants			
Sophora chathamica (Kowhai)[1]	32		

Note: [1] Sophora chathamica (Kowhai) was only recently reclassified and therefore may still be known as Sophora microphylla by some nurseries within the Wellington region.

Initial Planting

- Planting to occur within 10m strip along stream
- Mixture of Group 1 and 2 plants to be planted throughout site with an average spacing of 1m, and
- Group 3 plants to be planted in scattered groups.

Subsequent Planting

- Subsequent planting should fill any gaps to create a matrix with an average spacing of 1m, and
- Plants (planted during the initial planting stage) may require removal to ensure that no fewer than 15 plants from the subsequent list are planted.

4.4 Planting Zone C

The area subject to this planting treatment is located on the northern end of the Retirement Area. As there is a significant amount of existing vegetation within this area, the planting treatment proposed generally follows the subsequent planting outlined in Table 5.11 of the Management Plan. Modifications have been made to the table to allow for the site conditions. The primary purpose of this planting treatment is to provide ecological enhancement. The total area of this planting treatment is 3188m^2.

Table 4.3

Zone C Planting Treatment

Plant Species	No. of Plants
Group 1 Plants	
Melicytus ramiflorus (Mahoe)	479
Alectryon excelsus (Titoki)	124
Corynocarpus laevigatus (Karaka)	124
Fuchsia excorticata (Tree Fuchsia)	124
Myoporum laetum (Ngaio)	124
Pennantia corymbosa (Kaikomako)	124
Pseudopanax arboreus (Fivefinger)	124
Pseudopanax crassifolius (Lancewood)	124
Schefflera digitata (Pate)	124
Sophora chathamica (Kowhai)[1]	124
Group 3 Plants	
Weinmannia racemosa (Kamahi)	480
Knightia excelsa (Rewarewa)	223
Elaeocarpus dentatus (Hinau)	223
Metrosideros robusta (Northern Rata)	223
Rhabdothamnus solandri (NZ Gloxinia)	223
Streblus banksii (Large leaved milk tree)	223

Note: [1] Sophora chathamica (Kowhai) was only recently reclassified and therefore may still be known as Sophora microphylla by some nurseries within the Wellington region.

Initial Planting

- Mixture of all plants to be interplanted into existing vegetation,
- *Streblus banksii* (Large leaved milk tree) to be planted in a group,
- *Rhabdothamnus solandri* (NZ Gloxinia) to be planted in a group,

- *Streblus banksii* (Large leaved milk tree) and *Rhabdothamnus solandri* (NZ Gloxinia) may need to be planted at a later date due to the rarity of seed sources within the Wellington Region.

Subsequent Planting

- No subsequent planting to take place on this site.

4.5 Planting Zone D

Planting treatment for this area follows a modified Table 5.13 of the Management Plan. A modified form of this table has been adopted because of the dry, exposed nature of these sites. The planting treatment outlined in this section is applicable to a number of areas on both sides of the motorway footprint within Retirement Area No. 7 (16950 m^2).

Table 4.4

Zone D Planting Treatment

Initial Planting	No. of plants	Subsequent Planting	% of Plants
Group 1 Plants		*Weinmannia racemosa* (Kamahi)	50
Leptospermum scoparium (Manuka)	3280	*Knightia excelsa* (Rewarewa)	30
Hebe stricta var. atkinsonii (Koromiko)	3280	*Elaeocarpus dentatus* (Hinau)	10
Kunzea ericoides (Kanuka)	3280		
Group 2 Plants		*Metrosideros robusta* (Northern Rata)	10
Brachyglottis repanda (Rangiora)	851		
Olearia paniculata (Akiraho)	851		
Coprosma robusta (Karamu)	851		
Myrsine australis (Mapou)	851		
Olearia paniculata (Akiraho)	851		
Pittosporum tenuifolium (Kohuhu)	851		
Plagianthus regius (Lowland Ribbonwood)	851		
Group 3 Plants			
Geniostoma rupestre var. ligustrifolium (Hangehange)	280		
Macropiper excelsum (Kawakawa)	280		
Myoporum laetum (Ngaio)	280		
Pseudopanax arboreus (Fivefinger)	280		
Pseudopanax crassifolius (Lancewood)	280		
Sophora chathamica (Kowhai)[1]	280		
Group 4 Plants			
Metrosideros robusta (Northern Rata)	339		

Note: [1] Sophora chathamica (Kowhai) was only recently reclassified and therefore may still be known as Sophora microphylla by some nurseries within the Wellington region.

Initial Planting

- Mixture of Group 1, 2 and 3 plants to be planted at 1m spacing throughout site, and
- Group 4 plants to be planted in groups in drier areas of site.

Subsequent Planting

- Subsequent planting should fill any gaps to create a matrix with an average spacing of 1m, and
- Plants (planted during the initial planting stage) may require removal to ensure that no fewer than 170 plants from the subsequent list are planted.

4.6 Plant Sourcing / Supply

As outlined in the Management Plan, eco-sourced plants from the west coast of the Wellington Region up to Palmerston North area are required for planting at this site. Seed from *Leptospermum scoparium* and *Sophoro chatamica* should be collected from within the Wellington ecological region (ie. south of Paekakariki to Upper Hutt, and west of the Rimutaka Ranges).

4.7 Initial Pest and Weed Control

Rabbit repellent (Plant Plus or similar) should be applied to the outer 5 rows of plants at the same time as planting. One litre of Plant Plus is required for treatment of 100 plants.

To allow plants to establish, grass control in the immediate area of individual plants is necessary. It is recommended that this be done through spot spraying of an appropriate herbicide prior to planting, followed by the use of a weed mat. Gorse, grass and other weeds should be kept clear of weed mats for 36 months following planting.

4.8 Land Acquisition/Leasing

Retirement Area No. 6 is owned partly by Transit and partly by Mr Walsh. Negotiations are currently underway for the acquisition of the remainder of the retirement area located within Mr Walsh's property.

Land to the west of the retirement area may be purchased as part of land severance negotiations, potentially allowing planting downstream of the retirement area as outlined in this Implementation Plan.

4.9 Fencing

The following bullet points outline the type of fencing and issues to be addressed through the fencing contract:

- The recommended fence type is standard post and 6 strand wire fencing. No gates should be installed to ensure that stock grazing within the planted areas does not occur.
- Due to the steep nature of the property, fence lines may need to alter from that shown on paper to more practical or stable positions. These changes are unlikely to be significant.
- Continued grazing of the retirement area should occur until immediately prior to planting . This will ensure continued control of weeds and improve ease of planting.
- If fencing of the retirement areas occurs some time prior to planting, it is recommended that a temporary Taranaki gate be installed and left open to allow stock to continue to graze the area. The Taranaki gate should be removed and the fence reinstated immediately following planting to prevent any accidental stock access.

4.10 Other Sediment Control Measures

Engineered sediment control mechanisms will form an integral part of the proposed Transmission Gully Motorway. Preliminary design of these engineered sediment control measures will be carried out during the resource consent application stage, with final details being provided during the detailed design stage of the project.

Additional sediment control measures may include;

- sediment ponds,
- sediment pits
- silt fences,
- hay bales, and
- earth bunds.

Although the location and design detail of these structures has not been determined at this stage and may be dependent of resource consent conditions, consideration of their potential impact on any advance planting is important. Sediment ponds are likely to impact the largest area outside the motorway footprint. In order to operate effectively sediment ponds need to be located at low points, downslope of any construction areas. The likely location of any sediment ponds is therefore in valleys, directly alongside existing watercourses. It is therefore highly likely that the construction of sediment ponds will affect some sediment control planting in Retirement Area No. 6.

5 Ongoing Retirement Area Management

5.1 Pest and Weed Control

Ongoing plant and animal pest control will be necessary. It is recommended that possum, rabbit and hare control be undertaken by trapping and shooting on an annual basis. The use of these methods is preferable over poisons because of the potential risk of poisons for the farm dogs. This is particularly important while the farm remains in agricultural production.

Ongoing control of gorse and noxious weeds is also important, particularly while the farm remains in agricultural production. Wellington Regional Council biosecurities staff have also indicated that it will be necessary to be vigilant for the following pest weeds:

- Nodding Thistle (*Carduus nutans*)
- Darwin's Barberry (*Berberis darwinii*)
- Banana Passionfruit (*Passiflora mollisima/mixta*)
- Snakefeather (*Asparagus scandens*)

These pest plants are currently present in surrounding areas and are easily spread into newly developed areas. It is therefore recommended that the Environmental Management Plan prepared for the construction phase of Transmission Gully Motorway include appropriate mitigation measures, which will ensure that construction machinery is adequately cleaned prior to entering construction sites. This will minimise the risk of seeds or plant fragments being brought into Transmission Gully.

5.2 Plant Maintenance

Plants are to be kept clear of grass and weeds within the 300mm diameter of the weed mat for 36 months after initial and subsequent planting.

Any plants that die for any reason during this 36 month period shall be replaced with a similar species by the contractor and at the contractors expense. Replacement plants shall be selected in accordance with plant lists contained within this Implementation Plan. The contractor shall consult with the engineer to the contract before replacing plants to gain confirmation that the proposed species are acceptable. Initial planting replacement shall be carried out in winter 2003, 2004 and 2005. Subsequent planting replacement shall take place in the three successive winters following planting.

Retirement area management following the three year establishment period will be determined by Transit New Zealand on a site by site basis at the end of this establishment period. Possible options for long term management include long term maintenance contracts, inclusion of sites in Council's reserve inventory or involvement of local community groups.

5.3 Plant Monitoring

An appropriately qualified person will inspect the planting at the following times:

- Prior to planting to discuss the areas to be planted with the planting contractor
- During planting to inspect progress
- On completion of planting to verify completion
- Once every 3 months over the first year and then every 6 months of the maintenance period thereafter, to monitor growth, weed control and verify replacement planting
- At the end of the maintenance period to verify replacement planting

During monitoring inspections plant coverage will be visually assessed to provide an indication of when planted areas are effectively controlling sediment and runoff and if any plant mixes appear more effective. Additional monitoring may be implemented during the later stages of the retirement period and during the construction period.

5.4 Contingency Plan

(a) Fire

In the event of a fire on the site, the following personnel should be contacted immediately:

Fire Department	Phone: 111
Transmission Gully Motorway Project Manager, Transit New Zealand	Phone: (04) 801 2580
Transmission Gully Motorway Project Director, Beca Carter Hollings & Ferner Ltd	Phone: (04) 473 7551

Once the fire has been suppressed, an assessment of the damage to plants will be carried out. The damage assessment will identify:

- the cause of the fire,
- replacement planting,
- replacement fencing,
- any preventative measures, and
- effect on retirement period and progress of Transmission Gully Motorway.

Refer also to '(d) Other Environmental Incidents' below.

(b) Drought or Frost

The effect of drought or frost on planting areas will be assessed as part of the ongoing maintenance program (refer to Section 5.1.2).

(c) Site Accidents

All site workers shall be bound by the appropriate company Health and Safety Management Plan, which shall comply with the requirements of the Health and Safety in Employment Act. The Health Safety Management Plan shall incorporate the following:

- safety training requirements,
- hazard identification and management systems,
- safety / accident record sheets, and
- emergency plan.

(d) Environmental Incidents

There is the potential for unforeseen environmental incidents to occur during works associated with the planting, fencing and ongoing maintenance of this retirement area.

Prior to works being carried out on the site, the contractor shall have a hazard identification and management system in place. The system will ensure the assessment, reduction and where possible elimination of any potential environmental hazards. An emergency plan shall be prepared to identify responsibilities and procedures to be followed in the event of an environmental incident.

The treatment of significant environmental incidents shall be discussed with Transit New Zealand, the nominated site engineer, Wellington Regional Council, Porirua City Council and Wellington City Council. Key contact details for Environmental Incidents are as follows:

Transmission Gully Motorway Project Manager, Transit New Zealand	Phone: (04) 801 2580
Transmission Gully Motorway Project Director, Beca Carter Hollings & Ferner Ltd	Phone: (04) 473 7551
Wellington Regional Council	Phone: (04) 384 5708
Porirua City Council	Phone: (04) 237 5089

6 Land Retirement Programme

Planting of Retirement Area No. 6 will occur as and when land and funding becomes available. Originally it was envisaged that planting within this retirement area will commence in 2003. However, as retirement areas 1 and 3 are not available for Plants in 2002 we propose to plant the area instead as it has now been purchased by Transit.

7 Conclusion

This Implementation Plan incorporates the land retirement and planting principles outlined in the Management Plan, but is tailored to the specific requirements of Retirement Area No. 6. The plan outlines planting specifications, monitoring, pest management, fencing and various other requirements and will form the basis of any planting contracts associated with Retirement Area No. 6. The plan allows for planting in Winter 2002 and with additional planting carried out in successive winters and following completion of the construction of the motorway.

This Implementation Plan has been prepared with input from WRC and DOC.

Report Prepared By: Jennifer Bristow *Signed* .....

Report Reviewed By: Stephen Fuller *Signed* .....