

21. Terrestrial ecology

Overview

The Project traverses highly modified land, which has mainly been converted to pasture with relatively few areas of native vegetation remaining. Within this modified landscape populations of indigenous fauna are small and species of conservation interest are restricted to specific sites, typically associated with fragments of native vegetation. These habitats have been identified and described.

A conservative approach has been taken to quantifying the loss of vegetation and terrestrial habitats. The adverse effects on terrestrial ecology will arise during construction as a result of vegetation clearance and disturbance of habitats and / or species.

An extensive ecological mitigation package is proposed to remedy and mitigate the adverse effects of construction. This will include retirement from farming of approximately 400ha of marginal land and replanting of 271ha of this land. Mitigation sites have been identified (including the early retirement sites established in recent years by the NZTA), the sites chosen for the range of potential ecological and hydrological benefits they can provide the retirement and revegetation of land above the Project alignment will provide additional benefits such as reduced erosion, and improved water quality. There will be some minor potential effects on the habitat of terrestrial fauna during construction. This can be effectively managed by the translocation of habitats such as logs and bolder slopes, and by careful construction management methods.

In the long term, as the retired areas mature, the Project is expected to have a positive effect on terrestrial ecology.

21.1 Introduction

This chapter presents the findings of investigations undertaken to determine the actual and potential effects of the Project on terrestrial ecology. Terrestrial ecology includes terrestrial vegetation and terrestrial fauna such as birds, bats, lizards and terrestrial invertebrates. This chapter also describes potential effects on wetlands habitats for flora and birds.

Initially desktop study of ecological databases and previous relevant studies identified information about the existing terrestrial ecology which informed the methodology used for field surveys undertaken within and adjacent to the Project designation. Once a baseline of terrestrial ecology had been determined, the impacts of the construction and operation of the Project were assessed. This first assessment stage was undertaken without the application of any specific ecological mitigation for the Project. On the basis of this initial assessment the ecologists then worked closely with the design team to seek to avoid potential adverse ecological effects that had been identified, where possible. Where avoidance was not possible, ecological mitigation was then developed to mitigate any remaining adverse effects.

The final assessment stage considered the actual and potential environmental effects, following implementation of the proposed mitigation.

21.2 Existing terrestrial ecology

21.2.1 Ecological investigations

The identification of effects on terrestrial ecology required the assessment of the composition and values of the existing terrestrial ecology. This relied on two complementary methods:

- desktop studies of available relevant information such as ecological databases and existing datasets and previous ecological surveys; and
- field surveys.

The description of existing terrestrial ecology in this section includes a brief overview of the investigations undertaken. Further details on the methods used and findings of these investigations are contained in the relevant technical reports provided in Volume 3:

- Terrestrial vegetation and habitats: Description and values (**Technical Report 6**);
- Herpetofauna and terrestrial macro-invertebrates: Description and values (**Technical Report 7**); and
- Avifauna and bats: Description and values (**Technical Report 8**).

21.2.2 Terrestrial flora and habitats

21.2.2.1 Wellington Ecological District

The Project area is entirely within the Wellington Ecological District (ED)¹¹⁷ which is characterised by steep, strongly faulted hills and ranges, and the Wellington and Porirua Harbours. The ED was originally forested with fringes of salt marsh vegetation around the harbours. Near the coast, rimu / rata / kohekohe forest would have dominated while podocarp forests (kahikatea, totara, matai) would have been prevalent on the river terraces and lower slopes with miro / rimu / tawa forest at higher altitudes.

Today, the Wellington ED is almost entirely modified by farming and urbanisation, with pasture, plantation pine, gorse and regenerating shrublands throughout, although some small forest remnants occur. The Main Alignment corridor has mostly been cleared of native vegetation and converted to exotic vegetation, including pasture and pine plantation. Areas of extensive grazing land are located on the steeper hill country in Te Puka Stream and Horokiri Stream areas and the Duck Creek Catchment. It also includes the lower lying valley occupied by Battle Hill Farm Forest Park (BHFFP).

117. Ecological districts are classified by the Department of Conservation. Although the Project is located entirely within the Wellington ED, in the Te Puka and Horokiri valleys it is on the margins of the Tararua ED.

There are occasional remnant pockets of indigenous vegetation, including areas in Te Puka Stream and Duck Creek tributaries and within Porirua Park Bush. There are areas of regenerating second growth bush, notably in the Cannons Creek Catchment. There are also extensive areas of former pasture that are reverting to natural vegetation largely characterised by gorse, tauhinu and other small leaved species such as twiggy coprosma, manuka and kanuka.

There are extensive areas of commercial pine plantation on the hills east of Horokiri Stream (Akatarawa Forest), and smaller areas scattered through the remainder of the corridor. Within the BHFFP there are still small remnants of native vegetation which provide good representations of the types of indigenous flora which would have once been typical of the region. Vegetation includes a small coastal forest remnant (35ha) which can be found on the western side of the BHFFP, as well as areas of low producing grassland and indigenous forest within the plantation forest on the eastern side of the park. The bush is dominated by tawa and titoki, while the upper slopes are almost pure kohekohe. In swampy lower areas, kahikatea, pukatea and swamp maire are present.

The middle part of the Main Alignment corridor (Sections 3 to 7) has a more gently rolling topography and is characterised by a closer pattern settlement; a patchwork pattern of boundary shelter planting and differing land management; a wide variety of vegetation including exotic shelter trees, small plantations, amenity trees, and areas of native re-vegetation.

The area between Linden and Cannons Creek comprises rural fringe land. The hills form the backdrop to the Porirua East urban area, and comprise a mixture of former pasture that has reverted to gorse and mahoe shrubland; rough pasture on the ridgelines small pine plantations areas of remnant or regenerating indigenous forest and peri-urban activities.

21.2.2.2 Threatened plant species

Field surveys found only one species within the Project area that has a national threat classification (de Lange et al 2009)¹¹⁸. This species was, *Leptinella tenella*, (shown in Figure 21.1) and is classified as 'At Risk – Declining'.

118. De Lange, et al. 2009: Threatened and uncommon plants of New Zealand (2008 Revision). New Zealand Journal of Botany 47: 61–96.



Figure 21.1: *Leptinella tenella*

L. tenella is endemic to the North Island and northern South Island. It is a lowland species whose habitat is usually located on stream margins where they enter estuaries, on lake margins or on the margins of freshwater swamps and wetlands bordering saltmarsh. This species is sometimes found on cattle pugged swampy ground bordering saltmarshes. It is intolerant of shading and grass competition and favours sites that are kept open through periodic disturbance from high tides and flooding.

During this study *L. tenella* was present in an area of heavily grazed, sphagnum dominated wetland within the Horokiri Valley. This wetland is otherwise unremarkable, however, the presence of this species elevates its ecological significance slightly.

21.2.2.3 Ecologically significant sites

Within the Project area there are a number of areas of ecological significance. There are two types of area:

- **protected natural areas** (PNA) that are formally protected¹¹⁹; and
- **significant natural areas** (SNA) that are not formally protected¹²⁰

These areas are listed in Table 21.1 (only PNAs and SNAs within the proposed designation are listed) and shown on plan **GM04**.

119. Protected means either: a scenic reserve or conservation land protected under the Reserves Act 1977 (including local purpose reserves and stewardship areas), a private or National Covenant (QEII) attached to the title of the land, or public land which has a management plan (e.g. regional parks).

120. Areas identified through district wide or regional surveys as having ecological value, but not necessarily formally protected.

Table 21.1: Relevant protected natural areas and significant natural areas within the Project area

Name	Total size (ha)	Significance	Description	In relation to Project
Protected natural areas				
MacKays Crossing Wetland and Wildlife Reserve	9.68	Regional	Moderately sized area of raupo reedland wetland which lies partly in the proposed designation. Considered to be regionally significant. DOC Wildlife Management Reserve. KCDC Ecosite 106.	Within proposed designation.
Rowans Bush	2.8	Regional	Partially protected by QEII covenant (QEII 5/07/363). Kohekohe and titoki forest on lowland hill country. Part of a series of fragments that provides links between Kapiti Island and the Tararua Ranges. Eastern half of their site is protected in part under QEII covenant. KCDC Ecosite K139.	Within proposed designation.
Akatarawa/Whakatikei Forest Park	15,439	-	GWRC water collection area and regional forest park. Identified in BRWR ¹²¹ as site 19b – Lowland to montane miro, rimu, rata, tawa, kamahi forest. Has a high diversity of native bird life and this area of vegetation has large corridor benefits and wider ecological habitat benefits.	Within proposed designation (very small area of park only)
Battle Hill Forest Farm Park	502	-	Much of this park is open space and farmland. There are a number of small wetland and bush fragments that lie within it that are considered to have ecological value. However there are no indigenous plant communities within the proposed designation.	Within proposed designation.
Horokiri Wildlife Management Reserve	6.25	-	Wildlife Management Reserve. Coastal wetlands and saltmarsh. Crown land reserve. PCC Ecosite 30.	Downstream of Project
Pauatahanui Inlet Wildlife Refuge	506	National	The eastern half of Pauatahanui Inlet. Estuary, open water & tidal flats. A Wildlife Refuge ¹²² and BRWR site 5a, nationally significant coastal estuary with intertidal sand flats and regionally rare salt marsh and saline herbfield, rushland and shrubland communities.	Downstream of Project.
Pauatahanui Wildlife Management Reserve	47.4	Regional	Wildlife Management Reserve ¹²³ . Coastal wetlands and saltmarsh. Mixed private and public ownership. PCC Ecosite 65.	Downstream of Project.

121. Biological resources of the Wellington region, Wellington Regional Council, 1984

122. Under the Wildlife Act 1953 (DOC Conservation Unit R26053).

123. Under Reserves Act 1977 (DOC Conservation Unit R27056).

Name	Total size (ha)	Significance	Description	In relation to Project
Scoresby Grove Kanuka Forest	4.7	-	Private land with covenant. Small forest remnants within built up areas. PCC Ecosite 70a.	Within designation. proposed
Duck Creek Scenic Reserve	1.18	-	Coastal wetland and saltmarsh. Scenic reserve ¹²⁴ . PCC Ecosite 22.	Downstream of Project.
Whitby West Bush	9.16	-	Small forest remnants within built-up area. Mixed private / public land. PCC Ecosite 155b.	Within designation. proposed
Belmont Regional Park	3,446	-	Much of this park is open space and farmland. There are a number of small wetland and bush fragments that lie within it that are considered to have ecological value including Wellington City Council Prime Bush Remnants.	Within designation. proposed
Cannons Creek Bush	41.66	-	Seral Forest with maturing tawa podocarp. Lowland tawa, kohekohe, mahoe forest remnant and gorse shrubland. Sizeable areas of forest. PCC Ecosite 12.	Within designation. proposed
Porirua Park Bush	16.4	-	Porirua Park Bush is well fenced and surrounded by a combination of farmland, residential areas and school facilities. BRWR site 13d – Regionally representative example of lowland tawa, kohekohe forest remnant. PCC Ecosite 76.	Within designation. proposed
Significant natural areas				
Paekakariki Bush B – I		-	KCDC Ecosite K222 – 229. Eight small fragments of kohekohe forest of varying sizes and conditions. All are unfenced and heavily grazed by stock.	Within designation. proposed
Transmission Gully / Wainui Saddle	0.287	-	Small forest remnant within farmland, PCC Ecosite 172.	Within designation. proposed
Transmission Gully Riparian Area	1.877	-	Riparian areas within farmland, PCC Ecosite 199.	Within designation. proposed
James Cook Drive Bush	12.84	-	Small forest remnants within built-up areas, PCC Ecosite 33.	Within designation. proposed
Exploration Drive Kanuka	5.67	-	Small forest remnants within built-up areas. PCC Ecosite 190.	Within designation. proposed

124. Under Reserves Act 1977 (DOC Conservation Unit R27001)

Name	Total size (ha)	Significance	Description	In relation to Project
Head of Cannons Creek	1.06	-	Tawa, mahoe, mapou, porokaiwhiri, mamaku and cabbage tree. WCC 0702.15.	Within designation. proposed
Head of Cannons Creek	1.28	-	Primary forest of tawa, nikau, porokaiwhiri, mamaku, wineberry, mapou and mahoe. Secondary forest of mahoe, porokaiwhiri, lancewood, mamaku and mapou intermixing with primary forest remnant. WCC 0702.16.	Within designation. proposed
Roberts Bush	3.68	-	Gullies of mahoe forest including small areas of maturing tawa forest within pines adjacent to SH1. PCC Ecosite 88.	Within designation. proposed

21.2.2.4 Early retirement areas

As a condition of the existing designations areas were retired from pasture and planted in native vegetation. This was to provide advanced ecological mitigation for a range of potential effects of the Project including protection of aquatic habitat, erosion and sediment management and mitigation for vegetation loss. In total, approximately 31 hectares were planted and these areas now provide some of the best areas of indigenous forest within the Designation area, in particular around the Ration Stream and the Duck Creek catchments.

Table 21.2 provides details of the planting that has been done in the Horokiri Stream, Pauatahanui Stream, Ration Stream and Duck Creek catchments.

Table 21.2: Advance ecological mitigation planting

Catchment	Terrestrial vegetation planting (ha)	Riparian vegetation planting (ha)
Horokiri Stream	22.2	5.1
Pauatahanui Stream	1.0	1.3
Ration Stream	3.4	2.4
Duck Creek	4.5	4.5
TOTAL	31.1	13.3

These early retirement areas have been included as part of the mitigation of effects on terrestrial, freshwater and marine ecology and are referred to subsequently.

21.2.3 Terrestrial fauna

Several areas of habitat for herpetofauna and terrestrial invertebrates are present within the designation. Herpetofauna refers to amphibians and reptiles, whereas a terrestrial invertebrate refers to species without a backbone that are visible with the naked eye. As part of the ecological field surveys, an assessment of the prevalence of herpetofauna and terrestrial invertebrates within the Project area was undertaken. This utilised existing information based on previous studies as well as field surveys.

21.2.3.1 Terrestrial invertebrates

Terrestrial invertebrates represent a diverse group of species. Within the highly modified habitats found along most of the route in the Project area range of common terrestrial invertebrates were detected within the Project area including bees and wasps, butterflies and moths, spiders, snails and slugs, centipedes and millipedes, *Peripatus*, beetles, wetas, cockroaches, silverfish, cicadas, hoppers, dragonflies, midges, earwigs, ants, worms and slaters. These species are expected in this type of environment. None of the species are considered to be threatened or at risk.

Desktop studies identified several species of invertebrate of conservation concern that may be present along the alignment. However, when the small areas of potential habitats of these species were searched none were found. The most notable species recorded was *Peripatus novaezealandiae*

(commonly referred to as velvet worms, see Figure 6.14) which is one of five peripatus species in New Zealand. It is not threatened or at risk but is a species of local interest.

21.2.3.2 Lizards

Most of the Project area is in grazed pasture which provides relatively poor habitat for indigenous lizards (herpetofauna) due to the lack of potential refugia, habitat disturbance by stock, and the presence of introduced predators such as rodents, mustelids and cats. The exception to this is the larger scree slopes and stone fields towards the north of the Project area (through the Te Puka and upper Horokiri Valleys, and to a lesser extent Duck Creek) which provides good potential habitat.

Desktop studies identified several species of lizard of conservation concern that may be present along the alignment. However, only three herpetofauna species were detected during the field surveys: common geckos, common skinks and common copper skinks. These species were detected in relatively low numbers and are among the most common lizards found throughout the North Island. They are classified as not threatened¹²⁵. The range and count of species found is considered to be representative of inland pasture throughout the region.

In total, field surveys found four lizards and nine skin sloughs. Two common skinks were located at the southern end of the Main Alignment corridor under an object in un-grazed pasture. In comparison, the two copper skinks were found under a cover object in stone fields within the northern section. Manual searches located a juvenile and two female common gecko. All were found beneath rocks within a stone field in grazed pasture near the northern end of the alignment in the Horokiri and Te Puka Catchments. Also in the Te Puka Catchment nine gecko (probably common gecko) skink sloughs were found in the scree.

21.2.3.3 Birds

Initially, the study determined the likely presence of birds (avifauna) within the ecological district from existing data for the Project area from the Ornithological Society of New Zealand's (OSNZ) data atlas. This was followed up with field surveys using point counts, incidental observations and nocturnal surveys. Information from the Guardians of the Pauatahanui Inlet (GOPI) was also used, specifically in relation to bird species around Pauatahanui Inlet.

While much of the Project area lies within largely rural landscapes, mobile avifauna will have ranges extending across the Project area. There are several ecologically significant sites and habitats within, or in close proximity to, the Main Alignment corridor that are utilised by avifauna.

The field surveys (involving point counts) recorded approximately half (48%) of the bird species listed in the OSNZ data atlas for the wider Project area. This is likely to be a function of the narrower sample area of the field survey and the time of year the survey was undertaken (January – March). Nonetheless, the 37 species observed during the survey are considered to provide an accurate representation of bird species in the area, together with the addition of a few more species which were not observed but

125. Although not threatened, they are still protected under the Wildlife Act 1953 and potential effects will need to be mitigated. This is discussed in Section 21.5.1.3 of this report.

which are known to be present in the area at various times of the year. Of the 37 species recorded, 20 are native and 17 are introduced. Although introduced species make up less than half of the number of species, approximately two-thirds (69%) of the point counts were introduced species, indicating their relative presence in greater numbers than native species within the area.

The 20 native species recorded have the following classifications:

- 15 are Not Threatened;
- Three (3) are Threatened (bush falcon, kaka and pied shag); and
- Two (2) are At Risk (black shag and New Zealand pipit).

Thus, Threatened and At Risk species were present within the Project area but were only recorded in very low numbers.

As noted, the majority of habitat along the Project area comprises pasture and farmland. The greatest number of species (16 out of the 37 species observed) were recorded in this habitat type, and 75% of these were introduced species. In comparison, the forest provides primary habitat for fewer species, but a greater proportion of these were native species and include the Threatened bush falcon and North Island kaka. The freshwater habitats are utilised by introduced, native, Threatened and At Risk species.

Specific habitats of importance for birds are:

- **Ration survey area:** the high mean bird abundances and species diversity per count recorded are likely to be due to the variety of land uses within this area (rural residential, hobby farms, exotic plantation) and its relatively close proximity to Pauatahanui Inlet and Pauatahanui Stream, rather than a reflection of high habitat quality.
- **Te Puka survey area:** the habitat with the highest ecological value was found here, notably the forest remnants within the Te Puka Catchment. The occurrence of large trees (including emergent podocarps) together with important fruiting species within these remnants provides suitable nesting and feeding habitat for a variety of native, Threatened and At Risk species.
- **Porirua Park Bush survey area:** while no Threatened or At Risk species were recorded within the area, a relatively high diversity of native species was recorded, most notably in the older growth forest which had a greater diversity in vegetation than found elsewhere.
- Streams constitute the main freshwater habitat in the Project area and are likely to provide some feeding opportunities for native bird species (especially shags and waterfowl), while generally lacking in nesting habitat.
- Petrel habitat: most breeding colonies are located on islands (e.g. Kapiti and Mana) with the few mainland populations largely confined to coastal forested hilltops, such as 15 found at the northern end of the Project. As such, petrels may be observed at the very northern section of the Main Alignment, but their habitat will not be directly or indirectly impacted upon by the Project.

21.2.3.4 Bats

There are three native bat species in New Zealand. The only part of the Project area where bats are likely to be present is around the Wainui Saddle and northwards down the Te Puka valley. Field surveys were undertaken during January 2010 around this area. The survey failed to positively identify any bat activity, with the one possible record unable to be positively identified by DOC staff.

Clarification of bat presence and relative abundance in this forest will be confirmed by additional monitoring this coming spring (i.e. 2011).

21.3 Assessment of effects on terrestrial ecology during construction

Construction of the Project will have two direct impacts on terrestrial ecology:

- the loss of terrestrial habitat and species through clearance and modification (i.e. earthworks and veneration clearance) as part of construction activities; and
- the disturbance and displacement of terrestrial fauna through construction activities.

21.3.1.1 Loss of terrestrial habitat

Within the 483ha proposed designation, 363ha is in pasture, pine or cropland. Of the 120ha of vegetation dominated by native species, a total of 40ha will be permanently lost beneath the road footprint, and a further 80ha will be potentially affected by associated construction activities. Within the study area catchments there are approximately 5,500ha of indigenous vegetation communities (340ha forest, 2,000ha regenerating broadleaf, 750ha manuka / kanuka, 800ha wetlands etc.). The 120ha of affected native vegetation in the proposed designation represents approximately 2% of the native vegetation within the total study area (i.e. the combined area of the catchments affected). Table 21.3 provides a summary of the magnitude of impact to this vegetation as a percentage of the total vegetation of this type found within the study area.

Table 21.3: Magnitude of terrestrial vegetation loss and modification (without mitigation)

Description (listed north to south)	Maximum area of habitat loss (ha)	Study area (ha)	Loss as % of study area	Ecological value	Assessment of impact magnitude	Assessment of impact significance
Freshwater wetlands						
Wetlands of low value - (Sphagnum bog)	0.8	34	2%	Low	Low	Very low
Wetland of high value - (K106)	1.2	34	4%	High	Low	Moderate
Shrublands and scrub						
Shrublands of low value	50.0	1,202	3%	Low	Low	Very low
Shrubland boulderfields of moderate value (found in Te Puka, Upper Horokiri, Duck)	-	-	-	Moderate	Low	Low
Regenerating indigenous forest (kanuka dominant)						
Sites of moderate value (incl PCC33, PCC155b, Part PCC190, PCC196)	10	590	2%	Moderate	Low	Low

Description (listed north to south)	Maximum area of habitat loss (ha)	Study area (ha)	Loss % of study area	Ecological value	Assessment of impact magnitude	Assessment of impact significance
Regenerating broadleaf forest (mahoe dominant)						
Sites of low value (incl PCC199)	4.0	1,527	-	Low	Negligible	Very low
Sites of moderate value (incl PCC155b)	5.4		-	Moderate	Negligible	Very low
Sites of high value (incl Part PCC12, PCC76)	10.0		1%	High	Low	Moderate
Early Retirement Planting (No 1, 2, 3, 5, 6, 7)	17.7		1%	Moderate	Low	Low
Mature or maturing indigenous forest						
Sites of low value (incl K223-230, PCC88, PCC172)	16.6	225	7%	Low	Moderate	Very low
Sites of moderate value (incl K229, PCC33, Part PCC190)	1.7		1%	Moderate	Low	Low
Sites of high value (incl Akatarawa Forest, K139, PCC88, WCC0702.15, W0702.16)	1.7		1%	High	Low	Moderate
TOTAL (ha)	120					

21.3.1.2 Threatened plant species

As noted above, a locally uncommon endemic wetland plant, *Leptinella tenella* (At Risk – Declining), was found in a highly modified area of boggy pasture within the Project area. This area is likely to be used for the formation of a stormwater treatment pond. It is considered that careful design of this proposed stormwater treatment pond should adequately mitigate potential adverse effects on this species and good design may even create additional wetland habitat. This is included in the draft Ecological Management and Monitoring Plan (EMMP).

21.3.1.3 Terrestrial fauna

Indigenous insects of conservation interest (*Peripatus novaezealandiae*), and three common species of native lizard were found in low numbers, predominantly in scree and boulderfield habitat in the Te Puka Stream, Horokiri Stream and Duck Creek valleys. This habitat will be reduced by earthworks and any individuals of these species that have taken refuge in this habitat will potentially be lost.

21.3.1.4 Birds

One bush falcon (Threatened) was seen traversing the Horokiri Valley and one North Island kaka (Threatened) was seen over Wainui Saddle and traversing the upper Te Puka Valley. No breeding or foraging habitat for these species will be lost. It is considered unlikely that construction activity will displace these birds from their habitat.

One Pied Shag (Threatened) and one black shag (At Risk) were seen utilising habitat in the valley floors of the Horokiri and Pauatahanui catchments. These birds may be displaced from their streambed habitat by construction activity.

Several NZ Pipit (At Risk) were observed within the valley floor of the Te Puka and Horokiri Catchments. These birds may be displaced from their streambed habitat by construction activity.

In addition, the mature vegetation of Akatarawa Forest at the head of the Te Puka Valley, and Porirua Park Bush above Cannons Creek, contains good numbers of native birds including tui, kereru, kingfisher, fantail, tomtit and bellbird. Small sections of this vegetation will be affected by works, potentially causing disturbance and reducing habitat.

21.3.1.5 Bats

An unconfirmed recording of a native bat, probably the long tailed bat (Nationally Vulnerable) was recorded on the margins of Akatarawa forest at the head of Te Puka Valley. A minimal amount of potential bat habitat will be lost and it is unlikely construction will disturb and displace them.

21.3.1.6 Potential indirect impacts

In addition to these direct impacts on terrestrial habitat and species of terrestrial fauna, construction of the Project has the potential to cause indirect adverse effects on terrestrial ecosystems, in terms of the effects of dust, fire and the potential for the introduction of weeds to the area.

Significant amounts of airborne dust may be created during the period of construction in each catchment where large areas of earthworks are exposed. There is a small risk of adverse effects on adjacent native vegetation. This cannot be quantified but can be monitored, with appropriate management responses put in place (as proposed in the draft EMMP).

There is a risk of fire during the construction period caused by hot works, smoking, and vehicle exhausts. A fire during summer drought could potentially destroy more vegetation than construction activities. This risk cannot be quantified but can and has been managed at other major projects through appropriate management systems (as proposed in the draft CEMP).

There is a risk during construction of the introduction of weed species not currently present on site, as a result of the importation of aggregates, topsoil, plant stock, or as seed on vehicles. This risk also cannot be quantified but can and has been managed at other major projects through appropriate management systems (as proposed in the draft EMMP).

21.4 Assessment of operational effects on terrestrial ecology

The on-going effects on terrestrial ecology resulting from the operation of the Project are relatively limited. The potential effects are limited to the direct impacts on terrestrial fauna from the road and vehicular traffic.

21.4.1 Falcon and kaka

Both falcon and kaka are present in low numbers. Minimal habitat required by these forest species for roosting, nesting, or feeding will be lost. There is no evidence that either species is at risk of collision

with traffic. In the long term, retirement of pasture and revegetation of 115ha in the Te Puka and 247ha in the Horokiri Catchments, will expand forest habitat. Overall, it is considered the risk of adverse effects on these species from operation of the Project will be negligible and potentially positive.

21.4.2 Black and pied shag

Black and pied shag make use of the habitat provided by the main stem of the Horokiri Stream. Very little habitat required by black and pied shag for roosting and nesting, and feeding will be lost and in the long term the revegetation of the stream margins will provide additional roosting habitat. Overall it is considered the risk of adverse effects on these species from operation of the Project will be negligible, and potentially positive.

21.4.3 Bats

The presence of bats has not yet been confirmed around the Wainui Saddle. No habitat required by bats for roosting, nesting or feeding will be lost. There is no research in New Zealand on the effect of roads on bats, either in terms of disturbance or mortality. International research suggests that bats display clear avoidance behaviour of traffic. However, bat mortalities have been recorded near roads.

An accurate assessment of risk requires a better knowledge of bat distribution and abundance. However, assuming that bats are present in the forest above Wainui Saddle and actively forage along the bush margins of the Te Puka and Upper Horokiri Catchments there is a risk of mortality. This effect may, at least in part be mitigated by the retirement of pasture, and expansion of shrublands and scrub across the Project site.

Overall, and assuming bats are present around the Saddle, it is considered the risk of adverse effects from operation of the Project to be low to moderate. Regardless, monitoring of potential effects on any bats present is included as part of the draft EMMP. This includes the investigation of possible mitigation measures if operation of the Project is found to be causing bat mortalities.

21.4.4 Pipit

In the long term, the retirement and revegetation of pasture will reduce habitat for pipit in the Te Puka and Upper Horokiri Catchments, therefore it will impact on the local population. However, this revegetation is returning the landscape to its original forested habitat. Pipit are present today only as opportunistic species making use of a landscape that has been modified in such a way it provides habitat.

There is plenty of other habitat in the area available for pipit populations and there are not considered to be affected.

21.5 Measures to avoid, remedy or mitigate potential adverse effects on terrestrial ecology

21.5.1 Vegetation and terrestrial habitat loss

The Project will result in the permanent loss of 40ha of indigenous terrestrial vegetation and habitat. Potentially, an additional 80ha of indigenous vegetation will be temporarily lost due to construction activities, such as earthworks, but will be mitigated.

Considerable effort has been put into trying to limit the total vegetation loss associated with the Project. Some further avoidance of specific sites may be achievable through detailed design:

- Rowans Bush (KCDC Ecosite 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;
- the Transmission Gully Riparian Area (PCC Ecosite 199);
- Tawa remnants within Cannons Creek Bush (PP12) in the vicinity of the Cannons Creek Bridge; and
- Porirua Park Bush (PCC Ecosite 76).

However, the loss of mature and maturing native forests and of advanced regenerating native bush and scrub, which is relatively uncommon with the highly modified landscape of the study area, requires mitigation. Further, these plant communities provide habitat for most of the species of indigenous fauna of conservation concern that have been located during this study, and the loss of this habitat also needs to be mitigated.

21.5.1.1 Approach to terrestrial habitat mitigation

When considering how effects on terrestrial habitats will be managed it should be recognised that some degree of terrestrial habitat loss cannot be avoided completely (although every effort has been undertaken to reduce the degree of loss). The philosophy for the mitigation of adverse effects on terrestrial habitat is that across the entire Project area there will be no net loss of terrestrial habitat.

There is no national standard or guidance for the calculation of mitigation required for vegetation loss. A commonly used method is to apply environmental compensation ratios (ECR) to provide new vegetation with an ecological value as close as possible to the vegetation removed.

It is considered that a total of 250ha of revegetation will be required to mitigate the vegetation loss. This is based on the ECRs shown in Table 21.4.

Table 21.4: Mitigation for vegetation loss

Habitat type	Potential loss of native vegetation (ha)	ECR	Required mitigation area (ha)
Wetlands	2	3	6
Shrublands in pasture dominated by tauhinu	50	1	50
Kanuka scrub and low forest	10	2	20
Regenerating native forest (Mahoe)	37	3	111
Mature native forest (tawa, kohekohe)	21	3	63
TOTAL	120		250

This figure of 250ha is very conservative in that it assumes that all vegetation within the proposed designation will be lost which is extremely unlikely. Based on the ECRs and the planting areas required for mitigation, four types of terrestrial restoration treatments are proposed:

- **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:** as above but using rapid growing and strongly rooted species suited to riparian environments (e.g. toetoe, flax, kowhai, cabbage tree, tutu, kohuhu, wineberry), with some future canopy species interspersed (e.g. kahikatea, pukatea, swamp maire). The objective is to restore a forest canopy to streams that are revegetated.
- **Enrichment planting:** typically where there is already regeneration of open shrublands that can provide a nursery. 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 evaluation of potential mitigation area is detailed in **Appendix 11.G**. The sites are listed in **Appendices 11.H and 11.I** and shown on the maps in **Appendix 11.J**. The total planting areas proposed are summarised in Table 21.5.

Table 21.5: Mitigation planting for terrestrial vegetation loss

Planting type	Area (ha)
Existing Benefit (early retirement planting)	31
Revegetation Area (proposed)	53
Enrichment Area (proposed)	187
Retirement and Protection (proposed)	155
TOTAL	426

It can be seen that the proposed 426ha of mitigation planting is well in excess of the 250ha required using the applied ECRs. This is largely because the proposed planting for the mitigation of terrestrial vegetation loss will also provide riparian mitigation in many instances. This is discussed in relation to potential effects on freshwater ecology in Chapter 22.

With the proposed planting mitigation areas the adverse effects on vegetation and terrestrial habitat will be adequately mitigated. In the long-term there will be a net gain (and hence positive effect) in terms of terrestrial habitat across the Project area.

21.5.1.2 Terrestrial invertebrates

Potential effects on peripatus can be mitigated by translocation of logs and debris in pasture along the route immediately prior to vegetation clearance / construction. These habitats are easily identified and can be moved by hand or small vehicle to the edge of suitable vegetation adjacent to the clearance line.

21.5.1.3 Lizards

Logs and debris will be relocated as part of pre-construction site inspections (combined with peripatus search). Logs will be moved to the edge of suitable vegetation or restoration plantings. Logs can be left whole or cut into slabs to be placed around the edge of planted areas – these can be incorporated into planting plans for restoration sites. The rotting timbers then provide shelter for lizards, as well as habitats for invertebrates on which they feed.

Boulderfields within the Te Puka and Horokiri can also be searched prior to earthworks and any animals trapped and translocated to nearby safe habitats.

21.5.1.4 Bats

While the presence of bats around the Wainui Saddle has not been confirmed, if they are found to be present there is a low risk that they could be adversely affected by the operation of the Project (being struck by road traffic). In part this potential effect will be mitigated by the additional terrestrial habitat being provided. Further investigations to seek to confirm the presence or absence of bats are proposed and if they are found to be present then monitoring of potential impacts on any population is also proposed. This is included as part of the proposed monitoring in the draft EMMP. If bat mortalities are observed during monitoring, mitigation options would be investigated.