State Highway 2

Waikare Gorge Realignment:

Ecological Assessment

PREPARED FOR WAKA KOTAHI | January 2024

Stantec

Revision schedule

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1 Introduction

1.1 Background

Waka Kotahi the New Zealand Transport Agency (Waka Kotahi) is developing a resource consent application and Notice of Requirement in relation to the realignment of the Waikare Gorge section of State Highway 2 (SH2) between Napier and Gisborne. The existing Waikare Gorge section of SH2 is narrow and windy, and is regularly impacted by flooding and rockfalls which cause closure of the road. This was markedly illustrated in February 2023 when the Waikare Gorge bridge was destroyed during Cyclone Gabrielle, leading to a three-month closure before the installation of a temporary bailey bridge. There is no local road-based detour of SH2 through the Gorge, meaning that all road-based traffic between Gisborne and Napier needs to re-route via State Highway 5 and State Highway 30. This detour adds an additional 3 hours and 14 minutes to the journey time between Napier and Gisborne, or close to six hours for local communities travelling between Napier and Wairoa.

Enhancing the journey on SH2 through the Waikare Gorge has been identified as a project that could deliver a significant contribution to the region by improving safety, improving resilience, and enhancing access to economic and social opportunities.

1.2 Aim

Stantec has been requested to complete an Ecological Impact Assessment (EcIA) of the proposed SH2 realignment to support the resource consent application. The purpose of this assessment is to characterize the terrestrial and aquatic environments in the vicinity of the project, to assign ecological values of these areas, and to determine the likely impacts of construction and operation of the new road.

1.3 Project Description

1.3.1 Site Location

The proposed SH2 Waikare Gorge realignment project (the Project) is located west of the township of Putorino (Figure 1-1). The proposed two-lane highway is approximately 3.8 kilometres (km) in length and will include a passing lane for 1050 metres (m). The proposed realignment will traverse through existing farmland, and the two ends of the project link into the existing SH2 north and south of Putarino, respectively. The existing road will be retired or used for local access. The KiwiRail corridor is located east of the proposed realignment (upgradient) at the northern end of the Project for approximately 950 m before crossing over to be west (downgradient) for the remaining portion.

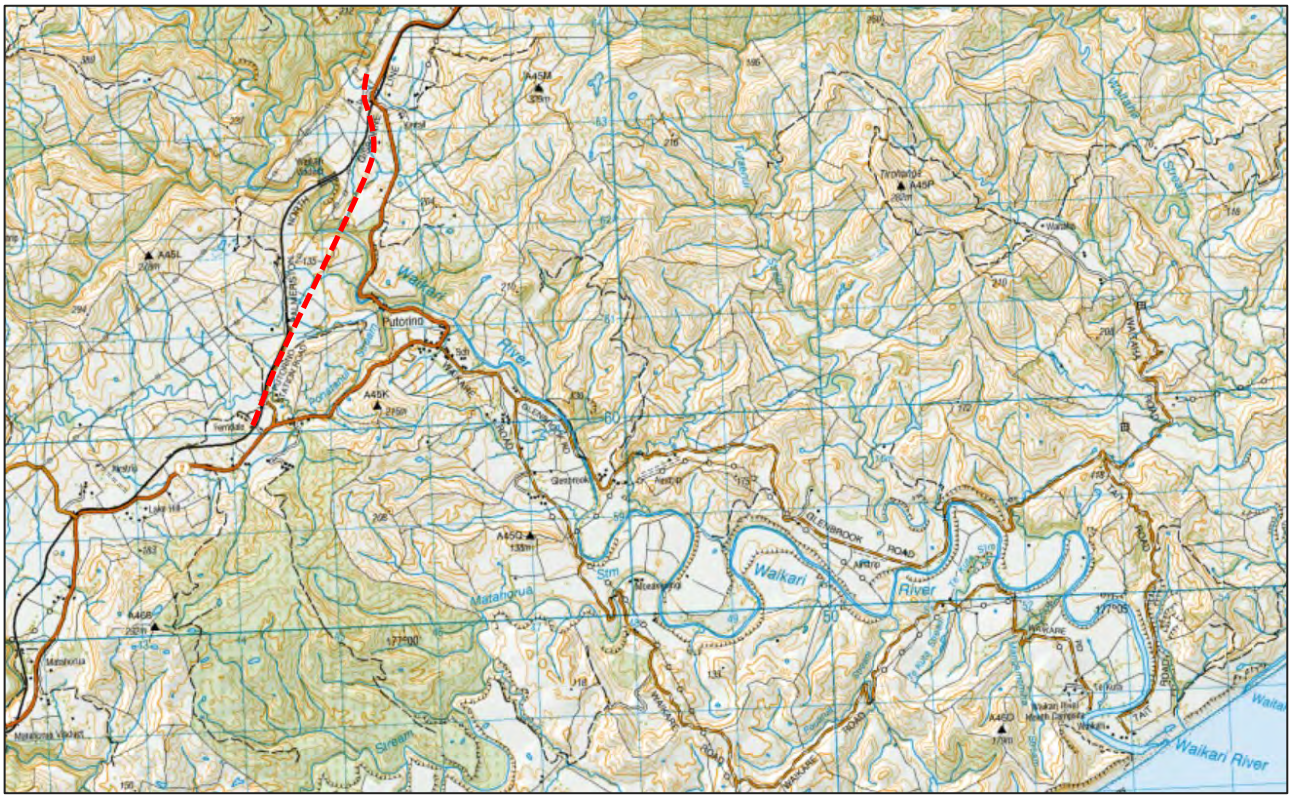

Figure 1-1: Indicative site location

1.3.2 Drainage design

The stormwater design adopts a treatment train approach, with vegetated fill batter slopes, swales and stormwater treatment facilities used in series to treat a wide range of contaminant types and improve the treated water quality. At the preliminary design phase, over 90% of the new road surface area can be treated to some extent before being discharged to the receiving environment, with 35% of runoff being treated by both swale and wetland.

Changes to existing watercourse catchments due to increased impervious surfaces and conveyance of runoff to stormwater treatment facilities will see an overall increase in runoff volumes directed to watercourses post-construction. Attenuation ponds with throttled outlets will be utilised to generally limit flow rates discharged into watercourses to pre-development levels (Stantec, 2022).

1.3.3 Bridges

The project includes the construction of a large bridge over the Waikari River and a second, smaller bridge over Pohatanui Stream / Kings Creek (Table 1-1). A bridge is also to be constructed over the railway line in the north.

Table 1-1: Proposed new bridges in the concept design

Code	Chainage	Name	Catchment area (Ha)	Average stream flow (L/s)[1]	Flow type[2]	Structure type	Culvert length (m)	Culvert grade (%)
B1	C13700	Waikari River	17,027	3,344	Permanent	Bridge	N/A	N/A
B2	C15550	King's Creek / Pohatanui Stream	493	58	Permanent	Bridge	N/A	N/A

Notes: 1. Stream flow estimates are from https://shiny.niwa.co.nz/nzrivermaps/
2. As per Auckland Council definitions.

1.3.4 Cross-drainage culverts

Five cross-drainage culverts will be required under the proposed road. These culverts have been designed to have capacity for 100-year design flows and to meet fish passage requirements if applicable. Key characteristics of these culverts are summarised in Table 1-2.

Table 1-2: Proposed culvert details in the concept design

Code	Chainage	Name	Catchment area (Ha)	Average stream flow (L/s)[1]	Flow type[2]	Culvert dimensions[3]	Culvert length (m)	Culvert grade (%)
C1	C12200	Anaura Stream tributary	71	11	Permanent	1.8 x 1.5m box culvert	64	3.4%
C2	C13190	Waikari River tributary (north)	141	17	Permanent	2.5m x 1m box culvert	118	3.2%
C3	C14200	Waikari River tributary (pond)	20	8	Intermittent	1.5m x 1m box culvert	94	13%
C4	C14700	Waikari River tributary (south)	36	3	Intermittent	900mm diameter round culvert.	51	6.3%
C5	C15290	King's Creek / Pohatanui Stream tributary[4]	11	3	Ephemeral	1,500mm diameter round culvert.	37	1.8%

Notes: 1. Stream flow estimates are from https://shiny.niwa.co.nz/nzrivermaps/
2. Flow type as determined by Stantec field staff.
3. Culvert details are from the stormwater design report (Stantec, 2022)
4. Not classified as a stream by Stantec ecologists. Assessed as potential wetland habitat.

2 Methodology

An ecological assessment was undertaken to determine the terrestrial and aquatic ecology values of the proposed route based on the concept design. The assessment included a review of desktop information complemented by site visits to describe and sample the vegetation, streams, wetlands, and fauna habitat in the vicinity of the route.

The methodology involved a desktop assessment of existing ecological information on the route, including:

- Regional and District Council plans and planning maps.
- Publicly available reports on the ecology and water quality of the area.
- Biological databases e.g., Land and Water Aotearoa (LAWA), NZ Freshwater Fish Database, NZ Herpetofauna Database, NZ Land Cover Database (LCDB v5.0).
- Waka Kotahi Research Reports.
- Project-specific information including the preliminary stormwater design and draft Assessment of Environmental Effects reports prepared by Stantec.

Terrestrial ecology assessments and field work comprised:

- Vegetation – description and mapping of areas of native and exotic vegetation within the proposed designation, including likely habitat for native fauna. Vegetation types are described in section 3.1.2 and mapped in Appendix C.
- Avifauna – description of avifauna habitat, supplemented by five-minute bird counts (Dawson & Bull, 1975) and casual observations. Bird count locations are summarised in Table 2-1 and mapped in Appendix C.
- Herpetofauna – review of records in the NZ Herpetofauna Database, supplemented by an assessment of available habitats for terrestrial and arboreal lizards. Herpetofauna habitat is descried in section 3.1.4.
- Bats – review of existing information on bat distribution, and identification of potential habitat and roost trees. Bat habitat is described in 3.1.5.

Aquatic and wetland ecology assessments and field work comprised:

- Aquatic ecology sampling at four (4) sites, where the following activities were completed:
    - Survey of macroinvertebrate communities by single kick net sample in accordance with protocols C1, P1 & P2 (Stark et al 2011).
    - Survey of fish communities by collecting six replicate eDNA samples at each location, which were analysed by Wilderlab in Wellington.
    - Stream Ecological Valuation (SEV) assessment in accordance with Auckland Council guidelines (Auckland Council, 2015).

  Aquatic sampling sites are summarised in Table 2-2, described in section 3.2, Appendix B and C.
- Wetlands – review of aerial photographs complemented by a site walkover to identify the presence of natural inland wetlands within 100 metres of the project, as defined in the Resource Management Act 1991 and the National Policy Statement for Freshwater Management 2020. Wetlands are described in section 3.2.6, Appendix B and E.

An initial site walkover was undertaken on 03-04 May 2022 to assess the overall route, classify vegetation and habitats potentially impacted, and identify any areas for targeted investigations. This visit was undertaken by a member of the ecology team in conjunction with Stantec civil engineers involved in the stormwater design. A second site visit was undertaken on 13-14 September 2022, focused on completing aquatic ecology surveys at locations where the proposed road alignment crosses watercourses. A third site visit was undertaken on 28 November 2023 to carry out an additional stream assessment at a site that was initially proposed for ecological offsetting (later discounted due to unavailability).

Maps of the proposed route were produced in ArcGIS using design drawings provided by Stantec engineers, supported by field information and publicly available data as described above. The project construction footprint was conservatively estimated to include the earthworks footprint, plus an additional 10m buffer, to account for vehicle movements and small changes in design. The ecology maps are presented in Appendix B (aquatic ecology and wetlands) and Appendix C (terrestrial ecology). Appendix B also includes a 100m buffer, within which the National Environmental Standards for Freshwater (NES-FW) 2020 rules on development in or near wetlands would apply. Finally, the maps show the proposed designation boundary, within which access tracks, turnaround areas, equipment storage areas, and other construction related activities may occur. The exact locations of these facilities will be determined during detailed design.

This report presents the results of the investigation. The assessment of effects methodology has been adapted from the Ecological Impact Assessment Guidelines described by EIANZ (Roper-Lindsay et al 2018) as detailed in Appendix A.

Table 2-1: Five-minute bird count locations (03 May 2022)

Reference	GPS Location	Time	Description
BC1	E1945480 N5662793	11:25 am	Elevated pasture overlooking farmland and railway corridor near northern end of the alignment. Surrounding land use pasture with scattered native and exotic trees. Weather still and calm.
BC2	E1945353 5662039	12:09 pm	Northern side of Waikare Gorge at edge of pasture, native kanuka and pine plantation habitats. Weather was clear and still.
BC3	E1944954 N5661540	2:16 pm	Elevated farmland adjacent to a field of crops and a farm access road, overlooking an online farm pond (open water), with pasture, stream and riparian vegetation habitats. Weather calm and clear.
BC4	E1944598 N5660835	3:08 pm	Open pasture with ephemeral stream and damp pasture / potential wetland habitat. Located in low lying area between a hill (east) and gravel road (west). Nearby overhead powerlines. Weather calm and clear.
BC5	E1944478 N5660508	3:44 pm	Open pasture with ephemeral stream and damp pasture / potential wetland habitat north of King's Creek. Weather calm and clear.

Table 2-2: Stream Ecological Valuation locations (September 2022 and November 2023)

Reference	GPS Location	Date	Culvert No.	Description
SEV1	E1945576 N5663459	13-Sep-2022	C1	Unnamed 2nd order tributary of Anaura Stream which is a tributary of the Waikari River. Located immediately downstream of SH2 below an existing culvert beneath SH2 and (separate) culvert under the rail line. Existing SH2 culvert to be extended.
SEV2	E1945420 N5662461	N/A*	C2	Unnamed 2nd order tributary of Waikari River north of Waikare Gorge, crossed by the proposed road. This tributary is also crossed by the existing SH2. *Not accessible due to difficulties in land access (landowner disallowed access).
SEV3	E1945315 N5662271	28-Nov-2023	N/A	Potential stream offset site located on an unnamed second order tributary of Waikari River, approximately 350m downstream of SEV2 on the same stream system. (Site later discounted for offsetting due to unavailability of land for the Project).
SEV4	E1944971 N5661572	14-Sep-2022	C3	Unnamed 2nd order tributary of Waikari River south of Waikare Gorge, crossed by the proposed road. Most of the reach within the Project footprint is a farm pond.
SEV5	E1944784 N5661109	14-Sep-2022	C4	Unnamed 1st order tributary of Waikari River south of Waikare Gorge, crossed by the proposed road. Crossed by the existing SH2 further downstream.

3 Existing Environment

3.1 Terrestrial Ecology

3.1.1 Ecological Context

The site is located within the Waihua Ecological District (ED) which is part of the Wairoa Ecological Region (McEwen, 1987). The Waihua ED includes the lowlands of the Hastings and Wairoa Districts from Pakuratahi Stream in the south, near Whakaari, to Waitaniwha Bay east of the Mahia Peninsular in the north.

The Waihua ED is typified by dry coastal hill country and river terraces draining to the coast. The climate is temperate with very warm dry summers, moderate winter temperatures, and rainfall of 1,000 to 1,500 mm per annum. The area has been modified by human activity, creating large areas of pasture and exotic forest, with scattered native shrubland. Historically, vegetation comprised fire-induced bracken fern and manuka, tending towards podocarp hardwood forest in the west. Dense stands of kahikatea and matai used to be present on the Wairoa River floodplain and locally elsewhere. Today, there is little indigenous native forest remaining in this ED (McEwen, 1987).

Notable native bird species in this ED includes spotless crake (*Porzana tabuensis tabuensis*), Australasian shoveler (*Anas rhynchotis*), New Zealand scaup (*Aythya novaeseelandiae*), grey teal (*Anas gracilis*), fernbird (*Bowdleria punctata vealeae*), and dabchick (*Poliocephalus rufopectus*) (McEwen, 1987). These are species predominantly associated with open water and wetlands.

3.1.2 Vegetation

Vegetation types within and adjacent to the Project footprint are mapped in Appendix C

Vegetation in and around the Project area is dominated by exotic species. Most of the alignment passes through farmland with heavily grazed pasture and scattered exotic trees including oak (*Quercus robur*), pines (*Pinus spp.*), poplars (*Populus spp.*) and occasional willow (*Salix babylonica* and *Salix fragilis*). A small pine (*Pinus radiata*) plantation is also present at Waikare Gorge east of the Project. Native vegetation is limited to the banks of the Waikari River, with sparse kanuka-dominated shrubland on smaller streams and tributaries, particularly where steeper topography is less accessible to stock. The Mackintosh dairy farm immediately south of Waikare Gorge has fenced and planted almost all riparian margins, but for other properties, streams and wetland areas remain unfenced. There is very limited mature native vegetation located within or adjacent to the project, however the Waikare Gorge supports mature trees and tawa (*Beilschmiedia tawa*) forest.

Table 3-1 lists the predominant native plant species encountered during the site walkover. One threatened plant species was found within the project area: kanuka (*Kunzea robusta*), classified as Threatened: Nationally Vulnerable. It is noted that this species of kanuka is widespread throughout New Zealand, but like all Myrtaceae, is at risk of myrtle rust. The Conservation status of all native Myrtaceae was raised in 2018 after the arrival of myrtle rust, an aggressive plant pathogen which was first detected on mainland New Zealand in 2017.

In the north of the alignment near the tie in with SH2, there is mixed native and exotic vegetation associated with the railway corridor and SH2 roadside. This vegetation is located behind fences and so has been protected from grazing by stock. Native shrubs, comprising of mahoe (*Melicytus ramiflorus*), kanuka, cabbage tree (*Cordyline australis*), karamu (*Coprosma robusta*), and bracken fern (*Pteridium esculentum*) are growing here, alongside exotic weeds (Plate 3-1 and Plate 3-2). Mature oak and pine trees occur along property boundaries near State Highway 2 (Plate 3-3). A patch of mature kanuka trees is located on Lee Farm on the eastern side of the proposed railway overbridge (Plate 3-4). The understorey is grazed pasture and wetland habitat adjacent to the railway line. A small area of rautahi (*Carex geminata*) and raupo (*Typha orientalis*) is also present east of SH2 on Anauru Stream (partly visible in Plate 3-1).

Further south, the proposed road crosses an unnamed tributary of Waikari River. At the point of the stream crossing, vegetation is sparse, and dominated by heavily grazed pasture with small riparian wetlands immediately adjacent to the stream channel. Regenerating kanuka shrubs are growing on the banks of this tributary to the west of the alignment (Plate 3-5 and Plate 3-6). This vegetation is unfenced and grazed, with limited understorey. Most or all of this vegetation is outside of the construction footprint.

The road crosses the Waikari River by way of a proposed bridge. Due to the extremely steep nature of Waikare Gorge, vegetation is fenced on both banks (Plate 3-7 and Plate 3-8), although the semi-mature nature of the trees indicates that it was likely grazed at some time in the past. Vegetation on the top of the bank consists of near-exclusive kanuka shrubland, with occasional divaricating shrubs and creepers including *Coprosma crassifolia* and pohuehue (*Meuhlenbeckia australis*). This is bordered by rank pasture grasses and weeds (paspalum, cocksfoot, inkweed), with bracken and *Oplismenus hirtilis* on the northern bank. Vegetation on the near-vertical escarpment was unable to be assessed for health and safety reasons, but there appears to be a higher diversity of native vegetation on the banks and the river edge in this location, including larger native trees and tree ferns. With the current bridge design, the vegetation on the banks of Waikare Gorge will not be removed, but will be directly impacted by increased shading and a reduction in precipitation immediately beneath the structure.

South of Waikari River, the Mackintosh dairy farm has fenced almost all permanent and intermittent streams and wetlands on the property. The upper reaches of the farm have been recently fenced and partly planted in exotic trees

(*Populus sp.*) and native shrubs (Plate 3-9). The native plantings including ecologically-appropriate pioneer species such as harakeke (*Phormium*) and karamu (*Coprosma robusta*) alongside coastal flax, akeake, lemonwood, black matipo, and some cultivars. There are also several check dams or farm ponds that have been formed in the upper reaches. It is unknown if these function as water supplies, sediment control, duck shooting, or other purposes. One of these ponds will be removed and the stream piped beneath the proposed road.

Downstream of the existing farm access track and east of the proposed road alignment, the main stream running through the property is fenced and supports semi-mature native vegetation (Plate 3-10). Species include kanuka, mahoe, cabbage tree and tree fuchsia, with low abundance of exotic species. This provides a contiguous connection of native vegetation to Waikare Gorge to the east. According to the current design, this vegetation is outside of the zone of works and will be unaffected.

Near the southern end of the alignment, the road crosses Torr Farm and runs parallel to the existing Putorino Station Road and railway line. This property is grazed with streams and riparian zones unfenced (Plate 3-11). The property includes the main stem of Pohatanui Stream (also known as Kings Creek) as well as a number of first order tributaries. The incised nature of Pohatanui Stream means that it is partly fenced and well vegetated with a narrow band of exotic and native trees, dominated by black wattle and crack willow (Plate 3-12). Other tributaries comprise pasture and pasture weeds with wetland species, mainly Edgar's rush (*Juncus edgariae*).

At the tie-in with State Highway 2, there is a residential dwelling surrounded by planted native and exotic trees including lemonwood, silver birch, pin oak, liquid amber, magnolia (Plate 3-13). There are also mixed native and exotic shrubs and weeds in the roadside reserve, dominated by kanuka, bracken, Chinese privet, English ivy, and rank grass (Plate 3-14). The remainder of the property is pasture with pastoral wetlands (discussed further in section 4.2.6).

Table 3-1: Native vegetation recorded within and adjacent to the project (May 2022)

Scientific Name	Common Name	Threat Status
Carex geminata	Rautahi	Not Threatened
Coprosma crassifolia	-	Not Threatened
Coprosma robusta	Karamu	Not Threatened
Cordyline australis	Cabbage tree	Not Threatened
Dodonea viscosa	Akeake*	Not Threatened
Fuchsia excorticata	Tree fuchsia, kōtukutuku	Not Threatened
Histiopteris incisa	Water fern	Not Threatened
Juncus edgariae	Edgar's rush	Not Threatened
Kunzea robusta	Kanuka	Threatened – Nationally Vulnerable
Melicytus ramiflorus	Mahoe	Not Threatened
Meuhlenbeckia australis	Large-leaved pohuehue	Not Threatened
Oplismenus hirtellus subsp. imbecillis	-	Not Threatened
Pellaea rotundifolia	Button fern	Not Threatened
Persicaria decipiens	Water pepper	Not Threatened
Phormium tenax	Harakeke, flax	Not Threatened
*Phormium spp.**	Flax cultivar*	N/A
*Pittosporum crassifolium**	Karo*	Not Threatened
*Pittosporum eugenioides**	Lemonwood*	Not Threatened
*Pittosporum tenuifolium**	Black matipo*	Not Threatened
Pteridium esculentum	Bracken	Not Threatened
Scheonoplectus tabernaemontani	Kuawa	Not Threatened
Typha orientalis	Raupo	Not Threatened

*Planted trees and shrubs

Plate 3-1: Mahoe and rautahi with exotic willow and pampas east of SH2 on the Anaura Stream tributary

Plate 3-2: Native shrubs with kanuka mahoe and cabbage trees growing within the rail corridor

Plate 3-3: Looking south where the road rejoins SH2 showing mature oak and pine trees, with agapanthus

Plate 3-4: Mature kanuka trees at the eastern side of the proposed over bridge (rail line at rear)

Plate 3-5: Northern-most stream crossing showing grazed pasture with kanuka to the west (right)

Plate 3-6: Kanuka shrubs and small pasture wetlands adjacent to the stream

Plate 3-7: Looking south across Waikari River showing fenced kanuka shrubland and bracken

Plate 3-8: Fenced kanuka with border of pasture grasses on the southern bank of Waikari River

Plate 3-9: Fenced and recently planted watercourse on the dairy farm

Plate 3-10: The same watercourse downstream with native vegetation that connects to Waikare Gorge

Plate 3-11: Looking south across Torr Farm showing stream crossing C4 and willow tree (left)

Plate 3-12: Mixed exotic and native trees on Pohatanui Stream including wattle and cabbage trees

Plate 3-13: Planted ornamental trees near the tie-in with State Highway 2 in the south

Plate 3-14: Roadside vegetation with bracken and Chinese privet, looking north along State Highway 2

3.1.3 Avifauna

A total of 18 bird species were identified during the site visit through roving transects and five-minute bird counts (Table 3-2). Nine native and nine exotic species were present, including one At Risk species, black shag (*Phalacrocorax carbo novaehollandiae*). The Threatened bush falcon (*Falco novaeseelandiae ferox*) was also observed flying near State Highway 2 to the south of the project footprint.

Avifauna habitat within and surrounding the project area is suitable for common native and introduced birds. The pastoral land use favours open ground birds such as magpies (*Gymnorhina tibicen*), which was the most conspicuous species observed. In addition to large areas of open pasture, habitat comprises of mature exotic trees such as oak (*Quercus robur*), pines (*Pinus spp.*), poplars (*Populus spp.*) and occasional willow (*Salix babylonica* and *Salix fragilis*) and wattle. These provide nesting and feeding habitat. Habitat is also provided by native and exotic shrubs present along streams, the railway line, and within restoration plantings. The Waikare Gorge itself provides a contiguous band of habitat for native forest birds, and likely supports waterfowl in the river itself. There are also small farm ponds which are suitable habitat for common native and exotic ducks.

Habitat for black shag and other waterfowl is limited within the Project area to small streams and farm ponds. No large lakes or wetland habitat[1] is present, and no roosts occur, however it is likely that the Waikari River presents quality feeding opportunities. The black shag was observed in an unnamed, second order tributary that discharges into the north of Waikare Gorge. It was likely feeding on eels, shrimp, koura, or other invertebrates (Heather & Robertson, 2005). The presence of a large waterfall downstream (refer Plate 3-37) limits the fish fauna present in this reach (SEV site 3).

Falcon breed in native and exotic forest (Heather & Robertson, 2005). Such habitat is present upstream and downstream of the Project (within Mohaka Forest, Waikari Gorge and small plantations) but not within the Project footprint itself. The open farmland does provide suitable foraging habitat.

Table 3-2: Avifauna species identified on site, May 2022

Scientific Name	Common Name	Threat Status	BC1	BC2	BC3	BC4	BC5
			11:21	12:09	14:16	15:08	15:44
Alauda arvensis	Eurasian skylark	Introduced and Naturalised	✓	-	-	-	-
Acridotheres tristis	Indian myna	Introduced and Naturalised	-	-	-	✓	-
Carduelis chloris	Greenfinch	Introduced and Naturalised	✓	-	✓	-	-
Circus approximans	Australasian harrier	Not Threatened	-	-	-	-	-
*Falco novaeseelandiae ferox**	Bush falcon*	Threatened: Nationally Increasing	-	-	-	-	-
Fringilla coelebs	Chaffinch	Introduced and Naturalised	✓	✓	-	✓	✓

[1] Natural wetlands have been identified, but these are grazed damp pasture with very limited habitat for open water and wetland birds.

Scientific Name	Common Name	Threat Status	BC1	BC2	BC3	BC4	BC5
			11:21	12:09	14:16	15:08	15:44
Gymnorhina tibicen	Australian magpie	Introduced and Naturalised	✓	✓	✓		✓
Meleagris gallopavo	Wild turkey	Introduced and Naturalised	-	-	-	-	-
Passer domesticus	House sparrow	Introduced and Naturalised	-	-	-	✓	✓
Prosthemadera novaeseelandiae	Tui	Not Threatened	-	✓	-	-	-
Phalacrocorax carbo novaehollandiae	Black shag	At Risk: Relict	-	-	-	-	-
Rhipidura fuliginosa placabilis	North Island fantail	Not Threatened	-	✓	✓		✓
Sturnus vulgaris	Starling	Introduced and Naturalised	-	-	✓	✓	✓
Tadorna variegata	Paradise shelduck	Not Threatened	-	-	-	-	-
Turdus merula	Blackbird	Introduced and Naturalised	-	-	✓	-	✓
Todiramphus sanctus vagans	NZ kingfisher	Not Threatened	-	-	✓	✓	-
Vanellus miles novaehollandiae	Spur-winged plover, masked lapwing	Not Threatened	-	-	-	-	-
Zosterops lateralis	Silvereye	Not Threatened	✓	✓	-	-	✓

*Observed flying a short distance south of the project area.

3.1.4 Herpetofauna

A search of the Department of Conservation New Zealand Herpetofauna Database found no records within 10 km of the proposed project. Within 15 km of the site there are records of three native species (Table 3-3). The closest record is located 12.5 km away. The lack of data is likely due to an absence of surveys in or near the project, rather than a lack of lizard species or suitable habitat.

Table 3-3: Herpetofauna recorded within 15 km of the project in the last 20 years (NZ Herpetofauna Database)

Scientific Name	Common Name	**Threat Status** (Hitchmough, et al., 2021)
Naultinus punctatus	Barking gecko	At Risk Declining
Woodworthia maculata	Raukawa gecko	Not Threatened
Oligosoma polychroma	Northern grass skink	Not Threatened

The site visit confirmed that there is suitable habitat for lizards within the project footprint. Quality habitat for arboreal geckos is present within the kanuka shrubland located within Waikare Gorge (Plate 3-15). Marginal habitat is provided by the scattered kanuka growing on some of the tributaries north of Waikare Gorge (Plate 3-16). Further south, there is limited habitat for geckos due to the intensity of farming, apart from native shrubland on a tributary of Waikare Gorge which is outside of the zone of work.

Habitat for terrestrial skinks is limited to small areas of rank grass and weedfields. The highest quality habitat is associated with the kanuka shrubland in Waikare Gorge, where a semi-contiguous band of rank grass and bracken is present next to fenced pasture (Plate 3-15). Other lower-quality habitat for skinks consists of exotic weeds and overgrown vegetation adjacent to the railway line, SH2 and other roads (Plate 3-16).

Although a targeted survey has not been undertaken, it is highly likely that both arboreal and terrestrial lizards are present within the Project footprint. Once the design is further progressed, further surveys and translocation are likely to be required.

Plate 3-15: Kanuka trees and rank grass along Waikari River are suitable for geckos and skinks

Plate 3-16: Kanuka growing along an unnamed tributary of Waikari River, north of Waikare Gorge

Plate 3-17: Pampas, blackberry and bracken weeds along the rail corridor provides skink habitat

Plate 3-18: Rank grass on State Highway 2 provides low quality skink habitat

3.1.5 Bats

Both long-tailed bats (*Chalinolobus tuberculatus*) and short-tailed bats (*Mystacina tuberculata rhyacobia*) are known to be present in the Hawke's Bay Region (Table 3-4). The closest known resident population of long-tailed bats occur at Boundary Stream Mainland Island in the Maungaharuru Range (Watts, 2018). This is approximately 15 km to the west of the Project. They also occur in Mohaka Forest within the Mohaka River catchment (HBRC, 2022). More recent surveys have also detected passing long-tailed bats at Lake Tutira and White Pine Reserve (HBRC pers. comm. 21/06/22), located 12 km and 19 km to the south respectively.

The site visit confirmed that the Waikari River corridor provides suitable feeding habitat for long-tailed bats. The river is likely to provide connectivity to the remnant native forest along the river, and to native and exotic forest in the wider landscape. There are limited large roost trees within the project area, although a small number of mature pine and oak trees occur near the tie-in to SH2 in the north. The site is not suitable for short-tailed bats, which require intact native forest habitat.

The presence of long-tailed bats can be confirmed by way of acoustic surveys undertaken during warm weather. Once the design is further progressed, further surveys can be completed.

Table 3-4: Bat species recorded in the Hawke's Bay Region

Scientific Name	**Common Name**	**Threat Status** (O'Donnell, et al., 2018)
Chalinolobus tuberculatus	Long-tailed bat	Threatened National Critical
Mystacina tuberculata rhyacobia	Central lesser short-tailed bat	At Risk Declining

Figure 3-1: Known locations of long-tailed bats in relation to the Project (alignment shown in red)

3.1.6 Other Fauna

A single yellow admiral butterfly (*Vanessa itea*) was observed in exotic stinging nettle (*Urtica urens*) beneath pine trees near Waikare Gorge (Plate 3-19 and Plate 3-20). A targeted invertebrate survey was not undertaken. Impacts on invertebrates are considered to be negligible, due to extensive pastoral land use and the paucity of native vegetation cover.

Exotic mammal species observed on site were hare and rabbits. Possums, rats, mice, hedgehogs, cats and mustelids are also likely to be present.

Plate 3-19: Yellow admiral

Plate 3-20: Exotic stinging nettle

3.2 Aquatic Ecology

3.2.1 Streams and Rivers

The project is located entirely within the Waikari River catchment. It includes seven crossings of existing watercourses, shown indicatively in Figure 4-1 and in more detail in Appendix B. From north to south the proposed road would cross an unnamed tributary of Anaura Stream at C1, an unnamed tributary of Waikari River at C2, Waikari River at B1, two minor tributaries of Waikari River at C3 and C4, a tributary of Pohatanui Stream at C5, and Pohatanui Stream at B2. The majority of watercourses along the route are unfenced from stock and show stock damage from grazing and pugging. The exceptions are the Waikari River main stem and watercourses within the Macintosh dairy farm (C3), which are fenced.

The two largest watercourses, Waikari River and Pohatanui Stream (also known as Kings Creek), would be crossed by bridges. The other five stream crossings are by culverts of between 40 metres and 120 metres in length. Details of the streams and proposed culverts are included in Table 1-2.

Figure 3-2: Proposed location of new culverts (C1 to C5) and new bridges (B1 and B2) on active water courses (background map from https://shiny.niwa.co.nz/nzrivermaps/)

An unnamed second-order tributary of Anaura Stream crosses the northern end of the alignment at C1 (Plate 3-21). This permanent watercourse is already piped under State Highway 2 and will remain in place. The existing culvert beneath State Highway 2 has a grating and is perched, causing a partial barrier to fish passage (Plate 3-22). The watercourse is also piped beneath the railway corridor immediately upstream of State Highway 2. Upstream of State Highway 2 and the rail line, the watercourse appears to be fenced and is well shaded by a mix of native and exotic shrubs and trees. Downstream of State Highway 2, the stream is unfenced and subject to stock damage.

The second stream crossing is an unnamed tributary of the Waikari River, designated as C2. This second-order tributary is a permanent watercourse that receives runoff from State Highway 2 and adjacent farmland. The stream is unfenced and subject to stock damage (Plate 3-23 and Plate 3-24). Upstream and downstream of the crossing point, the stream is partially shaded by kanuka shrubland, due to the presence of steep banks which provide some protection from stock. There is a small waterfall (circa one metre drop) within the section to be piped. A very large waterfall is also present where this tributary drops into Waikare Gorge (refer Plate 3-37 in Section 3.2.3).

Plate 3-21: Looking upstream along the Anaura Stream tributary in the north of the alignment (C1)

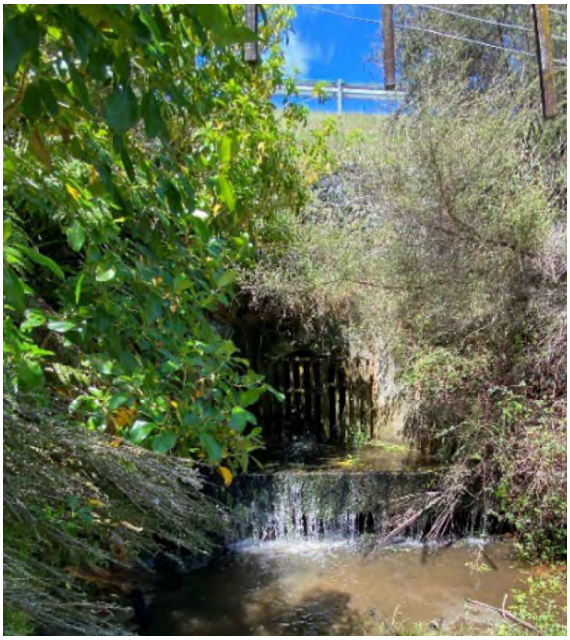

Plate 3-22: Anaura Stream tributary showing screen and perched culvert downstream of State Highway 2

Plate 3-23: Unnamed tributary of Waikari River at proposed stream crossing C2, looking downstream

Plate 3-24: Unnamed tributary of Waikari River looking upstream, showing stock damage

The Waikari River is the receiving environment for the project. The river itself is inaccessible at the bridge crossing point due to near vertical banks in the order of 60 to 80 metres high, according to topographic maps. The upper catchment arises in the Maungaharuru Ranges to the west, and discharges to Hawke Bay to the east, which is the ultimate receiving environment. Catchment land use is farmland (predominantly sheep and beef) with some pine plantation and native bush cover (LAWA, 2022). The catchment is characterised by riparian margins that are grazed to the stream edge with patchy tree cover (LAWA, 2022).

The project will cross the Waikari River by a new bridge. Two existing bridges cross the Waikari River in the vicinity of the project: the Palmerston North to Gisborne Rail Line upstream, known as Waikare Viaduct, and the existing State Highway 2 bridge downstream. There is a third crossing point downstream of Putorino township at Glenbrook Road. The latter is a regional river water quality monitoring site (refer Section 3.2.2).

The project crosses two unnamed tributaries of Waikari River south of Waikare Gorge. The first stream, located on the Mackintosh dairy farm, is fenced for its entire length, including associated first-order streams, and is very likely an intermittent watercourse. The proposed road crosses the stream at C3, shown in Plates 3-23 and 3-24. Upstream of the existing farm track and proposed road, the stream is modified through the formation of several farm ponds. The ponds, pipes and tracks on this reach likely form barriers to fish passage. Downstream of the proposed road crossing the watercourse drops into a deep gully and appears to have permanent flow. It is bordered by native vegetation on both banks, to a combined width of between 25 to 55 metres and connects contiguously to Waikari River.

The last tributary of Waikari River is located on Torr Farm (at C4). This stream is unfenced, with stock access, bank erosion, and sedimentation (Plate 4-26). There are two ephemeral tributaries / flow paths that feed into this channel, which are grazed and pugged. The larger of the two tributaries is a potential wetland area (Plate 4-28).

Plate 3-25: Deeply incised stream above farm pond on Macintosh's dairy farm at C3

Plate 3-26: Farm Pond at C3 (downstream of Plate 3-25)

Plate 3-27: Looking downstream from the proposed crossing at C3 showing start of native vegetation

Plate 3-28: Tributary of Waikari River at proposed crossing C4

Plate 3-29: Pohatanui Stream tributary looking downstream (C5)

Plate 3-30: Ephemeral tributary south of Plate 3-29 (classified as not a wetland due to pasture exclusion)

The main Pohatanui Stream (also known as King's Creek) is located on the Torr Farm near the southern end of the alignment. The stream is deeply incised, fenced from stock, and partly shaded in the vicinity of the proposed road at B2 (Plate 3-31 and Plate 3-32). The substrate of the stream is rock and bedrock (Plate 3-33). The watercourse is already piped for approximately 50 metres beneath existing roads and the railway line. The existing arched culvert is not perched (Plate 3-34) and the proposed road would be bridged across Pohatanui Stream.

A tributary of Pohatanui Stream, with two small side-branches, feeds into the main stem from the north-east. Part of this tributary will need to be piped and realigned downstream of Putorino Station Road. Upstream of Putorino Station Road, there is a small area of raupo where the stream is restricted between the railway line and existing road (Plate 3-35). Downstream of the road, the stream channel is ill-defined, consisting of pugged riparian wetlands (Plate 3-36). Two farm crossings with buried, undersized culverts are present.

Another first order, ephemeral tributary of Pohatanui Stream is present near the southern end of the alignment. This has no defined channel and is considered further in the wetlands section (Section 4.2.6).

Plate 3-31: Pohatanui Stream is deeply incised with a rock channel base

Plate 3-32: Pohatanui Stream at the location of the proposed road looking south towards SH2

Plate 3-33: Pohatanui Stream channel

Plate 3-34: The stream is piped beneath Putorino Station Road, the railway line and a farm track

Plate 3-35: Pohatanui Stream tributary looking downstream from the rail line, showing raupo

Plate 3-36: Pohatanui Stream tributary looking upstream showing pugged wetland channel

3.2.2 Water Quality

The Land, Air, Water, Aotearoa (LAWA) database lists one water quality monitoring site within the Waikari River catchment, located downstream of State Highway 2 at Glenbrook Road, Putorino (LAWA, 2022). A total of 10 parameters are monitored at this site, in addition to macroinvertebrates (refer Section 3.2.4).

Results from this site show generally good water quality, with most parameters falling within the best 50% of all sites nationally. The exceptions are for the nutrient parameters total phosphorus, dissolved reactive phosphorus and ammoniacal nitrogen (Figure 3-3, Figure 3-4, Figure 3-5). Dissolved reactive phosphorus does not meet the National Bottom Line for freshwater set in the NPS-FW (2020). This parameter achieves the lowest “D” attribute band, indicating ecological communities impacted by substantial DRP elevation. Nitrate nitrogen and ammoniacal nitrogen achieve higher water quality with an attribute bands of “A” and “B” respectively. The other parameters do not have assigned attribute bands.

For all (6) parameters with sufficient data, there is a long-term declining trend, indicting degrading water quality (LAWA, 2022).

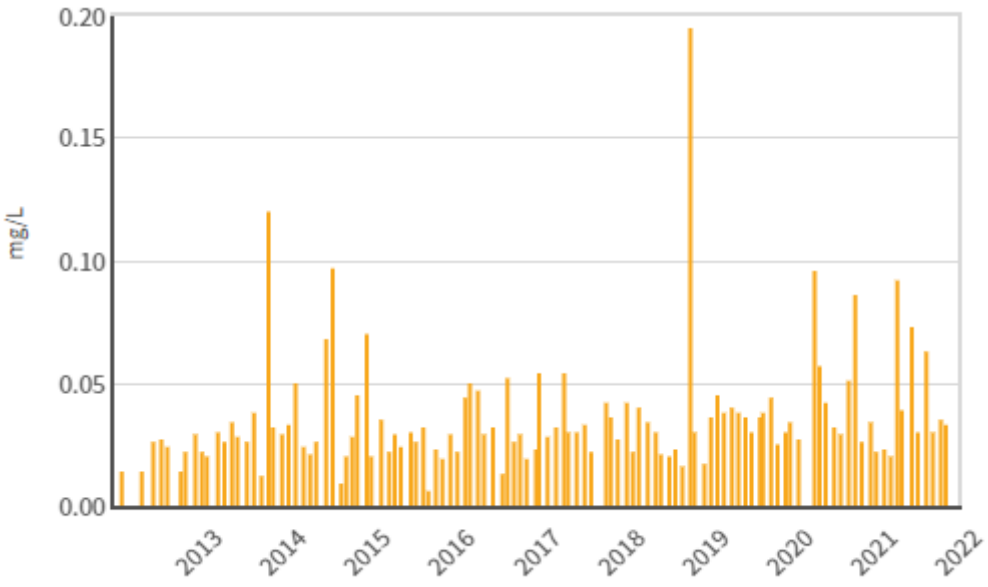

Figure 3-3: Total phosphorus at Glenbrook Road (LAWA, 2022)

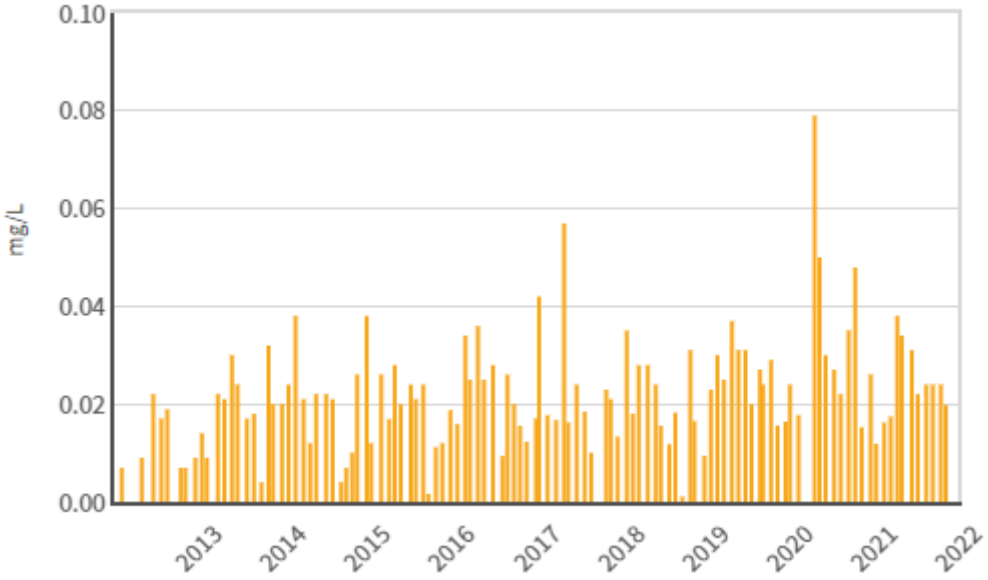

Figure 3-4: Dissolved reactive phosphorus at Glenbrook Road (LAWA, 2022)

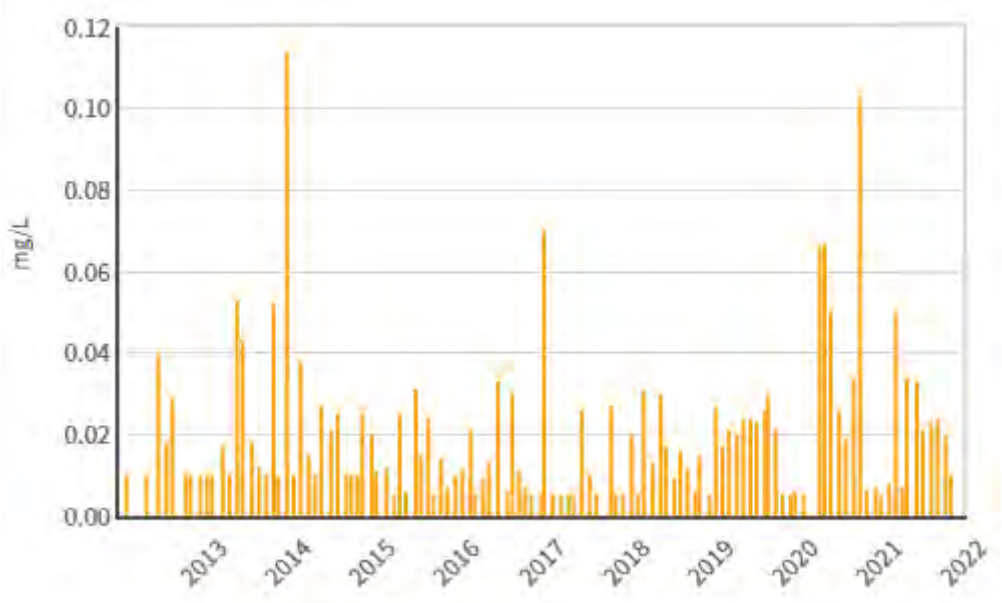

Figure 3-5: Nitrate nitrogen at Glenbrook Road (LAWA, 2022)

3.2.3 Fish

The LAWA database records that Waikari Catchment supports many freshwater fish species including longfin eel (*Anguilla dieffenbachii*), shortfin eel (*A. australis*), inanga (*Galaxias maculatus*), torrentfish (*Cheimarrichthys fosteri*), bluegill bully (*Gobiomorphus hubbsi*), and common bully (*Gobiomorphus cotidianus*), It also supports the estuarine species giant bully (*Gobiomorphus gobioides*), yellow eyed mullet (*Aldrichetta forsteri*), and estuarine triple fin (*Forsterygion nigripenne*). It is known to supports an "average" stock of rainbow trout and has value as an eel fishery (LAWA, 2022).

A search of the New Zealand Freshwater Fish Database (NZFFD) found 21 records for the Waikari River catchment. A total of 15 fish species have been recorded, comprising of 14 native species and 1 exotic species, plus native koura/freshwater crayfish and shrimp (Table 3-5). This includes six 'At Risk' fish species.

One NZFFD record is located on the Waikari River at State Highway 2 immediately downstream of the proposed project. Five fish species are recorded at this location, comprising of bluegill bully, common bully, longfin eel, shortfin eel, torrent fish, as well as koura. All of these fish species are migratory, moving between fresh and saltwater as part of their lifecycle.

There are no NZFFD records of fish surveys on the minor watercourses along the proposed road alignment. It was anticipated that the fish populations in these streams would be depauperate due to the extremely steep topography of Waikare Gorge (Plate 3-37). The near-vertical sides to the gorge make fish passage from Waikari River up into headwater tributaries extremely challenging, although does not preclude the presence of strong climbing species such as eels, as well as koura and shrimp.

The field survey conducted on 13 and 14 September 2022 included the collection of eDNA samples at three SEV survey sites at SEV1, SEV4 and SEV5 to determine the presence or absence of fish species in these watercourses. Sampling was also undertaken on 28 November 2023 at Site SEV3, which is located downstream of SEV2 on a tributary of the Waikari River. The locations of the survey sites are summarised in Table 2-2 and shown in the ecology maps in Appendix B.

Plate 3-37: Waterfall west of the proposed bridge (below SEV2 and 3)

The eDNA results confirmed that the only fish species present within the tributaries crossed by the Project are shortfin and longfin eels (Table 3-6). The Anaura Stream tributary (C1/SEV1) in the north of the alignment supported both species, as did Site SEV3 on a tributary of the Waikari River. Only shortfin eels were present on an unnamed tributary of Waikari River in the middle of the project (C3/SEV4), while no fish species were found in the farm pond (SEV4), which is an unnamed tributary of Waikari River with a perched pipe immediately downstream.

A Fish Index of Biotic Integrity (Fish IBI) score was also calculated for each of the sites surveyed (Table 3-6). This score provides an indication of the richness of the fish community by comparing the species recorded at a site to the species that would be expected to be present, based on the altitude of the site and its distance to the sea. The online MfE Fish IBI Calculator[2] was used to generate a score for each site, which was assessed against the Hawke's Bay Regional IBI categories. The IBI scores for each site were also used in the calculation of the Stream Ecological Value (SEV) scores (see Section 3.2.5).

Sites SEV1 and SEV3 both had an IBI score of 24, which puts them within the 'C' category, which is characterised as *"Low integrity of fish community. Habitat and/or migratory access is considerably impairing and stressing the community."*

Sites SEV4, where no fish species were detected, and SEV5, which had only shortfin eels, scored 0 and 20 respectively. This placed them within the 'D' category, which is characterised as *"Severe loss of fish community integrity. There is substantial loss of habitat and/or migratory access, causing a high level of stress on the community."*

[2] https://mfenz.shinyapps.io/fish-ibi-calculator/

Table 3-5: Fish and crustacean species recorded in the Waikari River catchment 222.000 (NZFFD, 07/07/2022)

Species Name	Common Name	Threat Status (Dunn, et al., 2018; Grainger, et al., 2018)
Aldrichetta forsteri	Yelloweye mullet	Not Threatened
Anguilla australis	Shortfin eel	Not Threatened
Anguilla dieffenbachii	Longfin eel	At Risk – Declining
Cheimarrichthys fosteri	Torrentfish	At Risk – Declining
Galaxias brevipinnis	Koaro	At Risk – Declining
Galaxias maculatus	Inanga	At Risk – Declining
Gobiomorphus basalis	Cran's bully	Not Threatened
Gobiomorphus cotidianus	Common bully	Not Threatened
Gobiomorphus gobioides	Giant bully	At Risk – Naturally Uncommon
Gobiomorphus hubbsi	Bluegill bully	At Risk – Declining
Gobiomorphus huttoni	Redfin bully	Not Threatened
Forsterygion nigripenne	Estuarine triplefin	Not Threatened
Oncorhynchus mykiss	Rainbow trout	Introduced and Naturalised
Paranephrops planifrons	Koura	Not Threatened
Paratya curvirostris	Freshwater Shrimp	Not Threatened
Retropinna retropinna	Common smelt	Not Threatened
Rhombosolea retiaria	Black flounder	Not Threatened

Table 3-6: Fish species detected from 6-replicate eDNA sampling at each site (Sept. 2022, Nov. 2023)

Common Name	Site			
	SEV1 (C1) **Anaura Stream tributary**	**SEV3** **Waikari River tributary in farmland**	**SEV4 (C3)** **Waikari River tributary at farm pond**	**SEV5 (C4)** **Waikari River tributary in farmland**
Shortfin eel	✓	✓	×	✓
Longfin eel	✓	✓	×	×
Fish-IBI score	24	24	0	20
Hawke's Bay Regional IBI category	C	C	D	D

3.2.4 Macroinvertebrates

Aquatic macroinvertebrates provide a robust indicator of long-term water quality and physical health of a stream or river. Waikari River at Glenbrook Road is a freshwater ecology monitoring site for HBRC (LAWA, 2022). Macroinvertebrate data from this site generally indicates fair water quality and habitat conditions. Taxonomic richness is high, with between 19 and 29 macroinvertebrate taxa being recorded per year. The percentage of sensitive mayfly, stonefly and caddisfly larvae (EPT taxa) in the samples range from 21% to 46%, however only limited recent data is available for this parameter, with two records in the last 10 years.

The macroinvertebrate community index (MCI) accounts for the relative tolerance or sensitivity of species (taxa) in each sample. The data for this site generally indicates "fair" water quality and habitat conditions, ranging from 88 to 108.7. However, the long-term trend for this site is declining. Two of the last five years has shown an MCI score of below 90, which does not meet the National Bottom Line of 90. The five-year median of 93.0 results in an attribute band of C.

The Quantitative Macroinvertebrate Community Index (QMCI) accounts the tolerance scores as well as the relative abundance of each taxon to determine an index of stream health. The QMCI score for this site generally indicates "fair" water quality and habitat conditions and has ranged from 3.4 and 5.1. However, scores since 2019 have been lower and the five-year median of 4.33 is below the National Bottom Line of 4.5 This results in an attribute band of D.

The macroinvertebrate Average Score Per Metric (ASPM) combines data from the MCI score, EPT-taxa abundance and percentage EPT abundance. The ASPM has ranged from 0.3 to 0.5. This meets or exceeds the National Bottom Line of 0.3 and results in an attribute band of B.

Table 3-7: Macroinvertebrate indices for Waikari River at Glenbrook Road (LAWA, 2022)

Metric	**Parameter**	**5-year Median Score**	**Quality Class** (Stark & Maxted, 2007)	**Attribute Band (NPS-FW 2020)**
No. taxa	Taxonomic richness, number of taxa	23	-	-
% EPT	Percentage of mayfly, stonefly and caddisfly taxa	37	-	-
MCI	Macroinvertebrate Community Index	93.6	Fair	C
QMCI	Quantitative Macroinvertebrate Community Index	4.33	Fair	D
ASPM	Macroinvertebrate Average Score Per Metric	0.380	-	B

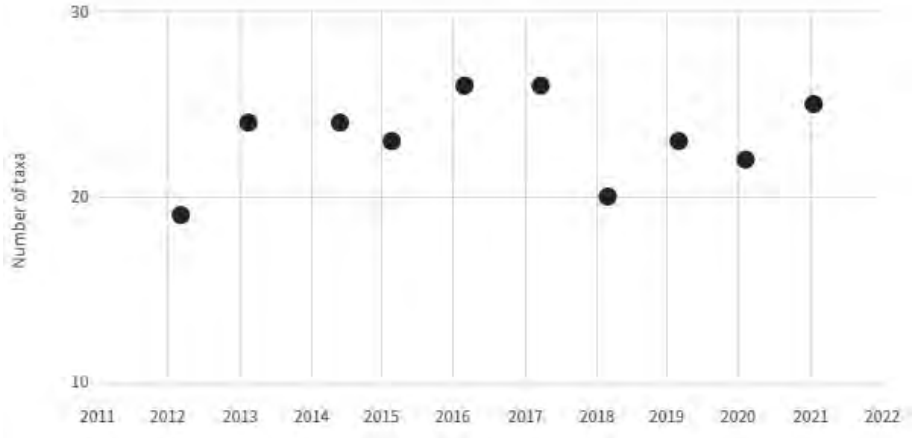

Figure 3-6: Taxonomic richness for Waikari River at Glenbrook Road (LAWA, 2022)

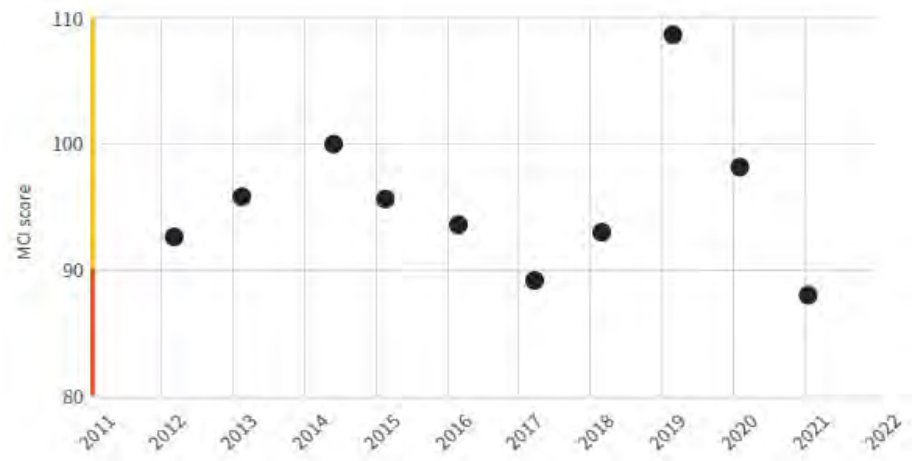

Figure 3-7: MCI scores for Waikari River at Glenbrook Road (LAWA, 2022)

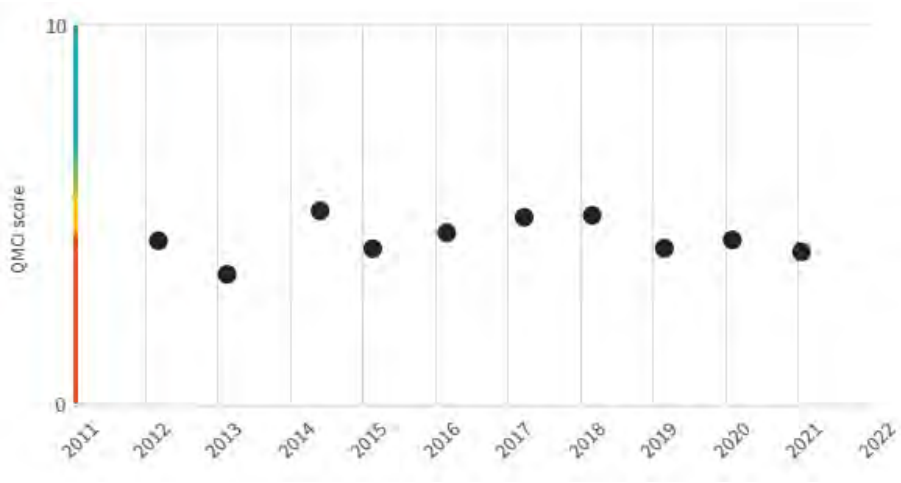

Figure 3-8: QMCI scores for Waikari River at Glenbrook Road

Single kick-net macroinvertebrate samples were collected at two sites (SEV1 and SEV5) during the September 2022 site visit and one site (SEV3) in October 2023. SEV4 was unable to be sampled for health and safety reasons. The macroinvertebrate samples for both SEV1 and SEV5 were analysed using Protocol P1, which uses coded abundance to classify the number of each taxa in the sample (Table 3-8). SEV3 was analysed as full counts (Protocol P2) but converted to coded abundance for comparison. The samples were analysed to produce MCI and SQMCI scores, which are complementary and allow a good overview of the water quality at a site. Results are provided in Table 3-8 and Table 3-9, while site locations are shown on the ecology maps in Appendix B.

The results show that macroinvertebrate communities in the tributaries are less diverse than at the long-term monitoring site on the Waikari River. This corresponds to less diversity of habitat in the smaller streams. Site SEV1 in the north downstream of SH2 had only eight taxa, but that included four sensitive EPT taxa (50%), SEV3 had the highest diversity with 20 taxa including 6 EPT taxa (30%), while site SEV5 had 13 taxa in total with two EPT taxa (15%).

All sites contained large numbers of *Potamopyrgus* snails, with SEV3 dominated by non-biting orthoclad midges and SEV5 also having abundant Oligochaete worms, ostracod shrimps and *Oxythira* axehead caddisflies, all of which are highly tolerant taxa. SEV3 had a diversity of insect species, including several species of Diptera flies.

The benthic communities at SEV1 were classified as “good” for the MCI metric and “fair” for the SQMCI. SEV3 was classified as “fair” and poor”, while SEV5 had the lower scores for both MCI and SQMCI metrics and was rated as having “poor” quality benthic communities. These sites are impacted by rural land use, with stock able to access the watercourses. SEV1 and SEV3 contains some riparian vegetation that provides shade to the channel while the stream reach surveyed at SEV5 was largely unshaded.

Table 3-8: Macroinvertebrate results for minor watercourses at sites SEV1, SEV3 and SEV5

Family	Taxa	Tolerance score*	SEV1 (C1) Anaura Stream tributary	SEV3 Waikari River trib north	SEV5 (C4) Waikare trib south
ANNELIDA (WORMS)	Oligochaeta	1	-	C	A
	Lumbricidae	5	-	-	R
MOLLUSCA	*Physa*	3	-	-	C
	Potamopyrgus	4	A	A	VA
	Sphaeriidae	3	R	-	R
CRUSTACEA	Ostracoda	3	-	-	A
EPHEMEROPTERA (MAYFLIES)	*Coloburiscus*	9	R	-	-
	Deleatidium	8	C	-	-
	Zephlebia	7	R	C	-
COLEOPTERA (BEETLES)	Dytiscidae	5	-	-	R
	Elmidae	6	-	R	-
TRICHOPTERA (CADDISFLIES)	*Aoteapsyche*	4	-	C	-
	Hydrobiosella	9	-	R	-
	Hydrobiosis	5	R	A	R
	Orthopsyche	9	-	R	-

Family	Taxa	Tolerance score*	SEV1 (C1) Anaura Stream tributary	SEV3 Waikari River trib north	SEV5 (C4) Waikare trib south
	Oxyethira	2	-	-	A
	Polyplectropus	8	-	R	-
	Psilochorema	8	-	-	R
DIPTERA (TRUE FLIES)	*Austrosimulium*	3	-	R	-
	Chironomus	1	-	C	-
	Eriopterini	9	-	R	-
	Lobodiamesa	5	-	R	-
	Maoridiamesa	3	-	C	R
	Molophilus	5	-	R	-
	Muscidae	3	-	R	-
	Orthocladiinae	2	R	A	-
	Polypedilum	3	-	C	R
	Tanytarsini	3		C	
ACARINA (MITES)	Acarina	5	R	-	C
ARACHNIDA (SPIDERS)	Dolomedes	5	-	R	-

*Tolerance scores: Red = tolerant taxa; Yellow = moderately sensitive taxa; Blue = highly sensitive taxa. Coded abundance: R = Rare; C = Common; A = Abundant; VA = Very Abundant; XA = Extremely Abundant

Table 3-9: Macroinvertebrate community metrics for minor watercourses at sites SEV1, SEV3 and SEV5

Metric	Description	SEV1 (C1) Anaura Stream tributary	SEV 3 Waikare River tributary north	SEV5 (C4) Waikare tributary south
No. taxa	Taxonomic richness, number of taxa	8	20	13
No. EPT taxa*	Number of mayfly, stonefly and caddisfly taxa	4	6	2
% EPT taxa*	Percentage of mayfly, stonefly and caddisfly taxa	50	30	15
MCI	Macroinvertebrate Community Index	108 (good)	95 (fair)	77 (poor)
SQMCI	Semi-Quantitative MCI/	4.9 (fair)	3.45 (poor)	3.3 (poor)
Band	Attribute Band NPS-FW 2020	C	D	D
Dominant	Dominant taxa	*Potamopyrgus* snails	*Orthocladiinae* midges, *Potamopyrgus* snail	*Potamopyrgus* snails, Oligochaete worms, Ostracod seed shrimps, *Oxyethira* caddisfly

*Excluding pollution-tolerant *Oxeythira*.

3.2.5 Stream Ecological Value

The Stream Ecology Valuation (SEV) method has been used to determine the ecological value of stream reaches and to calculate the potential loss of biodiversity associated with the new road project[3]. SEV is a method for quantifying the values of streams based on the performance of 14 key ecological functions (Storey, et al., 2011). The functions fall into four broad categories: hydraulic (four functions), biogeochemical (five functions), habitat provision (two functions) and biodiversity (three functions). The method assesses the performance of each function compared to reference or pristine conditions, resulting of a score of between 0 (severely degraded stream) and a theoretical maximum of 1 (pristine conditions).

Four sites were initially selected for assessment for the Project, comprising the four streams proposed to be piped (SEV1, 2, 4, 5 located at culverts C1, C2, C3, C4 as per Table 1-2). Landowner access was refused for site SEV2, meaning that only three SEV assessments could be completed during the September 2022 surveys. Although site SEV2

[3] The SEV methodology was developed by Auckland Regional Council (Rowe, et al., 2006) and later revised (Storey, et al., 2011).

was unable to be assessed, it is similar in nature to the other sites surveyed, so the individual metrics recorded from sites SEV1, 4 & 5 were averaged to obtain an SEV score for this site. Site SEV3 is located downstream of the project on the same river system as SEV2 and was surveyed as a potential offset site.

Results of the SEV assessments at the impact sites are presented in Table 3-10 and indicate that the ecological functions at all sites are significantly impaired. This is especially the case at site SEV4 where the channel is deeply incised and modified by a series of constructed farm ponds. All watercourses are located in farmland and are affected by grazing and a paucity of riparian vegetation.

The information obtained through these SEV assessments has confirmed that the minor watercourses within the project area are substantially modified by the productive pastoral land use. They contain fragments of their former values, have a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. Using the ecological value categories set out in Appendix A the ecological value of the minor water courses is assessed as 'Low' to 'Moderate'.

Table 3-10: Stream Ecological Valuation scores at sites SEV1, SEV3, SEV4, SEV5 and SEV2 (derived from the average scores of impact sites)

Function	SEV1 (C1) Anaura Stream tributary	SEV3 Waikari River trib north	SEV4 (C3) Waikare tributary at farm pond	SEV5 (C4) Waikare tributary south in farmland	SEV2 (C2) Derived average of SEV1, 4 & 5
Natural flow regime	0.55	0.73	0.31	0.61	0.48
Floodplain effectiveness	0.18	0.18	0.04	0.16	0.13
Connectivity for species migrations	1.00	1.00	0.30	1.00	0.77
Natural connection to groundwater	0.81	0.74	0.89	0.84	0.85
Hydraulic Functions	**0.64**	**0.66**	**0.38**	**0.65**	**0.55**
Water temperature control	0.12	0.30	0.60	0.40	0.37
Dissolved oxygen levels maintained	0.68	1.00	0.45	0.75	0.63
Organic matter input	0.00	0.03	0.00	0.00	0.00
Instream particle retention	0.13	0.78	0.00	0.56	0.32
Decontamination of pollutants	0.59	0.23	0.54	0.21	0.45
Biogeochemical Functions	**0.30**	**0.47**	**0.32**	**0.38**	**0.35**
Fish spawning habitat	0.42	0.50	0.05	0.05	0.14
Habitat for aquatic fauna	0.48	0.39	0.51	0.46	0.48
Habitat Provision	**0.45**	**0.45**	**0.28**	**0.26**	**0.31**
Fish fauna intact	0.40	0.40	0.00	0.33	0.40
Invertebrate fauna intact	0.42	0.51	0.3	0.24	0.32
Riparian vegetation intact	0.09	0.10	0.07	0.15	0.10
Biodiversity Provision	**0.30**	**0.34**	**0.12**	**0.24**	**0.22**
Overall SEV score	**0.419**	**0.492**	**0.289**	**0.411**	**0.388**

3.2.6 Wetlands

Wetlands are among the most threatened ecosystems in New Zealand and have been reduced significantly from their former extent. Only 10 percent of the original wetlands of New Zealand now remain (John R. Dymond, 2021). Wetlands are defined in the Resource Management Act (1991) as follows:

> **Wetland** includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions.

The National Policy Statement for Freshwater Management (NPS-FW) 2020 defines wetlands[4] as follows:

> **Natural inland wetland** means a wetland (as defined in the Act) that is not:
>
> (a) in the coastal marine area; or
>
> (b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or restore, an existing or former natural inland wetland; or
>
> (c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or
>
> (d) a geothermal wetland; or
>
> (e) a wetland that:
>
> (i) is within an area of pasture used for grazing; and
> (ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the *National Lit of Exotic Pasture Species* using the *Pasture Exclusion Assessment Methodology* (see clause 1.8)); unless
> (iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply.

The National Environmental Standards for Freshwater (NES-FW) 2020 place very strict rules on development in or near wetlands. If any earthworks are occurring in a wetland, resulting or likely to result in complete or partial drainage, then this would be prohibited under regulation 53 of the NES-FW. Any earthworks outside, but within 100m from a natural wetland resulting or likely to result in complete or partial drainage is a non-complying activity under regulation 52 of the NES-FW. However, there are consenting pathways for the construction and maintenance of specified infrastructure, which apply in this case. This assessment is outlined in further detail in the Assessment of Environmental Effects (AEE) in the resource consent application document.

The proposed project area crosses several first order tributaries and ephemeral streams/flow paths located in the upper extent of sub-catchments. All potential wetlands within 100 metres of the project were identified via aerial photographs and/or site investigations. Detailed information and photographs of each site provided in Appendix E

A total of 22 actual or potential wetlands were identified. Out of these, eight sites were considered to meet the criteria for a natural inland wetland under the NPS-FW and six are anticipated to be impacted by the proposed works. Some potential sites were excluded because they are farm ponds, which meet the criteria of a deliberately constructed wetland. Three sites were excluded based on the improved pasture rules, as defined in the NPS-FM above. These are areas of heavily grazed and pugged pasture, with small numbers of wetland plants and weeds such as buttercup, Edgar's rush, soft rush, native water pepper (*Persicaria decipiens*), and Mercer grass (*Paspalum distichum*).

Under the Resource Management Act, there is an obligation to apply the mitigation hierarchy of avoiding, minimising, and mitigating adverse effects, including on wetlands. Under the NES-FW there is also an obligation avoid the loss of the extent of natural wetlands. A number of design options were assessed at the outset of the Project as part of a Multi-Criteria Analysis (MCA) that was undertaken during the business case phase. This included high level assessments aimed at avoiding sensitive environments, based on information available at the time. Details on the MCA are set out in the AEE.

For the purposes of this project, six wetlands are potentially directly impacted by drainage or discharges from the Project and up to 1,600 m^2 of wetland area may be lost. Five comprise of small areas of damp pasture that have been created through changes in drainage, pugging and/or grazing by stock. Two sites have formed as a result of culvert installation which has created damp ground and wetland plants to grow upstream. Although it is not possible to entirely avoid impacts on all wetlands, there is the potential to minimise drainage and infilling of wetlands during the detailed design

[4] Definition correct as of February 2023 (MfE, 2023).

and phases of the Project. Potential impacts on wetlands could be minimised by using bridges over streams and wetlands, or by increasing the steepness of batter slopes. Recommendations for each wetland is provided in Appendix E.

An estimated total of 11,730 m^2 of new wetland area will be created by the Project, in the form of constructed wetlands for stormwater treatment and attenuation. These will be engineered banded bathymetry wetlands planted with native wetland and riparian plants. This will create over seven times the area of wetland that may be lost. However, the Project will not rely on these areas to offset wetland loss. Instead, it is proposed to restore existing areas of degraded natural inland wetlands located adjacent to the Project area, as described in Section 5.3.

4 Assessment of Effects

4.1 Overview

The proposed Waikare Gorge realignment will create a 3.8 km long section of new State Highway, changing approximately 75,000 m^2 of land from farmland, native vegetation, and exotic vegetation, into a sealed road surface. The project will result in short-term construction impacts as well longer-term operational impacts to terrestrial and aquatic ecology in and around the project area. As the road is still in the design phase, there are opportunities to avoid, minimise and mitigate effects that can be realised. There are also potential opportunities to address impacts during the construction and operation of the road.

Potential impacts during construction include but are not limited to:

- Loss and disturbance of native flora, fauna and associated habitat during vegetation clearance.
- Loss of stream and wetland habitat due to culverting, bridging and diversion of watercourses.
- Releases of sediment and contaminants to surface water, soil and/or groundwater.
- Noise, air, and light pollution from construction vehicles.

Potential impacts during operation include but are not limited to:

- Stormwater discharges to the Waikari River and tributaries, affecting water quality and quantity.
- Shading and reduction in moisture levels to vegetation beneath the bridge(s).
- Disturbance to fauna from traffic.
- Vehicle strike.
- Noise, air and light pollution from vehicles and streetlights.
- Increase in edge effects due to habitat fragmentation, particularly along the Waikari River.
- Creation of barriers to fish passage.
- Cumulative impacts on Waikari River from a fourth bridge over the river.

The ecological value, potential magnitude of adverse effect, and overall level of adverse effects of affected areas are discussed in the following sections, together with potential environmental management and mitigation.

4.2 Terrestrial Ecology

4.2.1 Flora

A map of vegetation types impacted by the Project is provided in Appendix C. The Project construction footprint has been conservatively assessed to include the earthworks footprint plus a 10-metre buffer. This allows for movement of construction vehicles, turnaround areas and storage yards, and minor changes during design and construction. It is noted that some construction activities (e.g., access tracks, turnaround areas, equipment storage yard) may need to occur outside of the construction footprint and within the designation. The applied buffer accounts for this, and because most of the site is pasture, no additional loss of native vegetation is anticipated. The vegetation loss calculations are therefore considered to be conservative.

The total area of vegetation loss for the project is 28 hectares (ha), of which 25 ha (90.6%) consists of exotic pasture (Table 4-1). Just under 1 ha of native vegetation is to be cleared, dominated by kanuka (*Kunzea robusta*) shrubland at Waikare Gorge, and scattered kanuka along small tributaries in the north of the alignment. Importantly, this number assumes that all vegetation beneath the Waikare Gorge bridge is lost due to shading and desiccation. Due to the design of the bridge and placement of footings outside of the Gorge, all of this vegetation will remain and at least some is likely to survive. There is also 1.14 ha of mixed native and exotic shrubland, consisting of native shrubs and trees interspersed with exotic weeds. This vegetation type is found along the rail corridor and on roadsides.

Table 4-1 Vegetation types within the construction footprint

Vegetation Type	Vegetation loss - within earthworks footprint		Vegetation loss - earthworks footprint + 10m buffer	
	Area (ha)	%	Area (ha)	%
Native shrubs and trees	0.47	2.57	0.85	3.04
Mixed native/exotic shrubs and trees	0.70	3.83	1.14	4.08
Exotic shrubs and trees	0.43	2.35	0.65	2.32
Pasture, grasses and weed fields	16.71	91.31	25.33	90.59
TOTAL:	**18.30**	**100**	**27.96**	**100**

The Threatened Environment Classification of lowland vegetation in and around the Project area is 'Chronically Threatened' with 10-20% of indigenous cover remaining (Landcare Research, 2022). This is because biodiversity in lowland environments, including in and around Hawkes Bay and Gisborne, has been severely degraded and remaining habitats are sparsely distributed and under-represented in the protected areas network.

Given the Chronically Threated classification, and presence of a Threatened plant species (kanuka), terrestrial vegetation within the Project area is considered to be of High ecological value. The impact of vegetation clearance is considered to be Moderate. Under the EcIA guidelines, this is considered to result in a Moderate adverse effect.

The Project shall ensure that any removal of native vegetation is minimised during design and construction, and mitigated through revegetation and rehabilitation. It is recommended that the design of Waikare Gorge Bridge incorporate a stormwater watering system to minimise potential "rain shadow" effects on native vegetation below the bridge. To mitigate for the impact of vegetation removal, the Project will prepare a Landscape Management Plan and identify areas for revegetation. This shall include a minimum of 5.0 hectares of native revegetation in or around the Project Area, ideally connecting to existing habitat such as Waikare Gorge. This is a ratio of >5 to 1 of revegetation versus native vegetation lost, or 3.5 to 1 if mixed exotic/native vegetation loss is also considered. Planting design shall incorporate native species eco-sourced from the local area, including kanuka. It is appropriate that revegetation planting be integrated with stream and wetland restoration required for the Project to create corridors of habitat.

4.2.2 Avifauna

Avifauna habitat within and surrounding the project area is suitable for common native and introduced birds. The pastoral land use favours open ground exotic passerines and common native birds. In addition to large areas of open pasture, habitat comprises of limited areas of native and exotic trees and scrubs which provide nesting and feeding habitat. There are also small streams and farm ponds which provide suitable habitat for waterfowl. Two Threatened species were identified during the site visit (black shag and falcon) however habitat values for these species are limited and will not be significantly changed as a result of the Project.

Avifauna habitat values within the project area are considered to be Low. The project will result in the loss of some feeding and roosting habitat for common native and exotic birds, and potentially result in the destruction of nests and nestlings in the absence of mitigation. Disturbance to birds will also be caused during construction, along with both disturbance and strike during operation. Overall, the impacts are considered to be Low due to the presence of the existing road and railway line which causes disturbance, and relatively short section of road. The overall level of adverse effect is assessed as Very Low. However, standard construction management should be implemented to avoid vegetation clearance during nesting, particularly during spring. There is the potential to result in a Net Gain for avifauna as a result of habitat restoration to be implemented as part of the Project.

4.2.3 Herpetofauna

There is suitable habitat for geckos and skinks within the project footprint, principally within the kanuka shrubland of Waikare Gorge and tributaries, and areas of weedfield. While the majority of this habitat will remain unaffected by the Project, surveys for lizards will be undertaken in these areas prior to construction. If required, translocation of lizards will be undertaken. Details will be included in the proposed Ecological Management Plan (a condition of consent).

4.2.4 Bats

The Waikari River corridor provides suitable feeding and commuting habitat for long-tailed bats, however there are few large roost trees within the project area. Surveys for bats will be undertaken prior to construction, concentrating on Waikare Gorge, Pohatanui Stream/King's Creek and the exotic trees at the northern extent of the alignment. Lighting design on the Waikare Bridge should account for the presence of bats, such as the use of shields and wavelengths that prevent attracting bats and nocturnal birds such as ruru (*Ninox novaeseelandiae*). It is considered highly unlikely that bat roosts will be found, but should this be the case, roost trees should be checked and then modified (through removal of bark, wrapping or filling of crevices) to ensure no roosting bats are present prior to felling. Details will be included in the Ecological Management Plan (a condition of consent).

4.2.5 Noise and Vibration

Noise and vibration have the potential to cause disturbance to fauna during construction and operation of the Project. The effects of Project construction noise and vibration on the surrounding environment have been assessed by GHD Limited (GHD, 2022). The authors concluded that unmitigated noise and vibration levels are predicted to be compliant at surrounding receivers during typical construction hours, but still recommented implementation of the Best Practicable Option (BPO) mitigation measures referenced within NZS 6803:1999, to minimise construction noise effects upon neighbouring properties.

Regarding operational noise, the authors concluded that: "*On the balance of the assessment of effects presented, the operational noise effects of the Project are considered acceptable without the need for noise mitigation above and beyond that already inherent to the proposed 'Do-minimum' design.*"

In terms of noise effects on the wider environment, the Project traverses several operational farms and is near an existing railway line and SH2. Given the level of activity in the existing environment and limited extent of native vegetation and habitats, it is considered unlikely that existing fauna populations are particularly sensitive to noise. Therefore, no noise mitigation is proposed.

4.2.6 Air and Light Pollution

No standalone assessments have been undertaken to date on the impacts on air and light pollution. During construction, air discharges and light pollution will be caused by construction vehicles, but these impacts will be localized and temporary. During operation, air and light emissions will be generated by vehicles, and light pollution will also be caused by streetlights. As the proposed road is largely straight, will replace a steep and windy road, and no increase in vehicle load is anticipated, air discharges are likely to decrease. Light pollution may adversely impact nocturnal species such as bats, ruru and insects and lead to increased risk of vehicle strike. For this reason, lighting design on Waikare Bridge should employ shields and wavelengths that prevent attracting nocturnal fauna. This been briefly discussed in Section 4.2.4 above. Other sections of the route provide limited habitat for nocturnal fauna, so are less of a concern for strike.

4.2.7 Weed and Pest Invasion

The construction and operation of roads can increase the prevalence and abundance and weeds and animal pests through vehicles being a vector for transport of pests, the creation of new corridors, habitat modification and edge effects.

For this Project, the risk of weed and pest invasion is limited due to the paucity of native habitat and prevalence of existing introduced species. During construction, the Project will incorporate standard environmental controls such as thoroughly cleaning and water-blasting all equipment prior to entry onto the site. Cleared areas shall be stabilized, and where possible, grass seeded or revegetated upon completion to limit available habitat for weeds. Limited native vegetation is to be cleared, and no native forest is affected, so edge effects are unlikely to be a problem. Conventional waste storage and regular removal will minimise rodents and other pests.

During operation, periodic weed control and maintenance will be required along the edge of the road and in restoration plantings. Pest control of species such as possums and rabbits may also be required should browsing be a problem. Details of vegetation maintenance will be provided in the Landscape Management Plan as a condition of consent.

4.3 Aquatic Ecology

4.3.1 Stream Loss

A total of six rivers and streams are intersected by the Project (Table 1-1, Table 1-2 and Appendix B). Options to avoid impacts to watercourses were considered during the project business case phase, and in early design. The Waikari River main channel and Pohatanui Stream/King's Creek are proposed to be crossed by bridges, which will avoid the need for stream loss via culverting.

Smaller watercourses that run across the general road alignment cannot be avoided and will require culverting, as bridges are not a practicable option for minor watercourses. Culverts with a total length of 364 m are proposed along the alignment, resulting in the piping of four streams for a total length of 339 m.

The width of each watercourse was calculated via measurements taken from aerial imagery, with the average width of the four sites varying between 1.10 and 2.09 metres (Table 4-2). The total area of stream channel that will be impacted amounts to approximately 484 m², which was calculated by multiplying the length of stream at each site that was to be culverted by its average width.

The Anaura Stream tributary (SEV1/C1) is already culverted beneath SH2 and the KiwiRail corridor and this existing culvert will be extended by approximately 44 metres to allow for road widening at the northern end of the Project. The three other sites will require the construction of new culverts on tributaries of the Waikari River, which consist of modified watercourses in pastoral land use. Sites C2 (SEV2) and C4 (SEV5) are small streams that are grazed and pugged, while C3 (SEV4) has been fenced and dug out to create a series of online farm ponds. A perched culvert is present downstream of these ponds which creates a barrier to fish passage.

The ecological value assigned to these watercourses is Moderate, the magnitude of stream habitat degradation due to culvert installation from the Project is Moderate and permanent. The overall level of effect of stream loss in the catchment is assessed as Moderate.

Table 4-2: Predicted lineal stream length to be culverted and total stream area impacted

Code	Chainage	Watercourse	Culvert length (m)	Length of stream impacted (m)	Average stream width (m)	Stream area impacted (m^2)	Comment
C1	C12200	Anaura Stream tributary	64	44	2.09	92	Existing 20 m culvert to be lengthened by an additional 44 m.
C2	C13190	Waikari River tributary (north)	118	150	1.29	193	Stream is highly sinuous
C3	C14200	Waikari River tributary (pond)	94	94	1.10	104	Existing farm pond in this reach
C4	C14700	Waikari River tributary (south)	51	51	1.87	96	Straight stream reach
C5	C15290	King's Creek / Pohatanui Stream tributary	37	N/A	N/A	N/A	Not a stream. Considered under the wetland assessment.
		Total:	**364**	**339**		**484**	

4.3.2 Water Quantity and Quality

During construction there will be negligible impact on stream hydrology / water quantity. There is the potential to impact water quality through the release of sediment and contaminants. This will be addressed through the application of standard erosion and sediment control methods, and dutiful storage and use of hazardous chemicals, including with spill kits present in all machinery on site. This is further discussed in Sections 4.3.3 and 4.3.4 below.

The proposed road will convert approximately 75,000 m^2 of land from farmland into impermeable surface. During operation, this will potentially increase the rate of stormwater runoff to adjacent watercourses (peak flow). This has been addressed through the construction of six detention basins to attenuate flows to at or near pre-design levels. These devices will have throttled discharge pipes to reduce the peak discharge from the new road surface to pre-development discharges to protect downstream receiving environment channels from bank and bed erosion.

The road will receive discharges of sediment, hydrocarbons, heavy metals and other contaminants from vehicles throughout operation. However, the proposed road will largely replace the existing SH2, which has no stormwater treatment, with a new road with stormwater treatment. The smoother alignment with lower grades and less corners is expected to reduce the discharge of contaminants when compared to baseline conditions, through less braking and other strain on vehicles. No increase in traffic volumes and associated discharges are expected, except through population growth.

The stormwater system will treat and attenuate flows from over 90% of the road surface prior to discharge and adopts a "treatment train" approach with devices in series, where space and topography permits (Stantec, 2022). Treatment trains take advantage of the strengths of different treatment processes (filtration, sedimentation, biological uptake, infiltration) to treat a wide range of contaminant characteristics (litter, oils, soluble metals, suspended solids). For this Project, the road corridor stormwater management will include vegetated swales, constructed wetlands, attenuation ponds, and rock riprap to capture and remove suspended sediment and associated contaminants. This includes approximately 2,900 linear metres of treatment swales and six stormwater treatment facilities as part of the design. Sizing of conveyance, treatment elements and overflow systems have been designed to the NZTA P46 Stormwater Specification to meet the water quality storm, 10-year annual return interval (ARI) amenity, 20-year ARI erosion standards and 100-year ARI flood protection performance standards (Stantec, 2022).

The ecological value assigned to these watercourses is Moderate. The magnitude of flow regime changes is potentially High but is substantially mitigated by the drainage design. Consequently, the overall level of effect on streams in the catchment is assessed as Low.

4.3.3 Sedimentation

A primary concern during the construction phase of the Project is the erosion of areas of disturbed soils and transport of sediment to the stream environment. Deposited sediment occurs naturally in the beds of rivers because of terrestrial weathering processes, bank erosion, and in-stream fluvial processes, and is transported longitudinally through the river network (Clapcott, et al., 2011). However, construction activities can result in an accelerated delivery of sediment to the stream and an increased proportion of finer sediment. Excess in-stream sediment is recognised as having adverse effects on stream health, by clogging interstitial spaces used as refugia by benthic invertebrates and fish, altering food resources and by removing sites used for egg laying.

The preliminary stormwater design (Stantec, 2022) recognises that the earthworks associated with the Project may increase the delivery of fine sediment to the stream and, without treatment, could have an adverse effect on stream water quality and ecology. An Erosion and Sediment Control Plan is required as a position of consent.

In summary, the ecological value assigned to minor watercourses in the project area is Moderate, the potential magnitude of adverse effect of sediment delivery from earthworks, without mitigation is Moderate, and the overall level of adverse effect is Moderate. The development and implementation of a comprehensive erosion and sediment control plan is expected to reduce the level of adverse effect to low.

4.3.4 Toxic contaminants

The risk of discharging fuel, cement slurry or other contaminants into streams during construction is managed primarily by ensuring good industry practice site management, as well as ensuring that construction activities occur in the dry, well separated from flowing water, and that fuel is not stored close to a watercourse.

The ecological value of stream reaches in the construction area is assessed as Moderate and the magnitude of adverse effect without mitigation is assessed as Moderate in terms of both water quality and benthic habitat, giving an overall level of effect from discharge of contaminants (other than sediment) of Moderate. However, these effects can be effectively avoided by construction methodology requirements that most construction activity will occur in the dry.

The development and implementation of an effective construction methodology will reduce the overall level of effect to low.

4.3.5 Barriers to fish passage

Clause 42(1) of the Freshwater Fisheries Regulations 1983 states that:

> "*no person shall construct any culvert or ford in any natural river, stream, or water in such a way that the passage of fish would be impeded, without the written approval of the Director-General incorporating such conditions as the Director General thinks appropriate*."

More recently, Part 3, Subpart 3 of the Resource Management Regulations (National Environmental Standards for Freshwater (NES-F 2020)) addressed the effects on fish passage of the placement, use, alteration, extension or reconstruction of specified structures, including culverts, in, on, over, or under the bed of any river or connected area. Regulation 70(2) of the NES-F sets out the permitted activity conditions for construction of a new culvert, while regulation 71 states that the construction of a culvert is a discretionary activity if it does not comply with any of the conditions in regulation 70(2).

The conditions of 70(2) are that:

a) the culvert must provide for the same passage of fish upstream and downstream as would exist without the culvert, except as required to carry out the works to place, alter, extend, or reconstruct the culvert; and

b) the culvert must be laid parallel to the slope of the bed of the river or connected area; and

c) the mean cross-sectional water velocity in the culvert must be no greater than that in all immediately adjoining river reaches; and

d) the culvert's width where it intersects with the bed of the river or connected area (s) and the width of the bed at that location (w), both measured in metres, must compare as follows:

   (i) where $w \leq 3$, $s \geq 1.3 \times w$:

   (ii) where $w > 3$, $s \geq (1.2 \times w) + 0.6$; and

e) the culvert must be open-bottomed or its invert must be placed so that at least 25% of the culvert's diameter is below the level of the bed; and

f) the bed substrate must be present over the full length of the culvert and stable at the flow rate at or below which the water flows for 80% of the time; and

g) the culvert provides for continuity of geomorphic processes (such as the movement of sediment and debris).

The fish populations of minor watercourses intersecting with the road alignment are limited to longfin and shortfin eels. This is likely due to the very steep topography, including waterfalls, which prevents upstream access of other species from the Waikari River. The design of all new culverts associated with the alignment will ensure that the upstream or downstream passage of eels is not constrained.

Glass eels, both shortfin and longfin, have their peak migration period from the sea into estuaries during August, September, and October, and then continue their upstream migration as juveniles through to the end of March or early April. The Project area is 20km upstream from the sea and the proposed culvert locations are in headwater streams near the top of the catchment, suggesting that juveniles would mostly arrive during January, February and March. On that basis it is recommended that the installation of new culverts should occur outside of that three-month period, if practicable.

The ecological value of the streams is Moderate. The magnitude of adverse effect of the new structures on eels is Low because they will not constrain upstream or downstream passage. The overall level of adverse effect on fish passage is assessed as Low.

4.3.6 Wetlands

Under the current design, the project will result in the loss of approximately 1,600 m² of natural wetland area. Options to avoid impacts to wetlands were considered during the project business case phase, and in early design[5]. These existing wetlands are all modified through the presence of existing culverts, online ponds, pastoral land use and grazing, with little to no native vegetation cover and limited biodiversity value. Potential impacts on wetlands could be minimised by using bridges over streams and wetlands, or by increasing the steepness of batter slopes. These options are to be further investigated during detailed design, along with updated mapping and assessment of the wetland areas affected. It is likely that the initial figure of 1,600 m² of wetland will be reduced once the detailed design has been completed and the exact boundaries of the roading alignment where they interact with areas of wetland have been defined. It is expected, however, that not all wetland loss can be avoided, and that some biodiversity offsetting will be required, as described in Section 5.3.

4.4 Cumulative Effects

Cumulative effects are changes to the environment that are caused by an action in combination with other past, present and future human actions (Roper-Lindsay, S.A., Hooson, Sanders, & Ussher, 2018). For this Project, there are potential cumulative effects from the presence of multiple bridges across Waikare Gorge.

There are three existing bridges that occur over the Waikari River. The Waikari Viaduct on KiwiRail land to the west, the SH2 bridge to the east, and Glenbrook Road further downstream. The SH2 bridge was severely damaged in February 2023 due to flooding caused by Cyclone Gabrielle and has since been demolished, with a temporary bailey bridge erected in its place.

The construction of a fourth bridge over the Waikari River is likely to result in some level of cumulative impacts, in the form of habitat degradation, disturbance, and the potential discharge of sediment during the construction phase. However, these impacts can be mitigated through the use of best-practice construction methodologies and will be minor compared to the massive levels of disturbance to the catchment caused by the aftermath of Cyclone Gabrielle, particularly with regard to sediment discharges into the Waikari River. It is also recommended that the temporary bailey bridge be removed upon completion of project, which will largely address the cumulative impacts of another bridge.

[5] Changes to the definition of 'natural wetlands' brought about by the introduction of the NPS-FM (2020), and a later amendment in December 2022 have created challenges in confirming wetland locations over the course of the Project.

5 Environmental Management

5.1 Summary of Adverse Effects

The level of adverse effects on terrestrial and aquatic ecology arising from the construction and operational phases of the project will range from Low to Moderate after mitigation (Table 5-1).

During the construction phase the level of adverse effects from the predicted loss of indigenous vegetation is assessed as Moderate. The detailed design shall investigate a stormwater irrigation system beneath Waikare Gorge Bridge to retain vegetation in this area, the construction methodology shall minimise vegetation clearance where possible, and a minimum of 5.0 hectares of native revegetation should be conducted. Impacts on avifauna are Low. Further investigations are proposed for herpetofauna and bats.

Barriers to fish passage and loss of stream habitat are assessed as having a moderate level of adverse effect. However, the design and installation of the required culverts will effectively avoid any adverse effects on fish passage.

Stream habitat loss could be largely avoided by using bridge crossings rather than culverts, but multiple bridge crossings are unlikely to be cost effective on this Project. If residual adverse effects cannot be adequately mitigated it is necessary to consider stream restoration and biodiversity offset options (refer Section 5.3).

The project will result in the loss of approximately 1,600 m^2 of natural wetland area. It is anticipated that some of that wetland loss can be avoided during detailed design, but that some biodiversity offsetting will be required (refer Section 5.3.

Table 5-1: Summary of potential ecological effects of the Waikare Gorge Realignment

Potential effect[1]		Feature	Factors considered in determining 'Magnitude of effects'		Factors considered in determining 'Level of effect'		Level of effect	
			Spatial scale of effect	Duration of effect	Magnitude of effect	Ecological value	Before mitigation	After Mitigation
Adverse effects during construction	Loss of indigenous vegetation and habitat	Threatened plants, avifauna, herpetofauna, bat habitat	Low	Persistent	Low	Moderate	Moderate	Low
	Construction noise and vibration	Avifauna, herpetofauna, bats	Large	Moderate	Low	Moderate	Low	Low
	Declines in water quality	Benthic biota and fish	Large	Short	Moderate	Moderate	Moderate	Low
	Loss of stream habitat	Benthic biota and fish	Medium	Persistent	Moderate	Moderate	Moderate	Moderate
	Loss of wetland habitat	Biodiversity	Medium	Persistent	Moderate	Moderate	Moderate	Moderate
Adverse effects during operation	Weed and pest invasion	Biodiversity, avifauna, herpetofauna, bats	Medium	Persistent	Low	Moderate	Low	Low
	Fauna strike	Avifauna, bats	Medium	Persistent	Low	High	Moderate	Low
	Operational noise and vibration	Avifauna, herpetofauna, bats	Medium	Persistent	Low	Moderate	Low	Low
	Light pollution	Bats, insects	Medium	Persistent	Low	High	Moderate	Low
	Changes to flow regime	Benthic biota and fish	Large	Persistent	Moderate	Moderate	Moderate	Low
	Declines in water quality	Benthic biota and fish	Large	Persistent	Moderate	Moderate	Moderate	Low
	Barriers to fish passage	Longfin/shortfin eel	Medium	Persistent	Moderate	High	Moderate	Low

5.2 Mitigation

Proposed mitigation measures to address potential impacts of the Project are summarised in Table 5-2 below.

The potential loss of stream habitat and natural wetlands may not be able to be avoided or adequately mitigated by the Project. This will need further investigation during the detailed design phase. It is anticipated however that offsets will be required as set out in Section 5.3.

Table 5-2: Summary of effects and proposed mitigation measures

Potential adverse effects	Proposed mitigation measure
Loss of indigenous vegetation	• During detailed design, investigate a stormwater system to water and sustain vegetation beneath Waikare Gorge bridge. • During construction, clearly demarcate and minimise areas of vegetation clearance using flagging tape, fencing or similar. • Conduct a minimum of 5.0 hectares of revegetation, incorporating eco-sourced native species, including kanuka. Details of the planting design and maintenance regime (including weed and/or pest control) to be included in the Landscape Management Plan.
Disturbance and killing of avifauna	• Avoid vegetation clearance during nesting, particularly during spring
Disturbance and killing of lizard population	• Surveys for arboreal geckoes and terrestrial skinks will be undertaken in suitable habitat within the designation boundary prior to construction. If required, translocation of lizards will be undertaken. Details of the survey design and management response will be included in the Ecological Management Plan
Disturbance and killing of bats	• Surveys for bats will be undertaken in potential habitats within the designation boundary prior to construction. Details of the survey design and a framework for a management response will be included in the Ecological Management Plan. • Lighting design on the Waikare Bridge shall use of shields and wavelengths that prevent attracting bats and nocturnal birds.
Degradation in water quality	• Implement an Erosion and Sediment Control Plan (ESCP) for general earthworks, culvert and bridge construction. The ESCP will incorporate the following principles: 1) minimise disturbance, 2) stage construction, 3) protect steep slopes, 4) protect waterbodies, 5) stabilise exposed areas rapidly, 6) install perimeter controls, 7) employ detention devices, 8) make sure the plan evolves, and 9) inspect, assess and adjust. • The bridge and culvert construction methodologies will be focused on isolating the works area from sensitive receiving environments, especially flowing water, thereby avoiding adverse effects. • Implement the proposed stormwater treatment train to attenuate flood flows and treat stormwater discharges.
Barrier to fish migration at new culverts.	• Design to culverts to provide for passage of climbing fish upstream and downstream as would exist without the culvert, except as required to carry out the works to place the culvert, and meet the conditions of Regulation 70(2) of NES-F (2020) • Works involving the disturbance of stream beds, including the placement of new culverts, should avoid the peak eel migration period of January, February, and March.
Loss of natural stream habitat	• During detailed design, investigate opportunities to avoid and minimise stream loss at all locations where culvert installation or extension is proposed. • Habitat loss is unlikely to be completely avoided, further details are provided in Section 5.3.1.
Loss of natural wetland habitat	• During detailed design, investigate opportunities to avoid and minimise wetland loss. • Wetland habitat loss is unlikely to be completely avoided or mitigated, further details are provided in Section 5.3.2.

5.3 Biodiversity offsets

Biodiversity offsets are measures taken to counterbalance any residual adverse impacts after the avoid, remedy, mitigate hierarchy has been implemented. As set out in Tables 5-1 and 5-2, it is expected that the potential loss of natural stream habitat and natural wetland habit cannot be adequately mitigated and will require biodiversity offsets.

5.3.1 Stream Loss

The Project has an obligation to achieve no net loss of ecological value in streams. This includes the requirement to investigate opportunities to avoid, minimise, restore and offset stream loss. During the detailed design phase of the Project, the following options will be further investigated:

- Whether some of the crossings can be bridged, or arched culverts installed.
- Whether some or all of the culverts can be reduced in length to reduce the length of stream loss.
- Whether additional stream length can be created within the designation, through realigning and increasing sinuosity of existing streams.

Where the above cannot be achieved, stream offsets will be required. The SEV score for a stream can be used to calculate the Environmental Compensation Ratio (ECR) for offsetting the adverse effects of piping or modifications of streams. The formula to calculate the ECR for a stream is:

$$ECR = \frac{Predicted\ loss\ of\ function}{Predicted\ gain\ through\ restoration}\ x\ 1.5\ delay\ factor$$

Where a stream to be degraded is similar in most respects to a reach that will be restored then, assuming full restoration is possible over a short period of time, a theoretical ECR close to 1:1 may be warranted. However, where the stream reach to be restored is lower in overall ecological value than the stream reach being degraded, then the ECR needs to be set at a higher level (Storey, et al., 2011). Environmental offsetting should be conducted on streams of the same stream order and streams that are close to the development site.

The SEV method used to calculate the ECR for potential impacts on stream habitat resulting from the Project is described in Appendix D . The SEV methodology has produced the following ECR to account for the loss of habitat to culverts:

$$ECR = \frac{0.819 - 0.000}{0.819 - 0.432}\ x\ 1.5$$
$$= \frac{0.819}{0.387}\ x\ 1.5$$
$$= 3.17$$

The length of stream affected by the project and calculation of biodiversity offsets are summarised in Table 5-3 (with further details in Table 3, Appendix D).

The amount of stream restoration required to offset the loss of ecological value at the impact sites has been calculated as 1,537 m^2 in stream area, which equates to 820 metres in stream length based on the average width of the proposed offset site on a tributary of Pohatanui Stream downstream of SEV4 (SEV4 = 1.87 m wide).

Restoration in this context would entail fencing and planting an area extending at least 15 m on either side of the stream, as well as the addition of in-stream habitat structure where needed. This could consist of large pieces of woody debris. A minimum riparian vegetation width of 15m on either side of the stream would achieve most of the identified aquatic benefits, such as shade, food supply, and habitat.

Table 5-3: Calculation of compensation stream length

Scenario effect	Affected streams		ECR	Offsetting calculations	
	Total length impacted (m)	Total stream area impacted (m^2)		Area of offsetting required (m^2)	Length of stream required at offset site (m)
Habitat loss to culverts	339	484	3.17	1,537	820

5.3.2 Wetland Loss

Under the NPS-FM (2020), the Project has an obligation to achieve no net loss, and preferably a net gain, in the extent and values of wetlands. This includes the requirement to investigate opportunities to avoid, minimise, restore and offset wetland loss.

The Project will result in the loss or modification of approximately 1,600 m^2 of natural wetland area. This is a preliminary figure however and will be reassessed following detailed design of the roading alignment, with the actual area of wetland affected likely to be less than this.

During the detailed design phase of the Project, the following options will be further investigated:

- Whether some potential wetlands can be avoided by altering the design of the Project, for example through the use of steeper batter slopes.
- Where wetlands cannot be avoided, they should be further assessed and described in detail following the National Wetland Delineation Protocols (MfE, 2020).
- Investigate opportunities to restore, enhance and expand areas of natural wetlands within the designation, for example in the tributary north of Pohatanui Stream/King's Creek.

Where the above cannot be achieved, wetland creation/or and enhancement will be required.

5.3.3 Stream and wetland offsetting sites

The requirement to offset the loss in ecological value for the impacted areas of stream and wetland habitat means that alternate sites within the same catchment where similar habitats can be restored have needed to be identified. A number of sites have been considered, both within and external to the designation, and further afield. Waka Kotahi is currently in negotiations to purchase a number of properties through which part of the proposed road alignment will be located. One parcel has been identified that contains areas of stream and wetland habitat that are in need of restoration (Figure 5-1). This property has a number of advantages, being within the Waikare Gorge catchment, adjacent to the project, and potentially owned by Waka Kotahi.

A potential stream offsetting site has been identified an unnamed tributary of Pohatanui Stream, immediately downstream of the Project and below SEV5. The stream is located near the northern boundary of the property and includes a first and second order stream with a similar habitat type to those streams that are being impacted by the project. This reach extends for more than 950 metres, so is more than adequate to accommodate the predicted 820 metres of stream restoration required according to the ECR calculations (Table 5-3). This stream reach also provides substantial scope for restoration given that it is surrounded by pasture and lacks riparian vegetation. It is therefore expected that best-practice restoration actions, such as establishing riparian plantings along both banks, will result in significant improvements to the ecological values of the stream.

The property also supports a number of headwater streams that contain riparian wetlands. Wetlands occur in most of the numerous gillies present on the property (circa eight sites), although some of these have become partially infilled with sediment following landslides during cyclone Gabrielle. Three of these potential wetland restoration sites have been mapped in Figure 5-1, with the final site(s) to be selected once design and land negotiations are further progressed, including considering potential changes to stormwater flows as a result of the Project. The three mapped wetlands range in size from 1,600 m^2 and 2,350 m^2 in area and together cover over 6,000 m^2. All wetlands on the property are located within open farmland, so have similar characteristics to the areas that will be affected by the Project. Restoration of wetlands will involve fencing them off from stock and planting with indigenous wetland species, and where possible, will connect to existing native vegetation and/or stream restoration sites (refer above). Removing barriers to fish passage, if present, will also be investigated. Given the number of wetlands on the property, and that the preliminary mapped sites together contain more than 3.5 times the area of natural wetland that will be impacted by the Project, the restoration will mean that there is no net loss of ecological value overall.

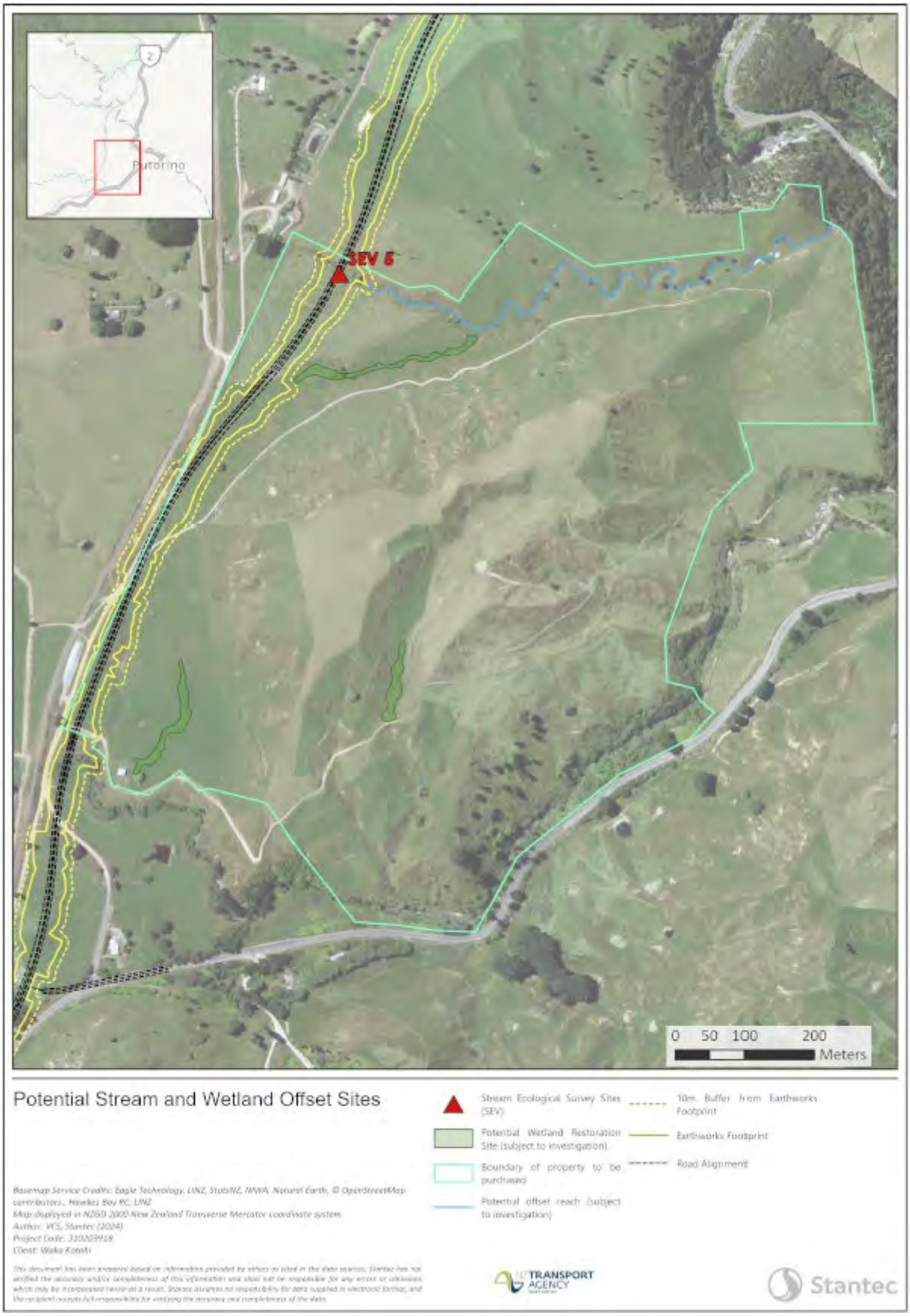

Figure 5-1: Location of stream and wetland habitats within a property to be purchased by Waka Kotahi.

6 NPS-FM requirements

The impacts of the Project on streams and natural inland wetlands, as outlined in Section 4.3, require that these be assessed against the relevant parts of the National Policy Statement for Freshwater Management 2020 (NPS-FM). Sections 3.22 and 3.24 of the NPS-FM, which are concerned with natural inland wetlands and rivers respectively, are included below and assessed against the relevant aspects of the Project.

NPS section	Assessment
Section 3.22 Natural inland wetlands	
(3) Every regional council must make or change its regional plan to ensure that an application referred to in subclause (2) is not granted unless:	
(a) the council is satisfied that:	
(i) the applicant has demonstrated how each step of the effects management hierarchy will be applied to any loss of extent or values of the wetland (including cumulative effects and loss of potential value), particularly (without limitation) in relation to the values of: ecosystem health, indigenous biodiversity, hydrological functioning, Māori freshwater values, and amenity values; and	The loss of wetland extent has been avoided where possible, but the required roading alignment has meant that some impacts on wetlands located along the route are unavoidable. These impacts have been minimised as much as possible, with the residual area of wetlands affected being estimated at 1,600 m² (Section 4.3.6; Appendix E
(ii) if aquatic offsetting or aquatic compensation is applied, the applicant has complied with principles 1 to 6 in Appendix 6 and 7, and has had regard to the remaining principles in Appendix 6 and 7, as appropriate, and	The Principles for aquatic offsetting and Principles for aquatic compensation that are referenced in Appendices 6 & 7 of the NPS-FM are addressed in Sections 5.3.2 & 5.3.3 of this document. The quantum of offsetting required for the loss of wetlands is to be determined following the finalisation of the detailed design plans for the road, during which the exact area of wetlands to be impacted will also be confirmed. The selection of two areas of natural wetland adjacent to the road alignment as potential restoration sites (see Figure 5-1) means that the ecological offsetting will be undertaken within similar wetland habitats as the areas that will be impacted.
(iii) there are methods or measures that will ensure that the offsetting or compensation will be maintained and managed over time to achieve the conservation outcomes; and	A comprehensive Wetland Restoration and Management Plan will be produced to guide the restoration works at the wetland offset sites and ensure that no net loss of wetland ecological value is achieved. It is recommended that this plan is included as a condition of consent, to be produced following the confirmation of final design and the associated reassessment of the wetland areas to be impacted.
(b) any consent granted is subject to:	
(i) conditions that apply the effects management hierarchy; and	These points will be included as conditions of consent, as ongoing monitoring is a standard requirement for

(ii) a condition requiring monitoring of the wetland at a scale commensurate with the risk of the loss of extent or values of the wetland; and	ecological offsetting. Conditions on Ecological Management are proposed (Conditions 10-23). Those that are specific to wetlands are covered under Conditions 21 and 22.
(iii) conditions that specify how the requirements in (a)(iii) will be achieved.	

Section 3.24 Rivers	
(3) Every regional council must make or change its regional plan to ensure that an application referred to in subclause (2) is not granted unless:	
(a) the council is satisfied that:	
(i) the applicant has demonstrated how each step in the effects management hierarchy will be applied to any loss of extent or values of the river (including cumulative effects and loss of potential value), particularly (without limitation) in relation to the values of: ecosystem health, indigenous biodiversity, hydrological functioning, Māori freshwater values, and amenity; and	The impacts of the Project on watercourses have been avoided and minimised as much as possible, with residual impacts related to the installation of culverts addressed in Sections 4.3.1 and 4.3.5. The total stream length impacted across the various sites subject to culverting has been calculated as 484 m².
(ii) if aquatic offsetting or aquatic compensation is applied, the applicant has complied with principles 1 to 6 in Appendix 6 and 7, and has had regard to the remaining principles in Appendix 6 and 7, as appropriate; and	The Principles for aquatic offsetting and Principles for aquatic compensation that are referenced in Appendices 6 & 7 of the NPS-FM are addressed in Sections 5.3.1 & 5.3.3 of this document, as well as Appendix D Using the SEV methodology to quantify the ecological values at the impacted sites and the ECR methodology to calculate the quantum of stream restoration required ensures that there will be no net loss of ecological value due to the Project.
(iii) there are methods or measures that will ensure that the offsetting or compensation will be maintained and managed over time to achieve the conservation outcomes; and	A comprehensive Stream Restoration and Management Plan will be produced to guide the restoration works at the stream offset site. It is recommended that this plan is included as a condition of consent, to be produced following the confirmation of final design and approval of the proposed restoration site.
(b) any consent granted is subject to:	
(i) conditions that apply the effects management hierarchy; and	These points will be included as conditions of consent, as ongoing monitoring is a standard requirement for ecological offsetting. Conditions on Ecological Management are proposed (Conditions 10-23). Those that are specific to riparian vegetation are covered under Conditions 20 and 22.
(ii) conditions that specify how the requirements in (a)(iii) will be achieved.	

7 Conclusion

Waka Kotahi is developing a resource consent application and Notice of Requirement in relation to the realignment of the Waikare Gorge section of State Highway 2 between Napier and Gisborne. The proposed two-lane highway re-alignment is approximately 3.8 kilometres (km) in length and will include a passing lane for 1,050 m.

This assessment has confirmed the Project footprint is dominated by exotic pasture. Native vegetation is limited to the banks of the Waikari River, with sparse kanuka-dominated shrubland on smaller streams and tributaries. The road alignment crosses several wetlands and existing watercourses, the majority of which are unfenced from stock and show stock damage from grazing and pugging. Ecological values are mostly moderate but some threatened and at risk species and habitats are known to occur.

The potential adverse effects of the Project on these receiving environments will be mitigated to the extent possible and the residual impacts on natural wetlands and streams can be fully offset using proposed wetland and stream offsetting methodology described in Section 5.3.3.

The overall assessment is that, provided recommended mitigation and offset measures are fully implemented, the adverse ecological effects of the Project will be low and will result in no net loss of ecological value.

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Appendices

We design with community in mind

Appendix A EcIA Methodology

Section 88 and Schedule 4 of the RMA require the applicant to make an assessment of any actual or potential effect that the proposed activity may have on the environment and the ways in which any adverse effects may be mitigated. Schedule 4 requires that any such assessment shall be in such detail as corresponds with the scale and significance of the actual and potential effects that the activity may have on the environment.

The assessment of effects methodology is broadly consistent with the 'Ecological Impact Assessment Guidelines' described by EIANZ (Roper-Lindsay et al 2018). It includes the following steps:

1. Assign **ecological value** to habitats potentially impacted by the project
2. Determine the **magnitude of ecological effect** (spatial scale or extent, temporal scale, duration, timing, uncertainty) from the proposed activity on the environment
3. Ascertain the **overall level of effect** (value x magnitude), and
4. Determine an **effects management response**

Step 1 in the process comprises assignment of ecological value. Although a wide range of metrics and measures are used in the assessment of freshwaters there is no unifying set of attributes used to assign value. Table 4-1 uses a series commonly used habitat and species values to identify 'Negligible' 'Low', 'Moderate', 'High' or 'Very High' categories.

Assigning value to aquatic species and habitats for assessment purposes (adapted from (Roper-Lindsay, et al, 2018)

Value	Habitat values	Species values
Very high	A reference quality watercourse at or near its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants from human induced activities. Negligible degradation e.g. stream within a native forest catchment.	Benthic invertebrate community: • Has high diversity, species richness and abundance. • Contains many taxa that are sensitive to organic enrichment and settled sediments. • Has MCI scores typically 120 or greater. • Has high EPT richness and proportion of overall benthic invertebrate community. Fish community is diverse and abundant. No pest or invasive fish species (excluding trout & salmon). Stream channel and banks are unmodified. Riparian vegetation with a well-established closed canopy.
High	A watercourse with high ecological or conservation value but is no longer reference quality. It has been modified through loss of riparian vegetation, fish barriers, and/or stock access. Slight to moderate degradation e.g. exotic forest or mixed forest/agriculture catchment.	Benthic invertebrate community: • Has high diversity, species richness and abundance. • Contains many taxa that are sensitive to organic enrichment and settled sediments. • Has MCI scores typically 100 or greater. • Has moderate to high EPT richness and proportion of overall benthic invertebrate community. Fish community is diverse and abundant. No pest or invasive fish species (excluding trout & salmon). Stream channel and banks are largely unmodified. Riparian vegetation is well-established.
Moderate	A watercourse which contains fragments of its former values but has a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. Moderate to high degradation e.g. high-	Benthic invertebrate community: • Has moderate diversity, species richness and abundance. • Has MCI scores typically 80 - 100. • Has low to moderate EPT richness and proportion of overall benthic invertebrate community. Fish community has moderate diversity and may include pest or invasive species.

	intensity agriculture catchment.	Stream channel is modified (e.g., channelised) Stream banks may be modified or managed and/or evidence of significant erosion. Riparian vegetation is fragmented.
Low	A highly modified watercourse with poor diversity and abundance of aquatic fauna and significant water quality issues. Very high degradation e.g. modified urban stream.	Benthic invertebrate community: • Has low diversity, species richness and abundance. • Is dominated by taxa that are not sensitive to organic enrichment and settled sediments. • Has MCI scores less than 80. EPT richness and proportion of overall benthic invertebrate community typically low or zero. Fish communities are low diversity, only 1-2 species, and may include pest or invasive fish species. Stream channel is highly modified (e.g., channelised, lined with artificial surfaces). Stream banks are highly modified or managed and/or evidence of significant erosion. Riparian vegetation is sparse or absent.
Negligible	Not Threatened Nationally, common locally, poor habitat with few species.	Nationally or locally common with a negligible contribution to local ecosystem services.

Step 2 requires an evaluation of the magnitude of effects on local ecological values based on footprint size, intensity and duration. The unmitigated 'Magnitude of Effect' that the activity is expected to have on species found in the Project area. It is evaluated as being either 'Negligible', 'Low', 'Moderate', 'High' or 'Very High', (Table 4-2) and is assessed in terms of:

a) Level of confidence in understanding the expected effect
b) Spatial scale of the effect (small = tens of meters, medium = hundreds of meters, large > 1km)
c) Duration and timescale of the effect (short = days to weeks, moderate weeks to months, persistent = years or more), and
d) Timing of the effect in respect of key ecological factors

Table 7-1: Evaluation of magnitude of effects for assessment purposes ((Roper-Lindsay, et al, 2018)

Magnitude	Determining factors
Very high	Total loss of, or very major alteration to, key elements/features/ of the existing baseline condition, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature.
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature.
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature.
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature.
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature.

Step 3 requires the overall level of effect to be determined using a matrix based on the ecological values and the magnitude of effects on these values. Table 5-3 shows the EIANZ (2018) matrix outlining criteria to describe the overall level of ecological effects. We have used the overall level of ecological effect to determine if effects management is required. Effects assessed as being Moderate, High or Very High in Table 4-3 warrant efforts to avoid, remedy or mitigate.

Table 7-2: Criteria for determining overall levels of ecological effects (Roper-Lindsay, et al, 2018))

Magnitude of effect	Ecological Value				
	Very high	**High**	**Moderate**	**Low**	**Negligible**
Very high	Very High	Very High	High	Moderate	Low
High	Very High	Very High	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very Low	Very low
Negligible	Low	Very Low	Very Low	Very Low	Very low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

Step 4 implementation of the effects management hierarchy to avoid, remedy or mitigate potential impacts. Where the effects can be adequately mitigated consider biodiversity offsetting.

Appendix B Ecology Maps: Aquatic Ecology

Appendix C Ecology Maps: Terrestrial Ecology

Appendix D SEV & ECR Assessment

Introduction

The Stream Ecology Valuation method (SEV) was developed by Auckland Regional Council (Rowe, et al., 2006). The SEV is based on 14 functions that were identified by an expert panel as being the most important, and that could be practically assessed. These functions are listed below in Table 1. These SEV scores can also be used to derive an Ecological Compensation Ratio (ECR). The ECR is used as a multiplier to the area of stream channel that will be impacted and is therefore able to quantify the amount of ecological offsetting that is required to ensure an overall net gain in ecological value.

SEV scores

SEV scores are presented in Table 3-10 (Section 3.2.5) for an unnamed tributary of Anaura Stream (SEV1, C1), and minor tributaries of Waikari River at (SEV2, C3) and (SEV5, C4). The score for SEV2 (C2), which was unable to be directly assessed, was derived from the average scores for each metric from the other three sites. Overall, these reaches are representative of the stream habitats that will be affected by the construction of culverts within the road alignment.

SEV scores for all sites reflect the extent to which ecological functions have been impaired by historical modifications to the stream and surrounding catchment. These modifications are driven largely by a change in land use from indigenous vegetation to production pasture. More specifically, the key factors include the loss of riparian vegetation, stock having access to the watercourses, and a loss of connectivity for fish migrations.

The loss of ecological function is more pronounced in the unnamed tributary at SEV4(C3) than at any of the other sites, but all sites show a marked deficiency in organic matter input, integrity of riparian vegetation and integrity of fish fauna.

Table 1: Function and SEV scores at impact sites (SEV1, 2, 4, & 5) and potential offset site

Ecological function	Impact sites				Offset site
	SEV1(C1)	SEV2(C3)*	SEV4 (C3)	SEV5(C4)	SEV5**
Natural flow regime (NFR)	0.55	0.48	0.31	0.61	0.61
Floodplain effectiveness (FLE)	0.18	0.13	0.04	0.16	0.16
Connectivity for species migrations (CSM)	1.00	0.77	0.30	1.00	1.00
Natural connectivity to groundwater (CGW)	0.81	0.85	0.89	0.84	0.84
Water temperature control (WTC)	0.12	0.37	0.60	0.40	0.40
Dissolved oxygen levels maintained (DOM)	0.68	0.63	0.45	0.75	0.75
Organic matter input (OMI)	0.00	0.00	0.00	0.00	0.00
In-stream particle retention (IPR)	0.13	0.32	0.00	0.56	0.56
Decontamination of pollutants (DOP)	0.59	0.45	0.54	0.21	0.21
Fish spawning habitat (FSH)	0.42	0.14	0.05	0.05	0.05
Habitat for aquatic fauna (HAF)	0.48	0.48	0.51	0.46	0.46
Fish fauna intact (FFI)	0.40	0.40	0.40	0.33	0.33
Invertebrate fauna intact	0.42	0.32	0.30	0.24	0.24
Riparian vegetation intact	0.09	0.10	0.07	0.15	0.15
SEV (mean function score)	**0.419**	**0.388**	**0.289**	**0.411**	**0.411**

*The scores for site SEV2 were derived from average scores for the other impact sites (SEV1, 4 & 5)

**The reach immediately downstream from SEV5 is the preferred offset site, so the SEV score for the impact site is also used as a proxy for the offset site in calculating the ECR (see Table 2)

Environmental Compensation Ratio (ECR) methodology

The SEV method was used to derive environmental compensation ratios based on the functions that will be lost at the impact sites and the potential improvements to be gained at an environmental compensation site (the offset site) following stream restoration works. This provides a scientific basis for determining an environmental compensation ratio scaled to the streams where the development and compensation is intended.

However, the functions lost at the impact site include not only those that are actually degraded as a consequence of the development, but also the potential for improvement in these functions that is forgone by development of the site (Storey, et al., 2011).

The formula below is used to calculate the ECR, which is used as a multiplier for the area of stream impacted. This calculation is then used to determine the area of stream that will need to be restored at the proposed offset site to result in no net loss of ecological value due to the works.

$$ECR = [(SEVi\text{-}P - SEVi\text{-}I)/(SEVm\text{-}P - SEVm\text{-}C)] \times 1.5$$

The values used in this calculation are defined as follows:

- SEVi-P is the potential SEV value for the site to be impacted, if best-practice stream restoration were theoretically undertaken. This score has been standardised across all impact sites, given their proximity to each other and the similar nature of the watercourses in each.
- SEVi-I is the predicted post-impact SEV value of the stream reach. This value defaults to zero, as culverting the impact stream reaches will eliminate the existing ecological value. Note that this is the standard approach to ECR calculations employed by Auckland Council, which is where the SEV methodology originated and where it has been employed the most.
- SEVm-C & SEVm-P are the current and potential SEV values, respectively, for the site where environmental compensation is to be applied.

The predicted SEV scores (SEVi-P, SEVm-P) are calculated using professional judgement and are based on the anticipated ecological benefits of undertaking best-practice stream restoration actions, such as riparian planting. In this case the metrics for SEVi-P and SEVm-P are the same, due to SEV5 acting as both an impact site and a proxy for the offset reach that is located immediately downstream of it.

When calculating the ECR the two metrics 'Fish Fauna Intact' and 'Invertebrate Fauna Intact' are excluded, as the response of biological communities to both impacts and restoration efforts can be highly variable and difficult to predict accurately. This means that the SEV scores used for calculating the ECR will differ slightly from those that were generated using the full suite of metrics (see Table 3-10, Section 3.2.5)

A separate ECR was calculated for each of the impact sites, with the same potential SEV score for the impact site (SEVi-P) used for all.

The output of the SEV assessment, and input to the ECR calculation are summarised in Table 2 below.

Table 2: Estimated current and potential SEV scores for the impact and compensation reaches

Ecological Function	Impact Reaches		Compensation Reach*	
	SEVi-P	SEVi-I	SEVm-C	SEVm-P
Natural flow regime	0.62	0.00	0.61	0.62
Floodplain effectiveness	0.6	0.00	0.16	0.6
Connectivity for species migrations	1	0.00	1.00	1
Natural connectivity to groundwater	0.82	0.00	0.84	0.82
Water temperature control	1	0.00	0.40	1
Dissolved oxygen levels maintained	0.75	0.00	0.75	0.75
Organic matter input	1	0.00	0.00	1
In-stream particle retention	0.68	0.00	0.56	0.68
Decontamination of pollutants	0.78	0.00	0.21	0.78
Fish spawning habitat	0.72	0.00	0.05	0.72
Habitat for aquatic fauna	0.86	0.00	0.46	0.86
Riparian vegetation intact	1	0.00	0.15	1
SEV (mean function score)	**0.819**	**0.00**	**0.432**	**0.819**

*SEV5 used as a proxy due to its proximity to the proposed offset reach

Calculation of offset area required:

$$ECR = [(SEVi\text{-}P - SEVi\text{-}I)/(SEVm\text{-}P - SEVm\text{-}C)] \times 1.5$$

The ECR calculation for this project, using the formula above, is:

ECR = [(0.819 - 0.00) / (0.819 – 0.432)] x 1.5 = **3.17**

Table 3: Calculation of total offset area required for each impact site

	Impact sites			
	SEV1	**SEV2**	**SEV4**	**SEV5**
Average width (m)*	2.09	1.29	1.10	1.87
Stream length impacted (m)*	44	150	94	51
Stream area impacted (m^2)*	92	193	104	96
Offset area required (m^2)**	292	612	329	303
Total offset area required (m^2)	**1,537**			

* See Table 4-2, Section 4.3.1

**Stream area impacted x ECR

The amount of stream length required to offset the ecological effects at the impact sites was calculated by dividing the total offset area required, **1,537 m²**, by the average width of the offset stream, **1.87 m**, which comes to a total of **820 m**.

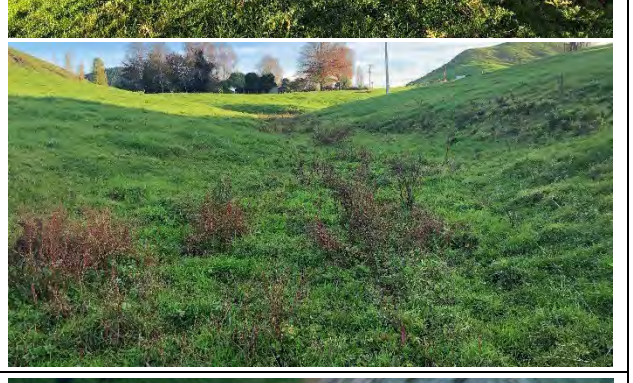
Appendix E Wetland Assessment

Assessment of potential wetlands within 100 metres of the project

#	Description	Likely to be Impacted?	Distance from construction footprint	Is it a natural inland wetland?	Photograph / Image
1	Farm pond and overland flowpath at north end of the alignment. Upstream of the project. Google Earth aerial photographs indicate that the pond was constructed prior to 2010. Located north and outside of the zone of works.	No impact. Upstream of zone of works and approximately 80m away from the existing and proposed SH2.	<100m but >10m	Yes, in part. Farm pond is a deliberately constructed wetland. Downstream area a natural wetland which likely pre-dates the pond. No further assessment as no works to occur in or near the area, and no discharges to it.	
2	Seepage located upstream of railway line and SH2. Natural hillside seepage wetland likely fed from a small spring. Upstream of the project and outside of the zone of works.	No impact. Upstream of zone of works and approximately 40m away from the extent of earthworks.	<100m but >10m	Yes. Seepage wetland. No further assessment as no works to occur in or near the area, and no discharges to it.	
3	Anaura stream tributary upstream of SH2, between railway line and SH2. Small area of wetland vegetation comprising crack willow (*Salix fragilis*) and rautahi (*Carex geminata*).	Yes. New longer pipe to be installed beneath SH2.	Within construction footprint	Yes. Induced wetland formed through stream flows being restricted between the two culverts under the railway line and SH2. Rapid test: Pass (all OBL or FACW). Approximately **50 m^2** of wetland vegetation to be lost. **Wetland loss may or may not be able to avoided or minimised depending upon the culvert design and extent of earthworks.**	
4	Anaura stream tributary with extensive macrophyte growths (water celery). Location of SEV1.	Yes. Earthworks in or adjacent to the stream. Stream will receive stormwater discharges from adjacent stormwater treatment wetland.	Within construction footprint	No. Water celery (*Apium nodiflorum*) is an OBL wetland species however this was growing in the water column as an emergent macrophyte. Site classified as a second order stream rather than wetland habitat.	
5	First order tributary upstream of the railway line.	Yes. New road passes over the watercourse.	Within construction footprint	No. Classified as a first order stream from aerial photography. Stream appears channelised with little or no wetland vegetation present. No site visit undertaken.	

6	Seepage between railway line and kanuka trees. Upstream (northern) end comprises of mixed pasture grasses and native rushes (*Juncus edgariae*). In the location of the bridge over the railway line, the area is shaded by native kanuka. South of the bridge location the area is fed by piped stormwater from the railway alignment and changes to riparian wetland habitat. This area was most likely connected to the first order stream above prior to the construction of the rail line.	Yes. Drainage will be changed and part of the wetland will be removed by bridge construction and infilling.	Within construction footprint	Yes. Induced wetland caused by lack of drainage adjacent to the railway line. Estimated that approximately **750 m^2** of wetland will be permanently lost as a result of construction of the bridge. **Wetland loss can be avoided or minimised by using a longer bridge with piles outside the wetland area.**	 
7	Stream with possible riparian wetlands. Stream is heavily grazed and has a farm bridge over it.	Yes. Area will receive treated stormwater discharges from an adjacent stormwater treatment wetland.	<100m but >10m	No. Classified as a stream from aerial photography. Stream appears channelised with little or no wetland vegetation present. No site visit undertaken.	
8	Isolated areas of riparian wetland on a first order tributary area of minor stream Poor ecological value, formed as a result of grazing and pugging.	Yes. Section of stream to be piped.	Within construction footprint	Yes. Induced wetland formed by bank collapse, grazing and pugging. Potential exclusion under pasture rules not further investigated at this stage. Approximately **100 m^2** of riparian wetland will be lost. **Stream and wetland loss can be avoided by using a bridge, although this is unlikely to be practical in this location.**	
9	Fenced off area of marginal pasture almost entirely creeping buttercup (>90%) with occasional soft rush (*Juncus effuses*), paspalum (*Paspalum dilatatum*), dock (*Rumex obtusifolius*) and creeping bent (*Agrostis stolonifera*).	Yes. Area will be converted into a large stormwater treatment wetland	Within construction footprint	Yes. Under the vegetation assessment criteria, the site fails the rapid test, passes the dominance test, but the prevalence test at 2.5-3.5 requires further soil or hydrology investigation. The site is almost exclusively buttercup, a facultative (FAC) species equally likely in wetlands and non-wetlands. Rapid test: Fail (not all OBW or FACW) Vegetation tool: Dominance test = pass (1 x dominant species, FAC); Prevalence test = not accurate 2.99 It is considered that the natural wetland is only a small portion of the fenced area, estimated at approximately **150 m^2**. **New stormwater treatment wetland to be constructed in this location, so wetland area and habitat will increase. Cannot be avoided unless treatment wetland located elsewhere.**	

10	Series of online farm ponds fenced from stock. Upstream of the project. Located west and outside of the zone of works.	No impact. Upstream of zone of works and ≥100m away from the existing and proposed SH2.	<100m but >10m	No. Deliberately constructed wetland.	
11	Online farm pond fenced from stock.	Yes. Pond will be removed and a culvert will be installed.	Within construction footprint	No. Deliberately constructed wetland.	
12	Online farm pond fenced from stock.	No impact. Upstream of zone of works and >10m away from the existing and proposed SH2.	<100m but >10m	No. Deliberately constructed wetland.	
13	Online farm pond fenced from stock.	No impact. Upstream of zone of works and >50m away from the existing and proposed SH2.	<100m but >10m	No. Deliberately constructed wetland.	
14	Online farm pond and riparian zone fenced from stock.	No impact. Upstream of zone of works and 50-100m away from the existing and proposed SH2.	<100m but >10m	No. Deliberately constructed wetland.	
15	Very small ephemeral stream / overland flow path feeding into permanent stream immediately to the north. Heavily grazed and pugged pasture.	Yes. Area to be earthworked. Permanent stream to be culverted.	Within construction footprint	No. Vegetation is almost entirely pasture grasses. Pasture exclusion applies.	
16	Ephemeral stream / overland flow path feeding into permanent stream to the north. Heavily grazed and pugged pasture. Species comprise: dominants = pasture grass such as ryegrass with creeping buttercup; also creeping bent (*Paspalum distichum*), clustered dock (*Rumex comglomeratus*), soft rush, water pepper, clover, paspalum (*P. dilatatum*)	Yes. Area to be earthworked. Culvert to be installed.	Within construction footprint	No. Although some wetland species are present, vegetation is dominated (>50%) by pasture species. Pasture exclusion applies.	

17	Online farm pond	No impact. Upstream of zone of works and 50m away from the existing and proposed SH2.	<100m but >10m	No. Waterbody constructed by artificial means.	
18	Drain between railway line and road. Includes macrophytes and marginal wetland plants: watercress, raupo, soft rush	Yes. Immediately upstream of zone of works but a new culvert will be installed which may lead to vegetation removal and alter drainage patterns.	<100m but >10m	Yes. Classified as stream with induced riparian wetland vegetation. Rapid test: Pass (all OBW or FACW) Approximately **50 m²** of wetland vegetation to be lost, conservatively estimated to include the entire area. **No viable option to avoid works in this area due to the need for a pipe here. Earthworks in the stream and wetland vegetation should be minimised where possible.**	
19	Intermittent stream channel, grazed and pugged. Includes extensive Mercer grass with soft rush.	Yes. Located within or immediately adjacent to the earthworks footprint.	<100m but >10m	Yes. First order stream with grazed and pugged wetland vegetation. Rapid test: Pass (all OBW or FACW) Approximately **500 m²** of wetland vegetation to be lost, conservatively estimated to include the entire area. **Wetland loss can be minimised by increasing the steepness of batter slopes during detailed design to reduce encroachment into the wetland.**	
20	Farm pond	No impact. Upstream of zone of works and 50-100m away from the existing and proposed SH2.	<100m but >10m	No. Deliberately constructed wetland.	
21	Intermittent stream channel, grazed and pugged. Includes pasture and wetland species including ryegrass, broad-leaf dock, creeping buttercup, white clover, clustered dock, some Mercer grass and water pepper. Becomes wetter with increasing buttercup and water pepper downstream (c.30m from zone of work) near Putarino Station Road.	Yes. Partly within and immediately downstream of zone of works. New culvert will be installed which may alter drainage patterns.	Within construction footprint	No. Although some wetland species are present, vegetation is dominated (>50%) by pasture grasses. Pasture exclusion applies.	 
22	Stream with possible wetland identified from aerial photography.	No impact. Located immediately adjacent to but at the southern end of works. Assumed no earthworks to occur in this area.	<10m	Unknown. No further assessment as no works to occur in or near the area (at very southern end of works).	
			TOTAL:	Approximately **1,600 m²** of wetland loss anticipated. All are induced and/or modified.	

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