

State Highway 16 Stage 2: Brigham Creek to Kumeū

Ecological Impact Assessment

Prepared for Waka Kotahi
Prepared by Beca Limited

18 November 2022



Creative people together transforming our world

Revision History

Revision N°	Prepared By	Description	Date
1	Sandy Huang	Draft for Technical Review	09/02/2022
2	Sandy Huang	Draft Incorporating Client Feedback	09/03/2022
3	Sandy Huang Connor Whiteley	Final Draft	18/11/2022

Document Acceptance

Action	Name	Signed	Date
Prepared by	Sandy Huang Connor Whiteley		18/11/2022
Reviewed by	Claire Webb		18/11/2022
Approved by	Peter Burgess		18/11/2022
on behalf of	Beca Limited		

© Beca 2022 (unless Beca has expressly agreed otherwise with the Client in writing).

This report has been prepared by Beca on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which Beca has not given its prior written consent, is at that person's own risk.

Contents

1	Executive Summary.....	5
2	Introduction.....	6
2.1	Purpose and Scope	6
2.2	Overview of Proposed Activity	6
2.2.1	Incorporated Effects Management.....	7
3	Site Location and Ecological Context	8
4	Methodology	10
4.1	Remote Review	10
4.1.1	Potential Wetland Identification	10
4.1.2	Potential Stream Identification	10
4.2	Field Investigation.....	11
4.2.1	Wetland Delineations.....	11
4.2.2	Watercourse Assessment.....	14
4.3	Data Analysis Process.....	14
4.3.1	Wetland Data Analysis.....	14
4.3.2	Watercourse Data Analysis	16
4.4	Calculation of Vegetation Loss	17
4.4.1	Terrestrial Vegetation.....	17
4.4.2	Riparian Vegetation	17
4.5	Ecological Impact Assessment.....	17
5	Watercourse and Wetland Statutory Classification	18
5.1	Statutory Classification of Watercourses.....	18
5.2	Statutory Classification of Wetlands	19
5.2.1	Wetland 1 (436 SH16)	19
5.2.2	Wetland 2 (522 SH16)	19
6	Ecological Features Description and Values.....	23
6.1	Terrestrial Vegetation	23
6.1.1	General Terrestrial Vegetation.....	23
6.1.2	Terrestrial Vegetation buffering the Wetlands (within 10 m).....	24
6.2	Wetlands.....	24
6.2.1	Wetland 1.....	24
6.2.2	Wetland 2.....	26
6.3	Streams and Rivers	28
6.3.1	Ngongetepara Stream.....	28
6.3.2	Watercourse 1.....	30
6.3.3	Watercourse 2.....	31
6.3.4	Watercourse 3.....	33

6.3.5	Watercourse 4.....	34
6.3.6	Kumeū River	35
6.4	Fauna.....	37
6.4.1	Freshwater Fish	37
6.4.2	Avifauna	38
6.4.3	Herpetofauna	38
6.4.4	Bats	39
7	Assessment of Ecological Effects	40
7.1	Key Ecological Effects	40
7.2	Magnitude of Effects (Unmitigated)	45
7.2.1	Temporary and Permanent Loss of Terrestrial Habitat	45
7.2.2	Loss of Wetland Habitat.....	46
7.2.3	Temporary and Permanent Loss of Riparian Habitat	46
7.2.4	Temporary and Permanent Loss of Fauna Habitat	47
7.2.5	Permanent Alteration of Benthic Habitat.....	49
7.2.6	Permanent Alteration in Hydrological Input	49
7.2.7	Temporary Reduction in Fish Passage.....	51
7.2.8	Temporary Degradation of Aquatic or Wetland Ecosystem from Sediment Runoff	51
7.2.9	Injury or Mortality of Fauna During Construction	53
7.3	Management of Effects.....	54
7.3.1	Fish Management Plan	54
7.3.2	Avoidance of Avifauna Breeding Season	54
7.3.3	Herpetofauna Survey and Relocation.....	55
7.3.4	Bat Roost Tree Risk Assessment.....	55
7.4	Overall level of Effects:	56
8	Conclusion	58
9	References	63
	Limitations.....	65
	Appendix A: Ecological Impact Assessment Guidelines	67
	Assigning Ecological Value.....	67
	Freshwater and Terrestrial Habitat / Community.....	67
	Species	70
	Assigning Magnitude of Impacts	71
	Assessing the Overall Level of Effects	72
	Appendix B: Wetland 2 (522 SH16) – Historic Aerial Imagery.....	74
	Appendix C: Wetland Plot Results and Delineated Extents	80
	Appendix D: Temporary and Permanent Vegetation Loss	88

1 Executive Summary

Waka Kotahi New Zealand Transport Agency (Waka Kotahi) is proposing to undertake safety improvements along a 4.3 km section of State Highway 16 (SH16) for the SH16 Brigham Creek to Waimauku Project – Stage 2 (the Project). This report sets out an assessment of the ecological values along SH16 that may be impacted by the proposed works, to evaluate opportunities and constraints regarding the upgrades and the need for any further management measures.

Potential ecological values identified within the SH16 Project corridor include:

- Terrestrial vegetation that is present within the road reserve / designation and within 10 m setbacks of wetlands.
- Two wetlands.
- Six permanent or intermittent streams.
- Native freshwater fish, avifauna, herpetofauna, and bats.

The potential and actual ecological effects arising from the proposed works are outlined below:

- Loss of terrestrial vegetation (temporary and permanent)
- Loss of wetland habitat (temporary)
- Loss of riparian habitat (temporary and permanent)
- Loss of fauna habitat (temporary and permanent)
- Alteration of benthic habitat (permanent)
- Alteration in hydrological input (permanent)
- Reduction in fish passage (temporary)
- Degradation of aquatic or wetland ecosystem from sediment runoff (temporary)
- Injury or mortality of fauna (during construction)

Management measures have already been integrated into the construction methodology to reduce ecological effects. This includes the requirement for an Erosion and Sediment Control Plan (ESCP), restoration planting, retention of trees where practical, and changing road design and construction to avoid and minimise potential impacts on the wetlands.

With the above management strategies integrated, it is expected that the proposed SH16 upgrades will lead to **Very Low or Low** effects on the terrestrial vegetation, streams, and wetlands.

However, additional management and mitigation measures are recommended to reduce potential injury or mortality to native fauna, particularly for herpetofauna and bats which will also require a survey prior to construction. The recommended measures are as follows:

- Implementation of a Fish Management Plan.
- Avoidance of avifauna breeding season and survey of any trees to detect active nests outside of the breeding season.
- Herpetofauna survey prior to construction, with potentially a further salvage or management plan based on survey results.
- Bat Roost Survey prior to construction to confirm presence of suitable roost trees.

2 Introduction

2.1 Purpose and Scope

Waka Kotahi New Zealand Transport Agency (Waka Kotahi) is proposing to undertake safety improvements along a 4.3 km section of State Highway 16 (SH16) for the SH16 Bringham Creek to Waimauku Project. As part of this, Beca Limited (Beca) has been commissioned to prepare an Ecological Impact Assessment (EclA) to support an application for resource consent and a variation to the designation. The purpose of the EclA is to identify ecological impacts arising from the Project and measures to address these impacts.

The scope of this EclA includes:

- A desk-based review of publicly accessible reports or information.
- Site visits to the locations of proposed works.
- An assessment of the ecological values of the streams, wetland, and terrestrial vegetation.
- An assessment of ecological effects from the proposed works and recommended management options.

2.2 Overview of Proposed Activity

Waka Kotahi is seeking to undertake safety, capacity, walking and cycling improvements to SH16 between Whenuapai and Kumeū. These proposed improvements form Stage 2 of the wider SH16 Bringham Creek to Waimauku Project, which was identified as a section of rural state highway that qualifies for the Safe Roads and Roadsides Programme. The safety improvements involve retrofitting the corridor with short-term safety mechanisms specifically designed to reduce the incidents of deaths and serious injuries.

The SH16 Stage 2 Project corridor extends from the end of the Auckland North-Western Motorway at the intersection of SH16, Bringham Creek Road and Fred Taylor Drive (Whenuapai) through to Weza Lane (east of Kumeū), and is a total distance of approximately 4.3 km. This SH16 corridor is zoned Strategic Transport Corridor within the Auckland Unitary Plan: Operative in Part (AUP:OP) and is also designated by Waka Kotahi. The corridor has been divided into four sections, based on key characteristics, so that appropriate treatments and options could be developed and assessed. The sections include:

- Section A: From Bringham Creek roundabout through to Coatesville-Riverhead Highway intersection.
- Section B: The SH16 / Coatesville-Riverhead Highway intersection.
- Section C: From Coatesville-Riverhead Highway intersection through to Taupaki Road / Old North Road roundabout.
- Section D: From Taupaki Road / Old North Road roundabout through to Weza, east of Kumeū.

The Project comprises the following physical changes to the SH16 corridor:

- Additional traffic lanes between Bringham Creek roundabout and Coatesville-Riverhead Highway
- A new two-lane roundabout at the intersection of Coatesville-Riverhead Highway
- Widened road shoulders
- Flexible median safety barrier between Bringham Creek roundabout and Taupaki Road
- A flush median between Taupaki Road and Kumeū
- A new 3 m wide shared-use path between Bringham Creek and Kumeū on the south side of SH16 including new footbridges over Bringham Creek and Kumeū River
- Retaining walls
- Stormwater network improvements; and
- Landscaping

2.2.1 Incorporated Effects Management

Measures to avoid or minimise ecological effects that have been incorporated into the construction methodology and Project design (relevant to reducing ecological effects) are summarised below:

- Sediment discharge will be appropriately managed through an Erosion and Sediment Control Plan (ESCP) based on Auckland Council's best practice controls (GD05/2016) (Blyth, 2022).
- Discharge into streams and wetlands will be managed by the stormwater design as outlined in Bridge & Fraser, (2022), including the increased treatment of road runoff (especially compared to baseline levels where most of the runoff is not treated) and the use of hydrologic mitigation (retention and detention) on discharge from additional impervious (e.g., retention swales, etc). This will significantly increase the percentage of discharge and runoff into the streams and wetlands that is be treated, compared to baseline levels where most is untreated.
- Vegetation that is removed to allow for construction will be reinstated based on the proposed Landscape and Ecological Planting Plan (LEPP; Beca Ltd, 2022c) to minimise effects on ecological features, such as streams and wetlands, or will be allowed to passively re-establish. The landscape planting focuses on native revegetation, and as such, will provide an overall improvement in native species composition and condition compared with existing vegetation when the reinstated vegetation reaches full establishment within approximately 5 – 10 years.
- Pest plant management will be carried out by the landscape contractor during the Defects Liability Period (i.e., 24 months), and later by Auckland Systems Management.
- It is anticipated that all of the trees located beyond the designation will be retained, with some alterations required in places based on the arborist assessment (Scott-Dye, 2022) and the proposed LEPP (Beca Ltd, 2022c)

Notably, following multiple workshops between the ecology, planning, and engineering teams, the road design and construction methodology has been changed to avoid and minimise potential adverse effects to the wetlands located at 436 and 522 SH16. These changes include:

- No longer occupying the wetland at 436 SH16 during construction.
- Changing the road widening and shared path design from an embankment to a retaining wall to minimise the extent of impact to the wetland at 522 SH16. An option to install a wooden boardwalk at this wetland was also explored but was estimated to produce a higher adverse effect in the long term than the retaining wall due to the impacts of long term maintenance requirements.

3 Site Location and Ecological Context

The Site consists of 4.3 km of road corridor along SH16 which will be subject to safety improvements (hereafter referred to as 'SH16 Site'; see Figure 1). It is located in northwest Auckland from Brigham Creek Road to the east of Kumeū and surrounded by a mixture of rural farmland and residential land.

To the northeast is the Waitematā Harbour inlet, which is part of the Hobsonville Peninsula. It is a significant ecological area (SEA-M2-57b) as it provides important habitat for highly diverse and productive estuarine flora and fauna, including migration pathways for native freshwater fish, and roosting and nesting sites for coastal birds (Auckland Council, 2022).

The Ngongetepara Stream flows south to north through the SH16 Site into Brigham Creek, and eventually discharges into the Waitematā Harbour inlet. The stream has a catchment area of approximately 1200 ha (Auckland Council Geomaps).

The Kumeū River and its tributaries also fall within the SH16 Site. They have an upstream catchment area of approximately 4566 ha and ultimately flow into the Kaipara Harbour (LAWA, 2021). They are associated with overland flow paths that have been extensively modified as a result of SH16 and horticultural land use (orchards). The overland flow paths drain the surrounding orchards and paddocks south of the motorway and many have been channelised, straightened, and diverted to accommodate flows from surrounding areas and the motorway itself.

Prior to human settlement, the SH16 Project corridor is likely to have been covered by puriri dominated broadleaf forest (WF7), kakikatea-pukatea dominated forest (WF8), and Kauri, podocarp, broadleaved forest (WF11) (Singers & Rogers, 2014). However, the area has since been cleared for development and only small strips of regenerating scrubland or mangrove forest remain, mostly lining the edges of streams and estuaries. This is consistent with the wider Rodney Ecological District which has undergone extensive historical vegetation clearance and land modification for farming (McEwen, 1987).

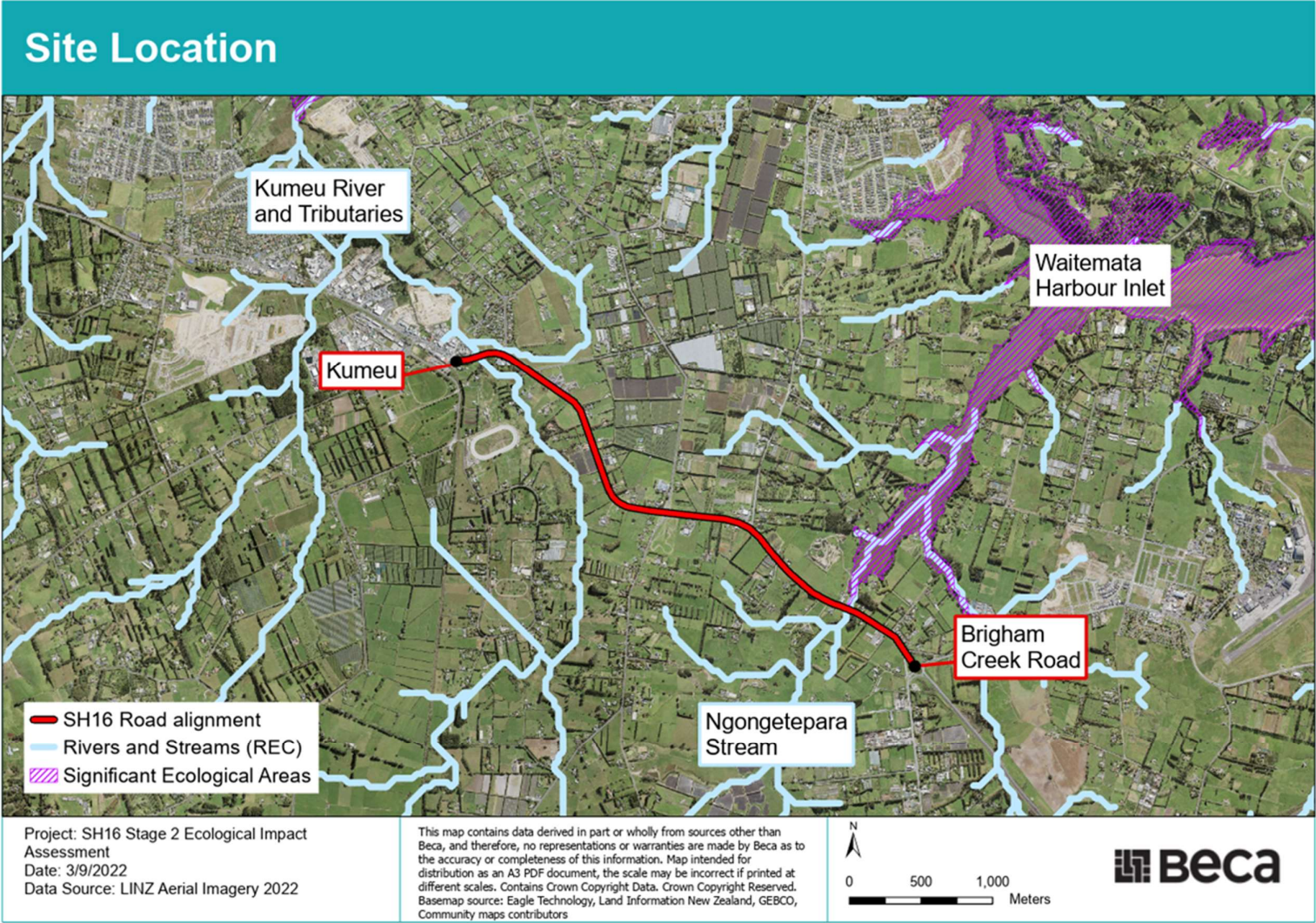


Figure 1. SH16 Site location and its surrounding environment.

4 Methodology

4.1 Remote Review

A remote (desk-based) review was used to identify and assess areas of ecological value that may be impacted by the physical changes to the SH16 corridor. GIS data and ecological information from the following sources were used:

- Auckland Council geospatial layers including potential and current ecosystem extents, significant ecological areas, catchment and hydrology layers, and contours.
- Google Earth and LINZ aerial imagery.
- Retrolens Auckland Council GeoMaps historic aerial imagery from.
- Freshwater Ecosystems of New Zealand (FENZ) geospatial layers of estimated historic and current extent of wetlands in New Zealand (Leathwick et al., 2010).
- New Zealand Freshwater Fish Database (NZFFD, administered by NIWA).
- eBird records for avifauna.
- iNaturalist and Department of Conservation (DOC) records for avifauna, herpetofauna, and bats.
- Other publicly accessible reports or information.

4.1.1 Potential Wetland Identification

Potential 'wetlands' within 100 m of the SH16 Site were screened via ArcGIS Pro 2.9.0 desktop geospatial software. The topography and underlying geology of the SH16 Site was first examined using contours, modelled overland flow paths and S-Map to understand where 'wet' areas might be located.

Once 'wet areas' were identified, they were examined in more detail using recent and historic aerial imagery from Google Earth (2020) and LINZ (2001 – 2017). Aerial photography was visually inspected for wetland features using cues such as colour, shape, texture, and location. Particular attention was also paid to low stature vegetation and sharp changes in vegetation composition. The aerial imagery was also similarly explored for any evidence of inundation (a primary indicator of wetland hydrology), and soil saturation (a secondary indicator of wetland hydrology), as well as a history of site management practices and land use.

This information is used to inform the scope of field investigation needed to confirm wetland characteristics and condition to enable an assessment of ecological values and fulsome description of wetland ecosystem types.

4.1.2 Potential Stream Identification

Potential 'watercourses' within 100 m of the SH16 Site were screened via Auckland Council Geomaps. The Contours, Overland Flow Paths and Rivers and Permanent Streams Layers were first examined.

Once potential 'watercourses' were identified, they were examined in more detail using recent and historic aerial imagery from Google Earth (2020) and LINZ (2001 – 2017). Aerial photography was visually inspected for consistent present of flow pathways, presence of defined channels, visual cue of water presence.

This information is used to inform the scope of field investigation needed to confirm the natural of the potential 'watercourses' characteristics and condition to enable an assessment of ecological values and fulsome description of each watercourse.

4.2 Field Investigation

To supplement the remote review, site walkovers were undertaken on 14th October 2020, 29th June 2021, 9th August 2021, 14th June 2022, and 17th October 2022.

In addition to detailed site walkovers, the project ecologist undertook repeated “drive bys” from June 2021 to the present, with “drive bys” occurring approximately every three weeks, and undertaking high level, vantage point observations of the potential wetland at 522 SH16.

4.2.1 Wetland Delineations

Following the identification of potential wetlands during the Remote Review stage (see Section 4.1.1), field assessments according to the Wetland Delineation Protocol were undertaken to ground-truth potential wetland areas. The field assessment and analysis of the field data are described below. The location of all plots and cores undertaken are provided within Figure 2 and Figure 3.

a. Vegetation Assessment Investigation

The wetland vegetation assessments were undertaken using the New Zealand Wetland Delineation Protocols and Ministry for the Environment Wetland delineation protocols (Clarkson, 2018; MfE, 2020). The vegetation plot data was collected initially on 29th June 2021 and 9th August 2021. Initial vegetation plots were selected at random locations to identify and confirm hydrophytic vegetation.

i. Further Vegetation Assessment Investigation at 522 SH16

Initially, two vegetation plots were surveyed at the site within the wet margins of the feature at 522 SH16. Species composition and percentage cover were recorded. Further detailed vegetation transects were deployed on 14th June 2022 to provide a higher resolution on the dominance and prevalence of wetland adapted vegetation, and to determine the

of exotic pasture species within the potential wetland area. Twenty one vegetation plots were surveyed using a transects to provide a representative sample of vegetation composition (see Figure 3 for locations). Transects focussed on the boundary between wet grassland and clearly upland species.

b. Hydric Soil Investigation – 522 SH16

Soil test pits were cored to ~40 cm depth across three transects going out from the ‘pond’ feature with a core taken at every 10 m and at the fenceline (see Figure 3 for locations). Soil composition / type (sand, clay), and presence of mottles or other features of note were recorded and interpreted in accordance with Fraser et al., (2018a)

Soil test pits were not undertaken at the feature occurring at 436 SH16

c. Hydrological Assessment Investigation

Hydrological investigation was undertaken in line with the Wetland Delineation Hydrology Tool for Aotearoa New Zealand (MfE, 2021b). Evidence of field indicators were recorded along with Project Ecologist observations.



Figure 2. The sample plot locations and indicative wetland extent for 436 SH16.

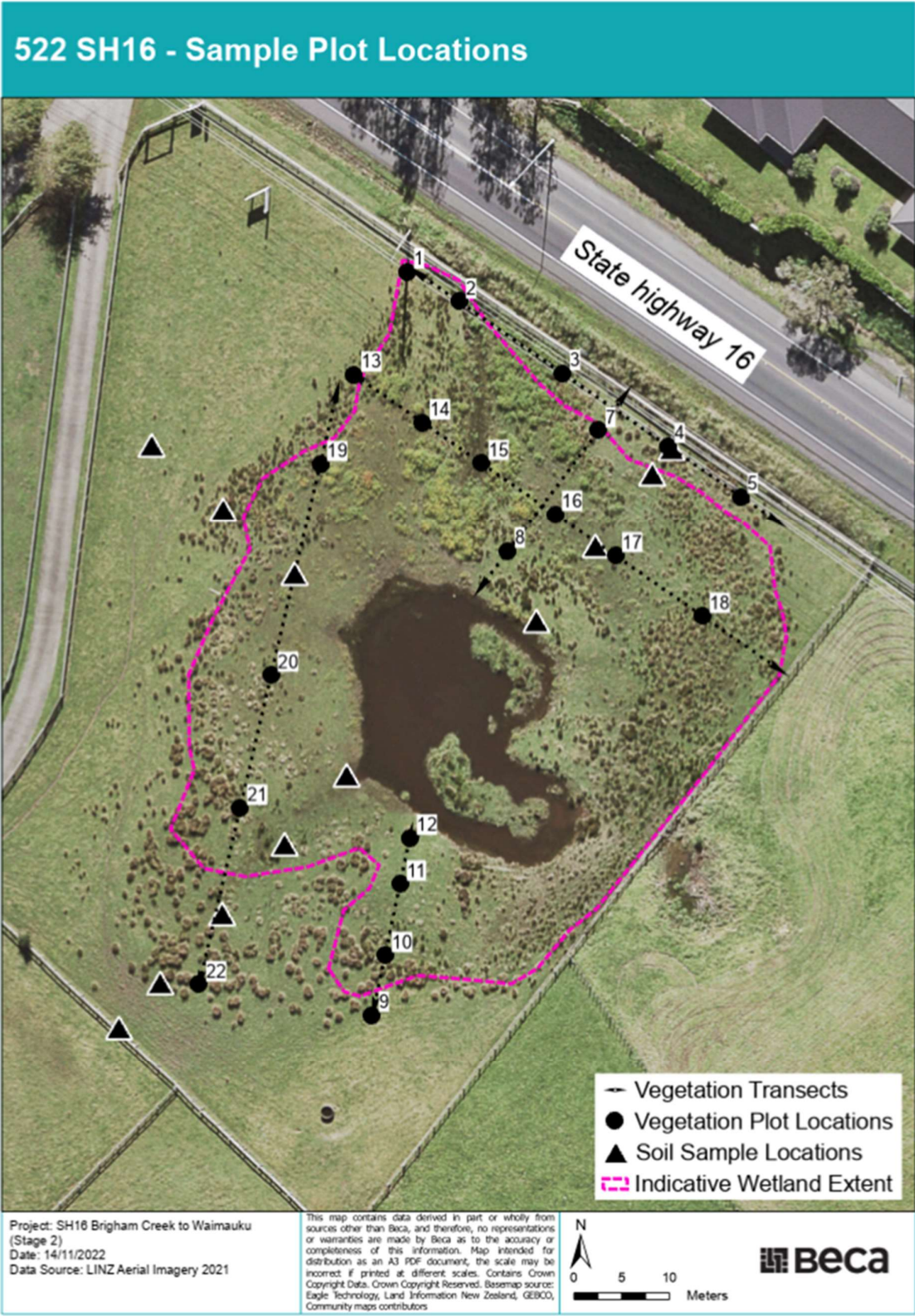


Figure 3. The sample plot and soil core locations and indicative wetland determined at remote review extent for 522 SH16.

4.2.2 Watercourse Assessment

Following the identification of potential watercourses from the Remote Review stage, they were each visited to collate field data using the Ecoline Assessment. No further stream or river methodologies or tools were deployed due to the perceived effect by the project.

a. Ecoline Assessment

A watercourse assessment was completed following methods outlined in the Watercourse Assessment Methodology: Infrastructure and Ecology Document (Version 2.0) (Lowe et al., 2016). Data collected included: channel condition and morphology, bank and channel modification, stream bank erosion, debris jams, streambed substrate composition, channel shade and riparian vegetation.

4.3 Data Analysis Process

4.3.1 Wetland Data Analysis

The wetland analysis was undertaken using the New Zealand Wetland Delineation Protocols and Ministry for the Environment Wetland delineation protocols (Clarkson, 2018; MfE, 2020). When applying the vegetation tests, a dominance test score of 50% and a prevalence index value of 2.9 – 3.1 is considered to be marginal, and the assessment is considered along with other indicators of wetland conditions such as soil and hydrology. Where hydric soils and hydrological indicators were present in proximity to the vegetation plot and there were no notable gradient changes, then the marginal vegetation results are interpreted as a positive for a wetland.

a. Wetland Extent and Boundary Mapping

Where possible, a preliminary feature boundary was determined using predicted (prehuman arrival) wetland extents as modelled by Ausseil et al., (2008) and shown in FENZ geospatial layers (Leathwick et al., 2010). The preliminary feature boundary is then ground-truthed during the site visit using visual clues such as changes in topography, vegetation, soil and hydrological indicators.

The preliminary feature boundary is refined based on contours, vegetation plots (where appropriate), soils and hydrology information gathered during field investigations and represents the spatial extent of wetland ecosystem. The wetland boundary is not an exact surveyed extent as wetlands exhibit a gradation in vegetation, hydrology and soils and the precise location of the boundary occurs within a margin of approximately 10 m depending on topography.

The wetland boundary may be further refined to represent the spatial extent of the wetland ecosystem that meets the National Policy Statement for Fresh Water Management (2020; NPS-FM) definition of a *natural inland wetland* (if any).

b. Wetland Description and Classification

Wetland characteristics, composition, function and condition are described in accordance with relevant ecological literature. Wetland class and type are determined using Johnson & Gerbeaux (2004) and Johnson & Rogers (2003). This provides ecological context regarding significance and value of wetland ecosystems.

c. Wetland status under the RMA and NPS-FM

i. Statutory Definitions

The Resource Management Act 1991 (RMA) defines wetlands as, “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 Environmental Standards for Freshwater (2020; NES-F) sets out controls relating to development of ‘natural wetlands’. ‘Natural wetlands’ are defined in the NES-F (via the National Policy Statement for Fresh Water Management (2020; NPS-FM) as:

“... a wetland (as defined in the Act) that is not:

a) A wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or

b) A geothermal wetland; or

c) Any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain-derived water pooling.”

‘Natural inland wetlands’ are defined under the NPS-FM as a subset of ‘natural wetlands’ that are not in the coastal marine area. This includes both freshwater and inland saline wetlands.

ii. Statutory Interpretation

The Project’s planning team has undertaken an assessment on the definition of ‘natural wetland’ under the NPS-FM. The position is set out in Section 10.3.2 of the Assessment of Effects on the Environment Report (AEE) (Stirling et al., 2022). The planning team has advised us to apply the NPS-FM definition as set out in Clause 3.21 of the NPS-FM. We have therefore focused on that definition, rather than the MfE Guidance on defining a wetland in this ECIA.

iii. Statutory Wetland Assessment

An assessment of the wetland features present in the Project corridor was completed using the definitions set out in the RMA and the NPS-FM and in accordance with the guidance provided in Section 10.3.2 of the AEE provided by the Project Planner. Features that exhibited wetland characteristics as determined by the presence of hydric vegetation, soils and hydrology using the Wetland Delineation Protocols were deemed to meet the RMA wetland definition.

With regards to an assessment against the NPS-FM exclusions, the approach and methodology is described below.

During the desktop review stage, a preliminary assessment against the exclusion criteria was applied to exclude obviously non-wetland and geothermal wetlands, as well as constructed stormwater ponds and swales. This was undertaken by reviewing site information using aerial photography, desktop geospatial biodiversity information and professional judgement to rule out solely terrestrial and geothermal characteristics and stormwater infrastructure. All other wet areas were assessed for wetland characteristics as described in Section 4.3.1.

For sites exhibiting wetland characteristics that meet the RMA definition, historic and current land management practices were investigated by a further review of aerial photography and existing publicly available data (see Section 4.1 for data sources), informal discussion with landowners, Waka Kotahi, and incidental site observations.

This involved a review of historic aerial imagery from Retrolens between 1940 – 2017 to identify, where possible whether a naturally-occurring wetland was present historically and to document any land modifications at the site as related to wetland or overland flow paths.

Exotic pasture species were defined using the Greater Wellington Regional Council Pasture list (Greater Wellington Regional Council, 2020) as well as the draft National Pasture List (Cosgrove et al., 2022) in the absence of an Auckland region-specific pasture species list. In addition to these species, creeping bent (*Agrostis stolonifera*) was included at this site based on the widespread distribution of creeping bent within pasture in the Auckland Region. Creeping bent is commonly associated with grazed pasture and roadside vegetation in Auckland as evidenced in several recent wetland delineation studies by undertaken in the region and described by (Johnson & Brooke, 1998). Creeping bent was historically utilised as a pasture species in several countries (USA and UK) as well as New Zealand but has been set aside more recently in favour of rye / clover pasture mixes (Stewart et al., 2014). It is currently used as a turf species for lawns, golf courses etc but is still commonly present in New Zealand pasture. This approach was agreed with an independent ecology peer reviewer, Dr. Vaughan Keesing (Boffa Miskell) commissioned to review wetland delineations for this project.

Vegetation plots results within each plot, were used to determine the extent to which exotic pasture species dominated the wetland feature. Visual field observations were used to determine the presence of temporary rain derived pooling on the site. Although not required under the NPS-FM definition, the Wetland Hydrology Tool (Van Meewen-Dijkgraaf, 2020) was also used to investigate and identify hydrology at the site.

4.3.2 Watercourse Data Analysis

a. Watercourse Description and Classification

The analysis of the collected data from the ecoline assessment along with the initial Remote Review work enabled the analysis of the natural or artificial element of the watercourses.

Where an Artificial Watercourse is confirmed, its date of origin is attempted to be isolated by the review of further historic aerial imagery or plans that confirm the construction of the Artificial Watercourse.

Where a Natural Watercourse is confirmed, it is subsequently identified as a stream and its characteristics, composition, function, and condition are described in accordance with relevant ecological literature.

b. AUP OP Statutory Stream Classification

A watercourse classification was completed based on definitions from Chapter J of the AUP:OP and the Practice and Guidance note for River/Stream Classification (refer Auckland Council, 2021; Table 1).

Table 1. AUP: OP criteria for permanent, intermittent rivers and streams and ephemeral streams

Criterion	Definition
<i>Permanent river or stream</i>	
1	Evidence of continuous flow
<i>Intermittent river or stream,</i>	
<i>Ceases to flow when bed is above water table. To be intermittent, a river must exhibit at least three of the following</i>	
1	Evidence of natural pools
2	Well defined channel. Banks and bed can be distinguished
3	Surface water present (more than 48hrs after a rain event)
4	Rooted terrestrial vegetation not present across the entire cross-sectional width of channel
5	Organic debris present in floodplain
6	Evidence of substrate sorting processes, including scour and deposition
<i>Ephemeral stream</i>	
1	Stream bed above the water table at all times.
2	Water present only during and shortly after rain fall

4.4 Calculation of Vegetation Loss

The **permanent loss** of riparian, wetland, and terrestrial vegetation was estimated based on the area that will be displaced from the permanent installation of infrastructure (i.e., will be lost beneath the extended carriage following road widening, installation of the shared-use path and / or pedestrian bridge, and stormwater network upgrades).

The **temporary loss** of riparian, wetland, and terrestrial vegetation was estimated based on the construction buffer – an estimated buffer area around infrastructure to enable flexibility for the contractor to undertake activities, such as earthworks, to enable the construction of infrastructure (i.e., carriageway, shared-use path, pedestrian bridge, stormwater network). This construction buffer will vary from area to area dependent on the variations within the landscape. Our assessment takes a conservative approach on the area required for this buffer area, and the effects on each ecological feature. The vegetation removed to enable construction will either be restored with native vegetation as part of landscape planting (see Beca Ltd, 2022c), or be allowed to re-establish passively.

4.4.1 Terrestrial Vegetation

The loss of terrestrial vegetation within the existing road reserve / designation along the SH16 Site in regard to trees, has been determined within the arborist report (Scott-Dye, 2022). While there is an aim to retain trees where practical, on a conservative basis, it has been assumed that all 80 trees within the road designation and rural zone will be permanently lost (see Scott-Dye, 2022).

4.4.2 Riparian Vegetation

The extent of the riparian yards for permanent and intermittent streams were determined according to Chapter E15 – Vegetation Management and Biodiversity of the AUP:OP This included either a 10 m or 20 m riparian setback from the edge of the streams as appropriate for urban and rural zones, respectively.

4.5 Ecological Impact Assessment

The Environment Institute of Australia and New Zealand (EIANZ) guidelines set out a methodology to assign ecological value to species and ecosystems. They are based on four assessment criteria which are consistent with the significance assessment criteria set out in the Proposed National Policy Statement for Indigenous Biodiversity (2019) Appendix 1: Criteria for identifying significant indigenous vegetation and significant habitat of indigenous fauna (see Appendix A: Table A. 1 – Table A. 4). In summary:

- Attributes are considered when considering ecological value or importance. They relate to matters such as representativeness, rarity and distinctiveness, diversity and patterns, and the broader ecological context.
- Determining Factors for valuing terrestrial species; terrestrial species span a continuum of very high to negligible, depending on aspects such as whether species are native or exotic, have threat status, and their abundance and commonality at the site impacted.
- Ecological Values are scored based on an expert judgement, qualitative and quantitative data collected.

Once ecological values have been identified and scored, the severity of potential impacts is assessed by using the criteria set out in Appendix A: Table A. 5. The project design and delivery proposed as part of the works are included in the assessment of magnitude (quantum of change from existing ecological baseline).

An overall level of effects is determined by combining the magnitude of effects and the ecological values of the feature impacted (Appendix A: Table A. 6). Effects management measures recommended in this report are also evaluated to determine whether, once implemented, it will result in a change in magnitude and whether any residual adverse effects require biodiversity offset/compensation.

5 Watercourse and Wetland Statutory Classification

The desk-based assessment identified six potential watercourses and two wetlands that are within 100 m of the SH16 Site and may be impacted by the Project. They were subsequently confirmed and classified on-site. This classification is in accordance with the policy interpretation guidance provided to the ecologists by the Project Planning and Legal team (see Section 4.3.1c and 4.3.2b for further details). The results of the classifications are discussed below (also see Table 2 and Table 3; see Figure 4 for locations).

5.1 Statutory Classification of Watercourses

The physical characteristics of the watercourses were assessed to determine whether they meet definitions for permanent, intermittent and ephemeral watercourses set out in the AUP OP Chapter J1 Definitions.

The results of the classifications for each stream reach are summarised in Table 2.

Table 2. Summary of watercourses identified along SH16 and their classification results based on AUP:OP criteria (Auckland Council, 2021).

Watercourse:	Location:	AUP:OP Criteria Met	Classification
Ngongetepara Stream	Intersects SH16 near Brigham Creek Culvert	Evidence of continuous flow	Permanent river or stream
Watercourse 1*	256 SH16	- Well defined channel. Banks and bed can be distinguished - Surface water present (more than 48hrs after a rain event) - Rooted terrestrial vegetation are not present across the entire cross-sectional width of channel	Intermittent stream
Watercourse 2	1385 Coatesville Riverhead Highway	Evidence of continuous flow	Permanent stream (flowing into an online amenity pond)
Watercourse 3	429 SH16	- Evidence of natural pools - Well defined channel. Banks and bed can be distinguished - Surface water present (more than 48hrs after a rain event) - Rooted terrestrial vegetation not present across the entire cross-sectional width of channel	Intermittent stream
Watercourse 4	436 SH16	Evidence of continuous flow	Permanent river or stream
Kumeū River	Intersects SH16 near 7 Main Road	Evidence of continuous flow	Permanent river or stream

*The proposed work activities are not expected to impact Watercourse 1 (see Section 7.1); however, Watercourse 1 has been included in this EclA for completeness due to the proximity of the works to the watercourse.

5.2 Statutory Classification of Wetlands

Based on the review of the data collected on Wetland 1 (located at 436 SH16) and Wetland 2 (located at 522 SH16), both present a natural ecosystem that contain plants that are adapted to wet conditions. While not assessed, it is expected that animals with adaptations to wet condition are also likely to be present, and therefore both have been assessed as meeting the RMA definition of 'wetland'.

5.2.1 Wetland 1 (436 SH16)

i. Assessment of NPS-FM Natural Wetland Exclusion Clause a) *Constructed by Artificial Means*

Current and historic land modifications and management

A review of historic aerial imagery shows that since from at least 1963 there has been a definite shift in vegetation composition compared to the surrounding pasture. The wetland is noted as following a dendritic pattern i.e., following a flow path and suggests that it is naturally-occurring wetland. Furthermore, the direction of flows is away from SH16, and therefore reduces the risk of impoundment effect associated with SH16. While it cannot be disqualified that SH16 is having an effect on the current functioning of Wetland 1, it does not appear to have been a drive in its formation.

ii. Assessment of NPS-FM Natural Wetland Exclusion Clause c) *Improved Pasture*

Limb 1 – improved pasture dominated by more than 50% exotic pasture species...

Limited information was available on the pasture management practices currently employed at 436 SH16. The site is grazed by stock with cattle noted on the site during the site visit. No other practises have been noted during the site visit or during the drive-by's by the reporting ecologist on their weekly commutes. The dominance of pasture species is informed by species composition and percentage cover collected from the vegetation plots. As described in more detail in Section 6.2.1, given the dominance of soft rush (*Juncus effusus*) and creeping buttercup (*Ranunculus repens*), it is not possible to assess the area as being dominated by pasture species.

Limb 2 – subject to temporary, rain-derived pooling...

Wetland 1 has been noted as occurring within a shallow depression. The soils were noted as wet underfoot with pools of standing water, and appeared to be poorly drained (high soil-moisture content) with a hydrogen sulphide odour, indicating that prolonged periods of saturation within the soils.

5.2.2 Wetland 2 (522 SH16)

i. Assessment of NPS-FM Natural Wetland Exclusion Clause a) *Constructed by Artificial Means*

Current and historic land modifications and management

A review of historic aerial imagery clearly shows that both the pond and the drainage channel (while poorly maintained) have been constructed by humans. The remainder of Wetland 2 has likely formed due to the installation of SH16 altering the local hydrology, and subsequently natural process acting on this modified hydrology, resulting in a wetland forming. A timeline of historic land modification was compiled to describe as far as possible, the formation and persistence of Wetland 2 and is summarised below (also see Appendix B for the imagery):

- **1940:** The site has been cleared of forest vegetation (assumed present pre-human occupation) and has been developed into pasture. SH16 / predecessor is already present through the landscape. No drainage channel is observable. The area occupied by Wetland 2 has a darker colouration than the surrounding pasture which could indicate an area of soil saturation or colonisation by scrub or low stature vegetation rather than shadow associated with low resolution aerial photography. The pattern does not appear to be dendritic i.e., following a flow path, drain or stream, which would suggests that a naturally-occurring

wetland could have been present. Instead, it implies that SH16 may be impounding the natural drainage of the paddock.

- **1950:** The site has remained as pasture and shows the presence of at least one, if not two, drainage channels cutting through the Wetland 2 area. One drainage channel extends under SH16 before confluence with a tributary of the Kumeu River. There is no distinguishing greyscale shift that suggests that there is soil saturation or the presence of vegetation that differs from the surrounding pasture.
- **1963:** The site remains in pasture with the presence of one drainage channel cutting through the Wetland 2 area. The imagery shows a darker colouration that suggests the colonisation of low stature vegetation.
- **1975:** The site remains in pasture and aerial imagery shows there is no distinct greyscale shift i.e., vegetation compared to the surrounding pasture, and there is no evidence of a drainage channel.
- **1996:** The imagery shows a farm pond / sediment pond within the Wetland 2 area, with an area of open water smaller than that present today. Given there is no evidence prior, it was likely this pond was constructed within the centre of Wetland 2.

This review suggests that there have been a series of historic modifications to the site dating back 82 years with the earliest being the installation of a drainage channel(s) circa 1950 – most recently, the excavation of a small pond and associated drainage channel between 1975 – 1996, and ultimately the installation of the driveway for 522 SH16. Furthermore, Waka Kotahi has authorisation to mow the road verge including the outer edge of the wetland feature. It is reasonable to assume that these modifications have altered the natural drainage patterns and possibly groundwater levels within the site that may have resulted in the formation of Wetland 2. Based on Section 4.3.1c, this wetland would not be considered a Natural Wetland under the NPS-FM as it is constructed by artificial means.

ii. Assessment of NPS-FM Natural Wetland Exclusion Clause c) *Improved Pasture*

Limb 1 – improved pasture dominated by more than 50% exotic pasture species...

Limited information was available on the pasture management practices currently employed at 522 SH16. The site is grazed by sheep and mowing occurs in summer months, as evidenced by incidental observations during the driveby's by the reporting ecologist on their weekly commute. These practices form part of a suite of pasture management techniques; however the extent to which these activities meet the interpretation of *improved pasture* is a planning matter and is out of scope for this assessment. It is addressed in the AEE (Section 10.3.2).

The dominance of pasture species is informed by species composition and percentage cover collected from the vegetation plots. As described in more detail in Section 6.2.2, the vegetation pattern across the site is a mosaic with many areas dominated by exotic pasture species (14 out of the 21 vegetation plots) whilst other areas dominated by exotic hydric herbs and rushes. As a result, the entire feature cannot be excluded on the basis of dominance of exotic pasture. However, the final mapped spatial extent of the wetland takes into account, to the best practical extent, areas dominated by exotic pasture species (see Appendix C).

Limb 2 – subject to temporary, rain-derived pooling...

During further site investigation at 522 State Highway 16, surface water was observed within the open water pond and in the surrounding rushland / herffield margins. Surface water within the pond and margins was also observed on several other occasions. The site was also noted to dry up completely during summer 2020/2021 drought in Auckland. This has led to the conclusion that Wetland 2 has permanent wetland hydrology demonstrated by the persistent soil saturation and shallow water table. The extent of soil saturation and the depth of water table (to the extent that it results in surface pooling) varies seasonally with the greatest extent observed during winter and spring and smallest extent in late autumn and summer. This is typical for palustrine swamp wetlands that persist year-round occupying a greater or less spatial extent based on seasonal rainfall.

Sensitivity: General

Table 3. Summary of the results for potential wetlands along SH16, including results from the assessments of hydrology, soil, and vegetation.

Wetland	Location	Hydrology indicators*	Hydric Soil	Vegetation Plot #	Hydric vegetation present in all strata (Rapid Veg. Test)	Is the plot dominated (cover) hydric species (Dom. Test)	Of the species present, how prevalent are hydric species (Preval. Index)	Wetland characteristics	Evidence of modification?	Pasture	NPS Wetland
Wetland 1	436 SH16	<i>Primary:</i> 1A: Surface water, 1C: soil saturation, 3A: hydrogen sulphide odor <i>Secondary</i> 4B: Geomorphic position	Not assessed	1	N	Y	Y - 2.8	Y	N	N	Natural Wetland
Wetland 2**	522 SH16	<i>Primary:</i> 1A: Surface water, 1B: Groundwater, 1C: soil saturation <i>Secondary</i> 3E: Dry-season water table, 3F: Saturation visible on aerial imagery, 4B: Geomorphic position	Present	1	N	<i>marginal - 50%</i>	<i>marginal - 3.1</i>	Y	Y	Y - 62%	Excluded as a Natural Wetland under Exclusion clause (a) interpretation
				2	Y	Y - 100%	Y - 1.8	Y		N - 1%	
				3	N	N - 33%	N - 3.3	N		Y - 73%	
				4	N	N - 33%	N - 3.2	N		Y - 71%	
				5	N	<i>marginal - 50%</i>	Y - 3.5	N		Y - 66%	
				7	N	Y - 100%	<i>marginal - 3.0</i>	Y		Y - 63%	
				8	N	Y - 75%	<i>marginal - 2.9</i>	Y		Y - 77%	
				9	N	N - 0%	N - 3.5	N		Y - 83%	
				10	N	Y - 67%	Y - 2.8	Y		N - 48%	
				11	N	N - 0%	N - 3.4	N		Y - 75%	
				12	Y	Y - 100%	Y - 2.4	Y		N - 44%	
				13	N	<i>marginal - 50%</i>	<i>marginal - 3.1</i>	Y		Y - 69%	
				14	N	Y - 67%	Y - 2.3	Y		Y - 52%	
				15	Y	Y - 100%	Y - 2.1	Y		N - 4%	
				16	N	<i>marginal - 50%</i>	N - 3.3	N		Y - 82%	
				17	Y	Y - 100%	Y - 2.0	Y		N - 11%	
				18	N	<i>marginal - 50%</i>	<i>marginal - 2.9</i>	Y		N - 49%	
				19	N	Y - 67%	Y - 2.7	Y		Y - 59%	
				20	N	N - 67%	Y - 2.5	Y		Y - 57%	
				21	N	<i>marginal - 50%</i>	Y - 2.8	Y		N - 49%	
				22	N	<i>marginal - 50%</i>	<i>marginal - 2.9</i>	Y		Y - 83%	

* The presence of one primary indicator, or two secondary indicators, confirms the presence of a wetland (MfE, 2021b).

** The results of the soil samples, pasture assessment and vegetation tests (i.e., dominance and prevalence tests) are shown in Appendix C.

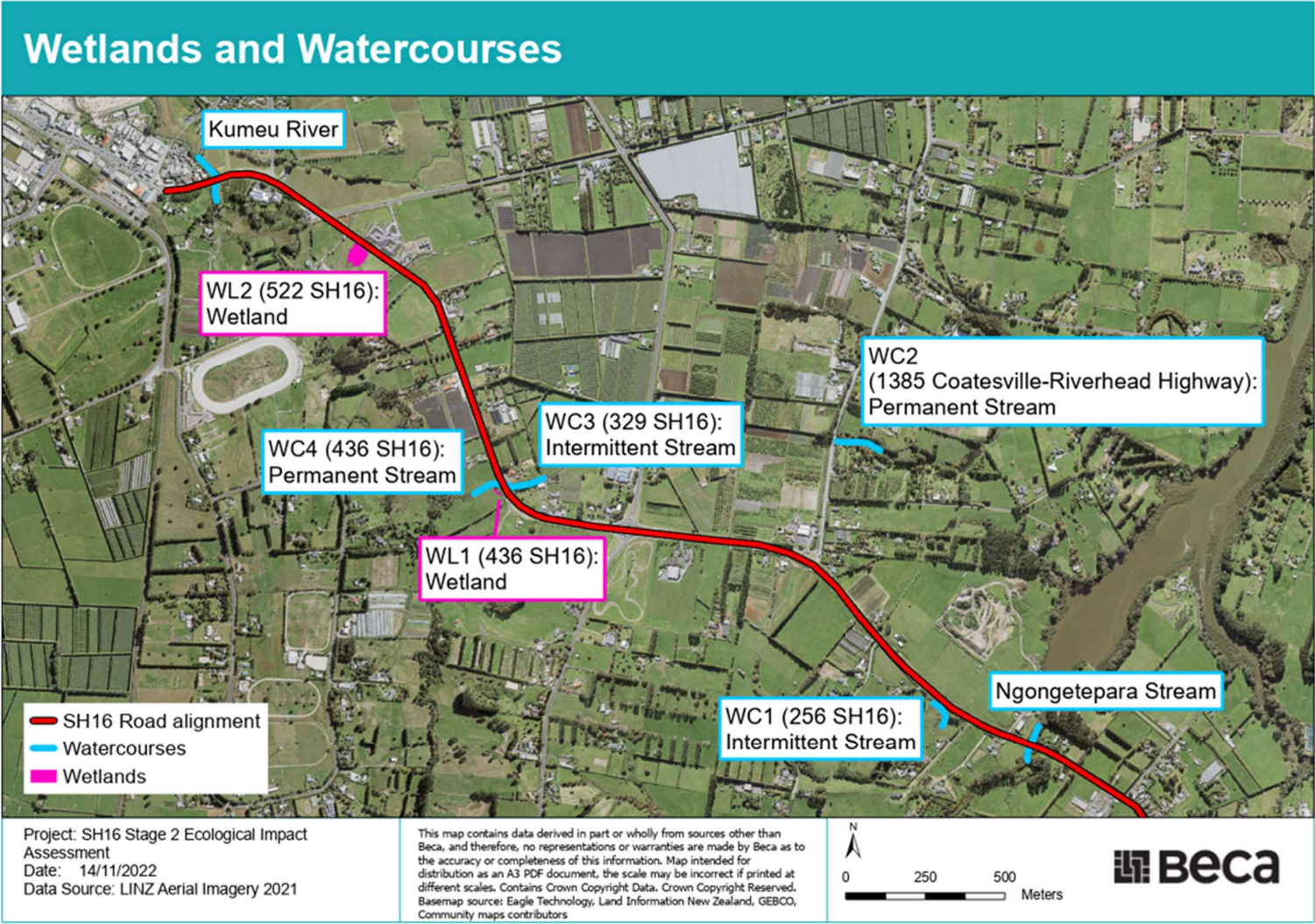


Figure 4. Locations of the confirmed watercourses and wetlands across the SH16 Site.

6 Ecological Features Description and Values

6.1 Terrestrial Vegetation

6.1.1 General Terrestrial Vegetation

Terrestrial vegetation within the road reserve / designation (but outside of specified stream and wetland sites) predominantly consists of rank grass with isolated patches of roadside trees and shrubs, or scattered, individual trees. The roadside trees are disconnected from large forests in the landscape, with stretches of farmland or residential land separating them. Any large, mature trees are mostly exotic species, such as poplars (*Populus* sp.), pin oaks (*Quercus ellipsoidalis*), sweetgum (*Liquidambar styraciflua*), Japanese cedar (*Cryptomeria japonica*), and pine (*Pinus radiata*), which were likely planted to act as shelterbelts (Scott-Dye, 2022).

In general, the trees are a mix of common native and exotic species. Several pests are also present, including tree privet (*Ligustrum lucidum*), Chinese privet (*Ligustrum sinense*), black wattle (*Acacia mearnsii*), monkey apple (*Syzygium smithii*), and willow (*Salix* sp.), phoenix palm (*Phoenix canariensis*), and Chinese fan palm (*Livistona chinensis*) (Scott-Dye, 2022). A single kauri tree (*Agathis australis*) is located at 436 SH16 (Scott-Dye, 2022), and has a conservation status of Threatened: Nationally Vulnerable due to the spread of Kauri dieback. There are also several kanuka (*Kunzea ericoides*) and manuka (*Leptospermum scoparium*), which despite being locally and nationally abundant, are also considered Threatened: Nationally Vulnerable due to the spread of myrtle rust.

The terrestrial vegetation assessed as having **Low** ecological value, based on low ratings for representativeness, rarity / distinctiveness, and diversity and pattern, and a moderate rating for ecological context (see Table 4).

Table 4. Scoring and justification for assigned ecological value to the terrestrial vegetation at the Site.

Matter	Rating	Justification
Representativeness	Low	- Species assemblage is a mix of native, exotic, and pest species, and not typical of natural forest. - Modified, roadside habitat of grass, shrubs, and trees. Therefore, lacking the typical tiers and structures of a native forest.
Rarity / distinctiveness	Moderate	- Low rarity / distinctiveness from modified, roadside habitat. - Native plants present are all regionally and nationally common, except for a single kauri, and several manuka and kanuka, which are Threatened: Nationally Vulnerable. - Native fauna presence – Mostly common native avifauna, Potentially At-Risk herpetofauna or Threatened bats, but in low abundance due to poor habitat quality (see Section 0).
Diversity and pattern	Low	Low diversity and pattern.
Ecological context	Low	- Generally, exists as isolated patches of vegetation, and lacks connectivity to high quality forest in the landscape. However, can provide small areas of 'stepping-stone' habitat, especially for highly mobile fauna, such as birds. - Large, mature trees are generally exotic species, which were planted to act as shelterbelts. - Provision of fauna habitat, although limited and of low quality. - Buffer for stormwater runoff into the streams and wetlands, and reduction of the heat island effect.

6.1.2 Terrestrial Vegetation buffering the Wetlands (within 10 m)

The terrestrial vegetation buffering both Wetland 1 and 2 (i.e., within a 10 m setback) consists mostly of pasture grass from the surrounding farmland. The edge along the road corridor is also mostly lined with rank grass, with isolated patches of small, exotic shrubs and trees.

The vegetation within 10 m of the wetlands is expected to provide limited filtration of surface water and or dust from the road corridor, and little shading for the wetland. Therefore, its ecological value is assessed as **Low**.

6.2 Wetlands

6.2.1 Wetland 1

Wetland 1 is a small, exotic rushland – palustrine seepage wetland located at 436 SH16. It is dominated by soft rush (*Juncus effusus* – *facultative wetland*), creeping buttercup (*Ranunculus repens* – *facultative*) and kikuyu grass (*Cenchrus clandestines* – *facultative upland*), and has a prevalence index of 2.8 (see Figure 5). The wetland is not fenced and shows extensive evidence of grazing and pugging.

It sits within a shallow depression and is approximately 179 m². It is likely being fed by seepage emerging from the surrounding sloped landscape and follows a natural flow pathway running parallel to SH16, towards the tributary of the Kumeū River.

Wetland 1 is assessed as having **Low** ecological value based on a low rating for representativeness, diversity and pattern, and ecological context, and a moderate rating for rarity/distinctiveness (see Table 5).

When considering the potential ecological value as directed by the NPS-FM, it is accepted practise to assess this value after reasonable restoration (fencing and native vegetation planting) The wetland could be restored to provide native habitat and have improved ecological functionality but would still be isolated within a modified, rural land usage landscape, and be exposed to continuous weed invasion. Thus, the potential ecological value that Wetland 1 could achieve would still be **Low**.

Table 5. Scoring and justification for assigned ecological value to Wetland 1.

Matter	Rating	Justification
Representativeness	Low	• Dominated by exotic species • Degraded habitat due to rural land use and stock access.
Rarity/Distinctiveness	Moderate	• Wetland ecosystem which is considered a threatened land environment.
Diversity and Pattern	Low	• Low diversity habitat and pattern
Ecological context	Low	• Buffering functions • Surroundings highly modified for rural and urban land use • Natural wetland hydrology despite modification



Figure 5. The vegetation within Wetland 1 during the site visit on 29th June 2021 .

6.2.2 Wetland 2

Wetland 2 consists of open water with exotic wet grassland and herbfield margins. It is a palustrine swamp wetland located within a paddock at 522 SH16, where it sits in a large, flat drainage basin. It is approximately 2,780 m² in size, with an area of open water in the centre. A pipe appears to drain water from the wetland and is connected to a dug-out channel adjacent to the wetland. The wetland is not fenced to exclude stock, which has resulted in grazed and degraded vegetation. Furthermore, it is understood that the landowner is currently mowing the wetland vegetation within the drier summer months.

The wetland margins consist of grassland / herbfield wetland vegetation types which grade into the surrounding pasture with some overlap of facultative species. Similarly, there are areas within the wetland margins that are slightly higher in elevation or further from the shallow open water that include several facultative and upland grass species. To determine the extent of the wetland characteristics, 21 vegetation plots were surveyed using a transects to provide a representative sample of vegetation composition. Transects focussed on the boundary between wet grassland and clearly upland species.

The vegetation plots analysis show that the wet grassland margins are dominated by creeping bent, birdsfoot trefoil (*Lotus corniculatus*), creeping buttercup, perennial ryegrass (*Lolium perenne*), white clover (*Trifolium repens*), Yorkshire fog (*Holcus lanatus*), *Isolepis reticularis* with patches of jointed rush (*Juncus articulatus*), soft rush, as well as large patches of water pepper (*Persicaria hydropiper*) and marsh bedstraw (*Galium palustre*) closer to the open water / pond section (see Figure 6). The vegetation plots show that of the 21 vegetation plot undertaken, most plots pass the dominance test and have a prevalence index of three or lower indicating the presence of hydric vegetation, although the scores were at the thresholds for these assessments. This means that the vegetation is hydric (wetland) in some areas, grading into marginally hydric at the edges further from the open water pond and channel. Overall, the vegetation composition is more consistent with wetland (hydric vegetation) than not.

However, given the mosaic of wetland grassland / herbfield and upland grassland throughout the wetland, an analysis of soils and hydrology is necessary to fully describe the wetland.

Hydric soils were found to extend from the open water pond to a distance of 20 – 30 m along the transects and were absent at 30 – 40 m from the open water. The soil samples closest to the pond (0 – 10 m) showed strong indications for hydric soils i.e., anoxic low chroma (5 / 2) grading to soils showing pale chroma and mottling occupying 50% of the soil matrix (10 – 30 m) to high chroma colours (dark yellowish brown) with little evidence of mottling etc (30 – 40 m) (Fraser et al., 2018).

An assessment of hydrology showed that the wetland had ponded surface water beyond the open water pond, and revealed saturated soils and groundwater infiltration in the soil core pits during several site visits in winter and spring. Furthermore, the open water pond contains visible surface water throughout the year and has only been observed to be dry during the 2020 / 2021 summer drought.

These indicators demonstrate that the water table is likely to be close to or at the surface, resulting in surface ponding during winter and spring, and causes the open water pond to overflow into the drainage channel flowing towards SH16. During the drier months, the level of surface water within the 'pond' has been observed as fluctuating and the soils have been firm enough to enable a mower to pass over the area. It is therefore reasonable to assume that there is a prolonged period of hydrological saturation with small periods of a likely lower water table in the drier months.

Wetland 2 is assessed as having **Low** ecological value based on a low rating for representativeness, diversity and pattern, and ecological context, and a moderate rating for rarity / distinctiveness (Table 6).

When considering the potential ecological value as directed by the NPS-FM, it is accepted practise to assess this value after reasonable restoration (fencing and native vegetation planting). Although, the wetland could

be restored to improve native habitat provision and ecological functionality, it would still be isolated within a highly modified, rural land usage landscape, and be exposed to continuous weed invasion. With these aspects considered, it is reasonable to assume that the potential ecological value Wetland 2 could achieve would be **Low – Moderate**.

Table 6. Scoring and justification for assigned ecological value to Wetland 2.

Matter	Rating	Justification
Representativeness	Low	• Dominated by exotic vegetation • Degraded habitat due to rural land use and stock access
Rarity/Distinctiveness	Moderate	• Wetland ecosystem which is considered a threatened land environment.
Diversity and Pattern	Low	• Low diversity habitat and pattern
Ecological context	Low	• Buffering functions • Surroundings highly modified for rural land use • Modified wetland hydrology



Figure 6. The vegetation (left) and open water area (right) within Wetland 2 during the site visit on 9th August 2021.

6.3 Streams and Rivers

6.3.1 Ngongetepara Stream

The section of Ngongetepara Stream intersecting SH16, is a permanent stream that flows into the Brigham Creek, and eventually the Waitematā Harbour. It passes underneath SH16 via a large steel arch culvert (see Figure 7). While the flow has been historically modified as a result of the construction of SH16 and the associated Brigham Creek Culvert, it still follows a predominately natural flow pathway.

The channel is approximately 4 m wide with steep incised banks on both sides. Based on NIWA data, the stream will likely have a soft bottom system of predominately mud, with some cobbles, gravels, and boulders present (Whitehead & Booker, 2020). The water flow is relatively homogenous, consisting primarily of slow-moving runs with occasional pools.

Both banks are covered in well-established vegetation, which provides moderate to good shading for the stream. The vegetation consists of native and exotic trees and shrubs, including kanuka, red matipo (*Myrsine australis*), cabbage tree (*Cordyline australis*), *Coprosma* spp., hangehange (*Geniostoma ligustrifolium*), and tree ferns. Several pest species are also present, including privet (*Ligustrum* sp.) and willow. Additionally, there is a large macrocarpa on the northern side of the stream.

The current ecological value of the Ngongetepara Stream is assessed as **Moderate** based on the presence of a predominately natural stream channel, with some modifications (Moderate), well established riparian vegetation (High), and a highly modified catchment consisting of farmland and residential land use (Low).

When considering the potential ecological value as directed by the NPS-FM, it is accepted practise to assess this value after reasonable restoration (fencing and native vegetation planting). Based on this, the stream could have increased indigenous riparian dominance, but would still be adversely affected by a modified, rural usage catchment. Overall, the potential ecological value of Ngongetepara Stream is assessed as **Moderate – High**.



Figure 7. The southern/upstream (top) and northern/downstream (bottom) sides of the Ngongetepara Stream to the culvert.

6.3.2 Watercourse 1

Watercourse 1 is an intermittent stream located at 256 SH16, that drains the surrounding farmland towards a tributary of the Ngongetepara Stream. The upstream end of the stream is located adjacent to a road drain from a separate catchment.

The stream has a narrow, incised channel, with poorly established riparian vegetation covering both banks (see Figure 8). The vegetation predominantly consists of pasture grass and herbaceous species. However, a moderate level of shade would be provided by the lining of large, exotic trees near the roadside, during certain periods of the day.

The existing ecological value of Watercourse 1 is assessed as **Low**, based on poorly established riparian vegetation (Low), and a highly modified, rural catchment (Low).

When considering the potential ecological value as directed by the NPS-FM, it is accepted practise to assess this value after reasonable restoration (fencing and native vegetation planting). Based on this, the stream could have increased native riparian cover and habitat provision for fauna. However, the stream would still be intermittent and adversely affected by a modified catchment for farmland and residential land use (Low). Therefore, the potential ecological value of Watercourse 1 is assessed as **Low**.



Figure 8. Watercourse 1 during the site visit on 20th July 2021.

6.3.3 Watercourse 2

Watercourse 2 is a permanent stream located at 1385 Coatesville Riverhead Highway, and is a tributary of the Huruhuru Stream. It is connected to a pond upstream on property 1368 Coatesville-Riverhead Highway via a culvert under the road corridor. It also flows downstream into two online, amenity ponds, situated on the same property, which were developed around 1986 according to historic aerial imagery.

The stream has a distinct channel that is approximately 0.5 – 1 m wide and deep, with gently sloping banks. The bottom substrate is mostly soft sediment with some pebbles. The stream also consists of slow runs, with still, shallow pools near the culvert. Excessive growth of pond starwort (*Callitriche stagnalis*) can be seen in this section of the stream, likely due to a lack of a shading from riparian vegetation (see Figure 9).

The true right bank of the stream is lined with a band of shrubs and large trees at the stream edge, before transitioning into mowed, lawn grass, while the true left bank is covered in a mix of dense ground cover, and scattered shrubs and trees (see Figure 9). The ground cover is mostly exotic species and herbaceous weed, such as natal lily (*Clivia miniata*), bamboo (Family: Poaceae), yellow archangel (*Lamium galbeobdolon*), Indian shot (*Canna indica*), arum lilies (*Zantedeschia aethiopica*), and tradescantia (*Tradescantia fluminensis*). The shrubs and small trees present are mostly native, such as tree ferns, cabbage trees (*Cordyline australis*), and karo (*Pittosporum crassifolium*), but the large trees are predominately exotic, such as willow, lilly pilly (*Syzygium* sp.), and red horse chestnut (*Aesculus x carnea*). Notably, it is relatively open with few scattered trees near the culvert, and most of the trees only exist further into the property.

The existing ecological value of Watercourse 3 is assessed as **Low**, based on the remnants of a natural channel but with some modification for the culvert and amenity pond (Moderate), well established riparian vegetation but consisting predominately of ground cover, weed species (Low), and a highly modified, rural catchment (Low).

When considering the potential ecological value as directed by the NPS-FM, it is accepted practise to assess this value after reasonable restoration (fencing and native vegetation planting). Based on this, the stream could have increased native, riparian cover, resulting in increased habitat provision for fauna and improved water quality. However, the existing modifications to the stream channel would remain, and the stream would still be adversely affected by a modified, rural usage catchment. Therefore, the potential ecological value of Watercourse 2 would be **Low – Moderate**.



Figure 9. The stream channel and riparian vegetation of Watercourse 2 near the culvert (top images) and further downstream (bottom images) during the site visit on 17th October 2022.

6.3.4 Watercourse 3

Watercourse 3 is a modified, intermittent stream located at 429 SH16, that drains farmland (and orchards) northeast of the highway. Flow is directed into a culvert which runs underneath SH16 and discharges into a tributary of the Kumeū River (i.e., Watercourse 4). Despite being part of this natural tributary, the stream has been modified and possibly straightened to function as a farm drain.

The stream has a wide, shallow channel that is approximately 2 m wide and 30 cm deep (see Figure 10). The banks are gently sloping, with vegetation covering one side and a fence along the other. The vegetation mainly consists of herbaceous plants and grass pasture, with some exotic shrubs or trees present. The stream consists of still pools, with excessive macrophyte growth visible throughout the channel (see Figure 10). This suggests that the stream is likely to be of poor water quality, containing excess inorganic nutrients and receiving little shading from its riparian vegetation.

The existing ecological value of Watercourse 3 is assessed as **Low**, based on its intermittent nature and modified stream channel (Low), poorly established riparian vegetation (Low), significant water quality issues (Low), and a highly modified, rural catchment (Low).

When considering the potential ecological value as directed by the NPS-FM, it is accepted practise to assess this value after reasonable restoration (fencing and native vegetation planting). Based on this, the stream could have increased riparian cover consisting of indigenous species, resulting in increased habitat provision for fauna and improved water quality. However, the existing modifications to the stream channel would remain, and the stream would still be adversely affected by a modified, rural usage catchment. Therefore, the potential ecological value of Watercourse 3 would still be **Low**.



Figure 10. The stream channel of Watercourse 3 during the site visit on 29th June 2021.

6.3.5 Watercourse 4

Watercourse 4 is a permanent stream located at 436 SH16, that flows in a south-westerly direction into the Kumeū River, located approximately 150 m downstream. The stream is connected to the upstream intermittent stream (i.e., Watercourse 3) via a culvert that runs beneath SH16 (see Figure 11).

The stream has a wide, shallow channel that is approximately 1.6 m wide and 30 cm deep (see Figure 11). The banks are densely vegetated with predominantly exotic trees and shrubs, including an abundance of blackberry (*Rubus* sp.) and Chinese privet, both of which are considered weeds in Auckland (Auckland Council, 2020). The blackberry in particular, has formed a thicket that complete covers a portion of the stream (Figure 12). Near the road, the bankside vegetation consists of willows and cabbage trees. The vegetation is expected to provide extensive shading throughout the stream, and add to the inorganic nutrient concentration via leaf litter. Additionally, the stream mostly consists of slow moving and shallow pools, with some riffles closer to the culvert.

The existing ecological value of Watercourse 4 is assessed as **Low** based on the presence of a predominately natural stream bank, with some modifications (Moderate), well established riparian vegetation but consisting predominately of weed species (Low), and a highly modified, rural catchment (Low).

When considering the potential ecological value as directed by the NPS-FM, it is accepted practise to assess this value after reasonable restoration (fencing and native vegetation planting). Based on this, the stream could have increased indigenous riparian dominance and habitat provision for fauna. However, the stream would still be adversely affected by a modified, rural usage catchment. Therefore, the potential ecological value of Watercourse 4 is assessed as **Low – Moderate**.



Figure 11. The culvert connecting Watercourse 4 and 3 (left) and the stream channel (right) of Watercourse 4 (taken during the site visit on 29th June 2021).



Figure 12. The thickets of vegetation covering a portion of Watercourse 4 (taken during the site visit on 29th June 2021).

6.3.6 Kumeū River

The section of Kumeū River intersecting SH16 near 7 main road is a permanent stream, with a catchment dominated by rural pastures and horticultural production. It flows south to north underneath a bridge from SH16, and eventually connects to the Kaipara River which discharges into the Kaipara Harbour. The river predominantly follows a natural overland flow pathway, although flow has been historically modified as a result of SH16.

The channel is approximately 3 m wide with moderately steep, deeply incised banks on both sides. It is densely vegetated along both banks, consisting of mostly exotic shrubs and herbaceous plants, and several mature, poplar trees (see Figure 13). Pest species are also present, including privet, black wattle, and woolly nightshade (*Solanum mauritianum*). This is likely to provide moderate shade for the stream. Based on NIWA data, it is likely have a soft bottom system made of predominately mud, and a small mix of cobbles, gravels and boulders NIWA (Whitehead & Booker, 2020). The water flow is relatively homogenous, consisting primarily of slow-moving pools.

The existing ecological value of the Kumeū River at the Site is assessed as **Moderate** based on the presence of a predominately natural stream channel, with some modifications (Moderate), well established riparian vegetation (High), and a highly modified catchment consisting of farmland, industrial land use, residential land use (Low).

When considering the potential ecological value as directed by the NPS-FM, it is accepted practise to assess this value after reasonable restoration (fencing and native vegetation planting). Based on this, the river could have increased indigenous riparian dominance, but would still be adversely affected by a modified, rural usage catchment. Therefore, the potential ecological value of the Kumeū River is assessed as **Moderate – High**.



Figure 13. The Kumeū River adjacent to the SH16 bridge. Left shows the upstream section viewed from the bridge, and right shows the river viewed from the western bank (taken during the site visit on 14th October 2020).

6.4 Fauna

6.4.1 Freshwater Fish

Both the Ngongetepara Stream and Kumeū River have a high diversity of fish, with four native species recorded between 2007 – 2014 in the Ngongetepara catchment, and eight native species recorded between 1991 and 2015 in the Kumeū River catchment (Table 7). Of the species found, two have a conservation status of At-Risk: Declining, the longfin eel (*Anguilla dieffenbachii*) and inanga (*Galaxias maculatus*). The Kumeū River also provides important spawning habitat for the redfin bully (*Gobiomorphus huttoni*).

According to the NIWA Freshwater Fish Database, there no records of freshwater fish for the localities of Watercourses 1 – 4. However, species from their wider catchments, namely, the Kumeū River or Redhills catchment, have the potential to be present, particularly the longfin and shortfin eels due to their climbing abilities (see Table 7).

Based on the presence of At-Risk species within the Ngongetepara Stream and Kumeū River, and potentially Watercourses 1 – 4, the freshwater fish community for the SH16 Site is assessed as having **High** ecological value.

Table 7. Fish records for the catchments of the Ngongetepara Stream, Kumeū River, and the Redhills from the New Zealand Freshwater Fish Database (Crow, 2017). Conservation status assigned using Dunn et al., (2018)

Catchment	Common Name	Scientific Name	Threat status	Most Recent Record
Ngongetepara Stream and tributaries	Longfin eel	<i>Anguilla dieffenbachii</i>	At-Risk: Declining	2014
	Banded kōkopu	<i>Galaxias fasciatus</i>	Not Threatened	2014
	Freshwater shrimp	<i>Paratya curvirostris</i>	Not Threatened	2007
	Shortfin eel	<i>Anguilla australis</i>	Not Threatened	2016
	Gambusia	<i>Gambusia affinis</i>	Introduced and Naturalised	2007
	Unidentified eel	<i>Anguilla</i> sp.	–	2014
Kumeū River and tributaries	Kōura	<i>Paranephrops</i> sp.	–	2007
	Longfin eel	<i>Anguilla dieffenbachii</i>	At-Risk: Declining	2013
	Inanga	<i>Galaxias maculatus</i>	At-Risk: Declining	2015
	Common bully	<i>Gobiomorphus cotidianus</i>	Not Threatened	2001
	Freshwater shrimp	<i>Paratya curvirostris</i>	Not Threatened	1991
	Shortfin eel	<i>Anguilla australis</i>	Not Threatened	2015
	Banded kōkopu	<i>Galaxias fasciatus</i>	Not Threatened	2014
	Redfin bully	<i>Gobiomorphus huttoni</i>	Not Threatened	2000
	Crans bully	<i>Gobiomorphus basalis</i>	Not Threatened	2001
	Gambusia	<i>Gambusia affinis</i>	Introduced and Naturalised	2015
	Goldfish	<i>Carassius auratus</i>	Introduced and Naturalised	2015
	Koi carp	<i>Cyprinus carpio</i>	Introduced and Naturalised	2013
	Kōura	<i>Paranephrops</i> sp.	–	2014
	Unidentified eel	<i>Anguilla</i> sp.	–	2016
	Unidentified galaxiid	<i>Galaxias</i> sp.	–	2015
Redhills catchment	Longfin eel	<i>Anguilla dieffenbachii</i>	At-Risk: Declining	2016
	Shortfin eel	<i>Anguilla australis</i>	Not Threatened	2014
	Banded kōkopu	<i>Galaxias fasciatus</i>	Not Threatened	1997
	Grass carp	<i>Ctenopharyngodon idella</i>	Introduced and Naturalized	2014
	Gambusia	<i>Gambusia affinis</i>	Introduced and Naturalized	2014
	Unidentified eel	<i>Anguilla</i> sp.	–	2007

6.4.2 Avifauna

Although the Buller's shearwater (*Ardenna bulleri*) and Caspian tern (*Hydroprogne caspia*) have been recorded approximately 2 km away from the SH16 Site (iNaturalist, 2020), they will not utilise the project footprint due to their habitat preferences as coastal birds. No other birds records have been found within 2 km of the Site (eBird, 2022).

Nevertheless, based on the shrubs and trees growing within the riparian margins of all of the streams and the road reserve / designation along the SH16 Site, there is potential foraging, roosting, and nesting habitat for passerine (perching) birds that are commonly found in peri urban environments or remnant bushes. This includes species such as sparrows (*Passer domesticus*), blackbirds (*Turdus merula*), common mynas (*Acridotheres tristis*), fantails (*Rhipidura fuliginosa*), and silvereyes (*Zosterops lateralis*).

The presence of wetlands also indicates that there is potential foraging, roosting, and nesting habitat for waders or open-country birds common to peri-rural environments. This includes species such as skylarks (*Alauda arvensis*), yellow hammers (*Emberiza citrinella*), and pukekos (*Porphyrio melanotus*). While Australian bitterns (*Botaurus poiciloptilus*), which have a conservation status of Nationally Critical, are also found in areas of rank-grass along paddock edges, they would use Wetland 1 or 2 transiently at most, due to their sensitivity to disturbance.

The potential avifauna habitat is of low quality, as it is generally small and / or is isolated from large forest remnants in the landscape. Additionally, the habitat is located in proximity to the road corridor, which results in an ongoing, background level of disturbance. Overall, the avifauna community is assessed as having **Low** ecological value, as only exotic species or common native species are expected to inhabit the SH16 Site.

6.4.3 Herpetofauna

There are no records of herpetofauna found within the SH16 Site extents according to iNaturalist and DOC, but several plague skinks (*Lampropholis delicata*), a pest species in Auckland (Auckland Council, 2020), have been recorded between approximately 200 m – 2 km from the Site, in 2018 – 2020 (iNaturalist, 2020).

Plague skinks occupy a diverse range of habitats, including highly modified urban environments, and are therefore likely to be present on Site. Additionally, Coppers skinks (*Oligosoma aeneum*), which has a conservation status of At Risk: Declining, share a similar niche to plague skinks and may be present in low numbers. Based on the habitat quality and surrounding environment, other native skinks, geckos, and frogs are unlikely to be present.

There is potential skink habitat within the SH16 Site based on the dense cover of roadside rank grass along the road corridor, despite a general paucity of other favoured cover object habitats such as rocks, leaf litter, and logs. Additionally, the undergrowth of grass, shrubs, rocks, and / or leaf litter covering the stream banks of Ngongetepara Stream, Watercourse 2 – 4, and Kumeū River can provide skink habitat within the stream riparian margins.

While it is well connected to adjacent grasslands from farms and roadside verges, the potential herpetofauna habitat is of low quality due to general roadside vegetation management using herbicides and mowing. Given the low habitat quality, any populations of copper skinks present are likely to be in low densities only. However, based on a conservative approach to the presence of copper skinks (At Risk: Declining), the herpetofauna community has been assessed as having **High** species value.

6.4.4 Bats

No bats have been recorded within the SH16 Site extents according to iNaturalist and DOC. However, one long-tailed bat (*Chalinolobus tuberculatus*; Threatened: Nationally Critical) (O'Donnell et al., 2013) has been recorded approximately 2 km from the Site in 2020, (DOC, 2021b). This distance is considered to be within its home range span (O'Donnell, 2001).

Potential bat habitat is limited to the Ngongetepara Stream, and any large, roadside trees along the SH16 Site. The riparian zone of the stream can provide potential foraging habitat and act as a corridor for bats to reach foraging or roosting habitat in the wider environment. In addition, there are some mature trees with stems >15 cm diameter at breast height (DBH), that may possess bat roosting characteristics such as cracks or crevices (DOC, 2021a). Nevertheless, the stream is adjacent to the road corridor, and is subject to an ongoing background of disturbance and increased predator pressure.

Outside of these areas, there is generally a lack of suitable foraging habitat, and large, mature trees possessing bat roost characteristics.

Given that there are no records, and that the potential bat habitat is limited and or low quality, any populations of long-tailed bats present are likely to be in very low densities only. However, based on a conservative approach to the presence of long-tailed bats (Threatened: Nationally Critical), the bat community is assessed as having **Very High** species value.

7 Assessment of Ecological Effects

7.1 Key Ecological Effects

Key adverse ecological effects arising from the Project are as follows:

- a) Loss of terrestrial vegetation (temporary and permanent)
- b) Loss of wetland habitat (temporary and permanent)
- c) Loss of riparian habitat (temporary and permanent)
- d) Loss of fauna habitat (temporary and permanent)
- e) Alteration of benthic habitat (permanent)
- f) Alteration in hydrological input (permanent)
- g) Reduction in fish passage (temporary)
- h) Degradation of aquatic or wetland ecosystem from sediment runoff (temporary)
- i) Injury or mortality of fauna (during construction)

In addition to the overview of proposed work activities (outlined in Section 2.2), there are some variations in the physical works that will be undertaken at each stream and wetland (see plans for general arrangement, stormwater, and landscape and ecological planting; Beca Ltd, 2022a, 2022b, 2022c, and see Bridge & Fraser, 2022 for detailed stormwater assessment, and location of discharge points and outfalls). Therefore, the resulting ecological effects can differ between locations across the SH16 Site, including within the general road reserve / designation across the project corridor, and at each stream and wetland. Details of the physical works in proximity to these locations, as well as their associated ecological effects, are summarised in Table 8. The loss of wetland and riparian vegetation extents can be seen in Appendix D.

The ecological effects are discussed in detail in Section 7.2.

Notably, the Project will not result in any ecological effects on Watercourse 1 (which had been included in the EclA for completeness). The nearby road drain to be redirected is part of a separate catchment to Watercourse 1 and will not affect the hydrology of the stream. Additionally, the proposed road corridor design, as well as the construction for the road and stormwater network improvements, will be at least 20 m away the stream. Therefore, Watercourse 1 is not assessed in Section 7.2.

Sensitivity: General

Table 8. Summary of physical works and ecological effects (see start of Section 7.1.) corridor-wide, and for each stream and wetland identified across the SH16 Site. Physical works for each location are based on the plans for general arrangement, stormwater, and landscape and ecological planting (see Beca Ltd, 2022a, 2022b, 2022c). Further stormwater design details and discharge points (DP) locations taken from Bridge & Fraser (2022). The loss of wetland and riparian vegetation can be seen in Appendix D.

Location	Physical Works				Ecological Effect*								
	Description	Area of Rip Rap Apron / Rock Channel ***	Area of Vegetation Loss	Area of Vegetation Restoration	a)	b)	c)	d)	e)	f)	g)	h)	i)
Corridor-wide (outside of streams and wetlands sites)	- Terrestrial vegetation clearance within the road reserve / designation for road widening, the installation of a shared-use path, and stormwater network improvements. - Tree retention and replanting where practical.	—	—	—									
Ngongetepara Stream	- Stormwater network improvements: - Removal existing outfalls, headwalls, and pipes - Installation of new outfalls, headwalls, and rip rap aprons. - Upgrade of riparian rock channels - Discharge from DP1 - Installation of a new pedestrian bridge with rip rap armour underneath and piles for stabilisation. - Widening of existing road corridor and installation of shared-use path. - Riparian vegetation clearance for the above works, and restoration planting post-construction.	Each area: 7 m ² , 5 m ² , 6 m ²	Total 625 m ² Temporary loss: 362 m ² Permanent loss: 263 m ²	756 m ²									
Watercourse 1 (256 SH16)**	- Stormwater network improvements resulting in the redirection of a nearby road drain towards Ngongetepara Stream (i.e., DP2). - Widening of the existing road corridor and installation of a shared-use path.	—	—	—									

Sensitivity: General

Location	Physical Works				Ecological Effect*								
	Description	Area of Rip Rap Apron / Rock Channel ***	Area of Vegetation Loss	Area of Vegetation Restoration	a)	b)	c)	d)	e)	f)	g)	h)	i)
Watercourse 2 (1385 Coatesville Riverhead Highway)	- Stormwater network improvements: - Installation of rip rap rock channel. - Redirection of discharge to DP4, which will then discharge into the Watercourse 2.	< 5 m ²	Total 95 m ² Temporary loss: 51 m ² Permanent loss: 44 m ²	50 m ²									
Watercourse 3 (429 SH16)	- Stormwater network improvements: - Installation of a new outfall, headwalls, rip rap apron, and rip rap rock channel - Discharge from DP6 and DP5 - Widening of existing road corridor and installation of shared-use path. - Riparian vegetation clearance for the above works, and restoration planting post-construction.	Each area: 5 m ² , 3 m ²	Total 256 m ² Temporary loss: 230 m ² Permanent loss: 26 m ²	276 m ²									
Watercourse 4 (436 SH16)	- Stormwater network improvements including: - Installation of a rip rap rock channel. - Modification of existing outfall. - Discharge from DP6 - Widening of existing road corridor and installation of shared-use path. - Riparian vegetation clearance and restoration planting.	<4 m ²	Total 213 m ² Temporary loss: 188 m ² Permanent loss: 25 m ²	213 m ²									

Sensitivity: General

Location	Physical Works				Ecological Effect*								
	Description	Area of Rip Rap Apron / Rock Channel ***	Area of Vegetation Loss	Area of Vegetation Restoration	a)	b)	c)	d)	e)	f)	g)	h)	i)
Kumeū River	Stormwater network improvements: – Installation new outfall at 472 SH16 – will discharge water from the road and cross catchment that originally was going to a private pond, into Kumeū River. – Modification of existing outfall at BP station. – Modification of existing outfall, and Installation of new outfall at 7 Main Road. – Discharge from DP7, 8, and 11. • Installation of a new pedestrian bridge, with rip rap armour underneath and piles for stabilisation. • Installation of shared-use path. • Riparian vegetation clearance for the above works, and restoration planting post-construction.	Each area: 3 m ² , 3 m ²	Total 332 m ² Temporary loss: 262 m ² Permanent loss: 70 m ²	348 m ²									
Wetland 1 (436 SH16)	• Stormwater network improvements: – Installation of an additional pipe near the wetland – Works at Taupaki roundabout / road. – will increase impervious surfaces and therefore discharge to the wetland. – Discharge from DP6	–	Terrestrial veg. buffering the wetland: Total 200 m ² Temporary loss: 200 m ²	Terrestrial veg. buffering the wetland: 200 m ²									

Sensitivity: General

Location	Physical Works				Ecological Effect*								
	Description	Area of Rip Rap Apron / Rock Channel ***	Area of Vegetation Loss	Area of Vegetation Restoration	a)	b)	c)	d)	e)	f)	g)	h)	i)
Wetland 2 (522 SH16)	- Stormwater network improvements within 10 m of the wetland: - Extension of the existing outlet pipe - Reduction of catchment due to footpath drainage flow (i.e., changed from wetland to the road) - Installation of a shared-use path adjacent to the wetland. - Clearance of wetland vegetation and terrestrial vegetation (within 10 m), which will be restored post-construction.	–	Terrestrial veg. buffering the wetland: Total 597 m ² <i>Temporary loss: 242 m²</i> <i>Permanent loss: 355 m²</i>	Terrestrial veg. buffering the wetland: 309 m ²									
			Wetland veg.: Total 83 m ² <i>Temporary loss: 78 m²</i> <i>Permenant loss ~5m²</i>	Wetland veg.: 78 m ²									

* Key ecological effects impacting each stream or wetland:

- | | |
|---|---|
| <ul style="list-style-type: none"> Loss of terrestrial vegetation (temporary and permanent) Loss of wetland habitat (temporary) Loss of riparian habitat (temporary and permanent) Loss of fauna habitat (temporary and permanent) Alteration of benthic habitat (permanent) | <ul style="list-style-type: none"> Alteration in hydrological input (permanent) Reduction in fish passage (temporary) Degradation of aquatic or wetland ecosystem from sediment runoff (temporary) Injury or mortality of fauna (during construction) |
|---|---|

**No ecological effect, but included for completeness.

*** Impact limited to the edges of the stream banks – areas are calculated based on an estimated extension of the rip rap from the stream edge towards the centre by approximately 1.5 m, and the width of each rip rap apron or rock channel.

7.2 Magnitude of Effects (Unmitigated)

7.2.1 Temporary and Permanent Loss of Terrestrial Habitat

Terrestrial vegetation will be cleared during construction for road widening, the installation of a shared-use path, and / or stormwater network improvements. This will affect the general terrestrial vegetation within the road reserve / designation across the SH16 Site, as well as within a 10 m setback of the wetlands.

The magnitude of effect for terrestrial vegetation loss at each locality is further discussed below (see Section 7.2.1a 0- 7.2.1b) and summarised in Table 9.

a. General Terrestrial Vegetation Corridor Wide

Terrestrial vegetation within the road reserve / designation (but outside of the stream and wetland sites) will be cleared across the SH16 corridor for road widening, the installation of a shared-use path, and / or stormwater network improvements. Much of this will pertain to rank grass and roadside trees and shrubs. Based on the designation, 80 native and exotic trees are proposed to be removed, including the Kauri tree, which is Threatened: Nationally Vulnerable (Scott-Dye, 2022).

This will reduce the physical extent of roadside vegetation, and thus the provision of ecosystem services, such as stormwater filtration, fauna habitat provision, and protection from wind and heat, although this was provided at a low level to begin with. Other than the loss of the kauri tree, there is minimal loss of botanical value associated with removing roadside vegetation.

While the removal of rank grass and 80 trees across the SH16 Site will not affect the underlying character and composition of a predominately rural landscape, it is expected to produce at least a partial change in condition at the roadside level. Therefore, the magnitude of effect has been assessed as **moderate**.

b. Terrestrial vegetation buffering Wetland 1 and 2 (within 10 m)

The terrestrial vegetation to be cleared within a 10 m setback of Wetland 1 and 2 is a mix of pasture grass from the farmland near the road, and roadside grass.

The reduction in terrestrial vegetation around the wetland will reduce the physical extent of the buffer between the wetland and the road, as well as the capacity of the remaining terrestrial vegetation to act as a buffer.

However, the level of filtration and shading provided by the grass was limited to begin with, and its partial removal will not produce a discernible decrease in buffering function for the wetlands. It is further expected that as the buffer will be re-planted with native vegetation as part of landscape planting (Beca Ltd, 2022c), its provision of ecosystem services and native habitat will be notably improved compared to the existing pasture and roadside grass. Additionally, although some of buffer for Wetland 2 will be permanently lost, the loss is small (i.e., approximately 14%) when considering the total buffer size.

Given the extent and duration of terrestrial vegetation loss, the magnitude of effect has been assessed as **negligible**.

c. Summary Table

Table 9. Summary of the magnitude of effects for terrestrial vegetation loss across the SH16 Site.

Location	Terrestrial Vegetation				Magnitude of Effect
	Description	Loss Type	Area	Restoration planting	
Terrestrial Vegetation	Rank grass with patches of native and exotic roadside shrubs and trees.	<i>Permanent</i>	80 trees (and grass verges)	–	Moderate
Wetland 1 Buffer (436 SH16)	Pasture grass, exotic roadside grass	<i>Temporary</i>	200 m ²	200 m ²	Negligible
Wetland 2 Buffer (522 SH16)	Pasture grass, exotic roadside grass	<i>Temporary</i>	242 m ²	309 m ²	Negligible
		<i>Permanent</i>	355 m ²		Negligible

7.2.2 Loss of Wetland Habitat

Wetland habitat from Wetland 2 will be cleared during construction for road widening, the installation of a shared-use path, and / or stormwater network improvements. Based on the delineated extents of the wetland as defined by the RMA, approximately 83 m² of the wetland will be cleared, respectively, at north-most corner of Wetland 2 (See Appendix D: Figure D 4). Much of which will be wetland adapted pasture species and exotic rush.

In the first instance, several design workshops have already been undertaken during the design process to investigate alternatives to avoid or minimise the impact on the wetlands. As a result, the road design and construction methodology were changed to reduce the extent of impact to the wetlands as much as possible. As an outcome of this only ~5m² of wetland will be lost permanently. The remaining effects from the temporary loss of approximately 78 m² of wetland vegetation are considered to be unavoidable in the context of the road safety upgrades and the provision of multi-mode transport options needed along this section of SH16.

The reduction of the physical extent of the wetland can decrease its capacity to provide ecosystem services, such as the ability to buffer surface water from the road corridor and to act as fauna habitat. However, this decrease will not be discernible, as the area of loss is small (approximately 3%) when considering total size of the wetland and the location of clearance at the wetland corner. Moreover, the majority of the effects will be temporary only, as all wetland vegetation cleared during construction will be actively replanted according to the LEPP (Beca Ltd, 2022c), and is expected to provide an improved value within 5 – 10 years following its reinstatement. Overall, the magnitude of effect has been assessed as **negligible**, even without further management.

7.2.3 Temporary and Permanent Loss of Riparian Habitat

Riparian vegetation will be cleared for road widening, the installation of a shared-use path, stormwater network upgrades, and / or the installation of a new pedestrian bridge. This will impact the Ngongetepara Stream, Watercourse 3 – 4, and the Kumeū River. Vegetation will be lost both temporarily during construction (and reinstated later) and permanently post-construction (see Table 10).

The loss of riparian vegetation will negatively impact stream function by reducing connectivity with adjacent habitats, shading, bank stabilisation, and the filtration of surface water runoff. However, as a similar composition and density of bankside vegetation is present throughout the impact reach of each stream, the relatively small extent of riparian vegetation loss will produce limited impacts on stream function. Much of the effects associated with vegetation loss will also be temporary only, as vegetation cleared to enable construction will be replanted or allowed to re-establish passively.

Furthermore, clearance of riparian vegetation can result in the potential establishment or spread of pest plants in the newly cleared areas. However, all pest plants are expected to be removed during the initial reinstatement and ongoing maintenance of the plantings. Maintenance will be undertaken in accordance with NZTA P39 Standard Specification for Highway Landscape Treatments and thereafter transferred to Auckland Systems Management maintenance contract.

Based on the above, the magnitude of effect has been assessed for each stream, with consideration to the extent of riparian vegetation loss, type of vegetation to be lost (and the ecosystem services they would have provided for the stream), and the duration of loss. The assessments are summarised in Table 10.

With regard to Watercourse 2, the area of restoration planting is less than the estimated area of riparian vegetation loss. However, the vegetation to be lost consists mostly of herbaceous weeds and a few young lilly pilli trees and / or cabbage trees, and would have provided minimal ecosystem benefits to begin with. Additionally, it is expected that the 50 m² of native revegetation (see LEPP; Beca Ltd, 2022c) will improve the native composition and ecological function of the riparian habitat compared to its current state within 5 – 10 years following reinstatement. Therefore, the magnitude of effect still considered to be low.

Table 10. Summary of the magnitude of effects for riparian vegetation loss from each stream.

Stream	Riparian Vegetation to be Lost				Magnitude of Effect
	Description	Loss Type	Area	Restoration planting	
Ngongetepara Stream	Mix of well-established shrubs and large trees, including both native and exotic species.	Temporary	362 m ²	756 m ²	Low
		Permanent	263 m ²		Low
Watercourse 2 (1385 Coatesville Riverhead Highway)	Mostly herbaceous weeds, and few trees.	Temporary	51 m ²	50 m ²	Low
		Permanent	44 m ²		Low
Watercourse 3 (429 SH16)	Mix of herbaceous plants and grass pasture, shrubs, and few trees.	Temporary	230 m ²	276 m ²	Low
		Permanent	26 m ²		Low
Watercourse 4 (436 SH16)	Mostly blackberry and Chinese privet, with some shrubs and a small tree immediately adjacent to the road	Temporary	59 m ²	213 m ²	Low
		Permanent	25 m ²		Low
Kumeū River	Mix of well-established shrubs and large trees, including both native and exotic species.	Temporary	262 m ²	348 m ²	Low
		Permanent	70 m ²		Low

7.2.4 Temporary and Permanent Loss of Fauna Habitat

Fauna habitat will be lost due to vegetation clearance for road widening, the installation of a shared-use path, stormwater network upgrades, and / or the installation of a new pedestrian bridge. The magnitude of effects for fauna habitat loss at each locality is further discussed below for avifauna, herpetofauna, and bats (see Section 7.2.4a0 – 7.2.4c), and summarised in Table 11.

a. Avifauna

Avifauna nesting, foraging and roosting habitat will be lost from the road reserve / designation across the SH16 corridor, and at each of the streams and Wetland. The physical extent of available avifauna habitat will be reduced temporarily during construction and permanently due to the extended carriage way. The construction will also create disturbance via noise and movement, which can result in short-term avoidance behaviour from native avifauna.

However, the area extents that will be impacted only represents a small proportion of similar avifauna habitat within the wider surrounding landscape. In addition, the connectivity of the vegetation from the roadside, streams, and wetlands will not be severed from the wider landscape during the works. As such, other avifauna habitat will be within the dispersal distances of the bird species likely to be present with the SH16 Site (Burge et al., 2017; New Zealand Birds Online, 2013)

Based on the area extent of habitat loss, the magnitudes of effect for the temporary and permanent loss of avifauna habitat have been assessed as **low** (see Table 11). Although an avifauna survey was not undertaken, the availability of bird records and habitat information has provided an adequate understanding of the local population for the purposes of this assessment.

b. Herpetofauna

Potential habitat for skinks may be lost from the road reserve / designation across the SH16 corridor, and at the Ngongetepara Stream, Watercourse 2 – 4, and Kumeū River. These areas may support small populations of the At-Risk copper skink. The impacts of habitat loss are expected to be reduced by the availability of skink habitat in the wider surroundings.

However, the magnitude of effect of habitat loss **cannot be assessed** with confidence until a herpetofauna survey has been completed (see Table 11). Based on the results of the survey, additional mitigation may be required to address any residual effects on the local population (e.g., herpetofauna habitat restoration, etc.) Thus, it is recommended that this survey is undertaken immediately prior to construction to determine further requirements

c. Bats

Potential roosting habitat for native bats may be lost from the road reserve / designation across the SH16 corridor and at Ngongetepara Stream. This will be lost due to vegetation clearance for the proposed works, in particular for the threatened long-tailed bat. The extent of roost habitat loss is expected to be small, as the habitat quality is low and only a few trees within the clearance areas will have the capacity to host roosting bats (DOC, 2021a). Additionally, the long-tailed bat has an average home range of 3.3 – 10.9 km and will be able to travel to other roost habitats present within the wider landscape.

However, the magnitude of effect of habitat loss **cannot be assessed** with confidence until a bat roost tree assessment has been completed (see Table 11). Based on the results of the assessment, additional mitigation may be required (e.g., retention of specific bat roost trees, bat habitat restoration, etc.). Thus, it is recommended that this assessment is undertaken prior to construction to determine further requirements.

d. Summary Table

Table 11. Summary of the magnitude of effects for fauna habitat loss across the SH16 Site.

Location	Loss of Fauna Habitat		Magnitude of Effect		
	Loss Type	Area	Avifauna	Herpetofauna	Bats
Corridor-wide	<i>Permanent</i>	80 trees (and grass verges)	Low	Cannot be assessed	Cannot be assessed
Ngongetepara Stream	<i>Temporary</i>	362 m ²	Low		
	<i>Permanent</i>	263 m ²	Low		
Watercourse 2 (1385 Coatesville Riverhead Highway)	<i>Temporary</i>	51 m ²	Low		–
	<i>Permanent</i>	44 m ²	Low		–
Watercourse 3 (429 SH16)	<i>Temporary</i>	230 m ²	Low		–
	<i>Permanent</i>	26 m ²	Low		–
Watercourse 4 (436 SH16)	<i>Temporary</i>	59 m ²	Low		–
	<i>Permanent</i>	25 m ²	Low		–
Kumeū River	<i>Temporary</i>	262 m ²	Low		–

	<i>Permanent</i>	70 m ²	Low		–
Wetland 2 (522 SH16)	<i>Permanent</i>	83 m ²	Low	–	–

7.2.5 Permanent Alteration of Benthic Habitat

The installation of rip rap aprons and rock channels as part of stormwater network improvements will permanently alter a very small portion of the benthic composition, located at the bank edge of the Ngongetepara Stream, Watercourse 2 – 4, and the Kumeū River.

The impacts include increasing the number of large cobbles and /or boulders of the benthic composition at the stream bank edges, which can increase habitat diversity and alter the stream flow profile. However, the amount of rip rap to be placed at each stream is relatively small given their impact reaches, and they will not be placed throughout the full cross section of any of the streams (i.e., have been estimated to extend approximately 1.5m from the stream edge towards the centre). Additionally, as cobbles and boulders are already present within the Ngongetepara Stream and Kumeū River, the rip rap will not significantly change the existing composition of the streambed.

Therefore, the works will not produce a discernible change in any of the streams from baseline benthic habitat or hydraulic conditions, and are assessed to have **negligible to low** magnitudes of effect (see Table 12).

Table 12. Summary of the magnitude of effects for benthic habitat alteration at each stream across the SH16 Site.

Stream	Area of Rip Rap	Magnitude of Effect
Ngongetepara Stream	7 m ²	Low
	5 m ²	
	6 m ²	
Watercourse 2 (1385 Coatesville Riverhead Highway)	<5 m ²	Negligible
Watercourse 3 (429 SH16)	3 m ²	Negligible
	3 m ²	
Watercourse 4 (436 SH16)	<4 m ²	Negligible
Kumeū River	5 m ²	Negligible
	3 m ²	

7.2.6 Permanent Alteration in Hydrological Input

The increase in impervious surface across the SH16 project corridor physical works to improve the stormwater network (e.g., adding outfalls, etc) will result in alterations to hydrological input to the streams and wetlands. However, much of this will be well-managed and minimised by the stormwater design (due to the treatment of runoff, as well as hydrologic mitigation via retention and detention; (Bridge & Fraser, 2022)), and as such the magnitude of effect on the streams and wetlands will be **Negligible**. This is further discussed for each stream and wetland below (See Section 7.2.6a - 7.2.6g), and is summarised in Table 13.

a. Permanent Increase in Hydrological Input to Ngongetepara Stream

Hydrological input into Ngongetepara Stream will permanently increase due to additional discharge from an increase in impervious surface area within the SH16 project corridor (captured by DP1). However, the amount of hydrological input will be small, particularly when compared to the size of the stream, and will not produce a discernible change in stream hydrology. Furthermore, water quality will not be affected as current discharge into the stream is untreated, but 88% of the discharge will be treated following the completion of works (Bridge & Fraser, 2022).

b. Permanent Increase in Hydrological Input to Watercourse 2

Hydrological input into Watercourse 2 will permanently increase due to the redirection of excess discharge from the SH16 project corridor into the watercourse (captured by DP4). However, as the amount of

hydrological input will be small relative to the size of the watercourse, and will be treated, it will not produce a discernible change in the hydrology or water quality of the Watercourse 2 (Bridge & Fraser, 2022).

c. Permanent Increase in Hydrological Input to Watercourse 3

Hydrological input into Watercourse 3 will permanently increase due to additional discharge from an increase in impervious surface area from road widening near the watercourse (captured by DP6), and between Coatesville Riverhead Highway and Taupaki Road (captured by DP5). However, the hydrological input to the stream from the discharge will be small, particularly following stormwater design mitigation and the use of retention swales, and will not produce a discernible change in stream hydrology. Furthermore, water quality will not be affected as the discharge from DP5 is treated, and there will be an increase in the percentage of treated discharge from DP6 compared to existing levels (76% of discharge is currently treated, but 94% will be treated following the completion of works) (Bridge & Fraser, 2022).

d. Permanent Increase in Hydrological Input to Watercourse 4

Hydrological input into Watercourse 4 will permanently increase due to additional discharge from an increase in impervious surface area from road widening (captured by DP6). However, as the amount of hydrological input will be small, particularly following stormwater design mitigation and the use of retention swales, and will not produce a discernible change in stream hydrology. Furthermore, water quality will not be affected as currently only 76% of discharge into the stream is treated, but 94% will be treated following the completion of works (Bridge & Fraser, 2022).

e. Permanent Increase in Hydrological Input to the Kumeū River

Hydrological input into the Kumeū River will permanently increase due to the installation of the new outfalls at 472 SH16, the BP, and at 7 Main road, which will capture additional discharge from the cross catchment (that was originally flowing to a private pond) and capture discharge from the road corridor more effectively (see DP7, 8, and 11 in Bridge & Fraser, 2022).

However, the level of increase contributed by the discharge will be small, and will not produce a discernible change in the hydrology of the Kumeū River. Furthermore, the water quality of the Kumeū River will not change from baseline levels, as additional discharge due to the increase in impervious area from the shared-use path at Kumeū River is considered to be clean water (i.e., DP11), and all other discharge will be treated (Bridge & Fraser, 2022).

f. Permanent Increase in Hydrological Input to Wetland 1

Hydrological input into Wetland 1 will permanently increase due to an increase in impervious surface and flows from the new shared-use path near the Taupaki roundabout / road, as well as the installation of an additional pipe which will connect to the existing outfall (captured by DP6).

However, the amount of hydrological input contributed by the discharge from the shared-use path will be small, and is considered clean water, and as such will not produce a discernible change in the hydrology or habitat quality of the wetland. Moreover, while the additional pipe will increase the efficiency of flows, it will not contribute a higher volume of water than existing levels (Bridge & Fraser, 2022).

Although stormwater will spill over from the outfall into the wetland during severe rainfall events (i.e., events of 10- or 100-year Average Recurrence Intervals), this already occurs with the current outfall design. Additionally, the estimations of spill over increases in the future is attributed to climate change, not stormwater network improvements.

g. Permanent Decrease in Hydrological Input to Wetland 2

The new shared-use path will result in surface water on the road corridor to drain away from Wetland 2. This is expected to permanently reduce the level of hydrological input for WL2 compared to existing conditions, where surface water can drain to either side of the road corridor.

However, the road corridor only contributes a small amount of discharge to the wetland, and is unlikely to be driving wetland hydrology as Wetland 2 is fed by a mix of surface water and groundwater. Furthermore, Wetland 2 sits within a large depression in the land, and the water from the surrounding slopes and landscape will still drain towards the wetland post-construction. Therefore, the new design will not produce a discernible effect on the hydrological functioning of Wetland 2.

h. Summary Table

Table 13. Summary of the magnitude of effects for alterations to hydrological input alteration to streams and wetlands across the SH16 Site.

Stream	Magnitude of Effect
Ngongetepara Stream	Negligible
Watercourse 2 (1385 Coatesville Riverhead Highway)	Negligible
Watercourse 3 (429 SH16)	Negligible
Watercourse 4 (436 SH16)	Negligible
Kumeū River	Negligible
Wetland 1	Negligible
Wetland 2	Negligible

7.2.7 Temporary Reduction in Fish Passage

A coffer dam (made of steel sheet, sandbags, or earth bunds) and divert methodology to create a dry working environment may be required to install the new outfalls at Ngongetepara Stream and Kumeū River (see Blyth, 2022). This will reduce fish passage, in particular for migratory fish, such as the redfin bully (*Gobiomorphus huttoni*), common bully (*G. cotidianus*), banded kōkopu, shortfin eel, and the longfin eel. However, given that the dam and diversion is for the purpose of installing new outfalls, its effects will be temporary only (approximately 1 – 2 weeks), and will be limited to a small scale, at the stream edge.

Based on the above, the magnitude of effect of the diversion and reduced connectivity is expected to be **Negligible**.

7.2.8 Temporary Degradation of Aquatic or Wetland Ecosystem from Sediment Runoff

Earthworks will be required for road widening, installation of the shared-use path, stormwater network improvements, and / or the installation of a pedestrian bridge. This will occur in proximity to each of the streams and wetlands.

However, any sediment discharge to the streams and wetland from disturbance during earthworks will be well managed by the implementation of control measures according to the ESCP. Given this, there is expected to be no discernible changes to the water quality and health of the streams, nor the quality and substrate composition of the wetland. Thus, the magnitude of effect is assessed as **Negligible** for all streams and wetlands (see Table 14).

Table 14. Summary of the magnitude of effects for stream and wetland degradation from sediment runoff across the SH16 Site.

Stream or Wetland	Magnitude of Effect
Ngongetepara Stream	Negligible
Watercourse 2 (1385 Coatesville-riverhead highway)	Negligible
Watercourse 3 (429 SH16)	Negligible
Watercourse 4 (436 SH16)	Negligible
Kumeū River	Negligible

Wetland 1 (436 SH16)	Negligible
Wetland 2 (522 SH16)	Negligible

7.2.9 Injury or Mortality of Fauna During Construction

The proposed works can potentially cause injury or mortality to native fauna present at the SH16 Site, which are protected under the Wildlife Act 1953. The magnitude of effects for freshwater fish, avifauna, herpetofauna, and bats are further assessed in Section 7.2.9a - 7.2.9d, and is summarised in Table 15.

a. Freshwater Fish

Temporary stream diversions via a coffer dam (made of steel sheet, sandbags, or earth bunds) is proposed for the Ngongetepara Stream and Kumeū River to install the new outfalls. Freshwater fish can potentially become stranded during the diversion and pumping process of setting up the coffer dam in the stream. Eels are especially at risk as they burrow into sediments when disturbed.

However, given the temporary duration and small scale of works, and that fish are likely to avoid the area once works have begun due to disturbance, it is unlikely for fish to be present in the dam during the set-up process and to become stranded. The magnitude of effect has been summarised for each stream in Table 15, based on the scale and duration.

b. Avifauna

Native avifauna can potentially be injured or killed during vegetation clearance for road widening, the installation of a shared-use path, stormwater network upgrades, and / or the installation of a new pedestrian bridge. Such works will be undertaken within the road reserve / designation across the SH16 corridor, and at each of the streams and Wetland 2 within the SH16 Site.

Nesting birds and their eggs or chicks are the most likely to be impacted, as other adult birds will likely avoid the area once vegetation clearance or construction begins due to disturbance. However, the likelihood of injury and mortality is low, as only some trees or shrubs within the clearance area may contain active nests. Additionally, avifauna inhabiting the SH16 Site are likely to be common native species that are locally abundant, thus, only a small proportion of the local population will be affected if injury / mortality occurs. Therefore, the magnitude of effect is assessed **Low** for all Site localities (see Table 15).

c. Herpetofauna

Herpetofauna can potentially be injured or killed during vegetation clearance for road widening, the installation of a shared-use path, stormwater network upgrades, and / or the installation of a new pedestrian bridge. This can impact copper skinks, which have a conservation status of At-Risk: Declining, currently utilising the grass verges within the road reserve / designation corridor-wide, and at the Ngongetepara Stream, Watercourse 3 – 4, and the Kumeū River. However, based on the reduced quality of habitat within the SH16 Site from herbicides and mowing, the population of copper skinks is likely to be in low abundance only.

As there is a level of uncertainty associated with estimating copper skink population based on habitat assessments alone, and thus the likelihood of encountering a copper skink during construction, a magnitude of effect **cannot be assessed** with confidence (see Table 15). Nevertheless, as all native fauna is protected under the Wildlife Act., measures to avoid injury/mortality are required even at low magnitudes of effect.

d. Bats

Bats can potentially be injured or killed during vegetation clearance for road widening, the installation of a shared-use path, stormwater network upgrades, and / or the installation of a new pedestrian bridge. This can impact long-tailed bats, which have a conservation status of Threatened: Nationally Critical, inhabiting the roadside trees within the road reserve / designation corridor-wide and at the Ngongetepara Stream.

Roosting bats are the most likely to be impacted due to vegetation clearance during the day. The likelihood of this is low, as only a limited number of trees are expected to be suitable for bat roost, and among these, even less trees are expected have active roosts.

Given the uncertainty of estimating the bat population based on habitat assessments alone, and thus the likelihood of encountering a roosting bat during construction, a magnitude of effect **cannot be assessed** with confidence (see Table 15). Nevertheless, as all native fauna is protected under the Wildlife Act., measures to avoid injury/mortality are required even at low magnitudes of effect.

e. Summary Table

Table 15. Summary of the magnitude of effects for the injury or mortality of fauna across the SH16 Site.

Location	Magnitude of Effect			
	<i>Freshwater Fish</i>	<i>Avifauna</i>	<i>Herpetofauna</i>	<i>Bats</i>
Corridor-wide	–	Low	Cannot be assessed	Cannot be assessed
Ngongetepara Stream	Low	Low		
Watercourse 2 (1385 Coatesville riverhead highway)	–	Low		–
Watercourse 3 (429 SH16)	–	Low		–
Watercourse 4 (436 SH16)	–	Low		–
Kumeū River	Low	Low		–
Wetland 2 (522 SH16)	–	Low	–	–

7.3 Management of Effects

The (unmitigated) level of ecological effects is already considered to be low due to strategies that have been incorporated into the proposed works (i.e., ESCP, stormwater design, restoration planting, retention of trees, avoidance, and minimisation of construction impacts on the wetlands), and there is no further management of effects required with regard to the RMA framework.

However, as most native fauna is absolutely protected under the Wildlife Act 1953 even at low magnitudes of effect, it is advised to engage a suitably qualified and experienced ecologist to assist in the management of fauna.

7.3.1 Fish Management Plan

A Native Fish Management Plan is to be developed and implemented to minimise any potential impacts to native fish within the Ngongetepara Stream and Kumeū River.

This management plan will outline the procedures to salvage and safely relocate the native fish out of the impact zone prior to works being undertaken. The plan will detail permitting requirements, habitat isolation, fish capture methodologies and timing, pest management, release sites, post-relocation monitoring, and incidental kill and harm minimisation protocols.

7.3.2 Avoidance of Avifauna Breeding Season

To avoid injury / mortality to native nesting birds and their eggs or chicks during works, tree felling as part of vegetation clearance should ideally be avoided during peak breeding season. For native passerine species such as fantails and silvereyes, this is August to March (New Zealand Birds Online, 2013).

If tree felling within the breeding season cannot be avoided, the trees must be inspected for nests by a qualified ecologist one week prior to the planned felling. If the active nests of any native bird species protected under the Wildlife Act 1953 are found, the tree cannot be felled and must be clearly marked and cordoned off until the nesting birds have fledged, or the nest has been naturally abandoned.

7.3.3 Herpetofauna Survey and Relocation

A precautionary approach should be taken to avoid the likelihood of any injuries / mortality to herpetofauna. Prior to vegetation clearance, the area should be surveyed by a herpetologist, permitted by the Department of Conservation. If native herpetofauna are confirmed to be present, the herpetologist must be onsite to oversee vegetation clearance, in order to search for and rescue any native lizards found, before relocating them to an alternative location on the Site. A lizard management plan may be required as a condition of the herpetologist's wildlife permit.

7.3.4 Bat Roost Tree Risk Assessment

To avoid injury and / or mortality to native bats roosting during the day, tree felling as part of vegetation clearance should be overseen by a specialist bat ecologist, certified by the Department of Conservation.

Any trees to be felled that have a DBH >15 cm will be assessed for roost features using the roost identification criteria from the Bat Roost Protocol (DOC, 2021a). If any Moderate or High value roost trees are found, then they must be monitored for bat activity for a minimum of two nights immediately prior to felling. If bat roost is confirmed, then the tree must be clearly marked and cannot be removed, and the Department of Conservation must be informed.

7.4 Overall level of Effects:

A summary of the overall level of ecological effects following related management measures is provided below in Table 16

Table 16. Summary of the overall ecological effects for each locality across the SH16 Site. The overall level of effect is assessed using Appendix A: Table A6.

Ecological Effect	Ecological Component	Ecological Value	Magnitude of Effect (Unmitigated)	Further Management Recommended	Magnitude of Effect (Revised)	Overall Level of Effect
Permanent loss of terrestrial habitat	General terrestrial vegetation	Low	Moderate	–	–	Low
	Terrestrial vegetation buffering Wetland 2	Low	Negligible	–	–	Very Low
Temporary loss of terrestrial habitat	Terrestrial vegetation buffering Wetland 1	Low	Negligible	–	–	Very Low
	Terrestrial vegetation buffering Wetland 2	Low	Negligible	–	–	Very Low
Loss of wetland habitat	Wetland 2	Low	Negligible	–	–	Very Low
Permanent loss of riparian habitat	Ngongetepara stream	Moderate	Low	–	–	Low
	Watercourse 2 (1385 Coatesville riverhead highway)	Low	Low	–	–	Very Low
	Watercourse 3 (429 SH16)	Low	Low	–	–	Very Low
	Watercourse 4 (436 SH16)	Low	Low	–	–	Very Low
	Kumeū river	Moderate	Low	–	–	Low
Temporary loss of riparian habitat	Ngongetepara stream	Moderate	Low	–	–	Low
	Watercourse 2 (1385 Coatesville riverhead highway)	Low	Low	–	–	Very Low
	Watercourse 3 (429 SH16)	Low	Low	–	–	Very Low
	Watercourse 4 (436 SH16)	Low	Low	–	–	Very Low
	Kumeū river	Moderate	Low	–	–	Low
Permanent loss of fauna habitat	Avifauna	Low	Low ¹	–	–	Very Low
	Herpetofauna	High	Cannot be assessed ²	–	–	N/A ²
	Bats	Very High	Cannot be assessed ³	–	–	N/A ³
Temporary loss of fauna habitat	Avifauna	Low	Low ¹	–	–	Very Low ¹
	Herpetofauna	High	Cannot be assessed ²	–	–	N/A ²
	Bats	Very High	Cannot be assessed ³	–	–	N/A ³
Permanent alteration of benthic habitat	Ngongetepara stream	Moderate	Low	–	–	Low
	Watercourse 2 (1385 Coatesville riverhead highway)	Low	Negligible	–	–	Very Low
	Watercourse 3 (429 SH16)	Low	Negligible	–	–	Very Low
	Watercourse 4 (436 SH16)	Low	Negligible	–	–	Very Low
	Kumeū river	Moderate	Negligible	–	–	Very Low
	Ngongetepara stream	Moderate	Negligible			Very Low

Sensitivity: General

Permanent alteration in hydrological input	Watercourse 2 (1385 Coatesville riverhead highway)	Low	Negligible	–	–	Very Low
	Watercourse 3 (429 SH16)	Low	Negligible			Very Low
	Watercourse 4 (436 SH16)	Low	Negligible			Very Low
	Kumeū river	Moderate	Negligible	–	–	Very Low
	Wetland 1	Low	Negligible	–	–	Very Low
	Wetland 2	Low	Negligible	–	–	Very Low
Temporary reduction in fish passage	Freshwater Fish	High	Negligible ⁴	–	–	Very Low⁴
Temporary degradation of aquatic or wetland habitat from sediment runoff	Ngongetepara stream	Moderate	Negligible	–	–	Very Low
	Watercourse 2 (1385 Coatesville riverhead highway)	Low	Negligible	–	–	Very Low
	Watercourse 3 (429 SH16)	Low	Negligible	–	–	Very Low
	Watercourse 4 (436 SH16)	Low	Negligible	–	–	Very Low
	Kumeū river	Moderate	Negligible	–	–	Very Low
	Wetland 1	Low	Negligible	–	–	Very Low
	Wetland 2	Low	Negligible	–	–	Very Low
Injury or mortality of fauna during construction	Freshwater fish	High	Low ⁴	Implementation of the fish management plan	Negligible	Very Low⁴
	Avifauna	Low	Low ¹	Avoidance of tree felling during breeding season and nest survey	Negligible	Very Low¹
	Herpetofauna	High	Cannot be assessed ²	Herpetofauna survey, and search and rescue	N/A	N/A²
	Bats	Very High	Cannot be assessed ³	Bat Roost Tree Assessment and vegetation clearance protocols for high and moderate	Negligible	N/A³

1. Assessment of effect for avifauna at the following locations:

- *Corridor-wide*
- *Ngongetepara stream*
- *Watercourse 2 (1385 Coatesville riverhead highway)*
- *Watercourse 3 (429 SH16)*
- *Watercourse 4 (436 SH16)*
- *Kumeū River*
- *Wetland 1 (436 SH16)*
- *Wetland 2 (522 SH16)*

2. Assessment of effect for herpetofauna at the following locations:

- *Corridor-wide*
- *Ngongetepara stream*
- *Watercourse 2 (1385 Coatesville riverhead highway)*
- *Watercourse 3 (429 SH16)*
- *Watercourse 4 (436 SH16)*
- *Kumeū River*

3. Assessment of effect for bats located corridor-wide (i.e., trees within the road reserve / designation across the SH16 corridor) and at the Ngongetepara stream.

4. Assessment of effect for freshwater fish at the Ngongetepara stream and the Kumeū River.

8 Conclusion

The Project has the potential to impact streams, wetlands, terrestrial vegetation, and native fauna.

The actual and potential ecological effects arising from the works are outlined below, and summarised in Table 17 for specified locations (i.e., corridor-wide, streams, and wetlands) across the SH16 Site.

- Loss of terrestrial vegetation (temporary and permanent)
- Loss of wetland habitat (temporary and permanent)
- Loss of riparian habitat (temporary and permanent)
- Loss of fauna habitat (temporary and permanent)
- Alteration of benthic habitat (permanent)
- Alteration in hydrological input (permanent)
- Reduction in fish passage (temporary)
- Degradation of aquatic or wetland ecosystem from sediment runoff (temporary)
- Injury or mortality of fauna (during construction)

Management has been incorporated into the proposed work activities construction methodology to reduce ecological effects. This includes the ESCP (Blyth, 2022), management of discharge to streams and wetlands through stormwater design and mitigation (Bridge & Fraser, 2022), restoration planting according to the LEPP (Beca Ltd, 2022c), retention of roadside trees according to the arborist report and LEPP (Beca Ltd, 2022c; Scott-Dye, 2022), and the alteration of road design and construction to avoid and minimise impacts to the wetlands.

Overall, with the above management strategies integrated, the proposed SH16 upgrades will lead to **Very Low or Low** effects on the terrestrial vegetation, streams, and wetlands. However, additional management measures are recommended to reduce potential injury or mortality to native fauna, particularly for herpetofauna and bats which will also require a survey prior to construction. The recommended management and mitigation measures are as follows:

- Implementation of a Fish Management Plan.
- Avoidance of avifauna breeding season and survey of any trees to detect active nests outside of the breeding season.
- Herpetofauna survey prior to construction, with potentially a further salvage or management plan based on survey results.
- Bat Roost Survey prior to construction to confirm presence of suitable roost trees.

Table 17. Summary of the ecological effects and management measures at each site to reduce the overall level of effect to low or very low.

Location	Ecological Effect	Incorporated Management (in black) and Further Recommended Management Measures (in red)	Overall Level of Ecological Effect
Corridor Wide (outside of streams and wetlands sites)	Temporary and permanent loss of terrestrial habitat	- Vegetation planting for wetlands and wetland buffers as part of the LEPP - Retention of trees where practical	Low
	Temporary and permanent loss of fauna habitat	- Vegetation planting for wetlands and wetland buffers as part of LEPP - Retention of trees where practical	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed - Bats – Low
	Injury or mortality of native fauna	- Avoidance of tree felling during avifauna breeding season and nest survey - Herpetofauna survey, and search and rescue. - Bat Roost Tree Assessment and vegetation clearance protocols for high and moderate.	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed - Bats – Low
Ngongetepara Stream	Permanent loss of riparian habitat	Riparian vegetation planting as part of the LEPP	Low
	Temporary loss of riparian habitat	Riparian vegetation planting as part of the LEPP	Low
	Permanent loss of native fauna habitat	Riparian vegetation planting as part of the LEPP	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed - Bats – Cannot Be Assessed
	Temporary loss of native fauna habitat	Riparian vegetation planting as part of the LEPP	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed - Bats – Cannot Be Assessed
	Permanent alteration of benthic habitat	N/A	Very Low
	Permanent increase in hydrological input	Management through stormwater design and mitigation	Very Low
	Temporary reduction in fish passage	N/A	Very Low
	Degradation of aquatic ecosystem from sediment runoff	Implementation of the ESCP	Very Low
	Injury or mortality of native fauna	- Implementation of the fish management plan - Avoidance of tree felling during avifauna breeding season and nest survey - Herpetofauna survey, and search and rescue - Bat Roost Tree Assessment and vegetation clearance protocols for high and moderate	- Freshwater fish – Very Low - Avifauna – Very Low - Herpetofauna – Cannot Be Assessed - Bats – Low
Watercourse 1 (256 SH16)	No ecological effects	N/A	No effect
Watercourse 2 (1385 Coatesville)	Permanent loss of riparian habitat	Riparian vegetation planting as part of the LEPP	Low
	Temporary loss of riparian habitat	Riparian vegetation planting as part of the LEPP	Low

Sensitivity: General

Riverhead Highway)	Permanent loss of native fauna habitat	Riparian vegetation planting as part of LEPP	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed - Bats – Cannot Be Assessed
	Temporary loss of native fauna habitat	Riparian vegetation planting as part of the LEPP	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed - Bats – Cannot Be Assessed
	Permanent alteration of benthic habitat	N/A	Very Low
	Permanent increase in hydrological input	Management through stormwater design and mitigation	Very Low
	Degradation of aquatic ecosystem from sediment runoff	Implementation of the ESCP	Very Low
	Injury or mortality of native fauna	- Avoidance of tree felling during avifauna breeding season and nest survey - Herpetofauna survey, and search and rescue	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed.
Watercourse 3 (429 SH16)	Permanent loss of riparian habitat	Riparian vegetation planting as part of the LEPP	Very Low
	Temporary loss of riparian habitat	Riparian vegetation planting as part of the LEPP	Very Low
	Permanent loss of native fauna habitat	Riparian vegetation planting as part of the LEPP	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed - Bats – Cannot Be Assessed
	Temporary loss of native fauna habitat	Riparian vegetation planting as part of the LEPP	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed - Bats – Cannot Be Assessed
	Permanent alteration of benthic habitat	N/A	Very Low
	Permanent increase in hydrological input	Management through stormwater design and mitigation	Very Low
	Temporary reduction in fish passage	N/A	Very Low
	Degradation of aquatic ecosystem from sediment runoff	Implementation of the ESCP	Very Low
	Injury or mortality of native fauna	- Avoidance of tree felling during avifauna breeding season and nest survey - Herpetofauna survey, and search and rescue	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed.
Watercourse 4 (436 SH16)	Permanent loss of riparian habitat	Riparian vegetation planting as part of the LEPP	Very Low
	Temporary loss of riparian habitat	Riparian vegetation planting as part of the LEPP	Very Low
	Permanent loss of native fauna habitat	Riparian vegetation planting as part of the LEPP	- Avifauna – Very Low - Herpetofauna – Cannot Be Assessed
	Temporary loss of native fauna habitat	Riparian vegetation planting as part of the LEPP	Avifauna – Very Low

Sensitivity: General

			• Herpetofauna – Cannot Be Assessed
	Permanent alteration of benthic habitat	• N/A	• Very Low
	Permanent increase in hydrological input	• Management through stormwater design and mitigation	• Very Low
	Temporary reduction in fish passage	• N/A	• Very Low
	Degradation of aquatic ecosystem from sediment runoff	• Implementation of the ESCP	• Very Low
	Injury or mortality of native fauna	• Avoidance of tree felling during avifauna breeding season and nest survey • Herpetofauna survey, and search and rescue	• Avifauna – Very Low • Herpetofauna – Cannot Be Assessed
Kumeū River	Permanent loss of riparian habitat	• Riparian vegetation planting as part of the LEPP	• Low
	Temporary loss of riparian habitat	• Riparian vegetation planting as part of the LEPP	• Low
	Permanent loss of native fauna habitat	• Riparian vegetation planting as part of the LEPP	• Avifauna – Very Low • Herpetofauna – Cannot Be Assessed • Bats – Cannot Be Assessed
	Temporary loss of native fauna habitat	• Riparian vegetation planting as part of the LEPP	• Avifauna – Very Low • Herpetofauna – Cannot Be Assessed • Bats – Cannot Be Assessed
	Permanent alteration of benthic habitat	• N/A	• Very Low
	Permanent increase in hydrological input	• Management through stormwater design and mitigation	• Very Low
	Temporary reduction in fish passage	• N/A	• Very Low
	Temporary degradation of aquatic ecosystem from sediment runoff	• Implementation of the ESCP	• Very Low
	Injury or mortality of native fauna	• Implementation of the fish management plan • Avoidance of tree felling during avifauna breeding season and nest survey • Herpetofauna survey, and search and rescue	• Freshwater fish – Very Low • Avifauna – Very Low • Herpetofauna – Cannot Be Assessed
Wetland 1 (436 SH16)	Temporary loss of terrestrial vegetation buffering the wetland (within 10 m)	• Wetland vegetation planting as part of the LEPP	• Very low
	Permanent increase in hydrological input	• Management through stormwater design and mitigation	• Very Low
	Degradation of wetland ecosystem from sediment runoff	• Implementation of the ESCP	• Very Low
Wetland 2 (522 SH16)	Temporary loss of terrestrial vegetation buffering the wetland (within 10 m)	• Wetland and terrestrial vegetation planting as part of the LEPP	• Very low
	Permanent loss of terrestrial vegetation buffering the wetland (within 10 m)	• Wetland and terrestrial vegetation planting as part of the LEPP	• Very low

Sensitivity: General

Loss of wetland habitat	• Changes in road design and construction to avoid and minimise impacts to the wetland. • Wetland vegetation planting as part of the LEPP	• Very Low
Permanent loss of native fauna habitat	• Changes in road design and construction to avoid and minimise impacts to the wetland. • Wetland vegetation planting as part of the LEPP	• Very Low
Temporary loss of native fauna habitat	• Changes in road design and construction to avoid and minimise impacts to the wetland. • Wetland vegetation planting as part of the LEPP	• Avifauna – Very Low • Herpetofauna – Cannot Be Assessed • Bats – Cannot Be Assessed
Permanent decrease in hydrological input	• Management through stormwater design and mitigation	• Very Low
Degradation of wetland ecosystem from sediment runoff	• Implementation of the ESCP	• Very Low
Injury or mortality of native fauna	• Avifauna nest survey within wetland habitat	• Avifauna – Very Low

9 References

- Auckland Council. (2020). Auckland Regional Pest Management Plan 2020 - 2030. In *Auckland Council*. <https://www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/topic-based-plans-strategies/environmental-plans-strategies/docsregionalpestmanagementstrategy/auckland-regional-pest-management-plan-2020-2030.pdf>
- Auckland Council. (2021). *Auckland Unitary Plan Practice and Guidance Note: River/Stream Classification* (RC 3.3.17 (V2); Auckland Unitary Plan Operative in Part). <https://content.aucklanddesignmanual.co.nz/regulations/practice-notes/Documents/RC 3.3.17 Stream Classification.pdf>
- Auckland Council. (2022). Schedule 4 Significant Ecological Areas - Marine Schedule. In *Auckland Unitary Plan Operative in part*. Auckland Council. <https://unitaryplan.aucklandcouncil.govt.nz/Images/Auckland Unitary Plan Operative/Chapter L Schedules/Schedule 4 Significant Ecological Areas - Marine Schedule.pdf>
- Ausseil, A., Gerbeaux, P., Chadderton, W., Stephens, T., Brown, D., & Leathwick, J. (2008). *Wetland ecosystems of national importance for biodiversity: Criteria, methods and candidate list of nationally important inland wetlands* (Contract Report LC0708/158). Landcare Research.
- Beca Ltd. (2022a). *SH16 Safety Improvements Stage 2 Brigham Creek To Kumeu - General Arrangements* (3235084-CA-1201 TO 1213).
- Beca Ltd. (2022b). *SH16 Safety Improvements Stage 2 Brigham Creek To Kumeu - Stormwater Design* (3235084-CD-2100 to 2127).
- Beca Ltd. (2022c). *SH16 Safety Improvements Stage 2 Brigham Creek To Kumeu - Landscape and Ecological Planting Plans* (3235084-AL-6000 TO 6300).
- Blyth, C. (2022). *SH16 Safety Improvements Stage 2 - Erosion and Sediment Control Plan (Rev2)*. Beca Ltd.
- Bridge, S., & Fraser, S. (2022). *SH16 Brigham Creek to Kumeu Safety Improvements - Stormwater Report for Resource Consent Application Stage 2*. Beca Ltd.
- Burge, O., Innes, J., Fitzgerald, N., & Richardson, S. (2017). *Habitat availability for native New Zealand bird species within the Cape-to-City footprint: a preliminary assessment* (No. LC2898). <https://www.pfhb.nz/assets/Image-Gallery/Burge-et-al-2017-Habitat-availability-for-native-NZ-bird-species-within-the-Cape-to-City-footprint.pdf>
- Clarkson, B. R. (2018). Wetland Delineation Protocols. In *Landcare Research Contract Report: LC3354*.
- Cosgrove, G., Dodd, M., & James, T. (2022). National list of exotic pasture species. In *Ministry for the Environment*.
- DOC. (2021a). *Bat Roost Protocols (BRP) Ver. 2*.
- DOC. (2021b). *Bats and Conservancies Database*.
- eBird. (2022). *eBird Basic Dataset. Version: EBD_reINov-2022*. <https://doi.org/https://doi.org/10.15468/dl.t44f88>
- Fraser, S., Singleton, P., & Clarkson, B. (2018). Hydric Soils – Field Identification Guide. In *Landcare Research* (No. LC3233). <https://www.envirolink.govt.nz/assets/R13-5-Hydric-soils-field-identification-guide.pdf>
- Greater Wellington Regional Council. (2020). *Technical guidance for the determination of natural wetlands under Greater Wellington's proposed Natural Resources Plan - Attachment 1 Pasture Species list from NZ Grasslands Association*.
- iNaturalist. (2020). *iNaturalist Herpetofauna*.
- Johnson, P., & Gerbeaux, P. (2004). Wetland Types in New Zealand. *Department of Conservation*.

- <https://www.doc.govt.nz/documents/science-and-technical/WetlandsBW.pdf>
- Johnson, P., & Rogers, G. (2003). *Ephemeral wetlands and their turfs in New Zealand*. <http://www.doc.govt.nz>
- LAWA. (2021). *Kumeu River*. <https://www.lawa.org.nz/explore-data/auckland-region/river-quality/kaipara-river/kumeu-river/>
- Leathwick, J. R., West, D., Chadderton, L., Gerbeaux, P., Kelly, D., Robertson, H., & Brown, D. (2010). *Freshwater Ecosystems of New Zealand: User Guide*.
- Lowe, M., Ingley, R., & Young, D. (2016). *Watercourse assessment methodology: infrastructure and ecology version 2.0*. Prepared by Morphum for Auckland Council. Auckland Council technical report, TR2016/002.
- McEwen, M. (1987). Ecological Regions and Districts of New Zealand. In *New Zealand Biological Resources Centre*. <https://www.doc.govt.nz/documents/science-and-technical/ecoregions1.pdf>
- MfE. (2021a). *Defining “natural wetlands” and “natural inland wetlands”* (ME 1590). Ministry for the Environment. <https://environment.govt.nz/assets/publications/Defining-natural-wetlands-and-natural-inland-wetlands.pdf>
- MfE. (2021b). *Wetland delineation hydrology tool for Aotearoa New Zealand* (ME 1575). Ministry for the Environment.
- New Zealand Birds Online. (2013). *New Zealand Birds Online: The digital encyclopedia of New Zealand Birds*. <https://www.nzbirdsonline.org.nz/>
- O'Donnell, C. F. J. (2001). Home range and use of space by *Chalinolobus tuberculatus*, a temperate rainforest bat from New Zealand. *Journal of Zoology*, 253(2), 253–264. <https://doi.org/10.1017/S095283690100022X>
- O'Donnell, C. F. J., Christie, J. E., Lloyd, B., Parsons, S., & Hitchmough, R. A. (2013). Conservation status of New Zealand Bats. *New Zealand Threat Classification Series 6, Department of Conservation*. www.doc.govt.nz
- Scott-Dye, C. (2022). *SH16 Stage 2 Bringham Creek to Kumeū - Arboricultural Assessment*. Peers Brown Miller Ltd.
- Singers, N. J. D., & Rogers, G. M. (2014). *A classification of New Zealand's terrestrial ecosystems*. www.doc.govt.nz
- Van Meewen-Dijkgraaf, A. C. (2020). *Statement of Primary Evidence of Astrid Cora Van Meewen-Dijkgraaf - Ecology*.
- Whitehead, A. L., & Booker, D. J. (2020). *NZ River Maps: An interactive online tool for mapping predicted freshwater variables across New Zealand*. <https://shiny.niwa.co.nz/nzrivermaps/>

Limitations

This report has been prepared by Beca solely for Waka Kotahi New Zealand Transport Agency. Beca has been requested by the Client to provide an ecological assessment for the proposed safety improvements along SH16 between Bringham Creek Road and Kumeū, Auckland. This report is prepared solely for the purpose of the assessment of potential ecological effects of the works (Scope). The contents of this report may not be used for any purpose other than in accordance with the stated Scope.

This report is confidential and is prepared solely for the Client. Beca accepts no liability to any other person for their use of or reliance on this report, and any such use or reliance will be solely at their own risk.

This report contains information obtained by inspection, sampling, testing or other means of investigation. Unless specifically stated otherwise in this report, Beca has relied on the accuracy, completeness, currency, and sufficiency of all information provided to it by, or on behalf of, the Client or any third party, including the information listed above, and has not independently verified the information provided. Beca accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the information provided.

The contents of this report are based upon our understanding and interpretation of current legislation and guidelines (“Standards”) as consulting professionals and should not be construed as legal opinions or advice. Unless special arrangements are made, this report will not be updated to take account of subsequent changes to any such Standards.

This report should be read in full, having regard to all stated assumptions, limitations, and disclaimers.



Ecological Impact Assessment Guidelines



Appendix A: Ecological Impact Assessment Guidelines

Assigning Ecological Value

Freshwater and Terrestrial Habitat / Community

The freshwater habitat features were assessed considering each of the attributes in Table A. 1, and terrestrial habitat features were assessed considering attributes in Table A. 2. Features of interest were subjectively given a rating on a scale of 'Very Low' to 'High' for each attribute and assigned a value in accordance with the description provided in Table A. 3.

Table A. 1. Matters that may be considered when assigning ecological value to a freshwater site or area (adapted from Roper-Lindsay et al., 2018).

Value	Explanation	Characteristics
Very High	A reference quality watercourse in condition close to its pre-human condition with the expected assemblages of flora and fauna and no contributions of contaminants from human induced activities including agriculture. Negligible degradation e.g., stream within a native forest catchment	Benthic invertebrate community typically has high diversity, species richness and abundance. Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments. Benthic community typically with no single dominant species or group of species. MCI scores typically 120 or greater. EPT richness and proportion of overall benthic invertebrate community typically high. SEV scores high, typically >0.8. Fish communities typically diverse and abundant. Riparian vegetation typically with a well-established closed canopy. Stream channel and morphology natural. Stream banks natural typically with limited erosion. Habitat natural and unmodified.
High	A watercourse with high ecological or conservation value but which has been modified through loss of riparian vegetation, fish barriers, and stock access or similar, to the extent it is no longer reference quality. Slight to moderate degradation e.g., exotic forest or mixed forest/agriculture catchment.	Benthic invertebrate community typically has high diversity, species richness and abundance. Benthic invertebrate community contains many taxa that are sensitive to organic enrichment and settled sediments. Benthic community typically with no single dominant species or group of species. MCI scores typically 80-100 or greater. EPT richness and proportion of overall benthic invertebrate community typically moderate to high. SEV scores moderate to high, typically 0.6-0.8. Fish communities typically diverse and abundant. Riparian vegetation typically with a well-established closed canopy. No pest or invasive fish (excluding trout and salmon) species present. Stream channel and morphology natural. Stream banks natural typically with limited erosion. Habitat largely unmodified.

Value	Explanation	Characteristics
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-intensity agriculture catchment.	Benthic invertebrate community typically has low diversity, species richness and abundance. Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments. Benthic community typically with dominant species or group of species. MCI scores typically 40-80. EPT richness and proportion of overall benthic invertebrate community typically low. SEV scores moderate, typically 0.4-0.6. Fish communities typically moderate diversity of only 3-4 species. Pest or invasive fish species (excluding trout and salmon) may be present. Stream channel and morphology typically modified (e.g., channelised). Stream banks may be modified or managed and may be highly engineered and/or evidence of significant erosion. Riparian vegetation may have a well-established closed canopy. Habitat modified.
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 typically has low diversity, species richness and abundance. Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments. Benthic community typically with dominant species or group of species. MCI scores typically 60 or lower. EPT richness and proportion of overall benthic invertebrate community typically low or zero. SEV scores low to moderate, typically less than 0.4. Fish communities typically low diversity of only 1-2 species. Pest or invasive fish (excluding trout and salmon) species present. Stream channel and morphology typically modified (e.g. channelised). Stream banks often highly modified or managed and maybe highly engineered and/or evidence of significant erosion. Riparian vegetation typically without a well-established closed canopy. Habitat highly modified.

Table A. 2. Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community.

Matters	Attributes to be assessed
Representativeness	Criteria for representative vegetation and aquatic habitats: Typical structure and composition Indigenous species dominate Expected species and tiers are present Thresholds may need to be lowered where all examples of a type are strongly modified Criteria for representative species and species assemblages: Species assemblages that are typical of the habitat Indigenous species that occur in most of the guilds expected of the habitat type
Rarity/distinctiveness	Criteria for rare/ distinctive vegetation and habitats: Naturally uncommon, or induced scarcity Amount of habitat or vegetation remaining Distinctive ecological features National priority for protection Criteria for rare/ distinctive species or species assemblages: Habitat supporting nationally Threatened or At Risk species, or locally uncommon species Regional or national distribution limits of species or communities Unusual species or assemblages Endemism
Diversity and pattern	Level of natural diversity, abundance, and distribution Biodiversity reflecting underlying diversity Biogeographical considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	Site history, and local environmental conditions which have influenced the development of habitats and communities The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (form "intrinsic value" as defined in RMA) Size, shape and buffering Condition and sensitivity to change Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material Species role in ecosystem functioning – high level, key species identification, habitat as proxy

Table A. 3. Rating system for assessing ecological value of terrestrial and freshwater systems (Roper-Lindsay et al. 2018).

Value	Description
Negligible	Feature rates Very Low for at least three assessment attributes and Low to Moderate for the remaining attribute(s).
Low	Feature rates Very Low to Low for most assessment attributes and moderate for one. Limited ecological value other than providing habitat for introduced or tolerant indigenous species.
Moderate	Feature rates High for one assessment attribute and Low to Moderate for the remainder, <u>OR</u> the project area rates Moderate for at least two attributes and Very Low to Low for the rest. Likely to be important at the level of the Ecological District.
High	Feature rates High for at least two assessment attributes and Low to Moderate for the remainder, <u>OR</u> the project area rates High for one attribute and Moderate for the rest. Likely to be regionally important.
Very High	Feature rates High for at least three assessment attributes. Likely to be nationally important.

Species

The EIANZ provides a method for assigning value (Table A. 4) to species for the purposes of assessing actual and potential effects of activities.

Table A. 4. Criteria for assigning ecological values to species.

Ecological Value	Species
Very High	Threatened (Nationally Critical, Nationally Endangered, Nationally Vulnerable)
High	At Risk (Declining, Recovering, Relict, Naturally Uncommon)
Medium	Native – Not threatened
Low	Introduced

Assigning Magnitude of Impacts

The magnitude of impacts is determined by the scale (temporal and spatial) of potential impacts identified and the degree of ecological change that is expected to occur as a result of the proposed activity (Roper-Lindsay et al. 2018).

Based on the assessor's knowledge and experience, the magnitude of identified impacts on the ecological values within the project area and zone of influence were assessed and rated on a scale of 'Very High' to 'Negligible' based on the description provided in Table A. 5.

Table A. 5. Criteria for describing the magnitude of effects (Roper-Lindsay et al. 2018).

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

Assessment also considered the temporal scale at which potential impacts were likely to occur:

- Permanent (>25 years).
- Long-term (15-25 years).
- Medium-term (5-15 years).
- Short-term (0-5 years).
- Temporary (during construction)

Assessing the Overall Level of Effects

The overall level of effect on each ecological feature identified within the zone of influence were determined by considering the magnitude of impacts and the values of impacted ecological features (Roper-Lindsay et al. 2018).

Results from the assessment of ecological value and the magnitude of identified impacts were used to determine the level or extent of the overall impacts on identified ecological features within the project area and zone of influence using the matrix described in Table A. 6.

Table A. 6. Matrix combining magnitude and value for determining the level of ecological impacts (Roper-Lindsay et al. 2018).

Effect Level		Ecological and/or Conservation Value				
		Very High	High	Moderate	Low	Negligible
Magnitude	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

Results from the matrix were used to determine the type of responses that may be required to mitigate potential direct and indirect impacts within the project area and within the zone of influence, considering the following guidelines (Roper-Lindsay *et al.* 2018):

- A 'Low' or 'Very Low' level of impact is not normally of concern, though design should take measures to minimise potential effects.
- A 'Moderate' to 'High' level of impact indicates a level of impact that qualifies careful assessment on a case-by-case basis. Such activities could be managed through avoidance (revised design) or appropriate mitigation. Where avoidance is not possible, no net loss of biodiversity values would be appropriate.

A 'Very High' level of impact is unlikely to be acceptable on ecological grounds alone and should be avoided. Where avoidance is not possible, a net gain in biodiversity values may be appropriate.

A large, white, serif capital letter 'B' is centered on the right side of a teal rectangular background.

Wetland 2 (522 SH16) – Historic Aerial Imagery

Appendix B: Wetland 2 (522 SH16) – Historic Aerial Imagery



Figure B 1. Historic aerial imagery of Wetland 2 from 1940 (indicated in red circle) (image retrieved from Retrolens; www.retrolens.co.nz).



Figure B 2. Historic aerial imagery of Wetland 2 from 1950 (indicated in red circle) (image retrieved from Retrolens; www.retrolens.co.nz).



Figure B 3. Historic aerial imagery of Wetland 2 from 1963 (indicated in red circle) (image retrieved from Retrolens; www.retrolens.co.nz).



Figure B 4. Historic aerial imagery of Wetland 2 from 1975 (indicated in red circle) (image retrieved from Retrolens; www.retrolens.co.nz).



Figure B 5. Historic aerial imagery of Wetland 2 from 1996 (indicated in red circle) (image retrieved from Auckland Council GeoMaps; [www. geomapspublic.aucklandcouncil.govt.nz](http://www.geomapspublic.aucklandcouncil.govt.nz)).



Wetland Plot Results and Delineated Extents

Appendix C: Wetland Plot Results and Delineated Extents

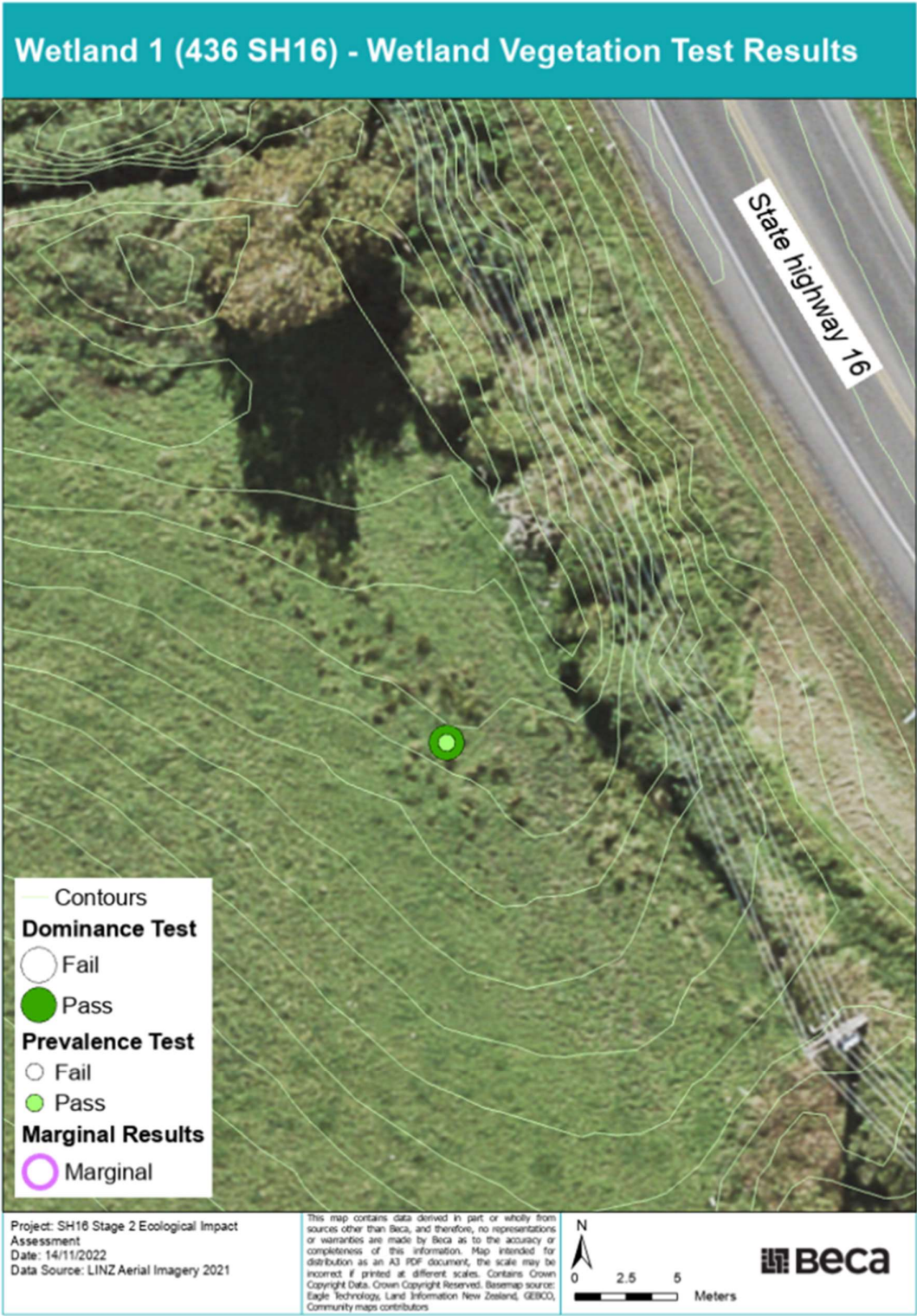


Figure C 1.Results of the Dominance and Prevalence Tests undertaken at Wetland 1 (436 SH16).



Figure C 2.Results of the pasture assessment undertaken at Wetland 1 (436 SH16).



Figure C 3. The final delineated extent of Wetland 1 (436 SH16) following refinement based on an assessment of the hydrology and vegetation.

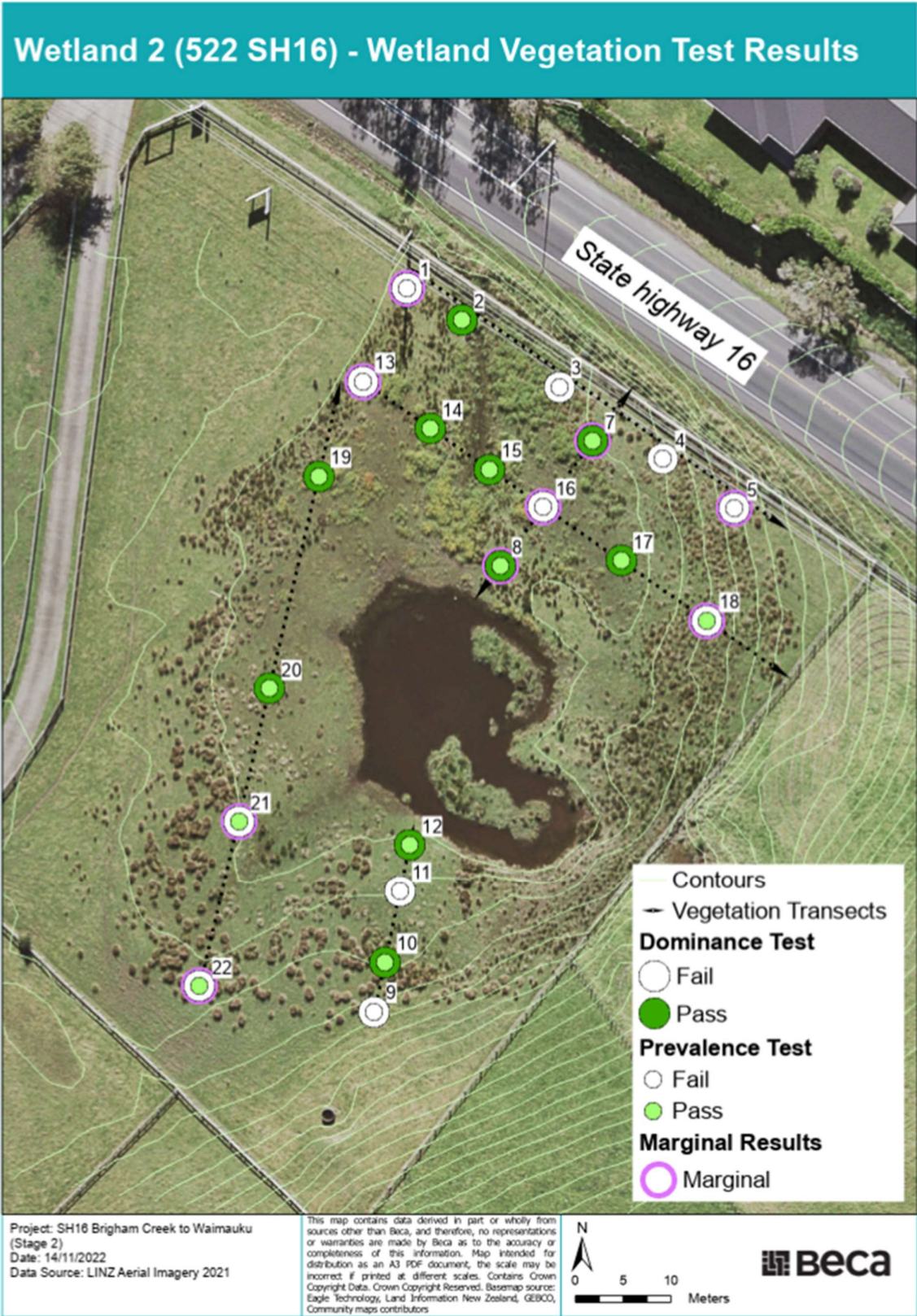


Figure C 4.Results of the Dominance and Prevalence Tests undertaken at Wetland 2 (522 SH16).

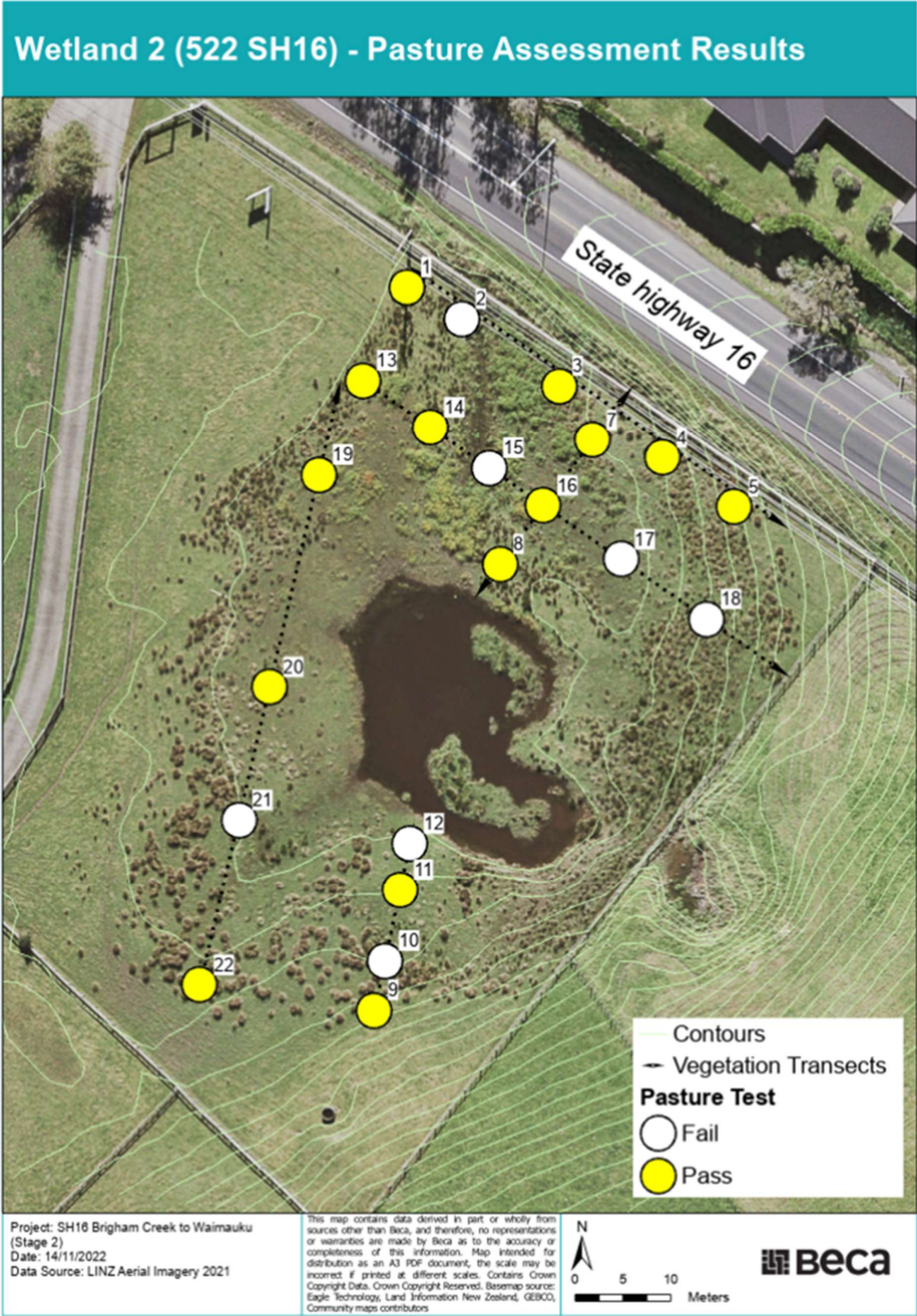


Figure C 5.Results of the pasture assessment undertaken at Wetland 2 (522 SH16).

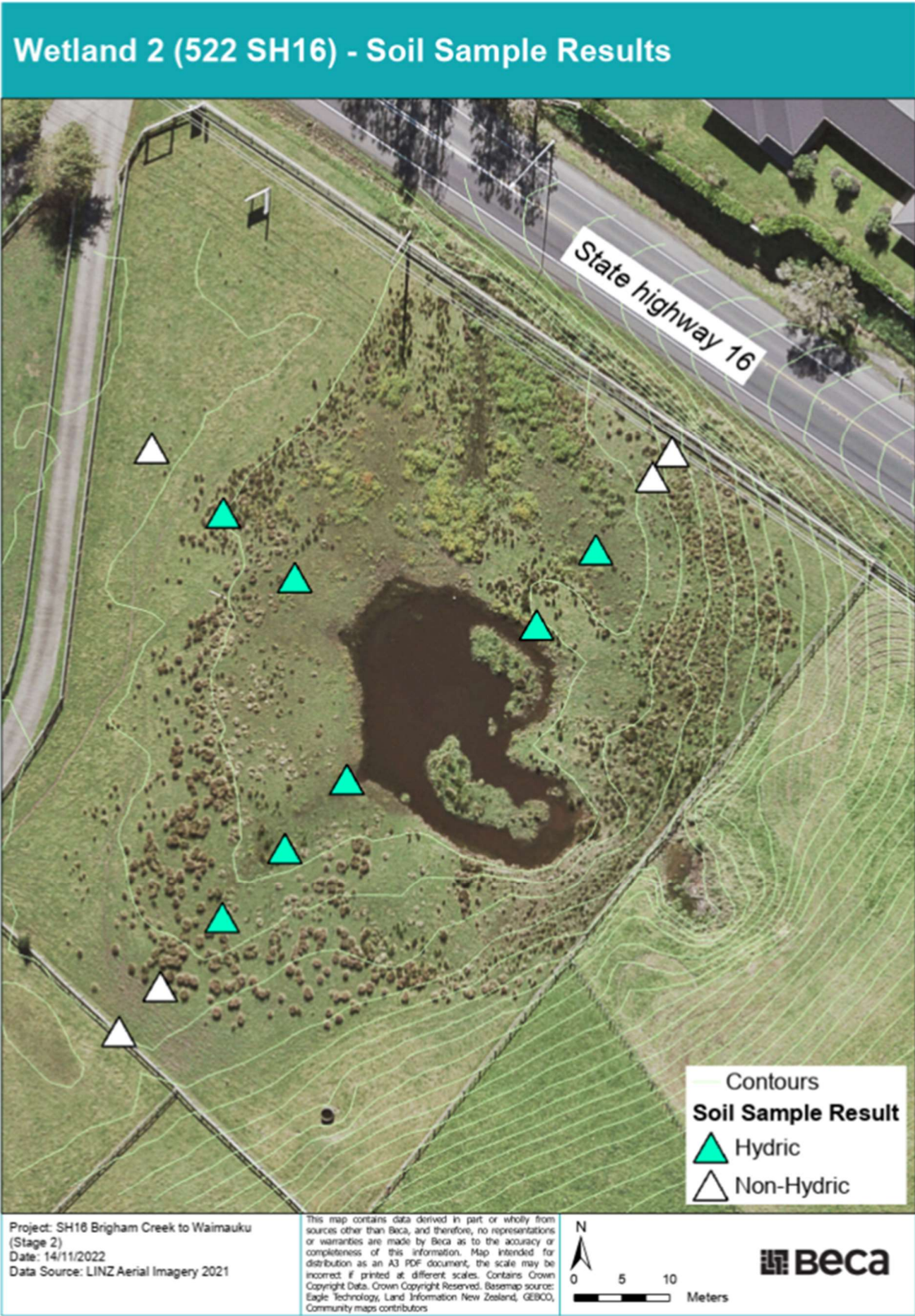


Figure C 6. Results of the soil sample taken at Wetland 2 (522 SH16).



Figure C 7. The final delineated extent of Wetland 2 (522 SH16) following refinement based on an assessment of the hydrology, soil, and vegetation.

D

Temporary and Permanent Vegetation Loss

Appendix D: Temporary and Permanent Vegetation Loss

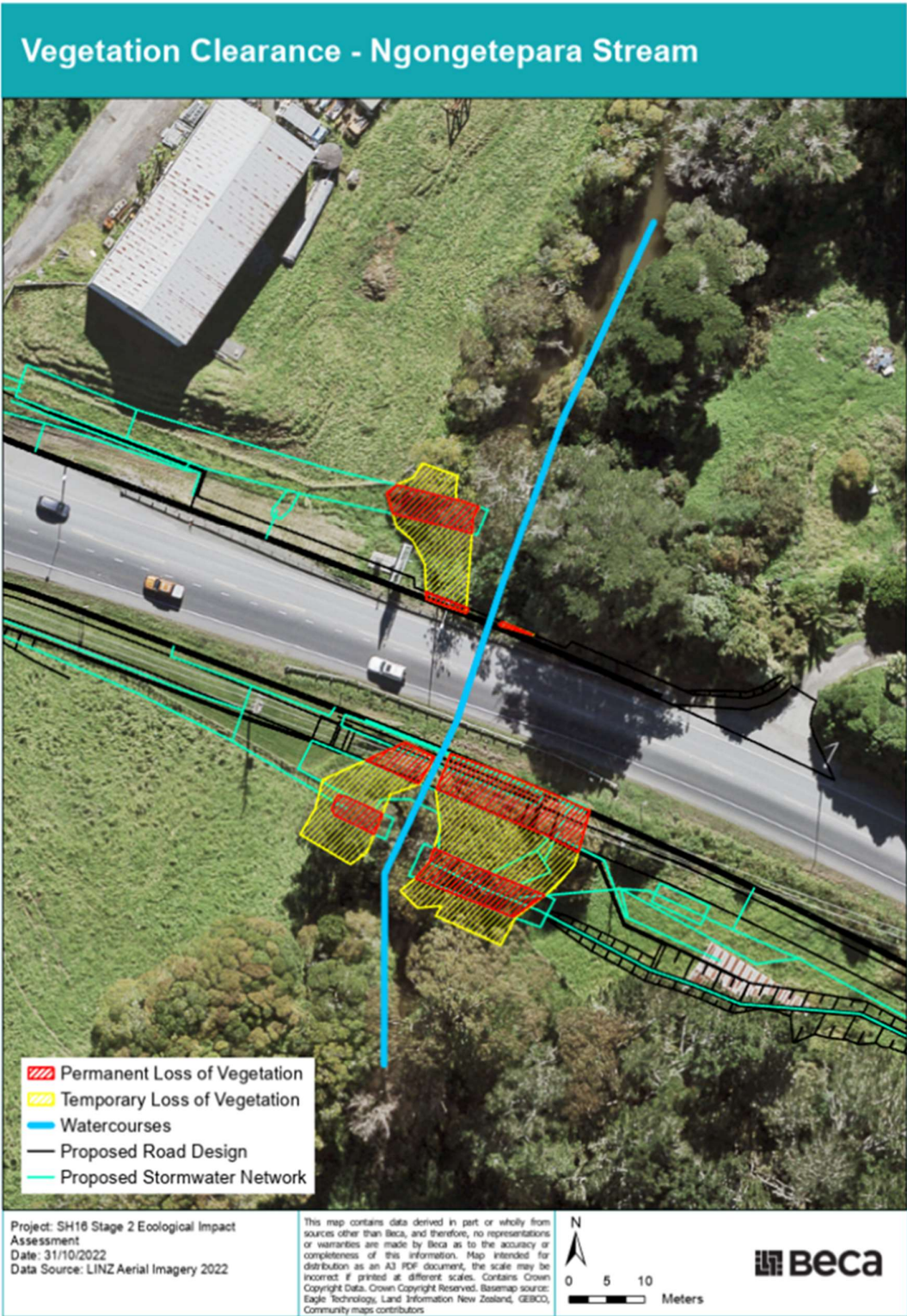


Figure D 1. The temporary and permanent loss of vegetation at the Nongetepara Stream due to proposed works.



Figure D 2.The temporary and permanent loss of vegetation at Watercourse 2 due to proposed works.

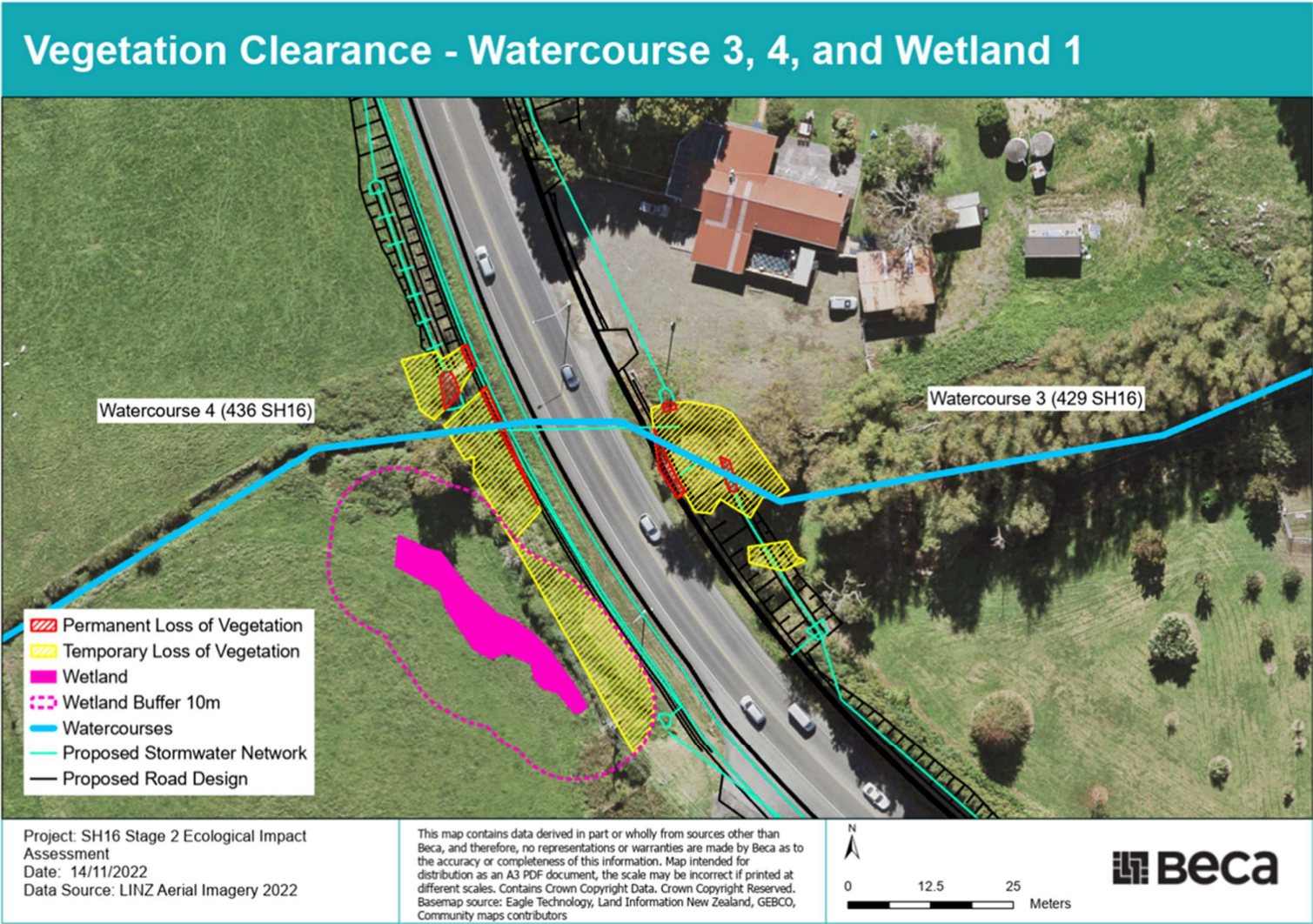


Figure D 3.The temporary and permanent loss of vegetation at Watercourse 3, Watercourse 4, and Wetland 1, due to proposed works

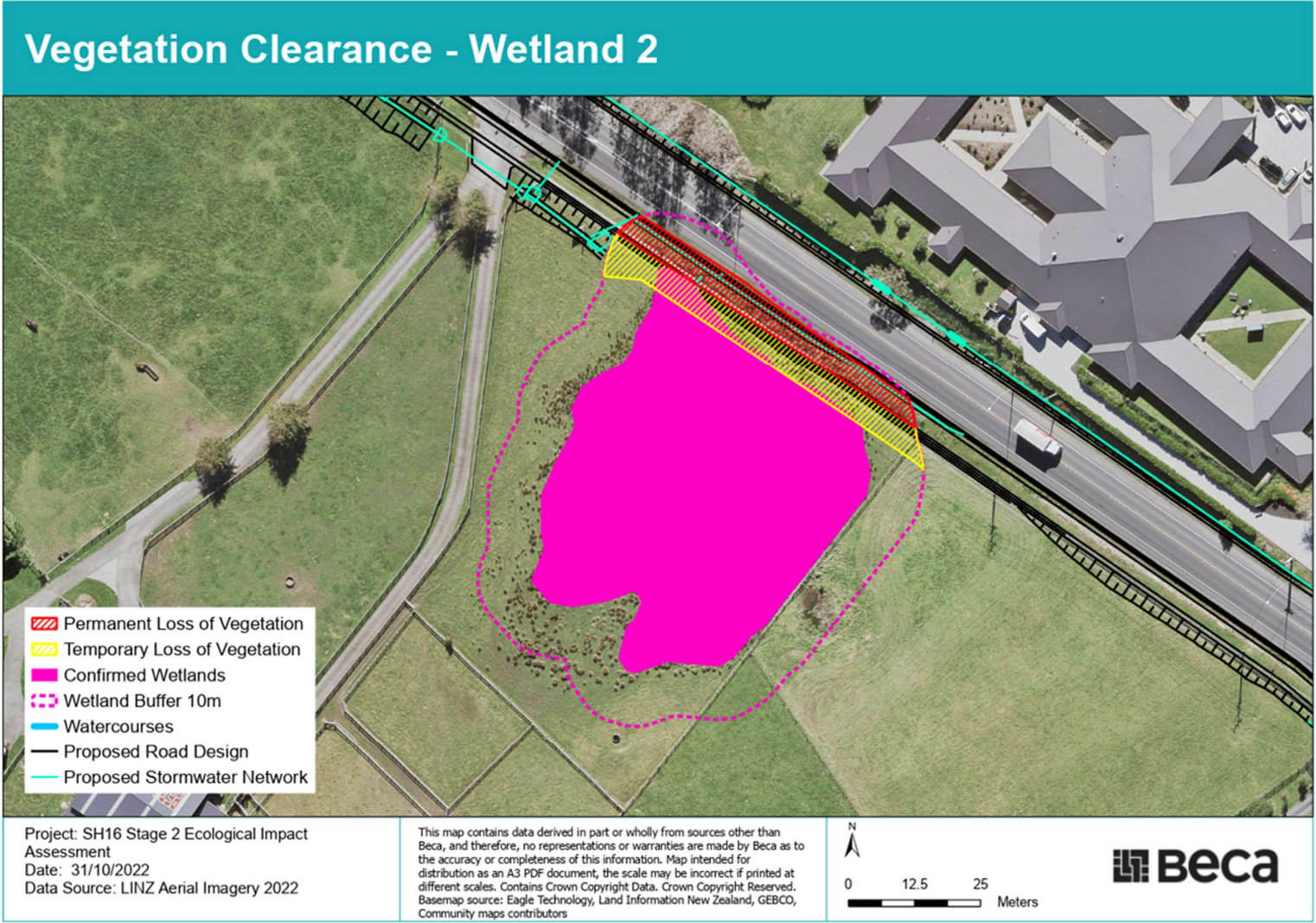


Figure D 4. The temporary loss of vegetation at Wetland 2, as well as temporary and permanent loss of terrestrial vegetation within a 10 m buffer of the wetland due to proposed works.

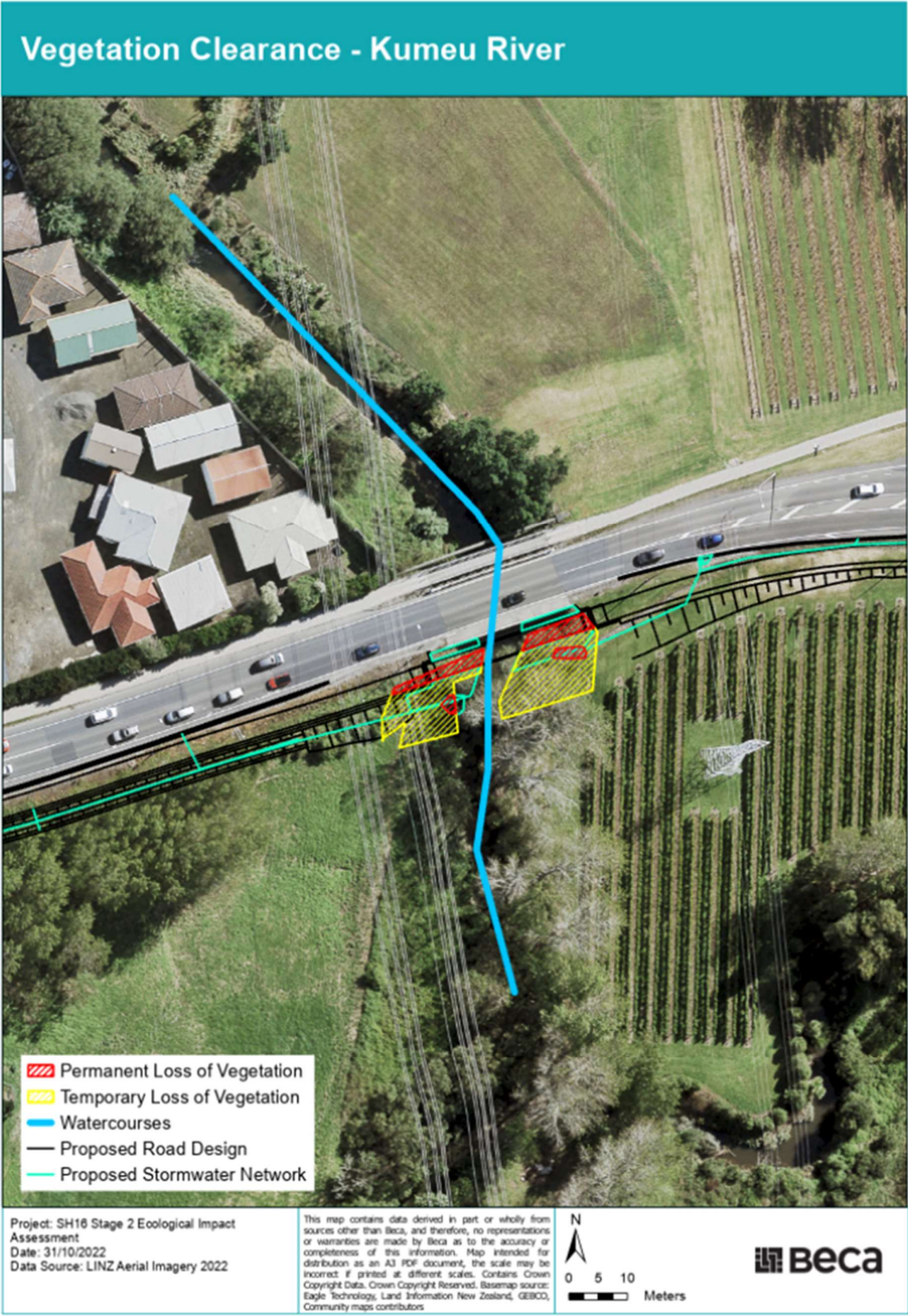


Figure D 5.The temporary and permanent loss of vegetation at the Kumeū River due to proposed works.