



Whenuapai Wastewater Servicing Scheme Package 1

Ecological Impact Assessment

Prepared for Watercare Services Ltd
Prepared by Beca Limited

5 September 2022



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Revision History

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Reviewed by	Raymond Chang/Sarah MacCormick		5/09/2022
Approved by	Jenny Vince		5/09/2022
on behalf of	Beca Limited		

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Executive Summary

Beca Ltd has been commissioned on behalf of Watercare Services Ltd (Watercare) to prepare an Ecological Impact Assessment (EclA) to support consenting requirements associated with Whenuapai Redhills: Package 1 Project. The works are located between Brigham Creek Road (north), the South-Western Motorway (west), Northside Drive (south) and Mamari Road (east). These works will provide a new wastewater pipeline and pumpstation to accommodate for the growth of the North West region of Auckland.

Three key elements are involved in these project works: a new gravity pipeline, a new pump station with an emergency wastewater overflow outfall into the stream, and a new rising main with a culvert.

Ecological site investigations have recently been undertaken by Tonkin & Taylor Ltd (T&T) over a series of site visits and surveys for a similar geographic area to inform a Plan Change application by Oyster Capital for Spedding Block. T&T's investigations of the area were undertaken between January and February 2020, in July 2020, and a wetland specific site visit was undertaken in September 2020 to identify key terrestrial and freshwater ecological features across the site. This report *Tonkin & Taylor (2021) Plan Change Assessment of Ecological Effects – Spedding Block, Whenuapai* dated 3 September 2021; has been referred to, where appropriate, to avoid duplication of efforts. The potential adverse ecological effects identified as part of this EclA are as follows:

Potential temporary construction stage effects:

- Sediment runoff and/or discharge of sediment laden water into streams;
- Hydrological disturbance to degraded natural wetland;
- Temporary reduction in fish passage;
- Potential injury and/or mortality to fish;
- Potential injury and/or mortality to bats;
- Potential injury and/or mortality of lizards;
- Disturbance to birds;
- Disturbance to degraded natural wetland habitat;
- Removal of riparian vegetation.

Potential permanent operational effects:

- Loss and disturbance to in-stream habitat;
- Permanent loss of a section of degraded natural Wetland C.

Effects management and mitigation proposed in this report to address these effects include implementation of environmental management during construction including:

- Native fish salvage and management plan;
- Bat management;
- Lizard management;
- Bird management;
- Wetland and riparian vegetation restoration and planting plan;
- Stream compensation.

With the implementation of the mitigation measures listed above, the overall level of the ecological effects associated with these works is **Low**, with minimal residual adverse effects expected.

1 Introduction

The Whenuapai Redhills: Package 1 Project (the Project) is located between Tamiro Road, Brigham Creek Road (north), South-Western Motorway (west), Northside Drive (south) and Mamari Road (east). These works will provide a new wastewater pipeline and pumpstation to accommodate for the growth in the Whenuapai catchment.

Three key elements are involved in these project works: construction of a gravity main, a pump station with an emergency wastewater overflow outfall to the stream, and a rising main with culvert across Sinton Stream. In relation to potential ecological effects, these works will involve earthworks within the riparian yard and a wetland area, vegetation removal within a riparian area, and groundwater diversion and dewatering.

Beca has been commissioned on behalf of Watercare to prepare an Ecological Impact Assessment (EclA) to support an application for resource consents for these proposed construction works.

1.1 Purpose and Scope

The purpose of this EclA is to quantify the ecological values of the habitat and species within the proposed works footprint, and to determine the ecological impacts of the proposed works to construct the pipeline, rising main, and pump station.

The scope of this report includes the following:

- A desktop-based review of information held by Auckland Council and other publicly accessible reports, data, and information;
- A site visit examining wetland, freshwater, and riparian habitat features affected by the area of works;
- An assessment of the ecological values in the works area;
- An assessment of ecological effects and recommended mitigation prepared in general accordance with the EIANZ Ecological Impact Assessment Guidelines (Roper-Lindsay et al., 2018).

1.2 Project Description

The Project aims to provide wastewater servicing capacity for approximately 10,240 dwellings, or 30,720 people, in the Whenuapai catchment. This growth is projected to occur by 2041. The Project includes the following five key components (see Figure 1):

1. A **Pump Station** at a point where the Whenuapai and Redhills Catchments meet at 23-27 Brigham Creek Road, with an emergency overflow outfall to the Sinton Stream
2. A **Gravity Main Pipeline** (approximately 700m long and 375 – 475 mm in diameter) between Whenuapai Village Pump Station on Tamiro Road and the new pump station
3. A **Rising Main** (approximately 1.4km long and 500 mm in diameter) between the Pump Station and a proposed new break pressure chamber on Mamari Road (the boundary of Package 2)¹.
4. A **Culvert** (approximately 63 m long including wing wall and rip rap) to provide access for the rising main across Sinton Stream.

¹ An extension of the rising main is part of 'Package 2' and will be designed to connect to the planned Northern Interceptor Phase 2 tunnel and deliver flows from the Whenuapai Catchment to the Rosedale Wastewater Treatment Plant for treatment. Package 2 is subject to a separate consent application.

5. A **Break Pressure Chamber** which connects to the Massey Connector rising main (proposed under Package 2).

The Project extends from the existing Whenuapai Village pump station site in Tamiro Road in the north, across Brigham Creek Road, to Spedding Road in the south. Refer to Beca Assessment of Environmental Effects (AEE) for further specification of the relevant regulatory framework.

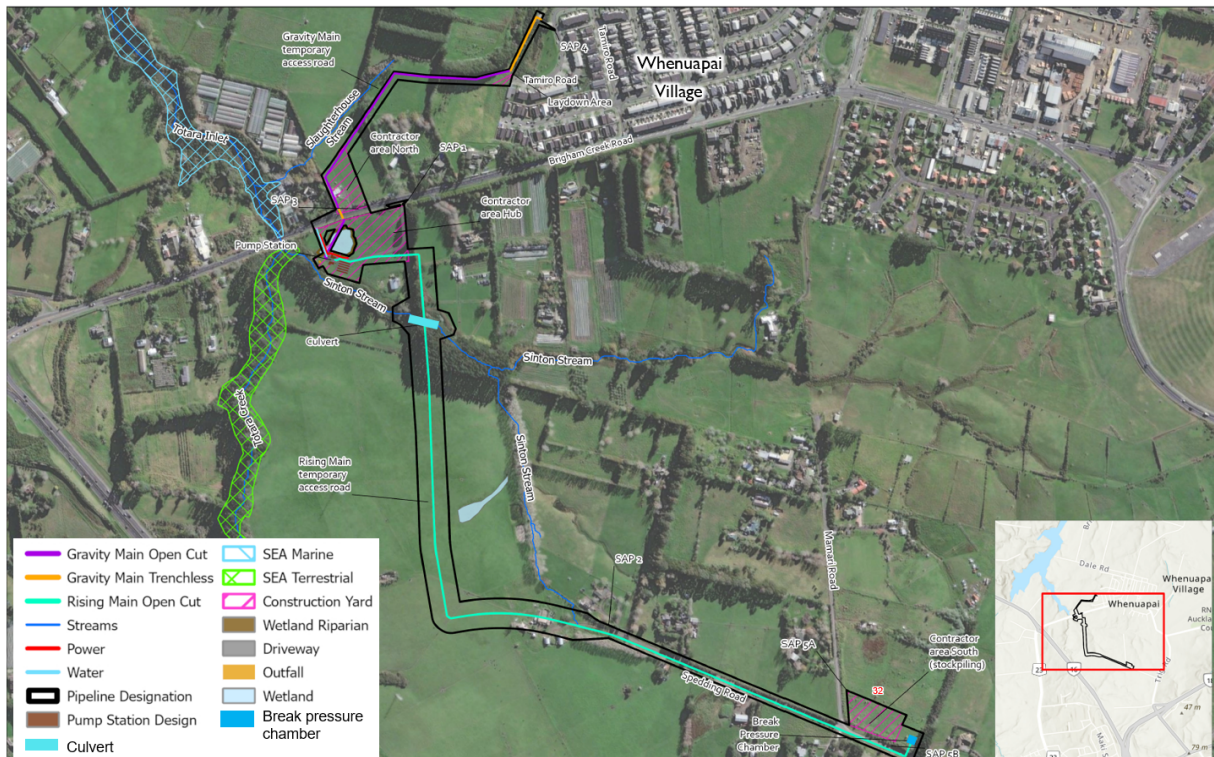


Figure 1. Package 1 – 'the Project' overview

1.2.1 Proposed Works Methodologies

The proposed works to construct the new pump station, gravity pipeline, and rising main will require works over a period of approximately 18-20 months. The gravity pipeline is intended to run underground for its full length. The rising main pipe will be primarily underground but will cross Sinton Stream via a culvert. Both pipelines will be installed predominantly by conventional open cut trenching to be opened and closed progressively, with trenchless methods used for a short section beneath Brigham Creek Road and near the existing Whenuapai Village pump station. The pump station will be predominately underground requiring excavation depths of approximately 9.5 m, constructed near Sinton Stream and a wetland area. For use during construction, a temporary metallised hardstand area of approximately 5,000 m² will be installed near the pump station and wetland. The construction of an emergency overflow outlet from the pump station wet well is required comprising an outlet of a new pipe, wingwall and rip rap on the bank of Sinton Stream. This will allow for the discharge into Sinton Stream if the pumping station becomes overloaded with wastewater.

2 Site Location and Ecological Context

The Site (refer Figure 2) is located in the suburb of Whenuapai, Auckland on the northeast border of the North-Western motorway. It sits within the Tamaki Ecological District which was historically characterised by taraire and pūriri forest, but has been subject to extensive vegetation clearance and landform modification for urban use over time (McEwen, 1987). Prior to any development, the Site would have been covered by a mixture of Pūriri forest (WF7), and Kauri, Podocarp, broadleaved forest (WF11) (Singers & Rogers, 2014). Currently, the site and surrounding land is predominantly pastoral lifestyle blocks.

The Site is within a predominantly rural-residential agricultural area in a Future Urban zoned area. The Site is within a High Use Aquifer Management Area, subject to a high number of water takes/allocations (Auckland Council, 2022). There are a series of streams in the vicinity of the site area which discharge downstream into the Tōtara Inlet and Brigham Creek (Sinton and Slaughterhouse Streams). These eventually discharge into an arm of the Waitematā Harbour. Tōtara Creek is classified as a terrestrial Significant Ecological Area (SEA_T_2034) and Brigham Creek as a marine Significant Ecological Area (SEA_M2_57b) (refer Figure 2 for location). The key ecological areas and features within the Project vicinity are detailed in Section 5 below.

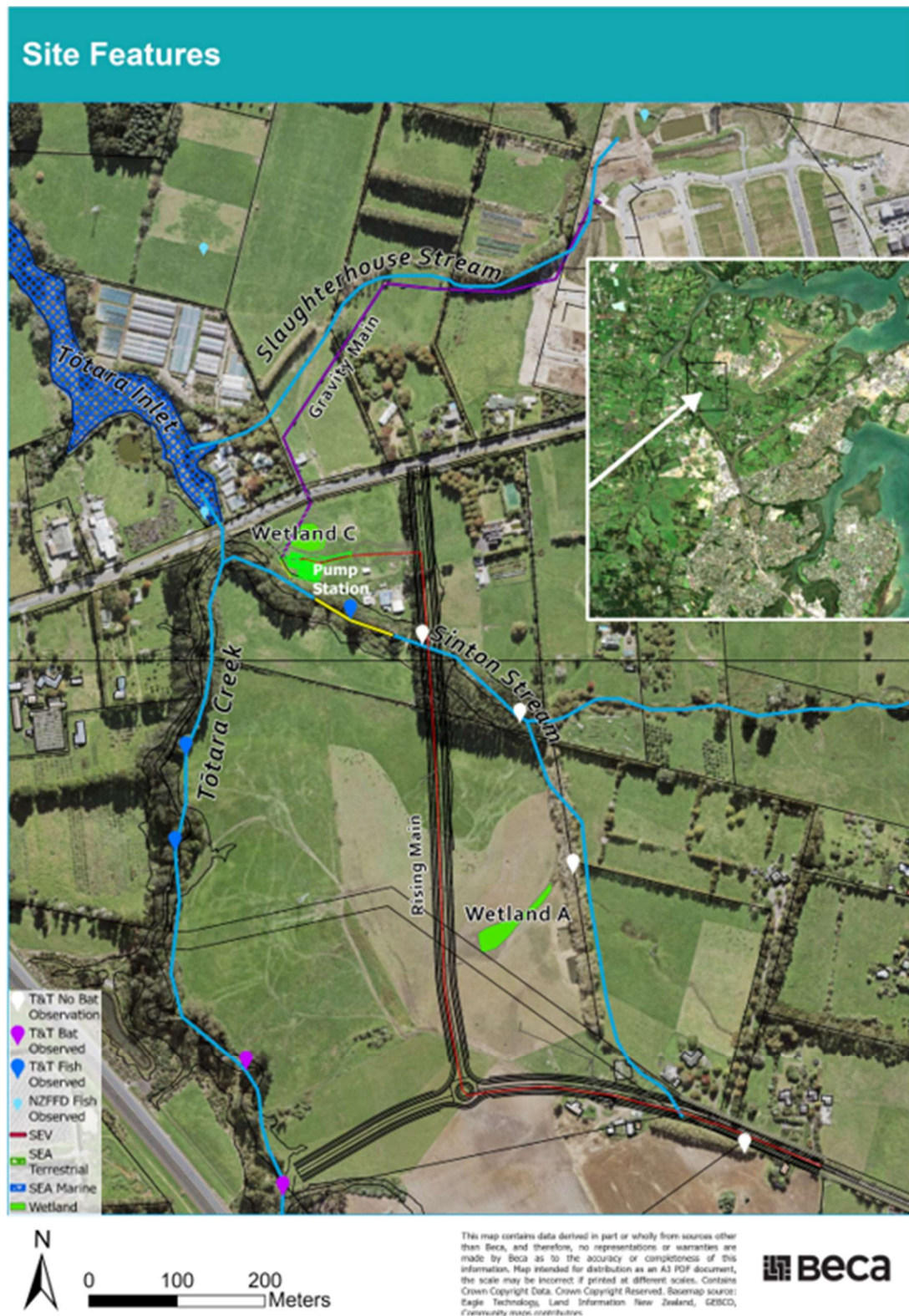


Figure 2: Site in relation to surrounding landscape features and fauna alongside gravity main, pumpstation, and rising main alignment.

3 Methodology

This report has been informed by a desktop review of existing information, field investigations (undertaken by others) and a site walkover by Beca Ltd as outlined below.

3.1 Desktop Review

A desktop based review was undertaken by Beca Ltd using ecological information from the following sources:

- Auckland Council GeoMaps data and geospatial layers including: catchment and hydrology, ecosystems potential extent, SEAs;
- Previous Report: *Tonkin & Taylor Ltd, 2021. Plan Change Assessment of Ecological Effects – Spedding Block, Whenuapai.*
- New Zealand Freshwater Fish Database (NZFFD) (Crow, 2017); and
- Other publicly accessible reports or information.

The Tonkin & Taylor Ltd (T&T) report delineated the two 'natural wetlands' that are assessed in this report. A delineated 'natural wetland' is subject to regulation under the National Environmental Standards for Freshwater Regulations 2020 (NES FW 2020). Beca Ltd accept and rely on the wetland delineation and have used this as the basis for the assessment in this report.

3.2 Field Investigation

Comprehensive ecological field investigations were carried out by T&T between January and February 2020, and in July 2020, and along with a wetland specific site visit in September 2020. Data from this report has been used where appropriate and a brief description of methods are outlined below. Refer to (Tonkin & Taylor Ltd, 2021) for further details regarding the field investigation methods.

A site walkover by Beca Ltd was undertaken as part of the initial scoping in 28 February 2020 to view the Project location and identify any other ecological features of key importance. Two additional potential wetlands were subsequently identified via desktop. Detailed investigations at these two potential wetland areas were conducted on the 5th July 2022 during a site walkover in general accordance with the New Zealand Wetland Delineation Protocols and current Ministry for the Environment guidance in order to classify potential wetlands and delineate extent where necessary (Clarkson, 2018; Clarkson, 2014; Fraser et al., 2018; Ministry for the Environment, 2021a, 2021b; see Figure 4 for overview), and were assessed as described below in Appendix E. The remaining ecological features have been identified and delineated through the T&T field investigations which we reference here and did not seek to validate separately.

3.2.1 Automatic Bat Monitoring

T&T deployed eight Department of Conservation (DOC) Automatic Bat Monitors (ABMs) across the site, targeting potential roosting trees and areas of likely bat foraging for a total of 20 nights in March 2020. This was to identify the presence of the long-tailed bat (*Chalinolobus tuberculatus*) with a conservation status of 'Nationally Critical'.

3.2.2 Vegetation assessment

Terrestrial habitat assessments were also completed following 'Rapid Ecological Assessment' methodology developed by Auckland Council (2012) to capture the species composition and ecological value of terrestrial vegetation at the site.

3.2.3 Fish and macroinvertebrate sampling

T&T undertook a fish survey within Sinton Stream and Tōtara Creek. A combination of un-baited fyke nets ($n = 3$) and Gee minnow traps (GMTs) ($n = 6$) were deployed over one night in July 2020. Macroinvertebrate samples were taken with kick nets in Sinton Stream in July 2020.

3.2.4 Stream Ecological Valuation (SEV) for Sinton Stream

A Stream Ecological Valuation (SEV) (Storey, et al., 2011) was carried out by T&T for the impact reach where culvert construction will take place at Sinton Stream on 27th October 2020. The methodology includes a fish survey, aquatic macroinvertebrate sampling, cross-sections to record habitat characteristics such as depth and substrate, and qualitative assessment of attributes such as channel modification and riparian vegetation class. Different weightings are given to the different collections of attributes and the values of a stream are quantified based on the performance of 14 ecological functions, which fall under broader categories of hydraulic, biogeochemical, habitat provision and biodiversity (Storey, et al., 2011). These functions are used to determine an overall SEV value between 0 (a stream with the minimum ecological valuation) and 1 (a stream with the maximum ecological valuation) which is interpreted alongside SEV values for reference streams of the same stream type. Interpretation of SEV scores is given in Table 1.

Table 1. Interpretation of SEV scores (adopted from Neale et al., 2016).

Score	Category
0 – 0.4	Poor
0.41 – 0.60	Moderate
0.61-0.80	Good
0.81+	Excellent

An Ecological Compensation Ratio (ECR) can be calculated from SEV scores for an impact and mitigation reach by determining the difference between potential SEV scores after restoration at both reaches in comparison to their current values multiplied by a factor to account for lag in time before commensurate biodiversity values are achieved at the mitigation reach.

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

- *SEVi-P is the potential SEV value for the site to be impacted.*
- *SEVi-I is the predicted SEV value of the stream to be impacted after impact.*
- *SEVm-C is the current SEV value for the site where environmental compensation is applied.*
- *SEVm-P is the potential SEV value for the site where environmental compensation is applied.*

$$\text{Restoration length required} = (\text{impact area} \times ECR) / \text{restoration channel width}$$

3.2.1 Wetland delineation assessment of Wetlands A and C

A wetland delineation assessment to determine the wetland extent was undertaken by a suitably qualified ecologist from T&T during visits in both July and September 2020. The presence of two 'natural wetlands' (natural wetland A and natural wetland C) was confirmed during these visits.

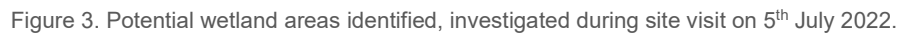
3.2.2 Classification of additional potential wetland areas

Desktop screening for 'natural wetlands' was undertaken by Beca for each block of land using ArcGIS Pro 2.9.0 desktop geospatial software with a particular focus on the confirmed pipe alignment that had not previously been assessed by T&T. GIS data and ecological information were used from the following sources:

- Google Earth and LINZ aerial photography;
- Auckland Council geospatial layers;

- Retrolens historical imagery;
- Manaaki Whenua soil information from S-map (Manaaki Whenua, 2021);
- Freshwater Ecosystems of New Zealand (FENZ) historic wetland typology geospatial layer (Leathwick et al., 2010).

The topography and underlying geology of the site was first examined using contours, modelled overland flow paths and S-Map to understand where 'wet' areas might be located. The site was then examined for any predicted (prehuman arrival) wetland extents as modelled by Ausseil et al. (2008) and shown in FENZ geospatial layers (Leathwick et al., 2010). Subsequently, recent aerial imagery from Google Earth (accessed June 2022) and LINZ (accessed June 2022) were visually inspected for wetland features. The photography was analysed for hydrophytic plant communities using visual cues such as colour, shape, texture, and location. Particular attention was also paid to low stature vegetation which may be indicative of rushlands, and sharp changes in vegetation composition. The aerial imagery was also explored for any evidence of inundation (a primary indicator of wetland hydrology), and soil saturation (a secondary indicator of wetland hydrology).



Weather was cloudy with showers at the time of the site visit and 41.7mm mm of rain had accumulated in the two weeks prior (Whenuapai Aws; NIWA, 2021).

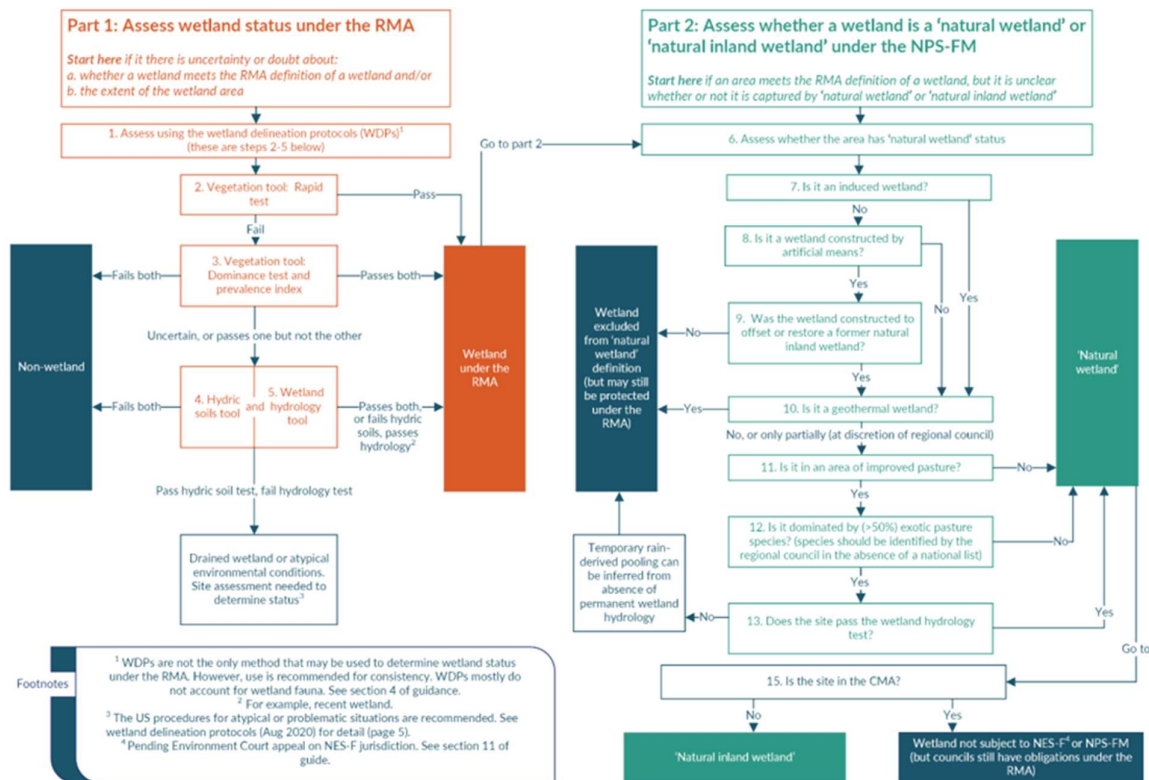


Figure 4. Assessing 'natural wetland' and 'natural inland wetland' status under the NPS-FM (MfE, 2021).

3.3 Assessment Methodology

A desktop assessment of ecological effects was undertaken in accordance with Ecological Impact Assessment (EiA) EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems (Roper-Lindsay et al., 2018). The EIANZ guidelines set out a methodology to assign ecological value to species and ecosystems based on four assessment criteria which are consistent with 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. These are reproduced in this report as a series of tables in Appendix B. In summary:

- Particular attributes are considered when determining ecological value or importance. These relate to matters such as representativeness, the rarity and distinctiveness, diversity and patterns, and the broader ecological context;
- The value of terrestrial species is determined from the following factors; whether species are native or exotic, have threatened conservation status, and their abundance and commonality at the Project site;
- Ecological Values are scored based on an expert judgement, and qualitative and quantitative data collected. The freshwater features assessment has additionally been guided by an adaption to the EIANZ methodology to provide linkage to some of the common stream ecological value assessment methodology.

Once ecological values have been identified and valued, the severity of potential impacts is assessed by determining the change from baseline ecological values likely to occur as a result of the proposal/project. This provides a magnitude of effect as determined by the criteria set out in Appendix B.

Finally, once these two factors have been determined (the ecological value and the magnitude of effect), an overall level of effect on each of the identified ecological values is assessed.

4 Wetland classification

The two additional potential wetland locations (in addition to those already canvassed by T&T) were identified in the vicinity of the project works via desktop observations as these were observed to be areas of contour depression adjacent to the stream (potential wetland 1) and sloping down towards a stream (potential wetland 2). Areas such as this are considered indicators of potential wetlands. A site visit was undertaken on 5th July 2022 to delineate these potential wetland areas. After completing a wetland assessment (refer Appendix E) following the wetland delineation protocols, these areas were confirmed to be **not** areas of natural wetland.

Neither of the two areas are modelled as historic wetland (Ausseil et al., 2008; Leathwick et al., 2010). In historic aerial imagery from 1959 (Figure 5), Potential wetland 1 consists of a stream channel and potential adjacent riverine wetland vegetation located within the floodplain. Potential wetland 2 consists solely of pasture in 1959, however since this time the area has been excavated for a silage storage area and drainage channel. This excavation has subsequently formed an area of contour depression.

These two potential wetland areas are mapped in Figure 3 and were investigated during the site visit in accordance with the methodology described in Section 3.2.2.



Figure 5. Aerial imagery from 1959 showing approximate locations of potential wetland areas (sourced from Auckland Council Geomaps, accessed 28/7/2022).

5 Ecological Values

The following section assesses the current ecological values for the sites described in Section 2 above. The potential ecological value of existing streams has also been assessed, following reasonable restoration as directed by the National Policy Statement: Freshwater Management (NPS FM) 2020. The key ecological features within the Project site for which value has been assessed are:

- Sinton Stream;
- Slaughterhouse Stream;
- Wetland A;
- Wetland C;
- Vegetation;
- Terrestrial Fauna.

5.1 Sinton Stream

Sinton Stream flows from east to west across the site, discharging into Tōtara Inlet and into Brigham Creek (refer Figure 2). The downstream reach of Sinton Stream is permanent with water flowing year-round. In-stream habitat heterogeneity is present (i.e. pool, riffle, run habitats). It has a mix of exotic and indigenous riparian vegetation providing moderate shading, including a large stand of pine trees (*Pinus* spp) (Figure 6 and Figure 7). Immediately downstream of the pine stand is a culvert approximately 5.1 m in stream length, identified to be flowing unimpeded through low flow conditions.

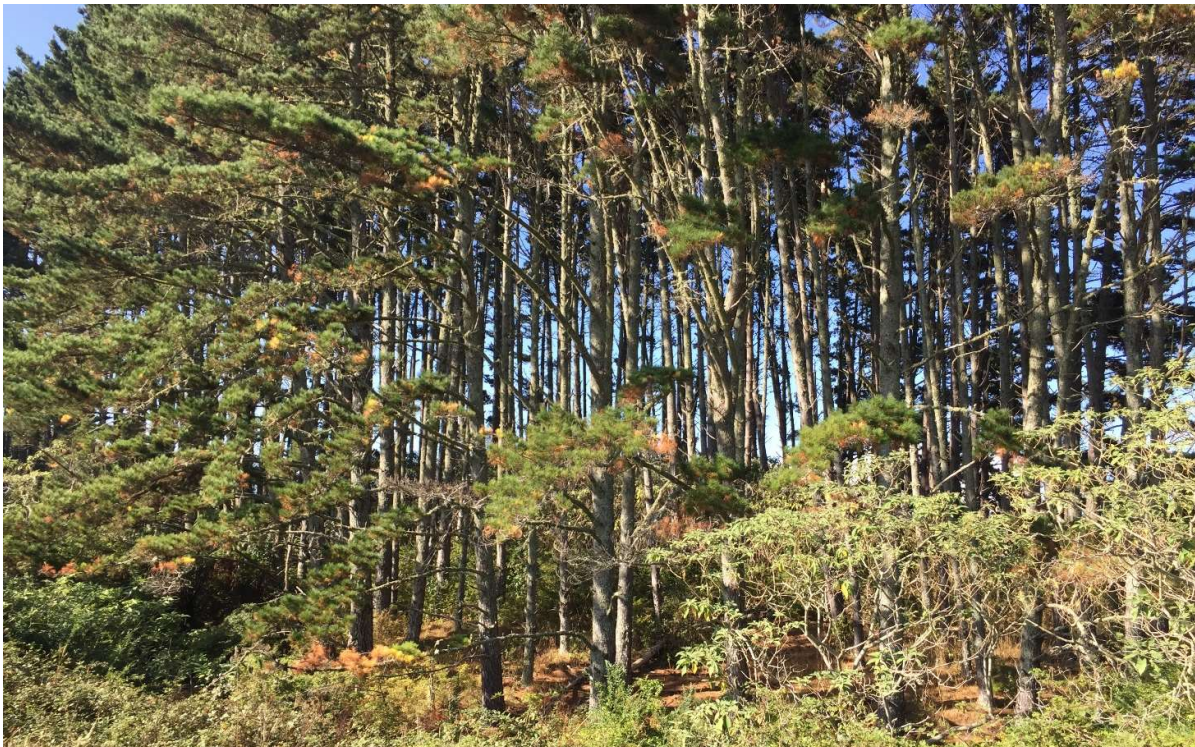


Figure 6: Sinton Stream crossing area pine shelter belt vegetation to be removed. Image taken during Beca site visit 28 February 2020.



Figure 7: Riparian vegetation at the proposed emergency overflow location at Sinton Stream. Image taken during Beca site visit 3 December 2021.

5.1.1 Stream Ecological Valuation

An SEV was completed for a 100 m reach of the Sinton Stream (refer Figure 2). The reach in its current ecological condition scored highest for its biogeochemical function (optimal oxygen availability and no surface reaching macrophytes) and hydraulic functionality (natural channel with no modifications), and lowest for biodiversity (riparian area low diversity) (see Table 2). The table below provides a score for Sinton Stream ecological value in its current form, and a score assuming future proposed riparian restoration. The overall SEV score of 0.69 for the stream in its current form demonstrates that it displays 'Good' ecological condition (Table 1).

Table 2: SEV scores for the Sinton Stream for four key ecological functions. Refer to Appendix B for detailed scorings.

Function Category	Sinton Stream Current	Sinton Stream Reach Potential assuming Restoration
Hydraulic	0.72	0.96
Biogeochemical	0.82	0.91
Habitat Provision	0.39	0.43
Biodiversity	0.42	0.27
SEV (excl IFI and FFI)	0.69	0.83
Overall mean SEV score	0.646	0.717

5.1.2 Ecological value of Fish

The New Zealand Freshwater Fish Database (NZFFD) show records of several native fish species immediately upstream of the Project extent (Table 3) within Tōtara Creek. A similar range of species is expected to be present in Sinton Stream, as both Tōtara Creek and Sinton Stream are upstream tributaries of Tōtara Inlet. No fish records were available within Slaughterhouse Stream. Fish trapping at Tōtara Creek

and Sinton Stream using fyke nets and gee minnow traps during the site survey by Tonkin & Taylor Ltd (2021) caught one shortfin eel (*Anguilla australis*), three longfin eel (*Anguilla dieffenbachii*), 41 inanga (*Galaxias maculatus*), nine banded kokopu (*Galaxias fasciatus*), and freshwater shrimp. Due to the presence of several native fish species, two of which have the conservation status of 'At risk – declining', the ecological value of fish present is assessed as **High**.

Table 3: Fish species recorded as present in Tōtara Creek in the NZFFD (Crow, 2017). Conservation status assigned using Dunn et al., (2018).

Species	Conservation Status	Abundance	Year Recorded
Shortfin eel (<i>Anguilla australis</i>)	Not Threatened	13	2019
Longfin eel (<i>Anguilla dieffenbachii</i>)	At risk - declining	13	
Banded kokopu (<i>Galaxias fasciatus</i>)	Not Threatened	3	
Inanga (<i>Galaxias maculatus</i>)	At risk - declining	1	
Common bully (<i>Gobiomorphus cotidianus</i>)	Not Threatened	244	
Crans bully (<i>Gobiomorphus basalis</i>)	Not Threatened	7	
Koura (<i>Paranephrops spp.</i>)	At risk - declining	2	
Rudd (<i>Scardinius erythrophthalmus</i>)	Introduced and Naturalised	4	

5.1.3 Macroinvertebrates

Macroinvertebrate Community Index (MCI) samples were taken by T&T for macroinvertebrates in Sinton Stream. These identified Sinton Stream to have an MCI value of 85 and QMCI of 3.8. This MCI value is classified within attribute band 'D' under the NPS FM (2020) below the national bottom line MCI value of 90 and QMCI value of 4.5, indicating poor macroinvertebrate diversity. These were noted to have been taken post heavy rainfall in 48 hours prior to visit which may have influenced taxa richness somewhat, however it is likely this that these samples are representative of a stream system impacted by the surrounding agricultural land use. Therefore, the macroinvertebrate ecological value is classified as **Low**.

5.1.4 Overall

The reach of Sinton Stream at the Project site is assessed as having **Moderate** ecological value. This is based on the value of the sparse predominantly exotic vegetation providing partial shading (Low-Moderate), moderate fish diversity with several 'At risk' species (Very High, refer Section 5.1.2), degraded macroinvertebrate community (Low, refer Section 5.1.3), agricultural catchment (Low-Moderate).

The NPS FM 2020 directs a value assessment to consider the potential restored value of any freshwater feature being impacted. Following reasonable restoration (fencing and native vegetation planting) as directed by the NPS FM 2020, the stream could have increased effective habitat provision for fauna but will still be affected by the agricultural and developing residential – industrial catchment. Therefore, potential ecological value is assessed as **Moderate**.

5.2 Slaughterhouse Stream

Slaughterhouse Stream flows from east to west, discharging into Tōtara Inlet (refer Figure 2). There are several mature exotic trees surrounding the stream in shelterbelt patches, providing low to moderate shading value (Figure 8) and is otherwise surrounded by farmland and lifestyle properties. This is a permanent stream with low flow rates and a natural channel bed comprised of predominantly stiff clay.

No information on fish present in this stream is available so the value of in-stream fauna cannot be considered for this stream in the assessment. However, because it connects to Tōtara Inlet it is likely it has a similar diversity of species to Sinton Stream.

There is sparse mixed native and exotic vegetation surrounding the stream and providing partial shading (with a Low-Moderate value). There is also a natural incised stream bank and surrounding agricultural uses in the catchment (contributing to a Low value rating). Therefore, the reach of Sinton Stream at the Project site is assessed as having a **Low-Moderate** ecological value in its current condition.

The NPS FM 2020 directs a value assessment to consider the potential restored value of any freshwater feature being impacted. Following reasonable restoration as directed by the NPS FM 2020, the stream could have increased effective habitat provision for fauna but will still be affected by the agricultural and developing residential – industrial catchment. Therefore, the potential ecological value of Slaughterhouse Stream is assessed as **Moderate**.



Figure 8: Slaughterhouse Stream riparian area. Image taken during Beca site visit 3 December 2021.

5.3 Natural wetland A

Natural wetland A is located approximately 60 m east of the rising main and associated designation (refer Figure 2). This wetland has been delineated in Tonkin & Taylor Ltd (2021) and has been classified as a 'natural wetland', therefore subject to regulation under the NES FW (2020).

The wetland is within a slight topographical depression, which may be a historic tributary or flow path to the Sinton stream. The wetland area is highly modified and degraded as it is in a paddock with unrestricted stock access. Exotic pasture grasses form the dominant cover (~88%), *Juncus edgariae* (~10%), and *Ranunculus repens*, *Plantago major*, *Trifolium repens*, and *Rumex obtusifolius* (~2%) (see Figure 2).

Despite wetlands being a threatened ecosystem type naturally (Beverley R. Clarkson et al., 2013) (very high rarity), this wetland is a highly modified and degraded pasture wetland dominated by exotic wetland vegetation (with low representativeness, low diversity and pattern), and limited habitat provisioning for fauna (low ecological context value). Therefore, this wetland is considered to have **Low** ecological value consistent with the T&T value assessment.



Figure 9: Wetland A surface water observable (Tonkin & Taylor Ltd, 2021).

5.4 Natural wetland C

Wetland C is located approximately 10 m north of the proposed pump station location (refer Figure 2). This wetland is affected by the wastewater gravity pipe and pump station works and classified as a 'natural wetland' and therefore subject to regulation under the NES FW (2020).

This wetland has been delineated in Tonkin & Taylor Ltd (2021). It has formed within a small overland flowpath depression sloping towards Sinton Stream. Whilst the wetland extent is not well defined due to historical modification, this wetland has been delineated based on topographical depression changes and

the extent of presence of wetland vegetation Wiwi (*Juncus edgariae*). This wetland is dominated by exotic grasses, *Persicaria decipiens*, and Wiwi. It is ephemeral, in terms of that it expands and contracts in extent seasonally based on hydrological conditions.

Although wetlands are a threatened ecosystem type naturally (Beverley R. Clarkson et al., 2013) (very high rarity), this wetland is a highly modified, degraded pasture wetland dominated by exotic wetland vegetation (with low representativeness, low diversity and pattern), and limited suitable habitat for fauna (resulting in a low ecological context value). Overall, we concur that this wetland has **Low** ecological value, consistent with the T&T value assessment.



Figure 10: Area surrounding Wetland C looking towards Sinton Stream. Image taken during Beca site visit 3 December 2021.



Figure 11: Wetland C vegetation (inclusive of *Juncus edgariae*, *Pericaria decipiens*, *Ranunculus repens*). Image taken during Beca site visit 3 December 2021.

5.5 Vegetation

Pasture grasses cover most of the terrestrial landscape, with exotic trees and shrubs forming shelter belts and riparian margins. Vegetation species along the riparian area of Sinton Stream are mostly exotic mature tree species with the presence of common native species with conservation status 'Not Threatened' (refer Table 4). Vegetation species alongside the riparian area of Slaughterhouse Stream include predominantly exotic mature trees. There is mixed native vegetation growing adjacent to existing Whenuapai Village Pump Station in the open space zone (Figure 12).

Table 4: Vegetation species observed within the Site.

Common Name	Scientific Name	Conservation Status	Location
-	<i>Eucalyptus spp.</i>	Exotic	Sinton Stream and Slaughterhouse Stream riparian area
Sugi Conifer	<i>Cryptomeria japonica</i>	Exotic	
Monterey Cypress	<i>Cupressus macrocarpa</i>	Exotic	
Pine	<i>Pinus radiata</i>	Exotic	Sinton Stream riparian area
Glossy Privet	<i>Ligustrum lucidum</i>	Exotic	
-	<i>Coprosma robusta</i>	Not Threatened	
Wheki	<i>Dicksonia squarrosa</i>	Not Threatened	
Ponga	<i>Alsophila dealbata</i>	Not Threatened	
Tauhinu	<i>Pomaderris amoena</i>	Not Threatened	
Red matipo	<i>Myrsine australis</i>	Not Threatened	
Black poplar	<i>Populus nigra</i>	Exotic	Slaughterhouse Stream riparian area
Weeping Willow	<i>Salix babylonica</i>	Exotic	
Mānuka	<i>Leptospermum scoparium</i> <i>var. scoparium</i>	At Risk – Declining	Open space zone
tī kōuka/Cabbage Tree	<i>Cordyline australis</i>	Exotic	
Harakeke/Flax	<i>Phormium tenax</i>	Exotic	



Figure 12: Mixed native vegetation looking south from pump station locality. Image taken during Beca site visit 3 December 2021.

Vegetation present at the Project site comprises indigenous and exotic species (moderate representativeness), common weedy species along with native species with one species having 'At Risk – Declining' conservation status (moderate rarity/distinctiveness, low diversity and pattern). The vegetation present also forms a buffer from surrounding agricultural activities and an ecological corridor for freshwater fauna (moderate ecological context).

Overall, the vegetation in the open space zone and the riparian vegetation alongside both Sinton Stream and Slaughterhouse Stream is considered to have **Moderate** ecological value.

5.6 Terrestrial fauna

5.6.1 Bats

An automatic bat survey was undertaken by Tonkin & Taylor Ltd (2021) to record long-tailed bat (*Chalinolobus tuberculatus*) activity. Two general locations were assessed:

1. Sinton Stream - the riparian margin and shelter belt vegetation
2. Tōtara Creek corridor

Long-tailed bat activity was recorded at two locations along the Tōtara Creek corridor, approximately 300 m from the works at the closest point (Figure 2). Whilst a high level of activity was not recorded during the survey, the long-tailed bat species have a conservation status of 'Threatened – national critical' and therefore the ecological value of any bats present is assessed as **Very High**.

5.6.2 Lizards

No records are present for native lizards within the site area. Incidental observations recorded in Tonkin & Taylor Ltd (2021) identified only the exotic Plague Skink (*Lampropholis delicata*) as present. It is possible the native Copper Skink (*Oligosoma aeneum*) species may be present within the areas where construction is planned due to presence of suitable habitat along riparian margins within rank pasture grasses and leaf litter. The ecological value of any lizards present is assessed as **Low** due to the limited likelihood of uncommon, 'At Risk' species being present.

5.6.3 Birds

Several common indigenous and exotic native birds species were observed within the site or have recorded observations within the vicinity as identified in Tonkin & Taylor Ltd (2021) during a site visit (refer to list in Table 5). All birds observed have the conservation status of either 'Introduced and Naturalised' or native 'Not Threatened'.

Table 5: Birds observed during Tonkin & Taylor Ltd (2021) site visit. Conservation status assigned using (Robertson et al., 2016).

Common Name	Scientific Name	Conservation Status
Welcome shallow	<i>Hirundo neoxena</i>	Not Threatened
White-faced heron	<i>Egretta novaehollandiae</i>	Not Threatened
Skylark	<i>Alauda arvensis</i>	Introduced and Naturalised
Paradise shelduck	<i>Tadorna variegata</i>	Not Threatened
Swamp harrier	<i>Circus approximans</i>	Not Threatened
Pukeko	<i>Porphyrio melanotus</i>	Not Threatened
Sacred kingfisher	<i>Todiramphus sanctus</i>	Not Threatened
Silvereye	<i>Zosterops lateralis</i>	Not Threatened
Kereru	<i>Hemiphaga novaeseelandiae</i>	Not Threatened
Spur-winged plover	<i>Vanellus miles</i>	Not Threatened
Yellowhammer	<i>Emberiza citrinella</i>	Introduced and Naturalised

The ecological value of the bird species present is assessed as **Low** due to the observed presence of introduced species or species of 'Not Threatened' status only.

6 Assessment of Ecological Effects

This section considers the potential temporary and permanent operational effects of the Project (without any recommended ecological management actions). The potential ecological effects of the Project include but are not limited to:

Temporary construction stage effects:

- Sediment runoff and/or discharge of sediment laden water into streams;
- Hydrological disturbance to degraded natural wetland;
- Temporary reduction in fish passage;
- Potential injury and/or mortality to fish;
- Potential injury and/or mortality to bats;
- Potential injury and/or mortality of lizards;
- Disturbance to birds;
- Disturbance to degraded natural wetland habitat;
- Removal of riparian vegetation

Permanent operational effects:

- Loss and disturbance to in-stream habitat;
- Permanent loss of a section of degraded natural Wetland C.

Recommended ecological management and mitigation actions to address the effects described below are outlined in Section 6.1.

6.1 Magnitude of Effects

Temporary effects

6.1.1 Sediment runoff and/or discharge of sediment laden water into streams

The construction of the pump station and culvert in the stream may result in sediment runoff into Sinton stream if not appropriately controlled. Discharge of sediment is also possible during the open trenching of the wastewater pipe, as the pipe runs adjacent to Slaughterhouse Stream and Sinton Stream for a section.

Sediment laden water or runoff during construction may impact ecological health of the streams by reducing water clarity and light attenuation, may smother benthic organisms upon settling, and reduce visibility for any fish present. A Erosion and Sediment Control Plan (ESCP) (refer Appendix H of the AEE) outlines the necessary methods to manage the risk of uncontrolled sediment runoff and discharge of sediment laden water into Slaughterhouse Stream, Sinton Stream, and Wetland C from the open cut pipe trenching works. Wetland A will not be affected as it is more than 40 m away from the pipe trenching works. The ESCP has been developed in accordance with industry best practice guidelines following Auckland Council GD05 - Guidance for Erosion and Sediment Control. With this management method, the management of effect is assessed as **Low**.

6.1.2 Temporary reduction in fish passage

For works to construct the culvert the temporary diversion of Sinton Stream is required. This involves the implementation of a cleanwater stream diversion channel lined with geotextile cut around the works site over an approximate 83 m length adjacent to the diverted reach of Sinton Stream, with geotextile-lined clay fill coffer dams at the entry and exit to the channel (refer to Appendix A). The temporary diversion is expected to be in place for approximately 12 weeks. This will result in a temporary restriction of fish passage in the main stream, however still allows for water and fish to travel between up- and downstream of the diverted reach

The magnitude of effect of this diversion is considered **Moderate**, as the diversion may result in the temporary loss of in-stream functionality and disturbance to the natural passage of fish and other fauna.

6.1.3 Potential injury and/or mortality of fish

Works in the stream to construct the culvert in Sinton Stream may result in the potential injury and/or mortality of fish species present within the 71 m length of stream affected by the culvert works if not appropriately managed, indirectly from habitat degradation from the in-stream works or directly from injury during the works. As fish are protected under the Wildlife Act 1953 and there are two fish species noted to be present with a conservation status of 'At Risk – Declining', the magnitude of effect is **Moderate**.

6.1.4 Potential injury and/or mortality to bats

The clearing of riparian vegetation along the Sinton and Slaughterhouse Stream riparian margin may affect terrestrial fauna habitat. Clearance of the stand of pine trees or other mature trees may result in damage to bat roosts if present. Mature trees with large diameters and cavities, flaking bark and split branches potentially offer bat roost habitat, therefore these mature pine trees have the potential to be used intermittently as bat roost trees. Bat activity has been detected along Tōtara Creek but not along the Sinton Stream, therefore the magnitude of effect of removal of these trees with very low likelihood of bats present is identified to be **Low**, as the removal may result in the loss of a minor proportion of the range of these indigenous bat species protected under the Wildlife Act 1953.

6.1.5 Potential injury and/or mortality of lizards

The riparian vegetation clearance at Sinton and Slaughterhouse Streams has the potential to cause injury and/or mortality of native copper skink, if present on the site. Any lizards present would likely only be impacted if areas of long rank grass or where substantive leaf litter in the riparian zone is removed or disturbed. Given that no native lizards have been recorded in the area and although potential suitable habitat is present in the riparian zones, the magnitude of effect is expected to be **Low**.

6.1.6 Disturbance to birds

The riparian vegetation clearance at Sinton and Slaughterhouse Streams are likely to result in temporary disturbance to avifauna. Due to their highly mobile nature, it is likely that direct impacts on birds will be largely avoided as they are expected to disperse to other habitats away from the riparian vegetation during the period of vegetation clearance. However, any nests present particularly in the mature pine trees may be damaged, and due to the length of the period of works there is risk of disturbance during the nesting season. The magnitude of this effect is expected to be **Low**.

6.1.7 Temporary loss of degraded natural wetland habitat

Groundwater drawdown

The temporary diverting and dewatering of groundwater will be required as a result of the pipe trenching for installation of 475 mm diameter PVC pipe and for construction of the pump station. This has a risk of resulting in temporary hydrological changes to Wetland C, along with temporary degradation of its ecological value and functioning through groundwater drawdown. As this wetland expands and contracts based on hydrological conditions, it is expected to respond similarly to the dewatering. This effect is not expected to extend long term as according to the Tonkin & Taylor Ltd (2022) Groundwater Assessment, the dewatering is not anticipated to result in a material reduction in base flows through the wetland, and groundwater below the pump station is expected to recharge to levels prior to construction. Therefore, these construction activities are not expected to result in any substantial effects to the hydrology of Wetland C.

Vegetation Removal

Construction access is required through Wetland C via a temporary access road adjacent to the alignment of the proposed pipeline. The road is expected to be 6 m wide and comprised of 300-400 mm of aggregate (refer to Construction Methodology by Brian Perry Civil, 2021). The temporary construction access is to be removed following completion of construction and the area impacted reinstated as wetland.

Sediment Runoff

Trenching works through Wetland C and the construction of the pump station directly adjacent may result in sediment runoff into the natural wetland. While wetlands naturally trap sediments as one of their ecosystem functions, this wetland has already been degraded by livestock grazing pressure and it may not be able to effectively buffer the sediment runoff. Any sediment runoff has the potential to temporarily degrade the ecological value and functioning of the wetland.

Summary

Overall, there is a potential risk of degradation of ecological value and function due to these works, particularly in relation to vegetation removal and sediment runoff, therefore the magnitude of effect is assessed as **High**.

There is no effect to Wetland A as it is not within the zone of influence of any construction works.

6.1.8 Removal of riparian vegetation

Clearing of riparian vegetation around Slaughterhouse and Sinton streams is required for the pipeline, the pipe bridge, and pump station construction. Removal of this predominantly exotic riparian vegetation may result in the loss of its buffer function, resulting in reduced prevention of runoff from surrounding paddocks entering the stream, reduced temperature regulation due to a reduction in shading, reduced organic inputs (leaf litter), and increased likelihood of bank erosion until the riparian area is restored (Collier et al., 1995). The riparian vegetation clearance is assessed as a **Moderate** magnitude of effect until new plantings mature over a moderate length time scale.

Permanent Effects

6.1.9 Loss and disturbance to in-stream habitat

The construction of the culvert within Sinton Stream and the emergency overflow outfall, including the placement of rip-rap to prevent scour will disturb the in-stream and bank-side habitat. The section of the stream where the rip-rap and culvert is placed will be permanently modified, and this section of natural channel permanently lost, however fish passage will be sufficiently maintained due to the design of the 3500 x 3500 mm concrete box culvert (with natural compacted clay bed, with no height/grade alterations). Sheet piling to support the stream embankment may disrupt the bank and riparian habitat integrity, with geotextile placed to prevent erosion.

To compensate for the loss of natural stream channel due to the construction of a culvert in Sinton Stream, an Environmental Compensation Ratio (ECR) was calculated from the SEV assessment of the impact reach (refer Storey et al., 2011).

We have noted that T&T considered permanent disturbance of a 71 m reach of Sinton Stream for the basis of calculating an ECR. However, the drawings available (see Appendix A) illustrate that the permanent effects of the proposed culvert crossing are 63 m in total. We have therefore provided an updated ECR based on a disturbed length of stream at 63 m.

The ECR identified that to compensate for the loss of 63 m of stream length (culvert length of 43.14 m, with a 5 m length of wingwall and 5m length of rip rap at each end of the culvert) due to the construction of the culvert crossing, 426 m of stream would be required for compensation based on the calculated ECR of

6.75:1 The calculation utilises the SEV values (determined by T&T) excluding IFI and FFI biotic functions as recommended in (Storey et al., 2011).

ECR

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

$$= [(0.83-0.2)/(0.83-0.69)] \times 1.5$$

$$= 6.75$$

Compensation Length

$$\text{Compensation Length} = [(\text{impact length} \times \text{stream width}) \times \text{ECR}] / \text{restoration channel width}$$

$$= [(63.14 \times 1.92) \times 6.75] / 1.92$$

$$= 426.2 \text{ m (818.3 m}^2\text{) total stream bed area}$$

There is 440 m of Sinton Stream available and 474 m of Sinton A available (refer Tonkin & Taylor Ltd, 2021 report Appendix A) in terms of area for riparian plantings, therefore all restoration can be completed within the impacted stream.

Additionally, the construction of the culvert and associated wing walls and riprap into the Sinton Stream will result in disturbance in the stream bed, impacting the heterogeneity of the river and disrupting fauna habitat. Although the culvert is designed specifically for low flow conditions, has a natural clay layer, and will not impede fish passage, this will result in the loss of a section of natural stream therefore the overall magnitude of effect is **High**.

6.1.10 Alteration of hydrology of Wetland A & C

The permanent occupation of a 475mm diameter PVC pipe approximately 2.8 m beneath the ground level of Wetland C is unlikely to result in the loss of extent or value of Wetland C in the long term. Minor alteration of soil profile will occur but at a depth that will not alter the species composition or extent of wetland vegetation which is generally shallow rooted. The occupation of the pipe is also not anticipated to result in a material reduction in surface or groundwater flows through the wetland (T&T, 2022). The magnitude of a potential alteration of hydrology because of the permanent occupation of the pipe is **negligible**.

There is no effect to Wetland A as it is not within the zone of influence of any construction works.

6.1.11 Summary of effects

Table 6: Summary of potential unmitigated ecological effects during these works.

Impact	Ecological component	Ecological Value (habitat or species)	Magnitude of Effect	Current Level of Effect (unmitigated)
Temporary				
Sediment runoff and/or discharge of sediment laden water into streams	Sinton Stream	Moderate	Low	Low
	Slaughterhouse Stream	Low-Moderate		Low
Sediment runoff and/or discharge of sediment laden water into wetland	Wetland C	Low	High	Low
Temporary reduction in fish passage	Sinton Stream	Moderate	Moderate	Moderate
Potential injury and/or mortality to fish	Freshwater fish	Very High	Moderate	High
Potential injury and/or mortality to bats	Bats	Very High	Low	Moderate
Potential injury and/or mortality of lizards	Lizards	Low	Low	Very Low
Disturbance to birds	Birds	Low	Low	Very Low
Temporary loss of degraded natural wetland habitat (due to groundwater drawdown, vegetation removal, sediment runoff)	Wetland C	Low	High	Low
	Wetland A	Low	Negligible	Very Low
Removal of riparian vegetation	Sinton Stream	Moderate	Moderate	Moderate
	Slaughterhouse Stream	Low-Moderate		Moderate
	Vegetation	Moderate		Moderate
Permanent				
Loss and disturbance to in-stream habitat	Sinton Stream	Moderate	High	Moderate
Alteration to hydrology	Wetlands C	Low	Negligible	Very Low

7 Recommended ecological management actions

7.1 Effects Management

Overall, the potentially adverse ecological effects associated with the works cannot be avoided in the first instance as there is a functional need for the undertaking of these works to allow the development of necessary wastewater pipeline infrastructure for future development of the surrounding area.

The following section recommends ecological management actions to remedy or mitigate the potential effects outlined in Section 5 above.

7.2 Minimisation

7.2.1 Native Fish Salvage and management plan

Prior to in-stream works proceeding it is recommended that the impact reach be isolated (using stop-nets) and fish present in this section be caught and translocated to a suitable aquatic habitat (preferably downstream within Sinton stream). It is recommended that a native fish management plan is developed and implemented to minimise any potential impacts to native fish within the affected stream reach. This management plan should outline the procedures to salvage and safely relocate the native fish out of the impacted reach prior to instream works being undertaken. This will likely involve isolating the impact reach using stop-nets and a combination of trapping, slow dewatering and sorting through dewatered materials to capture and safely relocate fish outside of the works zone. The stop-nets should be retained within the stream until the works are completed, to ensure that no fish re-enter this section of the stream.

7.2.2 Bat management

It is recommended that where there is vegetation removal of mature trees in riparian areas (in particular part of the Pine tree stand at Sinton Stream and the shelterbelt area at Slaughterhouse Stream) that these sites are surveyed for suitability of bat roost habitat. This should be done before clearance work begins by a suitably qualified ecologist to avoid the injury or mortality of roosting long-tailed bats in accordance with the Wildlife Act 1953.

7.2.3 Lizard management

Native lizards are protected under the Wildlife Act 1953 and the construction activities have the potential to impact native skink species. It is recommended that a lizard survey is completed prior to construction by a suitably qualified herpetologist confirm the presence/absence of lizards within the construction footprint prior to the commencement of works.

If native lizards are found to reside within the site, a lizard management plan will be required. Management will need to be developed and implemented by a DOC-permitted lizard ecologist (herpetologist), and prior to the start of works, adverse effects on native skinks present at the site will need to be mitigated by relocating them to protected, suitable habitat. Should lizard salvage and relocation be determined to be required, typical actions are expected to be the capture and release by an experienced herpetologist, outside of winter months and in accordance with Department of Conservation Wildlife Authority requirements. A lizard release site will need to be secured and should be under pest control both prior to, and following relocation. The release site should also be monitored for lizard presence, abundance and habitat suitability outside of winter months.

All herpetology work should be carried out by a herpetologist who is experienced in lizard salvage and relocation operations and holds a current Wildlife Act Authority Permit to survey or undertake salvage and relocations.

7.2.4 Bird management

Vegetation clearance within the riparian areas may result in the disturbance of birds, particularly is nesting is occurring. Direct impacts to birds are expected to be avoided as they are anticipated to disperse to other habitats during the period of vegetation clearance. However, it is possible that bird nests could be present in the riparian vegetation planned for clearing. Therefore, risk of possible disturbance or harm could be reduced by undertaking vegetation clearance outside of nesting season (for most species between September and February). If this is not possible, the riparian areas planned for vegetation clearance will be surveyed for the presence of bird nest before clearance works begins by a suitably qualified ecologist in accordance with the Wildlife Act 1953.

7.3 Remediation

7.3.1 Wetland and riparian vegetation remediation and planting

Wetland

As the Wetland C disturbance is unable to be avoided for pipe trenching and the associated access road, it will be remedied by planting of the wetland following construction. Wetland remediation will include the recontouring of land within the wetland that has been trenched to return the area to its original landform level, and planting of native wetland species appropriate to improve the ecological value and restore the functioning of this natural ecosystem. The aim of this remediation is to provide at least the values lost by the construction of the trench and temporary access.

A planting plan has been developed by Watercare to allow for the native revegetation of areas of vegetation removal and construction works surrounding the pump station and Wetland C (see Appendix D). This plan specifies new native plantings in the wetland near the pump station, and new plantings flax and sedges above the pump station surrounding the permanent hardstand. Native trees will be planted around the pump station for amenity.

As base flows through the wetland are unlikely to be materially reduced, effects management have not been specifically proposed with regard to this.

Planting the disturbed area of wetland and wetland margins should provide sufficient improvement of the wetland habitat affected by pipe trenching and construction of the temporary access track through the wetland area.

Riparian

The planting plan also specifies the re-plantings to occur in the riparian zone of Sinton Stream disturbed by the pump station works. Additionally, re-plantings with indigenous plant species comprising a variety of heights (small shrubs and larger trees) at other areas of vegetation removal is recommended, in the Sinton and Slaughterhouse stream riparian areas disturbed by open trenching.

The reinstatement of plantings and the removal of any exotic weed species present should provide sufficient management and remediation of any vegetation loss during the works, and assist to improve and maintain the ecological and indigenous habitat functionality of the stream habitat.

Over medium to long term time scales, the plantings are expected to result in a net positive enhancement of the riparian and wetland areas.

7.4 Compensation

7.4.1 Stream compensation

The loss of 63m length (121 m²) of natural channel bed of the Sinton Stream as a result of the culvert crossing has the potential to negatively impact the overall ecological value of the stream. The Environmental Compensation Ratio (ECR) was calculated to be 6.75:1 (refer Storey et al., 2011). This requires 426.2 m in length of stream to be compensated. To compensate for the impact of this channel modification, a reach of Sinton stream is proposed to be enhanced with riparian habitat features along the 426.2 m of stream, to improve and maintain the ecological and indigenous habitat functionality of the Sinton stream freshwater environment.

Assuming this is implemented, this will achieve no net loss of ecological value at Sinton Stream and will likely result in an improved riparian area downstream of the culvert installation over a medium-to-long term time scale.

8 Overall effect assessment with recommendations

A summary of the overall level of ecological effects following any related management measures is provided below in Table 7.

Table 7: Overall level of ecological effects with effect management implemented.

Impact	Ecological component	Ecological Value (habitat or species)	Effects management	Revised Magnitude of Effect	Revised/ Overall Level of Effect
Temporary					
Sediment runoff and/or discharge of sediment laden water into streams	Sinton Stream	Moderate	Erosion and Sediment Control	Low	Low
	Slaughterhouse Stream	Low-Moderate			Low
Sediment runoff and/or discharge of sediment laden water into wetland	Wetland C	Low	Erosion and Sediment Control	Low	Very Low
Temporary reduction in fish passage	Sinton Stream	Moderate	Native fish salvage	Low	Low
Potential injury and/or mortality to fish	Freshwater fish	Very High	Native fish salvage	Negligible	Low
Potential injury and/or mortality to bats	Bats	Very High	Survey for suitable bat roost habitat in clearance areas	Negligible	Low
Potential injury and/or mortality of lizards	Lizards	Low	Lizard survey to confirm presence/absence	Low	Very Low
Disturbance to birds	Birds	Low	Avoid nesting season or undertake nest checks	Negligible	Very Low
Temporary loss of degraded natural wetland habitat (due to groundwater drawdown, vegetation removal, sediment runoff)	Wetland C	Low	Wetland vegetation reinstatement	Low	Very Low
	Wetland A	Low	Not Required	NA	Very Low
Removal of riparian vegetation	Sinton Stream	Moderate	Riparian vegetation restoration	Low	Low
	Slaughterhouse Stream	Low-Moderate			Low
	Vegetation	Moderate			Low
Permanent					
Loss and disturbance to in-stream habitat	Sinton Stream	Moderate	Stream Compensation	Low	Low
Alteration to hydrology	Wetland C	Very Low	Wetland vegetation reinstatement	NA	Very Low

9 Conclusion

The construction activities required to build the wastewater gravity pipeline, pump station, and rising main may result in the adverse ecological impacts identified in this report. Appropriate measures to address these adverse ecological effects have been detailed and are required to be implemented to manage the effects of the construction works. To manage the impact of the works the implementation of the following have been proposed:

- Native fish salvage and management plan;
- Bat management;
- Lizard management;
- Bird management;
- Wetland and riparian vegetation restoration and planting plan;
- Stream compensation.

The overall level of ecological effects of the proposed construction works are **Low**, assuming the implementation of all recommended effects management measures. This means that effects will be discernible, but the underlying character, composition, and attributes of the existing baseline condition will be similar to pre-development circumstances over a short to medium term time scale. Overall, if managed as recommended there may be a net gain in ecological value due to increased indigenous dominance in the wetland and riparian areas, and also has the potential to provide increased habitat for native fauna over a medium to long term time scale.

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11 Limitations

This report has been prepared by Beca Ltd solely for Watercare. This report is prepared solely for the purpose of the assessment of potential ecological effects of the proposed works (Scope). The report has been prepared to support a resource consent application and may be used by the Client and others in subsequent processes to consider the application to which the assessment pertains. The contents of this report may not be used by the Client for any purpose other than in accordance with the stated Scope.



Appendix A – Detailed Design Drawings

B

Appendix B – Ecological Impact Assessment Guidelines

Ecological Impact Assessment Guidelines

Assigning Ecological Value

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. Attributes 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.
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	Benthic invertebrate community typically has low diversity, species richness and abundance.

Value	Explanation	Characteristics
	degradation e.g., high-intensity agriculture catchment.	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 (Roper-Lindsay et al., 2018).

Matters	Topics for which criteria are needed
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 utilization
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 a freshwater or terrestrial system (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	Locally uncommon/rare, not nationally threatened or at risk
Low	Not threatened nationally, common locally

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. Summary of the criteria for describing the magnitude of effect (Roper-Lindsay et al., 2018).

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

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 are 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.

C

Appendix C – SEV Scores Sinton Stream

Table 8: Detailed SEV scores for Sinton Stream (Tonkin & Taylor Ltd, 2021).

Function category	Report section*	Function	Variable (code)	Sinton Stream	Sinton Potential
			Vchann	0.93	0.95
			Vlining	0.98	0.99
			Vpipe	1.00	1.00
Hydraulic	4.1	NFR	=	0.95	0.96
			Vbank	0.92	0.92
			Vrough	0.73	0.96
Hydraulic	4.2	FLE	=	0.67	0.88
			Vbarr	0.30	1.00
Hydraulic	4.3	CSM	=	0.30	1.00
			Vchanshape	0.90	0.96
			Vlining	0.98	0.99
Hydraulic	4.4	CGW	=	0.95	0.98
			Hydraulic function mean score	0.72	0.96
			Vshade	0.74	0.90
biogeochemical	4.5	WTC	=	0.74	0.90
			Vdod	1.00	1.00
biogeochemical	4.6	DOM	=	1.00	1.00
			Vripar	0.85	1.00
			Vdecid	1.00	1.00
biogeochemical	4.7	OMI	=	0.85	1.00
			Vmacro	1.00	1.00
			Vretain	0.94	0.98
biogeochemical	4.8	IPR	=	0.94	0.98
			Vsurf	0.37	0.37
			Vripfilt	0.82	0.96
biogeochemical	4.9	DOP	=	0.59	0.66
			Biogeochemical function mean score	0.82	0.91
			Vgalspwn	0.00	0.00
			Vgalqual	0.00	0.75
			Vgobspwn	0.20	0.20
habitat provision	4.10	FSH	=	0.10	0.10
			Vphyshab	0.79	0.99
			Vwatqual	0.47	0.55
			Vimperv	0.70	0.50
habitat provision	4.11	HAF	=	0.69	0.76

			Habitat provision function mean score	0.39	0.43
			Vfish	0.67	0.00
Biodiversity	4.12	FFI	=	0.67	0.00
			Vmci	0.02	0.02
			Vept	0.00	0.00
			Vinvert	0.12	0.12
Biodiversity	4.13	IFI	=	0.05	0.05
			Vripcond	0.55	0.76
			Vripconn	1.00	1.00
Biodiversity	4.14	RVI	=	0.55	0.76
			Biodiversity function mean score	0.42	0.27
SEV (excl IFI and FFI)				0.69	0.83
Overall mean SEV score (maximum value 1)				0.646	0.717

D

Appendix D – Watercare Planting Schedule

Table 9: Schedule of plantings around wetland, stream, and pump station supplied by Watercare.

PLANT SCHEDULE							
Code	Botanical Name	Common Name	Unit/ Grade	Max. Growth Size (H x W)	Plant Spacing (mm)	Percentage Mix	TOTAL (no.)
Wetland Riparian Planting							
CAR GEM	Carex geminata	Cutty Grass	1L/PB2	1.0 x 1.0m	750	10%	180
CAR VIR	Carex virgata	Pukio / Swamp Sedge	1L/PB2	1.0 x 1.0m	750	20%	360
COR FUL	Cortaderia fulvida	Toetoe	1L/PB2	1.5 x 1.5m	1000	30%	300
PHO COO	Phormium cookianum	Wharariki / Mountain Flax	1L/PB2	1.5 x 1.5m	1000	10%	100
PHO TEN	Phormium tenax	Harakeke / NZ Flax	1L/PB2	3.0 x 2.0m	1000	30%	300
Pump Station Low Amenity Planting							
CAR TES	Carex testacea	Grass / Sedge	2L/PB3	0.6 x 0.6m	500	20%	530
CAR VIR	Carex virgata	Pukio / Swamp Sedge	1L/PB2	1.0 x 1.0m	500	20%	530
COR FUL	Cortaderia fulvida	Toetoe	1L/PB2	1.5 x 1.5m	1000	10%	66
DIA NIG	Dianella nigra	Turutu	2L/PB3	0.5 x 0.5m	500	10%	265
PHO 'EG'	Phormium 'Emerald Gem'	Dwarf Flax	2L/PB3	0.6 x 0.6m	500	20%	530
PHO 'JS'	Phormium 'Jack Spratt'	Ornamental Flax	2L/PB3	0.6 x 0.6m	500	20%	530
Pump Station Screening Planting							
HEB STR	Hebe stricta	Koromiko	2L/PB3	2.5 x 1.5m	1000	25%	31
KUN ERI	Kunzea ericoides	Kanuka	2L/PB3	10.0 x 4.0m	2000	25%	31
LEP SCO	Leptospermum scoparium	Manuka	2L/PB3	4.0 x 3.0m	2000	25%	31
PHO TEN	Phormium tenax	Harakeke / NZ Flax	1L/PB2	3.0 x 2.0m	1000	25%	31
		Mahoe					
Stream Bank Reinstatement Planting							
COR FUL	Cortaderia fulvida	Toetoe	1L/PB2	1.5 x 1.5m	1000	30%	92
PHO COO	Phormium cookianum	Wharariki / Mountain Flax	1L/PB2	1.5 x 1.5m	1000	30%	92
PHO TEN	Phormium tenax	Harakeke / NZ Flax	1L/PB2	3.0 x 2.0m	1000	40%	122
						Sub Total	4121

TREE SCHEDULE						
Code	Botanical Name	Common Name	Unit/ Grade	Max. Growth Size (H x W)	Plant Spacing (mm)	TOTAL
CA	Cordyline asutralis	Cabbage Tree / Ti Kouka	PB18	10.0 x 2.0m	as shown	26
DD	Dacrycarpus dacrydioides	Kahikatea / White Pine	PB18	30.0 x 10.0m	as shown	6
MR	Melicactus ramiflorus	Mahoe / Whiteywood	PB18	5.0 x 4.0m	as shown	3
PR	Plagianthus regius	Manatu / Ribbonwood	PB18	12.0 x 4.0m	as shown	7
VL	Vitex lucens	Puriri	PB18	10.0 x 10.0m	as shown	3
					Sub Total	45

Planting Locations

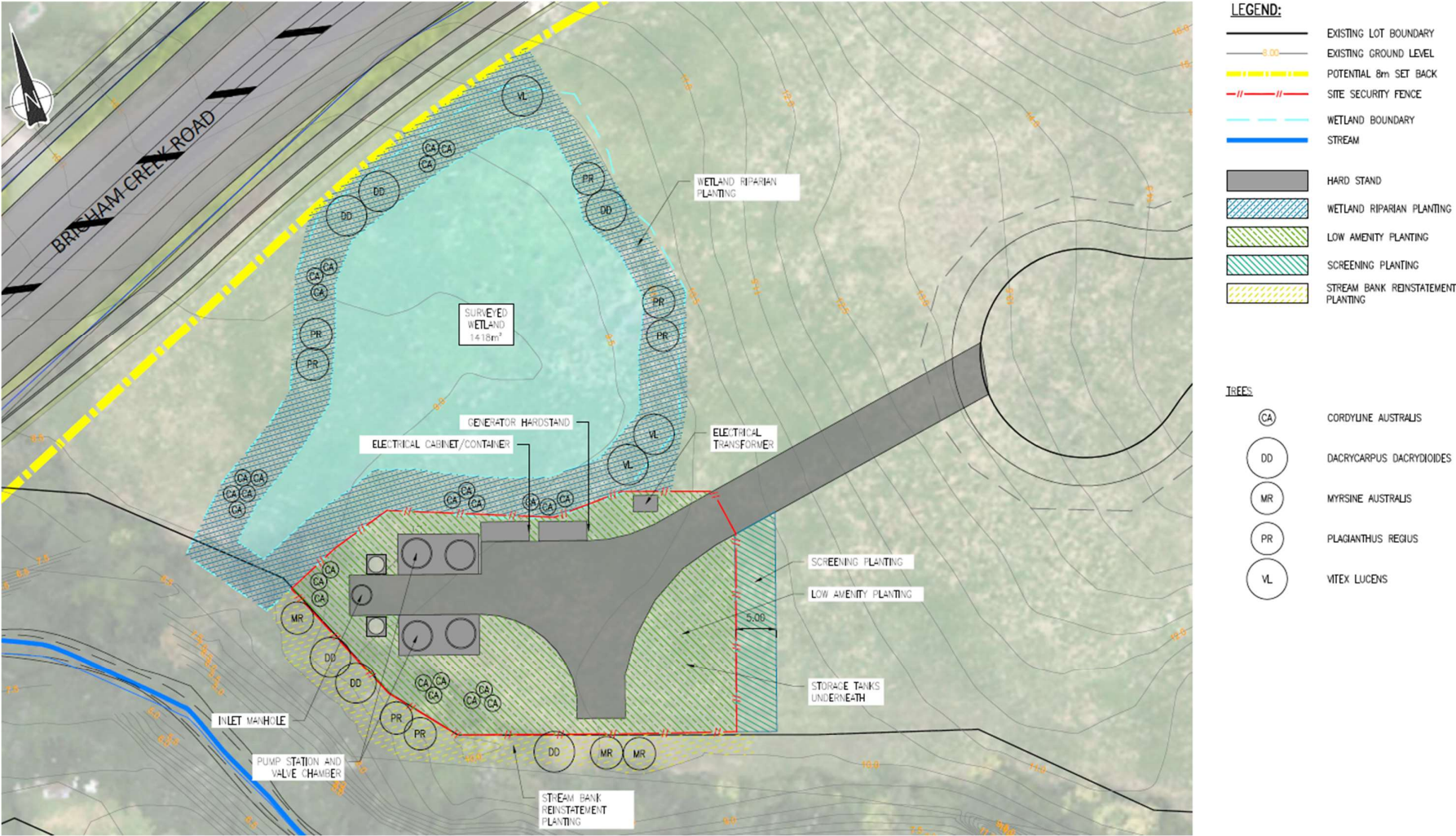
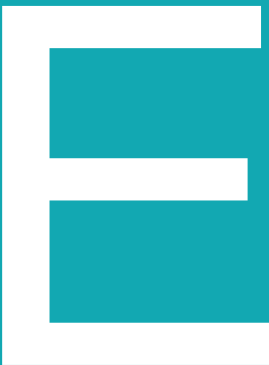


Figure A 1: Location of plantings in riparian area, wetland area, and above proposed pump station.



Appendix E – Potential wetland delineation plot results

11.1 Potential wetland 1

Potential wetland 1 is located on a low-lying river terrace that slopes down to Slaughterhouse stream. The putative wetland area is discussed in terms of vegetation, soils, and hydrology below (refer Figure 13 for the locations of each plot).

Four vegetation plots were completed within the potential wetland area, and one at the toe of a slope further south. Results of these investigations are shown in Table 10 & Table 12.

Plots 1-2 both consisted predominantly of pasture species and non-hydric vegetation and thus were assessed as non-wetland.

Plot 4 was located along at the edge of Slaughterhouse stream and consisted almost solely of creeping buttercup with a small amount of Yorkshire fog. This plot passed the dominance test, returned an uncertain prevalence index (between 2.5 and 3.5) and had saturated soils (primary indicator of hydrology; 1C), likely due to its proximity to the stream and recent rainfall. However, soils were not typically hydric and no FACW or OBL species were present within the plot or surrounding area (excluding macrophytes growing within the stream channel itself). As vegetation is not adapted to wet conditions, this area is considered to be a non-wetland.

Plots 5 and 6 were located on the river terrace. Plot 5 was dominated by creeping buttercup, Yorkshire fog and Geranium sp. Plot 6 was dominated by creeping buttercup, mock strawberry and hedge woundwort. Both plots passed the dominance test, returned uncertain prevalence index scores (between 2.5 and 3.5) and had saturated soils (primary indicator of hydrology; 1C). However, as it is likely that soils were only saturated due to recent rainfall, and no FACW or OBL species were present within the plot or surrounding area, these areas are also assessed as non-wetland. In addition, a depression within the main river channel was colonised by taro (*Colocasia esculenta*) of approximately 2m² area with no other FACW or OBL species surrounding the location. Taro is a FACW species however this area was very localised and we do not consider that this species is indicative or representative of the vegetation cover across this potential wetland extent.

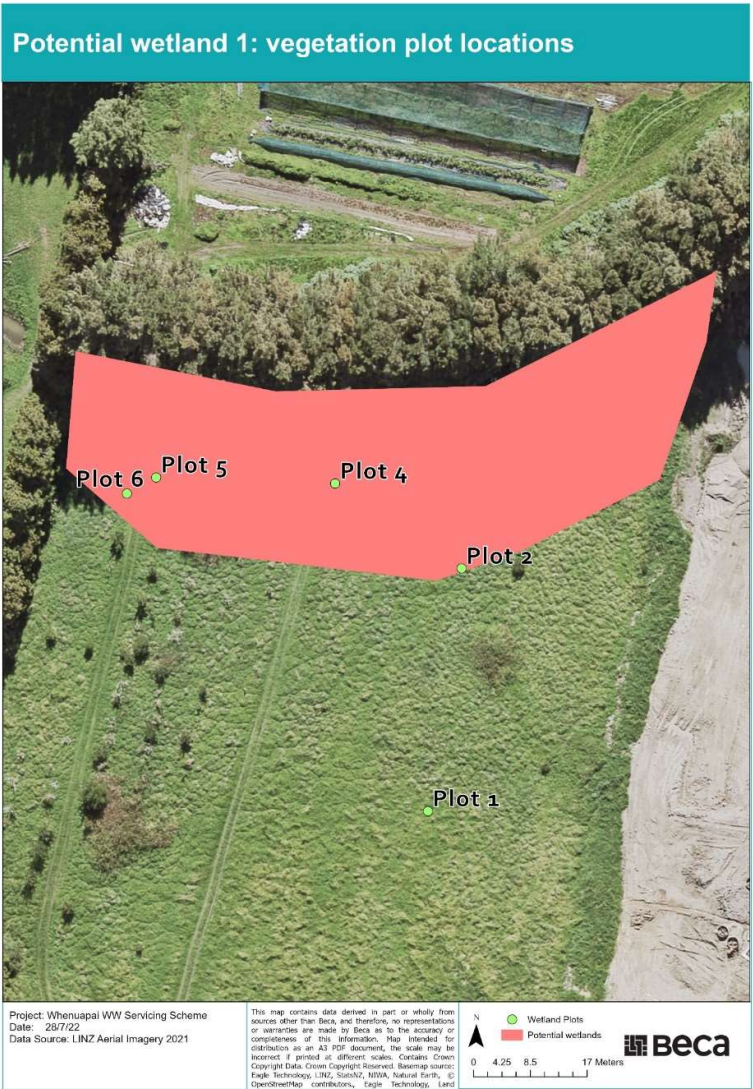


Figure 13. Locations of vegetation plots completed within, and adjacent to, Potential Wetland 1.

Table 10. Plot results following the wetland delineation protocols for potential wetland 1.

Plot	Rapid Test	Pasture Test	Dominance Test	Prevalence Index	Hydrology	Soils	Classification	Notes
1	Fail	Pass - 94%	Fail - 0%	Fail - 3.9	Absent	Non-hydric	Non-wetland	Fails vegetation tests
2	Fail	Pass - 89%	Fail - 0%	Fail - 3.9	Absent	Subsoil hydric	Non-wetland	Fails vegetation tests
4	Fail	Fail - 5%	Pass - 100%	Uncertain - 3.0	Present (1C)	Non-hydric – silt loam	Non-wetland	Fails FAC-neutral test – no FACW or OBL species present. Soil saturation likely a result of recent rainfall and/or adjacent stream level.
5	Fail	Fail - 47%	Pass - 100%	Uncertain - 3.1	Present (1C)	Non-hydric – silt loam	Non-wetland	Fails FAC-neutral test – no FACW or OBL species present. Soil saturation likely a result of recent rainfall rather than wetland hydrology
6	Fail	Fail - 2%	Pass - 100%	Uncertain - 3.0	Present (1C)	Not investigated	Non-wetland	Fails FAC-neutral test – no FACW or OBL species present. Soil saturation likely a result of recent rainfall rather than wetland hydrology

11.2 Potential Wetland 2

Potential Wetland 2 consists of an excavated storage area historically for silage and an artificial watercourse that drains it (Figure 14). Four plots were completed here near the base of the storage area, and one further west along the drainage channel. Results of these investigations are shown in Table 11, Table 10 & Table 13.

Plots 8-11 were located downslope of the excavated storage area. Plot 8 consisted predominantly of creeping buttercup, creeping bent, and perennial ryegrass. This plot passed the dominance test, returned an uncertain prevalence index (between 2.5 and 3.5) and did not show any hydrology indicators. Creeping bent was the only FACW species, therefore vegetation largely considered to be not adapted to wet conditions and in the absence of hydrological indicators, this area is considered to be a non-wetland.

Plot 9 consisted predominantly of white clover, kikuyu, perennial ryegrass, and *Juncus australis*. As this plot passes the pasture test, and has no hydrology indicators or hydric soils, this area is considered to be non-wetland.

Plot 10 consisted predominantly of *paspalum dilatatum* and bird's-foot-trefoil. This plot fails the dominance test and returned an uncertain prevalence index (between 2.5 and 3.5). This plot had saturated soils (primary indicator of hydrology; 1C) however it is likely that soils were only saturated due to recent rainfall, and no dominant FACW or OBL species were present within the plot or surrounding area, therefore these areas are also assessed as non-wetland.

Plot 11 was located within a localised depression of pooled water, dominated by Water pepper and Mercer grass (refer Table 14). This plot passes the vegetation tests and has surface water present (primary indicator of hydrology; 1A). As this area is formed within a constructed watercourse it is a localised constructed wetland.

Plot 12 was located further west along the drainage channel, dominated by broad-leaved plantain and creeping buttercup. This plot failed the vegetation test, had had saturated soils (primary indicator of hydrology; 1C) with clay mottling. However, as it is likely that soils were only saturated due to recent rainfall, and no FACW or OBL species were present within the plot or surrounding area, this is assessed as non-wetland.



Figure 14; Image of excavated storage area taken during site visit on 5th July 2022.

Table 11: Plot results from the wetland delineation protocols for potential wetland 2.

Plot	Rapid Test	Pasture Test	Dominance Test	Prevalence Index	Hydrology	Soils	Classification	Notes
8	Fail	Fail - 29%	Pass - 67%	Uncertain - 3.1	Absent	Not investigated	Non-wetland	
9	Fail	Pass - 77%	Fail - 0%	Fail - 3.7	Absent	Non-hydric – silt loam	Non-wetland	Fails vegetation tests
10	Fail	Pass - 75%	Fail - 0%	Uncertain - 3.4	Present (1C)	Not in investigated	Non-wetland	Soil saturation likely a result of recent rainfall rather than wetland hydrology.
11	Fail	Fail - 0%	Pass - 100%	Pass - 2.1	Present (1A)	Not investigated	Constructed Wetland	Formed within constructed watercourse
12	Fail	Fail - 36%	Fail - 50%	Fail - 3.6	Present (1C)	Hydric – clay loam with mottling	Non-wetland	Soil saturation likely a result of recent rainfall rather than wetland hydrology.



Figure 15: Locations of vegetation plots completed within, and adjacent to, Potential Wetland 2.

Table 12. Species present and composition within each plot taken for potential wetland 1.

Plot number	Common name	Species name	Percentage	Dominant	Status	Pasture species	Biostatus
1	Creeping buttercup	<i>Ranunculus repens</i>	5	no	FAC	No	Exotic
1	Kiuyu	<i>Cenchrus clandestinus</i>	90	yes	FACU	Yes	Exotic
1	Lotus	<i>Lotus pedunculatus</i>	2	no	FAC	Yes	Exotic
1	Cocksfoot	<i>Dactylis glomerata</i>	5	no	FACU	Yes	Exotic
1	Blackberry	<i>Rubus fruticosus</i>	1	no	FAC	No	Exotic
2	Creeping buttercup	<i>Ranunculus repens</i>	10	no	FAC	No	Exotic
2	Cleavers	<i>Galium aparine</i>	1	no	FACU	No	Exotic
2	Cocksfoot	<i>Dactylis glomerata</i>	90	yes	FACU	Yes	Exotic
4	Creeping buttercup	<i>Ranunculus repens</i>	100	yes	FAC	No	Exotic
4	Yorkshire fog	<i>Holcus lanatus</i>	5	no	FAC	Yes	Exotic
5	Creeping buttercup	<i>Ranunculus repens</i>	35	yes	FAC	No	Exotic
5	Cocksfoot	<i>Dactylis glomerata</i>	10	no	FACU	Yes	Exotic
5	Yorkshire fog	<i>Holcus lanatus</i>	45	yes	FAC	Yes	Exotic
5		<i>Geranium homeanum</i>	26	no	FAC	No	Exotic
6	Creeping buttercup	<i>Ranunculus repens</i>	60	yes	FAC	No	Exotic
6	Yorkshire fog	<i>Holcus lanatus</i>	2	no	FAC	Yes	Exotic
6	Mock strawberry	<i>Potentilla indica</i>	35	yes	FAC	No	Exotic
6	Hedge woundwort	<i>Stachys sylvatica</i>	25	yes	FAC	No	Exotic
6	Cleavers	<i>Galium aparine</i>	1	no	FACU	No	Exotic

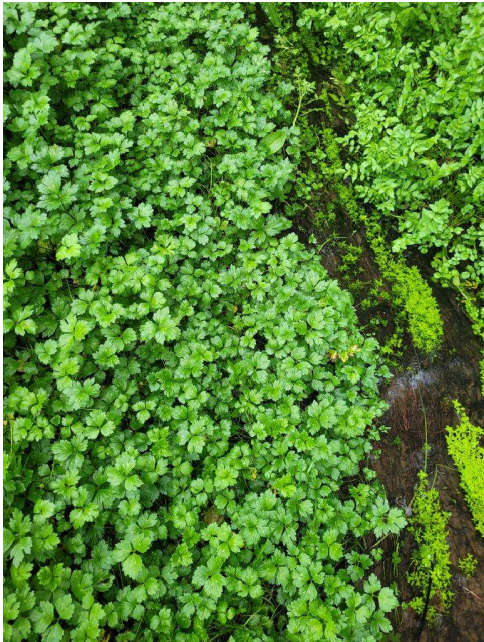
Table 13: Species present and composition within each plot taken for potential wetland 2.

Plot number	Common name	Species name	Percentage	Dominant	Status	Pasture species	Biostatus
8	Creeping buttercup	<i>Ranunculus repens</i>	40	yes	FAC	No	Exotic
8	Creeping bent	<i>Agrostis stolonifera</i>	25	yes	FACW	No	Exotic
8	White clover	<i>Trifolium repens</i>	3	no	FACU	Yes	Exotic
8	Broad-leaved dock	<i>Rumex obtusifolius</i>	3	no	FAC	No	Exotic
8	Broad-leaved plantain	<i>Plantago major</i>	1	no	FACU	No	Exotic
8	Perennial ryegrass	<i>Lolium perenne</i>	25	yes	FACU	Yes	Exotic
8	Cleavers	<i>Galium aparine</i>	1	no	FACU	No	Exotic
8	Cocksfoot	<i>Dactylis glomerata</i>	1	no	FACU	Yes	Exotic
9	Creeping buttercup	<i>Ranunculus repens</i>	11	no	FAC	No	Exotic
9		<i>Juncus australis</i>	20	no	FACW	No	Native
9	White clover	<i>Trifolium repens</i>	50	yes	FACU	Yes	Exotic
9	Broad-leaved dock	<i>Rumex obtusifolius</i>	2	no	FAC	No	Exotic
9	Broad-leaved plantain	<i>Plantago major</i>	2	no	FACU	No	Exotic
9	Perennial ryegrass	<i>Lolium perenne</i>	30	no	FACU	Yes	Exotic
9	Cleavers	<i>Galium aparine</i>	1	no	FACU	No	Exotic
9		<i>Cenchrus clandestinus</i>	40	yes	FACU	Yes	Exotic
10	Creeping buttercup	<i>Ranunculus repens</i>	10	no	FAC	No	Exotic
10		<i>Juncus australis</i>	15	no	FACW	No	Native
10	White clover	<i>Trifolium repens</i>	15	no	FACU	Yes	Exotic
10	Broad-leaved dock	<i>Rumex obtusifolius</i>	2	no	FAC	No	Exotic
10	Creeping bent	<i>Agrostis stolonifera</i>	5	no	FACW	No	Exotic
10	Yorkshire fog	<i>Holcus lanatus</i>	2	no	FAC	Yes	Exotic
10	Catsear	<i>Hypochaeris radicata</i>	1	no	FACU	No	Exotic
10	Paspalum	<i>Paspalum dilatatum</i>	50	yes	FACU	Yes	Exotic

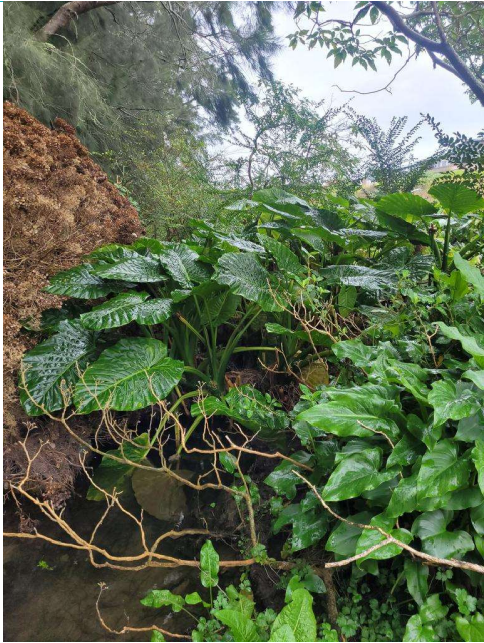
10		<i>Cenchrus clandestinus</i>	10	no	FACU	Yes	Exotic
10	Lotus	<i>Lotus pedunculatus</i>	20	no	FAC	Yes	Exotic
11	Creeping buttercup	<i>Ranunculus repens</i>	6	no	FAC	No	Exotic
11	Mercer grass	<i>Paspalum distichum</i>	20	yes	FACW	No	Exotic
11	Water pepper	<i>Persicaria hydropiper</i>	70	yes	FACW	No	Exotic
11	Broad-leaved plantain	<i>Plantago major</i>	1	no	FACU	No	Exotic
11	Broad-leaved dock	<i>Rumex obtusifolius</i>	1	no	FAC	No	Exotic
12	Perennial ryegrass	<i>Lolium perenne</i>	10	no	FACU	Yes	Exotic
12	Paspalum	<i>Paspalum dilatatum</i>	5	no	FACU	Yes	Exotic
12	Broad-leaved plantain	<i>Plantago major</i>	40	yes	FACU	No	Exotic
12	Broad-leaved dock	<i>Rumex obtusifolius</i>	1	no	FAC	No	Exotic
12	Lotus	<i>Lotus pedunculatus</i>	5	no	FAC	Yes	Exotic
12	Catsear	<i>Hypochaeris radicata</i>	5	no	FACU	No	Exotic
12	Yorkshire fog	<i>Holcus lanatus</i>	7	no	FAC	Yes	Exotic
12	Cocksfoot	<i>Dactylis glomerata</i>	15	no	FACU	Yes	Exotic
12	Creeping buttercup	<i>Ranunculus repens</i>	30	yes	FAC	No	Exotic

Table 14: Image of the potential wetland plots undertaken at each of the two possible wetland sites.

Plot 1	
	
Plot 2	
	
Plot 4	



Taro within Slaughter House Stream



Plot 5



Plot 6 - No images

Plot 8



Plot 9



Plot 10

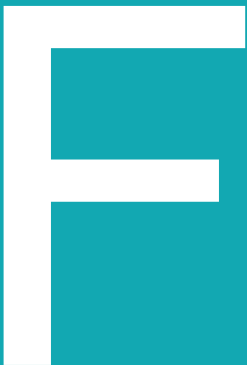


Plot 11



Plot 12





Appendix F – Tonkin & Taylor Ecological Impact Assessment



Plan Change Assessment of Ecological Effects

Spedding Block, Whenuapai

Prepared for
Oyster Capital Limited

Prepared by
Tonkin & Taylor Ltd

Date
September 2020

Job Number
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Document Control

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Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
08/04/2020	1	Final	Alicia Wong	Justine Quinn Matt Baber	Tim Fisher
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Oyster Capital Limited

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Appendix A :	Ecological Features and Offset Plans
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1 Executive Summary

This assessment of ecological effects report has been prepared in support of a private plan change (PPC) request by Oyster Capital (the Applicant) to the Auckland Unitary Plan Operative in Part (AUP). The plan change seeks to rezone approximately 52 hectares of land from Future Urban to Business – Light Industry, referred to as the Spedding Road Plan Change Area (SBPCA).

The SBPCA is located within the Tamaki Ecological District (TED) and the site drains to the upper Waitematā Harbour. Several stream systems are present within the SBPCA, including Totara Creek and Sinton Stream, which both flow into the Totara Inlet and Brigham Creek which is a Significant Ecological Area (SEA). The riparian margin of the lower Totara Creek is also a SEA, however has extensive weed infestations. Some riparian vegetation is present along the other streams however this is typically exotic and fragmented. Several wetlands are present within the SBPCA, all of which have unrestricted stock access and consequently are highly modified. The remainder of the SBPCA is in agricultural landuse, dominated by pasture grasses. At Risk - Declining inanga and longfin eel have been recorded within the streams. The Threatened Nationally – Critical long tailed bat was also recorded along the riparian margin of Totara Creek.

A change of zoning and subsequent rural to industrial land use poses a range of potential adverse effects to the ecological values that have been identified within the SBPCA. This report provides a comprehensive assessment of ecological effects to address all ecological effects anticipated to be required to enable the proposed landuse as envisaged through the plan change process, including some matters that would typically be left to a resource consent phase. The specific matters relate to the construction of the Spedding Road extension which is critical to enable the development of the Spedding Block. The effects expected include:

- Sediment entering the receiving environment from the works associated with landuse change;
- Potential impacts on water quality and quantity resulting from increased imperviousness;
- Increased stream bank erosion, changing the sedimentation regime along freshwater systems and into estuarine and marine environments resulting from a modified hydrologic regime;
- Modification or loss of stream, including specifically a 63 m culvert (including apron and rip-rap) in Sinton Stream resulting in modification of 71 m (136 m²) of Sinton Stream and reclamation of 46 m² SintonA Stream to enable the construction of Spedding Road extension;
- Potential impacts on fish passage from the proposed culvert in Sinton Stream to enable the Spedding Road extension;
- Impacts on native vegetation including specifically removal of up to 1,820 m² exotic riparian vegetation along Sinton Stream to enable the Spedding Road extension; and
- Potential impacts on native bats, birds and lizards from the landuse change and the removal of riparian vegetation required for the Spedding Road extension.

The ecological values of the site and the magnitude of effects have been assessed in accordance with the Ecological Impact Assessment Guidelines. Measures have been recommended to avoid, remedy and mitigate actual and potential effects of the landuse change. For those residual adverse effects associated with the Spedding Road extension, an assessment of offset required has been undertaken and proposed within this assessment and provided for in the proposed Precinct provisions. To address the effects of the Spedding Road extension:

- Riparian margins will be planted and enhanced along 1,407.1 m² streambed area to offset the loss or modification of 182.4 m² streambed area; and
- Removal of 1,820 m² exotic riparian vegetation will be addressed through the planting and enhancement of 3,640 m² riparian margin.

The level of detail provided within the plan change assessment of ecological effects report is commensurate with the level that would be provided to support a resource consent application. Therefore, it is considered that it is sufficient to inform a complete assessment of the ecological effects to enable the proposed plan provisions to be accepted.

2 Introduction

This assessment of ecological effects report has been prepared in support of a private plan change (PPC) request by Oyster Capital (the Applicant) to the Auckland Unitary Plan Operative in Part (AUP).

The plan change seeks to rezone approximately 52 hectares of land from Future Urban to Business – Light Industry. The plan change further seeks to apply precinct provisions to facilitate the transition from semi-rural land uses to the development of a light industrial business area in an integrated and comprehensive manner.

The land subject to this plan change is referred to as the Spedding Block Plan Change Area (SBPCA) and is shown Figure 2.1 below. The Spedding Block Precinct is located approximately 23 kilometres northwest of central Auckland and is under Oyster Capital's control. The SBPCA encompasses the following properties:

- 23-27 Brigham Creek Road
- 31 Brigham Creek Road
- 13 Spedding Road
- 15-19 Spedding Road

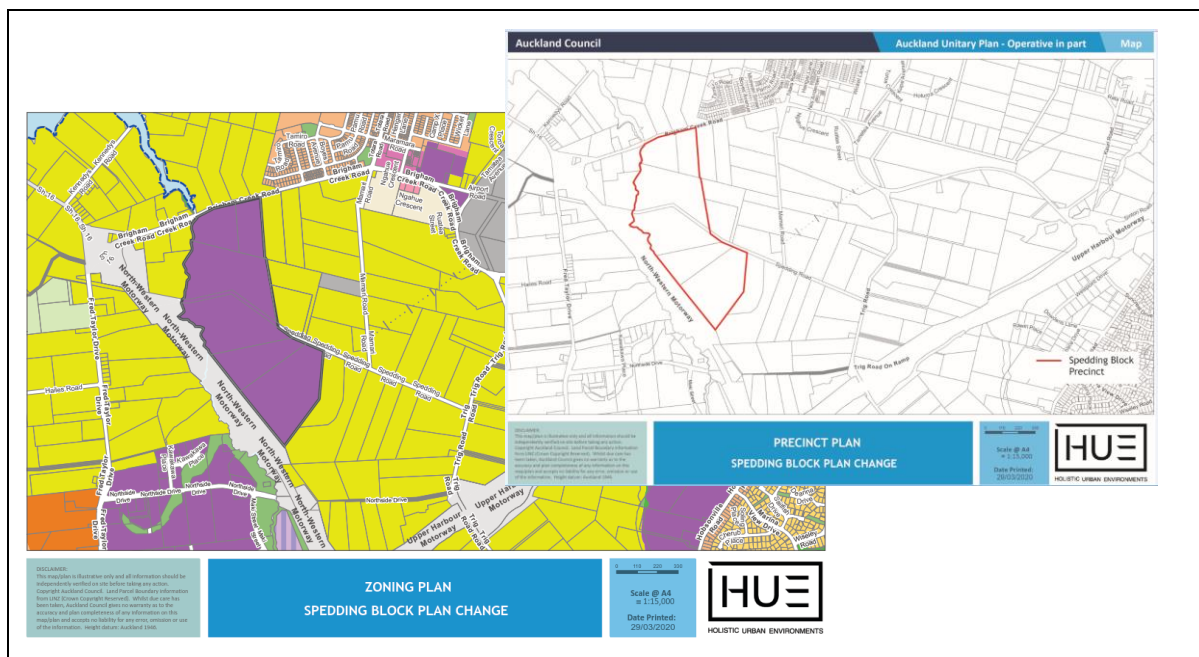


Figure 2.1: Spedding Block Plan Change Area in the context of the wider locality

A conceptual layout of the SBPCA associated with the PPC includes:

- Zoning change to Business – Light Industry;
- Extension of Spedding Road to connect with Brigham Creek Road:
 - Construction of a new stream crossing (culvert) over Sinton Stream for the Spedding Road extension;
 - Modification and loss of stream and terrestrial habitats to enable the proposed extension of Spedding Road; and
- Applying a Stormwater Management Area – Flow 1 (SMAF) control across the SBPCA.

2.1 Purpose and scope

The purpose of this report is to provide an assessment of ecological effects to accompany a PPC application for Oyster Capital. The assessment of ecological effects associated with the PPC is based on field assessments within the SBPCA and includes the following:

- Description of the ecological values within the SBPCA;
- An assessment of the ecological effects associated with the proposed PPC; and
- Recommendations to avoid, remedy, mitigate potential adverse effects and offset and/or compensate potential residual adverse effects.

This assessment of ecological effects should be read in conjunction with the supplementary Assessment of Environmental Effects (AEE) prepared by Beca with input from T+T in relation to the proposed activity standards and any potential ecological effects in relation to enabling the extension of Spedding Road.

2.2 Site description

The SBPCA is located within the Tamaki Ecological District (TED) and the site drains to the upper Waitematā Harbour. The SBPCA is bound to the west by Totara Creek and to the north by Brigham Creek Road. The western boundary is bound by the Upper Harbour Motorway (State Highway 18 [SH18]). The end of the current Spedding Road partially forms the eastern boundary of the SBPCA and the southern boundary is formed by Pikau Stream and private properties.

Some standalone residential dwellings are present however, the majority of the site is in pasture and is actively grazed by livestock (*Figure 2.2*).

Totara Creek flows north alongside the western SBPCA boundary to the Totara Inlet and Brigham Creek which is a Significant Ecological Area – marine (SEA-M2-57b¹), recognised for its extensive shellfish beds and abundant fish and bird life. The inlet and creek are also important for migratory freshwater fish. Sinton Stream and Pikau Stream are also located in the SBPCA and are tributaries of Totara Creek.

A terrestrial Significant Ecological Area (SEA) (SEA_T_2034) is present along the riparian margins of Totara Creek, meeting the criteria for threat status and rarity².

The site is located within a High Use Aquifer Management Area (HUAMA) (Kumeu Waitematā Aquifer) and subject to 'Rural' Macroinvertebrate Community Index Controls (MCIC). HUAMA are aquifers which are subject to a high number of water takes/allocations. MCIC are in place to guide expectations around water quality impacts from discharges.

The SBPCA is also located within the North West Wild Link between the Waitakere Ranges and Hauraki Gulf Islands. The North West Wild Link is a conservation project which aims to create safe, connected, and healthy habitats for native fauna across Auckland.

¹ Auckland Unitary Plan Operative in Part, Schedule 4 Significant Ecological Areas – Marine Schedule.

² Auckland Unitary Plan Operative in Part, Schedule 3 Significant Ecological Areas – Terrestrial Schedule.



Figure 2.2: SBPCA referred to within this assessment.

3 Methods

A combination of desktop review of relevant databases and site visits were used to assess the ecological values of marine, freshwater and terrestrial ecosystems in the SBPCA and the surrounding environs. The following sections briefly describes the methodologies carried out.

3.1 Desktop review

A desktop review of available information and databases relevant to the ecological values of the SBPCA was undertaken. This includes:

- Auckland Council GeoMaps;
- Auckland Council Herpetofauna database;
- Department of Conservation National Bat database;
- National Institute of Water and Atmosphere (NIWA) New Zealand Freshwater Fish Database (NZFFD);
- Auckland Unitary Plan Operative in Part (AUP); and
- Whenuapai Structure Plan with specific reference to:
 - Whenuapai Stream Classification Survey³,
 - Whenuapai Wetland Classification Survey⁴, and
 - Whenuapai Esplanade Reserve Scoping Study⁵.

3.2 Site walkover

Ecologists from T+T visited the SBPCA on several occasions in January and February 2020 and again in July 2020. A wetland specific site visit was undertaken in September 2020 to obtain accurate wetland extent. The detail provided in this report has been assessed based on observations in both summer and winter conditions.

During our site visits, key terrestrial and freshwater ecological features were identified, characterised and mapped across the site (Appendix A, Figure 1).

3.2.1 Freshwater values

Streams in the Auckland Region are classified as either permanent, intermittent, ephemeral, or artificial in accordance with the criteria outlined in the AUP. Streams classified as either permanent or intermittent are protected under the AUP.

Streams were initially identified, mapped, and classified according to these criteria in January 2020. The weather during the January 2020 site visit was dry and sunny. In the 48 hours prior to the January site visit, 0 mm of rainfall was recorded at the Auckland Council rain gauge⁶ approximately 2 km away. A follow-up stream classification was undertaken in July 2020⁷ to confirm the initial stream classifications and extents. The weather during the July site visit was rainy. In the 48 hours prior to

³ Memorandum from Morphem Environmental Limited to Auckland Council, titled 'Subject: Whenuapai Stream Classification Survey', dated 30 May 2016.

⁴ Memorandum from Morphem Environmental Limited to Auckland Council, titled 'Subject: Whenuapai Wetland Classification Survey', dated 15 July 2016.

⁵ Report prepared by Morphem Environmental Limited, titled 'Whenuapai Esplanade Reserve Scoping Study', prepared for Auckland Council, dated 21 July 2016.

⁶ Auckland GeoMaps, 2020. Rainfall data from Whenuapai @ Airbase.

⁷ Undertaking classifications in July to October is consistent with guidance to classify streams in Auckland.

the July site visit, 32 mm of rainfall was recorded at the Auckland Council rain gauge⁶ approximately 2 km away.

The observed extent of intermittent and permanent streams in the SBPCA was generally less than that identified by the Auckland Council GeoMaps (ACGM) overland flow path layer (>4000 m² catchments). Many of the smaller overland flow paths appear to have been heavily modified/reclaimed and some were clearly ephemeral streams that flowed only during and immediately after rainfall. These stream extents have been cross-checked with those undertaken by Morphum Environmental Limited to inform the Whenuapai Structure Plan.

Representative SEV along Sinton Stream and Sinton A (tributary of Sinton Stream) and macroinvertebrate sampling (Protocol C2⁸) in Sinton Stream and Totara Creek was also carried out in July 2020. Stream survey locations were selected based on presence of stream habitat suitability and were carried out along a 100 m reach.

A fish survey was undertaken within Sinton Stream and Totara Creek. A combination of un-baited fyke nets ($n = 3$) and Gee minnow traps (GMTs) ($n = 6$) were deployed and left overnight on 6 July 2020 and retrieved during the morning of 7 July 2020.

3.2.2 Wetland values

Wetlands are defined in the Resource Management Act (1991) 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”. Wetlands, irrespective of their biodiversity values, are subject to the same provisions of the AUP as intermittent and permanent streams.

Wetlands were identified, during an initial site walkover in January and a follow-up walkover in July, in accordance with the definition provided in the Resource Management Act (1991) (Appendix A, Figure 1). Wetland characteristics including vegetation type and dominance, vertical structure, and community complexity (diversity) were recorded. The wetlands observed on site were easily defined due to vegetation present and local topography. Intermittent wetlands are areas of shallow water and are seasonally influenced, the full extent and structure is limited during summer and drier months. The extent of wetlands was confirmed in July 2020.

Following the release of the National Policy Statement for Freshwater Management (NPS FM) in August 2020, a further survey of the wetlands in accordance with the natural inland wetland definition was undertaken in September 2020. The wetland extent was surveyed by a registered surveyor alongside an ecologist.

3.2.3 Terrestrial values

Vegetation across the SBPCA was assessed and categorised in accordance with ecosystem types described in the Indigenous terrestrial and wetland ecosystems of Auckland⁹.

No specific surveys were undertaken for nationally Threatened or At Risk birds, lizards or invertebrates or plants on the basis that the habitat available onsite was considered unsuitable for ‘Threatened’ or ‘At Risk’ species within these taxonomic groups.

As habitat was suitable for nationally Threatened (Nationally Critical) long-tailed bat (*Chalinolobus tuberculatus*), additional surveys were undertaken. To assess potential long-tailed bat presence and activity, eight Department of Conservation (DOC) acoustic frequency compression Automatic Bat

⁸ Stark, J. D. Boothroyd, I. K. G., Harding, J. S. Maxted, J. R. Scarsbrook, M. R. (2001). Protocols for sampling macroinvertebrates in wadeable streams. New Zealand Macroinvertebrates Working Group Report No. 1, ISSN 1175-7701

⁹ Singers, N., Osborne, B., Lovegrove, T., Jamieson, A., Boow, J., Sawyer, J., Hill, K., Andrews, J., Hill, S., and Webb, C. (2017). Indigenous terrestrial and wetland ecosystems of Auckland. Auckland Council.

Monitors (ABMs) were deployed across the site, targeting potential roosting trees and areas of likely bat foraging.

ABMs were deployed on 28 February for a total of 20¹⁰ nights, and were retrieved on 19 March (Figure 3.1). Monitoring during full moon and one night either side should be avoided¹¹. A full moon occurred on 10 March 2020, therefore data collected on the nights of 9, 10 and 11 March 2020 were excluded from analysis.

Weather data was sourced from the Auckland Council @ Whenuapai Airbase weather station.

The recordings were processed using an automated AI-based tool¹² which identified long-tailed bat recordings. Results were then manually checked for quality assurance purposes using the DOC BatSearch 3.11 programme.



Figure 3.1: Automatic Bat Monitor deployment locations (dots). Bat activity detection on a valid night indicated in green, bat activity detection on a technically invalid night in blue, no bat activity detected indicated in white, and automatic bat detectors failure and faults indicated in red.

¹⁰ Monitoring nights were considered to be 'valid' where weather parameters met the following conditions: Air temperatures to remain at least 10°C from sunset until four hours after sunset; no more than 2.5mm of rain in the first two hours after sunset; mean overnight wind speed does not exceed 20 km/h; and maximum overnight wind gust does not exceed 60 km/h.

¹¹ Smith, D., Borkin, K., Jones, C., Lindberg, S., Davies, F. & Eccles, G. (2017). Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature. NZ Transport Agency research report 623. 249pp.

¹² Automated AI-based tool developed by Tonkin & Taylor Ltd. Comprehensive testing of the AI-based counting tool and its accuracy is currently being undertaken. Preliminary results where the tool has been used to independently re-count datasets that have been already been manually counted indicate the accuracy is in the order of 95%. More information about this tool is available on request.

3.2.4 Marine values

A desktop assessment was undertaken to determine the existing values of the marine receiving environment just downstream of the SBPCA.

3.3 Assessment of ecological effects

The method applied to this assessment of ecological effects broadly follows the Ecological Impact Assessment Guidelines (EclAG)¹³. Using a standard framework and matrix approach such as this provides a consistent and transparent assessment of effects.

Outlined in the following sections, the guidelines have been used to ascertain the following:

- The level of ecological value of the environment;
- The magnitude of ecological effects from the proposed zone change on the environment; and
- The overall level of effect to determine if mitigation is required.

The framework for assessment provides structure to quantify the level of ecological effects but needs to incorporate sound ecological judgement to be meaningful. Deviations or adaptations from the methodology are identified within each of the following sections as appropriate.

Further detail regarding these guidelines is included in Appendix B.

3.4 Determination of offset/compensation requirements

Two different methods have been used to quantify offset/compensation requirements for freshwater and terrestrial habitats affected by this project.

The SEV and associated environmental compensation ratio (ECR) is a tool used to quantify the amount of streambed area that is required to be restored to achieve no net loss, which takes into account the extent and type of stream impacted or lost and the type of enhancement works proposed. The objective is to achieve a 'no-net-loss' in ecological function as a result of the activities. The ECR calculation formula requires SEV scores to be calculated for both the impact and proposed mitigation (or offset, if applicable) sites. This provides a basis from which to quantify and scale the likely loss in values and functions at an impact site with the increase in stream ecological values and functions at a compensation or mitigation site.

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

Where:

SEVi-P is the potential SEV value for the site to be impacted.

SEVi-I is the predicted SEV value of the stream to be impacted after impact.

SEVm-C is the current SEV value for the site where environmental compensation is applied.

SEVm-P is the potential SEV value for the site where environmental compensation is applied.

$$\text{Restoration length required} = (\text{impact area} \times \text{ECR}) / \text{restoration channel width}$$

While the SEV and ECR is appropriate for streams, the use of ECRs (or multipliers) to determine terrestrial compensation requirements has increasingly been challenged due to a lack of transparency and the often ad-hoc nature of their application.

To address these concerns, T+T has recently adapted the Biodiversity Offset Accounting System¹⁴ to determine the type and magnitude of proposed habitat and restoration measures that are

¹³ Roper-Lindsay, J., Fuller, S.A., Hooson, S., Sanders, M.D., and Ussher, G.T. (2018). Ecological Impact Assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

considered likely to achieve NNL or preferably NG outcomes. These adaptations are termed Qualitative Biodiversity Compensation Models (**QBCMs**). The QBCMs follow the same approach as the Biodiversity Offset Accounting System but are based in part on qualitative information derived from expert assessment and available literature where quantitative data is not available. While there are potential limitations and constraints with the development and application of the QBCMs (and biodiversity models in general), the QBCM constitutes a recognised improvement over the status quo. That is, that this approach provides transparency, robustness and a validation process for determining compensation requirements to address residual adverse effects.

Based on data inputs, QBCM's calculate whether a 'no-net-loss' or 'net-gain' biodiversity outcome will be achieved, whilst accounting for uncertainty and time lag between loss at impact sites and gain being created at offset sites. In summary, the model:

- Accounts for 'like-for-like' biodiversity trades/currencies aimed at demonstrating 'no-net-loss' or 'net-gain';
- Calculates the present biodiversity value to estimate whether 'no-net-loss' or 'net-gain' can be achieved;
- Incorporates the use of a time discount rate to account for time lag. We have used a discount rate of 3% to account for the temporal-lag between the impact occurring (due to the development) and the biodiversity gains being generated (due to the offset actions). The worked examples provided in the model User Manual apply a discount rate of 3%, as informed by research conducted as part of DOC's research project on biodiversity offsetting in New Zealand; and
- Makes an allowance for uncertainty of success (i.e. a degree of confidence) in relation to proposed offset actions.

These methods have been used to quantify offset requirements for residual effects on aquatic and terrestrial habitats.

4 Ecological values

4.1 Terrestrial ecological values

4.1.1 SEA and riparian vegetation

The SBPCA has been heavily modified through agricultural and horticultural land use. Historical land use changes from forest cover to intensive agriculture and horticulture since pre 1940s have severely degraded the landscape.

Across the SBPCA, vegetation is limited to exotic trees planted to create shelter belts along boundary lines, streams or to form ornamental and amenity gardens. The SBPCA is still at large, actively farmed, and so pasture grasses form the predominant cover.

Vegetation observed is predominately grazed pasture grasses with stands of mature exotic trees and exotic shrubs limited to shelter belts and riparian margins along watercourses such as Sinton Stream.

Notwithstanding its status as a SEA (SEA_T_2034), the riparian margins of Totara Creek are dominated by exotic canopy species with a mixed native and exotic understory, which includes a high proportion of invasive weeds.

A species list of the vegetation observed in the riparian margin along Sinton Stream and the SEA is provided in Appendix C. Photographs of the vegetation across the site is provided in Appendix F.

4.1.2 Terrestrial fauna

Potential habitat for terrestrial fauna across the SBPCA was sparse and limited to vegetation along riparian margins, shelter belts, and remnant, isolated trees. These areas at a local and landscape-level have the potential to provide habitat, refugia, food source, and connectivity for the nationally Threatened' long-tailed bat, and non-threatened native birds, lizards, and invertebrates. Landscape connectivity is particularly relevant given the location of the site in relation to the North West Wildlink.

Of the 20 nights of acoustic bat survey, 16 were deemed valid¹⁰ based on weather parameters and moon phase¹⁵.

Two bat search phase echolocation calls were recorded across all 6¹⁶ functioning ABMs during valid survey nights – one pass at ABM7 (night of 3 March), and another at ABM1 (night of 17 March). No feeding buzzes were recorded.

A mean of 0.02 passes/ABM/night recorded during this survey represents a very low level of activity. This suggests that at the time of survey, bats were only occasionally active on site. Bat activity was recorded along Totara Creek corridor and this indicates that it currently supports bat movement across the landscape. Bat activity was not recorded along the riparian margins and shelter belt vegetation along Sinton Stream during this survey.

However, the SBPCA is situated between two known populations of long-tailed bats located in the Waitakere Ranges and Riverhead Forest. Riparian margins across the SBPCA may support bat foraging and movement across the landscape. Trees with cavities, flaky bark and split branches (e.g. macrocarpa, gums and pine) potentially offer bat roost habitat and it is possible these may be intermittently used as roost trees.

¹⁵ Four nights were invalid; three due to the full moon and one night on either side, and the fourth (18 March) due to low temperatures in the first 4 hours after sunset.

¹⁶ ABM4 was faulty and so did not record any data while ABM6 was lost in the stream.

Due to long-tailed bats having a high threat status of 'Threatened – Nationally Critical'¹⁷, this species is considered as having very high ecological value.

The SBPCA may also support a large array of common native and non-native bird species typical of the available habitat, namely within open flat farmland and exotic vegetation along riparian margins. None of the species observed at the time of our site visit are classified as 'Threatened' or 'At Risk'. The marine SEA is adjacent to the SBPCA and large flat farmland may provide periodic roosting of wading and coastal bird species (such as dotterels [*Charadrius obscurus*]), although this would be either infrequent or unlikely due to existing disturbances from livestock grazing pressure.

There are no records of native lizards in the SBPCA or in the surrounding Whenuapai area. Only exotic plague skinks (*Lampropholis delicata*) were observed during our site walkover. While no native skinks were observed, the native copper skink may be present on site. This species is classified by the Department of Conservation as 'Not Threatened' but like all native lizards is legally protected under the Wildlife Act (1953). The native copper skink is likely to be limited to suitable habitat along riparian margins; particularly along Totara Creek and Sinton Stream where rank pasture grasses and leaf litter are relatively more abundant. Farm and building debris can also act as refuge habitats. The vegetation observed across the PCA is unlikely to support populations of nationally 'Threatened' or 'At Risk' lizards due to the lack of contiguous remnant native vegetation.

Table 4.1 provides a summary of terrestrial fauna observed during site visits, recorded on relevant databases, and that are likely to frequent the SBPCA.

The terrestrial vegetation, albeit dominated by exotic species, in the SBPCA is considered as having low to very-high ecological value due to the potential for native terrestrial fauna habitat and detection of occasional long-tailed bat activity.

Table 4.1: Summary of indigenous terrestrial fauna confirmed or potentially present within the SBPCA.

Common name	Scientific name	Observed/ detected in the SBPCA	Recorded within and in the vicinity of the SBPCA	Likely to frequent the SBPCA	Threat status ^{17, 18, 19}
Bat					
Long-tailed bat	<i>Chalinolobus tuberculatus</i>		Y	Y	Threatened – Nationally Critical
Lizard					
Copper skink	<i>Cyclodina aenea</i>	-	-	Y	Not Threatened
Avifauna					
Chaffinch	<i>Fringilla coelebs</i>	-	-	Y	Introduced and Naturalised

¹⁷ O'Donnell, C. F. J., Borkin, K. M., Christie, J. E., Lloyd, B., Parsons, S., and Hitchmough, R. A. (2017). Conservation status of New Zealand bats. Department of Conservation.

¹⁸ Hitchmough, R. Barr, B., Lettink, M., Monks, J., Reardon, J., Tocher, M., van Winkel, D., and Rolfe, J. (2015). Conservation status of New Zealand reptiles. Department of Conservation.

¹⁹ Roberston, H. A., Baird, K., Dowding, J. E., Elliott, G. P., Hitchmough, R. A., Miskelly, C. M., McArthur, N., O'Donnell, C. F. J., Sagar, P. M., Scofield, R. P., and Taylor, G. A. (2016). Conservation status of New Zealand birds. Department of Conservation.

Common name	Scientific name	Observed/ detected in the SBPCA	Recorded within and in the vicinity of the SBPCA	Likely to frequent the SBPCA	Threat status ^{17, 18, 19}
Welcome shallow	<i>Hirundo neoxena</i>	Y	-	Y	Not Threatened
White-faced heron	<i>Egretta novaehollandiae</i>	Y	-	Y	Not Threatened
Pipit	<i>Anthus novaeseelandiae</i>	-	-	Y	At Risk – Declining
Skylark	<i>Alauda arvensis</i>	-	Y	Y	Introduced and Naturalised
Paradise shelduck	<i>Tadorna variegata</i>	Y	Y	Y	Not Threatened
Swamp harrier	<i>Circus approximans</i>	-	Y	Y	Not Threatened
Pukeko	<i>Porphyrio melanotus</i>	Y	-	Y	Not Threatened
Sacred kingfisher	<i>Todiramphus sanctus</i>	Y	-	Y	Not Threatened
Silvereye	<i>Zosterops lateralis</i>	Y	-	Y	Not Threatened
Mallard x grey duck hybrid	<i>Anas superciliosa x platyrhynchos</i>	-	-	Y	Not Threatened
Kereru	<i>Hemiphaga novaeseelandiae</i>	-	Y	Y	Not Threatened
Spur-winged plover	<i>Vanellus miles</i>	Y	-	Y	Not Threatened
Yellowhammer	<i>Emberiza citrinella</i>	Y	-	Y	Introduced and Naturalised
New Zealand dotterel	<i>Charadrius obscurus</i>	-	-	Y	At Risk - Recovering

4.2 Wetland ecological values

Five wetlands were identified across the SBPCA (Appendix A), and all were assessed as having low current ecological value based on the dominance of exotic vegetation, short stature (averaging 0.2 m in height), low vegetation species diversity and degradation associated with pastoral land use and active livestock grazing pressure. All of the wetlands identified had unrestricted stock access and so were heavily modified. For these reasons, they do not support a high diversity of indigenous wetland vegetation or fauna and are highly unlikely to support any cryptic threatened taxa, e.g. wetland bird species that require greater coverage (e.g. spotless crane [*Porzana tabuensis*]).

Wetland A forms in a slight topographical depression that slopes down towards the Sinton A Stream on what may be a historic tributary. The extent of the wetland is not well defined due to modification; however, the wetland has been mapped around the presence of *Juncus edgariae* and topographical change. The extent of the wetland was confirmed during our second site visit in July 2020 and again in September 2020. This wetland has been highly degraded by active livestock grazing pressure, resulting in an average vertical height stature of 0.2 m. Exotic pasture grasses form the dominant cover (~88%), with *Juncus edgariae* forming roughly 10%, and the last 2% of the cover was made up of *Ranunculus repens*, *Plantago major*, *Trifolium repens*, and *Rumex obtusifolius*. No habitat for wetland birds was observed. The wetland is classified as a Natural Inland Wetland (following the NPS FM 2020).

Wetland B is not evident on historic aerials and records show that the land around the wetland has been worked over for many years. Notwithstanding, the area ponds over with open standing water during winter months and has a clearly defined wetland margin.

Two of the wetlands (Wetland A1 and A2) are entirely artificial, in that they are old rectangle ponds that have been constructed alongside the upper bank true left margin of the Sinton A Stream. These constructed ponds are not classified as Natural Inland Wetlands (following the NPS FM 2020).

Wetland C forms in a slight overland flowpath depression that slopes down towards the Sinton Stream on what may be a historic tributary. The extent of the wetland is not well defined due to modification; however, the wetland has been mapped around the presence of *Juncus edgariae* and topographical change. The extent of the wetland was confirmed during our second site visit in July 2020 and again in September 2020.

All wetlands have a currently moderate ecological value on the basis that:

- Wetlands are a threatened ecosystem with less than 1% remaining in the Ecological District and ~ 9.4% nationally; and
- Despite being threatened, wetlands onsite are highly modified and degraded pasture wetlands that are dominated by exotic wetland vegetation and provide low quality habitat for native fauna.

The wetlands identified across the SBPCA have been accurately delineated following the September 2020 survey. The ecological value of these wetlands is moderate due to their threatened ecosystem status nationally, notwithstanding their general degradation by livestock grazing pressure and low likelihood of habitat provision for fauna.

Photographs of wetlands are provided in Appendix F.

4.3 Freshwater ecological values

Two major sub-catchments are located in the SBPCA. The Sinton Stream flows from east to west along the northern part of the SBPCA, while the Totara Creek flows south to north along the western boundary.

Mapping of stream networks was undertaken by Morphum Environmental to inform the Whenuapai SMP²⁰. This primarily relied on modelling of overland flow paths to estimate the location of ephemeral/intermittent transition points. Some field validation was then undertaken but only to certain locations and stream types. The report identifies that *“Due to inaccuracies in the stream network alignment, there is a risk that some permanent or intermittent streams have not been identified, and conversely, that some modelled permanent or intermittent streams are not actually present. It is recommended that the stream network is surveyed to provide an accurate baseline for the development of the structure plan.”*

All streams in the SBPCA have been classified and ground-truthed. Permanent and intermittent stream tributaries of Totara Creek, Sinton Stream, and Pikau Stream were identified in the SBPCA. Many of these streams either lack intact riparian margins or have been reduced to single rows of shelter belt vegetation. The stream extents have been cross-checked with those reported in the Whenuapai Structure Plan and are consistent²¹. Previous site assessments undertaken by Morphum Environmental have also identified extensive stock damage in sections (refer to section 4.3.4 for more discussion).

²⁰ Memorandum from Morphum Environmental Limited to Auckland Council, titled ‘Subject: Whenuapai Stream Classification Survey’, dated 30 May 2016.

²¹ Noting that as described above there were limitations to how much of the stream classification was field validated.

Permanent and intermittent watercourses are subject to the provisions of Chapter 3 of the AUP. A description and evaluation of ecological value for each watercourse is provided below and photos are available in Appendix D.

4.3.1 Totara Creek and tributaries

Totara Creek flows for approximately 800 m along the north western boundary of the SBPCA and discharges into the estuarine Totara Inlet and Brigham Creek. Totara Creek flows through a terrestrial SEA and discharges into a marine SEA. The SBPCA is located in the lower reaches of the Totara Creek, which has a total catchment area of 680 ha, within a developing catchment, characterised by future urban, light industrial and commercial land use. Upstream of the SBPCA, provision is made for a 'green' network along the creek. Totara Creek is natural in character, deeply incised, and channel widths average wider than 3 m. The riparian margin is dominated by exotic species (namely *Cryptomeria japonica*, *Eucalyptus* spp, and *Pinus* spp), however provides shade and organic matter input which contributes to the ecosystem functioning of the creek. Access to the bed of the Totara Creek is largely restricted due to bank incision, the channel is comprised mainly of bedrock substrates (stiff clay), riffles, runs and pools, with sediment deposition evident in areas of slower flow. Some bank erosion is evident and some sections of the riparian margin have eroded into the stream.

Totara A is a highly modified intermittent tributary of Totara Creek and is located on the true right bank within the SBPCA. Upon examination of historical aerial photos (Appendix E) taken from 1940, the upper portion of Totara A has been artificially constructed to connect to a constructed silage pit. The previous landowners have confirmed that they had enlarged the silage pit and dug a drainage channel into the ground to take water and seepage away from the pit. Therefore, the natural portion of Totara A is approximately 77 m in length from where it flows into Totara Creek. The riparian margins were largely unvegetated or planted with willow (*Salix* sp.). Stock access was unrestricted and consequently, trampling damage of the stream banks was evident. Inorganic materials (tyres, concrete slabs, and plastic sheets) had been dumped at the head of the overland flowpath feeding this stream. Totara A was dry during our site visit in January and was confirmed to be flowing (intermittent) in July.

Totara B is an intermittent tributary observed just downstream of where Totara Creek exits the North-Western Motorway culvert. Totara B was dry during our site visit in January and was confirmed to be flowing (intermittent) in July. Totara B is approximately 115 m in length and is located within a relatively dense, but narrow, riparian margin consisting of *Ligustrum sinense* (Chinese privet) and eucalyptus. There was evidence of channel modification including manual scraping of bank margins and presence of nova coil pipes. At the time of site inspection, an isolated pool was observed downstream of the pipes, however the pipes showed evidence of being dry for a long time (extensive cobwebs, dry leaves).

4.3.2 Sinton Stream and tributaries

Sinton Stream dissects the SBPCA from an east to west direction and discharges into Totara Inlet and Brigham Creek. The downstream reaches of Sinton Stream were flowing at the time of the site visit and the stream in the SBPCA (~440 m) has been classified as permanent. A culvert of less than 10 m wide is located along Sinton Stream, immediately downstream of the existing pine block located at 31 Brigham Creek Road. The culvert does not appear to be perched and water appears to be flowing unimpeded through during low flow conditions.

The upper reaches of the Sinton Stream are expected to be predominantly intermittent in nature, as the contributing catchment decreases. The upper reaches are impacted by agricultural landuse and aerial imagery indicates that the riparian margins are effectively absent. The upstream catchment will influence the quality and ecological values of the Sinton Stream.

A major tributary of Sinton Stream extends south towards the end of Spedding Road. Referred to as SintonA, it is a modified, soft bottom stream which has been fenced from stock for most of its length. The stream is classified as intermittent as it had some standing water during the site walkover in January and was confirmed to be flowing during July. The stream is highly modified, with evidence of channel straightening, and minimal instream channel heterogeneity. SintonA is approximately 475 m in length and it terminates near the end of the existing Spedding Road. Riparian margins were mostly lacking on the true left side and limited to a single row of willow on the true right side; however, several small exotic dominated wetlands were observed along the western side of SintonA and are discussed in Section 4.2 above. Near the confluence of SintonA with the Sinton Stream, the stream passes through a stand of pines, which provide some shade to the lower reaches.

4.3.3 Pikau Stream

Approximately 330 m of the lower, permanent reaches of the Pikau Stream form the southern boundary of the SBPCA. Natural undercuts were present in some locations which are expected to provide habitat for aquatic fauna. Stock trampling damage and erosion along the stream banks was evident in some sections of the stream, and riparian vegetation was sparsely distributed.

4.3.4 Esplanade provisions

Morphum Environmental (on behalf of Auckland Council) have surveyed streams within the proposed SBPCA to identify those streams with a channel width of greater than three metres to determine where there is potential for esplanade reserves to be required under section 230 of the Resource Management Act (1991). This work was undertaken in 2016²² and has been reviewed to inform this assessment of esplanade requirements. Morphum undertook rapid field assessments to measure the width of streams at representative cross sections to determine where stream widths either were less than three metres, greater than three metres or greater than three metres due to stock damage (Figure 4.1).

The assessment that follows relates to ecological and physical matters in relation to stream widths and should be read in conjunction with the Assessment of Environmental Effects that supports the plan change.

Morphum identified that the entire length of Totara Creek within the SBPCA was wider than three metres; therefore would trigger esplanade reserve provisions. This is consistent with our field observations made of Totara Creek and is considered an accurate representation of the stream width.

Morphum identified that the lower reaches of the Sinton Stream (downstream of the existing culvert) were wider than three metres and would trigger esplanade provisions. Upstream of the pine block (31 Bringham Creek Road) to the edge of the SBPCA the stream was measured as being less than three metres. Pikau Stream in the SBPCA was measured as less than three metres in the upper reaches and wider than three towards the lower reaches before the confluence with Totara Creek.

²² Ingley, R., and Macintosh, K. (2016). Whenuapai Esplanade Reserve Scoping Study. Prepared by Morphum Environmental Ltd for Auckland Council (project number P00965).

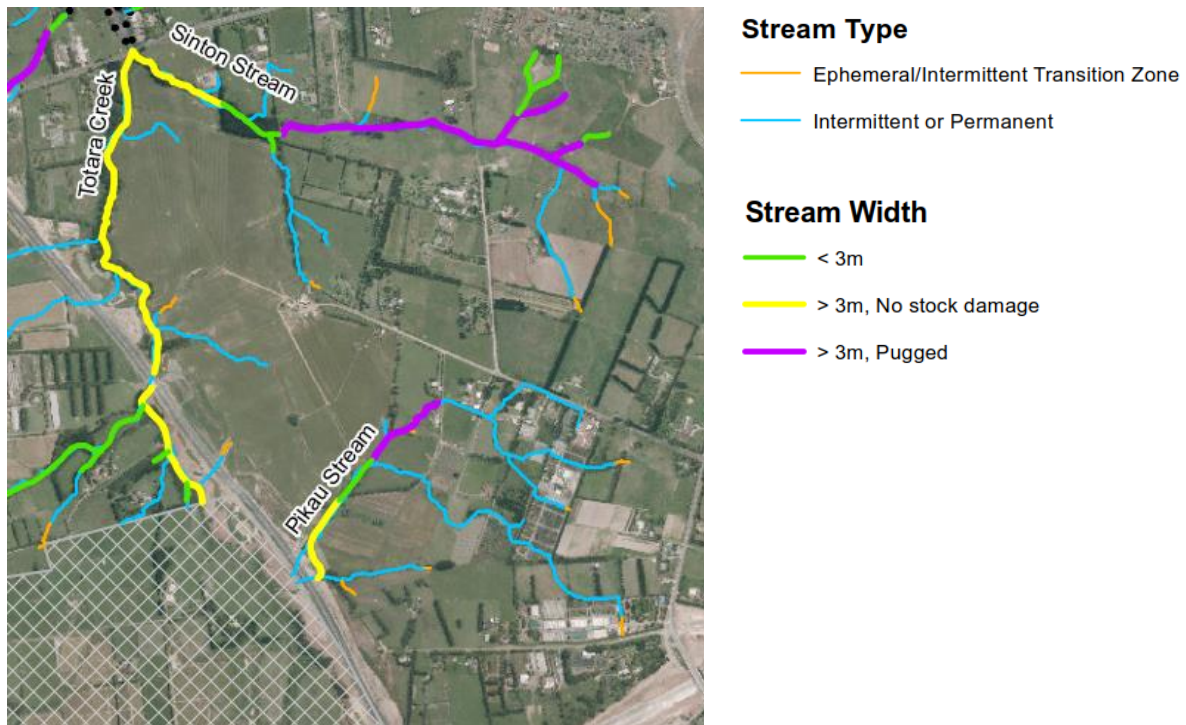


Figure 4.1: Stream widths within the SBPCA as surveyed and modelled by Morphum Environmental for the Whenuapai Esplanade Reserve Scoping Study.

4.3.5 Native freshwater fish

Fish caught in fyke nets and Gee minnow traps during our fish survey included one shortfin eel (*Anguilla australis*), three longfin eel (*Anguilla dieffenbachii*), 41 inanga (*Galaxias maculatus*), nine banded kokopu (*Galaxias fasciatus*), and NZ freshwater shrimp. Inanga and longfin eel are both classified as At Risk – Declining²⁴, which means that while the species is not currently threatened and may appear to be common, the population is declining. Considering the proximity to the coast and the altitude, the species present are indicative of a ‘good’ index of biological integrity (IBI)²³.

A desktop review of streams within the vicinity of the SBPCA was carried out using the NZFFD. Several native fish species have been recorded immediately downstream and upstream of the site within Totara Creek and its tributaries (Table 4.2). In addition to the fish species we caught during our fish survey, common bully (*Gobiomorphus cotidianus*) and Cran’s bully (*Gobiomorphus basalis*), have also been recorded. When including these species in the IBI, a score of 46 is returned, indicative of ‘very good’ IBI. All of these species are anticipated to be present in Totara Creek, Pikau Stream, and Sinton Creek in the SBPCA. Intermittent tributaries of these streams may provide habitat for fish during periods of peak flows.

Diadromous migration is an important life history trait of many of the species that were identified within Totara Creek (Table 4.2). Fish species that undertake diadromous migration spend a period of time at sea to complete their life cycle. The occurrence of diadromy within Totara Creek shows that the connection between marine habitats and upstream freshwater habitats is vital for these species. Likewise, it is important to highlight that as fish are highly mobile, migration between freshwater habitats will occur during most of the year and not just at key migration times. The presence of the threatened and at-risk species in the SBPCA identifies that maintaining and/ or improving instream

²³ As determined by the Index of Biotic Integrity calculator for the Auckland Region, which returned a score of 40.

habitat health and connectivity to higher quality upstream and tributary habitats is an important priority.

Several culverts were identified in the SBPCA, including a culvert between Totara Creek and Totara A and a culvert along Sinton Stream. However, the culverts observed do not appear to be perched nor restricting fish upstream and downstream passage.

Table 4.2: Freshwater fauna species present in Totara Creek and Sinton Stream

Common name	Scientific name	Threat status ²⁴	Diadromous ²⁵	Fyke net & Gee minnow	NZFFD
Longfin eel	<i>Anguilla dieffenbachii</i>	At Risk – Declining	Y	Y	Y
Shortfin eel	<i>Anguilla australis</i>	Not Threatened	Y	Y	Y
Common bully	<i>Gobiomorphus cotidianus</i>	Not Threatened	Y	-	Y
Cran's bully	<i>Gobiomorphus basalis</i>	Not Threatened	N	-	Y
Inanga	<i>Galaxias maculatus</i>	At Risk - Declining	Y	Y	Y
Banded kokopu	<i>Galaxias fasciatus</i>	Not Threatened	Y	Y	Y
New Zealand freshwater shrimp	<i>Paratya curvirostris</i>	Not Threatened	N	Y	Y

4.3.6 Macroinvertebrates

Twenty-one invertebrate taxa were recorded from the kick samples collected from Sinton Stream and Totara Creek. The MCI-sb scores for Sinton Stream and Totara Creek indicate 'fair' and 'poor' habitat and water quality. While invertebrate communities, Consistent rainfall in the two weeks prior and heavy rainfall in the 48 hours prior to sampling likely influenced the low taxa richness recorded, especially for Totara Creek. Higher baseline taxa richness is expected for both streams, however we do consider that the MCI-sb values are representative of the agricultural land use in both catchments. Summary results for the samples collected for Sinton Stream and Totara Creek are provided in Table 4.3.

Table 4.3: Summary results for macroinvertebrates collected in Sinton Stream and Totara Creek in the PCA (July 2020).

Site name	Taxa richness	EPT richness	Number of individuals	MCI-sb value	MCI-sb class	QMCI-sb value	QMCI-sb class
Sinton Stream	15	6	64	85	Fair	3.8	Poor
Totara Creek	6	16	25	70	Poor	4.1	Fair

²⁴ Dunn, NR, Allibone, RM, Closs, GP, Crow, SK, David, BO, Goodman, JM, Griffiths, M, Jack, DC, Ling, N, Waters, JM, and Rolfe, JR (2018). Conservation status of New Zealand freshwater fish, 2017. New Zealand Threat Classification Series 24. Wellington: Department of Conservation. Retrieved from www.doc.govt.nz.

²⁵ McDowall, R. M. 2000. The reed field guide to New Zealand freshwater fishes.

4.4 Marine ecological values

The streams within the SBPCA discharge to Brigham Creek which in turn discharges to the Upper Waitemata Harbour (UWH).

The UWH catchment encompasses approximately 185 km² fed by seven tidal creeks, one of which is the Brigham Creek. A study undertaken to inform the development of the Rural Urban Boundary in 2013 provides some summary information relating to the marine water quality, sediment contaminants, and benthic health of the UWH and Brigham Creek. The UWH catchment has been assessed as having a marine water quality of 'degraded 1' due to consistently 'poor' or 'fair' results, while the Brigham Creek area specifically is 'poor'²⁶. In 2012 the sediment quality was similar, being classified as 'degraded 1' and having amber level environmental response criteria (ERC²⁷) at Brigham Creek. The benthic health grade for the Brigham Creek area was classified as 4, on a scale of 1 to 5 where 5 is unhealthy (polluted by sediment or contaminants). A grade of 4 indicates that the resilience of the ecosystem is severely compromised. On the whole the UWH and Brigham Creek area is identified as having a level of degradation.

Notwithstanding its degraded state, the Brigham Creek is a recognised significant ecological area – marine (SEA-M2-57b²⁸) immediately north of Brigham Creek Road). Brigham Creek is identified as a SEA due to the value of the habitat present, comprising of mangrove forest and scrub occurring in areas of frequent tidal inundation with abundant silt deposition. Brigham Creek is recognised for its extensive shellfish beds and wading bird habitat. Wading bird species that actively use this habitat include variable oystercatcher (*Haematopus unicolor*), pied stilt (*Himantopus leucocephalus*), royal spoonbill (*Platalea regia*), New Zealand kingfisher (*Todiramphus sanctus*), and pied shag (*Phalacrocorax varius*). Additionally, the area is identified as a valuable migration pathway for a number of different species of native freshwater fish.

4.5 Summary of ecological values

In summary, the ecological values of the SBPCA are of low to moderate overall ecological value, reflective of the high level of modification observed.

Terrestrial SEA and non-SEA vegetation and habitat of **low** to **high** ecological value is for the most part concentrated along riparian margins of Totara Creek and Sinton Stream. SBPCA is located between two known threatened nationally critical long-tailed bat populations and it is likely that the riparian margins along the streams and other mature trees scattered across the site supports foraging, commuting and potentially roosting. Potential lizard and bird habitat have also been identified across the site.

The intermittent and permanent watercourses have **high** to **low** current and wetlands have **moderate** value present ecological value, however, have the potential to be enhanced. Totara Creek and Sinton Stream provide direct connectivity to the wider catchment and both provide an important migratory pathway for native freshwater fish, including 'Threatened' and 'At-Risk' species.

The marine SEA located immediately downstream of the SBPCA is of **moderate** to **high** ecological value and has been identified as sensitive to changes in the upstream land-use.

²⁶ Carbines M, Walker J, Cameron M, Vaughan M (2013). Identification of degraded marine receiving environments. Auckland Council working report, WR2013/009

²⁷ ERC were developed by Auckland Council to define a relevant set of criteria to assess whether concentrations of contaminants present in receiving-water sediments are likely to result in adverse environmental effects. Green reflects a relatively low level of impact; amber indicates effects may begin to show and red reflects conditions where significant degradation has probably already occurred.

²⁸ The 'M2' SEA classification identifies the area as being of regional, national or international significance which does not warrant a SEA-M1 identification as these areas are generally more robust.

5 Assessment of ecological effects

A change of zoning and subsequent rural to industrial land use poses a range of potential adverse effects to the ecological values that have been identified within the SBPCA. This section provides an assessment of the ecological effects of the proposed plan change and subsequent development of the SBPCA and is provided at two scales.

The first is an overall assessment in relation to the potential effects of the plan change at a plan change scale. Where required, a more detailed assessment of the specific potential effects relating to the proposed Spedding Road and Brigham Creek Road connection is provided. This includes specifically:

- Stream (46 m² streambed area) reclamation resulting from the Spedding Road extension;
- Modification of 71 m of Sinton Stream (136 m² streambed area) and potential fish passage effects resulting from the placement of a new 63 m culvert (including apron and rip-rap) along Sinton Stream; and
- Riparian vegetation removal (1,820 m²) on each bank of the Sinton Stream resulting from the Spedding Road alignment and Sinton Stream crossing point.

The assessment for these activities in the SBPCA is intended to provide a level of detail commensurate with the scale and significance of effect that would be expected with a resource consent. The assessment that follows provides sufficient detail to support the proposed plan change provisions outlined in detail in the plan change documentation. This is unusual for a project at plan change stage, however, provides more certainty to future development of this site and more importantly, provides a complete assessment of the true ecological effects associated with the plan change. The intention is to provide sufficient detail regarding the proposed measures to demonstrate certainty in the ecological outcome and consistency with the objectives and policies. For ease of reference, a summary of the specific ecological effects resulting from the Spedding Road extension is provided in Section 5.8.

Our assessment is based on the proposed concept plan and a general change from rural to industrial land use. A summary of activities and the relative magnitude and overall effects according to the EclAG is provided in Section 5.10.

5.1 Earthworks and sediment discharge

While no earthworks are proposed and future earthworks will be addressed at the resource consent stage, consideration is given to the potential effects of sediment resulting from the land use change. Earthworks activities associated with the land use change, including any works in watercourses, have the potential to result in an uncontrolled discharge of sediment laden water. Increased sediment in the receiving environment can impact water quality within the freshwater and marine environment and result in sediment deposition, changing habitat features. Further, modifications to landforms through earthworks can result in changes to contributing catchments.

Totara Creek, Sinton Stream, and Pikau Stream are all sensitive to sediment deposition, particularly the downstream SEA marine environment where extensive shellfish beds form key food source for wading and coastal avifauna.

It is the intention that the landforms remain much the same, with no changes to contributing catchments proposed. Earthworks controls will be addressed at the time of resource consenting however it is considered that potential sediment effects from earthworks across the site can be managed through implementation of erosion and sediment control plans (ESCP) that are designed and maintained in accordance with Auckland Council GD05 - Guidance for Erosion and Sediment

Control²⁹. Particular consideration should be made where earthworks will occur located in close proximity to wetlands or watercourses³⁰. A temporary stream diversion has been proposed to enable the Sinton Stream culvert to be constructed in a dry environment (DWG SK016B, Crang Civil). This reduces the likelihood of potential sediment effects during works and provides for fish passage to be maintained during construction.

Development of these ESCP will reduce the potential for an uncontrolled discharge of sediment laden water to the environment, to an overall low magnitude of effects.

5.2 Water quality and quantity

Under the current land use, the hydrological cycle occurs in a relatively unmodified state and water is filtered through the soil or grassed paddocks prior to entering streams. A future change to an urban land-use will result in an increase in impervious surfaces across the SBPCA and will subsequently alter the quality and quantity of water entering the receiving environment.

The streams within the SBPCA, including Totara Creek, Sinton Stream, and Pikau Stream, are all subject to degraded water quality resulting from current agricultural land-use, minimal riparian buffers, and unrestricted stock access. Many of the tributaries of these streams are expected to exhibit macrophyte growth which is an indicator of nutrient enrichment.

Increased impervious surfaces have the potential to alter the volume and rate at which stormwater enters the receiving environment. High velocity flows can cause stream erosion and scour, which contributes to bank instability and sediment deposition. In contrast, baseflows can be reduced as a result of infiltration being reduced as surface flows are directed to the stormwater network. The use of detention and retention (by SMAF 1 hydrological mitigation) of stormwater across the site are best practice approaches to stormwater management and reduces the potential for these effects to occur.

In addition, stormwater runoff within industrial areas typically contain heavy metals and hydrocarbons which can impact aquatic flora and fauna and the instream function of the stream systems. Industrial and Trade Activities will require site and activity specific controls and specific consents in accordance with the AUP.

Auckland Council GD01 and GD04 provides guidance on applying a water sensitive urban design (WSUD) approach to treating urban stormwater runoff³¹. This includes using devices such as swales, rain gardens, tree pits and permeable paving to treat stormwater prior to it entering the receiving environment. Additional site-specific controls are usually required in industrial areas to address any specific contaminants that may be entrained in stormwater runoff from industrial and trade activity areas³².

A draft Stormwater Management Plan (SMP) has been developed by Tonkin + Taylor to guide the stormwater management approach for the SBPCA³³. The approach proposed has been informed by the requirements and direction set within the Whenuapai SMP (prepared for the Structure Plan) and

²⁹ Leersnyder, H., Bunting, K., Parsonson, M., and Stewart, C. (2016). Erosion and sediment control guide for land disturbing activities in the Auckland region. Auckland Council Guideline Document GD2016/005. Incorporating amendment 1. Prepared by Beca Ltd and SouthernSkies Environmental for Auckland Council.

³⁰ Refer to the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (Freshwater NES) for restrictions.

³¹ Cunningham, A., Colibaba, A., Hellberg, B., Silyn Roberts, G., Simcock, R., S. Speed, Vigar, N and Woortman, W (2017) Stormwater management devices in the Auckland region. Auckland Council guideline document, GD2017/001.

³² Defined in the AUP OP as "The area of land or coastal marine area where a particular industrial or trade activity is being undertaken, which may result in the discharge of environmentally hazardous substances associated with that activity onto or into land or water". Refer to Chapter J1 for the remainder of the definition which identifies inclusions and exclusions.

³³ Innes, S and van Wyk, M. 2020. Spedding Block Plan Change Area Stormwater Management Plan. Prepared by Tonkin + Taylor for Oyster Capital Limited.

the Region Wide Network Discharge Consent (NDC). The proposed key stormwater management requirements are listed below.

- Stormwater management of 100% of impervious areas by a designed in accordance with GD01;
- Hydrological mitigation to SMAF 1 standard;
- Protection of overland flow paths;
- Protection and enhancement of permanent and intermittent streams; and
- Consideration of erosion protection measures to minimise any potential negative impacts on the receiving environment.

A treatment train approach to stormwater management is proposed to meet the requirements set out above. This incorporates a sequence of stormwater management as set out below.

- Stormwater runoff controls at-source;
- Interception and treatment of overland flows; and
- Enhancement of receiving environments.

A summary of the measures proposed to meet these requirements follows, with a full assessment of the measures proposed provided in the SMP.

- Provide retention of minimum five millimetre runoff depth for all impervious areas, where practicable;
- Provide detention of the difference in runoff volume for the pre-development and post-development 95th percentile, 24 hour rainfall event minus the 5 mm depth retention volume;
- Where retention is not practicable, sufficient detention volume should be provided to include the retention volume as well;
- Use of inert building materials to reduce contamination of stormwater runoff;
- Rain water tanks where re-use is practicable;
- Contaminant specific treatment for industrial and trade activities;
- Bioretention devices for treatment and detention (e.g. Tree pits, vegetated swales, raingardens); and
- Green outfalls where these are practical.

Chapter E1 of the AUP identifies that where freshwater quality is degraded, that it be improved over time and that the macroinvertebrate community index (MCI) be used as a 'guideline' or indicator of freshwater ecosystem health. Aquatic macroinvertebrate community structure, abundance and diversity are standard indicators of the long-term health of streams. Different aquatic invertebrate taxa have varying tolerances of pollutants so their presence or absence can provide an indication of stream condition and overall health (i.e., water quality and habitat quality).

Policy E1.3.(2) identifies some 'national bottom lines' for stream health using the MCI and directs that where the current condition is lower than the bottom line that these systems be enhanced. The SBPCA is located within a MCI control layer, specifying a bottom line MCI for rural land use (i.e., MCI = <94). Under a future land use of urban, the national bottom line required to be met is 68. An MCI score of 94 is indicative of 'fair' stream health (i.e., MCI range 80-99) whilst anything lower than 80 is deemed 'poor' and representative of a degraded aquatic system. The proposed stormwater management approach needs to at least maintain, but preferably improve, on the existing condition³⁴.

³⁴ To be further informed following macroinvertebrate sampling in July 2020.

Many of the stream systems are expected to be nutrient and sediment enriched at present based on the unrestricted access by livestock and the adjacent agricultural land use. The lack of shade along a high proportion of intermittent watercourses within the SBPCA, it is expected that elevated water temperatures may be limiting the presence of some macroinvertebrate taxa. Riparian enhancement in the headwaters and weed control and improvement of riparian margins, near the confluence of Sinton Stream and Totara Creek will result in an improvement in instream habitat and water temperature control that will enhance conditions for aquatic fauna.

The proposed stormwater management measures in conjunction with the enhancement of riparian margins will result in no discernible change in the environment, and therefore water quality and quantity effects will have a low magnitude of effects.

5.3 Sedimentation

Changes in hydrologic regimes can result in increased stream bank erosion, consequently changing the sedimentation regime along freshwater systems and into estuarine and marine environments. While erosion is a natural process, the changes to the hydrologic regime can be quite disruptive to the natural process. Auckland Council have identified sedimentation from stream bank erosion as particularly important within sensitive marine receiving environments.

As described above, the marine SEA is a M2, meaning it is more robust to change than a M1. Further, there is extensive evidence that the environment is very degraded, which reduces its resilience to further impact. Irrespective of its existing state, the environment should be at least maintained and enhanced and measures are proposed to manage potential sedimentation effects.

The Auckland Council Stream Erosion Risk Tool was investigated to provide further quantifiable information regarding the potential risks of streambank erosion from within the plan change area. The tool is intended indicate a change in erosion potential i.e. how much the erosion risk changes. It does not quantify how much extra erosion will occur, nor what the change in sediment load will be to the receiving environment, so it cannot be used to directly assess effects. The tool will identify areas with increased erosion risk and where extra mitigation measures should be applied.

An assessment of the erosion risk at the SBPCA was undertaken and is reported in the SBPCA SMP³⁵.

The assessment compared the risk of erosion due to the shear stresses of the stream flows, pre- and post-development. The post development scenario assumed that the entire SBPCA will be developed with the remainder of the contributing catchment area consistent with existing development.

The assessment concluded that there is a low existing erosion risk, and there will only be small increases in erosion risk for most of the sections analysed, with similar frequencies in the different erosion threshold zones. Overall, the increased risk of stream erosion is estimated to be low.

To complement the results of the erosion risk tool, and to understand the potential effect of sedimentation on the receiving environment, we reviewed known information about the receiving environment. NIWA were engaged by the Ministry for the Environment to develop and apply a new empirical model that estimates mean annual river suspended sediment load and sediment deposition in coastal hydrosystems³⁶. The model includes suspended sediment load and inherently includes sediment supply from eroding streambanks as well as upstream hill-slope erosion processes.

³⁵ Innes, S and van Wyk, M. 2020. Spedding Block Plan Change Area Stormwater Management Plan (First Draft). Prepared by Tonkin + Taylor for Oyster Capital Limited. Dated 08/04/2020.

³⁶ Hicks, M., Semadeni-Davies, A., Haddadchi, A., Shankar, U and Plew, D. (2019). Updated Sediment Load Estimator for New Zealand. Prepared by NIWA for the Ministry for the Environment. March 2019. NIWA client report 2018341CH.

Shallow drowned valleys such as Brigham Creek have intermediate level deposition rates (median of 0.7 mm/year), where near-bed velocities are low, little resuspension by currents occurs, and a main channel morphology tends to be absent. The trapping efficiency of a shallow drowned valley is typically quite high (between 0.8 and 1). NIWA did not assess Brigham Creek specifically, however the nearby Lucas Creek which is a similar typology has a trapping efficiency of 0.95. Trapping efficiency is the proportion of incoming sediment load that is retained and settles within the water body measured on a scale of 0 to 1, where 1 means that 'all river-sourced sediment is retained in the coastal hydrosystem'. What this tells us, is that the UWH marine receiving environment is a natural deposition zone and sediment deposition is expected and required for the environment to continue to function.

The SBPCA is currently predominantly in rural land use which typically has a higher overall sediment load than urban land use. The change in hydrological regime may result in streambank sediment entering the receiving environment at times (e.g. after heavy rain). This will be balanced in part by the effective removal of contributing sediment loads from agricultural land use and the future potential benefits associated with planting along the riparian planting network throughout the plan change area (e.g., root establishment, increased streambank stability and filtering capacity).

Until further assessment is undertaken, a complete ecological assessment of the potential effects of sedimentation in the marine SEA cannot be completed. Further assessment of the change in sediment contribution to the wider environment will be undertaken prior to a plan change hearing, although this may be risk based. This will provide more assessment of the anticipated changes in sediment and will incorporate mitigation measures which will reduce the potential stream bank erosion and therefore sediment generation.

The following mitigation measures have been identified as being those which will aid in the management of erosion and sedimentation in the plan change area:

- Removal of stock from the site and therefore avoiding active bank de-stabilisation through stock access and pugging;
- Incorporation of green spaces adjacent to stream networks to provide for planting of riparian margins to improve bank stability and reduce erosion potential;
- Modification of hydrograph mitigated through stormwater detention measures which will slow flows;
- Remediation or removal of existing in-stream structures (culverts, inlets/outlets) which may be contributing to existing sedimentation;
- Opportunity to introduce more natural stream sinuosity in areas where streams have been channelised;
- Incorporation of erosion and scour protection measures at all outfalls to minimise erosion at new structures; and
- Targeted in-stream erosion protection measures may be required within the Totara Creek.

While the effectiveness of these measures cannot be quantified at this stage, they are considered to provide benefit to erosion and sediment generation from stream channels affected by the change in hydrology within the plan change area.

Irrespective, the overall increased risk of stream erosion is estimated to be low and is unlikely to result in discernible changes in the environment. The underlying baseline condition will be similar to pre-development so is considered to be a low magnitude of effect.

5.4 Stream habitat loss and modification

Auckland Council has identified that intermittent and permanent streams and wetlands are ecologically important, therefore they are protected under the AUP (Chapter E3). Changes in land-use often results in the loss of streams and wetlands to enable efficient use of land and maximum yield.

There are several streams and wetlands across the SBPCA including some within the centre of the site. The importance of these ecosystems within the SBPCA is recognised and as such, impacts to stream and wetland ecosystems will be minimised wherever practicable.

While the intention is to retain and enhance aquatic habitats in the SBPCA, it will be necessary to modify some streams to enable land development. The objectives, policies and rules relating to works in streams are within Chapter E3 of the AUP.

A small amount of stream loss is anticipated to be required to enable development of the site. These effects are unavoidable as they are related to the construction of the Spedding Road extension, the alignment of which has been informed by civil and transport engineers. As such, a complete assessment of the associated effects has been undertaken to inform the plan change provisions for the SBPCA. The assessment addresses those matters which would normally be subject to assessment at time of resource consent.

A maximum extent of stream loss has been identified to inform this assessment:

- A length of 71 m of Sinton Stream is proposed to be culverted by a 63 m culvert (including apron and rip rap), which would not meet permitted activity standards in the AUP. Design drawings have been provided by CrangCivil (Drawings SK016 and SK016A). The embedded nature of the culvert will mitigate some potential effects associated with habitat modification, however there remains residual effects warranting offset measures to be provided;
- 45 m (46 m²) of intermittent stream length will be reclaimed at the most upstream extent of SintonA Stream.

These environments are all protected, however are of a currently low to moderate ecological value, particularly when compared to the remainder of the site. It is not possible to remediate or mitigate stream reclamation at the point of impact. To 'mitigate' means to alleviate or moderate the severity of an activity, which is not possible in relation to stream reclamation as there is a complete and permanent loss of habitat. While stream reclamation cannot be mitigated, it can be offset. Offset measures are proposed to address the residual effects of the 71m Sinton Stream modification as a result of the proposed culvert and the proposed reclamation of SintonA Stream.

Offsetting is 'a measurable conservation outcome resulting from actions designed to compensate for residual adverse biodiversity effects arising from activities after appropriate avoidance, remediation, and mitigation measures have been applied'. To be considered an offset, the conservation outcomes resulting should be consistent with a set of offsetting principles, including the goal of 'no net loss'. The following text describes the measures proposed to address the stream loss, using the SEV method.

5.4.1 Stream loss and modification

Summary SEV scores for the current (SEV-C) and potential (SEV-P) values for the impact reaches (Sinton Stream and SintonA) (SEV-i) and the offset reaches (SintonA and Sinton Stream) (SEV-m) are provided in Table 5.1.

SEV scores are reported as values between 0 and 1, where values closer to 1 are indicative of higher quality ecological function. The SEV-C of 0.43 for SintonA is consistent with stream systems in an extensive agricultural land-use and the removal of intact riparian vegetation. Similarly, the SEV-C of

0.69 for Sinton Stream is consistent with a permanent watercourse with roughly 20 m of exotic dominated riparian vegetation. The SEVi-P scores for both streams assumes enhancement that is achievable under the proposed maximum development potential post-plan change and enhancement works are undertaken on Oyster Capital controlled land.

Table 5.1: SEV values (collected in July 2020) for impact and offset streams to inform offset calculations.

Stream ID	SEVi-C	SEVi-P	SEVi-I	Ecological gain (SEVm-P – SEVm-C)
Sinton Stream – culvert	0.69	0.83	0.2	
SintonA – reclamation	0.43	0.63	0	
SintonA – riparian planting, one bank				0.20
Sinton Stream – riparian enhancement, both banks				0.14

When entered into the ECR formula, $ECR = [(SEVi-P - SEVi-I) / (SEVm-P - SEVm-C)] \times 1.5$, a quantum of offset can be determined. An ECR has been calculated for each of the proposed impacts compared to each of the proposed offset sites. Calculations are provided in Table 5.2, based riparian planting along both margins of the Sinton Stream (downstream of the proposed culvert) and one margin on SintonA Stream (measures briefly described in Appendix H).

Table 5.2: ECR's and offset areas required to achieve no net loss of ecological function for the reclamation of SintonA Stream and Sinton Stream culvert.

Impact Sites Stream ID	SEVi-C	SEVi-P	Average width (m)	Length (m)	Streambed area (m ²)	Stream ID	Streambed area available (m ²)	ECR	Streambed area compensation required	Proportion of impact reach offset (%)	Offset streambed area still available (m ²)
Sinton Culvert	0.69	0.83	1.92	71	136.3	Sinton Stream Lower	570.2	6.86	934.7	0.61	0.0
					53.2	SintonA Stream	502.1	4.77	253.7	1.98	248.5
Sinton A Reclamation	0.43	0.63	1.025	45	46.1	SintonA Stream	248.5	4.74	218.7	1.14	29.7
Totals				116	182.4				1407.1		

Based on these calculations, it is considered that a no net loss of ecological function can be achieved with the proposed offset measures, and an additional 29.7 m² of streambed area along SintonA (if planted) will result in a slight net gain in the long-term. All of the proposed offset streams are located on either the same stream (downstream of the impact) or in a tributary of and are like for like in their stream system and characteristics (specially being in the same catchment).

5.4.2 AUP objectives and policies

Chapter E3 of the AUP outlines the policies and objectives in regard to lakes, rivers, streams and wetlands. The AUP requires that permanent loss of these aquatic systems is minimised and that significant modification or diversion of them is avoided. The AUP also recognises that a balance must be struck between the need to provide for infrastructure and development and the protection of aquatic systems. The Spedding Road extension avoids a natural inland wetland (Wetland A) and limits stream reclamation to only 45 m of modified stream with low ecological values.

In respect of the wider principles of offsetting (outlined in AUP Policy E3.3(4)), the offset works would be on streams that are like for like and proximate to the impact. Within Precinct A the

locations of the impact and associated offset are identified. The works will achieve no net loss as demonstrated through the use of the SEV methodology.

There are no provisions currently existing on the site that require riparian planting to be undertaken. As the enhancement works for the stream systems on site are identified as being required specifically to address potential stream loss effects (to a maximum streambed area) associated with the plan change, the principle of additionality will be met.

The following provides a technical ecological assessment of the relevant objectives and policies within E.3 against the proposed activities associated with the plan change. This assessment is not intended to be a complete assessment of the objectives and policies and should be read in conjunction with the planner's assessment for the application overall.

Within the SBPCA, stream loss will be minimised, a maximum extent of stream loss has been identified by the project team as being unavoidable. The proposed Spedding Road extension will avoid most streams and wetlands on site and all of those of higher ecological value. Additionally, all remaining streams on site being retained will be enhanced with riparian margin planting. Proposed planting schedules have been included in the proposed precinct provisions (Appendix I).

The adverse effects resulting from the reclamation of the headwater intermittent stream reaches are proposed to be offset onsite through riparian enhancement planting of the remaining and retained streams (Sinton Stream and SintonA). SEV and ECR calculations have been used to determine 'no-net-loss' of ecological function.

The proposed offset will be like for like, proximate to impact and will be additional to works otherwise required. Proposed enhancement offset planting will be native and consistent with those species' characteristic for the Auckland region, Tamaki ecological district and ecosystem type (VS5 Broadleaved scrub forest). Weed control will be undertaken and infill planting will be prioritised to stabilise banks where currently unvegetated.

5.4.3 Summary

Within the wider SBPCA, streams and wetland will be retained and enhanced where practicable.

Modification of up to 116 m of permanent and intermittent stream length will be unavoidable and these effects can be offset in the SBPCA.

Riparian planting will be undertaken along the remainder of the stream length in the SBPCA to connect the areas identified for aquatic and terrestrial (see section 5.6) offset which will include Sinton Stream and the majority of SintonA (Figure 2, Appendix A). Riparian margins of retained streams across the site will be planted with no less than 10 m³⁷ on all streams and up to 20 m on the Sinton Stream.

While the magnitude of effect associated with stream modification remains high, the effects can be offset and so are considered to be appropriately managed.

5.5 Fish passage

One culvert has been proposed to be included within the plan change application, being a crossing of Sinton Stream to enable the extension of Spedding Road. A single 3.5 x 3.5 m box culvert, with a length of 43.1 m, and an apron and rip rap, of 10 m at either end, is proposed (Drawings SK016 and SK016A, dated 07/09/2020).

³⁷ To avoid confusion, riparian planting widths specified are to be measured from the stream edge and are to be provided on each bank. That is, 10 m wide riparian margins, means planting of 10 m on each bank, as measured from the stream edge.

The culvert will be embedded to 25% (a depth of 875 mm) below the stream invert and has been designed to have a minimum water depth of 150 mm through a low flow channel. To maintain continuity, retention, and stability of the natural stream substrates the culvert will be filled with compacted clay. Soft bottom substrates will move through the low flow channel and establish a natural streambed. This will be consistent with the stream habitat upstream and downstream of the culvert. The low-flow channel will slope up to the culvert walls to assist in the natural stream bed formation. The proposed embedment and culvert width (being 1.3 x stream bankfull width) will prevent velocity increases that would otherwise occur if flows were constricted.

The culvert has been designed in accordance with the New Zealand Fish Passage guidelines³⁸ and the permitted activity standards of the Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (Freshwater NES).

On the basis that fish passage can be provided to swimming species (inanga) in the proposed culvert, and the culvert design is in accordance with the NZ guidelines, the magnitude of effect is low.

5.6 Impacts on terrestrial flora

Historical land-use across the SBPCA has resulted in an almost complete removal of vegetation which historically would have been a native puriri forest (WF7 according to the potential ecosystem extent on Auckland Council GeoMaps). Current vegetation consists predominately of grazed pasture grasses. Although the riparian vegetation along Totara Creek is listed as a broadleaved species scrub/forest (VS5) SEA, the vegetation is predominately exotic pine, cedar, and eucalyptus. Similarly, mature trees scattered across the PCA are exotic species such as *Salix* sp. and *Populus* sp.

Vegetation loss will be kept to a minimum across the SBPCA and will be avoided where possible. Some mature exotic species including pine, cedar, and eucalyptus are likely to be removed to facilitate land development. These trees tend to be located in the middle of paddocks, where they have been planted to form shelterbelts and in some gardens.

Exotic vegetation along riparian margins is proposed to be removed to improve the biodiversity value of these areas. The plants provide ecological function to the streams however are vectors of weeds and have an overall low ecological value. The proposed riparian enhancement will form part of a wider enhancement package across the SBPCA. Larger specimen trees that may need to be removed (and which provide value to fauna) should be replaced with native species that provide a similar fauna function.

In the SBPCA, it is anticipated that up to 1,820 m² of exotic dominated riparian margin along Sinton Stream will require removal to facilitate the construction of the Sinton Stream crossing. This vegetation is of low ecological value, including weed and pest species, however, still performs a valuable function as riparian vegetation. Therefore, its removal warrants measures being implemented to address effects associated with its loss. While not strictly offsetting, the compensatory replacement of the 1,820 m² of exotic, riparian vegetation, with 3,640 m² native riparian vegetation, along the Totara Creek is ecologically appropriate in terms of approach and magnitude for addressing any adverse effects.

In summary, the QBCMs suggest that Net Gain outcomes are likely to be achieved at 10 years through the replacement of 1,820 m² of exotic riparian vegetation with 3,640 m² of native riparian vegetation as detailed in Appendix J. These Net Gain outcomes would be expected to continue beyond 10 years, given that biodiversity values within the proposed native revegetation sites will continue to increase through time. This native riparian margin will be part of a contiguous enhanced riparian margin within a SEA, which will connect to the Sinton Stream riparian margin.

³⁸ Franklin, P., Gee, E., Baker, C. and Bowie, S. (2018). New Zealand Fish Passage Guidelines for Structures up to 4 metres. NIWA CLIENT REPORT No: 2018019HN.

5.6.1 Objectives and policies

Chapter E15 provides direction to the objectives and policies regarding vegetation and biodiversity management in the Auckland region. The AUP requires that areas of contiguous indigenous vegetation cover and biodiversity values are maintained or enhanced and where ecological values are degraded be enhanced whilst recognising the need for development. Enhancement includes activities for pest plant management and pest plant removal along all riparian areas, which is permitted (AUP OP Chapter E15.4.1).

The AUP identifies that vegetation contributes to a range of ecosystem services such as erosion and sediment control, reducing stormwater flows, protecting or enhancing water quality, provide amenity and natural character values as well as helps maintain indigenous biodiversity. Vegetation and indigenous biodiversity values in the area that are degraded will be restored and enhanced, as well as protected. Proposed planting schedules have been included in the proposed precinct provisions (Appendix I).

While for the most part, areas of contiguous vegetation cover are being protected and vegetation removal has been kept to a minimum, small areas where avoidance is not practicable is expected. Adverse effects from these activities (vegetation removal) are proposed and will be addressed onsite through restoration and enhancement planting and weed control. This enhancement planting will help improve the quality in ecological integrity for this area, especially the Significant Ecological Area along Totara Creek.

5.7 Potential impacts on terrestrial fauna

Current land-use across the SBPCA has resulted in the conversion of native vegetation to rank and grazed pasture grasses with ecological areas of value limited and concentrated to riparian margins, particularly Totara Creek and Sinton Stream.

The future change from rural to business land-use may indirectly affect native terrestrial fauna through the loss of habitat and food resources, however the majority of the vegetation along riparian margins will be kept and enhanced through infill planting, planting of up to either 10 m or 20 m, and weed management. Therefore, the magnitude of effects is considered low to moderate provided that the retained vegetation and habitat will likely increase in quality as a result of the proposed plan change.

Other possible indirect effects associated with land-use change include alterations to light and noise disturbance, as well as general disturbances during and post-construction and development during vulnerable months (i.e. breeding seasons).

Removal of vegetation has the potential to adversely affect terrestrial fauna. Potential direct effects to bats, avifauna and herpetofauna have been identified as damage to roost, nests, associated eggs, fledglings, and loss of individuals killed during vegetation removal, construction, and earthworks.

Native fauna (bats, lizards and birds) are protected under the Wildlife Act 1953, therefore it is considered prudent to manage potential direct and indirect effects on fauna which may result from the clearance of vegetation and potential bat, avifauna, and lizard habitat across the site.

Management plans are proposed to address high level changes associated with the plan change, which will be required and implemented through resource consent activities. For the 1,3820 m² riparian vegetation proposed to be removed along Sinton Stream, the provisions of the Wildlife Act 1953 will apply.

Sections 4.7.1 to 4.7.3 below details recommendations for managing each fauna group.

5.7.1 Bats

The presence of long-tailed bats on site has been confirmed, and while the low activity levels detected suggest occasional commuting and potentially foraging, it is possible that bats may intermittently roost in suitable habitat on site. This is most likely to be limited to solitary roosting, e.g. for up to several days at a time before the bat moves on. However, as our survey represents only a 3-week snapshot of activity we cannot rule out other possibilities based on our survey results, such as higher levels of activity at other times of year, or maternity roosting.

It is important to note that for the purposes of this assessment, we make the conservative assumption that long-tailed bats do roost intermittently within suitable habitat on site, on a solitary basis or in very low numbers; we also assume that no maternal colonies are found within roost habitat present. Should a maternal roost be discovered at any stage then a re-assessment of effects on long-tailed bats and revision of potential management measures will be required.

The confinement of bat activity to Totara Creek margins suggests that riparian margins and shelter belt vegetation support long-tailed bat movement across the landscape. These riparian margins, including large mature trees, are proposed to be retained and enhanced, thereby maintaining habitat and connectivity.

Land-use changes in the SBPCA will have the potential to directly and indirectly affect long-tailed bats in the immediate area. Potential direct effects may include foraging, commuting and roost habitat loss; injury and/or death of individual bats (in a worst-case scenario) during tree felling; and impacts on foraging and commuting behaviour patterns due to changes in levels of artificial light^{39 40}. Indirect effects may include an increase in predation pressure in the landscape due to an increase in pest numbers (e.g. rats, cats).

A Bat Management Plan (BMP) will be developed to include measures to avoid and/or mitigate potential impacts to long-tailed bats. Suitable management options may include some or all of:

- Retention of large, mature trees (both native and exotic) wherever possible, to maintain any potential roost habitat that exists on site;
- Retention and enhancement of stream riparian margins by restoration planting and weed management, particularly along Sinton Stream to maintain flight corridors across the SBPCA; this is important as long-tailed bats tend to use a network of landscape features such as gullies and stream corridors to disperse through an urban matrix;
- More comprehensive surveys to better understand spatial dynamics of bats in the landscape and assist with the refinement of Bat Management protocol;
- Detailed light design using best-practice⁴¹ options to minimise effects on long-tailed bats with particular consideration given to buildings and walkways along riparian edges and at proposed road over Sinton Stream;
- Where vegetation removal is unavoidable, implementation of best-practice vegetation removal protocols to avoid injury or death during clearance, potentially involving further acoustic survey immediately prior to clearance, timeframe restrictions and delays, and climbing trees (by an arborist) to confirm bats are currently absent;

³⁹ Borkin, K. M., Smith, D. H. V, Shaw, W. B., and McQueen, J. C. (2020). *More Traffic, Less Bat Activity: The Relationship between Overnight Traffic Volumes and Chalinolobus tuberculatus Activity along New Zealand Highways*. Acta Chiropterologica 21(2), 321-329.

⁴⁰ Smith, D., Borkin, K., Jones, C., Lindberg, S., Davies, F., and Eccles, G. (2017). *Effects of land transport activities on New Zealand's endemic bat populations: review of ecological and regulatory literature*. NZ Transport Agency research report 623.

⁴¹ Auckland Transport Code of Practice. Chapter 19, Street lighting.

- Planting of an appropriate area of fast-growing tree species which may form potential roost habitat over time, adjacent to culverts and bridges, to offset the loss of potential roost habitat (if removal is unavoidable); and
- Pest control to protect potential roost habitat within enhanced riparian margins along Totara Creek and Sinton Stream, to offset the loss of potential roost habitat (if removal is unavoidable).

Overall, the change in land-use may impact long-tailed bats. However, provided a Bat Management Plan is developed at time of resource consenting, to include appropriate management measures such as those mentioned above, it is considered these adverse effects can be adequately managed. Development of a BMP that addresses the proposed construction effects will occur at resource consenting stage.

Authorisation is sought to enable the removal of 1,820 m² riparian vegetation along Sinton Stream for the Spedding Road extension. Totara Creek is recognised as a flyway for bats, and Sinton Stream may provide a similar flyway/foraging habitat. The Spedding Road crossing may partially sever ecological connectivity for bats to approximately 150 m of riparian vegetation to the east of the proposed Spedding Road. Correspondingly the effect of the potential severance may result in the loss of the equivalent amount of foraging/flyway habitat. Due to the height of the existing trees it is expected that bats will 'tree hop' across the proposed Spedding Road. The proposed riparian enhancement in the lower Sinton Stream and along Totara Creek will improve the quality and quantum of available foraging/flyway habitat on site, which will address these potential effects. Bats may also be present within this vegetation proposed for clearance, however measures will be put in place to manage potential effects on bats in line with the requirements of the Wildlife Act 1953.

5.7.2 Lizards

Areas of long rank grass along the margins of riparian vegetation have the potential to support native skinks, particularly copper skink (*Oligosoma aeneum*). Potential direct and indirect effects of vegetation removal include tree removal, habitat loss, and food resources loss, however it is considered the enhancement planting and weed management particularly along Sinton Stream will provide an improvement on the current situation in the long-term.

To manage potential direct effects of vegetation removal on skinks, a Lizard Management Plan is recommended and will include salvage efforts pre-vegetation clearance. Overall, the impacts to lizard can be managed adequately through the implementation of the recommended lizard management plan at resource consenting stage.

Authorisation is sought to enable the removal of 1,820 m² riparian vegetation along Sinton Stream for the Spedding Road extension. Lizards may be present within this vegetation however measures will be put in place to manage potential effects on lizards in line with the requirements of the Wildlife Act 1953.

5.7.3 Birds

Overall, the future change in land-use is unlikely to adversely impact native birds as habitat suitability for native birds within the PSPA is low. Any potential adverse effects on birds that may arise can be managed through the development and implementation of a Bird Management Plan which addresses seasonal timeframe restrictions, pre-vegetation clearance surveys, and avifauna deterrence roofs and buildings to mitigate the risk of impacts on fauna. This will be prepared at resource consenting stage.

Authorisation is sought to enable the removal of 1,820 m² riparian vegetation along Sinton Stream for the Spedding Road extension. Birds (and nests, fledglings) may be present within the riparian vegetation however measures will be put in place to manage potential effects on birds in line with

the requirements of the Wildlife Act 1953. This may include avoiding bird breeding season and/or inspecting vegetation prior to clearance to ensure trees are clear of nesting birds.

It should also be noted that the Nationally 'At Risk' New Zealand dotterel is known to nest within large construction sites within the region. Sites under construction can offer suitable habitat for nesting dotterel when they offer bare ground and line of sight that provide dotterel with advanced warning of predators. As such the Bird Management Plan will also include proposed measures to monitor for and deter dotterel breeding pairs and measures to protect birds in the event that they do nest within the project footprint.

Retained wetlands may provide habitat for small native wetland bird species associated with vegetated marsh wetlands e.g. pied stilt and potentially the 'At Risk' spotless crane. These wetlands will provide little to no open water habitat and thus avoid risks to New Zealand Defence Force associated with bird strike from waterfowl.

5.8 Ecological effects approach - Spedding Road extension

The construction of the Spedding Road extension is critical to enable the development of the Spedding Block. There are some ecological effects associated with the Spedding Road extension, including specifically:

- Modification of 71 m (136 m²) Sinton Stream as a result of a proposed 63 m culvert (incl apron and rip-rap) and removal of up to 1,820 m² exotic vegetation within the riparian corridor to facilitate the Spedding Road stream crossing; and
- Reclamation of 45 m (46 m²) Sinton A Stream within the proposed Spedding Road corridor.

As these effects are related to infrastructure required to enable the land use change to occur, we consider that it is appropriate that these effects can be assessed and authorised through the plan change process. The level of detail provided within the assessment of ecological effects in the previous sections and Beca's assessment of environmental effects is commensurate with the level of detail that would be expected to support a resource consent application for these same activities.

For ease of reference, the overall ecological values and effects associated specifically with the proposed Spedding Road extension are repeated in this section.

In brief the ecological values of the impact areas are:

- Stream values of Sinton Stream at the proposed crossing are high, based on the presence of At-Risk Declining fish species and stream ecological valuation (SEV) score of 0.69;
- Stream values of Sinton A Stream at the proposed reclamation area are currently low due to modification and agricultural land use (SEV score 0.43). Potential ecological values are expected to be moderate (SEV score 0.63);
- The riparian margin of Sinton Stream at the proposed Spedding Road crossing is of low ecological value due to the composition being exotic and weed species. Notwithstanding it provides valuable contribution to the ecological function of the Sinton Stream margin; and
- The riparian margin of Sinton Stream at the proposed Spedding Road crossing offers low value habitat for native bats, lizards and birds.

The modification and/or loss of these ecosystem features is required to achieve the Spedding Road extension. Measures proposed to address these unavoidable effects include:

- Riparian planting of 1,407 m² stream bed area to offset the effects associated with the culverting and reclamation of a combined 182 m² stream bed area (described in section 5.4.1);

- Fish passage provided for swimming species, through the proposed Spedding Road Culvert in accordance with the NZ Fish Passage Guidelines (2018) and Freshwater NES (described in section 5.5);
- Erosion and sediment controls in accordance with Auckland Council Guideline Document 05 (GD05) to be implemented at time of construction to manage potential sediment effects resulting from the construction of the road (described in section 5.1 and shown on DWG SK016B);
- Riparian planting of 3,640 m² native vegetation along Totara Creek to address the effects associated with the loss of 1,820 m² exotic vegetation required to be cleared to enable the Spedding Road crossing (section 5.6); and
- Management of fauna that may be present in accordance with the requirements of the Wildlife Act 1953, including pre-clearance salvage, nest checks and bat tree-felling protocols.

5.9 Enhancement of ecological connectivity

The SBPCA is located in the middle of the North West Wild Link between the Waitakere Ranges and Hauraki Gulf Islands. The proposed enhancement of the riparian margins will provide for greater connectivity within the site and across the wider landscape.

The proposed ecological enhancements associated with the PPC, will contribute to restoring natural spaces and waterways to help create continuous and stepping-stone habitats. Specifically, this includes planting of Sinton Stream and SintonA to offset the modification and reclamation associated with the extension of Spedding Road and to facilitate the crossing of Sinton Stream. All remaining stream riparian margins within the SBPCA will be planted to 10 m and restored to improve biodiversity and habitat connectivity. This will include Totara Creek and Pikau Stream.

These margins provide improved connections between key ecological features including, the Brigham Creek marine SEA, the Upper Waitematā Harbour (part of the Hauraki Gulf Marine Park), Waiarohia Inlet, stream systems, and further ecological connections to the North-West Wildlink.

5.10 Summary of overall ecological effects

Table 5.3 provides a summary of each of the above activities in general accordance with the EclA guidelines, drawing on the information presented in the above sections. For each activity, the relevant ecological values, magnitude of effect after mitigation and the overall level of effect are provided. Refer to Appendix B for interpretation of this assessment.

Table 5.3: Overall level of ecological effect after mitigation measures are implemented.

Activity	Ecological value of the environment affected	Magnitude of effect with mitigation measures	Overall level of effect
Earthworks and sediment discharge	Freshwater environment – moderate in tributaries, high in Totara Creek due to presence of threatened fish, SEA status and value for fish migration.	Low If erosion and sediment control measures are implemented in accordance with GD05.	Low
Water quality and quantity	Marine environment – moderate , due to status as SEA but recognising existing degraded nature	Low If water sensitive urban design approach applied across site with recommendations of the	Low

Activity	Ecological value of the environment affected	Magnitude of effect with mitigation measures	Overall level of effect
	and the depositional nature of catchment	Stormwater Management Plan which aligns.	
Sedimentation (erosion)		Low Increased risk of erosion is low with mitigation measures proposed.	Low
Stream habitat loss	Streams low to high current value, but potential value moderate to high .	Low , as aiming to avoid and minimise across the SBPCA. High for areas of proposed reclamation, but effects can be offset onsite (positive effect) Low as culvert embedded and residual effects can be offset (positive effect).	Low to Very High Offset contributes a positive effect, but does not reduce the overall effect if the activity is reclamation.
Fish passage	High due to number and diversity of freshwater fish recorded and value as a migration pathway	Low to Negligible Culverts with fish passage provided to all species.	Low
Terrestrial flora	Low The existing vegetation across the SBPCA is exotic and weedy, and particularly along Sinton Stream.	Low Removal of weed species and replanting with natives to improve biodiversity while retaining function as habitat.	Low
Terrestrial fauna	Long-tailed bat - Very High Presence of Threatened – Nationally Critical long-tailed bats.	Low ¹ With management of artificial lighting, retention/planting of large mature trees, riparian margin retention and enhancement, vegetation removal protocols, pest control, implementation of fauna management plans during construction.	Moderate
	Common native birds and copper skink - Moderate Majority of the area is not considered a stronghold for native fauna and habitat values are limited.	Low Riparian margin retention and enhancement, implementation of fauna management plans during construction.	Low

1 With respect to long-tailed bats, we base our assessment on the assumption that solitary or low numbers of bats may roost on site intermittently, but no maternal roosts are present.

6 Conclusion

This assessment of ecological effects report has been prepared in support of the Spedding Block private plan change to rezone 52 hectares of land from Future Urban to Business – Light Industry.

The ecological values of the site are consistent with those anticipated within rural land use with isolated areas of higher ecological value. Overall, it is considered that the potential effects of the change in land use and some specified stream modification and vegetation clearance can be avoided, minimised, mitigated or offset.

Sufficient detail has been provided within this assessment to provide confidence that specific effects associated with the Spedding Road extension will be managed through the activity standards within the proposed precinct provisions. Where stream modification is expected to be required for the Spedding Road Extension, detail has been provided which identifies the quantum and location of riparian planting required to achieve no net loss of ecological function onsite. A similar assessment has been provided for vegetation clearance that will be required along Sinton Stream. Activity standards are proposed to enable the development of the Sinton Stream Culvert, with the requirement to provide fish passage as assessed in this report.

The AUP includes a comprehensive set of rules relating to identified features (for example E1 for stormwater, E3 for streams and E15 for vegetation). These are considered appropriate to address the potential for adverse effects beyond those identified specifically within this assessment. From an ecological perspective, these rules are appropriate to address relevant effects that may be generated at the time of resource consent.

With the implementation of the recommendations in this assessment, the overall level of ecological effect is considered to be low, except for bats where it may be moderate, and for streams where the effects are demonstrably offset to achieve no net loss of ecological function.

7 Applicability

This report has been prepared for the exclusive use of our client Oyster Capital Limited, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for a private plan change and that Auckland Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:

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Report Writer

Ecologist


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Justine Quinn

Senior Freshwater Scientist

Authorised for Tonkin & Taylor Ltd by:


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Tim Fisher

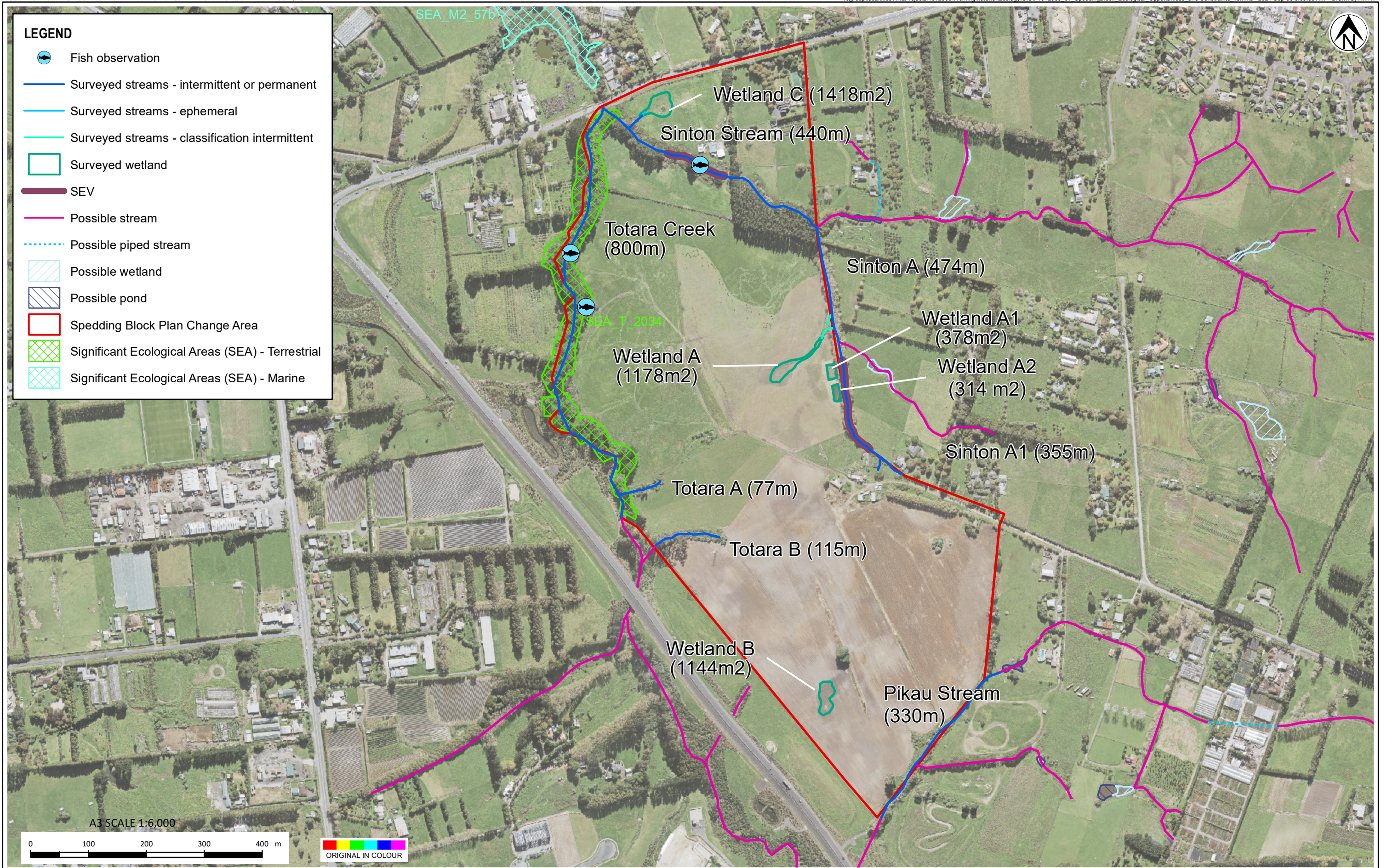
Project Director

Technical Review: Dr Matt Baber and Trevor Connelly.

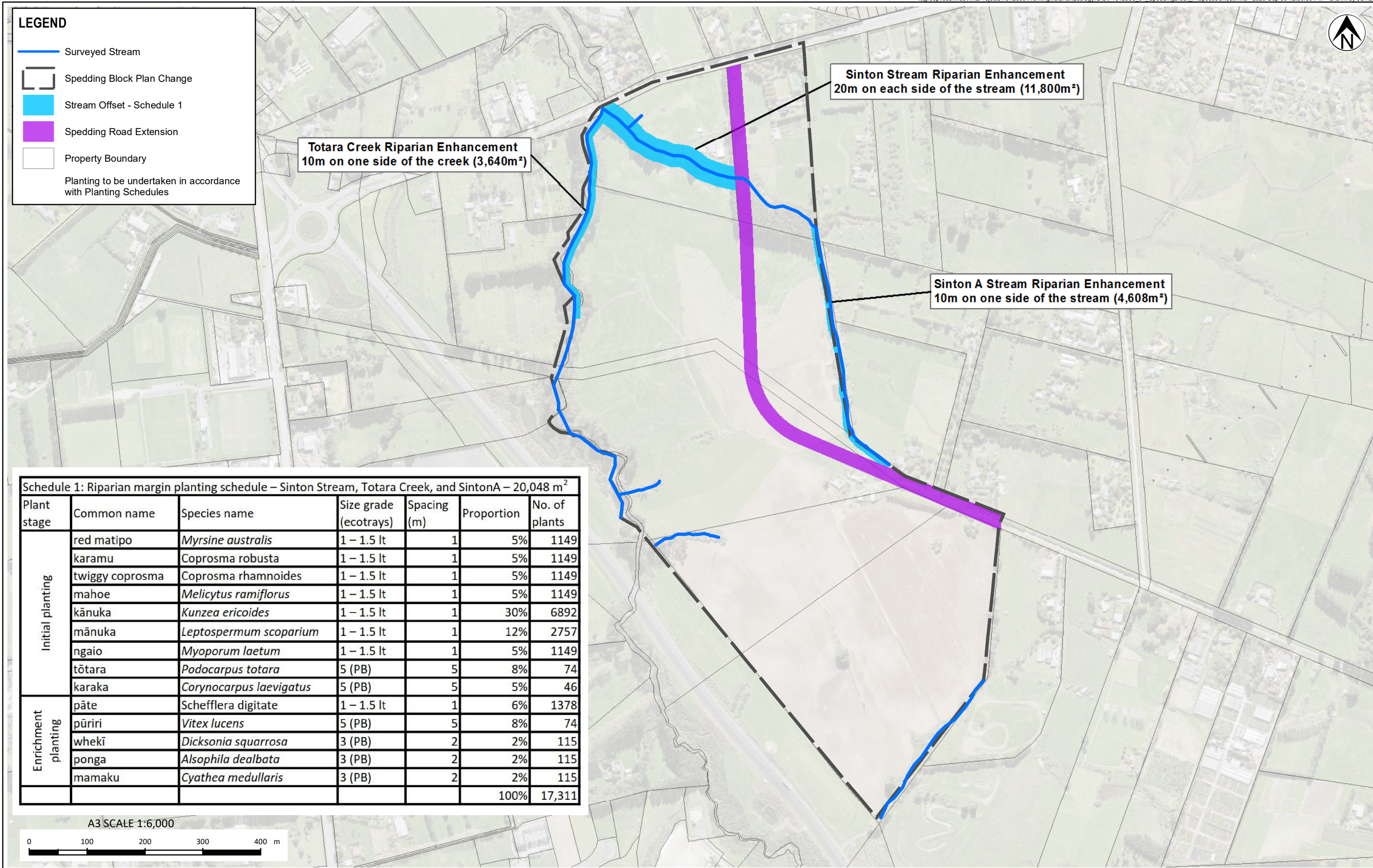
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Appendix A: Ecological Features and Offset Plans



NOTES: Basemap: Sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 4.0 New Zealand licence				PROJECT No. 1012893			CLIENT OYSTER CAPITAL LIMITED
				DESIGNED	ANTH	SEP.21	PROJECT SPEDDING BLOCK PLAN CHANGE
				DRAWN	ANTH	SEP.21	
				CHECKED	JORB	SEP.21	TITLE ECOLOGICAL FEATURES
0	First version	ANTH	JORB	01/09/21	JQU	03/09/21	
REV	DESCRIPTION	GIS	CHK	DATE	APPROVED	DATE	SCALE (A3) 1:6,000
LOCATION PLAN						FIG No. FIGURE 1.	REV 0

**NOTES:**

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Land Information New Zealand, Eagle Technology

0	First version	JORB	JQU	20/07/20
1	Second version	JORB	JQU	17/08/20

REV DESCRIPTION

GIS

CHK

DATE

LOCATION PLAN

APPROVED

DATE

PROJECT No. 1012893

DESIGNED
DRAWN
CHECKED

JORB SEP.20
JORB SEP.20
JQU SEP.20

CLIENT **OYSTER CAPITAL LIMITED**
PROJECT **SPEDDING BLOCK PLAN CHANGE**

TITLE OFFSET PLAN AND PLANTING SCHEDULE

SCALE (A3) 1:6,000

FIG No. FIGURE 2.

REV 1

Appendix B: Ecological Impact Assessment Guidelines

Appendix B Table 1: Ecological values assigned to freshwater ecology

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.
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.

Value	Explanation	Characteristics
		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 moderate to high, 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.

Appendix B Table 2: Factors to consider in scoring sites values in relation to species representativeness, rarity, diversity and pattern, and ecological context

Value	Species Values	Vegetation/Habitat Values
Very High	Nationally Threatened - Endangered, Critical or Vulnerable.	Supporting more than one national priority type. Nationally Threatened species found or likely to occur there, either permanently or occasionally.
High	Nationally At Risk - Declining,	Supporting one national priority type or naturally uncommon ecosystem and/or a designated significant ecological area in a regional or district Plan. At Risk - Declining species found or likely to occur there, either permanently or occasionally.
Moderate-high	Nationally At Risk - Recovering, Relict or Naturally Uncommon.	A site that meets ecological significance criteria as set out the relevant regional or district policies and plans.
Moderate	Not Nationally Threatened or At Risk, but locally uncommon or rare	A site that does not meet ecological significance criteria but that contributes to local ecosystem services (e.g. water quality or erosion control).
Low	Not Threatened Nationally, common locally	Nationally or locally common with a low or negligible contribution to local ecosystem services.

Appendix B Table 3: Summary of the criteria for describing the magnitude of effect

Magnitude	Description
Very high	Total loss of, or very major alteration to, key elements/features/ of the existing baseline ¹ conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR Loss of a very high proportion of the known population or range of the element/feature
High	Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR Loss of a high proportion of the known population or range of the element/feature
Moderate	Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR Loss of a moderate proportion of the known population or range of the element/feature
Low	Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR Having a minor effect on the known population or range of the element/feature
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating the 'no change' situation; AND/OR Having negligible effect on the known population or range of the element/feature

¹Baseline conditions are defined as 'the conditions that would pertain in the absence of a proposed action' (Roper-Lindsay *et al.*, 2018).

Appendix B Table 4: Timescale for duration of effect.

Timescale	Description
Permanent	Effects continuing for an undefined time beyond the span of one human generation (taken as approximately 25 years)
Long-term	Where there is likely to be substantial improvement after a 25 year period (e.g. the replacement of mature trees by young trees that need > 25 years to reach maturity, or restoration of ground after removal of a development) the effect can be termed 'long term'
Temporary¹	Long term (15-25 years or longer – see above) Medium term (5-15 years) Short term (up to 5 years) Construction phase (days or months)

¹Note that in the context of some planning documents, 'temporary' can have a defined timeframe.

Appendix B Table 5: Criteria for describing overall levels of ecological effects

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

Appendix B Table 6: Interpretation of assessed ecological effects against standard RMA terms.

Level of Ecological Effect (refer Table E3)	RMA Interpretation	Description
Very high	Unacceptable adverse effects	Extensive adverse effects that cannot be avoided, remedied or mitigated.
High	Significant adverse effects that could be remedied or mitigated	Adverse effects that are noticeable and will have a serious adverse impact on the environment but could potentially be mitigated or remedied.
Moderate	More than minor adverse effects	Adverse effects that are noticeable and may cause an adverse impact on the environment, but could be potentially mitigated or remedied.
Low	Minor adverse effects	Adverse effects that are noticeable but that will not cause any significant adverse impacts.
Very low	Less than minor adverse effects	Adverse effects that are discernible day to day effects but which are too small to adversely affect the environment.
Nil	Nil effects	No effects at all.

Appendix C: Terrestrial plant species list

Common name	Scientific name	Native	Pest ⁴²
Riparian vegetation along Sinton Stream			
Chinese privet	<i>Ligustrum sinense</i>		Y
Tree privet	<i>Ligustrum lucidum</i>		Y
pine	<i>Pinus</i> spp		
eucalyptus	<i>Eucalyptus</i> spp		
bamboo	<i>Bambusa</i> sp.		Y
woolly nightshade	<i>Solanum mauritianum</i>		Y
blackberry	<i>Rubus fruticosus</i>		Y
pampas	<i>Cortaderia selloana</i>		Y
gorse	<i>Ulex europaeus</i>		Y
wheki	<i>Dicksonia squarrosa</i>	Y	
ponga	<i>Alsophila dealbata</i>	Y	
tauhinu	<i>Pomaderris amoena</i>	Y	
red matipo	<i>Myrsine australis</i>	Y	
SEA riparian vegetation along Totara Creek			
Himalayan honeysuckle	<i>Leycesteria formosa</i>		Y
bindweed	<i>Convolvulus</i>		
tradescantia	<i>Tradescantia fluminensis</i>		Y
bamboo	<i>Bambusa</i> sp.		Y
wild ginger	<i>Hedychium gardnerianum</i>		Y
woolly nightshade	<i>Solanum mauritianum</i>		Y
pine	<i>Pinus</i> spp		
silver fern	<i>Cyathea dealbata</i>	Y	
hangehange	<i>Geniostoma ligustrifolium</i>	Y	
cabbage tree	<i>Cordyline australis</i>	Y	
red matipo	<i>Myrsine australis</i>	Y	
wheki	<i>Dicksonia squarrosa</i>	Y	
kauri	<i>Agatha australis</i>	Y	
eucalyptus	<i>Eucalyptus</i> spp		
gorse	<i>Ulex europaeus</i>		Y
sow thistle	<i>Sonchus oleraceus</i>		
Scottish thistle	<i>Onopordum acanthium</i>		
crack willow	<i>Salix</i> spp		Y
karamu	<i>Coprosma robusta</i>	Y	
arrowhead	<i>Sagittaria montevidensis</i>		Y
pampas	<i>Cortaderia selloana</i>		Y
rasp fern	<i>Doodia australis</i>	Y	
Douglas fir	<i>Pseudotsuga menziesii</i>		
macrocarpa	<i>Cupressus macrocarpa</i>		

⁴² Auckland Council (2019) Auckland Regional Pest Management Plan 2019-2020

purei	<i>Carex secta</i>	Y	
poplar	<i>Populus</i> sp.		
wattle	<i>Acacia</i> sp.		
karo	<i>Pittosporum crassifolium</i>	Y	
barberry	<i>Berberis glaucocarpa</i>	Y	
Japanese cedar	<i>Cryptomeria japonica</i>		

Appendix D: Watercourse Photos

Totara Creek



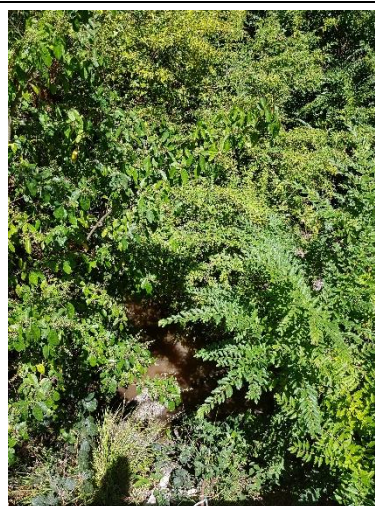
Totara A



Totara B



Sinton Stream



Sinton A



Pikau Stream



Appendix E: Historic Aerial Photographs



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Photograph Appendix E.1: Spedding Block aerial photograph taken on 23/04/1940. The natural extent of TotaraA prior to artificial modification (Retrolens).



Photograph Appendix E.2: Spedding Block aerial photograph taken in 1959. The natural extent of TotaraA prior to artificial modification (Auckland Council GeoMaps).⁴³

⁴³ Retrolens. Retrieved on 11.03.2020 from <http://retrolens.nz/map/#/1742442.7056626705/5925404.059946648/1748486.0082116267/5929455.222445869/2193/10>

Appendix F: Terrestrial and wetland photos

Sinton Stream riparian margin at proposed Spedding Road crossing



Wetland A



Appendix G: Proposed offset planting species list

Proposed riparian margin planting species list

Common name	Species name	Proportion	Spacing (m)
red matipo	<i>Myrsine australis</i>	5%	1
karamu	<i>Coprosma robusta</i>	5%	1
twiggy coprosma	<i>Coprosma rhamnoides</i>	5%	1
mahoe	<i>Melicytus ramiflorus</i>	5%	1
kānuka	<i>Kunzea ericoides</i>	30%	1
mānuka	<i>Leptospermum scoparium</i>	12%	1
ngaio	<i>Myoporum laetum</i>	5%	1
tōtara	<i>Podocarpus totara</i>	8%	5
karaka	<i>Corynocarpus laevigatus</i>	5%	5
pāte	<i>Schefflera digitate</i>	6%	1
pūriri	<i>Vitex lucens</i>	8%	5
whēkī	<i>Dicksonia squarrosa</i>	2%	2
ponga	<i>Alsophila dealbata</i>	2%	2
mamaku	<i>Cyathea medullaris</i>	2%	2

Appendix H: SEV and ECR assumptions

Function Category	Variable	ID: Sinton Stream SEV: SEVm-P/SEVi-P Offset: 20 m riparian margin enhancement, both banks Site: On site (PCA)	ID: SintonA SEV: SEVm-P/SEVi-P Offset: 10 m riparian margin planting, on one bank Site: On site (PCA)
Hydraulic	Vchann	Assumes slight change in an improvement/increase with roughness elements.	Assumes increase in roughness elements but no change to small incision and where channel has been straightened and/or deepened.
	Vlining	Assumes slight reduction in fine silt from riparian margin.	Assumes reduction of fine sediment loading due riparian cover (10 m on one bank) and reduced agricultural landuse in sub-catchment.
	Vpipe	Assumes no pipe.	Assumes one pipe after development.
	Vbank	Assumes no change in some evidence of channel incision.	Assumes no change in some evidence of channel incision.
	Vrough	Assumes dominated by native regenerating vegetation in late stage of succession, some low diversity regenerating and stock exclusion (to 20 m on each bank).	Assumes slight reduction in exotic vegetation through riparian enhancement, and increase in native regeneration in late succession and stock exclusion. Assumes stock grazing to continue at a setback from one bank.
	Vbarr	Assumes partial barrier (culvert) removed.	Assumes no change.
	Vchanshape	Autopopulated.	Autopopulated.
Biogeochemical	Vshade	Assumes very high and high shading from 20 m riparian margin enhancement along entire length	Assumes high and very high shading from 10 m riparian planting on western bank and existing vegetation on eastern bank retained.
	Vdod	Assumes no change	Assumes improvements to dissolved oxygen with reduction of soft sediment.
	Vveloc	Assumes no change to measured velocities	Assumes no change to measured velocities
	Vdepth	Assumes no change to measured depths	Assumes no change to measured depths
	Vripar	Assumes a full 20 m riparian margin	Assumes 10 m of riparian planting and remaining exotic trees on the other side of the bank.
	Vdecid	Assumes no change from no deciduous	Assumes some deciduous remain from exotic willow – slow removal expected.
	Vmacro	Assumes no change with no macrophytes	Assumes reduction in macrophytes following shading and change in landuse to reduce nutrients.
	Vretain	Autopopulated.	Autopopulated.
	Vsurf	Assumes no change from measured substrates	Assumes no change from measured substrates

Function Category	Variable	ID: Sinton Stream SEV: SEVm-P/SEVi-P Offset: 20 m riparian margin enhancement, both banks Site: On site (PCA)	ID: SintonA SEV: SEVm-P/SEVi-P Offset: 10 m riparian margin planting, on one bank Site: On site (PCA)
	Vripfilt	Assumes slight improvement to filtering following planting	Assumes improvements to filtering after vegetation cover – transform from pasture to riparian margin on one bank.
Habitat Provision	Vgalspwn	Assumes no change to existing lack of near-flat slope.	Assumes no change from existing small amount of near flat slope.
	Vgalqual	Assumes some improvement following the introduction of vegetation along the margins.	Assumes high quality after improvements to shading.
	Vgobspawn	Autopopulated.	Autopopulated.
	Vphyshab	Assumes slight increase in aquatic habitat diversity including wood, undercut banks, and rooted aquatic vegetation that are evenly distributed along reach. Assumes no change to existing hydrological heterogeneity. Assume very high channel shade and vegetation integrity with 20 m planting each bank.	Assumes slight increase in both aquatic habitat diversity and abundance. Assumes change to hydrological heterogeneity. Assumes increase to channel shade and riparian vegetation integrity due to 10 m native riparian planting on one bank.
	Vwatqual	No change from minimal due to low upstream quality – upstream/headwaters have either no riparian cover or are shaded by shelter belt vegetation.	Assumes no change to existing minimal due to low upstream quality – upstream/headwaters have either no riparian cover or are shaded by shelter belt vegetation.
	Vimperv	Assumes between 10-25% of the catchment above the site is impervious, however there are assumed high controls to flood flows and first flush runoff.	Assumes >25% of catchment impervious from development, however with high controls.
Biodiversity	Vfish	-	-
	Vmci	-	-
	Vept	-	-
	Vinvert	-	-
	Vripcond	Autopopulated.	Autopopulated.
	Vripconn	Assumes no change to existing where its not impeded.	Assumes no change to existing with no impeded apart from slight incision.

Appendix I: Proposed Planting Schedules

Schedule 1: Riparian margin planting schedule – Sinton Stream, Totara Creek, and SintonA – 20,048 m² offset planting

Plant stage	Common name	Species name	Size grade (ecotrays)	Spacing (m)	Proportion	No. of plants
Initial planting	red matipo	<i>Myrsine australis</i>	1 – 1.5 lt	1	5%	1149
	karamu	<i>Coprosma robusta</i>	1 – 1.5 lt	1	5%	1149
	twiggy coprosma	<i>Coprosma rhamnoides</i>	1 – 1.5 lt	1	5%	1149
	mahoe	<i>Melicytus ramiflorus</i>	1 – 1.5 lt	1	5%	1149
	kānuka	<i>Kunzea ericoides</i>	1 – 1.5 lt	1	30%	6892
	mānuka	<i>Leptospermum scoparium</i>	1 – 1.5 lt	1	12%	2757
	ngaio	<i>Myoporum laetum</i>	1 – 1.5 lt	1	5%	1149
	tōtara	<i>Podocarpus totara</i>	5 (PB)	5	8%	74
	karaka	<i>Corynocarpus laevigatus</i>	5 (PB)	5	5%	46
Enrichment planting	pāte	<i>Schefflera digitate</i>	1 – 1.5 lt	1	6%	1378
	pūriri	<i>Vitex lucens</i>	5 (PB)	5	8%	74
	whekī	<i>Dicksonia squarrosa</i>	3 (PB)	2	2%	115
	ponga	<i>Alsophila dealbata</i>	3 (PB)	2	2%	115
	mamaku	<i>Cyathea medullaris</i>	3 (PB)	2	2%	115
					100%	17,311

Appendix J: Qualitative Biodiversity Compensation Model (QBCM): Inputs, Assumptions and Outputs

The following tables set out QBCM inputs, assumptions and outputs. It is key to note that the data inputs provided in the tables below are informed through the detailed desktop and field investigations undertaken to inform the Ecology Report related documentation.

Table 1 relates to data inputs associated with the QBCM impact model, Table 2 relates to data inputs associated with the QBCM compensation model and Table 3 provides a summary of QBCM inputs and outputs.

The type and quantum of proposed habitat restoration and enhancement measures to address residual effects on native forests are expected to result in Net Gain outcomes within 10 years. Summary model inputs and outputs are provided in Table 3 below.

Appendix J Table 1: Description of data inputs for the QBCM (Impact Model).

Model inputs	QBCM: Impact Model Data Inputs
Biodiversity Value	Biodiversity value for a habitat type relates to the representativeness, rarity and distinctiveness, diversity and pattern, and ecological context associated with the habitats/vegetation types within a project footprint as <u>assessed against the benchmark</u> (refer to Section 5.2 and Table 4 of the Ecological Impact Assessment Guidelines (EciAG, 2018)). Biodiversity value for a species relates to the importance of the habitat(s) for that species relative to the benchmark.
Measurement Unit	For overall forest biodiversity QBCMs the Biodiversity value scale ranges from 0 – 5 in ascending order of biodiversity value 0 = No Value 1 = Low Value 2 = Moderate Value 3 = High Value 4 = Very High Value 5 = Very High Value (equal to benchmark)
Area of Impact (ha)	Area of impact based on GIS calculations
Based on Benchmark	The benchmark for riparian vegetation biodiversity value constitutes a <u>hypothetical but realistic future state, which includes:</u> Riparian forest Biodiversity – A large contiguous tract of mature native forest that has been subject to long-term pest control, with all species present at carrying capacity;
Measure prior to Impact	The measure prior to impact for each modelled biodiversity values was determined to be: A value of 1 relative to the benchmark of 5 for forest biodiversity. The riparian margin is considered to be low value because it is exclusively dominated by non-native plants though common native birds and potentially copper skink are likely to use this habitat.
Measure after Impact	Biodiversity values are expected to decline to zero after Project impacts

Appendix J Table 2: Description of data inputs for the QBCM (Compensation Model)

	QBCM: Compensation Model data inputs
Discount rate	A discount rate of 3% has been used to account for the inherent risk in the temporal-lag between the impact occurring (due to the development) and the biodiversity gains being generated (due to the compensation actions). The worked examples provided in the model User Manual apply a discount rate of 3%, as informed by research conducted as part of the Department of Conservation's research project on biodiversity offsetting in New Zealand (Maseyk et al. 2016).
Proposed revegetation compensation	0.364 ha of native riparian forest revegetation, coupled with: • Early planting weed pest control; • Deployment of logs to provide additional habitat diversity for flora and fauna
Confidence in Actions	Assumed a confidence of > 90% that the proposed revegetation compensation will achieve the predicted benefits to riparian forest species diversity
Time period over which to calculate NPBV	10 years
Measure prior to Offset	It is assumed that the riparian forest species diversity will equal 1 relative to the benchmark as the revegetation will be undertaken within predominantly exotic riparian margin and pasture.
Measure after the Offset	It is assumed that after 10 years of growth the forest species diversity will equate to 2 relative to the benchmark or 40% of the biodiversity value. It is considered of similar ecological value to the habitat that it is replacing despite being younger because the compensation plantings will include native species only.

Appendix J Table 3: Summary of data inputs and outputs for (QBCM) at 10 years

Model inputs		
Model descriptor	Biodiversity type	Native riparian forest
	Biodiversity component	Indigenous forest biodiversity
	Biodiversity attribute	Value
	Measurement unit	Value score relative to benchmark
	Benchmark	5
Impact model	Impact area (ha)	0.182 ha
	Pre-impact value relative to benchmark	1
	Post-impact value relative to benchmark	0
	Compensation area (ha)	0.364 ha

Model inputs		
Forest revegetation compensation model (10 years)	Pre-compensation value	1
	Post-compensation value	2
	Offset end point (years)	10
Model outputs		
Impact model		-0.04
Compensation model (revegetation)		+0.05
Net Present Biodiversity Value (NPBV) after 10 years*		+0.01 (Net Gain)

Notes:

1. A negative NPBV = Net Loss, a NPBV of 0 = No Net Loss and a positive NPB = Net Gain.

