

FRESHWATER AND WETLAND ECOLOGY ASSESSMENT

NZ Transport Agency Waka Kotahi
Mill Road Stage 1

SEPTEMBER 2026

NZ TRANSPORT AGENCY
WAKA KOTAHI

Contents

1 INTRODUCTION 11
1.1 Overview 11
1.2 Project Activities 11
1.2.1 Construction activities 11
1.2.2 Operational activities 12
1.3 Purpose and scope of this Report 12
2 METHODS 13
2.1 Project Area and Zone of Influence 13
2.2 Desktop Assessment 13
2.3 Assessment of Ecological Value and Effects 13
2.3.1 Assigning Ecological Value 14
2.3.2 Assessing the Magnitude of Effects 14
2.3.3 Assessing the Levels of Effects 15
2.3.4 Residual Effects Assessment 15
2.3.5 Stream Offset Methodology 15
2.3.6 Wetland Compensation Methodology 15
2.4 Field Investigations 16
2.4.1 Freshwater Ecology 16
2.4.2 Wetland Ecology 17
3 EXISTING ECOLOGICAL VALUE 18
3.1 Ecological Context 18
3.2 Land Use Overview 18
3.3 Freshwater Ecology 18
3.3.1 Ecological Context 18
3.3.2 Description of Freshwater Features 19
3.3.3 Ecological Value 22
3.4 Wetland Ecology 24
3.4.1 Ecological Context 24
3.4.2 Description of Wetland Features 25
3.4.3 Ecological Value 25
4 ASSESSMENT OF EFFECTS 27
4.1 Overview of Potential Ecological Effects 27
4.2 Design refinement and effects avoidance 27
4.2.1 Design Refinements - Streams 27
4.2.2 Design Refinements - Wetlands 27
4.3 Ecological Effects 28
4.3.1 Streams 28
4.3.2 Wetlands 29
4.4 Avoidance, minimisation and remediation measures 31
4.4.1 Watercourse modification – Installation of Culverts 31

4.4.2 Watercourse modification – Diversions 32
4.4.3 Watercourse modification – Riprap 33
4.4.4 Watercourse modification – Stream Loss 33
4.4.5 Temporary modification to fish passage 33
4.4.6 Instream works causing injury/mortality to native fish 33
4.4.7 Erosion and sedimentation from earthworks to streams 33
4.4.8 Operational Stormwater Discharge 34
4.4.9 Shading under Bridges 34
4.4.10 Loss of Wetland Habitat 34
4.4.11 Change to Stream and Wetland Hydrology 34
4.4.12 Discharge to wetlands 35
4.4.13 Fragmentation and edge effects 35
4.5 Magnitude and Level of Residual Effects 35
4.5.1 Streams 35
4.5.2 Wetlands 37
4.5.3 Overall effects conclusion 38
5 MANAGEMENT OF RESIDUAL EFFECTS 39
5.1 Overview 39
5.2 Offset Mitigation 39
5.2.1 Selection of offsetting Sites 40
5.2.2 Offset - Stream habitat 40
5.2.3 Residual effects - Wetland habitat 41
6 CONCLUSION 43
7 REFERENCES 44
APPENDIX A STATEMENT OF EXPERIENCE AND QUALIFICATIONS AND CODE OF CONDUCT 46
7.1 Rosa Kirkham 46
7.2 Katrina McDermott 46
APPENDIX B FRESHWATER ECOLOGICAL VALUE 48
APPENDIX C WETLAND DELINEATION PROTOCOLS AND WETLAND CONDITION INDEX 50
7.3 Wetland Definition 50
7.3.1 Wetland Delineation Protocol 50
7.3.2 Wetland Condition Index 51
APPENDIX D ECOLOGICAL MAP SERIES 54
APPENDIX E FRESHWATER ECOLOGY RESULTS 55
7.4 Macroinvertebrate results 55
7.5 eDNA results 58
7.6 Stream Ecological Valuation results (SEVc) 59
7.7 Stream site photos 61
APPENDIX F WETLAND ECOLOGY RESULTS 69
7.8 Wetland delineation results 69
7.9 Wetland Condition Index results 75

7.10 Wetland site photos **80**
APPENDIX G STORMWATER INFRASTRUCTURE 99
7.11 Consenting matters **99**
7.12 Outfalls **99**
7.13 Culverts **101**
7.14 Diversions **105**
7.14.1 Temporary diversions 105
7.15 Stream Daylighting **105**
7.16 Outfall and Culvert Descriptions **105**
Outfall RG MM03 at S01 105
Outfall TD MM03 at S02 105
Outfall 'SW Wetland 1' at DS01 105
Culvert MM01 at S03 106
Culvert MM01A at S04 106
Outfall RG MM06 at S04 106
Culvert MM01C at S05 106
Culvert MM01D at S06 106
Culvert MM02 at DS04 106
Outfall RG MM07 at DS04 – Ephemeral 107
Culvert MM02A discharging to MW08 – Ephemeral 107
Culvert MM03 at S11 107
Outfall RG MM08 at S11 107
Outfall RG MM10 at S14A 107
Culvert MM03A and MM04 at S16 and MW14 107
Culvert MM05 at S21 and MW21a 108
Culvert MM06 at S20 and MW21b 108
Outfall RG MM13 at S21 and MW21a 108
Culvert MM10 at S22 108
7.17 Proposed Design **109**
APPENDIX H ENVIRONMENTAL COMPENSATION RATIO ASSESSMENT FOR RESIDUAL STREAM EFFECTS 111
7.18 Background **111**
7.19 ECR Calculation 111
7.20 Impacted Sites **111**
7.21 Offset Sites **112**
7.22 Offset site justification 112
7.23 Offset and Restoration Assumptions 112
7.24 Environmental Compensation Ratio and Stream Value **113**
7.25 Stream Extent **115**
7.26 Conclusion **115**
Attachment A – Offset stream sites Photos **116**
Attachment B – Offset stream sites SEV ECR Assumptions **119**

7.27 SEV impact model predictions for Riprap 119
Attachment C - Assumptions used in the predicted scores for Restoration Sites 120
7.28 Intermittent Stream S17 at 116 Ranfurly 120
7.29 Intermittent Stream at S21 within Designation 121
7.30 Piped Stream TR01 at Totara Park 122
APPENDIX I WETLAND BIODIVERSITY COMPENSATION MODEL (BCM) 124
7.31 Introduction 124
7.32 Approach 124
7.33 Restoration and creation areas 125
7.34 Restoration Baseline 125
7.35 Restoration Constraints/opportunities 125
7.36 Wetland creation approach 125
7.37 Wetland creation outcome 125
7.38 Biodiversity Compensation Model (BCM) 125
7.39 Model limitations 129

Copyright information

Copyright ©. This copyright work is licensed under the Creative Commons Attribution 4.0 International licence. In essence, you are free to copy, distribute and adapt the work, as long as you attribute the work to the NZ Transport Agency Waka Kotahi (NZTA) and abide by the other licence terms. To view a copy of this licence, visit http://creativecommons.org/licenses/by/4.0/.

Disclaimer

NZTA has endeavoured to ensure material in this document is technically accurate and reflects legal requirements. However, the document does not override governing legislation. NZTA does not accept liability for any consequences arising from the use of this document. If the user of this document is unsure whether the material is correct, they should refer directly to the relevant legislation and contact NZTA.

QUALITY REVIEW AND APPROVAL RECORD

Item	Name	Date
Prepared by:	Katrina McDermott | Principal Ecologist | Boffa Miskell Rosa Kirkham | Ecologist | Boffa Miskell	September 2026
Reviewed by:	Dr Sarah Flynn | Senior Principal Ecologist | Boffa Miskell Dr Ian Boothroyd | Partner, Senior Ecologist | Boffa Miskell	September 2026
Approved for lodgement by:	Steph Kane, NZTA	September 2026

GLOSSARY

Specific terms	
AEE	Assessment of Environmental Effects
AUP(OP)	Auckland Unitary Plan (Operative in Part)
BCM	Biodiversity Compensation Model
DOC	Department of Conservation
EcIA	Ecological Impact Assessment
ECR	Environmental Compensation Ratio
ED	Ecological District
eDNA	Environmental DNA
EIANZ	Environmental Institute of Australia and New Zealand
FACW	Facultative Wetland Species
FMP	Freshwater Management Plan
HGM	Hydrogeomorphic Unit
IANZ	International Accreditation New Zealand
IUCN	International Union for Conservation of Nature
MCI	Macroinvertebrate Community Index
MCI-sb	Macroinvertebrate Community Index – Soft Bottom
MfE	Ministry for the Environment
NES-F	National Environmental Standards for Freshwater
NPS-FM	National Policy Statement Freshwater Management
NZFFD	New Zealand Freshwater Fish Database
NZTA	New Zealand Transport Agency Waka Kotahi
OBL	Obligate Wetland Species
QMCI	Quantitative Macroinvertebrate Community Index
QMCI-sb	Quantitative Macroinvertebrate Community Index – Soft Bottom
RMA	Resource Management Act 1991
SEA	Significant Ecological Area
SEV	Stream Ecological Valuation
SEVi	Stream Ecological Value at Impact
SEVi-C	Current SEV value at impact site
SEVi-I	Predicted SEV value at impact site
SEVi-P	Potential SEV value at impact site
SEVm-C	Current SEV value at mitigation site
SEVm-P	Potential SEV value at mitigation site
SEVp	Potential Stream Ecological Value
TAR	Threatened or At-Risk

WAA	Wildlife Act Authority
WCI	Wetland Condition Index
ZOI	Zone of Influence
General terms	
Biodiversity	The variety of life on Earth at all its levels, from genes to ecosystems, and can encompass the evolutionary, ecological, and cultural processes that sustain life
Ecology	The study of the relationships between living organisms, including humans, and their physical environment.
Effects management hierarchy	As per the NPS-FM definition "in relation to natural inland wetlands and rivers, means an approach to managing the adverse effects of an activity on the extent or values of a wetland or river (including cumulative effects and loss of potential value) that requires that: (a) adverse effects are avoided where practicable; then (b) where adverse effects cannot be avoided, they are minimised where practicable; then (c) where adverse effects cannot be minimised, they are remedied where practicable; then (d) where more than minor residual adverse effects cannot be avoided, minimised, or remedied, aquatic offsetting is provided where possible; then (e) if aquatic offsetting of more than minor residual adverse effects is not possible, aquatic compensation is provided; then (f) if aquatic compensation is not appropriate, the activity itself is avoided"
Habitat clearance	Earthworks and/or vegetation clearance
Net gain	Net gain means that the measurable positive effects of actions exceed the point of no net loss.
Net positive	Overall positive value for indigenous biodiversity in a like-for-like quantitative loss/gain calculation used to demonstrate and achieve net gain
Mitigation	As per the NZTA EcIA Guidelines (2023), this includes: avoid (partial), minimise, and remedy effects of ecological features
Site description	
Designation	Designation 6786
Project	Mill Road Stage 1 Project
Project Area	All land, including aquatic features, within the designation footprint of the proposed road and associated infrastructure (e.g. stormwater), extending to the outer limits of the finished earthworks profiles.

EXECUTIVE SUMMARY

This report assesses the freshwater ecological effects of the Mill Road Stage 1 Project ('Project') The assessment considers streams, wetlands, and threatened and at-risk aquatic fauna and habitat. The Project area is largely a modified landscape of the Puhinui and Papakura catchments. Freshwater habitats comprise predominantly of small headwater streams and wetland systems that have been substantially altered by historic farming, urban development, drainage, and vegetation modification. However, a number of higher-value freshwater and wetland habitats remain, particularly within Significant Ecological Areas (SEAs) at Puhinui Gully and Cheeseman's Bush, and within Tōtara Park.

Stream ecological values ranged from Low to High. The highest-value streams occur within SEAs and support important ecological functions, including habitat for indigenous freshwater fauna such as longfin eel and banded kōkopu. Wetlands were generally highly modified, exotic-dominated systems with low ecological value. However, four wetlands comprised *Machaerina* sedgeland, a wetland type regarded as regionally threatened and assigned high ecological value.

The Project has been refined to avoid and reduce ecological effects where practicable. Key design changes include avoidance of several stream and wetland features through alignment refinements, reductions in culvert lengths, realignment of stormwater outfalls, reductions in earthworks footprints, and use of bridge structures to avoid direct impacts on high-value habitats at Cheeseman's Bush and portions of Puhinui Gully. The Project will result in the diversion of approximately 250 m of stream length. The impacts to the streams are remediated through the new realignments with the replication of existing habitats in the new channels.

After avoidance, minimisation, and remediation measure are applied, the main residual adverse effects are the loss and modification of stream length and wetland extent. The Project will result in the loss of approximately 285.95 m of stream habitat through culverting, reduction in length from stream diversions, erosion protection works, and stream reclamation. Approximately 0.58 ha of natural inland wetland habitat will also be permanently lost, including 0.073 ha of high-value wetland.

Residual stream effects have been assessed using the Stream Ecological Valuation Environmental Compensation Ratio method. To address these effects, approximately 818 m of stream restoration and daylighting has been identified across three offset sites within the affected catchments. The offset package involves the restoration of degraded stream habitats, riparian planting, and daylighting of previously piped stream sections. Modelling indicates that the proposed offsets exceed the restoration quantum required to achieve no net loss of stream ecological function and will deliver a net gain in stream ecological value. The Project will also result in a net increase in stream length through stream creation and daylighting.

Residual wetland effects have been assessed using the Biodiversity Compensation Model (BCM). The proposed wetland compensation package includes restoration of approximately 0.689 ha of degraded wetland habitat and creation of approximately 0.267 ha of new wetland habitat within the affected catchments. BCM modelling demonstrates that a net gain of approximately 11.6% in wetland ecological value can be achieved

Overall, the Project will result in adverse effects on freshwater and wetland habitats, including unavoidable losses of stream and wetland extent. However, through implementation of the proposed avoidance, mitigation, offsetting, and compensation management measures, the assessment concludes that residual effects can be appropriately addressed. The stream offset programme is expected to achieve a net gain in stream ecological values, while the wetland compensation programme is expected to achieve no net loss and a positive biodiversity outcome for wetland values.

1 INTRODUCTION

1.1 Overview

This Freshwater and Wetland Ecological Impact Assessment (EcIA) has been prepared to assess the potential freshwater ecological effects associated with the Mill Road Stage 1 Project (the 'Project').

The assessment has been prepared to inform the statutory approvals required for the Project, including approvals sought under the Fast-track Approvals Act 2024. It forms part of a suite of specialist reports that collectively support the applications for statutory approvals.

This assessment relies on the description of the Project and works in Part B of the Substantive Application Report (SAR), and associated drawings in Appendix B of the SAR. Figure 1-1 below shows the designation footprint, the Significant Ecological Areas (SEAs) and stream network.

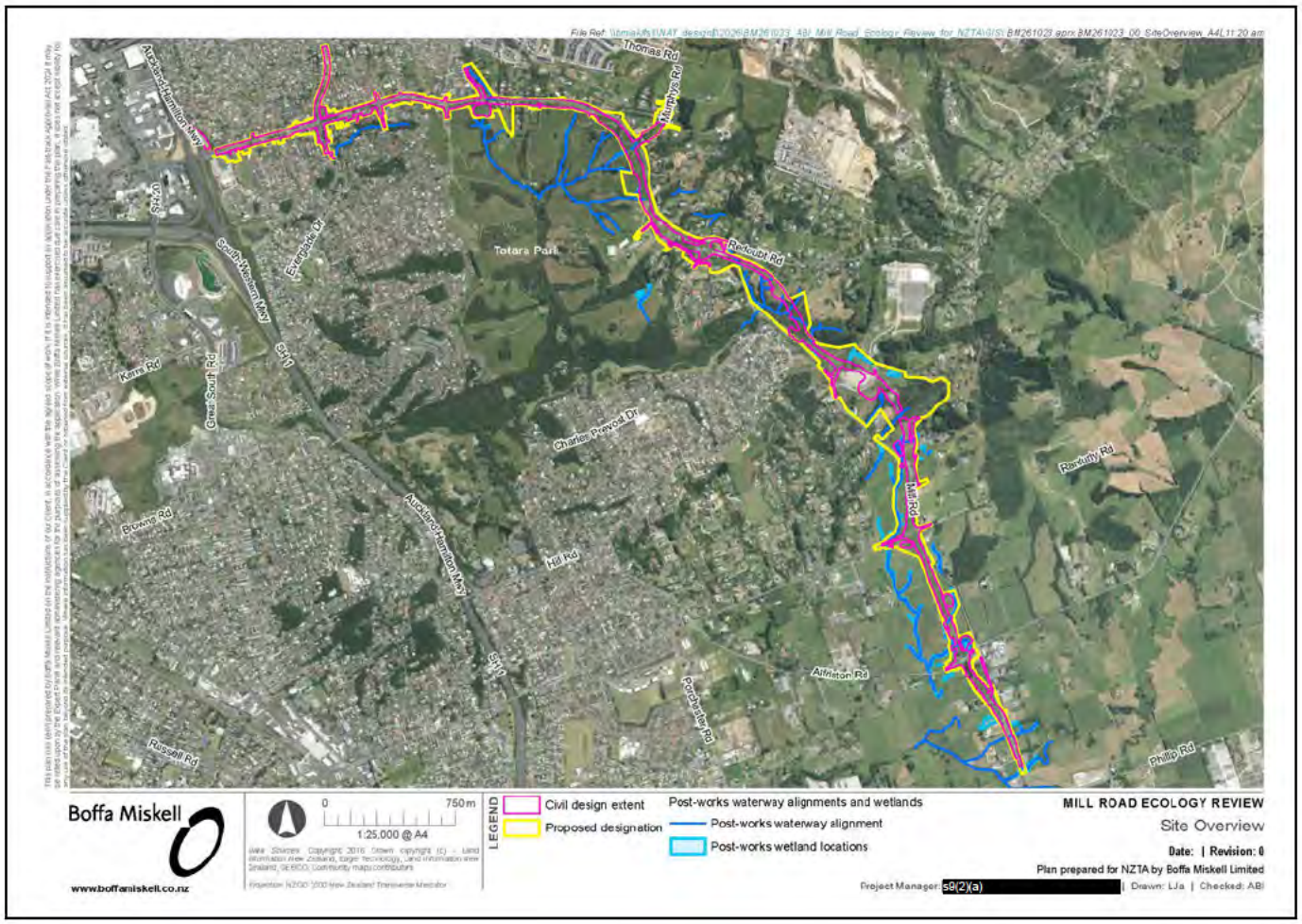


Figure 1-1 Mill Road Stage 1 Project Overview

1.2 Project Activities

The Project involves the construction of a new 4-lane corridor. A summary of construction and operational activities relevant to this EcIA is provided below.

1.2.1 Construction activities

- Site establishment activities including temporary fencing, establishment, temporary access construction, stockpiling, installation of erosion and sediment control measures
- Vegetation clearance – wetland and riparian

- Utility relocation, diversion and/or installation
- Earthworks – construction of road and ancillary infrastructure
- Structural works – installation of bridges and retaining walls
- Stream works – culvert replacement and/or installation, riprap apron installation, permanent and temporary stream diversions – refer to Appendix G for details.
- New stormwater wetlands – refer to the Stormwater Assessment (as part of the Substantive Application Report).
- Landscape and restoration planting.

1.2.2 Operational activities

- New and altered stormwater runoff/discharges – refer to Stormwater Assessment.
- Maintenance activities e.g. vegetation management

1.3 Purpose and scope of this Report

The purpose of this report is to evaluate the actual and potential effects of the Project on freshwater and wetland ecological values, including hydrological, habitat, macroinvertebrate, fish, and riparian function. It is informed by information collected during previous ecological assessments, in particular information collected in 2025 by AECOM. This information has been validated through targeted field visits and verification. An updated analysis of ecological values has been undertaken consistent with the Environmental Institute of Australia and New Zealand (EIANZ) Ecological Impact Assessment Guidelines (Roper-Lindsay et al., 2018). The assessment has been prepared by Katrina McDermott and Rosa Kirkham and their qualifications and experience are set out in Appendix A.

This report addresses:

- A description and analysis of the freshwater physical habitat characteristics, macroinvertebrate communities, and native aquatic fauna values of the streams and natural inland wetlands intersected by the Project and within the Zone of Influence (ZOI);
- An assessment of ecological values of identified freshwater habitats, including ecological significance;
- An assessment of actual and potential effects of the Project on freshwater ecological values as a result of the proposed activities;
- The application of the effects management hierarchy, including the provision of appropriate recommendations to avoid, minimise, and remedy the potential effects of the Project on ecological features; and
- Recommendations for addressing any residual effects, if required, through the application of offset or compensation measures.

2 METHODS

This report draws on previous ecological surveys and assessments undertaken for the Project. In particular, it draws upon field assessments undertaken by AECOM conducted between December 2024 and June 2025. The field assessment methods undertaken by AECOM and the assessment methods are described below. Further targeted site visits and visual assessments were undertaken in June 2026 to verify previously collected field data.

2.1 Project Area and Zone of Influence

The 'Project Area' encompasses all land (including freshwater features) within the designation footprint. The Project proposes bridges over two Significant Ecological Areas (SEAs) (Figure 1-1); a 40 - 50m bridge over 146 Mill Road (Cheesman's Bush) and a ~200 m bridge over 38 Mill Road (Puhinui Gully).

The ZOI of the Project relates to an area occupied by an ecosystem, habitat or species that are adjacent to, and may go beyond, the boundary of the Project Area. It is defined in the EIANZ Guidelines as "the areas/resources that may be affected by the biophysical changes caused by the proposed Project and associated activities." The distance of the ZOI and the type of effect from the Project can be different for different species and habitat types. For the purposes of this Project it is largely the remaining habitat directly adjacent or connected to the Project Area and describes the impacts of the Project on adjacent or connected freshwater and wetland habitats and associated native species.

It should be noted that the presence of habitats and/or species within the ZOI of the Project does not necessarily mean the ecological feature will be impacted by the Project.

2.2 Desktop Assessment

An initial desktop assessment of the proposed designation and road alignment was undertaken to gain an understanding of the ecological context of the Project. Previous ecological reporting was also reviewed. Sources included:

- Auckland Council Geomaps
- New Zealand Freshwater Fish Database (NZFFD)
- Department of Conservation Threat Classification Series
- River Environmental Classification (REC)
- Wilderlab Publicly available eDNA
- Indigenous terrestrial and wetland ecosystems of Auckland (Singers et al., 2017)
- Mill Road Corridor Study Assessment of Ecological Effects (Kessels & Associates Ltd, 2008)
- Mill Road Corridor Notice of Requirement Assessment of Ecological Effects (Boffa Miskell Ltd, 2014)

2.3 Assessment of Ecological Value and Effects

Ecological value has aspects of both quantity (rarity or extent) and quality (integrity, functionality or condition) and incorporates an array of attributes across multiple levels of ecological organisation (species, communities, habitats and ecosystems). The EIANZ (EIANZ 2018) guidelines provide a nationally consistent framework for assessing ecological impacts and are widely used to assess effects and effects management for infrastructure projects.

The assessment applies the effects management hierarchy. Effects that can be avoided, minimised, or remedied through design and construction methods are identified first. Residual effects are then considered in terms of the need for offsetting or compensation.

2.3.1 Assigning Ecological Value

The EIANZ impact assessment guidelines provide a summary scale whereby a site's value is assessed as the extent to which an area or site exemplifies qualities of representativeness, rarity/ distinctiveness, diversity and pattern, and ecological context characteristic of its ecosystem type and then ranked on a scale of Negligible to Very High for how many of those assessment matters are met (Table 2-1). We have assessed freshwater and wetland ecosystems / communities / habitats and species against these criteria to determine the overall value of the features. An interpretation of these criteria for freshwater habitats is provided in Appendix B

Table 2-1: EIANZ criteria for ascribing ecological value (EIANZ 2018).

Value	Description
Very high	Area rates High for 3 or all of the four assessment matters (representativeness, rarity/ distinctiveness, diversity/pattern, ecological context)
High	Area rates High for 2 of the assessment matters, Moderate and Low for the remainder, or Area rates High for 1 of the assessment matters, Moderate for the remainder
Moderate	Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder.

2.3.2 Assessing the Magnitude of Effects

Once the values of ecosystem components have been identified and determined, the magnitude of the impact, if an impact is likely/expected, is assessed. Magnitude of effect is a measure of the spatial extent or scale of the impact, its duration, and the degree of change that it will cause (reversibility) Table 2-2. A typical scale of magnitude ranges from "Negligible" to "Very High" (severe).

The magnitude of effects has been assessed at the sub-catchment scale.

Table 2-2: EIANZ criteria for ascribing magnitude of ecological impacts (EIANZ 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 fundamentally change 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
Notes: We note that where the level of effect is noted as moderate, high or very high, effects would typically be considered significant under the RMA and require mitigation	

2.3.3 Assessing the Levels of Effects

The overall level of effect, where there is a likely or predicted negative impact, was determined by applying the matrix below in Table 2-3, which combines the ecological value of the feature and the magnitude of the effect to determine the level of ecological effect. The level of effect was identified for each ecological feature after efforts to avoid, minimise or remember effects has been undertaken.

Table 2-3: EIANZ criteria for ascribing ecological value (EIANZ 2018).

		Ecological Value			
		Very High	**High**	**Moderate**	**Low**
Magnitude	**Very High**	Very High	Very High	High	Moderate
	High	Very High	Very High	Moderate	Low
	Moderate	Very High	High	Moderate	Very Low
	Low	Moderate	Low	Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low

2.3.4 Residual Effects Assessment

Of the potential adverse effects of the project that could not be avoided, minimised or remedied, residual effects are then considered in terms of the need for offsetting or compensation.

2.3.5 Stream Offset Methodology

Where moderate or greater residual stream effects remain, stream offsetting is recommended to achieve 'No Net Loss' of stream extent and value. The Stream Ecological Valuation (Storey et al., 2011) provides guidelines for calculating an Environmental Compensation Ratio (ECR) to offset the adverse effects of stream impacts and to ensure 'No Net Loss' of stream biodiversity values.

The ECR utilises the SEV score to calculate a ratio for the minimum stream area (stream bank width x stream length) to be restored as mitigation for stream loss (Storey et al., 2011). The aim of the ECR is to ensure No Net Loss of ecological function (loss of function at impact site, gain of function at offset site). The formula for the ECR calculation is set out below:

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

- SEVi-C & SEVi-P are the current and potential SEV values respectively for the site to be impacted.
- SEVm-C & SEVm-P are the current and potential SEV values respectively for the site where environmental offset is to be applied.
- SEVi-I is the predicted SEV value of the stream to be impacted, after impact.

Refer to Appendix B and Appendix H for more information on the SEV/ECR methodology.

2.3.6 Wetland Compensation Methodology

Where moderate or greater residual wetland effects remain, the Biodiversity Compensation Model (BCM) for New Zealand has been applied (Baber, Dickson, et al., 2021a). The BCM aims to outline the compensation strategy for the unavoidable loss of wetland values. The BCM is used as a decision support tool to help determine the type and magnitude of biodiversity compensation that is likely needed to achieve Net Gain outcomes for residual effects on biodiversity values associated with Project activities.

Net Gain outcomes occur when the biodiversity gains associated with compensation actions are greater than the impacts for a given biodiversity value.

Refer to Appendix I for more information on the BCM.

2.4 Field Investigations

2.4.1 Freshwater Ecology

Site investigations were completed from December 2024 to January 2025[1] at the Project stream sites and included stream classification, macroinvertebrate sampling, eDNA sampling (to confirm native freshwater fish presence), and Stream Ecological Valuations (SEVs), which are detailed further below.

Stream Classification

Stream classification was undertaken in the field[2] to determine whether stream sites were ephemeral, intermittent, or permanent, following the definitions provided in the Auckland Unitary Plan (Operative in Part) (AUP(OP))[3]. Each stream was ground truthed, mapped, and assessed using observable hydrological, geomorphological, and ecological indicators.

eDNA Sampling

Environmental DNA (eDNA) sampling, alongside available data from the NZFFD, was used to assess fish presence. Filtered water samples were taken using Wilderlab eDNA sample kits and sent to an International Accreditation New Zealand (IANZ) accredited laboratory (Wilderlab NZ Ltd) for analysis. Laboratory analysis included eDNA sequence counts using multi-species DNA metabarcoding targeting fish, macroinvertebrates, mammals, lizards, and birds. eDNA results were also used to inform the SEV score.

Stream Ecological Valuation Surveys

Stream sites were assessed using the SEV method developed by Auckland Council (Storey et al., 2011). This methodology was selected as it provides a standardised framework for quantifying the ecological function of streams and watercourses within the Auckland Region.

The SEV method evaluates stream condition across 14 key ecological functions, which are grouped into four broad stream function categories; hydraulic, biogeochemical, habitat provision, and biodiversity. Field data was collected and entered into the SEV calculator[4], which generates an overall SEV score for stream ecological function of 0-1. Scores are interpreted as detailed in Table 2-4 , below.

Table 2-4: Interpretation of SEV scores.

SEV Score	SEV Score Interpretation
0 – 0.40	Poor
0.41 – 0.60	Fair
0.61 – 0.80	Good
0.81 +	Excellent

Macroinvertebrate Sampling

Instream macroinvertebrate communities were sampled at SEV locations following protocols developed for the collection of macroinvertebrate samples from rivers and streams (Stark et al., 2001); (Ministry for the Environment, 2022a).

[1] Stream site S14A was revisited in August 2025 (following stream classification) to undertake a detailed stream survey (incl. SEV, eDNA and macroinvertebrates). This was required following design changes.
[2] Where access was available.
[3] Auckland Unitary Plan. Practice and Guidance note. River/Stream Classification. July 2021. RC 3.3.17 (V2).
[4] Permanent or intermittent SEV calculators were used relative to the associated stream classification.

Standard community-based invertebrate indices were used to interpret invertebrate data, including Quantitative Macroinvertebrate Community Index (QMCI), Macroinvertebrate Community Index (MCI), and soft-bottomed stream variants QMCI-sb and MCI-sb (Stark & Maxted, 2007). The interpretation for MCI and QMCI scores based on the National Objectives Framework (NOF) of the NPS-FM is provided in Table 2-5 below. The NOF attribute bands provide a standardised, nation-wide-system to consistently assess and interpret freshwater macroinvertebrate results. Macroinvertebrate results were also used to inform the SEV score.

Table 2-5 Interpretation of MCI and QMCI scores to denote stream health as per NPS-FM attribute bands A, B, C, and D (MfE, 2024).

MCI	QMCI	NPS-FM Attribute Band	Description
≥130	≥6.5	A	Macroinvertebrate community, indicative of pristine conditions with almost no organic pollution or nutrient enrichment.
≥110 and <130	≥5.5 and <6.5	B	Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution/nutrient enrichment.
≥90 and <110	≥4.5 and <5.5	C	Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment.
<90	<4.5	D	Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment. Communities are largely composed of taxa insensitive to inorganic pollution/nutrient enrichment.

2.4.2 Wetland Ecology

Wetland surveys were undertaken from December 2024 to January 2025 at potential wetland sites identified in the desktop assessment. This includes those directly under the alignment and within a 100 m buffer, in line with restrictions identified within the NES-F. The RMA definition of a wetland is *"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*". Wetland delineations were undertaken as per the wetland delineation protocols (Ministry for the Environment, 2022c). Wetland condition assessments were also undertaken, both of which are described below.

Wetland Delineation

The NPS-FM refers to a national wetland delineation protocol to assist in cases of uncertainty about the existence or extent of a wetland as defined in the RMA (Ministry for the Environment, 2022c). This protocol uses vegetation, soil and hydrology indicators and references a schedule of hydrophytic plants. "Hydrophytes" (hydrophytic vegetation) are defined in the Wetland Delineation Protocols as "plant species capable of growing in soils that are often or constantly saturated with water during the growing season". The NPS-FM protocol uses a standard vegetation plot to identify and delineate natural wetlands, and no minimum wetland size is specified. Therefore, the broad scope of the definition encompasses localised areas of wet-tolerant rushes and herbs within low-lying areas and overland flow paths. The vegetation, soil and hydrology tools are applied following a hierarchical sequence of tests, each requiring an increasing level of detail shown by the wetland delineation flow chart from the Ministry for the Environment (2022c) provided in Appendix C.

Wetland areas identified in the desktop assessment were then assessed, either through the 'Rapid Test' or through the undertaking of a more detailed plot survey that includes vegetation, soil and hydrology. Some further refinement of wetland boundaries was undertaken following site visits in June 2026.

Wetland Condition

Wetland condition was assessed using the Wetland Condition Index (WCI) in accordance with the Handbook for Monitoring Wetland Condition (Clarkson et al., 2004). This methodology provides a standardised approach for evaluating the ecological condition of wetlands in New Zealand, with, including hydrological integrity, physicochemical parameters, ecosystem intactness, animal and human disturbance,

and dominance of native plants, along with an assessment of pressures likely to be affecting wetland condition.

3 EXISTING ECOLOGICAL VALUE

3.1 Ecological Context

The Project Area is located within two Ecological Districts (EDs): the Manukau ED and the Hunua ED. Both EDs are heavily modified from their former condition, with the Project area now located within a predominantly modified landscape used for residential dwellings and farming.

The Manukau ED includes the lower lying flat areas of the Project, including the top part of the Murphy's Road and the Mill Road section between Ranfurly Road and Alfriston Road junction. Manukau ED comprises an area of approximately 62,100 hectares of low altitude flats and rolling hill topography. The once extensive wetlands and swamp forest areas have been modified and converted to agriculture. Only 6% of native vegetation remains in the Manukau ED.

The Hunua ED includes the Redoubt Road and Mill Road sections of the Project and is characterised by lowland hilly topography. The Hunua ED comprises an area of approximately 85,723 hectares ranging in altitude from sea level to 688 m.

3.2 Land Use Overview

Most habitats present within the Project Area and ZOI are heavily modified and mostly situated within residential or rural land use types.

The Urban Section of the Project (which includes widening of the existing Redoubt Road) is predominantly urban residential, with a large portion within Totara Park Open Space Recreation Zone. This mixed-use area has farmed areas used for grazing livestock and recreational activities, and conservation areas.

The Rural Section of the Project (which includes widening of the existing Mill Road) largely traverses land zoned rural/mixed rural, with the area to the west of Mill Road zoned as Future Urban.

Two areas of remnant/regenerating bush are located within the Project Area, under proposed bridges, and are referred to as Puhinui Bush and Cheeseman's Bush.

3.3 Freshwater Ecology

3.3.1 Ecological Context

The Project Area crosses the Puhinui and Papakura catchments, primarily intersecting headwater watercourses. The Puhinui catchment covers approximately 3,000 hectares, flowing west and then southwest through Manurewa, Wiri, and Manukau, before discharging into the Manukau Harbour. The catchment is heavily modified, with much of the upstream stream network flowing through commercial and residential areas. Many of the upper reaches are constrained within concrete-lined, unvegetated channels, reflecting a high degree of hydrological and habitat alteration[5].

The Papakura catchment covers approximately 4,000 hectares and flows in a general south-westerly direction toward the Pahurehure Inlet of the Manukau Harbour[6]. In the upper catchment, land use is predominantly rural, including sheep and beef farms, equestrian and lifestyle properties, and dairy farming. The lower catchment transitions to an urban residential environment with areas of commercial and industrial development.

No Wetland Management Areas[7] were identified on GeoMaps within the Project Area or ZOI and no mapped wetlands.

[5] https://www.lawa.org.nz/explore-data/auckland-region/river-quality/puhinui-stream.
[6] https://www.lawa.org.nz/explore-data/auckland-region/river-quality/papakura-stream.
[7] The Wetland Management Areas Overlay identifies significant wetland listed in Schedule 1 Wetland Management Areas Schedule of the AUP.

A desktop assessment was undertaken to identify potential stream habitat where direct or indirect impacts from the Project on stream ecosystems may occur.

3.3.2 Description of Freshwater Features

During the 2024/2025 field surveys 20 watercourses were surveyed, 18 of which were classified as intermittent and two as permanent[8]. Detailed stream assessments, including SEV surveys, macroinvertebrate sampling, and eDNA samples were undertaken at streams that were to be directly impacted by the Project. These included streams located *under* bridges over Puhinui Gully and Cheeseman's Bush. Stream visual assessments were undertaken in June 2026 to confirm previous survey findings and note any changes. No sampling was undertaken in 2026.

Detailed stream survey results and photographs are provided in Appendix B.

Stream Habitat

There was very high variability in stream habitat present across the Project Area, with streams located within SEAs and Totara Park generally having higher habitat value than those within pasture areas. Streams surveyed within the Project Area were predominantly soft-bottomed, with some small areas of bedrock observed. Streams in the Puhinui catchment were largely located within restored or regenerating riparian margins. Apart from Cheeseman's Bush, streams in the Papakura catchment largely flowed through actively grazed areas with riparian margins dominated by exotic grasses and shrubs. Hydrologic heterogeneity was highly varied, from very low with only slow runs in some streams running through pasture, to very high through the Puhinui Gully with runs, riffles, chutes, and deep and shallow pools observed. Many of the streams directly impacted, with the exception of Puhinui Gully, are smaller intermittently flowing headwater tributaries with shallower water and narrower wetted widths.



Figure 3-1: Examples of stream habitat present across the Project Area. (right) S03 located within Totara Park. (centre) S13 located within Puhinui Gully/SEA. (right) S18 located within grazed farmland.

Macroinvertebrate Communities

Macroinvertebrate results indicate varying ecological conditions within streams in the Project Area. Macroinvertebrate communities generally demonstrated higher ecological function at sites within Totara Park, or those with established riparian margins (e.g. S02, S03, S05, S11, and DS04), and lower ecological function within sites within actively grazed areas with little riparian margin (e.g. S04, S18, S20, and S22)

MCI scores resulted in most sites falling within the NPS-FM Attribute Bands B and C, indicating mild to moderate organic pollution or nutrient enrichment. No sites were within Attribute Band A. Three sites were

[8] As per the AUP(OP) stream classification.

within NPS-FM Attribute Band D for MCI which is indicative of severe organic pollution or nutrient enrichment, with all three sites located within grazed pasture.

QMCI scores, which also considers the relative abundance of the taxa, resulted in most sites sitting within NPS-FM Attribute Bands A or D.

MCI and QMCI scores are detailed in Table 3-1 and full macroinvertebrate data is included in Appendix E.

Table 3-1 Macroinvertebrate results for Mill Road Stage 1 stream sites

Stream ID	MCI-sb	QMCI-sb	Dominant taxa
S01	94.29*	4.82*	Mollusc *Potamopyrgus*
S02	117.64	6.51	True Fly *Polypedilum*
S03	115.60	7.92	True Fly *Polypedilum*
S04	92.62	3.93	MITES (*Acari*)
S05	115.71	7.24	Mayfly *Zephlebia*
S11	128.67	6.92	Mayfly *Zephlebia*
S12	118.15	3.10	Mollusc *Potamopyrgus*
DS04	107.60	7.00	Mayfly *Zephlebia*
S14	100.13	4.90	True Fly *Orthocladiinae*
S14A	103.56	5.82	Mayfly Zephlebia
S18	60.50	2.09	Mollusc *Potamopyrgus*
S20	86.20	3.39	Crustacea *Paraleptamphopus*
S22	80.00	2.49	Crustacea *Ostracoda*

Notes: * = MCI/QMCI (hard bottom). Cell shading indicates NPS:FM Attribute Band = Band A, Band B, Band C, Band D.

Freshwater Fish

Fish populations were inferred from eDNA surveys[9], the NZFFD and historical electrofishing survey data[10] (Table 3-2).

Six native fish species, and two native invertebrate species were recorded in streams within the Project Area or ZOI (Table 3-2). Of these, two have a conservation status of At Risk – Declining, and two of At Risk – Naturally Uncommon. The remaining two species are considered to be Not Threatened. The pest fish species mosquito fish (*Gambusia affinis*) were recorded at stream sites S01, S02, and S22, and may be present within stream sites.

The NZFFD contained two records relevant to the Project Area downstream of the streams within Totara Park on the Puhinui Creek, near the confluence with the tributary that flows from the Puhinui Gully, is a record from 2010 (Table 3-2). This included observations for the At Risk Kākahi/ freshwater mussel. While the upstream intermittent reaches impacted by the Project are not suitable for their habitation, they are sensitive to fine sediments and contaminants within the water, with juveniles particularly at risk. At the same location longfin eel were also recorded. A record from 2020, located on S13 within the Puhinui Gully, just upstream of Mill Road, recorded At Risk banded kōkopu, redfin bully, and longfin eel, amongst others (Table 3-2).

[9] Sampling of eDNA was undertaken during summer, when many intermittent streams had little flow.
[10] Electrofishing data was only collected at site S13 in 2020. Mill Road NZUP Summary Report (New Zealand Transport Agency Waka Kotahi (NZTA), 2021).

Table 3-2 Native freshwater fish species present within the Project stream sites

Species	Scientific Name	Conservation Status (Dunn et al. 2018)	Ecological value	Stream Reaches
Common bully	*Gobiomorphus cotidianus*	Not Threatened	Low	▪S13 ▪^S13, just upstream of Mill Rd
Cran's bully	*Gobiomorphus basalis*	At Risk – Naturally Uncommon	Low	^Downstream in Puhinui Creek.
Kōkopu/banded kōkopu	*Galaxias fasciatus*	At Risk – Naturally Uncommon	Low	*S12, *S12C(B), *S14 ▪^S13, just upstream of Mill Rd
Redfin bully	*Gobiomorphus huttoni*	At Risk – Naturally Uncommon	Low	^Downstream in Puhinui Creek. ▪^S13, just upstream of Mill Rd
Tuna hinahina/shortfin eel	*Anguilla australis*	Not Threatened	Low	*S03, *S04, *S05, *S11, *S12, *S12C, *S12C(b), *S19, *S20, *S22 ▪^S13, just upstream of Mill Rd
Tuna kuwharuwharu /longfin eel	*Anguilla dieffenbachii*	At Risk - Declining	High	*S12, *S12C(b) ^Downstream in Puhinui Creek. ▪^S13, just upstream of Mill Rd
Kākahi	*Echyridella menziesii*	At Risk - Declining [11]	High	^Downstream in Puhinui Creek.
Kōura/freshwater crayfish	*Paranephrops planifrons*	Not Threatened[9]	Low	*S05, *S12 ^Downstream in Puhinui Creek. ▪^S13, just upstream of Mill Rd

Notes: * = confirmed by eDNA. ▪ = confirmed by electrofishing in 2020 (also in NZFFD). ^ = NZFFD record.

Stream Ecological Valuation

As per the AUP(OP) stream classification [12], two streams were classified as permanent, and 18 [13] streams were classified as intermittent. SEVs were undertaken at nineteen stream sites and results are summarised in Table 3-3. These SEV scores were calculated with the inclusion of the FFI and IFI parameters [14] . Detailed results are included in Appendix B.

SEV scores ranged from 0.333 (S19 and S21) to 0.740 (S14), with corresponding ecological function categories ranging from Poor to Good. Generally, higher scores were recorded in the Puhinui catchment, suggesting areas of relatively intact stream function and habitat quality. In contrast, streams within the Papakura catchment typically exhibited lower SEV scores (with the exception of S14), ranging from 0.323 to 0.505, which fall within the Poor to Fair ecological condition categories. This indicates that stream habitat quality and ecological function at these sites is degraded, likely due to dominant pastoral land use and associated pressures on water quality and stream morphology.

Table 3-3 Stream Ecological Valuation results for the Project stream sites

Stream ID	Catchment	Classification	Hard /Soft Bottom	Riparian vegetation	SEVc	SEV Score Interpretation
S01	Puhinui	Permanent	Hard	Native taraire, tawa, podocarp forest	0.483	Fair
S02		Intermittent	Soft	Exotic scrub, Exotic dominated treeland	0.446	Fair

[11] (Grainger et al., 2018)

[13] SEVc score taken from neighbouring stream (S16) due to no water flow at DS05.
[14] FFI and IFI refer to parameters of the SEV score calculated from biotic data of fish and macroinvertebrate.

Stream ID	Catchment	Classification	Hard /Soft Bottom	Riparian vegetation	SEVc	SEV Score Interpretation
S03		Intermittent	Soft	Planted native vegetation >20 years	0.667	Good
S04		Intermittent	Soft	Exotic Grass	0.539	Fair
S05		Intermittent	Soft	Exotic dominated treeland	0.568	Fair
S11		Intermittent	Soft	Native broadleaved species scrub/forest	0.528	Fair
DS04		Intermittent	Soft	Exotic dominated treeland	0.678	Good
S12		Permanent	Soft	Native broadleaved species scrub/forest	0.681	Good
S13		Permanent	Soft	Native broadleaved species scrub/forest, Exotic scrub	0.596	Fair
DS03		Intermittent	Soft	Native broadleaved species scrub/forest	0.635	Good
S14	Papakura	Intermittent	Soft	Native taraire, tawa, podocarp forest	0.740	Good
S14A		Intermittent	Soft	Native taraire, tawa, podocarp forest	0.505	Fair
DS05*[1]		Intermittent	N/A	Exotic Grass	0.349	Poor
S17*[2]		Intermittent	Soft	Exotic Grass	0.334	Poor
S18		Intermittent	Soft	Exotic Grass	0.334	Poor
S19		Intermittent	Soft	Exotic Grass	0.333	Poor
S20		Intermittent	Soft	Exotic Grass	0.411	Fair
S21*[3]		Intermittent	Soft	Exotic Grass	0.333	Poor
S22		Intermittent	Soft	Exotic Grass	0.439	Fair

Notes: *[1] SEVc score taken from neighbouring stream (S16) due to no water flow at DS05. *[2] SEVc score adopted from S18. *[3] SEVc score adopted from S18.

3.3.3 Ecological Value

For the values assessment, streams were grouped according to shared attributes, including stream habitat, permanence classification, catchment, and existing ecological significance (i.e. SEA status). The ecological value of each group was determined using survey results and EIANZ criteria, including representativeness, rarity/distinctiveness, diversity and pattern, and ecological context. An interpretation of these criteria for freshwater habitats is provided in **Appendix B** and was used to guide the assessment alongside other parameters. Each group was assigned an ecological value (Table 3-4). Stream ecological values ranged from Moderate to High, reflecting differences in habitat quality, hydrological permanence, connectivity, and ecological context across the catchments.

Table 3-4 Ecological value assessment for the Project stream sites

Stream type	Ecological value attribute	Score	Justification
Intermittent streams within	Representative-ness	Low	Instream habitat has been significantly altered by human activities and riparian features have been affected by human activities. Overall SEV scores are > 0.400 and fish and macroinvertebrate

Stream type	Ecological value attribute	Score	Justification
Tōtara Park (Puhinui catchment) S02, S03, S04, S05			communities show only partial similarity to the expected assemblages for these stream types.
	Rarity/ distinctiveness	Low	No Threatened or At Risk species identified. Given location in headwater, intermittent streams lower likelihood of threatened or At Risk species utilising habitat.
	Diversity and pattern	Moderate	Natural diversity is reflected in a moderate range of vegetation and geomorphological features. Species diversity is considered moderate.
	Ecological context	Moderate	Streams are Order 1, intermittent and are located within a local reserve Tōtara Park, (except for S02). Sites form part of a restored network in the upper catchment. Lower reaches of streams provides a locally important breeding and feeding are for native freshwater fauna.
	Overall Score	***Moderate***	
Intermittent streams within Puhinui Gully SEA_T_4570 (Puhinui catchment) S11, DS03, DS04 S13a	Representative-ness	Moderate	Instream habitat and riparian features have been affected by human activities. However, headwater streams located within an SEA is a moderately rare habitat within the subcatchment. Overall SEV scores are > 0.500 and fish and macroinvertebrate communities show only partial similarity to the expected assemblages for these stream types.
	Rarity/ distinctiveness	Low	No Threatened or At-Risk species identified.
	Diversity and pattern	Moderate	Natural diversity is reflected in a moderate range of vegetation and geomorphological features, alongside very high patchiness and interspersion. Species diversity is considered moderate.
	Ecological context	Moderate	Streams are Order 1 and intermittent and are located within SEA_T_4570. Lower, permanent, reaches of streams provide a locally important breeding and feeding area for native freshwater fauna.
	Overall Score	***Moderate***	
Intermittent stream within Cheeseman s Bush (SEA_T_9102) (Papakura catchment) S14	Representative ness	Moderate	Instream habitat and riparian vegetation largely intact however, surrounding catchment modified. SEV score scores highest for all streams surveyed (0.740) but fish and macroinvertebrate communities show only partial similarity to the expected assemblages for these stream types.
	Rarity/ distinctiveness	High	Banded kokopu (At Risk) within stream.
	Diversity and pattern	Moderate	The Stream show a fair level of habitat variety and species representation, with species diversity being notable at a regional scale, however they are limited by the simple structure of the biological community.

Stream type	Ecological value attribute	Score	Justification
	Ecological context	High	Stream is permanent, Order 2. Habitat is an important habitat for native freshwater fish. Stream located within SEA_T_9102 (Cheesman's Bush).
	Overall Score	***High***	
Intermittent /permanent streams within the Papakura catchment S14A, DS05, S17, S18, S19, S20, S21, S22	Representativeness	Low	Instream habitat and riparian features have been significantly altered by human activities, with the majority of streams located within a pastoral landscape. The average SEV scores across all stream sites is approximately 0.380, and fish and macroinvertebrate communities show only partial similarity to the expected assemblages for these stream types with high proportion of tolerant fauna.
	Rarity/ distinctiveness	Low	Stream type is common within the catchment, with no distinctive features identified.
	Diversity and pattern	Low	Low natural diversity with few vegetation types or geomorphic features. Species diversity is considered low, with a lack of complexity.
	Ecological context	Moderate	Streams are Order 1 and 2, intermittent/permanent and are not located within a protected area. Habitats provides a locally important link in terms of connectivity for native freshwater fish.
	Overall Score	***Low***	
Permanent streams within SEAs (Puhinui catchment) S01, S12, S13	Representativeness	Moderate	Instream habitat largely intact however riparian features and water quality have been affected by human activities. SEV scores range from 0.483 for S01 and 0.681 for S12, and fish and macroinvertebrate communities show only partial similarity to the expected assemblages for these stream types.
	Rarity/ distinctiveness	High	Stream type is relatively uncommon within the subcatcment. At Risk longfin eel and banded kōkopu present in S12 and S13.
	Diversity and pattern	Moderate	Streams show a fair level of habitat variety and species representation, with species diversity being notable at a regional scale, however they are limited by the simple structure of the biological community.
	Ecological context	High	Streams are permanent, Order 2 streams. Habitat is an important link in terms of connectivity for native freshwater fish. Streams are located within SEAs with high riparian value.
	Overall Score	***High***	

3.4 Wetland Ecology

3.4.1 Ecological Context

The Project Area spans the Puhinui and Papakura Catchments, both of which are heavily modified and predominantly used for residential housing and pastoral grazing in the upper catchment. Many of the wetlands identified are associated within stream habitats, with several representing riparian wetlands. Many of these wetlands have formed in low-lying valley bottom systems and historically would have contained a mosaic of bog-fen type wetlands.

Previous assessments (Kessels & Associates Ltd, 2008) (Boffa Miskell Ltd, 2014) identified the general presence of wetlands; however, no wetland delineations were undertaken. Further assessments (New Zealand Transport Agency Waka Kotahi (NZTA), 2021) identified and delineated a number of wetlands which are within the current Project Area.

3.4.2 Description of Wetland Features

All potential wetlands within 100 m of the Project Area were mapped during the 2024/2025 surveys. Following the 2026 site visit, several wetland boundaries were refined. One wetland was removed and two additional wetlands were identified. All wetlands were identified using the wetland protocols as described in **Appendix C**.

Wetlands were primarily associated with riparian margins and waterways, with many in degraded condition due to extensive landscape modification. Wetlands across agricultural land and some regenerating bush areas were typically low value, low diversity systems dominated by exotic species such as creeping buttercup, soft rush, and Mercer grass. Low value wetlands and degraded wetlands associated with watercourses still provide some low level of ecosystem services through flow attenuation. There was no stock access to wetlands in Tōtara Park or the bush blocks, however, some wetlands within the southern extent of the Project Area had stock access. Only four high value wetlands were identified, three of which were identified within the Puhinui Stream SEA.

A total of 43 wetland features were surveyed and mapped (**Appendix D**) within the Project Area and the ZOI.

Wetland Delineations

Fifteen wetlands within the Puhinui catchment, and 28 wetlands within the Papakura catchment within the ZOI were delineated. Wetland delineations included a combination of rapid assessments, vegetation plots, and soil profile description plots. Wetlands that had similar hydrological and geomorphological characteristics to adjacent/connected wetlands were assessed jointly, i.e. wetlands 20a-20f were combined and treated as a single feature (hence subsequent descriptions refer to a total of 35 wetland features). Detailed delineation results and site photos are included in **Appendix F**.

All wetland sites were considered to meet the definition of a 'natural inland wetland' under the NPS-FM.

Wetland Condition Index

Identified wetlands were separated into units based on their geomorphology and hydrology (hydrogeomorphic units or HGMs). Wetlands were assessed using the Wetland Condition Index (WCI) methodology (Clarkson et al., 2004). Of the wetlands assessed, the majority were classified as 'Largely Modified' (n = 23), with the remainder classified as 'Seriously Modified' (n = 12)[15]. This indicates that the majority of wetlands surveyed are in a reduced ecological condition, with varying degrees of modification from their natural state.

3.4.3 Ecological Value

Wetlands surveyed were grouped into categories based on their Singers et al. (2017) classification and are presented in Table 3-5. To wetland types were present, from which ecological value was determined based on criteria including representativeness, rarity/distinctness, diversity and pattern, and ecological context. Ecological values for the wetland sites were **Low or Moderate** for exotic-dominated wetlands (EW) and **High** for *Machaerina* sedgeland (WL11).

Table 3-5 Ecological value assessment for Mill Road Stage 1 wetland sites

Wetland type	Ecological Value attribute	score	Justification
Exotic Wetland	Representative ness	Low	Wetlands are significantly hydrologically altered, with many having extensive stock damage. Typical of the wider catchment. WCI

[15] Eight wetlands were not assessed using the WCI

Wetland type	Ecological Value attribute	score	Justification
(EW) – MW01, 02, 04, 05, 06, 10, 10a, 11, 12, 13, 14, 15, 16, 17, 18, 19a, 19b, 20a, 20b, 20c, 20d, 20e, 20f, 21a, 21b, 22, 23, 24, 25, 26a, 26b, 26c, 27, 28, 29, 31, 32, 33, 34, PW01			results indicate that the wetlands range from Largely Modified to Seriously Modified.
	Rarity/ distinctiveness	Low	Wetlands primarily comprise exotic vegetation species. Wetland type is common across the catchment (and region), with limited distinctive ecological values. However, the features have some surface water detention capacity.
	Diversity and pattern	Negligible	Habitat diversity is low, with only moderate variation in vegetation and geomorphological structure. Species diversity is not significant at a local or regional scale.
	Ecological context	Moderate	Exotic wetlands provide limited ecosystem services such as flood attenuation, sediment trapping, nutrient assimilation, carbon storage, and erosion control.
	Overall Score	***Low***	
Exotic Wetland (EW) – MW14 and MW_03a 13a	Representativeness	Moderate	Wetland is somewhat hydrologically altered but fed from headwater spring. WCI results indicate that the wetland is Seriously Modified.
	Rarity/ distinctiveness	Low	Wetland primarily comprises exotic vegetation species. Wetland type is common across the region, with limited distinctive ecological values.
	Diversity and pattern	Low	Habitat diversity is low, with only moderate variation in vegetation and geomorphological structure. Species diversity is not significant at a local or regional scale. Native species, Eleocharis acuta is abundant in MW_14.
	Ecological context	Moderate	The wetland provides some ecosystem services such as flood attenuation, sediment trapping, nutrient assimilation, carbon storage, and erosion control. Wetlands are also considered protected under the NES-F.
	Overall Score	***Moderate***	
Machaerina Sedgeland (WL11) – MW03, 07, 08, 09	Representativeness	Low	Although some natural features remain, hydrology, riparian condition and geomorphological processes are highly altered. WCI results indicate that the wetlands are Largely Modified.
	Rarity/ distinctiveness	High	Wetland is considered a rare/distinctive wetland type as *Machaerina* sedgeland has a regional IUCN threat status of Critically Endangered (Singers et al., 2017). The wetland type also supports At Risk and locally uncommon fauna.
	Diversity and pattern	Moderate	Wetland contains a moderate range of habitat types with high patchiness/interspersion. Species diversity is notable at a regional scale.
	Ecological context	High	Provides a range of regulating ecosystem services, including streamflow regulation, erosion control, nutrient assimilation, and carbon storage. Has a regional IUCN threat status of Critically Endangered and are considered protected under the NES
	Overall Score	***High***	

4 ASSESSMENT OF EFFECTS

4.1 Overview of Potential Ecological Effects

The potential construction and operation effects of the Project on stream and wetland features include:

Construction

- Modification of watercourses, including:
  - Diverting flows into new stream alignment (diversions), including for temporary purposes.
  - Loss or replacement of aquatic habitat, with culverts or armouring, including for temporary purposes.
- Temporary habitat modification or disturbance from machinery, including changes to fish passage.
- Potential injury or mortality of native freshwater fish during construction activities.
- Short-term water quality effects (sediment mobilisation, contaminants).
- Alteration of water flows within tributaries and potential for erosion.

The effects of the loss of vegetation within the riparian margin are discussed within the Terrestrial Ecological Impact Assessment Report.

Operation

- Stormwater discharge effects, including increased in elevated levels of PAH and heavy metals.
- Changes in hydrology and flow regime.
- Shading effects from bridges.
- Changes to fish passage through new culverts, riprap, and diversions.

4.2 Design refinement and effects avoidance

The Project design has been refined to reduce the magnitude of effect on ecological values (prior to mitigation) to the extent practicable. Key design changes in relation to stream and wetland impacts are detailed below.

4.2.1 Design Refinements - Streams

- S02 (Tōtara Park) – Avoided entirely via realignment of road and reduction of earthworks footprint.
- DS04 (Puhinui Gully) – Reduction in culvert length and realignment of stormwater outfall reduced the impact.
- S11 (Puhinui Gully) – Realignment of stormwater outfall to avoid any impact.
- DS03 (Puhinui Gully) – Avoided entirely via realignment of stormwater outfall.
- S14 (Cheeseman's Bush) – Stream avoided through bridge design.
- DS05 (Papakura Catchment) – Reduction of earthworks footprint to avoid reclamation of the stream.
- S18 (Papakura Catchment) – Reduction of earthworks footprint to avoid reclamation of the stream.
- S20 (Papakura Catchment) – Reduction of earthworks footprint to reduce reclamation of the stream.

Although the design has been amended to avoid stream bed loss where practicable, direct and indirect effects, remain. These are further detailed in Section 4.4 below.

4.2.2 Design Refinements - Wetlands

- MW07 (Puhinui Gully) – Avoidance through reduction of the length of the culvert in this location and realignment of stormwater outfall to avoid the wetland.

- MW14 (Papakura Catchment)– Reduction of the earthworks footprint, reducing the extent of wetland reclamation.
- MW19a – Reduction of the earthworks footprint, reducing the extent of wetland reclamation.
- MW21a– Reduction of the earthworks footprint, reducing the extent of wetland reclamation.

Although the design has been amended to avoid of the loss of wetland habitat, direct and indirect effects remain.

4.3 Ecological Effects

4.3.1 Streams

The Project will impact a total of 681 linear meters of stream habitat, with an area of 2,361 m^2. Direct effects on streams include:

- Permanent modification to stream habitat from installation of culverts;
- Stream diversions;
- Permanent loss of stream habitat and habitat through reclamation of habitat; and
- Changes to stream habitat through extended scour protection of the streambed.

Table 4-1 below details the direct impacts on stream reaches, including their ecological value and total area of impact. Direct impacts will occur on 441 m of low impact stream habitat, 99 m of moderate value stream habitat and 140 m of high value stream habitat. This loss is associated with the project alignment, final earthworks contours, and stormwater infrastructure.

Table 4-1 Stream impacts detailing linear length and stream bed area and SEVp and SEVi from stream infrastructure. The SEV score are calculated excluding the FFI and IFI parameters as per standard methods for SEV modelling.

Stream ID/Classification	Ecological Value	Effect type	SEVp	SEVi	Bankfull width (m)	Stream impact length (m)	Stream impact bed area (m^2)
S02/intermittent	Moderate	Outlet structure	0.486	0.2	1.06 m	4 m	4.24 m^2
S03/intermittent	Moderate	New culvert	0.698	0.2	0.8 m	21.2 m	16.96 m^2
S04/intermittent	Moderate	New culvert	0.702	0.2	0.93 m	25.03 m	23.28 m^2
S05/intermittent	Moderate	New culvert	0.491	0.2	0.9 m	7.57 m	6.81 m^2
DS04/intermittent	Moderate	New culvert	0.745	0.2	3.7 m	37.56 m	138.97 m^2
S12/permanent	High	Diversion (under bridge)	0.765	N/A	1.08 m	33.56 m	36.24 m^2
S13/permanent	High	Diversion (under bridge)	0.610	N/A	1.21 m	70.63 m	85.46 m^2
		Daylighting	0.2	0.598	1.21	15.94 m	19.29 m^2
S13a/intermittent	Moderate	Stream loss	0.49*	0	0.3	4 m	1.2 m^2
S14/intermittent	High	Bridge	0.790	0.767	1.71 m	20.39 m	34.87 m^2
DS05/ intermittent	Low	Loss/diversion of water source	0.677	0.0	0.30	78.66 m	23.60 m^2
		Culvert	0.677	0.250	0.3	10 m	30.00 m^2

Stream ID/Classification	Ecological Value	Effect type	SEVp	SEVi	Bankfull width (m)	Stream impact length (m)	Stream impact bed area (m^2)
S17/intermittent	Low	Riprap associated with culvert upgrade	0.577	0.336	5.3 m	24.08 m	127.62 m^2
S18/intermittent	Low	Riprap associated with culvert upgrade	0.577	0.336	6.1 m	25.58 m	156.04 m^2
S19/intermittent	Low	Riprap (overlap from S20)	0.629	0.336	6 m	16.11 m	96.66 m^2
S21/intermittent	Low	New culvert	0.629	0.3	8.0 m	46 m	368.00 m^2
		Riprap	0.629	0.336	6.0	23.94 m	143.64 m^2
S20/intermittent	Low	New culvert	0.556	0.3	4.9 m	46.43 m	227.51 m^2
		Riprap	0.556	0.336	4.9 m	37.63 m	184.39 m^2
		Diversion	0.556	0.0	4.9 m	123.83 m	606.77 m^2
S22/intermittent	Low	riprap	0.563	0.336	3.3 m	8.91 m	29.40 m^2
Cumulative Total						**681.05 m**	**2,360.95** m^2

Note: *An SEV was not undertaken on this stream. A score of 0.49 has been applied, based on similar streams S02 and S05.

4.3.2 Wetlands

Several wetlands occur within the Project Area and will be directly affected by the Project, with some wetlands impacted in their entirety and others only partially affected. The Project will directly impact 0.58 ha of natural inland wetland habitat.

Where direct impacts occur, loss of wetland habitat has been assumed. Where a partial loss of wetland habitat is predicted, but it is of such a quantum or located as such that the continued function of the wetland cannot be assured, then loss of entire feature has been assumed. The calculation of the partial loss of wetland extents includes the loss of a buffer[16] area between the remaining wetland and the project footprint. The impacts on wetlands are detailed in Table 4-2. The majority of natural inland wetlands impacted are considered *exotic wetlands* and have generally low ecological value.

Indirect impacts on wetlands primarily associated with permanent stormwater outfalls discharging into wetlands are detailed in Table 4-3. Other effects are anticipated in addition to permanent loss of wetland extent and values include:

- Fragmentation of existing wetlands.
- Loss and/or reduction of ecosystem services provided by wetlands permanently lost or modified.
- Alterations to surface hydrology, hydroperiods, and flow regimes within wetlands which may result in changes to wetland function and vegetation community composition.

Table 4-2 Natural Inland Wetland Direct Impacts across the Project Area.

Wetland ID	Habitat Type	Ecological value	Effect type	Wetland Habitat Loss (ha)
MW_03	WL11 - exotic	High	Total habitat loss	0.073

[16] A buffer averaging 1 m wide was included around the remaining wetland to account for earthworks.

Wetland ID	Habitat Type	Ecological value	Effect type	Wetland Habitat Loss (ha)
MW_04	EW	Low	Partial habitat loss	0.0091
MW_06	EW	Low	Partial habitat loss	0.0655
MW_31*	EW	Low	Total habitat loss	0.0061
MW_32*	EW	Low	Total habitat loss	0.0212
MW_10	EW	Low	Partial habitat loss	0.0483
MW_10a	EW	Low	Total habitat loss	0.0131
MW_14	EW	Moderate	Partial habitat loss	0.1087
MW_19a	EW	Low	Partial habitat loss	0.0078
MW_19b	EW	Low	Partial habitat loss Rip-rap (US & DS)	0.0016
MW_20e	EW	Low	Partial Habitat loss	0.0012
MW_21a	EW	Low	Partial Habitat loss	0.0930
MW_21b	EW	Low	Partial habitat loss	0.0610
MW_25	EW	Low	Partial habitat loss	0.0662
Cumulative Total				**0.58 ha**

Note: *These wetlands are located under the bridge at Puhinui Gully, they will be directly impacted by civil works.

Table 4-3 Natural Inland Wetland Indirect Impacts across the Project Area.

Wetland ID	Habitat Type	Effect type
MW_01	EW	U/S Stormwater outfall
MW_02	EW	U/S Stormwater outfall
MW_04	EW	U/S Stormwater outfall
MW_05	EW	U/S Stormwater outfall
MW_07	WL11	U/S Stormwater outfall
MW_08	WL11	U/S Stormwater outfall (buffered by MW_07)
MW_20a	EW	Stormwater outfall
MW_21a	EW	Stormwater outfall (x2)

4.4 Avoidance, minimisation and remediation measures

4.4.1 Watercourse modification – Installation of Culverts

The Project will result in the installation or upgrade of 9 culverts[17], affecting 218 m of linear stream habitat. Full details of culverts are provided in **Appendix G.** Brief descriptions are provided below:

- S03/S04/S05/DS04: Culverts will be installed in the headwaters of the stream. The streams are of moderate ecological value, with no upstream habitat available. Fish passage will not be provided.
- DS05: A culvert will be replaced under the existing Mill Road to connect to S17. The stream is of low ecological value. Fish passage in the form of spoiler baffles or spat ropes will be provided.
- S16: New culverts will be installed, taking water from the S16/MW14 wetland complex, into the realigned DS05. Fish passage in the form of spoiler baffles or spat ropes will be provided.
- S17/S18/S19: New or upgraded culverts will be installed. These streams are of low ecological value. Fish passage in the form of spoiler baffles or spat ropes will be provided.
- S20/S21/S22: New or upgraded culverts will be installed. These streams are of low ecological value. Fish passage in the form of culvert with embedded streambed will be provided.

Installing culverts within stream habitat has the potential to have various adverse effects. Poorly designed or constructed culverts can create fish passage barriers from the introduction of vertical drops, the creation of long, uniform, high-velocity channels that lack resting habitat, or the formation of short but impassable high-velocity sections. Culvert installations can also result in physical barriers such as perched outlets, abrupt grade transitions, and right-angle channel alignments, all of which can impede or prevent fish movement.

For culverts where fish passage is provided, fish passage will be built according to the NES-F regulations (which require the same passage of fish upstream and downstream as would exist without the culvert), and the New Zealand Fish Passage Guidelines Version 2.0 (Franklin et al., 2024). They will generally provide for:

- Average water velocities that facilities the passage of the target species of fish for the length of the culvert;
- The fish passable velocity must be achieved in a portion of the flow cross-section that is a minimum of 150mm deep;
- Culverts (box) will be embedded into the stream bed by at least 2x the mean size of the coarse embedment material or 300 mm, whichever is greater. Or (round) between 1/3 and ½ of the culvert diameter;
- All aprons associated with culverts should not create excessive velocities, drops or shallow sheet flow and must consider fish passage; and
- Any riprap associated with the culvert must consider fish passage and should be designed to maintain a defined low-flow channel.

Appendix G contains indicative drawings of the proposed fish passage through culverts.

Table 4-1 outlines the SEV scores for the impact stream reaches. It is noted that the standard SEV scores for culverts are generally estimated between 0.2 and 0.3 depending on specific design etc. For the ECR modelling in following sections of this assessment, the SEV score for a standard culvert with no fish passage provided was set at 0.2, a culvert with baffles or spat rope was set at 0.25, and an embedded culvert with riprap throughout for fish passage was set at 0.3.

Culverts will be installed/replaced in streams of low and moderate ecological value. This assessment assumes that the culverts shown in **Appendix G** will be installed as part of the Project. These culverts have therefore been assessed as having a **low to moderate magnitude of effect**.

[17] This refers to culverts associated within intermittent or permanent watercourses only. It does not include culverts associated with stormwater conveyance only.

4.4.2 Watercourse modification – Diversions

The Project will result in the unavoidable modification and diversion of watercourses across the alignment. **Appendix D** shows the location of the proposed diversions in relation to the Project Area. In summary, the following diversions are required:

- Streams S12 and S13, both of high ecological value, require realignment around proposed bridge piles within the Puhinui Gully SEA. The realignment and associated daylighting will create an additional 20.91 linear meters of stream habitat.
    - Stream S12 will undergo a very small realignment, moving some 34.5 m of linear stream.
    - Stream S13 will see realignment of 91.54 m linear meters. This includes the daylighting of some 15 m of stream habitat through the removal of existing culverts.
- Stream DS05 (174 Mill Road) Papakura Catchment will be diverted through a new diversion channel. At DS05, 78.66 linear meters of stream habitat will be diverted through 171.1 linear meters of diversion channel.
- Stream S20 (2 Wastney Road) will undergo a series of modifications including the realignment of 123.83 linear meters of stream into 96 m of new channel. The result is a reduction in length of 27.52 m.

The diversions, or realigned channels, are to be ecologically functioning stream channels that reflect similar characteristics to the original channel. Detailed design of the diversions will be necessary to ensure they meet ecological objectives as outlined in the Freshwater Management Plan (FMP). The ecological objectives for stream diversion include:

- Diversions must be ecologically functioning diversions that replicate, as much as practicable, the existing stream habitat and function of the stream. The diversions must be fit for purpose and are maintained or improved from the stream to be lost.
- The new diversion channels must provide appropriate aquatic habitat for fish, macroinvertebrates and aquatic plants while conveying water.
- The diversion channel should mimic and improve upon, as much as practicable, the natural meanders of the section of stream being diverted. Where appropriate, the addition of boulders, submerged logs and other habitat features to aid in meander creation.
- Habitat diversity and channel complexity must at a minimum replicate the channel being diverted. Where practicable, it should be improved upon through the creation of natural features such as runs, riffles and small and large pools. These features can be created utilising natural substrates such as rocks, logs and large boulders. The extent of habitat created should at a minimum replicate existing habitat.
- The stream design should ensure that there is a baseflow, or a low-flow, channel, a bank full channel and a suitable floodplain area. The creation of a baseflow channel aims to maintain flowing water as much as practicable during dry conditions.
- Stream depth and wetted width affect the total area that that can be utilized by aquatic biota, and the volume of water conveyed during normal flows. Stream widths, depths and flows should mimic, as much as practicable, that of the stream to be diverted.
- Riparian vegetation is integral to the ecological success of the stream diversions. The final stream design must allow for the planting of riparian vegetation close to and extending over the water surface to create sufficient stream edge habitat
- Diversions to meet the thresholds of ecological monitoring outlined in the FMP.
- Replicate the SEV score of the pre-diversion channel. With the SEV score at 5-years post diversion livening and riparian restoration completions being no less than 80% of the pre-diversion SEV score. The scores are detailed in the FMP.

Construction must ensure the above Design Principles are met so the ecological objectives are realised. The Design Principles are detailed in the FMP, and include fish passage provisions, detailed habitat specifications that create habitat heterogeneity for native fauna, and flow objectives. Stream diversion shall also undergo riparian planting following completion of the stream channels.

The creation of diversion channels is a realignment of the existing stream channel and does not constitute a reclamation. In the application of the effects management hierarchy, the stream diversion represents a remedy. The final designs of the diversion channels will require input from a freshwater ecologist and engineer.

Provided stream Design Principles are followed, it is anticipated that stream diversions will have a **moderate magnitude of effect**.

4.4.3 Watercourse modification – Riprap

Riprap, or erosion protection measures, are required at proposed outfalls and culvert outlets. Locations of riprap are detailed in Table 2-1 and Table 4-1. Assessed impacts do not incorporate small areas of riprap placed within the stream channel that is less than 5 m in length. This level of erosion protection is generally considered to have a very low level of ecological impact and is not considered further.

Riprap will be installed along approximately 136.25 liner metres of stream habitat within the low ecological value streams S17, S18, S19, S20, and S21. The riprap design incorporates a meandering low-flow channel to maintain hydraulic connectivity and provide ongoing fish passage through the affected reaches. This design feature is intended to minimise effects on aquatic fauna movement while providing the required erosion protection and channel stability.

Riprap within these low value streams are considered to have a **moderate magnitude of effect.**

4.4.4 Watercourse modification – Stream Loss

Some unavoidable stream habitat loss will occur as a result of the Project. Stream S13a (38 Mill Road) will lose approximately 4 m of linear length from its upper reaches. Additionally, although most of Stream S20 (2 Wastney Road) will be diverted and retained, the Project will result in a net loss of 27.52 m of stream length.

The loss of these low and moderate ecological value stream habitats will have a **high magnitude of effect.**

4.4.5 Temporary modification to fish passage

During construction phases of the Project, streamworks may require the temporary blocking, or diverting, of the watercourse leading to a restriction to native fish passage. This has the potential to disrupt native fish migration and spawning, particularly for works within the lower reaches of streams. The timing of works will, as far as practicable, avoid the peak spawning period of March to June[18], and temporary diversions will allow fish passage where possible. Temporary disruption to fish passage that exceeds three months will require a Complex Fish Approval.

The FMP details the principles for temporary stream diversions. The Native Fish Capture and Relocation Plan details protocols for fish salvage, where required, to minimise harm to native aquatic fauna through freshwater fish salvage and relocation.

4.4.6 Instream works causing injury/mortality to native fish

During construction streamworks, such as the installation of culverts or diversion works, there is the potential to cause injury and/or mortality to native fish species. Construction methods and streamworks design have yet to be undertaken. Fish salvage shall be undertaken prior to all streamworks, as detailed in the Native Fish Capture and Relocation Protocols.

4.4.7 Erosion and sedimentation from earthworks to streams

During construction, Project earthworks have the potential to release sediment laden water into streams, temporarily reducing the water and habitat quality of receiving environments. Sediment discharge can lead to increases in water temperatures, reduced light penetration, reduced dissolved oxygen, smothering of interstitial spaces of aquatic habitat and the infilling of wetland habitat.

Sediment discharges are generally short-term and commonly triggered by rainfall events, but without effective erosion and sediment control measures, they have the potential to continue for the duration of

[18] Peak spawning for inanga and banded kokopu species.

construction activities. Many of the receiving environments of the Project have soft-bottomed streams that contain aquatic fauna that are tolerant to sediment fluxes. However, large or ongoing inputs can be detrimental to stream health. Particular concern arises when sediment is released to receiving aquatic environments during low-flow conditions. Although the volume of sediment discharged may be relatively small, these inputs can become chronic, resulting in a sustained increase in background instream turbidity. Under such conditions, fine sediment deposition may accumulate over extended periods, while suspended sediment concentrations remain elevated during base flows. These conditions can adversely affect instream fauna, having the potential to lead to mortality.

An Erosion and Sediment Control Plan (ESCP) for the Project has been prepared and complies with Auckland Council GD05: Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05). In our experience with comparable projects, effective implementation of a comprehensive ESCP is anticipated to result in a **low magnitude of effect** on stream receiving environments.

4.4.8 Operational Stormwater Discharge

Stormwater runoff from roads, if untreated, can degrade stream and wetland water quality through the discharge of contaminants such as hydrocarbons, heavy metals, and suspended sediments, and may also contribute to elevated water temperatures. The operational design of stormwater for the site includes a combination of treatment wetlands and swales that will treat water before it is discharged. The operational stormwater design in detailed in the Stormwater Assessment. The magnitude of effect from operational stormwater discharge is assessed as **low**.

4.4.9 Shading under Bridges

Two bridges are proposed to be constructed, both crossing over SEAs. The bridge within the Puhinui Gully will cross over high value streams S12 and S13, which will also require realignment to enable to placement of the bridge piers. The bridge within Cheeseman's Bush will cross over high value stream S14. The presence of the bridges will lead to increased shading of the stream and shading of the surrounding riparian vegetation. The bridges will be located over vegetation, which currently provides a high degree of shading to the existing streams.

The presence of bridges can impact canopy structure, light penetration, reduce rainfall, wind exposure, microclimate, long-term vegetation composition and fauna habitat. While there is no direct impact to the stream channel, indirect impacts in terms of changes to riparian vegetation and potential changes to riparian filtering are likely to occur with the riparian margin expected to transition to a lower stature community over time. The magnitude of effect from shading of the bridges is anticipated to be **low.**

The wetlands MW31 and MW32 are also located under the Puhinui Gully Bridge, however, they will be lost as part of the bridge construction and stream realignment.

4.4.10 Loss of Wetland Habitat

The loss of natural inland wetlands within the Project Area is unavoidable. The Project will result in the loss of 0.58 ha of natural inland wetland, of which 0.40 (68.8%) is low value exotic wetland, 0.109 (18.7%) is moderate value exotic wetland, and 0.073 ha is high value WL11-exotic wetland. A small number of wetlands will only be partially lost, with a reduction in their overall size and ecological function.

4.4.11 Change to Stream and Wetland Hydrology

An Assessment of Groundwater Effects[19] of the Project concluded that the effects of any groundwater abstraction from the Project are anticipated to have no detectable environmental impacts. Some groundwater drawdown and diversion of seasonal groundwater will occur to a tributary to the east of Cheeseman's Bush. Modelling indicated that the groundwater discharge to the tributary could be reduced by 25% relative to the baseline, however this represents <5% of total groundwater contribution to stream baseflow. The stream is predominantly rain-fed during winter from overland flow discharges, and the change is likely to be undetectable against natural fluctuations. In summer, the groundwater level is likely to be below the abstraction point so no groundwater diversion would occur.

[19] July 2026. Assessment of Groundwater Effects. NZTA Mill Road Stage 1.

The report states that identified wetlands adjacent to the road alignment, both along the ridgeline and in adjacent area, are situated within overland flow paths, suggesting they are unlikely to be sustained by groundwater sources.

4.4.12 Discharge to wetlands

Earthworks, and works within and adjacent to the wetlands, can result in uncontrolled discharges of sediment and contaminant laden water during construction and operation. Sediment laden discharges can have negative effects on wetland values. Increased sediment deposition within wetlands can result in changes to vegetation structure by increasing substrate height, modifying nutrient loads, and smothering herbaceous wetland species. If increased sediment loads are prolonged, this can result in changes to the species composition of wetland areas, and result in eventual transition to non-wetland communities.

As noted above, an ESCP has been prepared for the Project and has been lodged as part of the SAR. The ESCP complies with GD05. In our experience with comparable projects, effective implementation of a comprehensive ESCP is anticipated to result in a **low** magnitude of effect on wetland receiving environments.

4.4.13 Fragmentation and edge effects

Fragmentation of wetland habitats increases the area to edge ratio of the wetland, making wetlands more susceptible to invasion from pest species, and degradation from nutrient runoff and poor water quality. The high value wetland (MW_03, located in Tōtara Park) will be impacted by the Project and will be lost in its entirety. Therefore, no fragmentation or edge effects will occur. Whilst some of the low and moderate value wetlands will also be lost in their entirety, the majority will only be partially lost and therefore the retained wetland areas will be impacted through edge effects. These wetland areas already have low diversity and are typically dominated by exotic vegetation.

To prevent further degradation from fragmentation and edge effects to wetlands, wetlands directly adjacent to the earthwork's footprint, should ideally be restored and buffered with dense plantings on the roadside escarpments to minimise disturbance from construction and operational effects of the road. This restoration and buffering[20] will ensure that the remaining extent of wetlands are not functionally lost, and their ecological values are retained or enhanced over time. Therefore, the magnitude of effect from fragmentation and edge effects is considered **low.**

4.5 Magnitude and Level of Residual Effects

4.5.1 Streams

The magnitude and overall level of effect for the proposed works are detailed in Table 4-4. A number of mitigation measures are recommended to ensure the level of effect of the Project remains low.

Table 4-4 Magnitude of effect and subsequent level of effect from the Project upon freshwater features present within the Project Area.

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude (refer Section 3.1.2)	Residual Level of Effect
Construction					
Moderate value, headwater Streams	Moderate	Permanent modification to instream habitat from installation of culverts. Culverts will be installed in the	Moderate	Streams of moderate ecological value, with no upstream habitat available. Fish passage not provided. Headwater of stream will be permanently altered	Moderate

[20] The restoration and buffer planting of wetland edges for the purpose of mitigating edge effects to wetlands is separate to any restoration planting required as part of the offset package to address the loss of wetland extent.

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude (refer Section 3.1.2)	Residual Level of Effect
(S02, S03, S04, S05, DS04)		headwaters of the stream. No existing fish passage.			
Low value stream habitats *(DS05, S16,S17, S18, S19)*	Low	Permanent modification to instream habitat from upgrade/installation of culverts. Fish passage in the form of spoiler baffles or spat ropes will be provided.	Moderate	Streams are generally highly modified. Fish passage provided through culverts.	Low
Low value stream habitats *(S20, S21, S22)*	Low	New or upgraded culverts. Fish passage in the form of culvert with embedded streambed will be provided.	Moderate	Streams are of low ecological value but are lower in catchment and important migratory pathways for native fish species. Large culverts, with embedded stream material and a low flow channel.	Low
S12, S13	High	Stream diversion to avoid bridge piles within Puhinui Gully (SEA)	High	High value streams to be diverted. Permeant change to stream alignment, with alteration to key features of each stream.	Very High
DS05, S20	Low	Stream diversion to avoid road alignment.	High	Streams are highly degraded within a rural setting. Diversion fundamentally alter stream channel.	Low
S17, S18, S19, S20, S21	Low	Installation of riprap with a low flow channel.	Moderate	Extensive use of riprap armouring on stream channels. Low flow channel to be created, but key elements of channel substrate changed.	Low
S13a, S20	Low-Moderate	Stream loss associated with reclamation under the alignment, or a shortfall from stream diversion	High	Loss of low-medium value stream habitat.	Low-Moderate
Native Fish	Low to High	Kill or injure fish due to construction work e.g. temporary diversion/bunding.	Low	Assume fish salvage will be implemented through a Freshwater Management Plan.	Very Low to Low.
Streams (project wide)	Low to High	Construction activity related effects e.g. sediment discharge, machinery use and chemical storage.	Low	Temporary effects during construction. Low likelihood of occurring. System soft bottomed and most streams show communities that are	Low

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude (refer Section 3.1.2)	Residual Level of Effect
				tolerant of disturbance. ESCP to be implemented.	
Operation					
Streams (project wide)	Moderate to High	Stormwater operation – degradation of water quality. *Assume stormwater quality treatment provided to meet Auckland Council design standards.*	Low	Efficient water treatment prior to discharge will reduce effects.	Low
Native Fish	Low to High	Fish passage impediment through culverting.	Low	Culverts designed to meet fish passage requirements. Assume constructed and functioning correctly.	Low

4.5.2 Wetlands

Table 4-5 presents the assessment of effects from the construction and operation of the Project on wetland features.

Table 4-5 Magnitude of effect and subsequent level of effect from the Project upon wetland features present within the Project Area and ZOI.

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Residual Level of Effect
Construction					
Low value wetland habitats	Low	Permanent loss of habitat due to reclamation as a result of the works footprint and stormwater infrastructure including riprap. Impacts = 0.4 ha	High	The extent of the impact is high. Although low value, majority of features are lost and contribute to cumulative loss across the subcatchment.	Low
Moderate Value Wetland Habitats (MW14)	Moderate	Permanent Loss of the wetland feature as a result of the works footprint. Impacts = 0.109 ha	High	Loss of the majority of the moderate value feature. Cumulative loss of wetland habitats across the subcatchment.	Moderate
High Value Wetland Habitats	High	Permanent loss of wetland habitat under the alignment/culverting.	Very High	Permeant loss of 0.073 ha of high value wetland habitat. Fragmentation of remaining habitat with likely reduction in ecological functionality.	Very High

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Residual Level of Effect
		Potential degradation of remaining habitat.			
Wetland Project Wide	Low to High	Stormwater discharge during construction, including the release of sediment laden water. Assume ESCP in place.	Low	Temporary effects during construction. Low likelihood of occurring. ESCP to be implemented.	Very low to Low
Native Fish	Low to High	Kill or injure fish due to construction work e.g. temporary diversion/bunding. Native Fish Capture and Relocation Plan is in place, and a fish salvage has been undertaken prior to works.	Low	Fish salvage will be implemented through a Native Fish Capture and Relocation Plan.	Very low to Low
Operation					
Wetlands (project wide)	Low to High	Stormwater operation – degradation of water quality. *Assume stormwater quality treatment provided to meet Auckland Council GDO5 standards.*	Low	The proposed stormwater treatment will reduce contaminants in water from road, before discharging into wetland.	Low
Wetlands (project wide)	Low to Moderate	Fragmentation and edge effects resulting in increased pressure from invasive plants and nutrient runoff	Low	Minor shift away from baseline conditions	Very low to Low

4.5.3 Overall effects conclusion

The Project is located within a highly modified landscape, with modified and degraded stream and wetland habitats impacted by the landscape. Ecological values of streams and wetlands are primarily low, with higher value habitats present within SEAs and within the reserve of Totara Park. The main adverse effects occur where the Project directly intersects with aquatic habitats, requiring works such as culverting and/or reclamation.

Adverse effects have been reduced through Project design, however some effects on freshwater and wetland habitats remain unavoidable and residual effects remain.

The primary residual effects are driven by the loss of freshwater stream habitat and value through the installation of culverts, the reclamation of wetlands that intersect with the alignment, and modifications as the result of stream diversions.

Residual effects will be managed through offsetting/ compensation measures. This package of residual effects management is presented in the following section.

5 MANAGEMENT OF RESIDUAL EFFECTS

5.1 Overview

The offsetting proposed is intended to address residual effects to ensure no net loss of ecological value, and replacement or compensation for any loss of extent, across freshwater habitats affected by the Project.

Table 5-1 below describes the residual effects of the Project after the application of avoidance, minimisation and remediation measures.

The offsetting proposed is intended to address residual effects to ensure no net loss of ecological value, and replacement or compensation for any loss of extent, across freshwater habitats affected by the Project.

Table 5-1 Effects requiring mitigation and the proposed management plan

Ecological Feature	Ecological Value	Effects Description	Summary of offset	Management Plan
Streams				
Low to moderate value stream	Low-Moderate	Permanent modification to instream habitat from installation of culverts and riprap. Mitigation at the point of impact cannot be achieved.	Restoration of existing stream habitat Creation of stream habitat	FMP
Low Value Stream	Low	Permanent loss of stream habitat through shortfall in remedy of stream diversion. Mitigation at the point of impact cannot be achieved.	Restoration of existing stream habitat Creation of stream habitat	FMP
Wetlands				
Low to High value wetlands	Low-high	Permanent loss of habitat due to reclamation as a result of the works footprint and storm water infrastructure including riprap.	Restoration of existing wetland habitat Creation of new wetland habitat.	FMP

5.2 Offset Mitigation

The following stream and wetland habitat residual effects remain after measures to avoid, minimise or remedy have been considered:

- Permanent loss/modification of 681 m linear meters of stream habitat.
- Permanent loss/modification of 0.58 ha wetland habitat.

These effects are to be offset through the restoration of existing habitat and the creation of new habitat.

5.2.1 Selection of offsetting Sites

Offsetting sites for restoration were selected that were as close as practicable to the Project Area, and within the impacted catchments (Puhinui and Papakura). Site selection sought to locate restoration at sites that were similar to impact streams/wetlands, with similar stream orders to ensure stream functionality values are maintained. Restoration at sites that are degraded and able to be sufficiently restored for good ecological gains were prioritised.

The selection of offsetting sites for the creation of stream length and wetland habitat was more complex, as there are limited opportunities to create ecologically functioning stream and wetland habitat. It is important to ensure that an any created stream or wetland habitat can ecologically function and maintain aquatic communities.

A number of locations incorporating both stream and wetland features have been selected for offsetting that are all within the impacted catchments (Papakura and Puhinui). These areas include:

- The stream-wetland complex at 2 Wastney Road (S21)
- The stream-wetland complex at 116 Ranfurly Road (S17)
- The intermittent piped stream with exotic wetland fringes at Tōtara Park
- Three degraded exotic wetlands at (38 Mill Road) (PW01, MW33 and MW34)
- A wetland approximately 0.053 ha in area to be constructed adjacent to the stream diversion at S20 located at 2 Wastney Road
- A wetland approximately 0.214 ha in area to be constructed in Tōtara Park at TR01 stream offset area.

5.2.2 Offset - Stream habitat

The Environmental Compensation Ratio (ECR) has been used to calculate the appropriate quantum (stream length/area) of offset to achieve no net loss of stream function for residual effects on stream habitat. The ECR incorporates residual effects from impacts to stream habitat including from culverting, large areas of scour protection and stream loss.

Three stream offset areas have been identified within the impacted catchments – 116 Ranfurly Road (Stream S17), Totara Park (Stream TR01) and 2 Wastney Road (Stream S21). These areas are detailed below in Table 5-2.

Table 5-2 Available stream offset within proposed restoration sites.

Location	Restoration Action	Bankful width (m)	Available length (m)	Available area (m^2)
116 Ranfurly Road (S17)	Riparian Planting	5.3	349	1182
2 Wastney Road (S21)	Riparian Planting	6.0	223	2094
Totara Park (TR01)	Daylighting and riparian planting	1.0	246*	246
Total			**818 m**	**3,522 m^2**

**246 m of daylighting and revegetation planting at TR01*

The stream offsetting includes the daylighting (restoration of a former stream that is currently piped) of 246 linear m of stream within Tōtara Park, referred to as TR01. Daylighting includes the removal of existing pipes, creation of a stream channel, bank recontouring, and riparian planting.

The riparian planting of open stream channels at S17 (116 Ranfurly Road) and S21 (2 Wastney Road) involves the planting out to a minimum of 10 m from the stream edge. In some areas this includes the planting of wetland species within the riparian wetland margins.

The proposed restoration sites are of a degraded nature, with the proposed restoration actions resulting in a good uplift of ecological function and value (Table 5-3). Detailed descriptions and modelled outcomes are provided in **Appendix H**.

Table 5-3 Stream offset site modelled SEVm-C and SEVm-P

Stream ID/catchment	Location	SEVm-C	SEVm-P	Predicted gain following restoration
S17/Papakura	116 Ranfurly Road	0.339	0.577	Increase by 0.238
S21/Papakura	2 Wastney Road	0.348	0.629	Increase by 0.281
TR01/Puhinui	Totara Park	0.000	0.591	Increase by 0.591

Across the three proposed offsetting sites for restoration, there is 818 liner meters / 3,433 m^2 of stream habitat that is available for restoration. The quantum of restoration required by the ECR calculation to achieve no net loss of stream function is 2,600 m^2. Therefore, the restoration of all three identified sites will result in a net gain of stream function, with an additional improvement to 832 m^2 of stream habitat.

In addition to loss of stream function, there is a loss to stream length. Prior to any offset mitigation there is a loss of 82.66 linear m of stream length. Stream length will be created through the daylighting of 15 m of stream habitat at S13 (Puhinui Gully) and 246 m at TR01 (Tōtara Park). This will result in an overall net gain of stream length of 178 linear m of stream.

Stream restoration measures will be actioned through the FMP which includes stream planting plans.

Following the implementation of the stream offset measures proposed, we consider that residual effects have been addressed and that a Net Gain in stream ecological values can be achieved.

5.2.3 Residual effects - Wetland habitat

To address the residual effects of wetland extent loss and value due to the Project, both restoration of degraded wetlands and the creation of new wetlands will be undertaken. The Biodiversity Compensation Model (BCM) (Baber, Christensen, et al., 2021) was used to determine the quantum of offset that would result in a minimum of no net loss of wetland ecological values. The BCM allows for Net Gain outcomes to occur when the biodiversity gains associated with compensation actions are greater than the impacts for a given biodiversity value.

The total loss of wetland habitat is 0.58 ha, encompassing approximately 0.4 ha of EW low value wetland, 0.109 ha of EW moderate value wetland, and 0.073 ha of WL.11 high value wetland loss. The Project has limited opportunity to create or extend existing wetlands. Therefore, offsetting the loss of wetland extent and value cannot be solely addressed through the creation of novel wetland extent. We recommend a hybrid approach that utilises both wetland creation (where possible) and wetland restoration.

The residual effects on wetlands will be addressed through the restoration of 0.689 ha of existing exotic wetlands and construction of two wetlands totalling approximately 0.267 ha in size (Table 5-4). As indicated by the BCM, this will result in a Net Gain of wetland ecological value (11.6%) within 10 years. Full details are provided in the Biodiversity Compensation Model memo provided in **Appendix I**.

Table 5-4 Available restoration area within the wetland restoration sites

Location	Available Area (ha)
116 Ranfurly Road (MW19a)	0.267

Location	Available Area (ha)
2 Wastney Road (MW21a)	0.133
38 Mill Road (PW01, MW33 and MW34)	0.289
Creation of natural inland wetland at Tōtara Park (TW01)	0.214
Creation of natural inland wetland at S20 diversion	0.053
Total	**0.956 ha**

Wetland restoration measures will be actioned through the FMP which includes wetland planting plans.

Following the implementation of the wetland compensation measures proposed, we consider that no net loss in wetland ecological values will be achieved.

6 CONCLUSION

The Project is located within a highly modified landscape, with modified and degraded stream and wetland habitats impacted by the landscape. Ecological values of streams and wetlands are primarily low, with higher value habitats present within areas of SEA and within the reserve of Totara Park.

Efforts to avoid ecological effects on freshwater and wetland features have been undertaken through design refinements including the reduction of the earthworks footprint through the use the retaining structures, and the realignment of stormwater outfalls thereby reducing the scale of impacts on ecological features.

The Project will result in direct and indirect ecological effects on freshwater and wetland features (habitats and fauna). Key adverse effects include:

- Stream habitat impact of 681 linear meters, or 2,361 m^2 in area.
- Wetland habitat loss of 0.58 ha, including 0.073 ha of WL11 (Critically Endangered) wetland type.
- Potential mortality of injury to freshwater fish.
- Changes to fish passage.
- Changes to wetland hydrology

To address residual ecological effects, a package of offset and compensation measures has been developed, including 818 m of stream restoration and 0.93 ha of wetland restoration, incorporating 0.05 ha of newly created wetland habitat.

To address residual ecological effects, a suite of offset/compensation actions have been developed including:

- Restoration of 818 m of stream channel.
- Daylighting of 261 m of stream channel.
- Restoration of 0.689 ha of wetland habitat.
- Creation and restoration of 0.267 ha of wetland habitat.

The restoration requirements and further details on stream diversions are within the FMP. In response to other anticipated effects on streams and wetlands, the FMP also includes the following:

- Stream diversion design principles and ecological objectives.
- Riparian and wetland restoration methods and ecological objectives.
- Culvert designs for passage of native freshwater fish.
- Requirements for the monitoring of fish passage through new and upgraded culverts.

A separate Native Fish Capture and Relocation Plan has been prepared to address and management the risk of injury and mortality to freshwater fauna associated with instream works.

If the recommended mitigation, offset and compensation measures outlined are implemented the Project will result in a Net Gain in stream ecological value through the restoration of an additional 1,022 m^2 of stream habitat and the creation of an additional 178 linear m of stream habitat. There will be no net loss of wetland ecological value.

7 REFERENCES

Baber, M., Christensen, M., Quinn, J., Markham, J., Kessels, G., Ussher, G., & Signal Ross, R. (2021). The use of modelling for terrestrial biodiversity offsets and compensation: A suggested way forward. *Resource Management Journal*, *April 2021*, 28–33.

Baber, M., Dickson, J., Quinn, J., Markham, J., Ussher, G., Heggie-Gracie, S., & Jackson, S. (2021a). *A Biodiversity Compensation Model for New Zealand: A user guide (Version 1)* (Project Number 1017287.0000P.v1). Tonkin & Taylor Ltd.

Baber, M., Dickson, J., Quinn, J., Markham, J., Ussher, G., Heggie-Gracie, S., & Jackson, S. (2021b). *Biodiversity Compensation Model for New Zealand– Excel calculator tool (Version 1)* (Project Number 1017287.0000P.v1). Tonkin & Taylor Ltd.

Boffa Miskell Ltd. (2014). *Mill Road Corridor Notice of Requirement: Assessment of ecological effects*. Prepared by Boffa Miskell Ltd for Auckland Transport.

Clarkson, B. R. (2013). *A vegetation tool for wetland delineation in New Zealand*. Landcare Research for Meridian Energy Ltd.

Clarkson, B. R., Sorrell, B., Reeves, P. N., Champion, P. D., Partridge, T. R., & Clarkson, B. D. (2004). *Handbook for monitoring wetland condition: Coordinated monitoring of New Zealand wetlands* (Revised). Ministry for the Environment.

Franklin, P., Baker, C., Gee, E., Bowie, S., Melchior, M., Egan, E., Aghazadegan, L., & Vodjansky, E. (2024). *New Zealand fish passage guidelines: Version 2.0*. Prepared by NIWA for the Ministry for the Environment. https://niwa.co.nz/sites/default/files/inline-images/NZ%20Fish%20Passage%20Guidelines%202024%20v4.3_FINAL.pdf

Grainger, N., Harding, J. S., Drinan, T., Collier, K., Smith, B., Death, R., Makan, T., & Rolfe, J. R. (2018). *Conservation status of New Zealand freshwater invertebrates, 2018* (New Zealand Threat Classification Series No. 28). Department of Conservation. https://www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs28entire.pdf

Kessels & Associates Ltd. (2008). *Mill Road Corridor Study: Assessment of ecological effects*. Prepared by Kessels & Associates Ltd for Manukau City Council.

Maseyk, F. J. F., Ussher, G. T., Kessels, G., Christensen, M., & Brown, M. (2018). *Biodiversity offsetting under the Resource Management Act: A guidance document*. Prepared for the Biodiversity Working Group on behalf of the BioManagers Group.

Ministry for the Environment. (2022a). *National Environmental Monitoring Standards macroinvertebrates: Collection and processing of macroinvertebrate samples from rivers and streams. Version 1.0.0*. Ministry for the Environment. https://www.nems.org.nz/documents/macroinvertebrates/

Ministry for the Environment. (2022b). *Pasture exclusion assessment methodology*. Ministry for the Environment. https://environment.govt.nz/assets/publications/Pasture-exclusion-assessment-methodology.pdf

Ministry for the Environment. (2022c). *Wetland delineation protocols*. Ministry for the Environment. https://environment.govt.nz/assets/publications/Wetland-delineation-protocols.pdf

New Zealand Transport Agency Waka Kotahi (NZTA). (2021). *Mill Road NZUP Summary Report: Ecological Factual Report. Version 1*.

Roper-Lindsay, J., Fuller, S. A., Hooson, S., Sanders, M. D., & Ussher, G. T. (2018). *Ecological impact assessment (EcIA). EIANZ guidelines for use in New Zealand: Terrestrial and freshwater ecosystems* (2nd ed.). Environment Institute of Australia and New Zealand.

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

Stark, J. D., Boothroyd, I. K. G., Harding, J. S., Maxted, J. R., & Scarsbrook, M. R. (2001). *Protocols for sampling macroinvertebrates in wadeable streams* (p. 65). Prepared for the Ministry for the Environment.

Stark, J. D., & Maxted, J. R. (2007). *A user guide for the Macroinvertebrate Community Index* (Cawthron Report No. 1166). Prepared by Cawthron Institute for the Ministry for the Environment.

Storey, R. G., Neale, M. W., Rowe, D. K., Collier, K. J., Hatton, C., Joy, M. K., Maxted, J. R., Moore, S., Parkyn, S. M., Phillips, N., & Quinn, J. M. (2011). *Stream Ecological Valuation (SEV): A method for assessing the ecological functions of Auckland streams* (Auckland Council Technical Report No. 2011/009). Auckland Council.

APPENDIX A STATEMENT OF EXPERIENCE AND QUALIFICATIONS AND CODE OF CONDUCT

This Freshwater and Wetlands EcIA report is co-authored by Rosa Kirkham and Katrina McDermott.

7.1 Rosa Kirkham

The co-author of this report is Rosa Kirkham

I am an Ecologist at Boffa Miskell. I have been working as a freshwater scientist for over 6 years. I hold the qualifications of Master of Science – Physical Geography (2019) and Bachelor of Applied Science – Environmental Management and Zoology (2016), both from the University of Otago.

I am experienced at undertaking aquatic ecological assessments to inform effects management and mitigation to support consenting. In addition to this I have developed and implemented management and monitoring plans for a range of projects. My relevant experience includes the preparation of aquatic ecological assessments for the R2 Growth Cell Project, the Tauriko West – Tupenga Project, and the preparation of freshwater management plans for the Takitimu Northern Link Stage 2a Project.

I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and have complied with it in preparing this report. I confirm that the issues addressed in this assessment are within my area of expertise and I have not omitted material facts known to me that might alter or detract from the information contained in this assessment.

s9(2)(a)

Date September 2026

7.2 Katrina McDermott

The co-author of this report is Katrina McDermott.

I am a Principal Ecologist at Boffa Miskell. I have been working as an environmental consultant for over 15 years.

I have a Bachelor of Science (Biology and Geography) from the University of Auckland and a Master of Science (Geography) from the University of Auckland. I am a member of the New Zealand Freshwater Sciences Society and the New Zealand Coastal Sciences Society. I am a Certified Environmental Practitioner from the Environment Institute of Australia and New Zealand.

I am experienced in undertaking aquatic ecological assessments to inform effects management and mitigation to support consenting. I have developed and implemented many management and monitoring plans for large-scale developments and infrastructure projects. My relevant experience includes the preparation of aquatic ecological assessments for the Ara Tūhono – Warkworth to Te Hana roading project, and the preparation of freshwater assessment and related management plans for the OceanaGold Waihi North Project. Other infrastructure projects I have been involved in include O Mahurangi – Penlink, and Transmission Gully.

I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2023 and have complied with it in preparing this report. I confirm that the issues addressed in this assessment are within my area of expertise and I have not omitted material facts known to me that might alter or detract from the information contained in this assessment.

s9(2)(a)

Date September 2026

APPENDIX B FRESHWATER ECOLOGICAL VALUE

Table B-1 below outlines criteria which can be used to assign ecological value to freshwater habitats. An adapted version of this was utilised alongside Chapter 5.3 of the EIANZ EcIA Guidelines (Roper-Lindsay et. Al, 2018).

Table B-1: *Criteria for classification of freshwater stream ecological values (BML interpretation).*

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 / Medium	A watercourse which contains fragments of its former values but has a high proportion of tolerant fauna, obvious water quality issues and/or sedimentation issues. Moderate to high degradation e.g., high-intensity agriculture catchment.	• Benthic invertebrate community typically has low diversity, species richness and abundance. • Benthic invertebrate community dominated by taxa that are not sensitive to organic enrichment and settled sediments. • Benthic community typically with dominant species or group of species. • MCI scores typically 40-80. • EPT richness and proportion of overall benthic invertebrate community typically low. • SEV scores moderate, typically 0.4-0.6. • Fish communities typically moderate diversity of only 3-4 species. • Pest or invasive fish species (excluding trout and salmon) may be present. • Stream channel and morphology typically modified (e.g., channelised)

Value	Explanation	Characteristics
		• 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, 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 C WETLAND DELINEATION PROTOCOLS AND WETLAND CONDITION INDEX

7.3 Wetland Definition

The Resource Management Act (RMA) definition of a wetland is "*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*". Rules pertaining to wetlands in the AUP-OP use this definition.

The National Policy Statement for Freshwater Management (NPS-FM), which sets out the policy framework for the NES-F, uses the RMA definition for a “natural inland wetland”, but excludes features that are:

(a) in the coastal marine area; or

(b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or

(c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or

(d) a geothermal wetland; or

(e) a wetland that:

i) is within an area of pasture[21] used for grazing; and

ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless

iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply.

Exclusion e ii) is referred to as the “pasture exclusion” (Ministry for the Environment, 2022b).

7.3.1 Wetland Delineation Protocol

This protocol uses vegetation, soil and hydrology indicators and references a schedule of hydrophytic plants. "Hydrophytes" (hydrophytic vegetation) are defined in the Wetland Delineation Protocols as "plant species capable of growing in soils that are often or constantly saturated with water during the growing season".

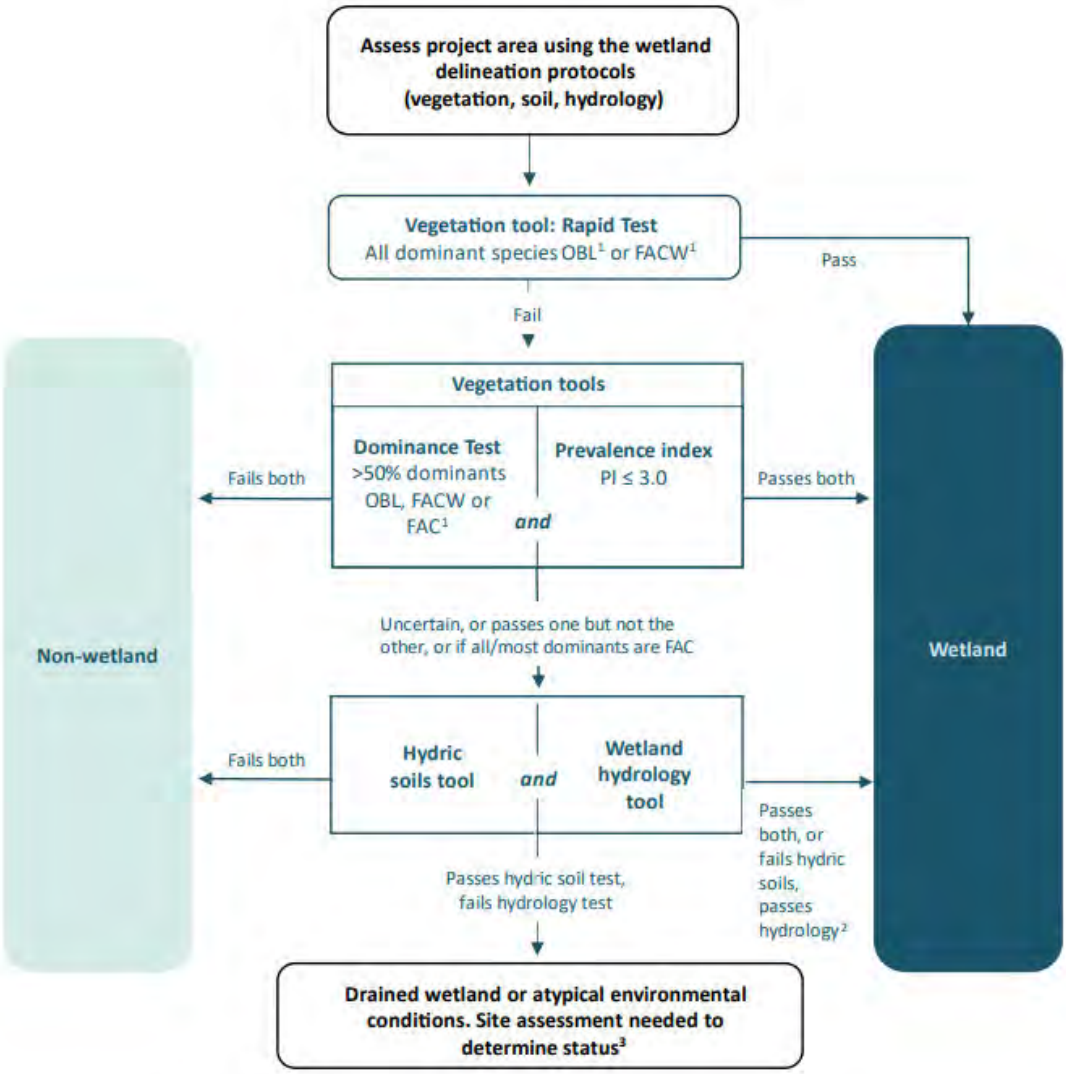
The hydrophyte categories (wetland indicator status ratings: (Clarkson, 2013), and subsequent updates) are:

- Obligate (OBL): occurs almost always in wetlands (estimated probability >99 per cent in wetlands)
- Facultative wetland (FACW): occurs usually in wetlands (67–99 per cent)
- Facultative (FAC): equally likely to occur in wetlands or non-wetlands (34–66 per cent)
- Facultative upland (FACU): occurs occasionally in wetlands (1–33 per cent)
- Upland (UPL): rarely occurs in wetlands (< 1 per cent), almost always in ‘uplands’ (non-wetlands).

The vegetation, soil and hydrology tools are applied following a hierarchical sequence of tests, each requiring an increasing level of detail shown by the wetland delineation flow chart provided in Figure C-

[21] Exclusion (e) is referred to as the “pasture exclusion” (MfE, 2022b).

7-1. The Rapid Test is used first, in which if all dominant species[22] have a wetland indicator status of OBL or FACW, the feature is a wetland.



Footnotes:
[1] Wetland indicator status abbreviations: FAC = facultative, FACW = facultative wetland, OBL = obligate wetland.
[2] For example, recent wetland.
[3] The US procedures for atypical or problematic situations are recommended.

Figure C-7-1: Key steps in NPS-FM Wetland Delineation Protocols.

7.3.2 Wetland Condition Index

Wetland values were assessed using a scoring system adapted from the Wetland Condition Index (WCI) score evaluation method in Clarkson et al (2004). WCI assigns rank scores across multiple attributes

[22] Dominant species = The most abundant plant species (when ranked in descending order of abundance, e.g., in a plot, and cumulatively totalled) that immediately exceed 50 per cent of the total cover for the stratum, plus any additional species comprising 20 per cent or more of the total cover for the stratum. This is known as the 50/20 rule, and is calculated for each stratum (tree, sapling/shrub and herb).

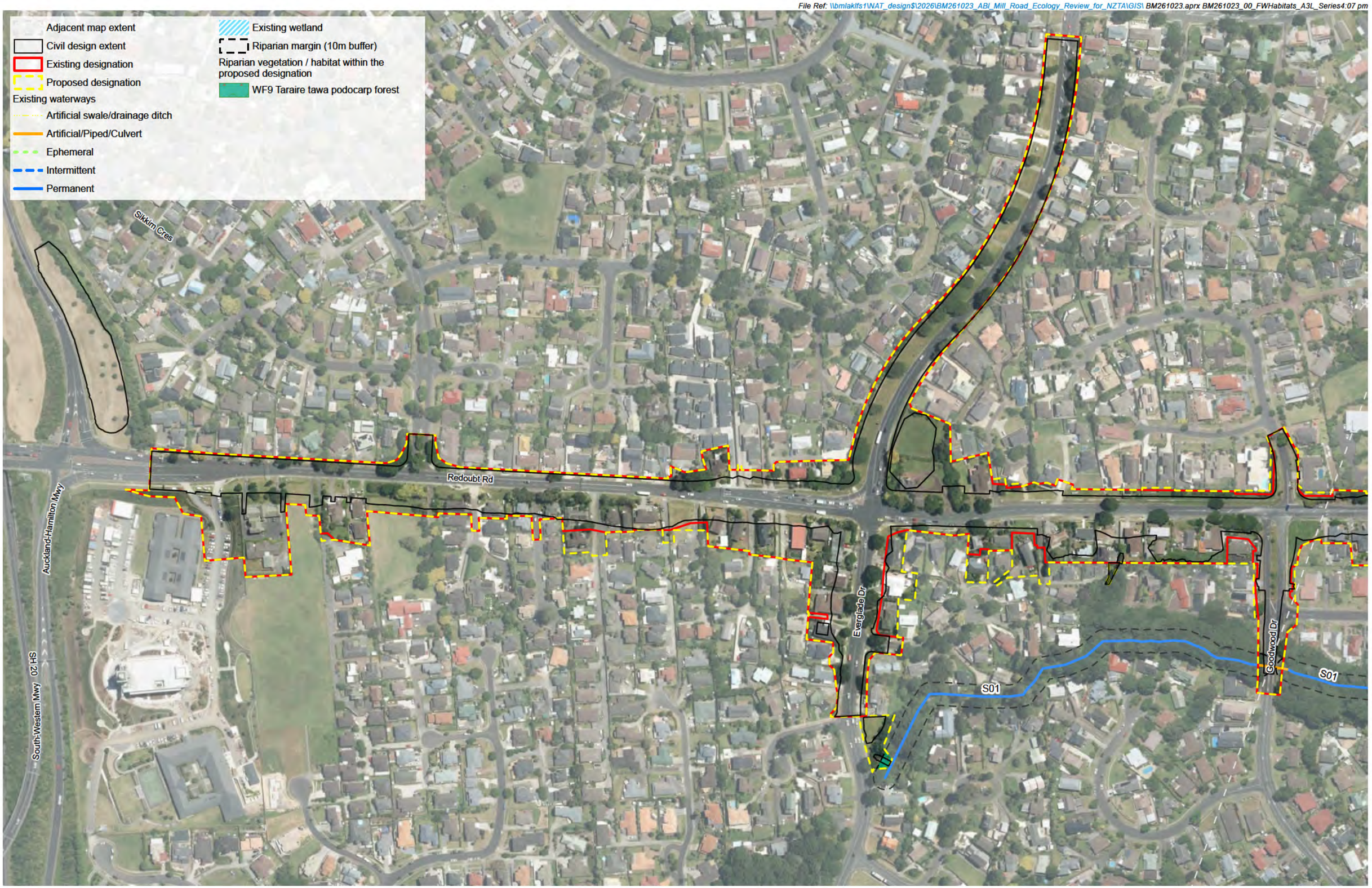
according to the degree of wetland modification and pressures and combines scores to provide an overall condition score for the wetland ecosystem. Modifications to the Clarkson et al (2004) index were made to ensure attributes assessed were relevant for wetland type present. In particular, attributes pertaining to well-developed peat wetlands were excluded, as the features evaluated for this Project are relatively recent, mineral wetlands. An explanation of attribute scores for wetland types is provided in Table 1.

Table C-1: Adapted "Wetland Condition Index" attributes (Clarkson et al. 2004). Scores between 1 – 5 are assigned to each attribute, with 5 representing the highest function/ lowest modification.

Pattern and processes	
Hydrological intactness:	The extent to which flow and sediment can enter soil substrates, groundwater and flow paths, and move through the catchment as it would in the absence of human modification
Physico-chemical processes:	Interactions between physical and chemical factors within a wetland ecosystem, including processes like sedimentation, nutrient cycling, redox reactions, pH changes, and the transformation of elements like carbon, nitrogen, and sulphur, influenced by the presence of water, vegetation, and anaerobic conditions prevalent in wetland environments.
Sediment assimilation, soil structure:	The way soil particles group together to form aggregates. Influences water and nutrient flow, aeration to plants and microbes, and resistance to soil erosion and compaction.
Vegetation intactness:	Continuity and consistency of canopy cover, canopy height, vertical layering, vegetation understory, and topography.
Water quality/ nutrient levels:	Trophic state of waterbody, indicated by nutrient levels and/ or algal growth.
Livestock access/ damage:	Livestock grazing causes soil compaction, which reduces soil porosity, decreases water infiltration and increases sediment runoff. Physical damage and deposition of urine and faeces results in microbial changes and alteration of physico-chemical processes.
Resilience to climate/ weather events (e.g. Flooding or drought):	The ability to recover from severe or prolonged weather events, and to adapt to long term changes.
Biodiversity	
T/AR or endemic species:	Presence of species listed as threatened/ at-risk according to Department of Conservation NZ Threat Classification System lists.
Wetland habitat type (T/R/AR):	Indigenous wetland ecosystem/ habitat identified as threatened, rare or at risk in the One Plan.
Species diversity (fauna and flora):	Variety present in indigenous flora and fauna assemblage present.
Indigenous vegetation cover (%):	Proportion of wetland feature in which native vegetation is dominant.
Connectivity to wider ecosystem integrity	
Variety of habitat types:	Variability in environmental gradients and community assemblages present.
Connectivity and migration barriers:	The ability of species to move freely within and between wetland and watercourse features and surrounding terrestrial habitats.
Surrounding land use:	Extent to which land use practices and modifications (e.g., due to agriculture, urban development, or forestry) influence ecological processes at a landscape scale.
Size, shape and buffering:	The dimensions of a wetland feature and the condition of its margins are factors in the resilience of the feature to disturbance and environmental changes.
Ecosystem Services	
Flood attenuation:	Ability to slow and absorb runoff, reducing peak flows and increasing water storage capacity in the catchment.
Streamflow regulation:	Ability to reduce 'peaks and troughs' in downstream flows and maintain baseflows.

Nutrient assimilation:	The process of absorbing nutrients from the environment and incorporating them into an organism's biomass.
Toxicant assimilation:	The process by which toxicants (harmful chemicals) are absorbed and taken up by organisms.
Carbon storage:	Accumulation of undecomposed organic matter in soil, sediments, and plants.

APPENDIX D ECOLOGICAL MAP SERIES



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

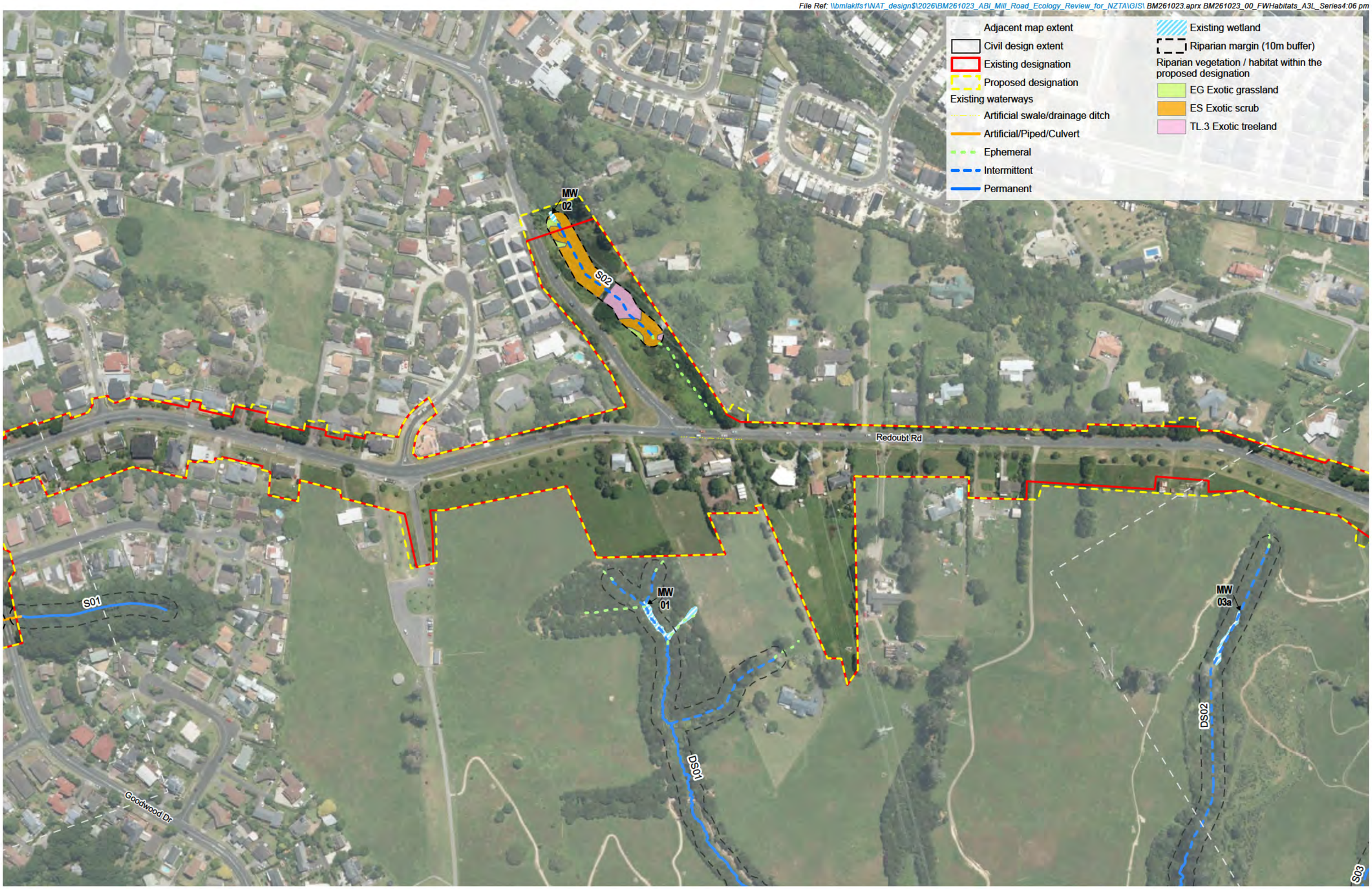
Freshwater Habitats

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 1



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

Freshwater Habitats

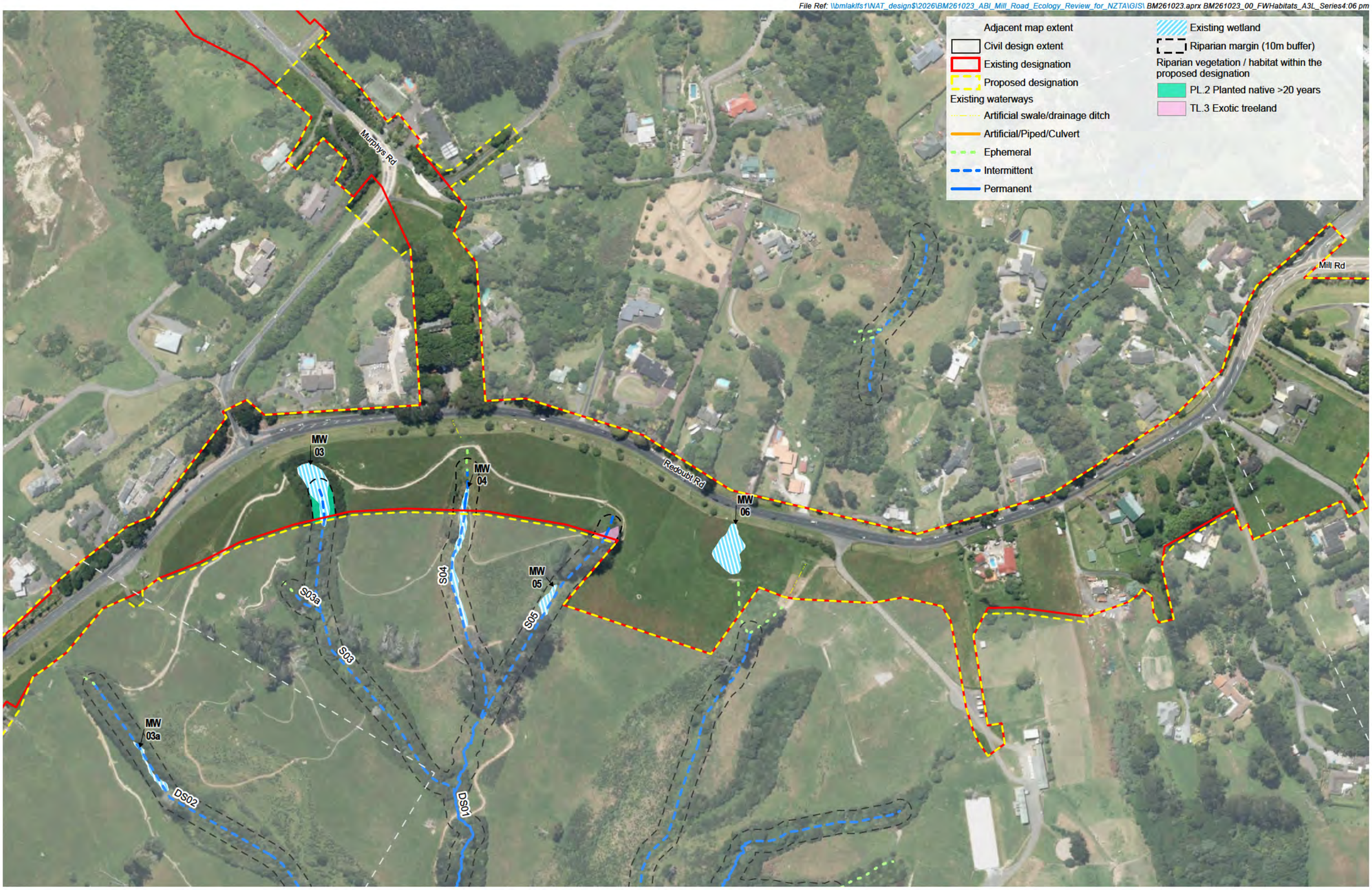
Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 2

File Ref: \\bmlaklfs1\NAT_design$\2026\BM261023_ABI_Mill_Road_Ecology_Review_for_NZTA\GIS\ BM261023.aprx BM261023_00_FWHabitats_A3L_Series4:06 pm



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

Freshwater Habitats

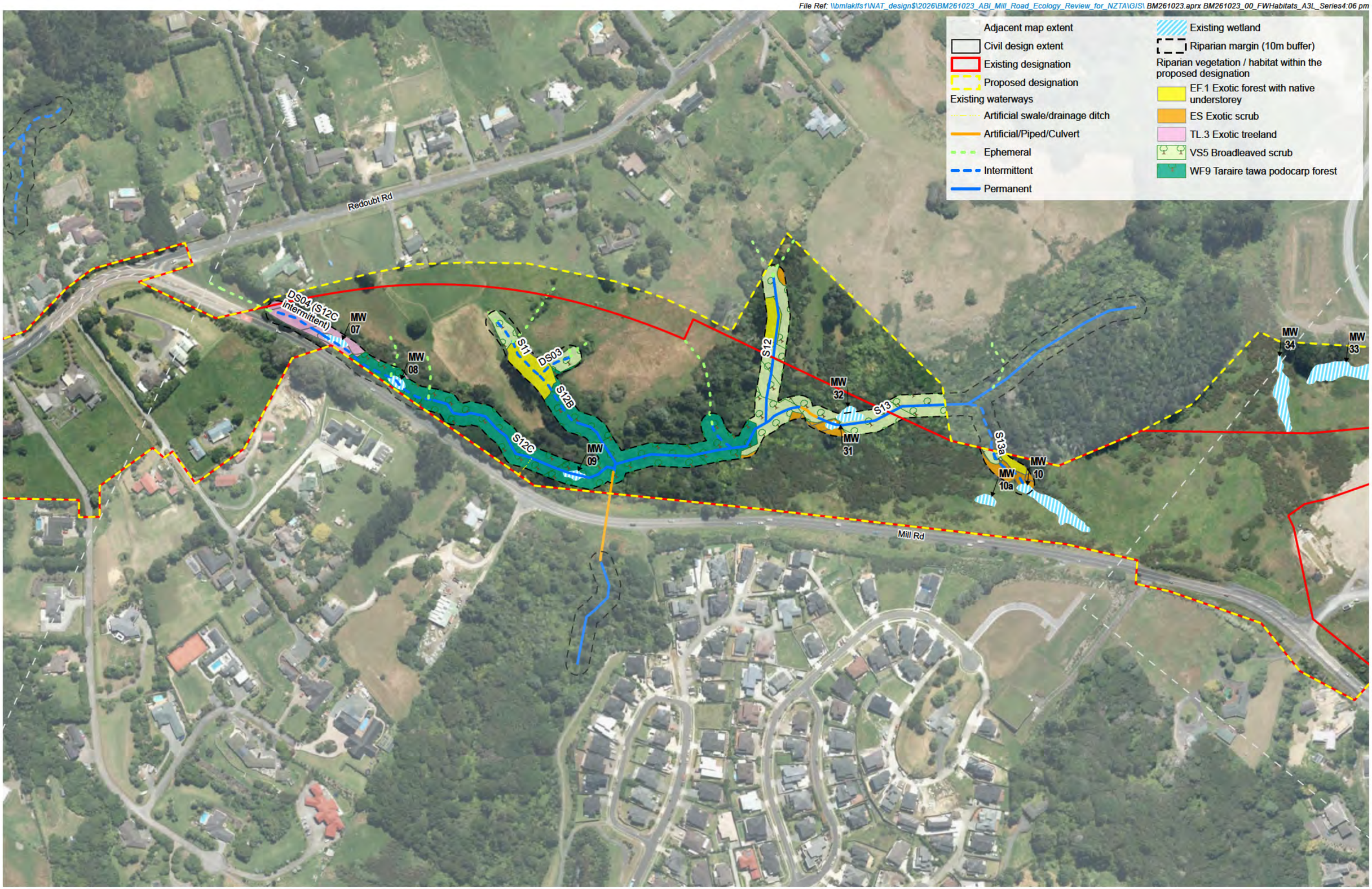
Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 3

File Ref: \\bmlaklfs1\NAT_design$\2026\BM261023_ABI_Mill_Road_Ecology_Review_for_NZTA\GIS\ BM261023.aprx BM261023_00_FWHabitats_A3L_Series4:06 pm



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

Freshwater Habitats

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 4



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

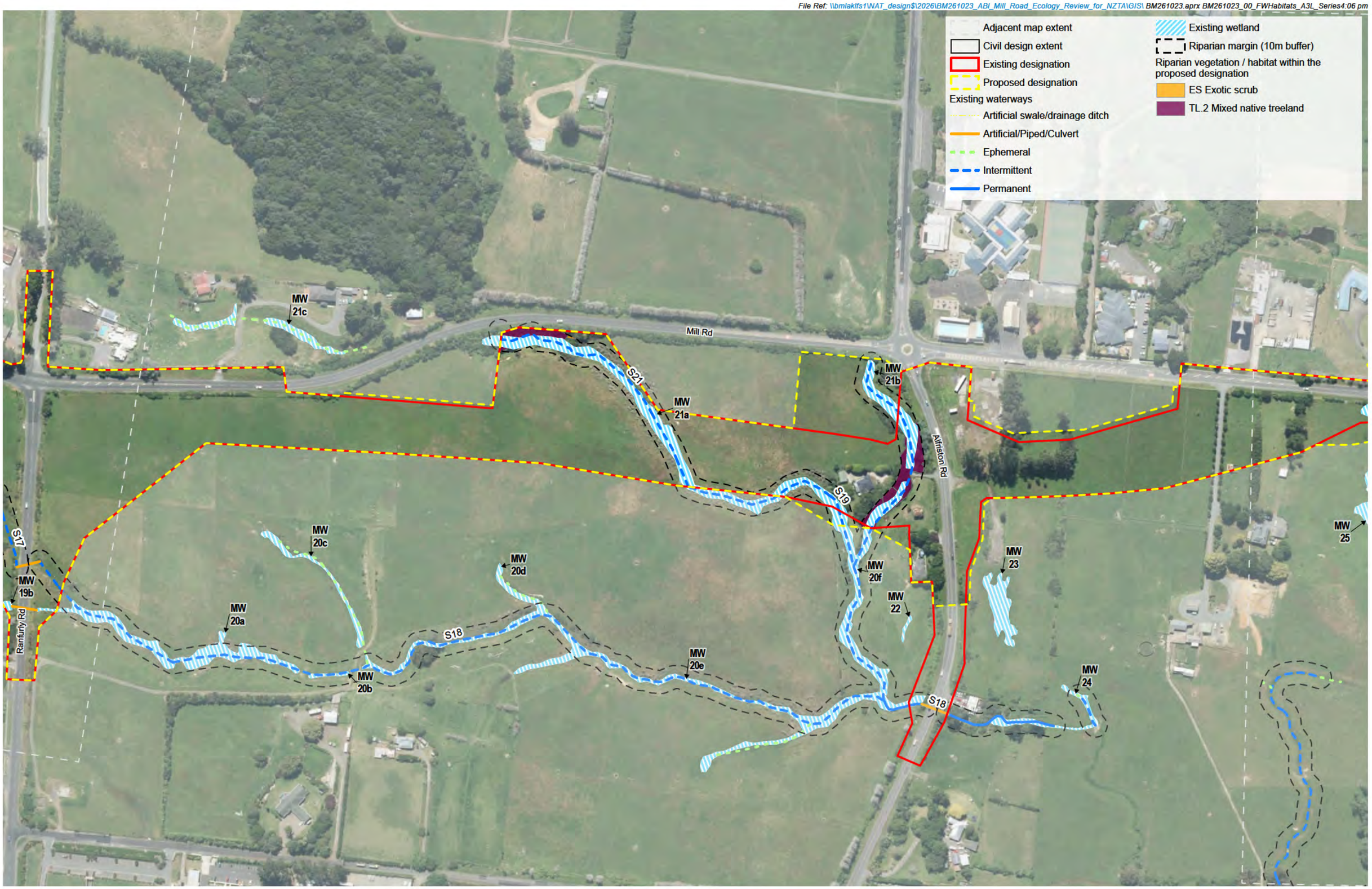
Freshwater Habitats

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 5



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

Freshwater Habitats

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 6



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

Freshwater Habitats

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 7



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

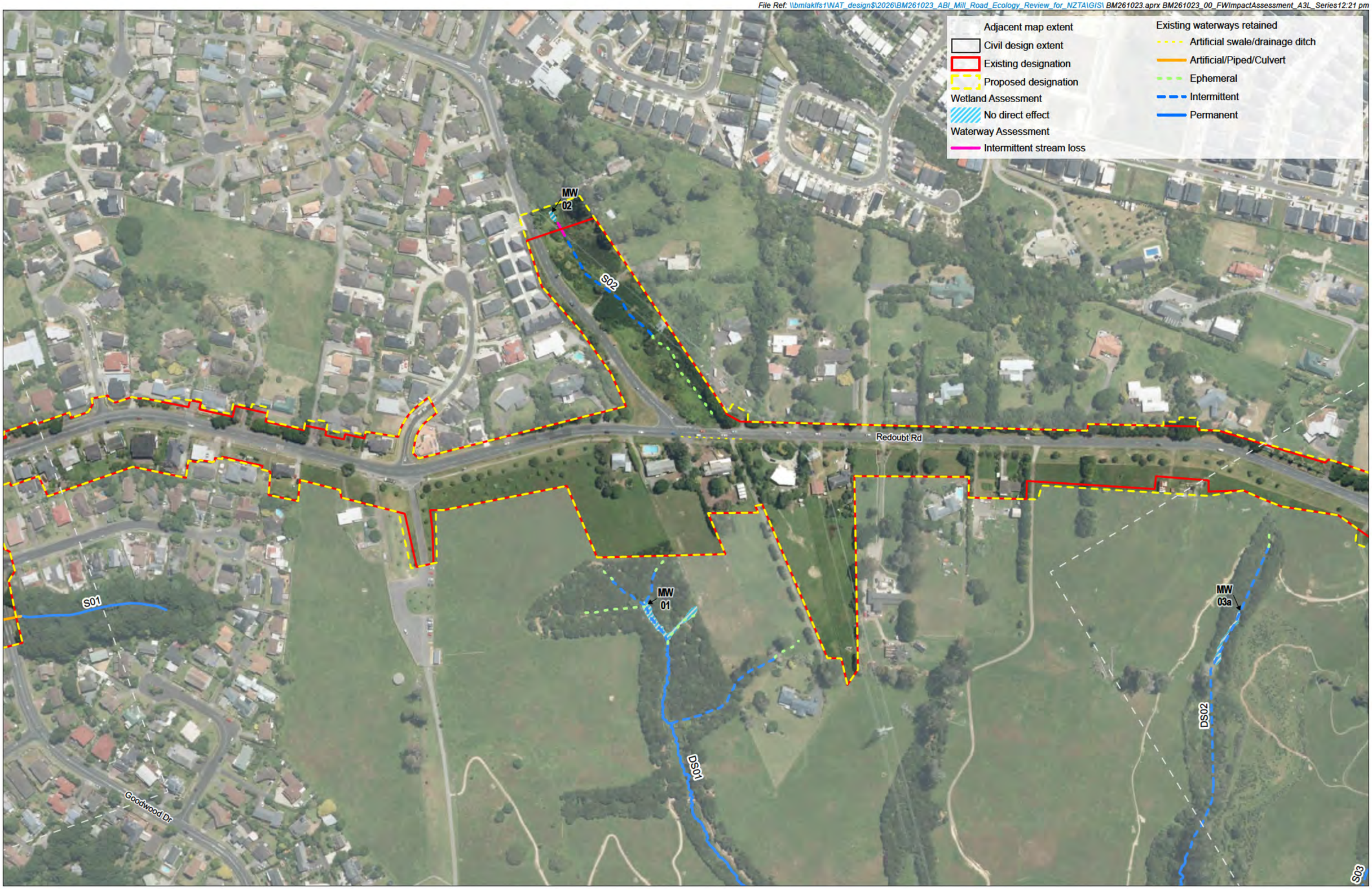
Freshwater Impact Assessment

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manages9(2)(a) | Drawn: LJa | Checked: KMc

Map 1



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

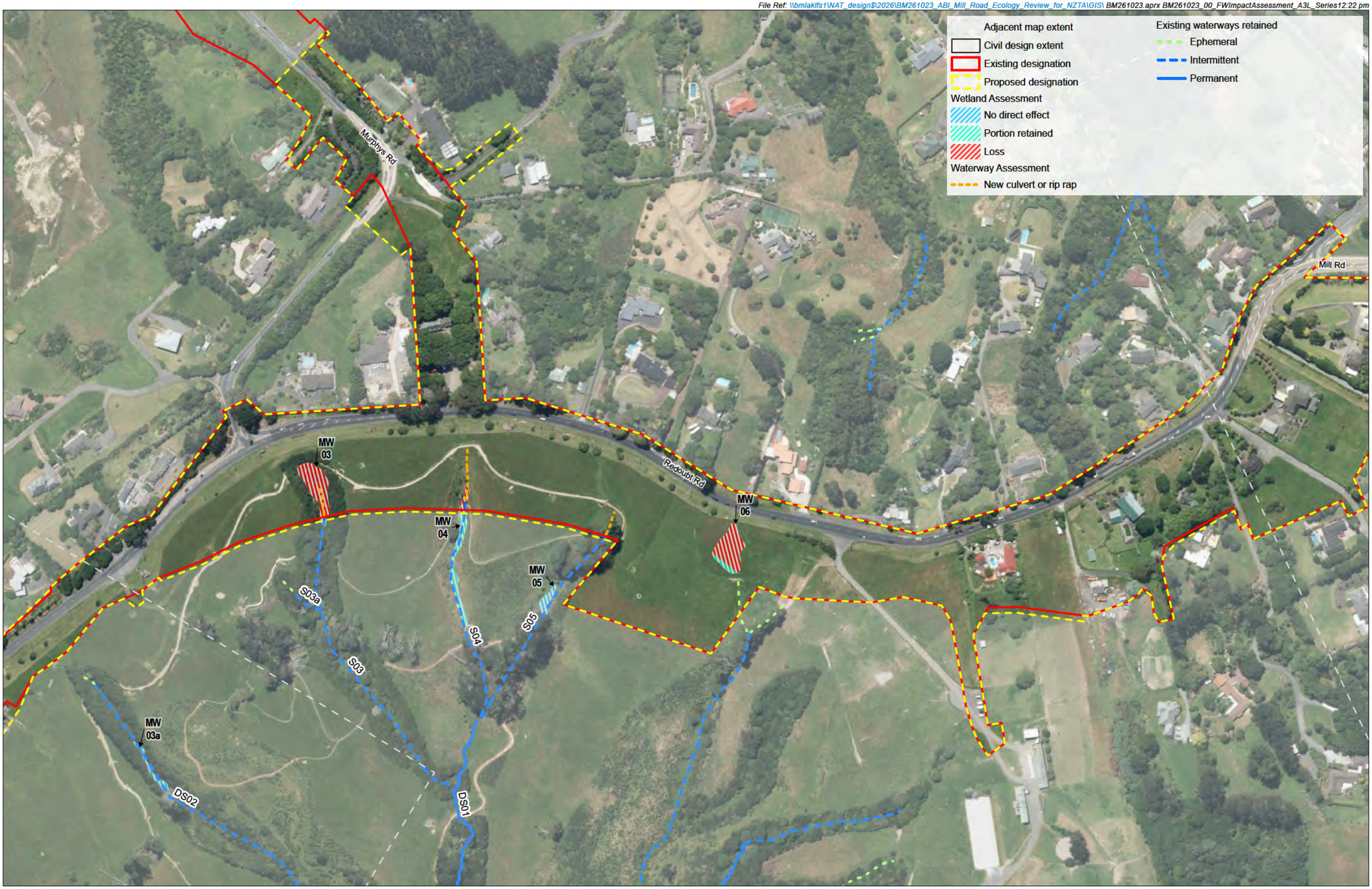
Freshwater Impact Assessment

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 2



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

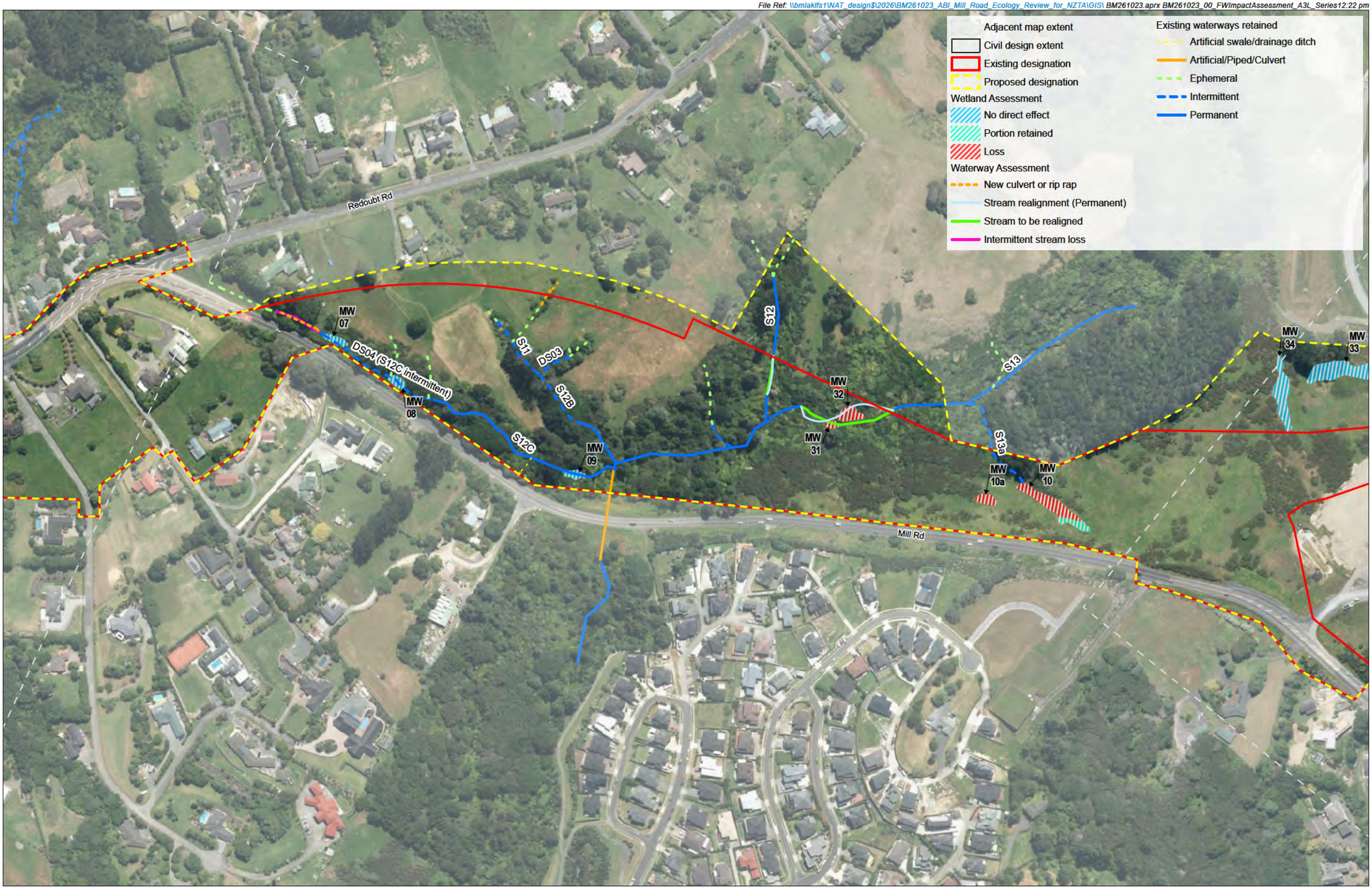
Freshwater Impact Assessment

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager s9(2)(a) | Drawn: LJa | Checked: KMc

Map 3



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

Freshwater Impact Assessment

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 4

Adjacent map extent
Civil design extent
Existing designation
Proposed designation
Wetland Assessment
No direct effect
Portion retained
Loss
Waterway Assessment
New culvert or rip rap
Stream realignment (Ephemeral)
Stream realignment (Intermittent)
Stream to be realigned
Intermittent stream loss
Ephemeral stream loss
Culvert to be replaced

Existing waterways retained
Artificial swale/drainage ditch
Artificial/Piped/Culvert
Ephemeral
Intermittent

MW 18
MW 14
MW 13
Mill Rd
S17
MW 19a
MW 17
MW 16
MW 18
MW 14
MW 13
PW01
MW 33
MW 34
MW 11
S14
Mill Rd
MW 12
S15
S17
MW 19a
MW 19c
MW 19b
S18
MW 20a
Polo Prince Dr

Boffa Miskell
www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m
1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

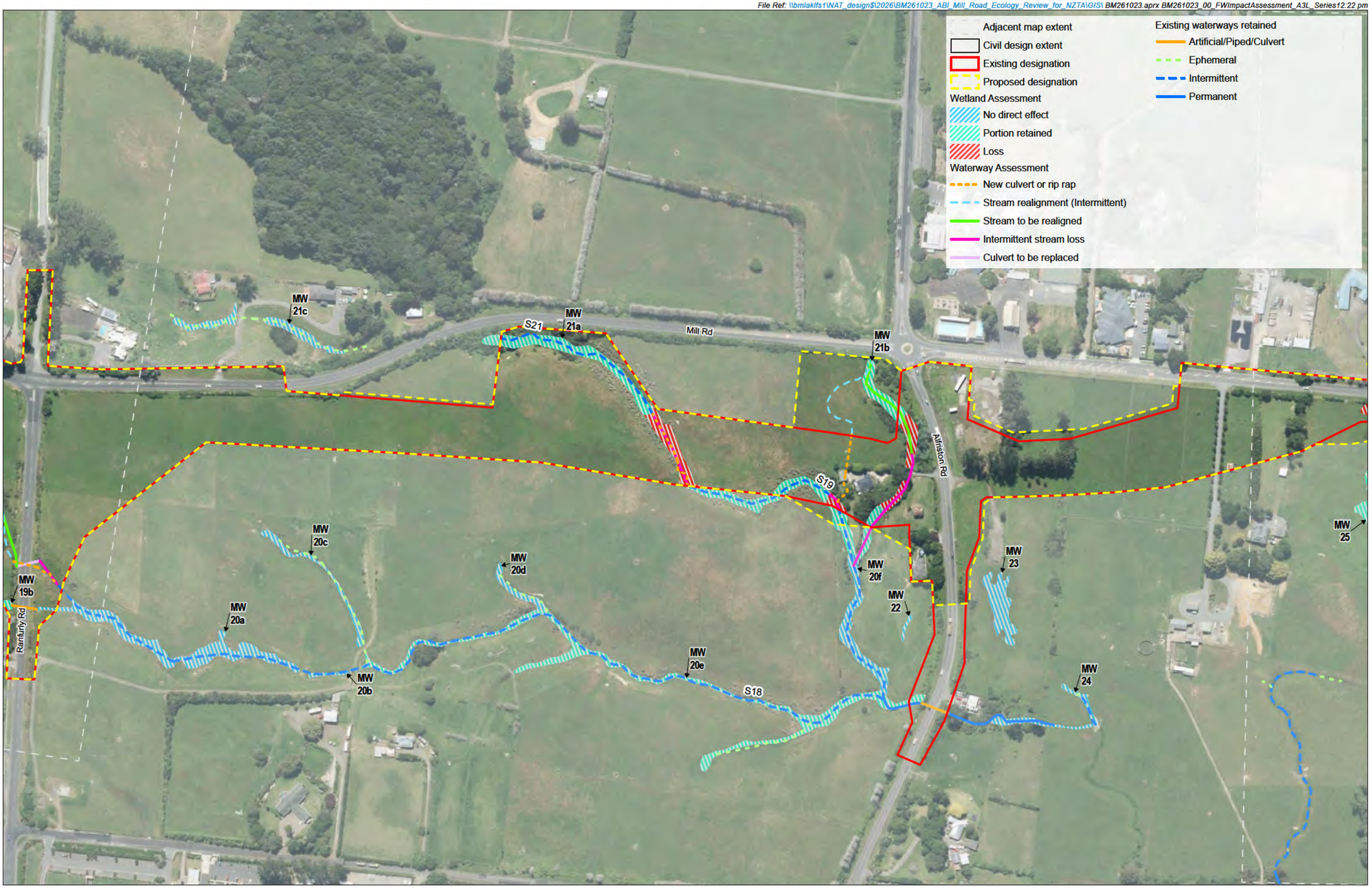
Freshwater Impact Assessment

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 5



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

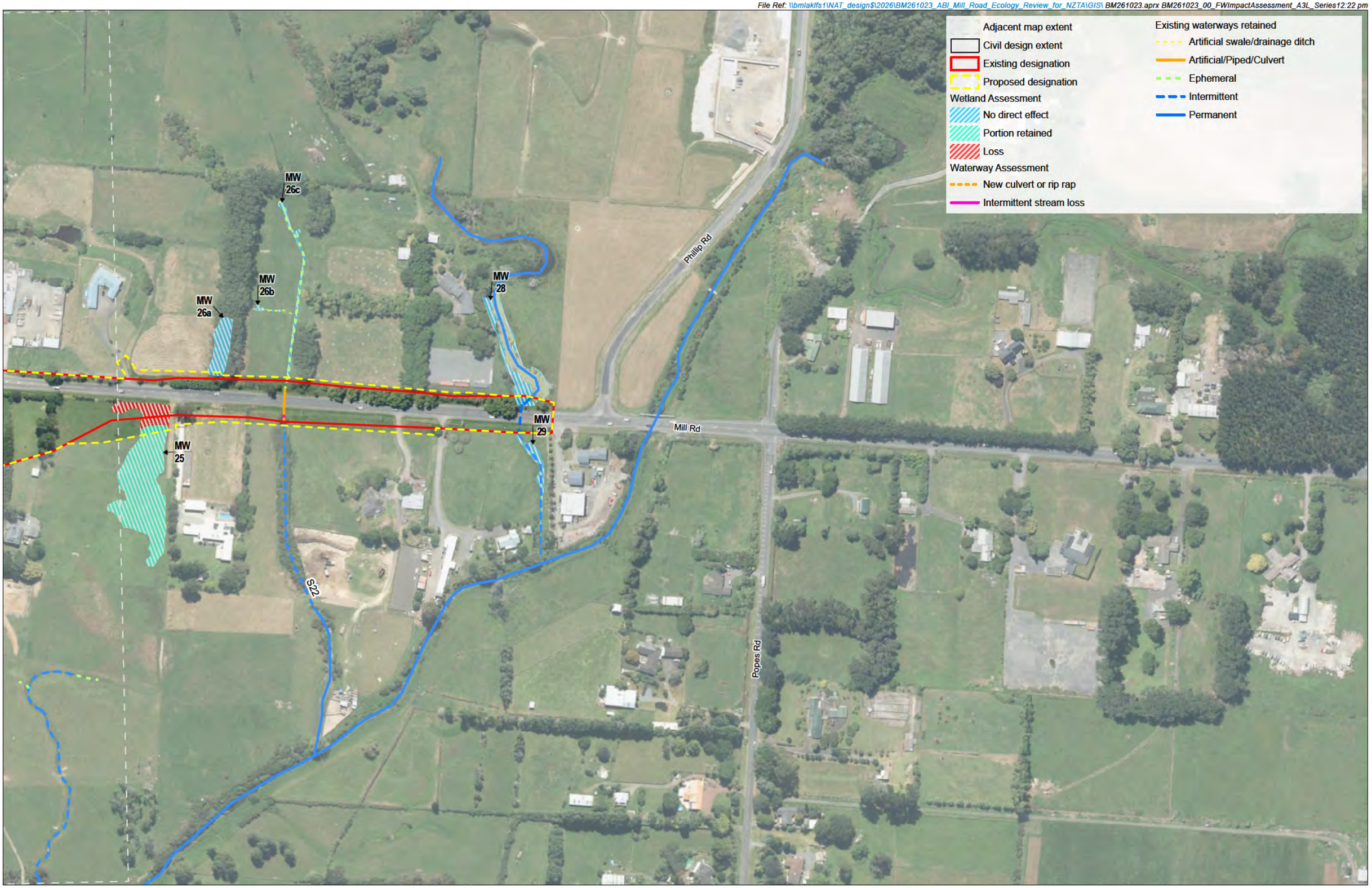
Freshwater Impact Assessment

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 6



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 50 m

1:3,000 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

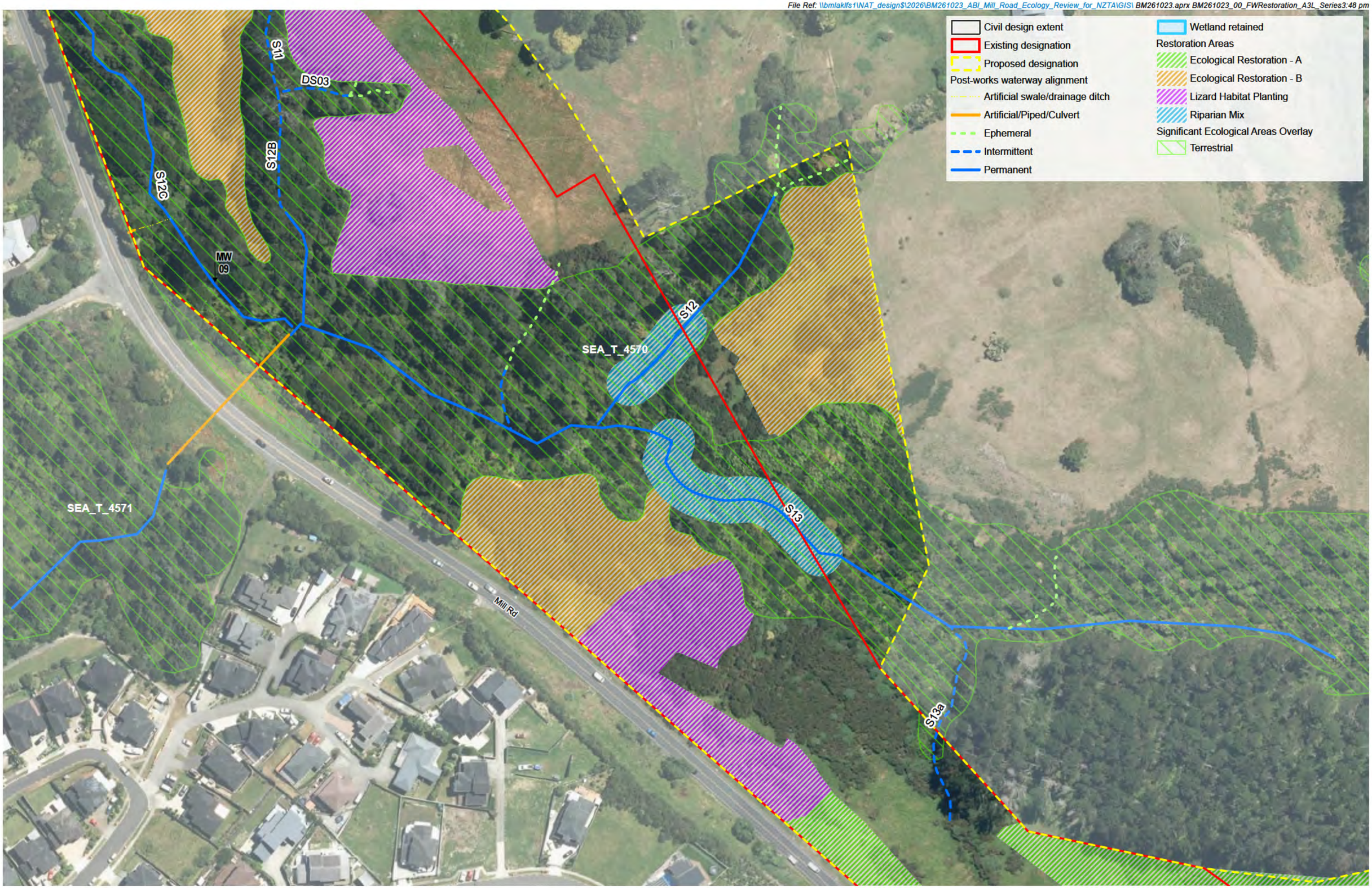
Freshwater Impact Assessment

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 7



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 40 m

1:1,500 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Plans and Places, Auckland Council, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

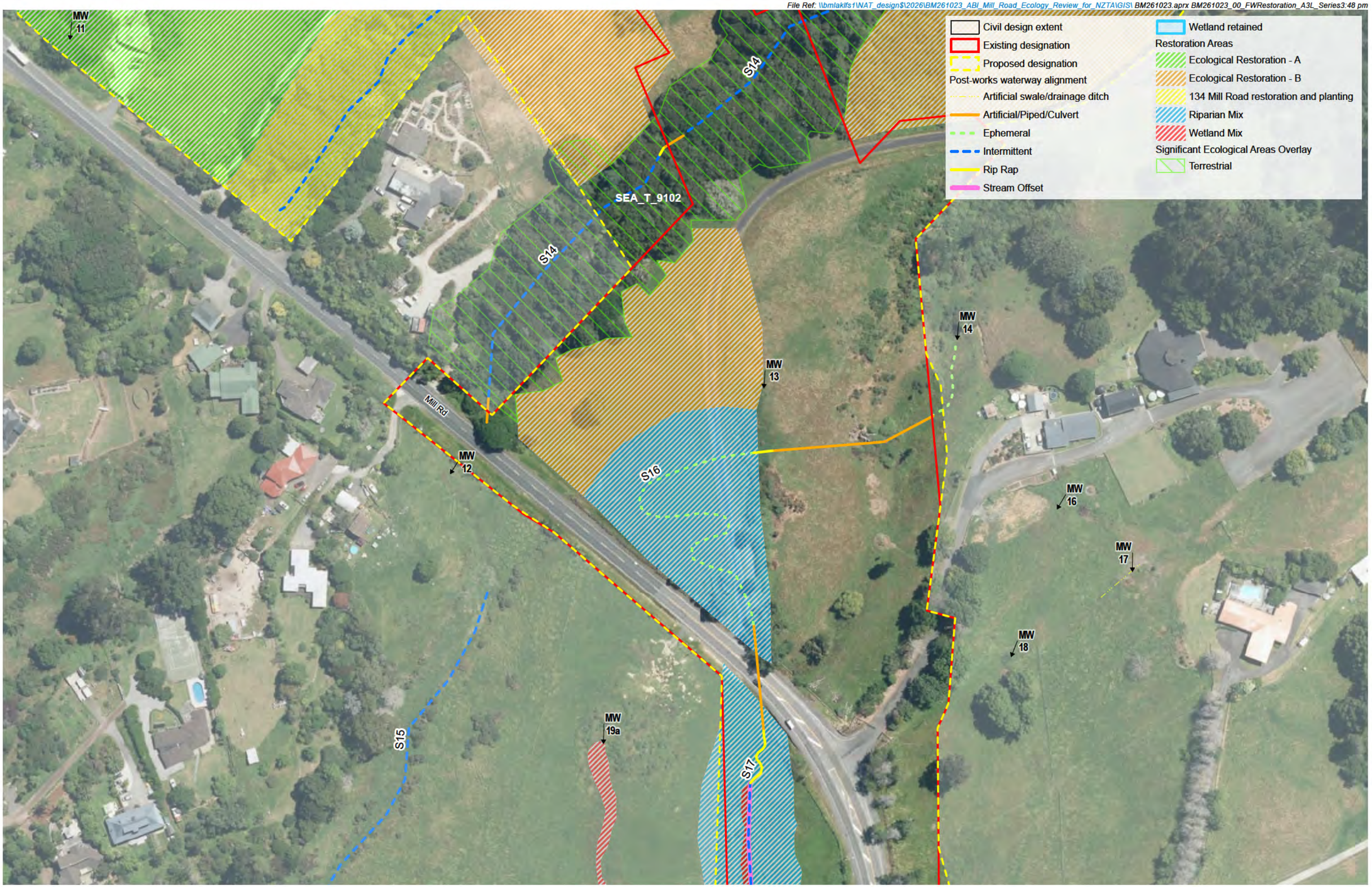
Freshwater Restoration: S12 / S13 stream diversions and riparian planting

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 1



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 40 m

1:1,500 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Plans and Places, Auckland Council, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

Freshwater Restoration: S16 realignment and riparian planting

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 2



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 40 m

1:1,500 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Plans and Places, Auckland Council, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

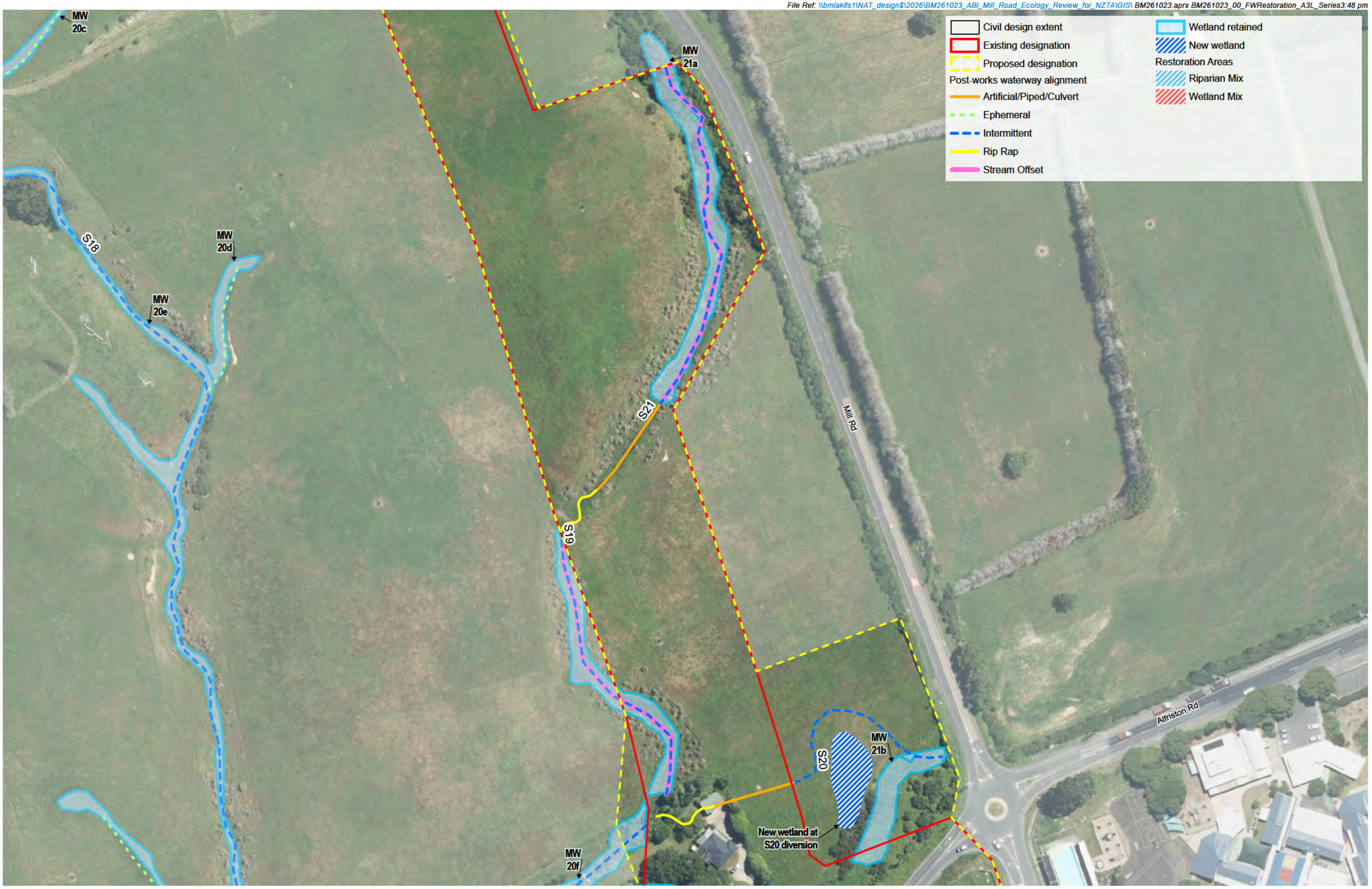
Freshwater Restoration: S17 stream offset planting

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 3



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 40 m

1:1,500 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Plans and Places, Auckland Council, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

Freshwater Restoration: S21 stream offset planting, S20 diversion and new wetland

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 4



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 40 m

1:1,500 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Plans and Places, Auckland Council, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

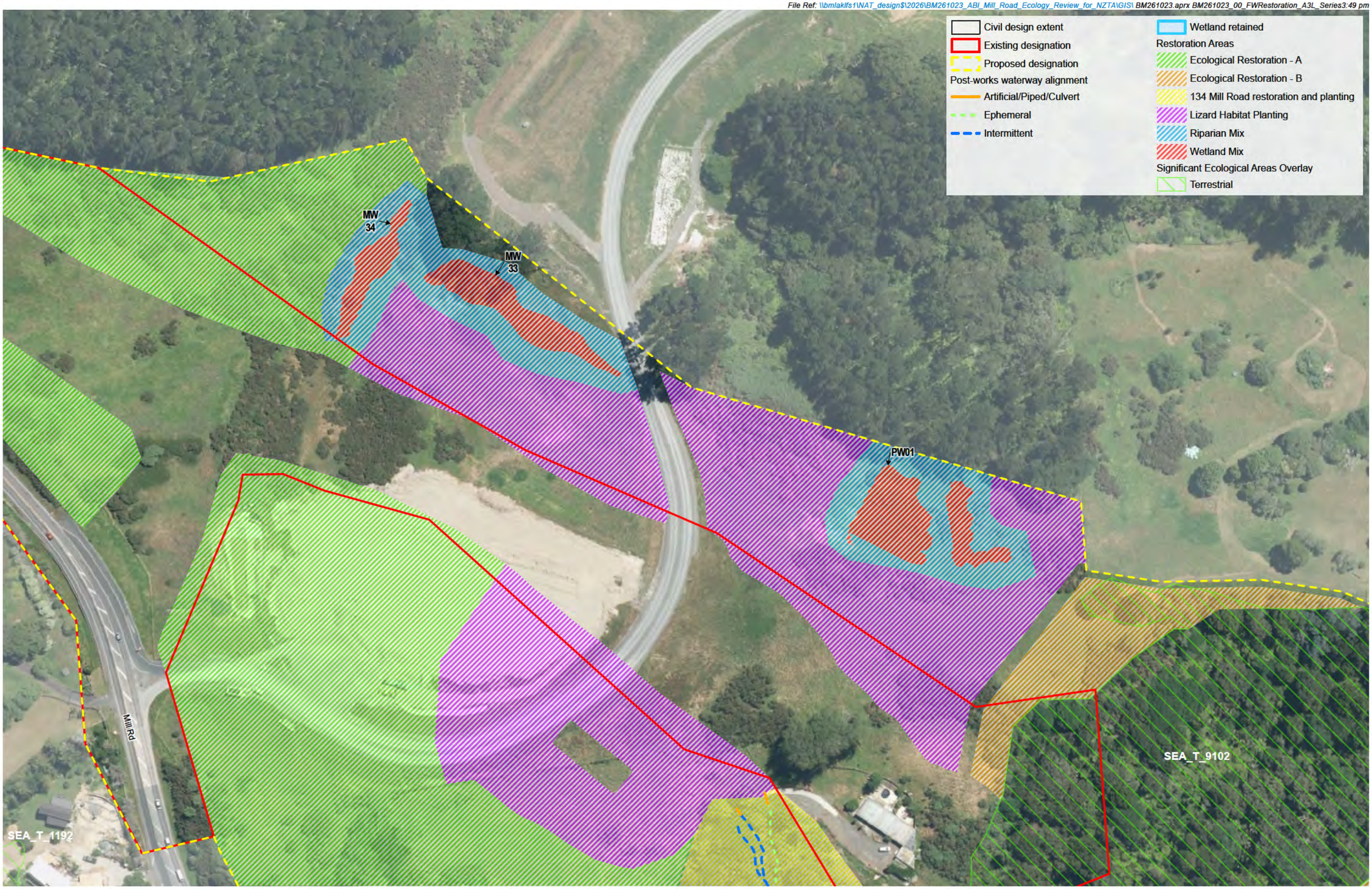
Freshwater Restoration: TR01 stream daylighting and TW01 new wetland

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 5



Boffa Miskell

www.boffamiskell.co.nz

This plan has been prepared by Boffa Miskell Limited on the instructions of our Client, in accordance with the agreed scope of work. If it is intended to support an application under the Fast-track Approvals Act 2024 it may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While Boffa Miskell Limited has exercised due care in preparing this plan, it does not accept liability for any use of the plan beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

0 40 m

1:1,500 @ A3

Data Sources: AECOM, Boffa Miskell, Copyright 2016 Crown copyright (c) - Land Information New Zealand, Plans and Places, Auckland Council, Eagle Technology, Land Information New Zealand, Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

MILL ROAD ECOLOGY REVIEW

Freshwater Restoration: MW33, MW34, PW01 wetland restoration

Date: 15 September 2026 | Revision: 0

Plan prepared for NZTA by Boffa Miskell Limited

Project Manager: s9(2)(a) | Drawn: LJa | Checked: KMc

Map 6

APPENDIX E FRESHWATER ECOLOGY RESULTS

7.4 Macroinvertebrate results

MCI scores ranged from 60.5 (S18) to 128.67 (S11), with most sites falling within NPS-FM Attribute Bands B and C (indicative of mild to moderate organic pollution or nutrient enrichment (Table 7-1). No sites were within Attribute Band A. Sites falling within Attribute Band 'B' were generally dominated by either *Polypedilum* or *Zephlebia* which are considered sensitive taxon, indicating high-quality stream conditions (Landcare Research, 2025b). Although *Polypedilum* are also considered sensitive taxa at soft-bottom sites, they can be present in streams varying water quality (Landcare Research, 2025a). Three sites (S18, S20, and S22) were within NPS-FM Attribute Band D for MCI which is indicative of severe organic pollution or nutrient enrichment. Taxa at these sites was dominated by *Potamopyrgus* (S18), *Paraleptamphopus* (S20), and *Ostracoda* (S22). Both *Potamopyrgus* and *Ostracoda* are considered highly tolerant taxa (Landcare Research, 2025c; Landcare Research, 2025d). These sites were located within grazed pasture.

QMCI scores ranged from 2.09 (S18) to 7.92 (S03), with most sites within NPS-FM Attribute Bands A or D (Table 7-1). Attribute Band A had five sites (S02, S03, S05, S11, and DS04), with communities dominated by the taxa *Polypedilum* or *Zephlebia*. Attribute Band D also had five sites (S04, S12, S18, S20, and S22) with communities generally dominated by tolerant species such as *Acari*, *Potamopyrgus, Paraleptamphopus* and *Ostracoda*.

The discrepancy between MCI and QMCI scores/Attribute Bands at a number of sites is a result of the quantitative nature of the QMCI which not only considers tolerance values of taxa, but their relative abundance and is generally considered more sensitive.

Table 7-1: Macroinvertebrate assessment results associated with SEVs

Taxa	S01	S02	S03	S04	S05	S12	DS04	S11	S14	S14A	S18	S20	S22
Beetle Hydrophilidae		1											6
Beetle Scirtidae												3	
Bug Microvelia					17				6	1	1	1	
Caddisfly Aoteapsyche	1												
Caddisfly Oeconesidae		4								1			
Caddisfly Orthopsyche													1
Caddisfly Plectrocnemia			1										
Caddisfly Polyplectropus	1	7	21	4	5	4	5	26	3	2		8	
Caddisfly Psilochorema			1										
Caddisfly Pycnocentria							1						
Caddisfly Triplectides								1					
Crustacea Corophium					2								
Crustacea Isopoda			2							2			
Crustacea Ostracoda				160					2		76		302
Crustacea Paracalliope			4	3	43								
Crustacea Paraleptamphopus	1	9				1				1		228	2
Crustacea Paranephrops					3								

Taxa	S01	S02	S03	S04	S05	S12	DS04	S11	S14	S14A	S18	S20	S22
Crustacea Talitridae								1					
Damselfly Xanthocnemis					1		11						
Dragonfly Procordulia							1						
HIRUDINEA (Leeches)													1
HYDROIDS									15	1			
Mayfly Atalophlebioides							2						
Mayfly Neozephlebia								29	12	4			
Mayfly Tepakia			3		2	6	85						
Mayfly Zephlebia			124	5	92	38	231	133	18	13			
MITES (Acari)			4	264	6	6							10
Mollusc Glyptophysa											1		
Mollusc Physella (Physa)												20	
Mollusc Potamopyrgus	6	4	8	26	11	123	80		1	10	462	48	4
Mollusc Sphaeriidae			5	19	3				1	2	1	48	3
NEMERTEA			2	8									3
OLIGOCHAETES	1	3	1	3		1						14	1
SPIDERS Dolomedes	1					1			2				
Stonefly Acroperla											1		
True Fly Austrosimulium											2		
True Fly Chironomus				25	5						3		29
True Fly Culex													25
True Fly Culicidae									5			34	
True Fly Empididae						1							
True Fly Ephydridae						1							
True Fly Hexatomini					1								
True Fly Limonia						1							
True Fly Molophilus		1											
True Fly Orthocladiinae				2				75	27				1
True Fly Paradixa			4		2			3	1				
True Fly Paralimnophila	1	1				2			1			1	
True Fly Polypedilum		12	135	10	1	17							8
True Fly Stictocladius								1					
True Fly Tanypodinae		4	2	1		1	2	2	5			54	3
True Fly Tanytarsini		1	4	4			2	9	5				1
Number of taxa	7	12	16	14	15	14	10	10	15	10	8	11	16
EPT value	2	2	5	2	3	3	5	4	3	4	1	1	1

Taxa	S01	S02	S03	S04	S05	S12	DS04	S11	S14	S14A	S18	S20	S22
% EPT	16.7	22.9	46.7	1.7	51.0	23.6	77.1	67.5	31.7	54.1	0.2	9.1	0.3
Number of individuals	12	48	321	534	194	203	420	280	104	37	547	459	400
MCI/MCI-sb	**94.3**	**117.6**	**115.6**	**92.6**	**115.7**	**118.1**	**107.6**	**128.7**	**90.7**	**112**	**60.5**	**86.2**	**80.0**
QMCI/QMCI-sb	**4.82**	**6.51**	**7.92**	**3.93**	**7.24**	**3.10**	**7.00**	**6.92**	**4.34**	**5.76**	**2.09**	**3.39**	**2.49**

7.5 eDNA results

Table 7-2 eDNA results associated with SEVs

Scientific Name	Common Name	S01	S02	S03*	S03	S04	S05	DS05	S11	S12	S12C	S12C (B)	S14	S14A	S16	S18	S19	S20	S22
Anguilla australis	Shortfin eel	5718	5815	2697	13056	29967	8261	0	170506	62816	67147	54064	0	36109	0	0	22805	175769	64968
Anguilla dieffenbachii	Longfin eel	23	0	0	0	0	0	0	0	961	0	2895	0	1186	0	0	0	0	0
Anguilla	Eels	0	0	2476	0	100	0	0	281	623	579	321	0	169	0	7	397	4153	603
Galaxias	Galaxiids	76	0	0	0	0	0	0	0	1992	0	592	771	14	0	0	0	0	0
Galaxias fasciatus	Banded kokopu	5606	0	0	0	0	0	0	0	80858	0	30639	107319	28731	0	0	0	0	0
Galaxiiformes	Galaxiids	0	0	0	0	0	0	0	0	0	0	0	693	0	0	0	0	0	0
Gambusia affinis	Mosquito fish	0	1532	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paranephrops	Freshwater crayfish	0	0	0	0	0	34593	0	0	18856	0	0	0	0	0	0	0	0	0

*eDNA taken within wetland

7.6 Stream Ecological Valuation results (SEVc)

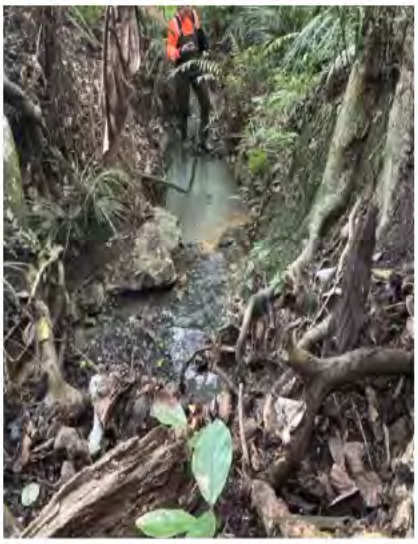
Table 7-3 Stream Ecological Valuation scores for streams S01 to S22

Variable	S01	S02	S03	S04	S05	S11	DS04	S12	S13	S14	S14A	S16	S17	S18	S19	S20	S22
Natural flow regime	0.10	0.10	0.60	0.72	0.73	0.58	0.58	0.85	0.49	0.69	0.21	0.53	0.30	0.30	0.45	0.38	0.36
Floodplain effectiveness	0.17	0.26	0.53	0.52	0.77	0.51	0.64	0.54	0.72	0.84	0.26	0.43	0.16	0.16	0.17	0.13	0.15
Connectivity for natural species migration	0.30	0.30	1.00	1.00	1.00	0.30	1.00	1.00	0.30	1.00	0.00	1.00	1.00	1.00	1.00	0.30	1.00
Natural connectivity to groundwater	0.83	0.83	0.83	0.81	0.84	0.76	0.89	0.92	0.89	0.86	0.86	0.83	0.83	0.83	0.74	0.73	0.83
Mean score	0.35	0.37	0.74	0.76	0.83	0.54	0.78	0.83	0.60	0.85	0.33	0.70	0.58	0.58	0.59	0.38	0.59
Water temperature control	0.74	0.86	0.80	0.40	0.44	0.72	0.80	0.74	0.74	0.80	0.60	0.10	0.08	0.08	0.20	0.60	0.70
Dissolved oxygen levels	1.00	0.40	0.60	0.60	0.60	0.60	0.60	0.60	0.50	0.68	0.50	0.40	0.68	0.68	0.34	0.34	0.20
Organic matter input	1.00	0.90	0.88	0.57	0.60	0.28	0.67	1.00	1.00	1.00	0.95	0.00	0.00	0.00	0.00	0.21	0.49
In-stream particle retention	0.20	0.20	0.56	0.86	0.72	0.48	0.50	0.92	0.66	0.72	0.52	0.00	0.20	0.20	0.20	0.50	0.20
Decontamination of pollutants	0.62	0.55	0.71	0.32	0.23	0.63	0.62	0.76	0.85	1.00	0.53	0.60	0.28	0.28	0.43	0.85	0.40
Mean score	0.71	0.58	0.71	0.55	0.52	0.54	0.64	0.80	0.75	0.84	0.62	0.22	0.25	0.25	0.23	0.50	0.40
Fish spawning habitat	0.10	0.05	0.05	0.05	0.10	0.05	0.40	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.18	0.18	0.05

Variable	S01	S02	S03	S04	S05	S11	DS04	S12	S13	S14	S14A	S16	S17	S18	S19	S20	S22
Habitat for aquatic fauna	0.70	0.42	0.70	0.38	0.38	0.59	0.41	0.67	0.66	0.68	0.56	0.21	0.33	0.33	0.36	0.47	0.38
Mean score	0.40	0.24	0.38	0.21	0.24	0.32	0.41	0.36	0.35	0.37	0.31	0.13	0.19	0.19	0.27	0.32	0.21
Fish fauna intact	0.33	0.42	0.42	0.42	0.42	0.42	1.00	0.33	0.33	0.46	1.00	0.42	0.42	0.42	0.42	0.42	0.42
Invertebrate fauna intact	0.30	0.67	0.94	0.68	0.74	0.84	0.79	0.78	0.84	0.70	0.67	0.19	0.19	0.19	0.07	0.38	0.49
Riparian vegetation intact	0.36	0.29	0.72	0.22	0.39	0.63	0.59	0.36	0.31	0.88	0.35	0.25	0.14	0.14	0.12	0.28	0.48
Mean score	0.33	0.46	0.69	0.44	0.52	0.63	0.79	0.49	0.50	0.68	0.67	0.28	0.25	0.25	0.20	0.36	0.46
SEVc Score	**0.483**	**0.446**	**0.667**	**0.539**	**0.568**	**0.528**	**0.678**	**0.681**	**0.596**	**0.740**	**0.505**	**0.358**	**0.334**	**0.334**	**0.333**	**0.411**	**0.439**
SEV Score Interpretation	**Fair**	**Fair**	**Good**	**Fair**	**Fair**	**Fair**	**Good**	**Good**	**Fair**	**Good**	**Fair**	**Poor**	**Poor**	**Poor**	**Poor**	**Fair**	**Fair**

7.7 Stream site photos

*Table 7-4 Stream site photos and description (Streams indicated by a * show photos from the AECOM site investigations, all other photos are from the Boffa Miskell site investigation.)*

Site description	Photo
Description: S01* Stream S01 is a permanent stream within the Puhinui catchment. This stream is likely to be impacted by stormwater scour protection.	
Description: S02* Stream S02 is an intermittent stream within the Puhinui catchment. This stream is likely to be impacted by stormwater scour protection. The gully was avoided following road realignment and reduction of the earthwork's footprint.	

Description: S03* Stream S03 is an intermittent stream within the Puhinui catchment. This stream is likely to be impacted by stormwater scour protection. The gully was avoided following road realignment and reduction of the earthwork's footprint.	
Description: S04* Stream S04 is an intermittent stream within the Puhinui catchment. The transitional zone between ephemeral and intermittent sections of the stream are to be culverted and the adjacent raingarden shall discharge at the true left bank of the stream.	
Description: S05 Stream S05 is an intermittent stream within the Puhinui catchment.	

Description: DS04* Stream DS04 is an intermittent stream within the Puhinui catchment. This stream is located within Watercare bush (SEA) and will be subject to culverting at the ephemeral/intermittent transitional zone.	
Description: S11* Stream S11 is an intermittent stream at the headwaters of Puhinui catchment (within SEA), the connected ephemeral tributary is to be culverted.	

Description: DS03* Stream DS03 is an intermittent stream that transitions into ephemeral at the headwaters of the Puhinui catchment (Within SEA). The stream is not directly impacted from works.	
Description: S12* Stream S12 is a permeant stream within the Puhinui catchment (within SEA). The stream will be diverted to accommodate the bridge pile.	
Description: S13 Stream S13 is a permanent stream within the Puhinui catchment (within SEA). The stream will be diverted to accommodate the bridge pile.	

Description: S13a Stream 13a is an intermittent stream within the Papakura catchment. It is a tributary to S13. The upper reach of the stream will be lost due to the construction footprint.	
Description: S14A* Stream S14A is an intermittent stream within the Papakura catchment. This stream is likely to be impacted by stormwater scour protection.	
Description: S14* Stream S14 is an intermittent stream within the Papakura catchment (Within SEA). The stream will be bridged which may lead to a riparian loss.	

Description: DS05 Stream DS05 is a small intermittent/ephemeral stream within the Papakura catchment. The stream is not directly impacted.	
Description: S16 Stream S16 is an ephemeral stream located within a wetland in the Papakura catchment. This stream will be diverted to avoid culverting the entirety of the channel.	
Description: S17 Stream S17 is an intermittent stream within the Papakura catchment. This stream will require a culvert upgrade under the road alignment to tie in the diversion channel. The wider extent of this stream shall be restored as part of the offset package.	

Description: S18* Stream S18 is an intermittent stream within the Papakura catchment. This stream will require a culvert upgrade under the road alignment.	
Description: S19 Stream S19 is an intermittent stream within the Papakura catchment. The stream is dominated by exotic wetland vegetation throughout the channel. This stream is located downstream of the Alfriston Roundabout and at the fork of S20 and S21.	
Description: S20 Stream S20 is an intermittent stream within the Papakura catchment. The stream is dominated by wetland vegetation throughout the stream bed. This stream shall be diverted to accommodate the road alignment.	

Description: S21* Stream S21 is an intermittent stream within the Pakapura catchment. This stream shall be culverted to accommodate the road alignment. This stream shall be restored as part of the offset package.	
Description: S22* Stream S22 is an intermittent stream within the Pakapura catchment. The existing road culvert shall be upgraded to facilitate the road alignment.	

APPENDIX F WETLAND ECOLOGY RESULTS

7.8 Wetland delineation results

Table 7-5: Wetland vegetation description, classification and positioning within Project designation

Wetland Name	NPS-FM Natural Inland Wetland	Vegetation Description	Direct or Indirect Effect	Within Designation	Within 100 m buffer	Singers et al. 2017 Classification	Value
MW01	Yes	Rapid assessment and vegetation plots undertaken. Soil profile description plot taken. Central wetland to North-Western section; Plot 1: 100% arum lily (*Zantedeschia aethiopica*) with cabbage trees (*Cordyline australis*) surrounding. Eastern section; Plot 1: 30% mercer grass (*Paspalum distichum*), 60% creeping buttercup (*Ranunculus repens*), 20% soft rush (*Juncus effusus*), and 10% nightshade (*Solanum mauritianum*). Plot 2: 20% arum lily, 30% soft rush, 30% blackberry (*Rubus fruticosus*), 40% mercer grass.	Indirect	No	Yes	EW Exotic wetland	Low
MW02	Yes	Rapid assessment undertaken Kikuyu (*Pennisetum clandestinum*), arum lily, saturated soils.	Indirect	Yes	Yes	EW Exotic wetland	Low
MW03	Yes	Rapid assessment undertaken. Soil profile description plot taken. Wetland dominated by 90% rautahi and pūrei (*Carex germinata, Carex secta*). Presence of kiokio (*Parablechnum novae-zelandiaei*), mamaku (*Cyathea medullaris*), cabbage tree (*Cordyline australis*), creeping buttercup (*Ranunculus repens*), and harakeke (*Phormium tenax*).	Direct	Yes	Yes	WL11 Machaerina sedgeland	High
MW03a	Yes	Rapid assessment undertaken Wetland dominated by Crex dominated Wetland hydrology present with saturated soils, ponding water.	Indirect	No	Yes	EW Exotic Wetland	Moderate
MW04	Yes	Rapid assessment undertaken. Soil profile description plot taken. Wetland dominated by 75% Yorkshire fog (*Holcus lanatus*) and soft rush (*Juncus effusus*). Minor presence of common bulrush (*Isolepsis prolifera*).	Indirect	No	Yes	EW Exotic Wetland	Low
MW05	Yes	Rapid assessment and vegetation plots undertaken. Soil profile description plot taken.	Indirect	No	Yes	EW Exotic Wetland	Low

Wetland Name	NPS-FM Natural Inland Wetland	Vegetation Description	Direct or Indirect Effect	Within Designation	Within 100 m buffer	Singers et al. 2017 Classification	Value
		Plot 1: 90% sharp spike sedge (*Eleocharis acuta*), 5% birdsfoot trefoil (*Lotus corniculatus*), 1% umbrella sedge (*Cyperus alternifolius*), 2% Yorkshire fog (*Holcus lanatus*). Plot 2: 100% fool's watercress (*Apium nodiflorum*). Plot 3: 100% fool's watercress.					
MW06	Yes	Rapid assessment and vegetation plots undertaken. Soil profile description plot taken. Plot 1: 2% muddy water, 10% soft rush (*Juncus effusus*), 53% creeping buttercup (*Ranunculus repens*), 40% kikuyu (*Pennisetum clandestinum*), and 2% dock (*Rumex sp.*). Plot 2: 88% creeping buttercup, 2% kikuyu, 5% soft rush. Plot 3: 97% creeping buttercup, 1% kikuyu, 1% dock. Plot 4: 5% muddy water, 80% creeping buttercup, 5% muddy water.	Indirect	Yes	Yes	EW Exotic Wetland	Low
MW07	Yes	Rapid assessment undertaken. Wetland dominated by 90% rautahi (*carex germinata*). Other species present include arum lily (*Zantedeschia aethiopica*), raupō (*Typha orientalis*), small leaf spiderwort (*Tradescantia fluminensis*), hedge nettle (*Stachys palustris*).	Indirect	Yes	Yes	WL11 Machaerina sedgeland	High
MW08	Yes	Rapid assessment undertaken. Wetland dominated by >90% rautahi (*Carex germinata*), and raupō (*Typha orientalis*).	Indirect	Yes	Yes	WL11 Machaerina sedgeland	High
MW09	Yes	Rapid assessment undertaken. Presence of rautahi (*Carex germinata*), creeping buttercup (*Ranunculus repens*), water celery (*Vallisneria americana*), montbretia (*Crocosmia x croxosmiiflora*).	Indirect	Yes	Yes	WL11 Machaerina sedgeland	High
MW10	Yes	Rapid assessment undertaken. Presence of kikuyu (*Pennisetum clandestinum*), soft rush (*Juncus effusus*), birdsfot trefoil *(Lotus corniculatus*), creeping buttercup (*Ranunculus repens*), dallisgrass (*Paspalum dilatatum*), mercer grass (*Paspalum distichum*), orchard grass (*Dactylis glomerata*), colonial bent (*Agrostis capillaris*). Dominance prevalence score indicative of NPS-FM wetland. Saturated hydric soils.	Direct	Yes	Yes	EW Exotic Wetland	Low
MW10a	Yes	Rapid assessment. Clear depression, with rush, creeping buttercup and Yorkshire fog.	Direct	Yes	Yes	EW Exotic Wetland	Low
MW11	Yes	Rapid desktop delineation	Indirect	No	Yes (fringes)	EW Exotic Wetland	Low
MW12	Yes	Requires further assessment, however, wetland vegetation e.g. Juncus sp. evident from roadside.	Indirect	No	Yes	EW Exotic Wetland	Low
MW13	Yes	Rapid assessment undertaken. Soil profile description plot taken.	Indirect	Yes	Yes	EW Exotic Wetland	Low

Wetland Name	NPS-FM Natural Inland Wetland	Vegetation Description	Direct or Indirect Effect	Within Designation	Within 100 m buffer	Singers et al. 2017 Classification	Value
		Species include soft rush (*Juncus effusus*), yorkshire fog (*Holcus lanatus*), pasture grasses. Pugging evident.					
MW14	Yes	Rapid assessment and vegetation plots undertaken. Soil profile description plot taken. Presence of yorkshire fog (*Holcus lanatus*), narrow-leaf dock (*Rumex stenophyllus*), mercer grass (*Paspalum distichum*), soft rush (*Juncus effusus*), birdsfoot trefoil (*Lotus corniculatus*), wild carrot (*Daucus carota*), and woolly nightshade (*Solanum mauritianum*) (located on the wetland border).	Indirect	Yes	Yes	EW Exotic Wetland	Low
MW15	Yes	Rapid assessment and vegetation plots undertaken. Soil profile description plot taken. Wetland consists of 70% soft rush (*Juncus effusus*), 20% creeping bent (*Agrostis stolonifera*), 4% creeping buttercup (*Ranunculus repens*), 5% yorkshire fog (*Holcus lanatus*), 2% clover (*Trifolium*), 2% birdsfoot trefoil (*Lotus corniculatus*).	Direct	Yes	Yes	EW Exotic Wetland	Low
MW16	Yes	Rapid assessment undertaken. Wetland dominated by soft rush (*Juncus effusus*). Likely an induced wetland associated with hillslope and drainage.	Indirect	No	Yes	EW Exotic Wetland	Low
MW17	Yes	This site is a stream/wetland complex. An ephemeral channel drains into a manhole. Rapid assessment undertaken. The exotic wetland is dominated by umbrella sedge (*Cyperus alternifolius*), soft rush (*Junus effusus*), creeping bent (*Agrostis stolonifera*), yorkshire fog (*Holcus lanatus*), gorse (*Ulex europaeus*), and creeping buttercup (*Ranunculus repens*) (on the riparian margin).	Indirect	No	Yes	EW Exotic Wetland	Low
MW18	Yes	Rapid assessment undertaken. Wetland dominated by creeping bent (*Agrostis stolonifera*). Permanently saturated ground. Presence of creeping buttercup (*ranunculus repens*), clover (*Trifolium*), and soft rush (*Juncus effusus*).	Indirect	No	Yes	EW Exotic Wetland	Low
MW19a	Yes	Impacted stream channel from grazing with a developed wetland habitat across the channel. Rapid assessment undertaken. Soil profile description plot taken. Wetland dominated by ~80% soft rush (*Juncus effusus*). Some patches of water pepper (*Persicaria hydropiper*), and chickweed (*Stellaria media*) present within the main channel.	Indirect	Yes	Yes	EW Exotic Wetland	Low

Wetland Name	NPS-FM Natural Inland Wetland	Vegetation Description	Direct or Indirect Effect	Within Designation	Within 100 m buffer	Singers et al. 2017 Classification	Value
MW19b	Yes	Impacted stream channel from grazing with a developed wetland habitat across the channel. Wetland dominated by ~80% soft rush (*Juncus effusus*). Some patches of water pepper (*Persicaria hydropiper*), and chickweed (*Stellaria media*) present within the main channel.	Indirect	Yes (marginal)	Yes	EW Exotic Wetland	Low
MW19c	Yes	Impacted stream channel from grazing with a developed wetland habitat across the channel. Rapid assessment undertaken. Soil profile description plot taken. Wetland dominated by ~80% soft rush (*Juncus effusus*). Some patches of water pepper (*Persicaria hydropiper*), and chickweed (*Stellaria media*) present within the main channel.	Indirect	Yes	Yes	EW Exotic Wetland	Low
MW20a	Yes	Impacted stream channel from grazing with a developed wetland habitat across the channel. Rapid assessment undertaken. Wetland dominated by ~80% soft rush (*Juncus effusus*). Some patches of water pepper (*Persicaria hydropiper*), and chickweed (*Stellaria media*) present within the main channel.	Indirect	Yes	Yes	EW Exotic Wetland	Low
MW20b	Yes	Impacted stream channel from grazing with a developed wetland habitat across the channel. Rapid assessment undertaken. Wetland dominated by ~80% soft rush (*Juncus effusus*). Some patches of water pepper (*Persicaria hydropiper*), and chickweed (*Stellaria media*) present within the main channel.	Indirect	No	Yes	EW Exotic Wetland	Low
MW20c	Yes	Impacted stream channel from grazing with a developed wetland habitat across the channel. Rapid assessment undertaken. Wetland dominated by ~80% soft rush (*Juncus effusus*). Some patches of water pepper (*Persicaria hydropiper*), and chickweed (*Stellaria media*) present within the main channel.	Indirect	No	Yes	EW Exotic Wetland	Low
MW20d	Yes	Impacted ephemeral stream channel from grazing. Presence of a developed soft rush (*Juncus effusus*) dominated (~90%) wetland habitat across the channel. Rapid assessment undertaken.	Indirect	No	Yes	EW Exotic Wetland	Low

Wetland Name	NPS-FM Natural Inland Wetland	Vegetation Description	Direct or Indirect Effect	Within Designation	Within 100 m buffer	Singers et al. 2017 Classification	Value
MW20e	Yes	Impacted ephemeral stream channel from grazing. Presence of a developed soft rush (*Juncus effusus*) dominated (~90%) wetland habitat across the channel. Rapid assessment undertaken.	Indirect	Yes	Yes	EW Exotic Wetland	Low
MW20f	Yes	This site is a stream/wetland complex. The wetland is dominated by reed sweetgrass (*Glyceria maxima*). Rapid assessment undertaken.	Indirect	No	Yes	EW Exotic Wetland	Low
MW21a	Yes	Rapid assessment undertaken. Soil profile description plot taken. Wetland dominated by water pepper (*Persicaria hydropiper*), soft rush (*Juncus effusus*), and bitter dock (*Rumex obtusifolius*).	Direct	Yes	Yes	EW Exotic Wetland	Low
MW21b	Yes	This site is a stream/wetland complex. The wetland is dominated by reed sweetgrass (*Glyceria maxima*). Rapid assessment undertaken.	Direct	Yes	Yes	EW Exotic Wetland	Low
MW22	Yes	Site confirmed as a small wetland. Includes patches of soft rush (*Juncus effusus*), and grazed pasture. Rapid assessment undertaken.	Indirect	No	Yes	EW Exotic Wetland	Low
MW23	Yes	Rapid assessment and vegetation plots undertaken. Soil profile description plot taken. Confirmed wetland, dominated by >80% creeping buttercup (*Ranunculus repens*), 5% water pennywort (*Hydrocotyle ranunculoides*), narrow-leaf plantain (*Plantago lanceolata*), selfheal (*Prunella vulgaris*), birdsfoot trefoil (*Lotus corniculatus*), and broom (*Cytisus scoparus*). Evidence of water pooling and slurry soils.	Indirect	No	Yes	EW Exotic Wetland	Low
MW24	Yes	Evidence of an impacted channel, and structural differences in vegetation. Similar habitat to upstream. Not directly impacted and unlikely to be.	Indirect	No	Yes	EW Exotic Wetland	Low
MW25	Yes	Rapid assessment undertaken. Presence of soft rush (*Juncus effusus*), yorkshire fog (*Holcus lanatus*), perennial rye (*Lolium perenne*), broadleaf dock (*Rumex ontusifolius*), creeping buttercup (*Ranunculus repens*), and dallisgrass (*Paspalum dilatatum*).	Direct	Yes	Yes	EW Exotic Wetland	Low
MW26a	Yes	Rapid assessment from roadside. Species visible from roadside include >90% soft rush (*Juncus effusus*).	Indirect	No	Yes	EW Exotic Wetland	Low
MW26b	Yes	From desktop view there is evidence of *Juncus sp.* and wetland hydrology. Species visible from roadside include >90% soft rush (*Juncus effusus*).	Indirect	No	Yes	EW Exotic Wetland	Low

Wetland Name	NPS-FM Natural Inland Wetland	Vegetation Description	Direct or Indirect Effect	Within Designation	Within 100 m buffer	Singers et al. 2017 Classification	Value
MW26c	Yes	From desktop there is evidence of *Juncus sp.* and wetland hydrology. Species visible from roadside include >90% soft rush (*Juncus effusus*).	Indirect	No	Yes	EW Exotic Wetland	Low
MW28	Yes	Within stream/pond margins there is evidence of wetland vegetation and hydrology.	Indirect	Yes	Yes	EW Exotic Wetland	Low
MW29	Yes	Presence of umbrella sedge (*Cyperus alternifolius*), soft rush (*Juncus effusus*), creeping buttercup (*Ranunculus repens*), and kikuyu (*Pennisetum clandestinum*).	Indirect	Yes	Yes	EW Exotic Wetland	Low
MW31	Yes	MW31/32 are combined wetlands on either side of S13 channel. Dominated by soft rush (*Juncus effusus*). Presence of ruatahi (*Carex geminata*), creeping buttercup (*Ranunculus repens*), and arum lily (*Zantedeschia aethiopica*).	Direct	Yes	Yes	EW Exotic Wetland	Low
MW32	Yes	MW31/32 are combined wetlands on either side of S13 channel. Dominated by soft rush (*Juncus effusus*). Presence of ruatahi (*Carex geminata*), creeping buttercup (*Ranunculus repens*), and arum lily (*Zantedeschia aethiopica*).	Direct	yes	Yes	EW Exotic Wetland	Low
MW33	Yes	Rapid assessment undertaken. Presence of soft rush (*Juncus effusus*), creeping buttercup (*Ranunculus repens*), yorkshire fog (*Holcus lanatus*), broad-leaved dock (*Rumex obustifolius*), and greater birdsfoot trifoil (*Lotus peduncilatus*).	Indirect	No	Yes	EW Exotic Wetland	Low
MW34	Yes	Rapid assessment undertaken. Presence of soft rush (*Juncus effusus*), creeping buttercup (*Ranunculus repens*), grey sedge (*Carex divulsa*), yorkshire fog (*Holcus lanatus*), and greater birdsfoot trifoil (*Lotus pedunculatus*).	Indirect	No	Yes	EW Exotic Wetland	Low
PW01	Yes	Rapid assessment undertaken. Dominated by soft rush (*Juncus effusus*), creeping buttercup (*Ranunculus repens*), hook grass (*Carex uncinata*), and orchard grass (*Dactylis glomerata*).	Indirect	No	Yes	EW Exotic Wetland	Low

7.9 Wetland Condition Index results

Table 7-6: Wetland condition index results for Mill Road Stage 1 wetland sites (Clarkson et al., 2004) MW1 to MW13

Wetland impact indicator	Wetland Condition Index													
	MW01	MW02	MW03	MW04	MW05	MW06	MW07	MW08	MW09	MW10	MW10a	MW11	MW12	MW13
Hydrological integrity	3	2	3	3	3	3	3	3	4	4		-	-	3
Physicochemical	3	3	3	3	3	2	3	3	3	3		-	-	3
Change in ecosystem intactness	3	4	3	2	3	3	3	3	4	4		-	-	3
Change in browsing, predation, and harvesting regimes	3	3	3	3	3	2	3	3	3	4		-	-	2
Change in dominance of native plants	2	2	4	3	3	4	4	4	4	3		-	-	2
Condition index (%)	53%	55%	62%	53%	56%	55%	60%	62%	67%	65%		-	-	48%
Catchment Index														
Modification to catchment hydrology	2	5	5	4	4	3	4	4	3	1		-	-	5
Water quality within the catchment	2	2	3	3	3	3	3	3	3	3		-	-	4
Animal access	3	3	3	3	3	3	3	3	3	4		-	-	5
Key undesirable species	2	3	2	1	2	2	3	3	2	3		-	-	2
% catchment introduced vegetation	2	4	3	3	3	3	3	3	2	2		-	-	3
Catchment pressures total score	56%	32%	36%	44%	40%	40%	36%	36%	48%	48%		-	-	24%
Condition Index % Overall	55%	44%	49%	48%	48%	48%	48%	49%	57%	56%		-	-	36%
Overall wetland condition category	Largely Modified	Largely Modified	Largely Modified	Largely Modified	Largely Modified	Largely Modified	Largely Modified	Largely Modified	Largely Modified	Largely Modified		-	-	Seriously Modified

Table 7-7 Wetland condition index results for Mill Road Stage 1 wetland sites (Clarkson et al., 2004) MW14 to MW20e

Wetland impact indicator	Wetland Condition Index											
	MW14		MW16	MW17	MW18	MW19a	MW19b	MW20a	MW20b	MW20c	MW20d	MW20e
Hydrological integrity	3	3	3	3	3	3	-	3	3	3	4	3
Physicochemical	3	3	3	3	3	3	-	3	3	3	3	3
Change in ecosystem intactness	4	3	3	3	3	3	-	3	2	3	4	3
Change in browsing, predation, and harvesting regimes	2	2	2	3	3	2	-	2	2	2	2	2
Change in dominance of native plants	2	3	3	3	3	3	-	3	3	3	3	3
Condition index (%)	55%	53%	54%	57%	57%	57%	-	54%	50%	53%	60%	55%
Catchment Index												
Modification to catchment hydrology	4	4	4	4	4	5	-	5	5	5	5	5
Water quality within the catchment	4	4	4	3	3	4	-	4	4	4	4	4
Animal access	5	5	5	4	4	5	-	5	5	5	5	5
Key undesirable species	3	3	2	2	1	3	-	3	3	3	3	2
% catchment introduced vegetation	4	3	3	4	4	4	-	4	4	4	4	4
Catchment pressures total score	20%	24%	28%	32%	36%	16%	-	16%	16%	16%	16%	20%
Condition Index % Overall	38%	39%	41%	45%	46%	37%	-	35%	33%	35%	38%	38%
Overall wetland condition category	Seriously Modified	Seriously Modified	Largely Modified	Largely Modified	Largely Modified	Seriously Modified	-	Seriously Modified	Seriously Modified	Seriously Modified	Seriously Modified	Seriously Modified

Table 7-8 Wetland condition index results for Mill Road Stage 1 wetland sites (Clarkson et al., 2004) MW20f to MW29

Wetland impact indicator	Wetland Condition Index											
	MW20f	MW21a	MW21b	MW22	MW23	MW24	MW25	MW26a	MW26b	MW26c	MW28	MW29
Hydrological integrity	4	3	3	3	3	-	4	-	-	-	-	-
Physicochemical	3	3	3	3	3	-	3	-	-	-	-	-
Change in ecosystem intactness	3	3	2	4	3	-	4	-	-	-	-	-
Change in browsing, predation, and harvesting regimes	2	2	3	2	3	-	4	-	-	-	-	-
Change in dominance of native plants	2	3	2	3	3	-	3	-	-	-	-	-
Condition index (%)	53%	53%	50%	54%	56%	-	65%	-	-	-	-	-
Modification to catchment hydrology	5	5	5	5	5	-	1	-	-	-	-	-
Water quality within the catchment	4	3	3	3	3	-	3	-	-	-	-	-
Animal access	5	5	4	5	5	-	4	-	-	-	-	-
Key undesirable species	2	3	3	2	2	-	3	-	-	-	-	-
% catchment introduced vegetation	4	4	4	4	3	-	2	-	-	-	-	-
Catchment pressures total score	20%	20%	24%	24%	28%	-	48%	-	-	-	-	-
Condition Index % Overall	36%	37%	37%	39%	42%	-	56%	-	-	-	-	-
Overall wetland condition category	Seriously Modified	Seriously Modified	Seriously Modified	Seriously Modified	Largely Modified	-	Largely modified	-	-	-	-	-

Table 7-9 Wetland condition index results for Mill Road Stage 1 wetland sites (Clarkson et al., 2004) MW31 to PW01

Wetland impact indicator	Wetland Condition Index					
	MW31	MW32	MW33	MW34	PW01	MW_03a
Hydrological integrity	3	3	3	3	3	
Physicochemical	3	3	3	3	3	
Change in ecosystem intactness	3	3	4	4	4	
Change in browsing, predation, and harvesting regimes	3	3	3	3	2	
Change in dominance of native plants	4	4	3	3	3	
Condition index (%)	60%	60%	57%	59%	57%	
Catchment Index						
Modification to catchment hydrology	3	3	4	4	4	
Water quality within the catchment	3	3	3	3	3	
Animal access	4	4	4	4	4	
Key undesirable species	4	4	3	3	3	
% catchment introduced vegetation	3	3	3	3	2	
Catchment pressures total score	32%	32%	32%	32%	36%	
Condition Index % Overall	46%	46%	44%	45%	47%	
Overall wetland condition category	Largely Modified	Largely Modified	Largely Modified	Largely Modified	Largely Modified	

Notes: The degree of modification was assessed using the following scoring 5 = very low/non, 4 = low, 3 = medium, 2 = high, 1 = very high and 0 = extreme.

7.10 Wetland site photos

*Table 7-10 Wetland site photos. (Wetlands indicated by a * show photos from the AECOM site investigations, all other photos are from the Boffa Miskell site investigation.)*

Site Description	Photo
Description: MW01	
Description: MW02*	

Description: MW03	
Description: MW03a	

Description: MW04*	

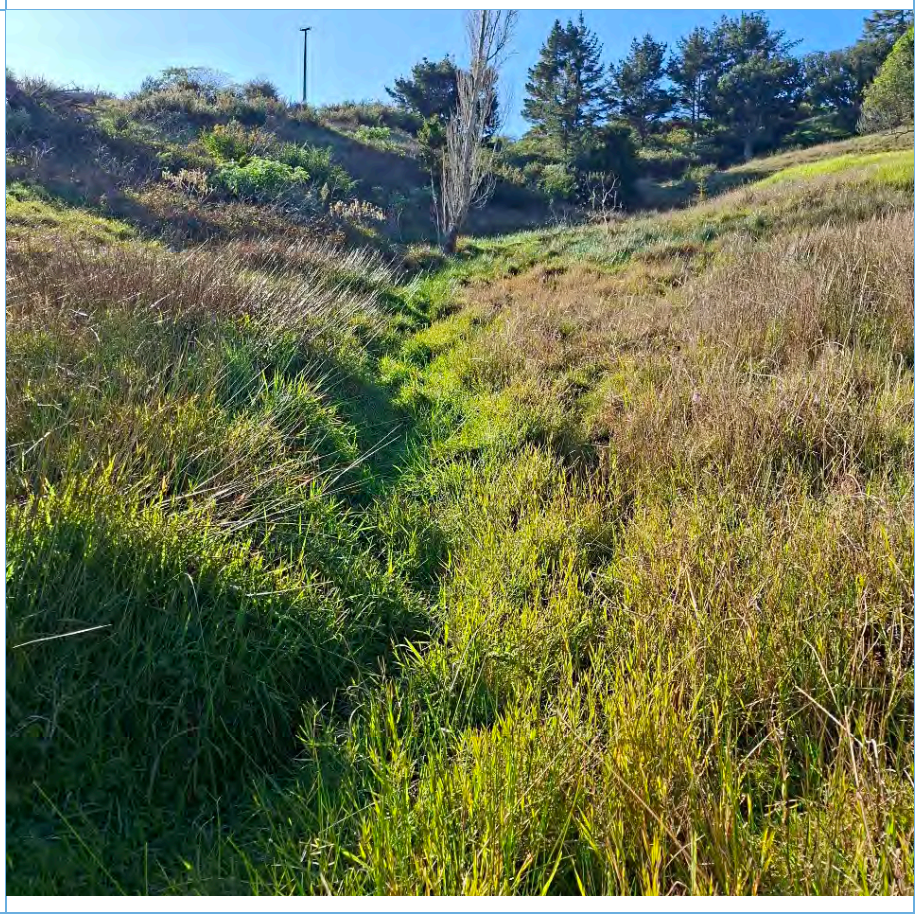
Description: MW05*	
Description: MW05*	

Description: MW06	
Description: MW07*	

Description: MW08*	
Description: MW09*	

Description: MW10*	
Description: MW10a	

Description: MW11*	
Description: MW12*	

Description: MW13	
Description: MW14	

Description: MW16*	

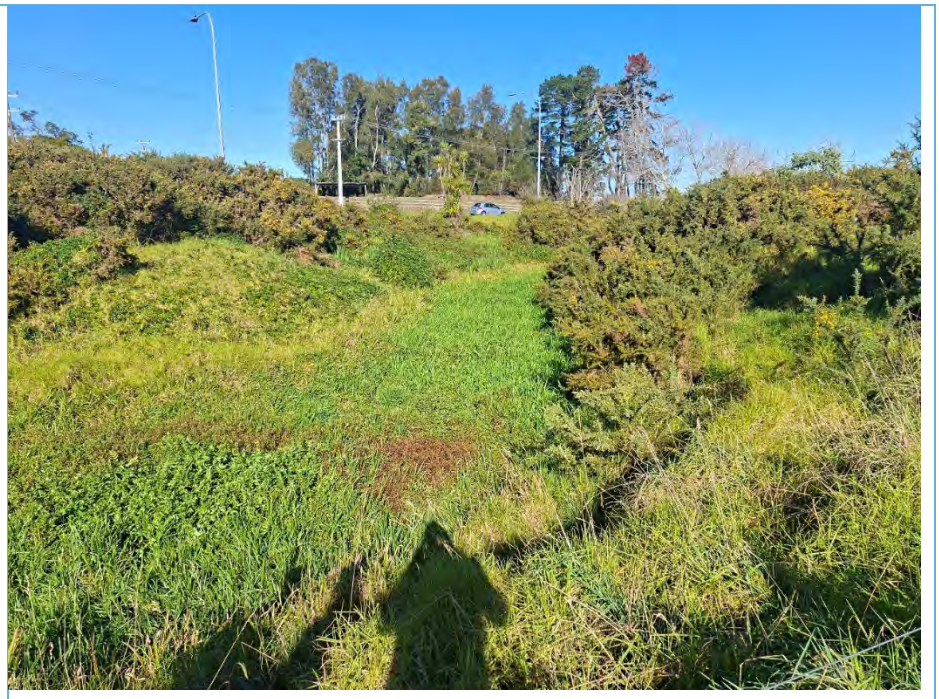
Description: MW17*	
Description: MW18*	

Description: MW19a*	
Description: MW20a*	

Description: MW20b*	
Description: MW20c*	

Description: MW20d*	
Description: MW20e*	

Description: MW20f*	
Description: MW21a	

Description: MW21b	
Description: MW22*	

Description: MW23*	
Description: MW23*	

Description: MW25	
Description: MW25*	

Description: MW28*	

APPENDIX G STORMWATER INFRASTRUCTURE

7.11 Consenting matters

Consenting triggers associated with stormwater outfalls and stream bed disturbance are provided in Table 7-11. Consenting triggers associated with culverts and stream bed disturbance are provided in Table 7-11Table 7-12. Wetlands have also been included in the tables to account for consenting triggers under Regulation 45 of the NES-F. The below tables provides a summary / overview of consenting triggers under the AUP and NES-F.

7.12 Outfalls

Consenting matters relating to stormwater outfalls are provided below in Table 7-11.

Table 7-11: Length of permanent scour protection within the stream bed removed and wetlands for the construction of stormwater outfalls

Feature	Stream ID	Associated wetlands	Catchment	Length of permanent permeable scour protection within the stream bed[23]*	Bed disturbance upstream or downstream of the structure**	Complies with standard E.3.6.1.14	Complies with Reg. 45 (wetlands)
New Outfall (RG MM03) Everglade	S01/ Permanent	N/A	Puhinui	>5 m	Approximately 2 m	No – Discretionary *	N/A
New Outfall (Wetland 1)	DS01/ Ephemeral	Within 100m of MW01	Puhinui	N/A	N/A	Yes - Permitted	Yes – unlikely to result in the complete or partial drainage or changes to hydrological function.
New Outfall (TD MM03)	S02/ Intermittent	Within 100m of MW02	Puhinui	<5 m	Approximately 2 m	Yes - Permitted	Yes – unlikely to result in the complete or partial drainage or changes to hydrological function.
New Outfall (RG MM06)	S04/ Intermittent	Within MW04	Puhinui	>5 m	Approximately 5 m	No – Discretionary *	No- Reg 45 (1) and (2) triggered
New Outfall (RG MM07)	DS04/ Ephemeral	N/A	Puhinui	N/A	N/A	Yes - Permitted	N/A
New Outfall (RG MM08)	S11 Ephemeral	Within 100m of MW09	Puhinui	N/A	N/A	Yes - Permitted	Yes – unlikely to result in the complete or partial drainage or changes to hydrological function.
New Outfall (RG MM09)	N/A	N/A		Puhinui	N/A	Yes - Permitted	N/A

[23] Stream bed is defined to be any stream habitat within the bankful width of the stream (as per the RMA definition).

New Outfall (RG MM10)	S14A/ Intermittent	N/A	Papakura	N/A	N/A	Yes - Permitted	N/A
New Outfall (RG MM11)	S18/ Intermittent	Within 100m of MW19a (upstream) and MW20a	Papakura	N/A	N/A	No – Discretionary*	Yes – unlikely to result in the complete or partial drainage. or changes to hydrological function.
New Outfall (RG MM12)	S21/ Intermittent	Within MW21a	Papakura	<5 m	Approximately 5 m	Yes - Permitted	No- Reg 45 (1) and (2) triggered
New Outfall (RG MM13)	S21/ Intermittent	Within 10m of MW21a	Papakura	N/A	N/A	No – Discretionary *	Yes – unlikely to result in the complete or partial drainage. or changes to hydrological function.

- *Standards E3.6.1.14 1(b) any required erosion or scour management works must not exceed 5 m in length either side of extended structure. **Calculated as 5m either side of the outfall structure to account for construction footprint.

7.13 Culverts

Consenting matters relating to culverts are provided below in Table 7-12.

Table 7-12: Proposed new and upgraded culverts associated with stream habitat, and details of any associated scour protection. Includes standards and regulations under the AUP and NES-F.

Feature	Stream ID	Associated Natural Inland Wetlands (NIL)	Catchment	Culvert length (m)	Impacted stream length (m)	Approximate Length of permanent permeable scour protection within the stream bed[24]	Complies with standard E.3.6.1.14	Designed for fish passage	Complies with NES-F Reg. 70. (fish passage)	Complies with Reg. 45 (wetlands)
New culvert MM01	S03 Ephemeral /Intermittent	MW03 NPS-FM NIL	Puhinui	>30 m	21.2 m	3 m	No – Discretionary *	No -No upstream fish habitat	No – Discretionary under Regulation 70(2)	No- Reg 45 (1) and (2) triggered
New culvert MM01A	S04 Ephemeral /Intermittent	MW04 NPS-FM NIL	Puhinui	>30 m	25.03 m (Int)	4.36 m Associated with outfall	No – Discretionary *	No - No upstream fish habitat	No – Discretionary under Regulation 70(2)	No- Reg 45 (1) and (2) triggered
New culvert MM01C	S05 Ephemeral /Intermittent	N/A	Puhinui	>30 m	7.57 m	2.4 m	No – Discretionary *	No - No upstream fish habitat	No – Discretionary under Regulation 70(2)	N/A
New culvert MM01D	S06	N/A	Puhinui	N/A	N/A	N/A	Yes - Permitted	N/A	N/A	N/A

[24] Stream bed is defined to be any habitat within the bankfull width of the stream (as per the RMA definition).

Feature	Stream ID	Associated Natural Inland Wetlands (NIL)	Catchment	Culvert length (m)	Impacted stream length (m)	Approximate Length of permanent permeable scour protection within the stream bed[24]	Complies with standard E.3.6.1.14	Designed for fish passage	Complies with NES-F Reg. 70. (fish passage)	Complies with Reg. 45 (wetlands)
	Ephemeral									
New culvert MM02	DS04 Ephemeral /Intermittent	MW07 NPS-FM NIL	Puhinui	>30 m ~44 m	37 m (intermit)	2.4 m	No – Discretionary *	No - No upstream fish habitat	No – Discretionary under Regulation 70(2)	No- Reg 45 (1) and (2) triggered
New culvert MM02A	DS04 Ephemeral	MW08 NPS-FM NIL	Puhinui	N/A	N/A	N/A	Yes - Permitted	N/A	N/A	Yes – unlikely to result in the complete or partial drainage or changes to hydrological function.
New culvert MM03	S11 Ephemeral	N/A	Puhinui	N/A	N/A	N/A	Yes - Permitted	N/A	N/A	N/A
New culvert MM03A,MM04, and stream diversion**	S16 Ephemeral	MW14 NPS-FM NIL	Papakura	>30 m 171.1 m diversion	N/A	8.3 m	No – Discretionary*	No - No upstream fish habitat	No – Discretionary under Regulation 70(2(b))	No- Reg 45 (1) and (2) triggered

Feature	Stream ID	Associated Natural Inland Wetlands (NIL)	Catchment	Culvert length (m)	Impacted stream length (m)	Approximate Length of permanent permeable scour protection within the stream bed[24]	Complies with standard E.3.6.1.14	Designed for fish passage	Complies with NES-F Reg. 70. (fish passage)	Complies with Reg. 45 (wetlands)
Culvert upgrade MM04A	S17 Intermittent	MW15 NPS-FM NIL	Papakura	~24 m (old) ~47 m (new)	10 m	N/A	No – Discretionary*	Yes SPOILER BAFFLES (OR SPAT ROPES). REFER TO DR-0506.	Yes - Permitted	No- Reg 45 (1) and (2) triggered
Culvert upgrade MM04B	S18 Intermittent		Papakura	~16 (new) ~35m (old)	N/A	25.58 m	Yes - Permitted	Yes SPOILER BAFFLES (OR SPAT ROPES). REFER TO DR-0506.	Yes - Permitted	No- Reg 45 (1) and (2) triggered
New Culvert MM05	S21 Intermittent	MW21a NPS-FM NIL	Papakura	>30 m	N/A	23.94 m	No – Discretionary*	Yes STREAMBED. REFER TO DR-0505	Yes - Permitted	No- Reg 45 (1) and (2) triggered
New Culvert MM06	S20 Intermittent	MW_26c NPS-FM NIL	Papakura	46.63 m	N/A	37.63 m	No – Discretionary*	Yes STREAMBED. REFER TO DR-0505	Yes - Permitted	No- Reg 45 (1) and (2) triggered

Feature	Stream ID	Associated Natural Inland Wetlands (NIL)	Catchment	Culvert length (m)	Impacted stream length (m)	Approximate Length of permanent permeable scour protection within the stream bed[24]	Complies with standard E.3.6.1.14	Designed for fish passage	Complies with NES-F Reg. 70. (fish passage)	Complies with Reg. 45 (wetlands)
Culvert upgrade MM10	S22 Intermittent	NPS-FM NIL	Papakura	<30 m	N/A	8.91m	No – Discretionary*	Yes STREAMBED. REFER TO DR-0505	Yes - Permitted	No- Reg 45 (1) and (2) triggered

* Culvert is greater than 30 m in length

+Culvert exceeds bed disturbance upstream and downstream of the structure.

**Diversion channel (E3.4.1 A19; AUP) will result in disturbance of the stream bed and has been considered in the activity table above.

A temporary culvert may be required within Puhinui gully at streams S12 and/or S13 to allow the construction of the bridge piers. The installation of any temporary culvert requires fish salvage and must be consistent with then FCRP.

7.14 Diversions

Consenting triggers relating to diversion channels are detailed below in Table 7-13.

Table 7-13: Consenting triggers relating to diversion channels under the AUP and NES-F.

Feature location	Catchment	Existing Stream Reach Length	Diversion length (m)	AUP (E3.4.1)	Complex Freshwater Fisheries Activities (Section 42 (4)(j)
S12	Puhinui	33.56 m	33.84 m	A19	Yes
S13	Puhinui	86.57 m (including culvert)	91.54 m	A19	Yes
S16/DS05	Papakura	78.66 m	171.1 m	A19	Yes
S20	Papakura	123.83 m	96.31 m	A19	Yes

7.14.1 Temporary diversions

The dimensions, design and placement of temporary stream diversions have not yet been determined. It is likely that temporary stream diversions may be required within S03, S05, DS04, S13, S12, S16, S17 and S20 for a period of more than three months to facilitate construction of permanent culverts and/or permanent diversions. Therefore, these works are likely to require Complex Freshwater Fisheries Approval under section 42(4)(j) of the Fast-track Approvals Act 2024 (FTAA).

7.15 Stream Daylighting

As part of the proposed mitigation for impacts on freshwater streams, two sections of streams will be daylighted. A 15.94 m length of daylighting will occur at Stream S13, and 246 m of stream will be daylighted at TR01 within Totara Park.

7.16 Outfall and Culvert Descriptions

Further details of proposed outfalls and culverts are outlined below.

Outfall RG MM03 at S01

A new outfall connected to a raingarden (RGMM03) at Everglade (SEA) is proposed to discharge into S01.

Outfall TD MM03 at S02

A new outfall connected to a proprietary device is proposed to discharge into S02.

Works are within 10 m of MW02 but are unlikely to result in the complete or partial drainage or changes to ecological functioning.

Outfall 'SW Wetland 1' at DS01

A new stormwater outfall at 'SW Wetland 1' is proposed above the headwaters of DS01 (>10 m away from intermittent stream channel). The proposed outfall shall discharge treated stormwater from the SW

Wetland 1. The proposed wetland and outfall have been designed to ensure stormwater infrastructure maintains new flow capacities modelled for the MR Stage 1 Project.

Culvert MM01 at S03

A new culvert (>30m in length) is proposed at the headwaters of S03 to facilitate the new MR Stage 1 road alignment. The culvert spans the transitional zone between ephemeral and intermittent stream channel leading to approximately 21.2 m of intermittent stream to be culverted. Construction works within the bed of a stream[25] will be required. Details of approximate stream bed disturbance are detailed in Section 4. Owing to no upstream habitat for freshwater fish, the culvert is not designed to meet provisions for fish passage and therefore will require Complex Freshwater Fisheries Approval under section 42(4)(j) of the Fast-track Approvals Act 2024 (FTAA).

S03 additionally contains wetland habitat that meets the definition of natural inland wetland under the NES-F. The proposed earthworks to construct the culvert will occur within the natural wetland (MW03).

Culvert MM01A at S04

A new culvert (>30m in length) is proposed at the headwaters of S04 to facilitate the new MR Stage 1 road alignment. The culvert spans the transitional zone between ephemeral and intermittent stream channel leading to approximately 25.03 m of intermittent stream to be impacted. Construction works within the bed of a stream will be required. Details of approximate stream bed disturbance are detailed in Section 4.Owing to no upstream habitat for freshwater fish, the culvert is not designed to meet provisions for fish passage and therefore will require Complex Freshwater Fisheries Approval under section 42(4)(j) of the Fast-track Approvals Act 2024 (FTAA).

S04 additionally contains wetland habitat that meets the definition of natural inland wetland under the NES-F. The proposed earthworks to construct the culvert will occur within the natural wetland (MW04).

Outfall RG MM06 at S04

A new stormwater outfall (RG MM06) connected to a raingarden is proposed at the headwaters of S04, discharging related stormwater to the intermittent stream. The proposed outfall has been designed to ensure stormwater infrastructure maintains new flow capacities modelled for the MR Stage 1 Project.

. Additionally, the proposed earthworks construct the outfall will occur within the natural wetland (MW04).

Culvert MM01C at S05

A new culvert (>30m in length) is proposed at the headwaters of S05 to facilitate the new MR Stage 1 road alignment. The culvert spans the transitional zone between ephemeral and intermittent stream channel leading to approximately 7.57 m of intermittent stream loss. Construction works within the bed of a stream will be required. Owing to no upstream habitat for freshwater fish, the culvert is not designed to meet provisions for fish passage and therefore will require Complex Freshwater Fisheries Approval under section 42(4)(j) of the Fast-track Approvals Act 2024 (FTAA).

Culvert MM01D at S06

A new culvert (≥30 m in length) is proposed to discharge into an ephemeral tributary of S06.

Culvert MM02 at DS04

A new culvert (>30m in length) is proposed at the headwaters of DS04 to facilitate the new MR Stage 1 road alignment. The culvert spans the transitional zone between ephemeral and intermittent stream channel leading to approximately 37.56 m of intermittent stream to be culverted. Construction works within the bed of a stream will be required. Owing to no upstream habitat for fish, the culvert is not designed to meet provisions for fish passage and therefore will require Complex Freshwater Fisheries Approval under section 42(4)(j) of the Fast-track Approvals Act 2024 (FTAA).

[25] The RMA defines the bed of a river/stream as “the space of land which the water of the river cover at it’s fullest flow without overtopping it’s banks.”

Work are within 10m of wetland MW07 but are unlikely to result in the complete or partial drainage of the wetland, or changes to the wetland hydrology.

Outfall RG MM07 at DS04 – Ephemeral

A new outfall connected to 'SW Wetland 2" is proposed to discharge into an ephemeral tributary of DS04.

Culvert MM02A discharging to MW08 – Ephemeral

A new culvert <30 m in length) is proposed to discharge into an ephemeral tributary of DS04.

Earthworks, including the diversion of water shall occur within 100m of a natural inland wetland (MW_08). The wetland is currently hydrologically maintained by natural fluctuations of the Puhinui stream tributary (DS04). Works are unlikely to result in the complete or partial drainage of all or part of the natural wetland or result in changes to the hydrological function of the wetland.

Culvert MM03 at S11

A new culvert (<30 m in length) is proposed to discharge into an ephemeral tributary of S11.

Outfall RG MM08 at S11

A new outfall connected to a raingarden is proposed to discharge into an ephemeral tributary of S11 within an SEA.

Outfall RG MM10 at S14A

A new outfall (RG MM10) connected to a raingarden is proposed to discharge into the upper banks of S14A.

Culvert MM03A and MM04 at S16 and MW14

New culverts MM03A (<30 m) and MM04 (>30m in length) is proposed to divert water from S16 under the MR Stage 1 Road alignment. The ephemeral stream reach will be realigned leading to a channel, linking up with DS04. A new recontoured stream diversion shall be constructed on the western side of the road alignment. The proposed diversion channel is to be approximately 171.1 linear m and shall be replanted following best practice stream restoration protocols (refer to Freshwater Management Plan).

Construction works to connect the stream to the new diversion channel will be required. Details of approximate stream bed disturbance are detailed in Section 4. The culvert is not proposed to prevent the passage of fish upstream or downstream. However, the culvert will not be situated parallel to the slope of the stream bed and therefore the culvert does not comply with Regulation 70(2(b)) of the NES- F.

S16 is a stream-wetland complex whereby hydrophytic vegetation is present within the stream channel and surrounding flood plain. These wetlands meet the definition of natural inland wetland under the NES-F. The proposed earthworks and vegetation clearance will occur within the natural wetland (MW14).

Culvert MM04A at S16/17 and MW19a

The existing culvert located under the existing Mill Road will require upgrading to facilitate the tie-in of the proposed diversion channel to the existing stream. Fish passage is already limited at the existing culvert and fish passage design upgrades are restricted due to the operational watermain pipe that traverses across the culvert. Efforts to incorporate fish passage design into the culvert upgrade shall be undertaken. Part of these works shall include upgrading the culvert to meet fish passage provisions under the NES-F, where feasible. This culvert is >30 m in length and has scour protection in excess of 5 m.

S16/S17 is a stream wetland complex whereby hydrophytic vegetation is present within the stream channel and surrounding flood plain. These wetlands meet the definition of natural inland wetland under the NES-F. The proposed scour protection will occur within the natural wetland (MW19a).

Culvert MM04B at S17/ S18

A new culvert is required under the existing Ranfurly Road to facilitate the construction of the Ranfurly Road Roundabout. Part of these works shall include upgrading the culvert to meet fish passage provisions

under the NES-F. An existing culvert will stay in-situ. The new culvert is <30 m in length, but has scour protection in excess of 5 m in length.

Outfall RG MM11 at S18

A new outfall connected to a raingarden is proposed to discharge into S18.

Culvert MM05 at S21 and MW21a

A new culvert (>30m in length) is proposed at S21 and MW21a to facilitate the road alignment. Construction works within the bed of a stream will be required. Details of approximate stream bed disturbance are detailed in Section 5. The culvert is not proposed to prevent the passage of fish upstream or downstream. The proposed new culvert complies with Regulation 70 of the NES- F

S21 is a stream wetland complex whereby hydrophytic vegetation is present within the stream channel. These wetlands meet the definition of natural inland wetland under the NES-F.

Outfall RG MM12 at S21 and MW21a

A new outfall connected to a raingarden is proposed to discharge into S21.

S21 is a stream wetland complex whereby hydrophytic vegetation is present within the stream channel. These wetlands meet the definition of natural inland wetland under the NES-F. The proposed earthworks and vegetation clearance will occur within the natural wetland (MW21a).

Culvert MM06 at S20 and MW21b

A new culvert (>30m in length) is proposed at a diverted S20 to facilitate the road alignment and Alfriston Road roundabout. Approximately 123.83 m of stream shall be diverted through 96.31 m of new stream channel. Construction works within the bed of a stream will be required. Details of approximate stream bed disturbance are detailed in Section 5. The culvert is not proposed to prevent the passage of fish upstream or downstream. The proposed new culvert complies with Regulation 70 of the NES- F as a permitted activity.

S20 is a stream wetland complex whereby hydrophytic vegetation is present within the stream channel. These wetlands meet the definition of natural inland wetland under the NES-F. The proposed earthworks and vegetation clearance will occur within the natural wetland (MW21b).

Outfall RG MM13 at S21 and MW21a

A new outfall connected to a raingarden is proposed to discharge into S20 and MW21a.

S21 is a stream wetland complex whereby hydrophytic vegetation is present within the stream channel. These wetlands meet the definition of natural inland wetland under the NES-F. The proposed earthworks and vegetation clearance will occur within the natural wetland (MW21a).

Culvert MM10 at S22

The existing culvert located under the existing Mill Road will require upgrading to facilitate the widening of the MR Stage 1 Road Alignment. Part of these works shall include upgrading the culvert to meet fish passage provisions under the NES-F.

7.17 Proposed Design

Detailed design of all streamworks have not yet been undertaken.

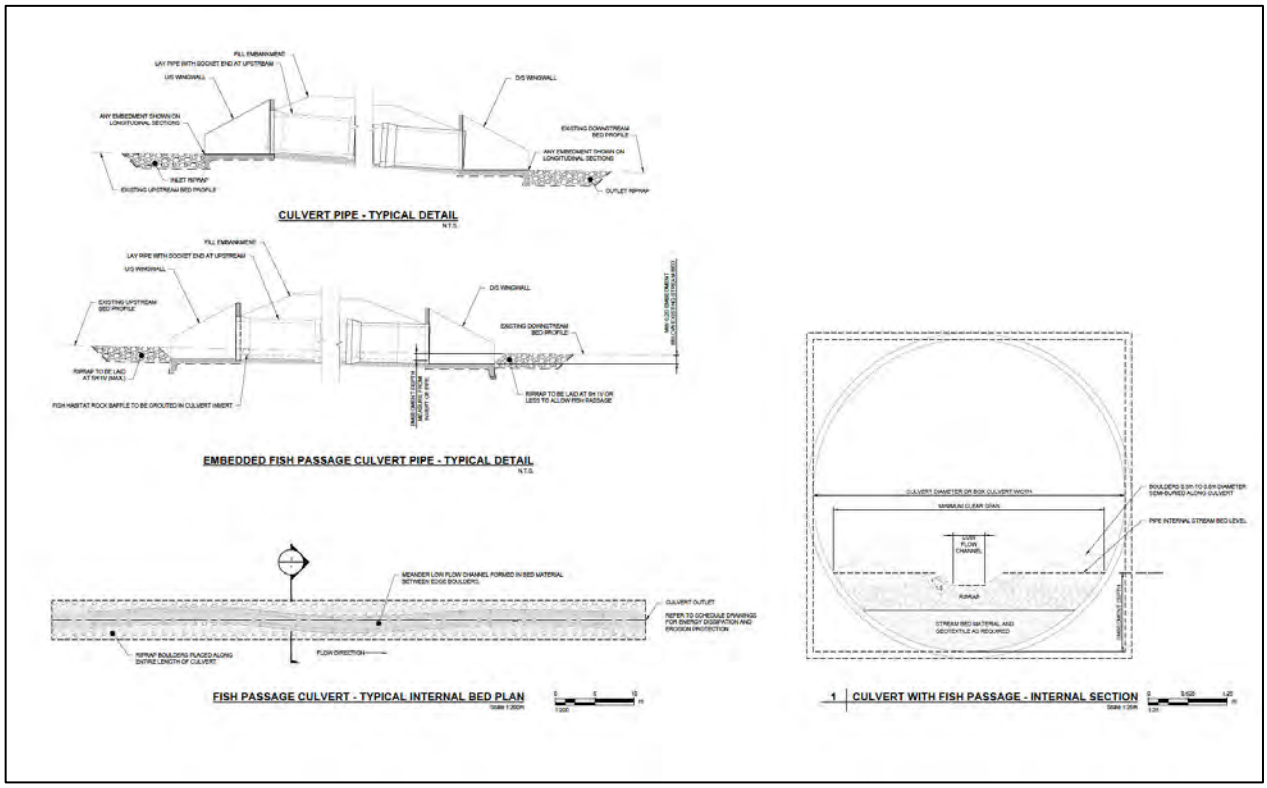


Figure 7-2: Mill Road Stage 1 Culvert Design – Culvert with Embedded Fish Passage. From AECOM Mill Road – Stage 1: Consenting Desing. Sheet Number 60755376-SHT-DR-0505.

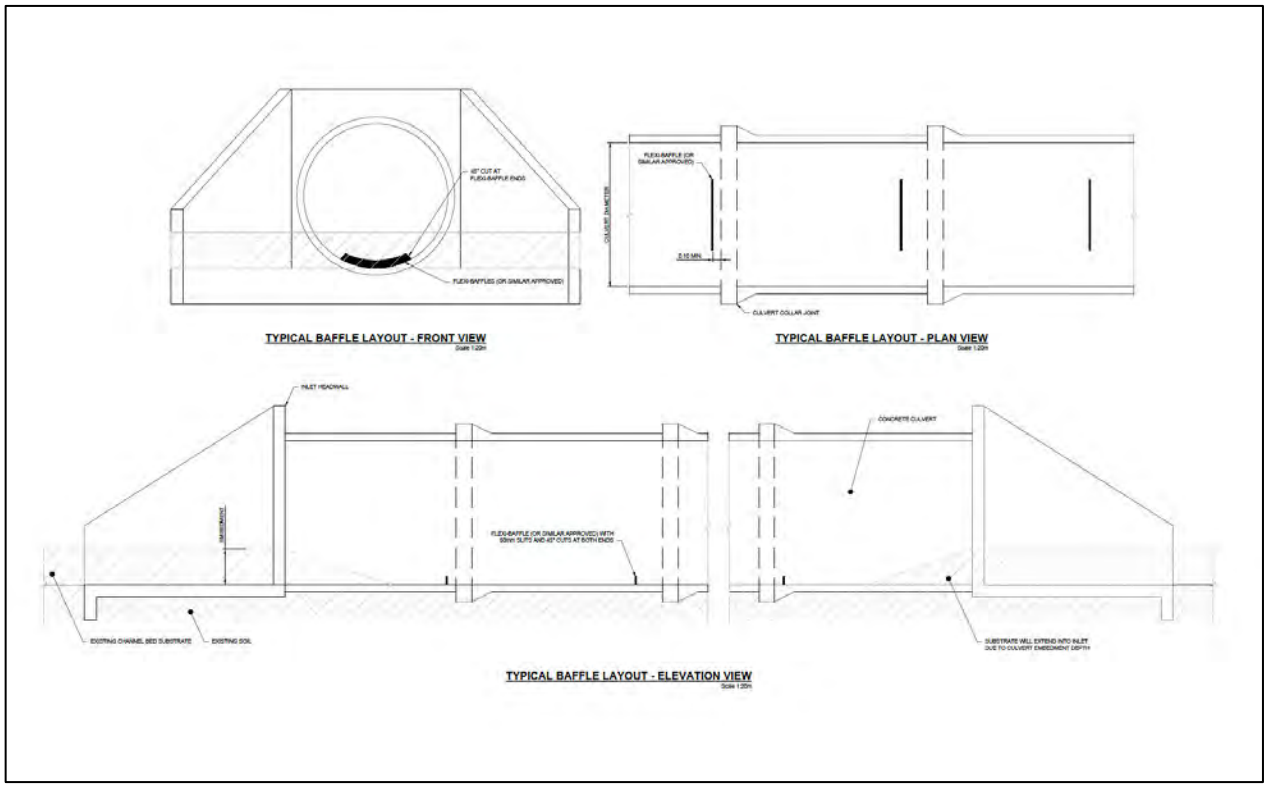


Figure 7-3: Mill Road Stage 1 Culvert Design – Culvert with Baffles. From AECOM Mill Road – Stage 1: Consenting Desing. Sheet Number 60755376-SHT-DR-0506.

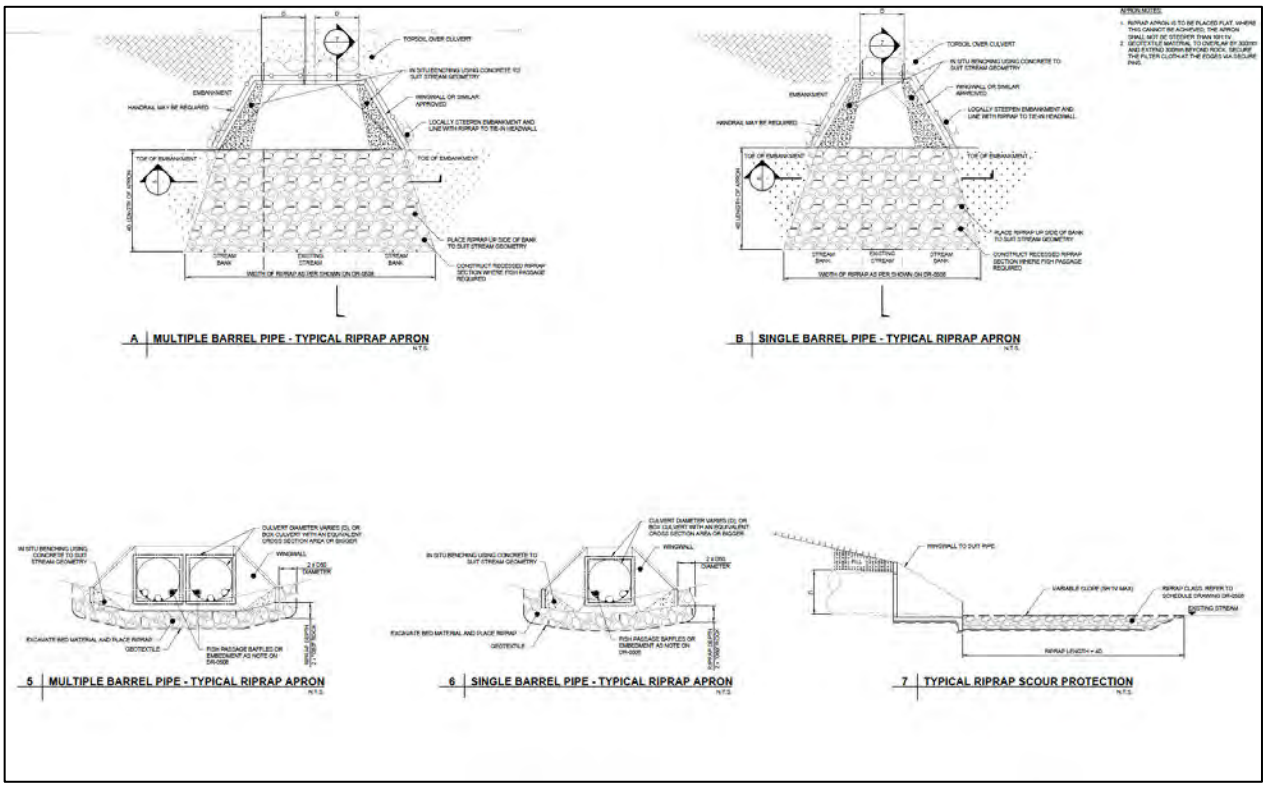


Figure 7-4: Mill Road Stage 1 Drainage Details Culvert Outfalls. From AECOM Mill Road – Stage 1: Consenting Desing. Sheet Number 60755376-SHT-DR-0507.

APPENDIX H ENVIRONMENTAL COMPENSATION RATIO ASSESSMENT FOR RESIDUAL STREAM EFFECTS

7.18 Background

The Project will result in direct impacts to 675 m of stream habitat through culverting, reclamation and erosion protection measures. A number of residual effects of the Project remain after the application of avoidance, minimisation and remediation measures and offset mitigation is required to address residual effects. Accordingly, three stream reaches are proposed for offset mitigation; S21, S17 and TR01. These locations, their values and their SEV scores are detailed in Appendix B.

Mitigation is required to ensure 'No Net Loss' of stream and extent and value as a result of the Project. The Stream Ecological Valuation (Storey et al., 2011) provides guidelines for calculating an Environmental Compensation Ratio (ECR) to offset the adverse effects of stream impacts and to ensure 'No Net Loss' of stream biodiversity function.

This assessment presents the results of the ECR to calculate the amount of stream offset required to achieve 'No Net Loss'. It also includes the assumptions used during the calculation and discusses the selection and appropriateness of stream offset sites.

7.19 ECR Calculation

The ECR utilises the SEV score to calculate a ratio for the minimum stream area (stream bank width x stream length) to be restored as mitigation for stream loss (Storey et al., 2011). The aim of the ECR is to ensure No Net Loss of ecological function (loss of function at impact site, gain of function at offset site). The formula for the ECR calculation is set out below:

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

- SEVi-C & SEVi-P are the current and potential SEV values respectively for the site to be impacted.
- SEVm-C & SEVm-P are the current and potential SEV values respectively for the site where environmental offset is to be applied.
- SEVi-I is the predicted SEV value of the stream to be impacted, after impact.

When calculating SEV scores for use within the ECR, the biotic function scores (IFI and FFI) are excluded from the score, with the remaining 12 attributes averaged to create the overall score.

7.20 Impacted Sites

A breakdown per SEV function (hydraulic, biogeochemical, habitat provision, and biodiversity), and justification for the predicted scores is provided in Attachment B. Approximately 675 m (2024 m^2) of streams shall be impacted as a result of the Project. The following assumptions about stream impact areas have been made:

- The impact length for culverts includes the upstream and downstream extent of any aprons, if present.
- The effects of riprap are included where the effect is considered moderate or higher, this generally equates to riprap associated with culverts and outfalls that is located within the streambed only and is greater than 5 m in length measure parallel to stream flow. Riprap less than 5 m is considered low impact and is not considered to have any residual effects required offset mitigation.
- The effects of bridging are considered.

7.21 Offset Sites

7.22 Offset site justification

Approximately 818 m (3,533 m^2) of stream habitat suitable for offset mitigation has been identified across three watercourses; S21, S17 and TR01. Figures of the sites are present in Attachment A. All sites are highly modified intermittent watercourses and are located within the same catchments as the impacted sites. The offset locations are briefly described below:

- S21: located within designation (soft-bottomed, intermittent tributary of Papakura stream), comprises approximately 233 linear meters of stream, equating to 1,338 m^2 of habitat.
- S17: located at 116 Ranfurly Road and streams within designation (soft-bottomed, intermittent tributary of Papakura stream), comprises approximately 349 m linear meters of stream, equating to 1,849 m^2 of stream habitat.
- TR01: currently piped intermittent tributary of Puhinui stream at Totara Park, comprises approximately 246 m, which once daylighted will equate to 246 m^2 of stream habitat.

Table 7-14: Proposed stream offset mitigation sites.

Site	Length available	Mitigation	SEVm-C	SEVm-P	Catchment	Within Designation	Address
S21	223 m	Restoration	*0.348*	*0.629*	Papakura	Yes	2 Wastney Road
S17	349 m	Restoration	*0.339*	*0.577*	Papakura	Yes	116 Ranfurly Road
TR01	246 m	Daylighting Restoration	*0.000*	*0.591*	Puhinui	No	Totara Park

The selection of offset mitigation restoration sites considered a number of factors including:

- 'Like-for-like streams. i.e. similar order, catchment and permanence classification.
- As close as possibly to the impact site, so ecological gains are in the same catchment as losses.
- Sites provide enough habitat to provide the quantum of mitigation required as a result of the Project.

The unavoidable loss of both ecological value and extent are satisfied through the offset mitigation of restoration and daylighting (creating of new open stream channel).

Offsetting of stream extent has further been demonstrated by creation of stream via the proposed diversion channel (DS05) where an additional 90 m of stream length can be created.

7.23 Offset and Restoration Assumptions

The following general assumptions were made in relation to offset sites and SEV ECR Scores. More detail assumptions associated with SEV ECR scores are available in Appendix A.

- Riparian restoration will be undertaken at offset sites (S17, S21) as well as all diversion channels (S12, S13, S16 and S20).
- Daylighting and riparian restoration will occur at TR01. The existing piped network will be removed and a meandering stream channel created.

- Ecological improvement through restoration of the riparian margin, to 10 m, with suitable native planting of the stream banks will occur and will be based on Auckland Council Riparian Facts – Stream Planting guide[26].
- Where practicable, vegetation within the 20 m riparian margin will be retained. This may include exotic species where they provide ecological value such as through shading. Any pest plant species shall be removed.
- All restoration planting will have a maintenance schedule for five years following completion of planting.
- All predicted SEV scores for stream restoration, stream diversion or stream daylighting sites are predicted at 10-years post completion.
- Only residual effects at diversion sites, following remedy, are included in SEV ECR calculations.
- Bank-full stream widths were used.

7.24 Environmental Compensation Ratio and Stream Value

The total impacted stream[27] is 386 m or 1,605 m^2. ECR calculations use predicted scores for the potential value of both the impact and mitigation sites (if restoration were to occur), as well as the predicted score following impact and the current value of the mitigation site. The ECR calculations are presented below in Table 7-15.

The ECR calculation ensures that, through stream function, there is no-net-loss to freshwater ecological values as a result of the Project.

Total stream impacts from the project will occur on 386 linear meters, or 1,605 m^2 of stream habitat. Across the restoration sites there is approximately 818 linear meters or 3,433 m^2 of stream habitat available for restoration. To ensure no net loss of stream ecological function, as calculated through the ECR, 2,600 m^2 of stream habitat requires restoration. This represents a residual restoration area of 832 m^2 that is proposed to be restored. This will result in no net loss of ecological function of streams as a result of the Project and a positive residual outcome of 832 m^2.

[26] https://www.aucklandcouncil.govt.nz/environment/plants-animals/plant-for-your-ecosystem/Documents/streamside-planting-guide.pdf
[27] Excluding diversions

Table 7-15: ECR calculation for impacted streams and offset location at Puhinui (TR01) and Papakura (S17)

ECR	S02	S03	S04	DS04	S14	S17	S18	S19
Effect type	*Culvert*	*Culvert*	*Culvert*	*Culvert*	*Culvert*	*Riprap*	*Riprap*	*Riprap*
SEVi-P	0.486	0.698	0.702	0.745	0.790	0.577	0.577	0.629
SEVi-I	0.2	0.2	0.2	0.2	0.2	0.336	0.336	0.336
SEVm-P	0.591	0.591	0.591	0.591	0.577	0.577	0.577	0.577
SEVm-C	0.000	0.000	0.000	0.000	0.339	0.339	339	0.339
ECR	**0.726**	**1.265**	**1.276**	**1.385**	**3.709**	**1.517**	**1.517**	**1.838**
Impact area (m^2)	4.24	22.4	23.27	138.972	34.87	**127.62**	156.04	96.66
Offset area required (m^2)	**3.077**	**21.455**	**29.706**	**192.44**	**129.31**	**193.64**	**236.75**	**177.70**
Offset Location	Puhinui (TR01)	Puhinui (TR01)	Puhinui (TR01)	Puhinui (TR01)	Papakura (S17)	Papakura (S17)	Papakura (S17)	Papakura (S17)

Table 7-16: ECR calculation for impacted streams and offset location at Papakura (S17 and S20)

ECR	S20	S20	S20	S21	S21	S21	S22	S13a	S05
Effect type	*Culvert*	*Riprap*	*Reclamation*	*Culvert*		*Riprap*	*Riprap*	*Reclamation*	*Culvert*
SEVi-P	0.556	0.556	0.556	0.556	0.629	0.629	0.563	0.550	0.719
SEVi-I	0.300	0.336	0.336	0.336	0.336	0.336	0.336	0.000	0.250
SEVm-P	0.577	0.577	0.629	0.577	0.629	0.629	0.629	0.629	0.629
SEVm-C	0.339	0.339	0.348	0.339	0.348	0.348	0.348	0.348	0.348
ECR	**1.610**	**1.383**	**1.175**	**2.066**	**1.755**	**1.562**	**1.213**	**2.938**	**2.508**
Impact area (m^2)	227.51	**184.39**	**134.85**	**234.00**	**42.66**	**143.64**	**29.40**	**1.20**	**6.81**
Offset area required (m^2)	**366.32**	**254.94**	**158.40**	**570.18**	**74.84**	**224.33**	**35.68**	**3.53**	**17.10**
Offset Location	Papakura (S17)	Papakura (S17)	Papakura (S21)	Papakura (S17)	Papakura (S21)	Papakura (S21)	Papakura (S21)	Papakura (S21)	Papakura (S21)

7.25 Stream Extent

The Project will result in the unavoidable loss of 27.52 linear meters of stream habitat. Through extended stream diversion and daylighting and additional 327.83 linear meters of stream habitat will be created. Stream diversions have sought to replace stream habitat at a minimum ratio of 1:1. However, this has not always been practicable, with a shortfall at the S20 Diversion.

The Project will see a net gain of 327.83 linear meters of stream habitat.

7.26 Conclusion

The application of the ECR to the will result in no-net-loss of ecological value for freshwater stream habitats as a result of the Project. The creation of additional habitat will result in no loss of stream extent as a result of the Project.

A FMP has been developed to outline the methods and measures required to achieve no-net-loss of ecological value.

Attachment A – Offset stream sites Photos

Table 7-17 Offset stream sites photo log and description

Site Description	Photo
TR01 Totara Park proposed daylighting and restoration site	
Description: Broken piped network at TR01. Evidence of stream flow suggestive of intermittent stream channel. Pipe is broken in several locations throughout the stream where the stream may intermittently flow above ground before returning to pipe.	
TR01 Totara Park proposed restoration site	

Description: Deep incised channel scour arising from broken piped network.	
S17 Restoration Site	
Description: proposed restoration site Stream S17 at 116 Ranfurly. The stream is a stream-wetland complex within open pasture.	
S21 Restoration Site	
Description:	

Attachment B – Offset stream sites SEV ECR Assumptions

7.27 SEV impact model predictions for Riprap

Table 7-18 Predicted change following impact of permeable scour protection from stormwater outfalls

SEV Function	Justification for predicted scores following installation permeable scour protection
Hydraulic function mean score	Vchann: Stream shall be lined with riprap impacting flow pattern (hydraulic complexity) leading to a reduction in score. Vlining: Bank and bed will be artificially lined (permeable lining) Vpipe: No piped inflows excluding the main stream channel culvert associated with the riprap outfall. Vbank: Banks potentially widen, artificially constructed to contain flows. Reduced connectivity to the floodplain. Vrough: Artificial surfaces will replace natural stream bed, banks and riparian zone. Vbarr: No change to barriers.
Biogeochemical function mean score	Vshade: Assumed no riparian planting adjacent to riprap outfalls therefore no effective shading. Vdod: Hard surface of riprap lining prevents anaerobic sediment forming reducing Dissolved Organic Matter (DOM) score. Vripar: No riparian vegetation. Vdecid: Assume no non-deciduous vegetation. Vmacro: Channel lining will largely prevent particle retention and limited macrophyte growth will occur. Vsurf: Riprap will consist of D50 substrate – i.e. assessed as cobbles like substrate. Vripfilt: Assumed liited filtering activity due to artificial structure and no riparian vegetation.
Habitat provision function mean score	Vgalspwn, Vgalqual, Vgobspwn: No spawning habitat, stream largely unsuitable. Vphyshab: Habitat diversity and abundance decreases, riparian integrity decreases. Vwatqual: Catchment-wide water quality will remain the same although cumulative effect of wider works considered. Vimperv: Catchment-wide proportion of impervious surfaces will slightly increase through project.
Biodiversity function mean score	Vfish: Excluded in SEVi. Vmci: Excluded in SEVi. Vripconn: Channel lining obstructing connection between stream and riparian zone
Overall mean SEV score	The average SEVi score for scour protection associated with stormwater outfalls across the project is 0.336.

Attachment C - Assumptions used in the predicted scores for Restoration Sites

7.28 Intermittent Stream S17 at 116 Ranfurly

Table 7-19 Current scores and predicted change following restoration for S17 at 116 Ranfurly Road

SEV Function	SEVm-C	SEVm-P	Justification for predicted scores following stream restoration
Hydraulic function mean score	0.58	0.66	Vchann: Early successional planting will increase channel shade, however unlikely to change flow patterns due to increased roughness elements from wetland vegetation. Vlining: Assumed reduction in unnatural loading of silt due to riparian buffer. Vpipe: No additional piped inflows will be created. Vbank: Assumed no change to connectivity. Vrough: Assume mature and regenerating indigenous vegetations will take place to improve on existing bare banks, long grasses and exotic vegetation. Vbarr: Assumed no change to any existing barrier to migration.
Biogeochemical function mean score	0.25	0.66	Vshade: Native riparian margin will be planted, leading to increased shading. Vdod: Effective shading may take some years to impact macrophyte growth, assume no change. Vripar: Planting of native early-stage riparian vegetation on the banks will improve the intactness of riparian zone. Vdecid: Non-deciduous native riparian planting will increase the proportion of non-deciduous cover. Vmacro: Assumed no change from SEVc due to natural presence of wetland vegetation and difficultly in predicting biological change. Vsurf: Assumed no change in substrate. An increase in organic matter may take place as riparian planting matures. Vripfilt: Improvement early-stage restoration planting on banks will improve filtering activity.
Habitat provision function mean score	0.19	0.20	Vgalspwn, Vgalqual, Vgobspwn: Amount of habitat cannot be increased. Vphyshab: Assumed increase in physical habitat quality (increase structure from woody debris and allochthonous material). However, assume riparian integrity improvements from early restoration planting. Vwatqual: Catchment-wide water quality will remain the same. Vimperv: Catchment-wide proportion of impervious surfaces will remain the same.
Biodiversity function mean score	0.14	0.43	Vfish: Excluded in SEVi. Vmci: Excluded in SEVi. Vripcond: Assumed improvement in riparian condition (cover, abundance, composition and structure) Vripconn: Have assumed no realistic change in connectivity.
Overall mean SEV score	0.339	0.577	The SEV score will increase by 0.239.

7.29 Intermittent Stream at S21 within Designation

Table 7-20 Current scores and predicted change following restoration for S21

SEV Function	SEVm-C	SEVm-P	Justification for predicted scores following stream restoration
Hydraulic function mean score	0.59	0.76	Vchann: Early successional planting will increase channel shade, however unlikely to change flow patterns due to increased roughness elements from wetland vegetation. Vlining: Assumed reduction in unnatural loading of silt due to riparian buffer. Vpipe: No additional piped inflows will be created. Vbank: Assumed no change to connectivity. Vrough: Assume mature and regenerating indigenous vegetations will take place to improve on existing bare banks, long grasses and exotic vegetation. Vbarr: Assumed no change to any existing barrier to migration.
Biogeochemical function mean score	0.23	0.62	Vshade: Native riparian margin will be planted, leading to increased shading. Vdod: Effective shading may take some years to impact macrophyte growth, assume no change. Vripar: Planting of native early-stage riparian vegetation on the banks will improve the intactness of riparian zone. Vdecid: Non-deciduous native riparian planting will increase the proportion of non-deciduous cover. Vmacro: Assumed no change from SEVc due to natural presence of wetland vegetation and difficultly in predicting biological change. Vsurf: Assumed no change in substrate. An increase in organic matter may take place as riparian planting matures. Vripfilt: Improvement early-stage restoration planting on banks will improve filtering activity.
Habitat provision function mean score	0.27	0.31	Vgalspwn, Vgalqual, Vgobspwn: Amount of habitat cannot be increased. Vphyshab: Assumed increase in physical habitat quality (increase structure from woody debris and allochthonous material). However, assume riparian integrity improvements from early restoration planting. Vwatqual: Catchment-wide water quality will remain the same. Vimperv: Catchment-wide proportion of impervious surfaces will remain the same.
Biodiversity function mean score	0.12	0.28	Vfish: Excluded in SEVi. Vmci: Excluded in SEVi. Vripcond: Assumed improvement in riparian condition (cover, abundance, composition and structure) Vripconn: Have assumed no realistic change in connectivity.
Overall mean SEV score	0.348	0.629	The SEV score will increase by 0.281.

7.30 Piped Stream TR01 at Totara Park

Table 7-21 Current scores for TR01 and predicted change following restoration

SEV Function	SEVm-C	SEVm-P	Justification for predicted scores following stream restoration
Hydraulic function mean score	0.00	0.48	Vchann: To daylight the channel the channel will require recontouring leading to a portion of the channel classed as straightened or deepened. The rest of the channel is classed as natural will some likely channel incision. Early successional planting will increase channel shade, Vlining: Assumed no relative change in bed lining. Vpipe: No additional piped inflows will be created. Vbank: Assumed no change to connectivity. Vrough: Early-stage native regenerating planting will take place to improve on existing bare banks, long grasses and exotic vegetation. Vbarr: Assumed no change to any existing barrier to migration.
Biogeochemical function mean score	0.00	0.74	Vshade: Native riparian margin will be planted, but effective shading may take several years to establish as the planted vegetation matures. Vdod: Effective shading may take some years to impact macrophyte growth. Vripar: Planting of native early-stage riparian vegetation on the banks will improve the intactness of riparian zone. Vdecid: Non-deciduous native riparian planting will increase the proportion of non-deciduous cover. Vmacro: Instream habitat improvement will improve particle retention. Riparian planting will also improve the source of leaf fall. Vsurf: Assumed combination of soft sediment, gravel and large cobble. An increase in organic matter may take place as riparian planting matures. Vripfilt: Improvement early-stage restoration planting on banks will improve filtering activity.
Habitat provision function mean score	0.00	0.36	Vgalspwn, Vgalqual, Vgobspwn: Amount and quality of habitat can be improve with riparian planting and daylighting. Vphyshab: Assumed increase in physical habitat quality (increase structure from woody debris and allochthonous material). However, assume some riparian integrity improvements from early restoration planting. Vwatqual: Catchment-wide water quality will remain the same. Vimperv: Catchment-wide proportion of impervious surfaces will remain the same.
Biodiversity function mean score	0.00	0.26	Vfish: Excluded in SEVi. Vmci: Excluded in SEVi. Vripcond: Assumed improvement in riparian condition (cover, abundance, composition and structure) Vripconn: Assumed minimal impediment to riparian connectivity.

Overall mean SEV score	0.00	0.591	The SEV score will increase by 0.591

APPENDIX I WETLAND BIODIVERSITY COMPENSATION MODEL (BCM)

7.31 Introduction

The following sections outline the proposed approach to managing wetland ecological effects of the Mill Road Project on wetland systems of all values (i.e. low moderate, and high). They are intended as an appendix to the ecological effects assessment which contains detailed information on the project and ecological context. They also explain the compensation modelling which underpins the approach to scoping an appropriate scale and ecological outcome (no ecological loss/ecological gain in biodiversity values) for effects management.

As set out in Section 4.5.2**Error! Reference source not found.** of the Freshwater and Wetland EcIA, Mill Road Stage 1 Project activities are expected to have a 'High' residual adverse effect regarding wetland extent loss that cannot practicably be avoided, remedied, or mitigated at the point of impact:

- Permanent loss of approximately 0.4 ha of Low value exotic wetland habitats;
- Permanent loss of approximately 0.109 ha of Moderate value wetland; and
- Permanent loss of approximately 0.073 ha of High value wetland.

Five Low value wetlands have been identified for habitat restoration, and two areas have been identified for wetland creation. As set out below, the biodiversity modelling predicts that the proposed type and quantum of wetland habitat restoration, enhancement, and creation will achieve a Net Gain within 10 years of implementation.

7.32 Approach

A mixture of low, moderate, and high value wetland extent will be lost as a result if the project. A compensation approach has been identified to manage the residual effects. The package will involve primarily the restoration and enhancement of existing wetland extents. However, two areas have been identified for wetland creation, and these have been utilised to manage effects. Restoration versus recreation is defined as:

- Wetland restoration is the active intervention and management, appropriate to the type and location of the wetland, aimed at restoring its ecosystem health, indigenous biodiversity, or hydrological function.
- Wetland creation is the modification of an area that is not currently a wetland[28] sufficient to intercept or otherwise interact with groundwater or surface water creating hydrological conditions suitable for the maintenance of a wetland ecosystem. The area of new wetland will then be planted with indigenous wetland species to for a novel wetland or extension to an existing wetland.

The proposed restoration and enhancement is a holistic, system-based approach which seeks to increase the ecological value and resilience of the wetland features present. This will include the establishment of riparian vegetation and progressive pest plant control, pest animal control, native revegetation of wetland areas and recreation of wetland extents.

The preliminary details of the restoration and enhancement approach that will form part of the effects management package for wetlands us provided below. This approach will need to be outlined in further detail in the consent conditions and a Wetland Management Plan which is intended to be a sub-part of a wider Ecological Management Plan. This should include the details of the methods, locations, and timing of the compensation actions as well as a monitoring programme to ensure and demonstrate success in attaining the modelled ecological values within this report.

The outcome of this restoration and creation package will be resilient, structurally complex native dominated wetland. Stock permanently excluded from both wetland and riparian areas. Wetland hydrology and hydrological regimes are sustainable and resilient.

[28] But may be directly adjacent to an existing wetland thereby expanding the area of an existing wetland.

7.33 Restoration and creation areas

7.34 Restoration Baseline

Low value wetland extent in the proposed designation identified for wetland restoration include:

- PW01[29] (0.041 ha and 0.096 ha)
- MW_34 (0.053 ha)
- MW_33 (0.099 ha)
- MW_19a (0.267 ha)
- MW_21a (0.133 ha)

The wetlands identified for restoration consist of low value exotic dominant wetlands typically associated with riparian margins.

7.35 Restoration Constraints/opportunities

Many of the low value wetlands have significant scope for pest plant and exotic species control and there is significant opportunity to improve wetland vegetation communities by the restoration and enhancement planting of native wetland vegetation. There in significant opportunity to create habitat for wetland bird species. MW_19a and MW_21a are low laying riparian wetlands and there is potential scope for the creation of freshwater fish spawning habitat.

7.36 Wetland creation approach

The method of wetland hydrology creation will be dictated by the location and adjacent features but will generally involve:

- The excavation and widening of terrestrial areas adjacent to the S20 stream diversion channel to recreate wetland hydrology and extent
    - Resulting in a wetland area of 0.053 ha
- The excavation of earth at the TW01 site sufficient to interact with groundwater and recreate wetland hydrology.
    - Resulting in a wetland area of 0.214 ha

Once the wetland hydrology has been established the general steps for restoration are as follows:

- Plant native wetland plants within areas of constructed wetland.
- Plant riparian vegetation on riparian area around constructed wetlands.
- Maintenance and replacement where needed of native plantings, and monitoring of constructed wetland during establishment phase.
- Pest plant control as and where required to prevent the establishment of wetland est plants
- Pest animal control during the restoration phase to increase resilience during periods of disturbance and restoration and lag between impact and establishment of resilient and structurally complex habitats.

7.37 Wetland creation outcome

Resilient, constructed, structurally complex wetland with riparian ecosystems on its boundaries. Stock permanently excluded from both wetland and riparian areas. Native dominated wetland with functional wetland hydrology and processes,

7.38 Biodiversity Compensation Model (BCM)

Modelling was undertaken using the qualitative Biodiversity Compensation Model (BCM V1; Baber, Christensen, et al., 2021; Baber, Dickson, et al., 2021a). This model was used as a precautionary assessment tool to ensure residual adverse effects could be feasibly managed. The results of the modelling are provided in Table 7-22, with details of this model and its inputs are provided in Table 7-23.

[29] PW01 consists of two adjacent features that have been grouped together under the one label.

The BCM V1 was use initially to model the impacts and to calculate the adequacy of the Effects management package in achieving an ecological gain in biodiversity. Calculations were done using the Biodiversity Compensation Model for New Zealand– Excel Calculator Tool (Version 1) (Baber, Dickson, et al., 2021b). The inputs to the model and explanation of those inputs are provided in Table 7-23. The scoring for pre and post impact values were derived from ecological value assessments following EIANZ (2018) guidance.

The approach for quantifying management actions has been considered both management and outcome of the freshwater wetlands present at a catchment scale to enable 'like with like' comparisons. This provides a holistic picture of management actions and cumulative increase in ecological value through the various management interventions.

Table 7-22 provides the output of the BCM and demonstrates the predicted outcome of 11.6% positive impact on wetland values within 10 years.

Table 7-22: BCM model outputs

	Total impact score	Low value wetlands	Moderate value wetlands	High value wetlands
Impact score	-0.24779	-0.12592	-0.06006	-0.06181
	Total compensation score	Low value wetland restoration	Wetland creation	
Compensation score	0.27659	0.18969	0.08689	
Net gain outcome	11.6%			

Table 7-23: Biodiversity Compensation Model for New Zealand inputs and explanations for Mill Road

Model inputs	Model inputs and explanation.
Project/reference name	Mill Road –wetland impact effects management
Biodiversity type	Mixture of low diversity exotic wetlands, moderate value wetland seepages, and high value wetland *macharina* sedgeland.
Technical expert input(s)	Rosa Kirkham
Benchmark	A benchmark of 5 equates to a large contiguous lowland freshwater wetland ecosystem type. This includes an intact and resilient riparian margin buffer consisting of native vegetation. The wetland system includes heterogenous landform which results in a diverse pattern of wetland hydrology. A full suite of indigenous flora and fauna present at or near carrying capacity. The wetland, as well as its riparian margins are protected from the impacts of stock and surrounding land uses.
How many habitat types OR sites are impacted	3
Number of proposed effects management measures	2 **Explanation:** The effects management measures have been partitioned to two distinct categories based on areas of wetland value and wetland creation. At each site there are several management measures/actions.

Model inputs	Model inputs and explanation.
Ecological Gain target	10% (i.e., the ecological gain score needs to be at least 10% higher than the impact score)
	Impact model inputs and descriptions
Habitat/site impacted	**Low value wetland**
Impact risk contingency	**Data input**: 1 – Negligible or low risk (calculated biodiversity impact score is multiplied by 1.0 (+0%)) **Explanation**: The impact risk was assessed as 'Negligible/low' because the wetland areas were assessed as being of 'low' value based on the ecological assessment. These wetlands have low native vegetation diversity.
Impact uncertainty contingency	**Data input**: 1 - Low uncertainty (calculated biodiversity impact score is multiplied by 1.5 (+5%)) **Explanation**: Low value wetlands are typically small, discrete areas with uniform vegetation communities typical of grazed pasture. They are not connected to broader ecological features being situated in agricultural land use.
Areal extent of impact (ha)	**Data input**: 0.4 ha **Explanation:** Area of impact/works footprint resulting in loss of ecosystem.
Value score prior to impact	**Data input**: 1.5 **Explanation**: A value of 1.5 relative to the benchmark of 5 for the wetland extent equating to an ecological value of 'Low' value.
Value score after impact	**Data input**: 0.001 **Explanation**: A value of 0.001 as there will be a permanent loss of habitat (noting that the formula cannot work with 0).
Habitat/site impacted	**Moderate value wetlands**
Impact risk contingency	**Data input**: 2 - Moderate risk (calculated biodiversity impact score is multiplied by 1.05 (+5%)) **Explanation**: The impact risk was assessed as 'Moderate' because the wetland features were assessed as being of 'Moderate' value with some natural vegetation diversity and hydrology.
Impact uncertainty contingency	**Data input**: 1 - Low uncertainty (calculated biodiversity impact score is multiplied by 1.05 (+5%)) **Explanation**: Moderate value wetlands are typically small, discrete areas with moderate diversity vegetation communities typical of wetland seepages. They are typically not connected to broader ecological features.
Areal extent of impact (ha)	**Data input**: 0.109 ha **Explanation:** Area of impact/works footprint resulting in loss of ecosystem.
Value score prior to impact	**Data input**: 2.5 **Explanation**: A value of 2.5 relative to the benchmark of 5 for the wetland extent equating to an ecological value of 'Moderate' value.

Model inputs	Model inputs and explanation.
Value score after impact	**Data input**: 0.001 **Explanation**: A value of 0.001 as there will be a permanent loss of habitat (noting that the formula cannot work with 0).
Habitat/site impacted	**High value wetlands**
Impact risk contingency	**Data input**: 3 – High risk (calculated biodiversity impact score is multiplied by 1.1 (+10%)) **Explanation**: The impact risk was assessed as 'High' because the wetland complex was assessed as being of 'High' value. These wetlands have high rarity and distinctiveness due to native vegetation, with intact wetland hydrology provide significant ecological services.
Impact uncertainty contingency	**Data input**: 2 - Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%)) **Explanation**: Moderate uncertainty due to the risk of irreplaceable biodiversity loss of high value wetland with distinctive vegetation.
Areal extent of impact (ha)	**Data input: 0.073** **Explanation:** Area of impact/works footprint resulting in loss of ecosystem.
Value score prior to impact	**Data input: 3.5** **Explanation:** A value of 3.5 relative to the benchmark of 5 for the wetland extent equating to an ecological value of 'High' value.
Value score after impact	**Data input:** 0.001 **Explanation:** A value of 0.001 as there will be a permanent loss of habitat within footprint of works (noting that the formula cannot work with 0).
Effects management model inputs	
	Low value wetlands
Effects management action	**Data input**: Effects management actions as described above under approach and outcome for this wetland.
Discount rate	**Data input**: 3% **Explanation**: Default
Finite endpoint	**Data input**: 10 years **Explanation**: At 10 years the wetland and riparian vegetation and buffer vegetation should be well established, resilient, and self-sustaining. Pest plant control in and around the wetland should have reduced pest plant presence in the wetlands.
Confidence contingency	**Data input**: 1 – Very High confidence (Likelihood of success is >90% **Explanation**: Wetland and riparian buffer planting and wetland restoration is a commonly applied effects management tool used to create or restore indigenous habitat. For low value wetlands planting of natives will quickly establish a more diverse vegetation community.
Areal extent (ha) of effects management	**Data input**: 0.689 ha **Explanation**: Area of wetland present in the across the Proposed Designation with low value.

Model inputs	Model inputs and explanation.
Value score prior to effects management measure	**Data input**: 1.5 **Explanation**: A value of 1.5 relative to the benchmark of 5 for the wetland extent equating to an ecological value of 'Low-Moderate' value.
Value score after effects management measure	**Data input: 3.5** **Explanation:** A value of 3.5 relative to the benchmark of 5 for the wetland extent equating to an ecological value of 'High' value – increased wetland vegetation density and diversity. Improving ecological services providing increase habitat complexity.
Wetland creation	
Effects management action	**Data input**: Wetland creation in available locations at TW01 and S20.
Discount rate	**Data input**: 3% **Explanation:** Default
Finite end-point	**Data input: 10** **Explanation:** At 10 years wetland hydrology will have stabilised and wetland vegetation should be well established, resilient, and self-sustaining.
Confidence contingency	**Data input**: 3 - Moderate confidence (Likelihood of success is > 50% **Explanation**: Riparian buffer planting and wetland restoration is a commonly applied effects management tool. The creation of wetlands is less certain in its outcome. Recreating the hydrology and processes to ensure a resilient and functional wetland is more uncertain than restoring an area of existing wetland. As such we have given this action a moderate confidence.
Areal extent (ha) of effects management type	**Data input: 0.267** ha **Explanation:** Preliminary figure of wetland recreation associated with TW01 and realignment of S20.
Value score prior to effects management measure (relative to benchmark)	**Data input:** 0.001 **Explanation:** A value of 0.001 as this will be carried out in a location that did not previously have a wetland (noting that the formula cannot work with 0).
Value score after effects management measure (relative to benchmark)	**Data input:** 3.5 **Explanation:** A value of 3.5 relative to the benchmark of 5 for the wetland extent equating to an ecological value of 'High to very high' value.

7.39 Model limitations

In applying any biodiversity offset or compensation model, it is important to acknowledge the limitations, constraints and uncertainties associated with such models (Maseyk et al., 2018). Notably for BCMs, these limitations, constraints, and uncertainties have the potential to generate false positives, i.e., instances where the models generate Net Gain outcomes when the converse is true (Baber et al., 2021b). Model inputs are conservative to minimise this risk, and Net Gain target outcomes are also conservative, equating to a target of 10% exceedance of No Net Loss.

It is also important to recognise that this approach is robust, provides transparency and a validation process for determining compensation requirements to address residual adverse effects.