REPORT

Tonkin+Taylor

DRAFT Native Freshwater Fish and Fauna Management Plan (NFFFMP)

Auckland Regional Landfill

Prepared for
Waste Management NZ Ltd
Prepared by
Tonkin & Taylor Ltd
Date
December 2019
Job Number
1005069.1115

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Document Control

Title: DRAFT Native Freshwater Fish and Fauna Management Plan (NFFFMP)					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
18/12/2019	1	Draft NFFFMP for consent application	K Park	J Quinn	S Eldridge

Distribution:

Waste Management NZ Ltd	1 electronic copy
Tonkin & Taylor Ltd (FILE)	1 electronic copy

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Glossary

Specific terms	
AC	Auckland Council
AEcE	Assessment of Aquatic and Terrestrial Ecological Values and Effects Report, Tonkin + Taylor, 2019
BEA	Bin Exchange Area
DOC	Department of Conservation
EERP	Ecological Enhancement and Restoration Plan
NFFFMP	Native Freshwater Fish and Fauna Management Plan
VCMP	Vegetation Clearance Management Plan
General terms	
Auckland Regional Landfill or ARL	Project name, encompassing the landfill itself as well as all ancillary activities.
Waste Management NZ Limited or WMNZ	Company name of applicant.
WMNZ landholdings	The entire landholdings secured by WMNZ at Wayby Valley.
Project footprint	The area that includes the Landfill footprint and also includes those areas outside the Landfill footprint but within the WMNZ landholdings where ancillary activities are proposed to occur
Landfill footprint	The area (plan area) occupied by the landfill which has a lining system onto which waste is placed.
Landholding description	
Western Block	The farm property previously known as Springhill Estate.
Eastern Block	Pine forestry block which includes Valley 1 and 2
Southern Block	Strip of land which access road runs through until it reaches the Eastern Block. This strip is mostly occupied by bush and forest plantation, within a separate valley across the southern side of the Western Block.
Waiteraire Tributary Block	South east corner of the site, covering tributaries that flow down towards the Sunnybrook Reserve.
Valley 1	The southernmost of the two valleys currently in forestry suitable for landfilling.
Valley 2	The northernmost of the two valleys currently in forestry suitable for landfilling, and that might be considered for development after Valley 1 has been filled, but does not form part of this consent application.
Waiteraire Stream	Stream next to the access road and bin exchange area.
Waiwhiu Tributary Block	Area of pine forestry east of Wilson Road ridge and west of Waiwhiu Stream.
WA Stream	Main stream within the northern half of the Western Block
WB Stream	Main stream within the southern half of the Western Block.
WV Stream	Main stream tributary within the Waiteraire Tributary Block.
V1 Stream	Main stream within Valley 1 of the Eastern Block.
S Stream	Main stream within Southern Block.

1 Introduction

1.1 Background

This draft NFFFMP has been prepared to support Waste Management NZ Ltd's (WMNZ) application for resource consents for the construction and operation of a new regional landfill facility on WMNZ landholdings, between Warkworth and Wellsford. The WMNZ landholdings are located near the Wayby Valley, adjacent to State Highway 1 (SH1) 13 km northwest of Warkworth, within the Rodney Ecological District in the northern part of the Auckland region. The Auckland Regional Landfill includes a landfill footprint located within a pine forested valley and will also require the construction of an access road, a bin exchange area, several smaller access roads and ancillary activities (such as office buildings), stockpiles, a clay borrow pit, and erosion and sediment controls (e.g., stormwater and sediment ponds and wetlands). The proposed landfill is described in detail in the Assessment of Environmental Effects (AEE) Report.

These project activities are expected to have a range of effects on the ecological values of the WMNZ landholdings and these effects are described in the Assessment of Aquatic and Terrestrial Ecological Values and Effects Report (AEcE) (Tonkin + Taylor, 2019) that accompanied the resource consent application (Resource Consent Application, Volume 2, Technical Report G) .

A suite of Ecological Management plans collectively sets out the procedures for addressing adverse ecological effects associated with the landfill through proposed conditions provided in the resource consent application. These plans also set out monitoring and the review process to be undertaken both pre and post construction with the individual monitoring requirements described in the individual management plans.

The collective objective of these draft plans is to set out the proposed range of measures to avoid, remedy, mitigate, offset or compensate for effects on ecological values. a.

1.2 Plan purpose and draft consent condition scope

The Native Freshwater Fish and Fauna Management Plan (NFFFMP) describes measures to salvage and relocate native freshwater fish, kōura and kākahi (hereafter 'freshwater fauna') that are known or likely to be adversely affected by the landfill project.

Legislation affords protection to native freshwater fish. All native freshwater fish on site are protected by the Freshwater Fisheries Regulations 1983, which prohibits intentionally killing or destroying indigenous fish. Furthermore, several freshwater fauna species identified or potentially present on site are classified as 'At Risk'[1] (NZTCS)[2][3].

This NFFFMP has been developed in accordance with the proposed Auckland Regional Landfill consent conditions (Consent application number BUN60339589).

These consent conditions will be addressed through the implementation, monitoring and reporting procedures set out in the NFFFMP and the interlinking plans.

[1] The Department of Conservation (DOC) administers the NZ Threat Classification System which is used to assess the threat status of all NZ taxa. (Townsend et al., 2008). Relevant documents in the Threat Classification series can be found at this website https://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system/.

[2] Dunn, N R, Allibone, R M, Closs, G P, Crow, S C, David, B O, Goodman, J M, Griffiths, M, Jack, D C, Ling, N, Waters, J M and Rolfe J R (2018). Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. 11 p

[3] Grainger, N, Collier, K, Hitchmough, R, Harding, J, Smith, B, & Sutherland, D (2014). Conservation status of New Zealand freshwater invertebrates, 2013. New Zealand Threat Classification Series 8. Wellington: Department of Conservation. Retrieved from www.doc.govt.nz

Further measures to address effects on freshwater fauna are detailed in the following plans:

- **The Construction Erosion and Sediment Control Plan (CESCP) and Construction Environmental Management Plan (CEMP)**, which provide the general procedures for all of the enabling works up until the landfill opens and set out the management procedures and construction methods to be undertaken in order to avoid, remedy or mitigate potential adverse effects arising from construction activities.
- **The Ecological Enhancement and Restoration Plan (EERP)** and **Off-Site Stream Compensation Plan (OSSCP)**, which provide detail on the location, magnitude and type of native habitat recreation and enhancement measures that are proposed to offset or compensate for residual effects on ecological values affected by the project, including for freshwater fauna.
- **The Vegetation Clearance Management Plan (VCMP)**, which provides detail on how adverse effects associated with vegetation clearance (including effects on water quality) will be avoided or minimised through vegetation clearance protocols. This includes the sensible placement of cleared vegetation to reduce risk.

1.3 Responsibilities and competencies

Figure 1.1 below sets out the roles and responsibilities in relation to the NFFFMP, with the WMNZ Regional Landfill Manager holding overall accountability for implementation of, and compliance with, this plan.

The lead project freshwater ecologist must be suitably qualified and experienced in freshwater fauna salvage and relocation operations.

Native freshwater fauna salvage requires a Ministry for Primary Industries (MPI) Special Permit under Section 97 of the Fisheries Act 1996. An authorisation from Fisheries New Zealand is required under section 26ZM (2) (a) of the Conservation Act 1987 to transfer any freshwater aquatic life to an appropriate freshwater waterbody in the same catchment. DOC approvals are also required to transfer fish to public conservation land and for electric fishing.

Freshwater fauna salvage and relocation described in this NFFFMP will be carried out in accordance with the above required permits and authorisations.

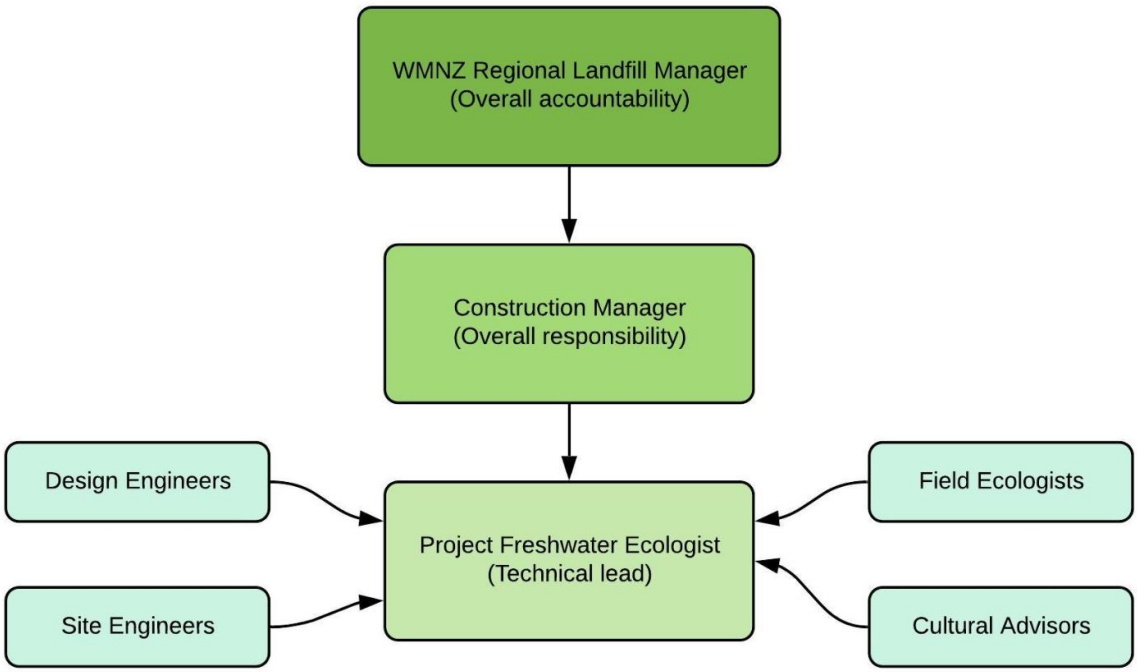

Figure 1.1: Roles and responsibilities for implementation of the NFFFMP.

1.4 Plan structure

The NFFFMP is set out as follows:

- Section 1 – Introduction (this section);
- Section 2 – Freshwater fauna values and effects summary;
- Section 3 – Freshwater fauna effects management – salvaging and relocation protocols;
- Section 4 – Freshwater fauna effects management – culvert design for fish passage; and
- Section 5 – Monitoring and reporting requirements.

2 Current understanding of freshwater fauna values

Detailed information on ecological values, effects and effects management on freshwater fauna are detailed in the AEcE and summarised below.

2.1 Freshwater fauna values

The NZ Freshwater Fish Database (NZFFD)[4] was reviewed to determine what freshwater fauna may be present on site prior to freshwater surveys commencing in winter 2018. NZFFD data for streams immediately surrounding the WMNZ landholdings were collated and are presented in Table 2.1. Two fish and one invertebrate species recorded in the NZFFD are identified as 'At Risk - Declining'.

Fish surveys were undertaken in August 2018 at seven sites, covering the Southern, Eastern and Western Blocks (see AEcE for methods). Six native fish species and the crustacean kōura (*Paranephrops* spp.) were recorded during fish surveys (Table 2.2). Fish species captured during the survey were similar to those recorded in the NZFFD. Crans bully (*Gobiomorphus basalis*) have previously been recorded in nearby catchments, including the reach downstream of the Eastern Block F3 site, but were not recorded at any of the project fishing sites.

With the exception of Crans bully, the fish species present in the Eastern Block were similar to those within forestry sites in the Waiteraire Stream catchment. No bullies (*Gobiomorphus* sp.) were recorded in the mid- and upstream extent of the Eastern Block sites (sites F4 and F5), even though they have been recorded at upstream sites in the Waiteraire Stream catchment. A series of 3 to 4 m high waterfalls are present through the main stem in the Eastern Block, which may present a partial barrier to some fish.

The presence of a perched culvert part way up the Southern Block stream reach may explain why no fish were caught at site F2. A perched culvert is also located within the Western Block F7 reach, and traps set above this culvert did not retrieve any fish.

Freshwater mussels (kākahi) have been found within forestry sites in the Waiteraire Stream catchment. They were not observed at any of the project fishing sites, although they were not searched for specifically.

Table 2.1: Freshwater fish database results (retrieved 30 August 2018)

Common name	Scientific name	Threat status [2] [3]
Shortfin eel	*Anguilla australis*	Not threatened
Longfin eel	*Anguilla dieffenbachii*	At risk - declining
Inanga	*Galaxias maculatus*	At risk - declining
Banded kōkopu	*Galaxias fasciatus*	Not threatened
Crans bully	*Gobiomorphus basalis*	Not threatened
Redfin bully	*Gobiomorphus huttonii*	Not threatened
Common bully	*Gobiomorphus cotidianus*	Not threatened
Unidentified bully	*Gobiomorphus* spp.	N/A
Freshwater mussel (Kākahi)	*Echyridella menziesi*	At risk - declining
Kōura	*Paranephrops* spp.	Not threatened
Freshwater shrimp	*Paratya curvirostris*	Not threatened

[4]National Institute of Water & Atmospheric Research Ltd. (NIWA) (2018b). New Zealand Freshwater Fish Database [Data set]. Retrieved from https://nzffdms.niwa.co.nz/search

Table 2.2: Presence/absence fish data from winter 2018 fish sampling efforts.

	Southern block		Eastern block			Western block	
Location	**Down-stream**	**Up-stream**	**Down-stream**	**Mid-reach**	**Up-stream**	**Down-stream**	**Up-stream**
Site name*	**F1**	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**
Longfin eel			●	●	●	●	
Shortfin eel						●	●
Banded kōkopu	●			●	●		●
Inanga	●						
Unidentified galaxiid				●			
Redfin bully	●		●				
Common bully	●		●			●	
Unidentified bully							●
Gambusia						●	
Unidentified fish							●
Kōura		●	●	●	●		
Freshwater shrimp	●					●	

* See Appendix A for a map of fish sampling sites.

2.2 Effects and proposed management for freshwater fauna

The potential effects on freshwater fauna resulting from the project have been assessed in terms of short and long term effects.

Short term effects relate to the effects within the construction phase which could include fish injury and/or mortality, and water quality effects resulting from sedimentation and cut vegetation storage.

Potential long term effects anticipated to occur from the project include reduced fish passage, water quality effects and changes to hydrology and loss of stream habitat area for freshwater fauna.

A range of mitigation measures are proposed throughout the life of the project in addition to measures described in this NFFFMP for the enabling works period. Some measures are identified which relate to best practice site management approaches which will mitigate some of the freshwater fauna effects anticipated from the project.

The following measures are recommended to minimise and mitigate effects on freshwater fauna within the impact footprint and in the receiving environment.

- Fish Recovery Protocols to salvage and relocate fish from within works footprints (detailed in this NFFFMP);
- Culverts designed for fish passage (addressed in this NFFFMP);
- Erosion and sediment controls to be implemented in accordance with Auckland Council GD05 (detailed in the CEMP);
- Vegetation Clearance Protocols to manage the potential effects of run off from cleared vegetation (detailed in the VCMP);

- Stormwater management approach to include filter strips, rain gardens, ponds, wetlands and consistent with Auckland Council GD01 for hard stand areas (roads, BEA, landfill) (detailed in the Operation and Maintenance Plan);
- Long term sediment ponds at stockpile locations, GD05 but long term (detailed in the CEMP); and
- Construction methodologies to be consistent with GD05 (detailed in the CEMP). Sensitive areas during construction are catchments with WMA/SEA/NSMA.

For residual adverse effects on freshwater ecology values that cannot be avoided, remedied or mitigated, to improve biodiversity values in other nearby locations, the offset and compensation measures are proposed and are detailed in the EERP and OSSCP.

3 Freshwater fauna salvaging and relocation protocols

The direct effects of stream works on freshwater fauna can be minimised and mitigated by implementing the NFFFMP prior to dewatering or excavating streams and wetlands

A combination of fish recovery methods (trapping, electric fishing, dewatering and muck out) will be applied in different habitats as appropriate. Each of these methods has inherent advantages and disadvantages. Once the proposed construction methods are known, site-specific freshwater fauna salvage plans for each individual works area to minimise potential additional effects on fish during recovery and to provide for the most effective recovery approach

It is proposed that appropriate measures will be applied across the site, with intensity of effort in any given area dictated by the likelihood of 'At Risk' species or type of habitat present.

Specific approaches for the V1 catchment are highlighted throughout the following sections due to the difficult and hazardous nature of access through this catchment.

3.1 Salvaging timing

It is considered that no less than 25% of the streams across the WMNZ landholdings are intermittent. Undertaking stream dewatering and construction during summer months when these intermittent streams are dry is a way of reducing potential effects on fish. It is also preferable to undertake salvage during summer months, as fish are more likely to avoid capture during winter months[5].

The timing of freshwater fauna salvage work will depend on the construction schedule and weather conditions. The Project freshwater ecologist shall consult with the earthworks contractor and/or engineers to plan the staging and sequence for work area isolation (fish exclusion screens), freshwater fauna salvage and dewatering.

For ease of access to the streams within forestry areas (i.e. Stockpile 2 and Valley 1), the NFFFMP will be implemented prior to harvesting.

Salvage in the V1 catchment is anticipated to be completed within one summer/autumn season, preferably between December and May because it is the optimum time for capturing native freshwater fish[5].

3.2 Salvaging footprint

Freshwater fauna salvage is proposed to reduce the potential effects of mortality or injury during construction. Desktop and field assessments have confirmed that freshwater fauna are present within the footprint. Therefore, salvage will be undertaken in all areas to be impacted by the footprint that contain suitable habitat for freshwater fauna. This includes habitat in streams and wetlands within Valley 1, the Western Block, WB Stream, Southern Block, S Stream and WV Stream.

Freshwater fauna salvage will be undertaken using methodologies in Section 3.3. The specific salvage methodologies will be guided by the Project freshwater ecologist based on their assessment of the freshwater habitat. The Project freshwater ecologist has discretion to include or exclude areas based on the type and quality of habitat being impacted.

V1 catchment requirements:

- For ease of access to the streams within forestry areas (i.e. Stockpile 2 and Valley 1), the NFFFMP will be implemented prior to harvesting. This will result in a higher success rate for

[5]Joy, M, David, B, Lake, M (2013). New Zealand Freshwater Fish Sampling Protocols. Part 1: Wadeable Rivers and Streams. Massey University

fish salvage compared to post-harvest when slash restricts access and stream habitats may be damaged.

- Because of the difficult and hazardous nature of access into the V1 catchment, freshwater fauna salvage efforts will be concentrated on the main reach through the catchment. Salvage will be undertaken on tributaries feeding the main reach where access is safe and practicable. However, it is expected that intermittent tributaries feeding the main reach will contain minimal habitat for freshwater fauna because salvage will be undertaken during summer months.
- Salvaging will progress from the most upstream extent of the catchment, working in a downstream direction. Salvage will be undertaken on one 'sub-reach' of approximately 150 m at a time, using the salvaging protocols described below.
- Prior to commencing salvage on each sub-reach, the Project ecologist will establish a safe access track down to and along the sub-reach. An arborist will assist in this access preparation stage, cutting and removing forestry slash and vegetation as required.
- Some portions of the main reach are expected to be inaccessible for salvage due to large piles of slash that cannot be safely cleared by an arborist.

3.3 Salvaging protocol

Salvaging will include a range of methodologies as described below, and will be in general accordance with standard survey protocols for New Zealand freshwater fish[5 6].

Once the work area is isolated, salvage will generally occur as a two-stage process, starting with trapping and/or electric fishing, followed by dewatering and muck out where site constraints allow.

3.3.1 Work area isolation

Prior to setting traps for fish capture, streams and wetlands affected by works are to be isolated using fish exclusion screens preventing native fish migrating into the designated works area. This means isolating both upstream and downstream extents of the works area, unless the full upstream extent is to be affected. The locations of the exclusion screens will be agreed with the earthworks contractor and Project freshwater ecologist once the streamworks staging plan and implementation programme has been prepared.

Fish exclusion screens are intended to be temporary, and therefore will be installed immediately prior to fish salvage and streamworks commencing (with the exception of the V1 catchment, explained in detail below). This reduces the risk of the screens being compromised, for example due to a wet weather event.

In brief:

- The temporary exclusion screens will be installed to minimise the ability of fish to swim under, or around the net, but shall not impede water flow. The exclusion screens will be embedded in the stream bed and banks and firmly secured.
- The top of the exclusion screens will extend well above the water surface to allow for increases in water level.
- Exclusion screens will preferably be constructed from fine (4 mm) mesh, although larger mesh (e.g. 8 mm) may be used if there is a risk of the mesh blocking due to instream organic debris. The mesh material will be supported by wire netting, with construction being similar to a super silt fence.

[6] Ling, N, O'Brien, L K, Miller, R, and Lake, M (2013). A Revised Methodology to Survey and Monitor New Zealand Mudfish Species. Department of Conservation, Wellington (unpublished)

- Each exclusion screen will be inspected and, where required, maintained daily by the contractor to ensure the screen's structural integrity is maintained until the works in that section are completed.
- If an exclusion screen fails or becomes over topped with water the methodology outlined within this report will need to be repeated.

V1 catchment requirements:

- The above described exclusion screens are intended to function temporarily and intended to be used immediately prior to streamworks commencing. Because freshwater fauna salvage in the V1 catchment is expected to happen progressively and well ahead of forestry clearance and streamworks, more permanent and rigid exclusion screens will be installed. The final design of these screens will be site-specific and determined by the Project freshwater ecologist, in consultation with the Project earthworks contractor and/or engineers.
- In early October prior to the first season of freshwater fauna salvage, a semi-permanent exclusion barrier, likely a perched culvert, will be installed on the main stream at the downstream extent of the V1 impact footprint. This timing will avoid peak upstream migration for most species recorded in the catchment (Appendix B), and thereby reduce the number of new season larvae and juvenile native fish entering the catchment prior to salvage.
- This downstream semi-permanent barrier will be in place throughout the fauna salvage period, and prior to forestry clearance and construction of the V1 stormwater ponds, therefore it will be designed to meet flood flow conveyance and forestry requirements.
- Each sub-reach to be fished within the V1 catchment will initially be isolated using the temporary exclusion screen construction detailed above. Following completion of salvage within that reach, a semi-permanent barrier will be installed on the downstream extent of the fished reach, and this will become the upstream barrier for the subsequent sub-reach to be fished. On completion of fish salvage in this next reach, this semi-permanent barrier can be removed and transferred to the downstream end of the reach, and freshwater fauna salvage can commence on the subsequent reach.
- The final design of the semi-permanent barriers will be determined by the Project freshwater ecologist, in consultation with the Project earthworks contractor and/or engineers. However, they are expected to be constructed as a perched culvert type design, with size and capacity appropriate to withstand a volume of summer flood flows expected for the given location in the catchment.

3.3.2 Trapping

Depending on water depth and area of wetted habitat, the trap density used will be nine fyke nets and 18 gee minnow traps per 150 m stream reach. This is a higher density than recommended in the New Zealand native fish monitoring protocols[5], because the objective of this exercise is fauna salvage rather than monitoring. The actual trap density used in each reach will depend on the available habitat, channel size and water depth. For example, fewer traps will be set in the reach if channel width is narrow and pool habitats are small.

For trapping in areas where there is insufficient water depth or channel width to deploy fyke nets, gee minnow traps will be deployed with the methodology similar to mudfish survey and monitoring protocols[6].

All fyke nets used will have an internal exclusion system to separate larger fish from smaller fish and reduce risk of predation.

Where there is a risk of night time anoxia (e.g. slow flowing streams), traps will not be fully submerged to allow the fish to have the ability to surface breathe.

Each trap will be checked the following morning, with any captured fish recovered, held and relocated according to the relocation protocol below.

Trapping effort for each 150 m reach will be set to a minimum of one night for stream reaches and will then proceed, depending on the following situations:

- If native fish with a conservation status of 'Threatened' or 'At Risk – Declining' are captured, trapping will continue until no further 'Threatened' or 'At Risk – Declining' individuals are captured.
- If native fish without the above conservation status are captured at densities of greater than 10 fish per 150 m reach, then trapping will continue until a reduction of > 50% between the highest and the lowest number of individuals captured on any one night is achieved.
- If the Project ecologist considers the site suitable, then the second or third night of trapping prior to dewatering may be done after partial dewatering has occurred in accordance with the dewatering protocol (Section 3.3.4).

Reduction rates are based on those consented for the Pūhoi to Warkworth project, and on our experience undertaking freshwater fauna salvage for this and other large development projects. In all cases, traps will be deployed for a maximum of four nights. This is because further nights trapping increase the risk of exclusion screen failure during rain events and we consider four nights will be sufficient to capture the majority of individuals present across the life stage/population spectrum.

3.3.3 Electric fishing

Electric fishing may be carried out instead of fish trapping in sections of streams where water depth is between approximately 100 mm and 600 mm, and where stream conditions are more suitable to this method (such as suitable flow rate and low macrophyte density).

This approach is only for use where trapping is unachievable (with the exception of V1 catchment streams, detailed in Section 3.3.4). It may also occur following partial dewatering if considered more effective than trapping.

In brief, the electric fishing protocols are:

- Electric fishing will occur for a minimum of three passes.
- After three passes, if the number of captured fish has decreased by > 50% between each of the three passes, then it will be considered appropriate to begin dewatering (Section 3.3.4).
- If native fish with a conservation status of 'Threatened' or 'At Risk – Declining' are captured, then further electric fishing passes will be undertaken until no further 'Threatened' or 'At Risk – Declining' individuals are captured.
- For native freshwater fish without the above conservation status, if the number of fish captured between any two consecutive passes decreases by < 50% then further electric fishing passes will be undertaken until the decrease is > 50% or < 10 individuals are captured.

3.3.4 Dewatering and muck out

On the completion of fish trapping or electric fishing efforts to the satisfaction of the Project freshwater ecologist, dewatering can commence. The Project freshwater ecologist must confirm that the dewatering can commence.

For stream reaches, a suitably qualified and experienced freshwater ecologist will be present during stream dewatering activities to inspect the streambed and channel base, under-bank margins and any other instream habitats for freshwater fauna that may have been missed.

In brief, the dewatering protocol is as follows:

- A fish exclusion screen will be installed on all pumps used during dewatering activities. This screen will have a maximum mesh size of 3 mm and will have intake velocities of < 0.3 m^3/ sec.
- If the isolated section does not need to be pumped then fish may be allowed to swim downstream, outside of the impact reach, as water recedes. This is less damaging to the fish than catching them with hand nets or electric fishing. As the water level recedes the downstream fish exclusion screen will be removed to allow the fish to escape.
- In streams with dense aquatic macrophytes, a channel / pools may need to be formed to assist fish movement. Any macrophytes or instream sediment moved to create the channel will remain in the stream during dewatering.
- Once stream dewatering is complete and the Project ecologist is satisfied with the level of fish capture effort, approved and consented streamworks can commence.

In streams and wetlands containing water at the time of consented streamworks, a suitably qualified and experienced freshwater ecologist will be present when sediment (spoil) is being mucked out (excavated) from a stream. This provides an additional backstop to salvage freshwater fauna that might remain after applying the salvage protocols described above.

In brief, the freshwater fauna salvage procedure for muck outs are:

- An excavator will spread out at least the top 300 mm layer of spoil in a thin layer on the bank near the stream for inspection by the freshwater ecologist.
- When it is safe to access the spoil, it will be visually checked for any fish, kōura or kākahi.
- Where practical, this will occur near the stream but in some situations, this may have to be at the disposal site (e.g. if the spoil is very liquid and needs removal from site).

Any fauna captured during dewatering and/or muck out will be relocated using the relocation protocols in Section 3.4.

V1 catchment requirements:

Freshwater fauna salvage will occur in V1 well in advance of any streamworks taking place. For this reason, streams will not be dewatered immediately following trapping. Instead, electric fishing following the protocols above will be undertaken as a 'last phase' step following trapping.

If practicable, ecological supervision of dewatering and muck out may occur in V1 when streamworks commences. However, this will be limited to the downstream extent of the main channel when muck out occurs for the stormwater ponds. The feasibility of ecological supervision of dewatering and muck out in this location will also depend on the stream being safely accessible, as forestry clearance prior to streamworks may block safe access to streams.

3.3.5 Kōura and kākahi

All kōura captured during trapping, electric fishing and/or dewatering and muck out activities will be relocated following the protocols in Section 3.4. Specific reduction rates are not considered necessary for kōura.

Kākahi inhabit stream beds where they are embedded within soft sediments. Kākahi will be salvaged using the following protocol:

- In wadeable streams and/or during dewatering, soft bed and bank sediments will be searched for kākahi by hand. A benthic viewer may also be used in deeper waters where visibility is adequate.
- Search efforts will target likely kākahi habitat, which includes soft sediments under undercut banks and submerged logs, and on the edges of large pools.

- Specific reduction rates are not provided for kākahi. However, kākahi will be salvaged from all suitable kākahi habitat where it is accessible.
- Salvaged kākahi will be relocated following the protocols in Section 3.4.

3.3.6 Biosecurity and pest fish

Unless being redeployed in the same subcatchment, all nets and/or traps used will be cleaned, sterilised and allowed to dry for no less than one week prior to use ensuring that all plant material (seeds or plant material that is able to regenerate) is either removed or dead, reducing the risk of transferring freshwater pest plants to new locations.

Any pest fish caught will be humanely euthanized using clove oil (50 mL per 10 L of water) or benzocaine (3.3% solution in ethanol, 50 mL per 10 L of water). All euthanized pest fish will be buried within the riparian margin of the stream in which they were caught.

For some fish relocation programmes, it is necessary to recycle stream water to reduce the risk of transporting unwanted organisms. For this site, it is not considered necessary as the trapping and relocation sites are highly connected therefore any unwanted organisms are likely to be present at both sites.

3.4 Relocation protocol

3.4.1 Handling, transport and relocation

Following capture, all freshwater fauna will be translocated in a lidded container of an appropriate volume of clean stream water for the number of fish caught. An aerator will be installed into the container and transferred to the relocation site within approximately one hour of capture.

Whilst contained, fish will be constantly monitored and if any individual fish show signs of stress (e.g. loss of righting response, gulping air, and/or gaping) the water will be changed to provide more oxygen and / or the fish will be moved to the relocation site immediately. Sensitive fish species, e.g. galaxiidae or gobiidae species, will be kept in a separate bucket to eels and kōura, to avoid any further disturbance to these species.

Large eels (> 500 mm) will be contained separately within wetted mesh sacks and kept hydrated to avoid injury to other smaller captured fish.

Fish will be handled with wet hands at all times. Handling of freshwater fish and kōura will be minimised in order to reduce stress.

V1 catchment requirements:

- Because access is difficult and hazardous through the V1 catchment, and freshwater fauna will be removed from the entire catchment, fish relocation will generally not be possible within the one hour time frame specified above. Instead, fish will be kept in specially prepared holding tanks near the point of capture for up to two days before being relocated in batches to the relocation site.
- The holding tank set up will consist of:
  - Multiple large plastic drums of approximately 125-200 L volume each with lids.
  - The holding tanks will be stationed at an appropriate location which facilitates safe transfer of the fish out of the catchment. This location will be specific to the method of transport (outlined below) used at each subreach. A firm and level space will be established with the help of construction labourers prior to positioning and filling the tanks.

  - To maintain fish health and water quality within the holding tanks, water will be either:
    - Cycled through the drums via a centrifugal or flexidrive pump. Water removal will occur via a hose (with attached fish screen) that will syphon water to a predetermined location that will not undermine the relocation site; or
    - If low stream water levels prohibit water being pumped to the holding tanks from the stream, water will instead be refreshed manually at a frequency determined appropriate by the Project ecologist. In this case, stocking rates will be reduced and a maximum of 20% water volume will be removed from each holding drum at any one time.
  - Aquarium bubblers will be used to circulate the water within the holding tanks. This will assist in maintaining adequate oxygen levels within the holding tanks and prevent water stratifying within the holding tanks.
  - Freshwater fauna species will be sorted and separated as described above. Appropriate stocking rates will be determined by the Project ecologist and will depend on the anticipated holding duration and weather conditions (such as temperature) at the time.
- Large eels, kōura and kākahi are generally more resilient to extended periods of time out of water and, depending on proximity to the relocation site, may therefore be transported on foot directly out of the V1 catchment the same day as capture. In this case, the following protocols will apply:
  - Eels will be transported within wet mesh sacks within waterproof backpacks, kept cool and open to ensure appropriate air exchange. Provided they are kept wet, cool and shaded or in water, eels may be held in sacks for up to three hours.
  - Kōura will be bagged in sealed and dampened aquarium plastic bags prevent moisture loss, and then transported within cooled foam containers. For short journeys and cool weather conditions, kōura will be covered in moist fabric and transported in plastic containers.
  - Kākahi will be transported in containers with water and bubblers where practicable, which is the preferred method for reduced transport stress in kākahi[7]. However, if this is not practicable due to site access or large numbers of kākahi are found, kākahi may be transported in cooled foam containers with dampened materials to maintain humidity.
  - Once out of the V1 catchment, eels, kōura and kākahi will be immediately transferred to aerated holding tanks on the back of a utility vehicle and transported to the relocation site.
- Freshwater fauna will be transported from holding tanks to the relocation site within three hours, where practicable. Fauna will be transported via one or a combination of the following ways, depending on ease of access out of that particular location in the V1 catchment:
  - By foot, with fish held in waterproof backpacks.
    - Fish will be separated by species as described above and stocked to an appropriate rate as determined by the Project Ecologist.
    - Once out of the V1 catchment, fish will be immediately transferred to aerated holding tanks on the back of a utility vehicle (ute).

[7] McEwan, A J, Dobson-Waitere, A R, and Shima, J S (2019). Comparing traditional and modern methods of kākahi translocation: implications for ecological restoration. New Zealand Journal of Marine and Freshwater Research, DOI:10.1080/00288330.2019.1636099

- Fish welfare will be checked prior to being transported to the relocation site. If fish appear to be suffering from stress, they will be held in the ute holding tanks until recovered and able to be transferred.

– By helicopter, with fish held in a rigid aerated tank, such as a water tank with caged pallet.
  - Fish will be separated by species as described above and stocked to an appropriate rate as determined by the Project Ecologist.
  - Fish will be transported in the tank by helicopter directly to the relocation site.

3.4.2 Relocation sites

The freshwater fauna relocation site(s) will predominantly be located within WMNZ landholdings and within the Hoteo catchment. Freshwater fauna will be released as close as possible to the capture site, depending primarily on ease of access into the site.

Preference will be given to relocation site(s) within the same catchment as the capture site, however depending on quantities of freshwater fauna salvaged, relocation into the adjacent Waiwhiu or Waiteraire Streams may be necessary.

Due to salvaging taking place across the entire V1 catchment, it will be more likely that freshwater fauna captured from this site will need to be released at a distant location. However, the streams in the Valley 2 catchment will be the preferred release site for fish relocated from the V1 catchment, providing a safe access route can be provided.

Key aspects of the freshwater fauna relocation site(s) are that they have abundant habitat and connectivity to upstream and downstream environments. In advance of relocating freshwater fauna to release sites in forestry, the forestry harvest cycle will first be confirmed so as to avoid release into sites that will be harvested within a certain number of years. In all cases freshwater fauna will not be released into areas within project footprint, even if construction has not yet begun in these areas at the time of release.

Potential relocation site(s) within WMNZ holdings include:

- WA Stream;
- WB Stream;
- S Stream;
- The Hoteo River, adjacent to the Western Block;
- Valley 2 streams;
- Main stem and tributaries downstream of the V1 Stream and Eastern Block confluence;
- WV Stream catchment; and
- Main stem and tributaries within Sunnybrook Reserve (subject to DOC approval).

The Project freshwater ecologist will ensure that fish caught are released in a distributed manner within the relocation site(s), particularly when releasing a large quantity of freshwater fauna at one time. This will avoid or reduce the risk of any predation risks or overstocking at a single release site.

Kākahi will be released in wadeable stream habitats with similar characteristics to the capture site(s). Preferably, these relocation site(s) will be well-shaded and slow flowing, with soft bed and bank sediments and suitable kākahi habitat features such as undercut banks. Due to the risks associated with burying kākahi[7], they will be placed on the stream sediments and allowed to bury themselves.

For all native freshwater fauna the following information will be recorded:

- Date and time of capture and release;
- Capture method;
- Capture and release locations (GPS coordinates); and
- Number and size of individuals of each species released.

4 Culvert design for fish passage

Culverts have the potential to restrict fish passage to upstream habitats if constructed poorly. Where practicable culverts will be constructed to be 'fish-friendly' and in accordance with New Zealand fish passage guidelines[8]. Culvert design will consider the order of preference outlined in the New Zealand fish guidelines (Figure 4.1).

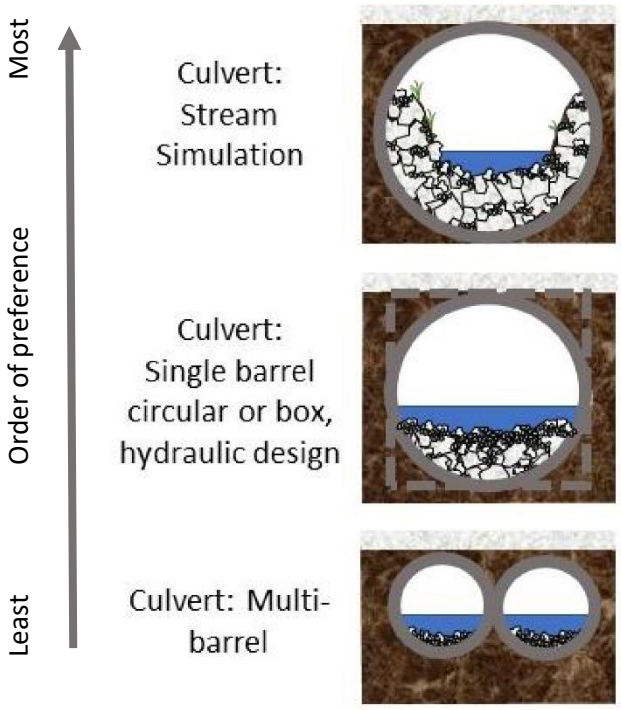

Figure 4.1: Order of preference for culvert design, based on the degree of connectivity each design facilitates. Modified from NIWA (2018a).

Within the Western Block, fish passage will be provided for all culverts constructed. Within the Southern Block, fish passage will be provided for one culvert. Two culverts in the Southern Block are unlikely to provide fish passage due to steep gradient, however the amount and quality of upstream habitat is limited in these locations. Notwithstanding this, detailed design for these two culverts will attempt to incorporate fish passage features as far as possible, but this will likely be limited to inclusion of spat rope.

With the exception of works within the V1 catchment, where practicable fish passage will be provided on diversions for temporary works during the migration period for target fish species (Appendix B).

[8]National Institute of Water & Atmospheric Research Ltd. (NIWA) (2018a). New Zealand Fish Passage Guidelines for structures up to 4 metres, 229 pages

5 Monitoring and reporting

5.1 Compliance monitoring report

A compliance monitoring report will be submitted annually to Auckland Council in June for the year to the end of April describing salvaging and relocation operations if any have taken place in the corresponding period.

This report shall include:

- Confirmation that freshwater fauna salvaging and relocation operations were undertaken in accordance with the NFFFMP and associated consent conditions;
- Salvage and relocation results, including species, size ranges and number of individuals relocated; and
- Recommendations for potential changes to improve the effectiveness of freshwater fauna management in relation to the NFFFMP scope.

Notable changes to salvage and relocation protocol will be considered after consultation with AC, DOC and iwi. Resulting changes and updates to the NFFFMP, following consultations, will be effective upon certification from ACT.

The compliance monitoring report shall also include representative photos showing:

- Salvaging methodologies; and
- Freshwater fauna captured including salvage, site photos and relocation site photos.

Annual reporting will cease once freshwater fauna salvage has been completed and all captured freshwater fauna have been relocated to the release site. A final report summarising the outcomes of NFFFMP implementation will . be prepared and submitted to AC within three months following final freshwater fauna release.

No post- monitoring of freshwater fauna is proposed within the relocation sites to determine if relocation has been successful. This is due to the inherent difficulties associated with marking individuals and with obtaining and interpreting meaningful data on the expectation that individuals may be difficult to detect and absence of detection does not constitute confirmation of relocation failure (e.g. individuals may all survive but may disperse away from the relocation site and outside of the monitoring footprint).

5.2 Permit reporting

Reporting requirements for any MPI Special Permits, Fisheries New Zealand authorisations and DOC approvals held will be adhered to. Details of those reporting requirements, such as who to report to and reporting frequency, are permit-specific and can be found in each relevant permit.

All records of native fish captured will also be sent to NIWA for inclusion in the New Zealand Freshwater Fish Database. This is typically a condition of MPI permits.

6 Applicability

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

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

Tonkin & Taylor Ltd

Report prepared by:

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Kylie Park

Aquatic Ecologist

Authorised for Tonkin & Taylor Ltd by:

.....

Simonne Eldridge

Project Director

Technical Review by Justine Quinn (Freshwater Scientist)

KYPA
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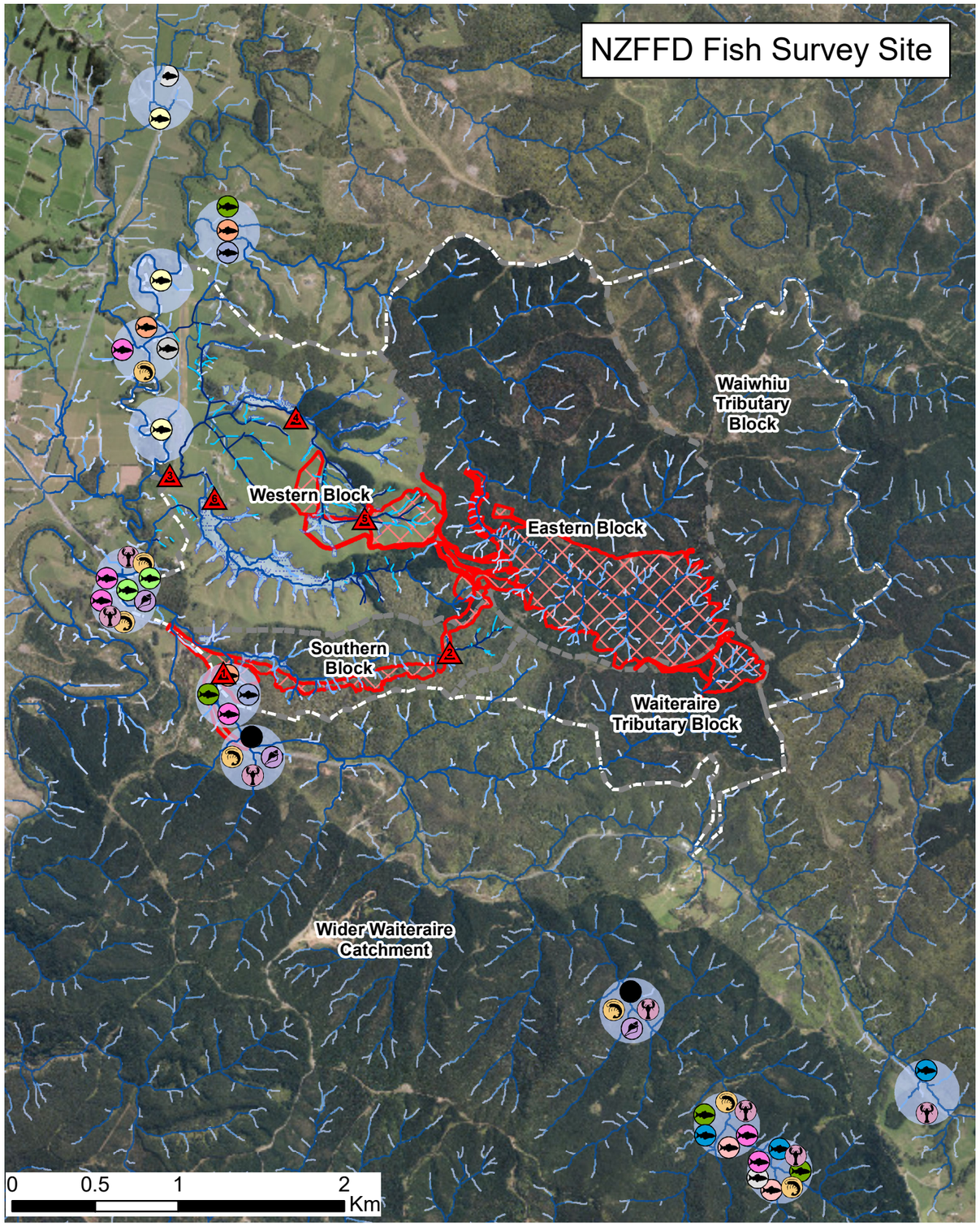
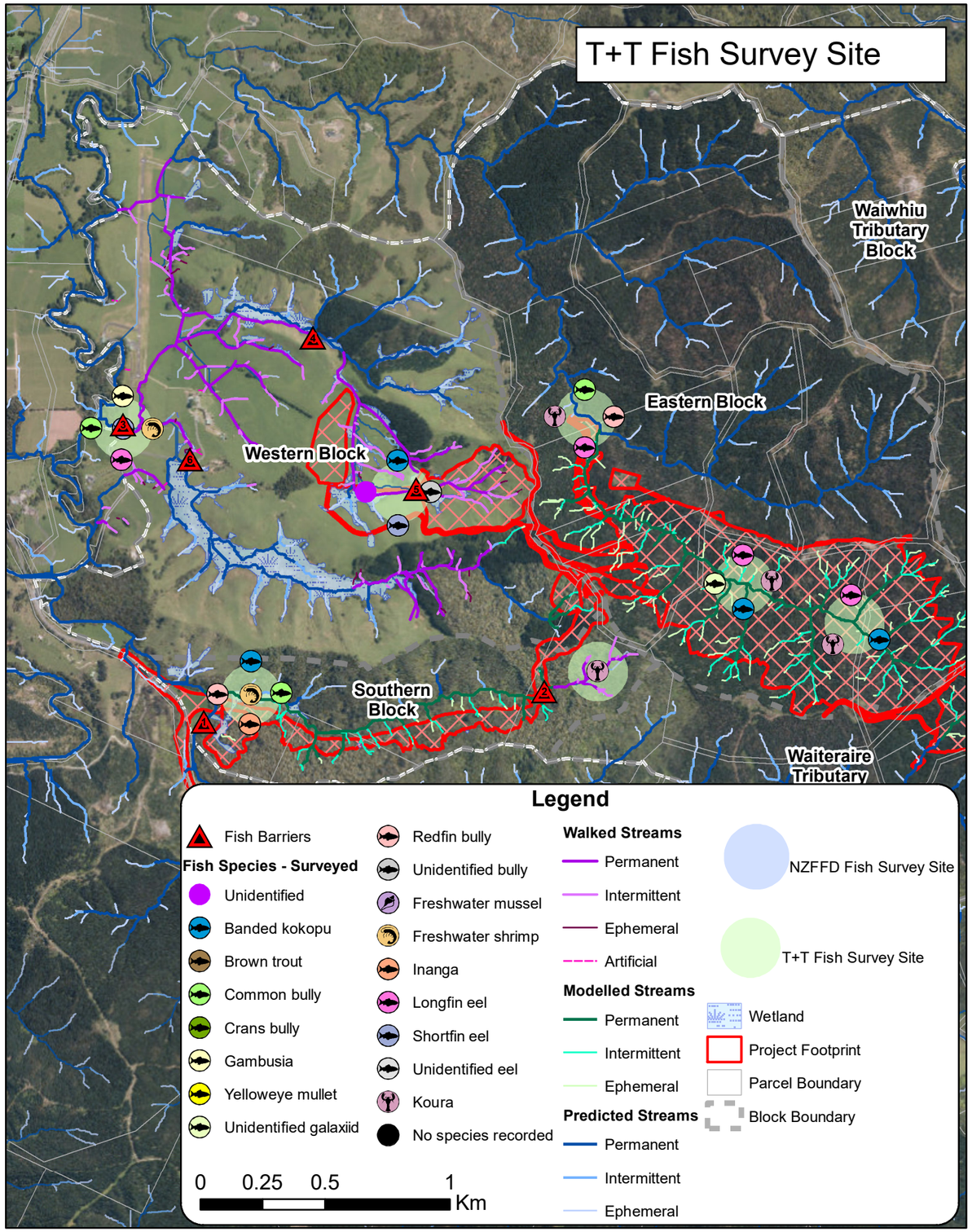
Appendix A: Fish sampling sites





Notes: Aerial Photograph: Sourced from the LINZ Data Service and licensed for re-use under the Creative Commons Attribution 3.0 New Zealand licence

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DRAWN	ANFL	May.19
CHECKED	DXLR	May.19
APPROVED	ALB	May.19

ARCFILE: 1005069-1115-FIG003.mxd
SCALE (AT A3 SIZE): NZFFD Map: 1:30,000; T+T Survey Site Map: 1:20,000
PROJECT No.: 1005069

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AUCKLAND REGIONAL LANDFILL FISH SURVEY LOCATIONS

FIGURE No.: Figure 3.
Rev.: 3

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Appendix B: Spawning and migration calendar for freshwater fauna known in ARL catchment

Thanks		D	J	F	M	A	M	J	J	A	S	O	N
Shortfin eel	Spawning												
	Upstream*												
	Downstream												
Longfin eel	Spawning												
	Upstream*												
	Downstream												
Inanga	Spawning												
	Upstream												
	Downstream												
Banded kōkopu	Spawning												
	Upstream												
	Downstream												
Crans bully	Spawning												
	Migrating												
Redfin bully	Spawning												
	Upstream												
	Downstream												
Common bully	Spawning												
	Upstream												
	Downstream												
Koura													

Calendar adapted from Smith (2014).

Red box indicates optimal time for undertaking fish surveys due to warmer water temperatures and fish activity (from Joy *et al.*, 2013). Light blue shading indicates range of spawning/migration, dark blue indicates peak. Grey shading indicates species is non-migrant or does not spawn in freshwater. Peach shading indicates species that are classified as At Risk – Declining.

*Timing of glass eel upstream migration to estuaries not included in calendar due to distance of the ARL site from the coast.

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