Bioresearches
A Babbage Company

Draft Environmental Management Plan

Takanini Stormwater Conveyance Channel Stage 2 & 3 (and Wider Sunfield Development)

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1 PURPOSE OF THE DOCUMENT

This Environmental Management Plan (EMP) has been prepared primarily for the purpose of managing, preventing and mitigating any potential environmental impacts associated with the construction and operation of the Takanini Stormwater Conveyance Channel – Stages 2 and 3 (TSCC), also known as the Awakeri Wetlands. The EMP provides general principals, approaches and measured considered within the design, and to be followed in construction of the channel. Additionally, maintenance and monitoring procedures have been outlined, as required for the functional operation of the TSCC.

The TSCC is located within the wider Sunfield development proposal, which is subject to a substantive Fast-track application under the Fast-track Approvals Act 2024. Whilst this report specifically responds to the TSCC, given the wider existing rural production environment is comparable, the principles and approaches of this EMP can be utilised and exploited for the wider Sunfield development proposal. This is also in recognition that this is a draft EMP, and a more detailed EMP is offered as a condition of consent for the Fast-track application.

2 INTRODUCTION

The flat farmland east of Takanini has been designated for residential development under Auckland's Unitary Plan – specifically known as the Takanini Strategic Area, which is a Special Housing Area (Tranche 3; Tranche 8 extension). The underlying peat soils here are subject to frequent flooding and there has previously been no stormwater servicing for the area, hindering the land's capacity for development.

To improve the flood capacity in the area, the Takanini Stormwater Conveyance Channel (TSCC) has been designed to convey stormwater flows and flood flows (up to the 1% Annual Exceedance Probability (AEP)) from the development areas to the Pahurehure Inlet (Figure 1). This project will also reduce the extent of the flood plain that covers a large part of the development area.

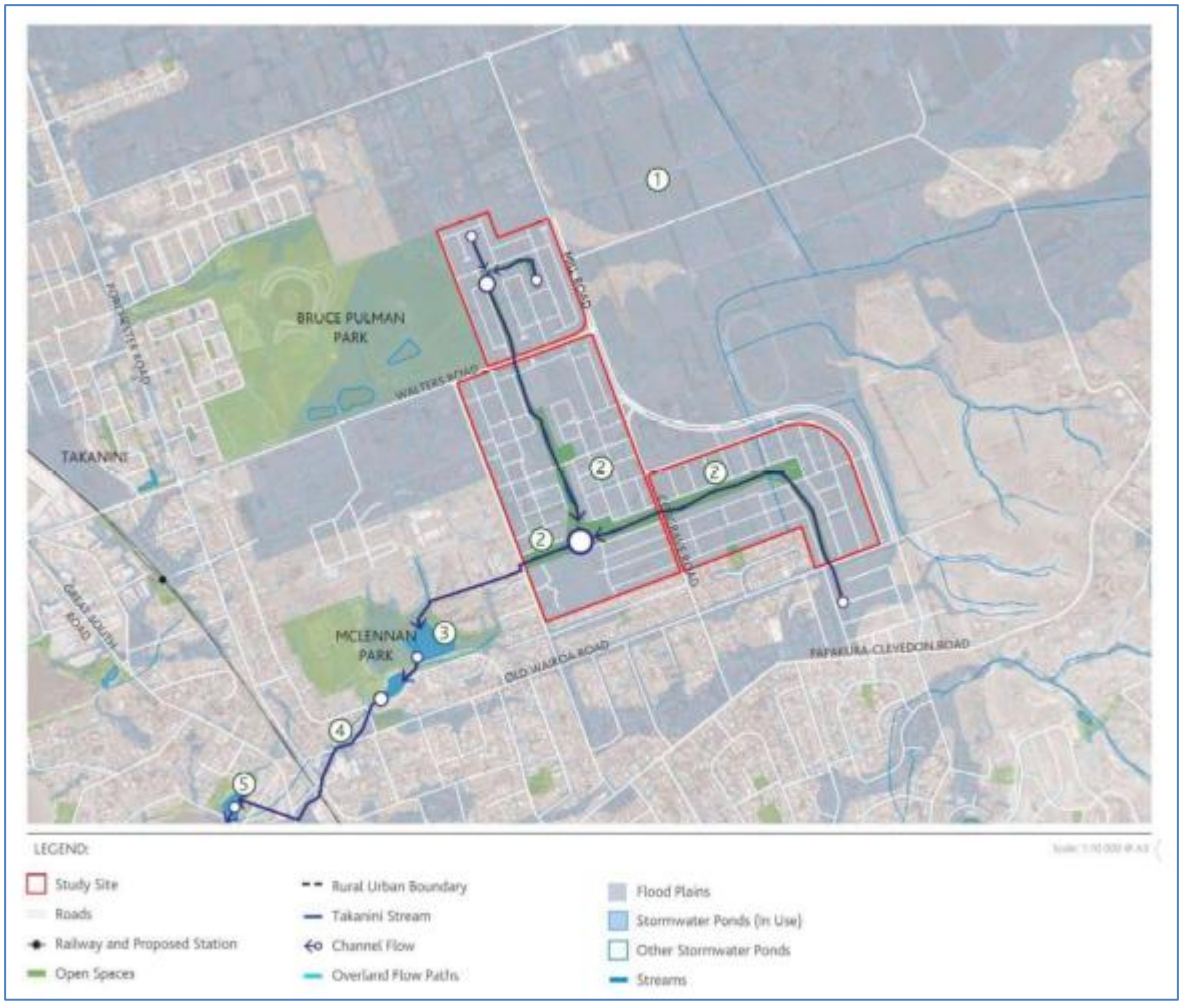

Figure 1. The Takanini Stormwater Conveyance Channel. Image reproduced from Auckland Council (2017).

Auckland Council completed Stage 1 of the TSCC in 2020, with 2100 linear metres of channel constructed, in addition to conveying storm water the channel which was designed to provide a range of habitat types.

Neighbouring developments are designed to fall towards the channel and ultimately discharge water to the McLennan Wetland, as shown in Figure 1.

Auckland Council owns the land for Stage 2 and Stage 3 of the TSCC, which is located within a road reserve and at 55A Cosgrave Road.

Stage 2 consists of the installation of a culvert under Cosgrave Road, and Stage 3 will include the creation of approximately 840 linear metres of channel and 29,300 m^2 of channel, including wetland, open water, floodplain and riparian habitats (Figure 2). Stage 3 will bring forward the extension and continuation of the TSCC through 55A Cosgrave Road.

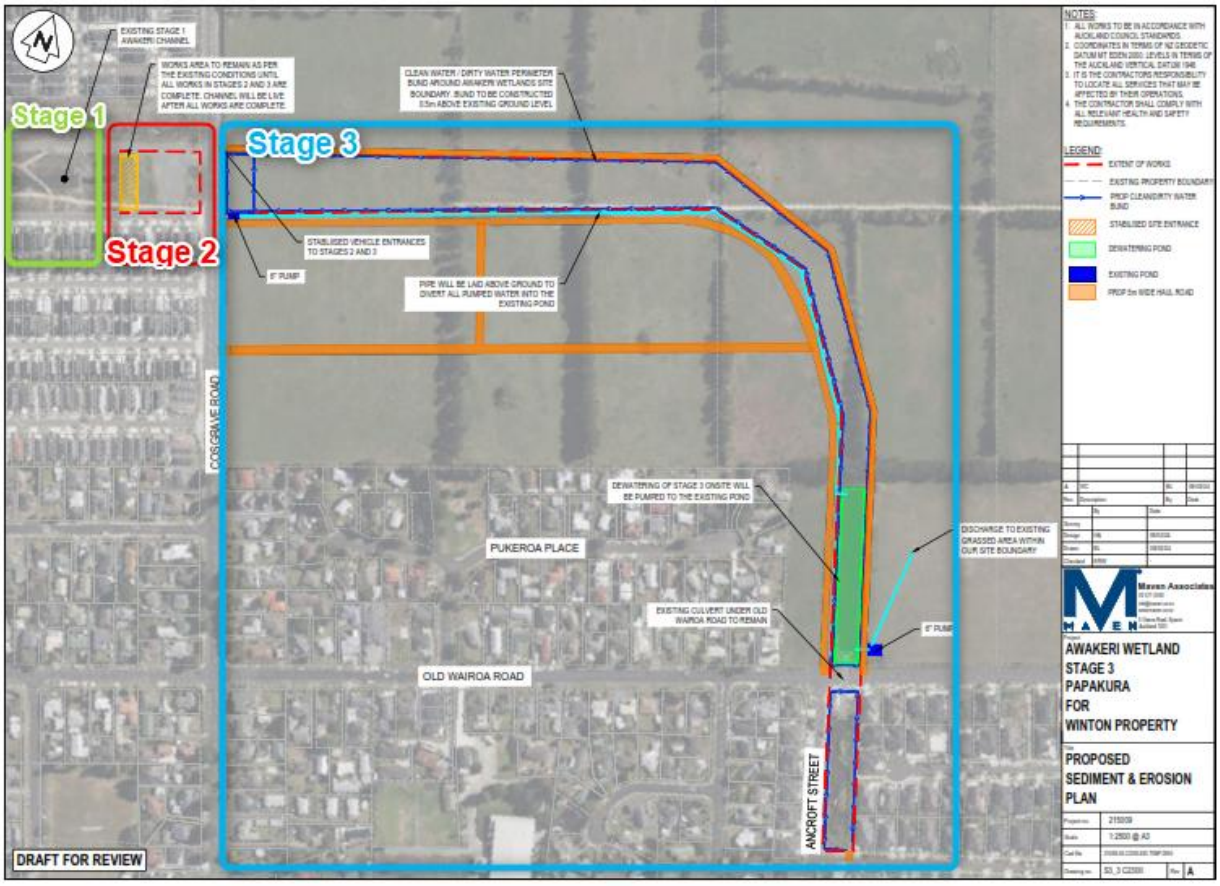

Figure 2. Stage 1 (completed), Stage 2 and Stage 3 of the TSCC

2.1 Context of This Document

This report has been prepared based on information in the Bioresearches report *Takinini Stormwater Conveyance Channel: Awakeri Wetlands*[1], the Healthy Waters report *Awakeri Wetlands Stage 2 Cosgrave Road Culvert*[2] and Auckland Council's *Awakeri Wetlands -Stage 3. Specimen Design Drawings*[3]. The Bioresearches report details the environmental impacts of the construction of Stage 2 and 3 of the TSCC, and provides information on the ecological management of those impacts and provides opportunities for a positive ecological outcome. As such, this report addresses:

- Habitat creation and enhancement of the conveyance channel;
- Provision of habitat through minimum base flows;
- Management of weed and pest species;
- Operation and maintenance practices to achieve ongoing establishment and enhancement of ecological values within the area; and
- Fish Management Plan.

2.2 Integration with Surroundings

The EMP highlights strategies to achieve the best ecological outcome of the project. The document focuses on the designation of the stormwater channel, and the design is intended to interact with the built environment of surrounding developments and habitats outside of the designation, such as McLennan Park, Bruce Pulman Park and remaining green areas.

[1] Bioresearches (2023). Takanini Stormwater Conveyance Channel: Awakeri Wetlands, Report for Winton Land Limited.
[2] Healthy Waters (2019). Awakeri Wetlands Stage 2 Cosgrave Road Culvert. Specimen Design Report.
[3] Auckland Council. Awakeri Wetlands – Stage 3 Specimen Design Drawing. Cosgrave Road, Takanini. WBS No. 008326

3 STATUTORY FRAMEWORK

This section summarises the legislation, policy, plans and strategies relevant to the protection, conservation and enhancement of nature conservation interests associated with the site. The ecological values described in this report allow significant ecological issues and adverse effects to be identified as they relate the Resource Management Act 1991 (RMA). The identification of significant values and subsequent management recommendations to mitigate adverse effects are consistent with standards and objectives of the following legislative, policy statement and regional plan documents.

3.1 Legislation

3.1.1 Resource Management Act 1991 (RMA)

The purpose of the RMA is to achieve sustainable management. Important elements of this are the maintenance of indigenous biodiversity and protection of significant indigenous vegetation and habitats. The RMA requires that any adverse effects of development be avoided in the first instance, and where avoidance is not reasonably practicable, impacts should be minimised, remedied, or mitigated. These elements are given effect in Sections 5, 6 and 7, and Schedule 4 sets out the requirements for effects assessments.

3.1.2 Wildlife Act 1953

The Wildlife Act (WA, 1953) provides legal protection to listed species classed as wildlife. It controls how people interact with Wildlife, including all native birds, bats, frogs and lizards and some invertebrates. Note is does not cover plants or freshwater fish.

3.1.3 National Environment Standards for Freshwater (NES-F, 2020)

The National Environmental Standards for Freshwater 2020 (NES-F) set requirements for carrying out certain activities that pose risks to freshwater and freshwater ecosystems.

3.1.4 The Reserves Act (1977)

The Reserves Act aims to provide for the benefit and enjoyment of public areas in New Zealand, including providing for wildlife, indigenous flora and fauna, as well as providing environmental and landscape amenity.

3.2 National Policy Statements

3.2.1 Freshwater Management

The National Policy Statement for Freshwater Management 2020 (NPS-FM) provides direction under the RMA, to local authorities on managing activities that affect the health of freshwater, and provides protections to freshwater bodies, including natural inland wetlands, includes provisions for monitoring and reporting on freshwater quality and quantity, and for addressing the impacts of land use activities on freshwater resources.

3.2.2 National Policy Statement for Indigenous Biodiversity (NPS-IB)

The NPS-IB provides direction to councils to protect, maintain and restore indigenous biodiversity in the terrestrial environment, requiring at least no further reduction nationally. It is considered relevant to the proposal because the site is in the terrestrial environment, and it contains indigenous biodiversity as defined in Section 1.6 (Interpretation) of the NPS-IB.

The NPS-IB requires that indigenous biodiversity that is not protected by an SNA (or SEA for the purpose of this assessment):

a. Is managed by applying the effects management hierarchy (avoid, minimise, remedy, offset, compensate), where those effects are significant.
b. is managed to give effect to its Objective and Policies, where those effects are not significant (Section 3.16 (2)).

The terrestrial vegetation within the site is not subject to a SEA and therefore the proposed works would need to be consistent with Policy 8 (NPSIB), which addresses maintaining indigenous biodiversity outside of SNAs, and Section 3.16, which requires that significant adverse effects be managed by applying the management hierarchy (avoid, minimise, remedy, offset, compensate).

The NPS-IB recognises Tangata Whenua as kaitiaki of, and partners, in the management of indigenous biodiversity (NPSIB, Policy 2). At the time of preparation of this report, no acknowledged taonga species have been identified in the public domain.

3.3 Regional Plans and Policies

The Auckland Unitary Plan (AUP) is the principal statutory planning document for Auckland. It was prepared by Auckland Council for the purpose of giving effect to the RMA as a regional council and as a territorial authority.

4 EXISTING ENVIRONMENTAL CONDITIONS

Pre-construction ecological values of the site were assessed in the Ecological Values and Assessment of Effects report (Bioresearches, 2023), and are summarised below. Overall, the site has been heavily modified and contains limited ecological values and habitats, due to its extensive history of agricultural use.

4.1 Terrestrial ecological values

The site has been extensively modified, with little historic (pre-human) ecological characteristics remaining. The site has been heavily cleared and used for agricultural land use for at least 40 years, although partial vegetation clearance of the site occurred over 60 years ago.

The majority of the vegetation within the site consists of exotic pasture grasses and crops with exotic shelter belts, due to the agricultural and pastoral land use of the site. Native vegetation is limited to occasional indigenous trees in the shelter belts and riparian margins. The botanic values of the site are considered low.

The lack of suitable habitat within the site and connectivity to the wider environment decreases the likelihood of stable terrestrial fauna populations such as herpetofauna, avifauna and bats. The value of terrestrial vegetation within the site pertaining to ecological connectivity and function is considered negligible. However, isolated copper skink (*Oligosoma aeneum*) populations may be present in dense ground cover and woody debris piles.

4.2 Freshwater ecological values

The freshwater ecological values were poor, with the only aquatic habitats present consisting of artificial drainage channels created for the agricultural land uses. The water present within the artificial channels did contain some connectivity to the wider catchment, however the soft substrates, lack of hydrological diversity and highly turbid waters would only provide habitat to tolerant fauna species.

4.3 Receiving environment

The receiving environment of the stormwater flow is the existing Stage 1 TSCCs. Bioresearches (2023) identified in an Assessment of Ecological Effects that the McLennan Park Wetland (downstream of the Stage 1 TSCC) potentially contains both “At Risk” - *Anguilla dieffenbachia,* longfin eel; and “Not Threatened” native freshwater species. It therefore is considered to have “moderate” ecological value. Ducks and pūkeko were observed during a site visit, whilst little shags (Not Threatened) and black shags (Naturally Uncommon) have been recorded within the vicinity of the wetland and may use the habitat for feeding.

The existing Stage 1 TSCC eventually discharges to the Pahurehure Inlet. which has been historically degraded by sediments and stormwater contamination from the surrounding urban and rural area (Land

Air Water Aotearoa [LAWA], 2024). Recent monitoring results show estuary macrofauna and mud content of the inlet showing signs of very high impacts and degradation (4.90 and 66.2% respectively), however heavy metals, including copper, mercury, zinc, lead and arsenic are within the limits in which ecological impacts will be unlikely (LAWA, 2022).

5 ECOLOGICALLY SENSITIVE DESIGN PRINCIPLES

Significant emphasis has been placed on ecological restoration and improvements as part of this project, and this approach has been developed to ensure the project achieves:

- An overall aim to preserve and enhance local ecological values and integrity;
- Improvements to terrestrial habitat values;
- Improvement to freshwater habitat values; and
- Measures to ensure the improvement of these values are achieved, including appropriate planting zones and ecosourcing.

5.1 Local ecological and landscape integrity

The existing environmental values in the surrounding area have been heavily modified, with the continuation of the TSCC providing the opportunity for great ecological uplift within area. Accordingly, a key component of the project includes the restoration of wetland ecosystem throughout South Auckland. Given the soil types present within the site, there is opportunity to restore a peat bog wetland ecosystem. This restored ecosystem will help support effective water filtration and treatment, and retention.

5.2 Terrestrial ecological benefits

Stage 1 provides greenway corridors to McLennan Park wetland and Bruce Pulman Park. These connections will be extended through the implantation of Stage 2 and Stage 3 of the TSCC. The wetland present within McLennan Park provides habitat to native fish, and native and exotic bird species. Although primarily a sports field, Bruce Pulman Park has some pond habitat that can be used by native birds.

Auckland Council (2017), in the Ecological Management Plan for Stage 1, describes the ecological value of the wider landscape from the site in detail. A map indicating these values is shown in Figure 3. In general, the site occurs within the centre of several areas of ecological significance. The map identifies these values, numbered 1-4, which are briefly described below:

1. Pahurehure Inlet: Coastal inlet of importance to threatened and endangered wading birds, such as the wrybill and black stilt. Minimising impacts on this environment is a core principal of this project.
2. Terrestrial Significant Ecological Area (SEA) associated with Tōtara Park to the north of the site.
3. Terrestrial SEA vegetation associated with Kirks Bush.
4. SEA_T_5248 and SEA_T_4362 (Red Hills)

The revegetation of the site will act to create ecological corridors and stepping stones for native avifauna, moving between the Pahurehure inlet and the surrounding forested areas described above.

Stepping stones are paramount in maintaining the ecological integrity of an area, by providing food resources and shelter for native species within an urban environment.

As quoted in Maven Associates (2017):

"In broad terms, development of the open waterway has potential to provide significant ecological benefits in terms of water quality, habitat (both aquatic and terrestrial) and food source for fauna, as well as the ability to recreate a measure of the original peat forest that would have occurred in this region".

Figure 3 : Map showing the site (red) and surrounding ecological values, labelled 1-4. Source : Auckland Council, 2017.

5.3 Aquatic ecological benefits

Stage 2 and Stage 3 of the TSCC have been designed with the intent of improving aquatic habitat in three ways; creating connectivity to the eastern portion of the catchment, filtration of stormwater and creation of freshwater habitat for flora and fauna.

Currently, the Stage 1 TSCC contains no connectivity to the freshwater catchment to the east of the stormwater channel. Water within this eastern catchment drains from the farm channels and enters roadside drains and piped reaches before discharging into the Pahurehure Inlet. The installation of this culvert will connect the existing Stage 1 TSCC (and therefore the McLennan Park wetland) to the waters existing in the Stage 3 area, increasing the area of available habitat for native fauna.

As described prior, the Pahurehure Inlet is described to be of poor health. The project will further manage the generation of stormwater from the surrounding residential developments, using best practice techniques to ensure water quality impacts to the downstream and estuarine receiving environment are minimised as far as practicable. This will be achieved by:

- Residential development areas will be designed to allow for groundwater recharge, as required by the Auckland Unitary Plan for peat soils. Overland flow paths will be directed towards the conveyance channel.
- Filtration of pollutants within the stormwater channel through the vegetated margins. Stage 3 will be conveying water to Stage 1 TSCC, and towards McLennan Park wetland which is proposed to be upgraded to increase stormwater treatment. The McLennan Park wetland will provide further treatment to stormwater captured and conveyed through Stage 1 and Stage 3.

Natural stream reaches currently remaining within the area lack sufficient stream extent and have little to no baseflow during the dryer months (GHD, 2016). The aquatic habitat quality and quantity within the TSCC channel will be significantly increased through the design to provide for common and threatened indigenous species. The meandering watercourse will consist of deep pools and runs, and shallower margins around wetland vegetation which will be established on the near-flat sloping margins and be inundated during flood flows, providing idealistic spawning habitat for indigenous galaxiids. McLennan Park wetland provides habitat with for native fish, and it can be readily assumed the connectivity of Stage 1 TSCC and McLennan Park wetland has resulted in the upstream migration of fish to Stage 1 and will further inhabit Stage 3 upon completion.

As with Stage 1, weirs will be spaced through the Stage 3 channel to allow for the control of water levels. Fish passage has been designed within the weirs to provide for permanent upstream and downstream fish movements. The culvert under Cosgrove Road will be installed with fish passage in mind, with the culverts sufficiently embedded to provide a permanent water level and flat sloping angle of the culvert should allow upstream and downstream migrations to a range of indigenous species.

5.4 Planting zones

The channel profiles, similarly to Stage 1, have been split into various planting zones. These are based on the slope and hydrological variation according to different levels of submersion within the wetland.

The zones, species mixes and planting layouts have been designed to match those of Stage 1. Plants have been selected for their ability to compensate for flood flows, and to survive periods of inundation.

Historically (pre-human), the site would have contained a mixture of bog/fen habitat, pūriri forest (WF7-1), and kahikatea, pukatea forest (WF8) (Bioresearches, 2023). Small sections of taraire, tawa, podocarp forest (WF9) would have also been present.

These forest and fen mosaic ecosystems are characteristic of the Manukau ecological district, from which all plants for the Stage 2 and 3 planting are to be eco-sourced from.

The planting zones have been described by Auckland Council (2017) as they occur within Stage 1, which will also be adopted in Stage 2 and 3 (South Pacific Architecture, 2024). A brief description of the zones follows:

- Aq (Aquatic Planting) – plants found within the permanent water channel, along flatter terraces. Tolerate full submersion and lie flat in flood conditions.
- Lf (Low Flat Planting) – Above permanent water level, but still prone to regular inundation. Predominantly sedges and grasses, as well as swamp maire and tī kouka.
- Ls (Lower Slope Planting) – Outside of the regular flooding area, but may flood in moderate to large events (five-year flood event). Some canopy trees such as taraire are included to increase shade coverage.
- Tc (Upper Bank and Terrace Planting) – Beyond flood zone, with increased range of canopy trees.
- Rr (Rongoā and Raranga Planting) – In places, planting reflects traditional Māori uses of plants, such as medicine (rongoā) and weaving (raranga). These species have been informed by Mana Whenua.
- Sa (Special Activity planting) – Different planting palettes to suit special requirement areas such as playgrounds.

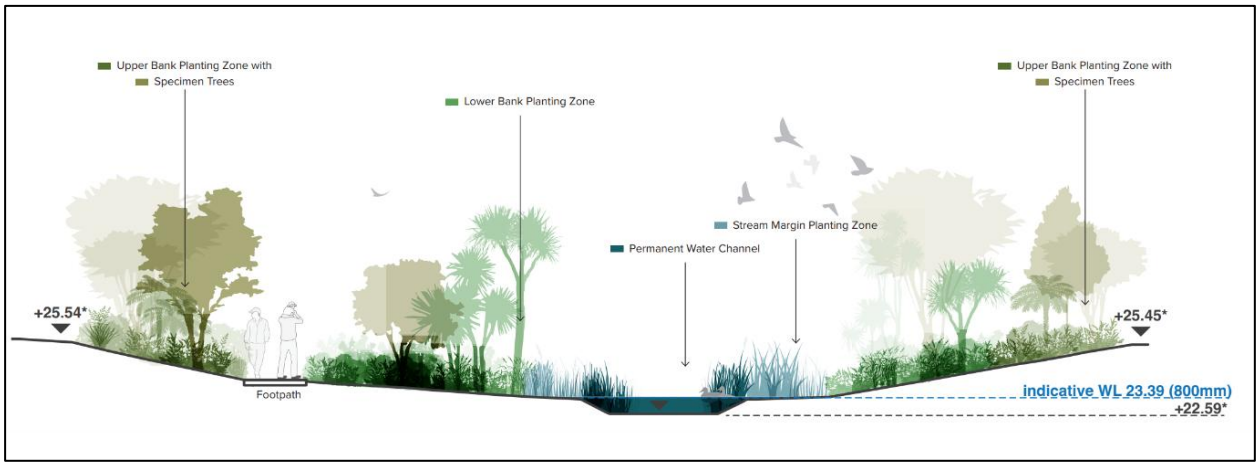

Figure 4 : Indicative cross-section of typical planting of the wetlands (Studio Pacific Architecture, 2024)

5.5 Methods to establish planting zones

Revegetation must be carefully considered in order to ensure the successful establishment of planting zones. In order to improve the establishment of plants, the following measures have been adopted:

- All plants shall be eco-sourced from the Manukau Ecological District;
- Planting areas include minimum 300mm topsoil or local peat soil;
- Planting areas below the 10% AEP flood level shall be covered with 100% biodegradable coconut matting or similar, with jute mesh;
- Planting areas above the 10% AEP flood level to include 100mm of aged arbor mulch (not processed wood chip); and
- Trees and subcanopy species to be planted in pioneer (year 1) and enrichment (year 3) stages, to accommodate for differing shade and shelter requirements of plant species.

5.6 Terrestrial fauna

The majority of the vegetation within the site consists of exotic pasture grasses and crops with exotic shelter belts, due to the agricultural and pastoral land use of the site. Native vegetation is limited to occasional indigenous trees in the shelter belts and riparian margins.

However, there is still potential for indigenous fauna to occur within the works area. As recommended in Bioresearches Awakeri Wetlands Ecology Report (2023), nesting bird checks should be conducted where vegetation clearance cannot occur outside the native bird nesting season (September to February inclusive).

The outcome of the revegetation of the site is the increase in available habitat for native fauna species. The addition of fruiting and flowering native tree species will increase food resources for native birds, whilst an increase in ground cover planting will eventually lead to the provisioning of native skink habitat.

5.7 Aquatic fauna

The project site contains a series of farm drainage channels as described in Section 3.2, these are of low ecological value, however have the potential to provide habitat for robust indigenous fauna such as shortfin eel. The excavation of the Stage 3 TSCC will result in an increase in the population of native fish due to the restoration of connectivity and an increase in habitat types. As such, it is expected shortfin eel, banded kōkopu and potentially īnanga could utilise the constructed Stage 3 TSCC.

A Fish Management Plan for the construction of the channel is provided in Appendix A.

6 IMPLEMENTATION AND OPERATION

The following subsections describe specific measures are proposed to ensure that the ecological improvements are successfully established, and maintained through the ongoing operation of the channel.

6.1 Erosion and sediment control

For the duration of the contract works period, erosion and sediment control measures are to be implemented as per the Proposed Sediment and Erosion Plan (Maven Associates, 2024a and 2024b) and Earthworks Management Plan (Maven Associates, 2024c).

The final intent is for the TSCC shape to have a maximum bank slope of 1 to 4, to reflect natural terraced watercourses. At these gradients, slope stability will be provided and the terraces will be heavily planted to achieve rapid canopy closure, reducing the likelihood of erosion and surface soil runoff. Where the banks will be exposed to flooding and high-water tables, the banks will be further stabilised with Geoweb, which prevents scour and erosion whilst accommodating planting.

Sediment control within the catchment will be supported by treatment of high contamination generating areas and recharge from impervious areas from the surrounding prior to discharge to the TSCC. Sediment control within the channel will be provided by riparian and in-stream planting and weir structures within the channel.

6.2 Earthworks

The site sits within a large area of peat soils, which stretches from the edge of the Takanini residential area up the flat river plain to Clevedon. These soils are poorly draining with very high moisture content, and therefore at high risk of flooding.

During the earthworks period, silt control measures are to be applied as above, and regular monitoring is required to ensure contaminated material is not used on site. Any topsoil used in the project will be screened and ensured to be weed-free to prevent accidental introduction and spread of weed species.

6.3 Creation of aquatic and microorganism habitats

The following measures are in place to allow for the creation of aquatic and terrestrial macro and microorganism habitat within the newly constructed wetland environment.

6.3.1 Maintenance of base flow

Similarly, to Stage 1, the Stage 3 channel will have a series of weirs established throughout the wetland to maintain sufficient water levels. These weirs have been designed to allow for fish passage, while ensuring water depths of approximately 0.3 m are maintained year-round, creating habitat for a range of organisms. The base of the low-flow channel will not be lined, ensuring naturalisation of the area is

achieved over the long term. This maintenance will improve the flow of surface water and reduce flooding risk to the area (GHD, 2016).

6.3.2 Permanent water level

The low flow channel depth has been selected in respect to water quality, flow characteristics, safety considerations, and industry guidelines.

The low-flow depth will ensure a permanent presence of:

- Low water velocities, minimising erosion and scour throughout the channel and provides suitable wetland habitat for a range of indigenous species.
- Sufficient control of water temperatures, minimising fluctuations and providing stable habitat conditions.

6.3.3 Maximum water level during low flow

The minimisation of cut depths during construction and weirs during operation will control water levels within the channel and minimise the effects of long-term dewatering (GHD, 2016) as much as practicable; while limiting groundwater drawdown and providing appropriate aquatic habitat.

6.3.4 Riparian planting

Appropriate variation in riparian planting has been created to help establish habitat for native fauna. Close to the wetland edge, sedges and submerged plants create habitat for aquatic organisms and wading birds. In particular, native fish use vegetated edges for spawning habitat and shelter. Further up the bank, riparian planting incorporates canopy species in order to provide shade to the aquatic environment, decreasing water temperatures and UV exposure, and improving the biological function of the wetland. Shade along edges of vegetation also increases the value of habitat to native skinks.

6.3.5 Fish Passage

Fish passage has been considered in the designs of the culvert. The culverts under Stage 2 will be sufficiently embedded, over 50% of the culvert height, ensuring water levels are sufficiently maintained to provide passage for a range of aquatic fauna. The culvert alignment and gradient also ensures the slope of the culverts are near-flat which allows for both swimming and climbing capable species. This gradient also means a fish ladder is not required. The weirs within the channel have the provision for fish passage with a limited height to 50 mm above water surface. However, assessment of the completed Stage 1 TSCC showed water levels to have dropped below the weir crest and prevents the passage of fish. Once constructed, monitoring of the weirs and water levels is therefore recommended to ensure permanent fish passage is provided, and if required, remediation of the structures are undertaken to achieve this.

In addition, macrophyte control within the waterways will aid in the maintenance of fish passage, as pest aquatic macrophytes can inhibit waterflow. Aquatic macrophyte control can be conducted as part of the

weed removal in section 6.1 of this report. Hand-removal is necessary for the removal of weeds within waterways.

6.4 Plant establishment and erosion control

The wetland planting will be subject to intermittent inundation, which may create problems for successful plant establishment. Proposed mitigation with regards to scour and erosion protection are outlined below for the various planting zones (adapted from Auckland Council, 2017).

Table 1: Mitigation techniques for scour and erosion according to height above channel/water's edge

Zone	Surface Cover	Risk of scour/erosion	Protection measures
Low-flow channel	Naturalised channel with pools and slight channel meander	Highly susceptible to scour and erosion. Velocities are expected to be lower at the base of the channel	Low velocities maintained along low flow channel (<0.6 m/s) Weirs at regular intervals to drop sediment load from channel
Wetland bench	Wetland sedges	Moderate initial risk during flood events, dropping to low as plants establish. Wetland grasses will slow velocities and roots will bind soils	Geoweb cells to be used. Increased density of plants to speed up coverage and increase protection
Sloping Banks	Manuka, ferns and native sedges. Specimen trees with mass branches above 1% AEP	Low risk. Roots of grasses and trees will strengthen channel banks over time	Slope has been maintained as relatively flat (1v:4h) Mulch planted areas
Floodplain	Footpath and specimen trees	Low risk. Large specimen trees and hard surfaces will naturally protect from scour and erosion	Cross-sectional area provided will limit velocities in flood events. No additional protection required, mulch to planting beds

Other practices to increase establishment include:

- Seedlings to be grown in media with similar properties to peat soil;
- Plants to be supplied with completed copies of the NZPPI Nursery Management Declaration form and Plant Transport Declaration form to aid in the control of Myrtle Rust spread;
- Plants should be pre-ordered to ensure required numbers are reached from eco-sourced nurseries; and
- Pest control measures will be put in place to prevent damage to new plantings (section 6.2).

6.5 Enrichment planting

Similar to Stage 1, the planting will occur in two stages. The first stage is the initial or pioneer planting stage, which includes fast-growing, light-loving species that will establish and create canopy cover.

The second stage includes enrichment species, which require some shelter and shade cover in order to establish. This planting will occur in year 3 of the maintenance schedule.

In this way, staged planting aims to mimic natural succession, speeding up the process to minimise weed infiltration, whilst also allowing for the natural regeneration of nearby native species.

7 MAINTENANCE AND MONITORING

7.1 Plant Weed and Pest Species Control

Weed control will be required both prior to works during vegetation clearance, and following planting during the maintenance period. This section details weed control requirements during both stages. In keeping with Mana Whenua values, due to the proximity of the planting and works to waterways, chemical control has been minimised. Spraying should be avoided within 3 m of the wetted edge of watercourses.

The landscape contract details a maintenance period of five years. This ensures that at the completion of the five-year period and return of the planted area to council, plants are well-established and canopy cover has been achieved. All planting is to be mulched to reduce the risk of weed regrowth. However, some weed control will be inevitably required.

The following table has been adapted from Auckland Council (2017) and includes common weed and pest plant species, and their appropriate removal method. In accordance with section 7.2.1 below, weed control monitoring and maintenance shall occur on a monthly basis for the first two years, dropping to bi-annually within years 3-5.

Table 2: Table listing common pest plant and weed species, and their control methods

Weed Type	Typical Species	Primary Control	Secondary Control	Disposal
Trunked Weeds	Privet, brush wattle, acacia, willow, phoenix palm	Fell at ground level, treat stump immediately with organic stump paste	Fell at ground level and remove, stump paste to kill roots or spray regrowth	Mulch and spread on site where specified, or remove from site
Herbaceous Weeds	Gorse, *Cotoneaster,* woolly nightshade	Ring-bark or grub out	Fell and apply Cut'n'Paste gel to stump	Remove from site to prevent re-spread
Vine Weeds	Moth plant, honeysuckle, *Eleagnus, Clematis*	Manually dig out root masses	Spray foliage with approved herbicide or cut and apply Cut'n'Paste gel	Remove from site to prevent re-spread
Rhizomatous Weeds	Arum lily, wild ginger	Manually dig out roots and nodules	Spray foliage with approved herbicide or cut and apply Cut'n'Paste gel	Remove from site to prevent re-spread
Ground Weeds	*Tradescantia,* periwinkle	Manual hand-weeding		Remove from site to prevent re-spread

Aquatic Weeds	Iris, *Zizania,* alligator weed	Manual weeding		Remove from site to prevent re-spread

7.2 Animal Pest Control

Uncontrolled environmental pests can negatively impact both on newly planted areas and existing biodiversity. Rodents, possums and even native pūkeko are all known pests to replanting areas. The following measures are recommended to reduce the impact of pests.

Table 3: Table with common pests likely to impede ecological outcomes, and their control methods

Pest Species	Primary Control	Additional Notes
Rabbit	Manual cull prior to works commencing. Use of biodegradable plant guards to prevent damage to new plants	Monitor over maintenance period, secondary cull may be required.
Possum	Manual cull prior to works commencing. Lockable bait delivery, or self-resetting instant kill trap (Flipping Timmy). Trap stations 100m apart. In first instance, where required bait type shall be potassium cyanide (controlled substance licence required) or cholecalciferol.	Where bait take remains high, bait should be varied to avoid build-up n the environment. Signage required to avoid harm to dogs and children in the community.
Mustelids	Manual cull prior to works commencing. Lockable bait delivery, or self-resetting instant kill trap (Flipping Timmy). Trap stations 100m apart. In first instance, where required bait type shall be potassium cyanide (controlled substance licence required) or cholecalciferol.	Where bait take remains high, bait should be varied to avoid build-up n the environment. Signage required to avoid harm to dogs and children in the community.
Pūkeko	Use of biodegradable plant guards to prevent damage to new plants; Ensure plant specimens are large enough to withstand pulling	

7.2.1 Pest Control Monitoring and Triggers

Efficacy of pest control would be monitored via records of percentage bait take for bait stations and number of triggers and carcasses removed for instant kill traps.

- Bait replacement should be maintained weekly throughout a pulse period where bait take is more than 50% at any station. If bait take remains over 50% for more than three consecutive weeks, bait toxin type should be changed.
- Traps should be checked twice per week for the first two weeks and then weekly if traps are triggered more than 50% of their reset life. If more than 50% remains, traps may be checked less than weekly as determined by the pest control provider.

7.2.2 Timing of Pulsed Control

The pest management programme would be pulsed three times per year. Each pulse would consist of a 6-week period through September to October, January to February, and May to June.

Table 4: Pulsed control program for pest animal management

Time	Activity	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Three times per year	Pulse period												
	Bait stations	Refill baits				Refill baits				Refill baits			
	Self-setting instant kill	Check for carcasses				Check for carcasses				Check for carcasses			

7.2.3 Record Keeping

Accurate recording of results from the pest control programmes is important for providing information on the status of predator populations on the properties over time. Annual reports summarising the results of the pest control should be prepared and made available to Council compliance for review. The pest control operator would be responsible for collecting data on trap catches, maintaining the pest control devices, and preparation of summary reports.

At a minimum, the following set of information should be collected:

- Location of the traps;
- Number of kills;
- Number of traps nights; and
- Lure/bait (i.e., apple) used.

Baiting records:

- Placement of bait stations
- Bait type
- Timing of placement
- Quantity used during each re-baiting
- Quantity of bait take each check (i.e., percentage bait-take)

7.2.4 Health and Safety

When using toxin-based baits, always follow the manufacturers' instructions, and ensure the baits are stored in a dry safe area locked away from pets and children. If bait is consumed by a person, call the poison hotline (**0800 764 766**) immediately. If a pet consumes brodifacoum, take them to a vet immediately to receive Vitamin K1, an effective antidote to the anticoagulant.

7.3 Maintenance Plan

The proposed maintenance period, similarly to Stage 1, is 5 years. The schedule below, adapted from Auckland Council (2017), summarises the proposed maintenance tasks and frequencies that will be written in to the contract.

Maintenance should be undertaken monthly for the first two years following planting, and bi-monthly for years 3-5.

Table 5: Table showing maintenance activities and frequencies during the five year maintenance period

Activity	Timing/Frequency	Notes
Weed Control	At each maintenance visit	Control weeds each visit according to recommended methods outlined in section 7.1.
Bark Mulch	Monitor at each maintenance visit	Check mulch levels at each visit, ensure 100mm depth is maintained, look for washouts or loss of mulch and top up as necessary.
Geo-web and wave cloth	Monitor at each maintenance visit	Check that products are in working order and geotextiles have not become unpinned.
Staking	Monitor at each maintenance visit	Check that stakes are not rubbing and causing damage to new plants. Re-tie or loosen webbing as needed. Replace broken stakes, remove entirely once no longer needed and at the end of five-year period.
Watering	Monitor during the establishment phase and particularly during the first and second summers after planting, and extended dry periods	Arrange watering as required
Replacement of dead plants	Monitor at each maintenance visit; planting only during planting months of April-September	Replace dead plants with same species; should a species continue to fail, consult the landscapers or ecologist for a suitable replacement.

Upon handover of the planting back to Council at the completion of the five-year maintenance period, the following measures of success shall have been reached:

- No mature weeds present within the planted area;
- Canopy closure (minimum 80%) of all planting areas; and
- Survival of 90% of plants.

Mature weeds means no fruiting or flowering bodies are present, or weeds of sufficient size to spread through vegetative means.

Canopy closure means that sufficient vegetation exists in the canopy layer, to a coverage of 90%, that weed growth in the understorey is suppressed due to lack of sunlight and/or space.

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APPENDIX A – FISH MANAGEMENT PLAN

Native Fish Relocation Plan:

Takanini Stormwater Conveyance Channel Stage 2 and 3

MARCH 2024

Native Fish Relocation Plan

Takanini Stormwater Conveyance Channel Stage 2 and 3

PREPARED BY: LAURA DRUMMOND, M.SC. (HONS)
AQUATIC ECOLOGIST

FOR: **SUNFIELD DEVELOPMENTS LIMITED**

DATE: **12 MARCH 2024**

REFERENCE: BIORESEARCHES (2023).NATIVE FISH RELOCATION PLAN. TAKANINI STORMWATER CONVEYANCE CHANNEL STAGE 2 AND 3. WINTON LAND LIMITED

1 INTRODUCTION

Bioresearches were engaged by Sunfield Developments Limited to prepare a Native Fish Relocation Plan (NFRP) for streamworks proposed at 55A Cosgrave Road, Ardmore. The streamworks proposed will include the reclamation and construction of approximately 1,800 linear metres of artificial channels.

A formal fish survey has not been conducted, however records from the New Zealand Freshwater Fish Database shows shortfin eel (*Anguilla australis*), banded kōkopu (*Galaxias fasciatus*), have been captured within the surrounding area. Due to the degraded state of the artificial channels; it is expected only shortfin eel would be present throughout.

This document provides the Native Fish Relocation Plan (NFRP) with the methodology for the native fish recovery and relocation, in accordance the conditions of consent including:

i) Details pertaining to fish exclusion barriers to prevent migration into the site;

ii) Trapping and electrofishing methodology methodologies;

iii) Transport methodology

iv) Location and description of the translocation site;

v) The procedure to humanely euthanise pest fish; and

vi) The timing and duration of fish capture in relation to the staging of streamworks;

vii) The name, experience and qualifications of those involved in undertaking the fish relocations.

Figure 1. Map of the site (yellow polygon) with the area subject to the reclamation (green polygon), channel drainage (orange lines), and relocation site (Stage 1 TSCC, blue polygon).

2 METHODOLOGY

2.1 Commencement of recovery plan

Fish removal and relocation will occur no more than one week prior to the commencement of any instream works. To reduce stress during the relocation, the fish recovery may be carried out in stages in accordance with the extent of area being worked.

2.2 Exclusion Screens

Prior to capturing fish, a barrier (exclusion screens) to fish movement shall be placed at the upstream and downstream extents of the intermittent natural stream reaches proposed to be realigned to prevent fish from recolonising the impacted areas. Due to the complete lack of upstream freshwater connectivity within the artificial reaches, fish barriers will only be required on the downstream end, where the drainage channels intersect.

Exclusion screens will be constructed from steel warratahs and shade cloth. The shade cloth allows water to continue to flow downstream while preventing fish passage. The exclusion screen will extend 1 m past the wetted widths of the aquatic habitat and will be embedded into the dry ground or the banks.

Warratahs will be securely hammered into the ground and evenly spaced across the aquatic habitat to effectively support the shade cloth. Where extra support is considered necessary, wire will be threaded horizontally across through the warratahs to further support the shade cloth. Shade cloth will then be fastened to the warratahs and wire supports (where applicable) using zip ties. The shade cloth will extend above the water level to an approximate height of 0.5 m. Along the stream bed the shade cloth will either be embedded and pinned, or an apron of the shade cloth will be formed and pinned.

Example photographs of fish exclusion screens.

2.3 Fish Capture Methodology

The *New Zealand Freshwater Fish Sampling Protocols* (Joy *et al.* 2013) will be followed unless specified within this plan. Setting of Gee-minnow traps will also be in general accordance with *A Revised Methodology to Survey and Monitor New Zealand Mudfish Species* (Ling *et al.* 2013)

Suitability qualified freshwater ecologists shall conduct the fish relocation. These ecologists will be two of:

- Treffery Barnett, M.Sc (Hons), Senior Freshwater Ecologist
- Christel du Preez, M.Sc (Hons), Senior Ecologist
- Kate Feickert, PG.Dip.Sc, Senior Ecologist
- Laura Drummond, M.Sc (Hons), Aquatic Ecologist
- Lucia Duder, PG.Dip.Sc, Ecologist

All ecologists listed have conducted multiple successful freshwater fish relocations, have electric fishing licences and have extensive experience in freshwater fish handling and ecology. At least one of them will be present on site during the relocation.

Native fish present shall be captured over at least two days using a combination of netting/trapping and electric fishing.

Water levels permitting, baited Gee-minnow traps and fyke nets will be placed at intervals over the stream works area and left in place overnight. Fine meshed fykes with a separator grill will be used to reduce the risk of predation and injury/mortality within the nets. All nets and traps will be set with an airspace to provide trapped fish access to atmospheric oxygen and will be set in general accordance with the *New Zealand Freshwater Fish Sampling Protocols* (Joy *et al.* 2013), with small buoys placed in the fyke nets if required.

Trap densities will be set per Joy (*et* al., 2013) with one fyke and two Gee-minnow traps every 25 m. Where water depth prevents fyke nets being set, the densities of Gee-minnow traps will be increased. The traps will be checked the following morning, prior to 9 am, with any captured fish recovered.

Where environmental conditions allow for safe electrofishing, a minimum of two electric fishing runs within the areas will be carried out over the trapping period. One electric fishing run will be undertaken prior to setting any traps or nets and another electric fishing run will be undertake post the last occasion of retrieving the traps or nets. Electric fishing shall be undertaken using an electric fishing machine (EFM 300). When used correctly, the EFM 300 temporarily stuns the fish, allowing them to be caught without damage.

2.4 PERFORMANCE STANDARDS

As a minimum performance for trapping, if more than ten native fish (excluding juvenile shortfin eels) are caught during a single trapping effort within the staged area of the site, then trapping will continue until numbers are depleted to the satisfaction of the project ecologist (using an 80% removal rate as a target, based on the Hayne's (1949) regression method). A single trapping effort is considered to be one night of trapping.

In relation to juvenile shortfin eels (<350mm), fishing will continue until a 50% removal rate is achieved (based on the Hayne's (1949) regression method).

Dewatering will commence provided that the electric fishing minimum performance standards have been met. Native fish, such as eels (*Anguilla* spp.), will burrow into silt substrates when they are disturbed or as water levels decrease. As a result of this, during the dewatering stage, a freshwater ecologist will be present to search through drained habitat, rocks/debris, remaining pools or thick sediment for any remaining fish. Once dewatering is completed an excavator will be used to carefully scrape out any thick layers of sediment. Any sediment removed from aquatic habitat will also be handed checked by the freshwater ecologist.

2.5 Fish Handling and Relocation

Fish handling will be in accordance with Section 3.9 of the *New Zealand Freshwater Fish Sampling Protocols* (Joy *et al.* 2013) and the Bioresearches MPI Special Permit 689.

All native fish captured will be relocated on the day of capture to suitable alternative habitat. Ideally fish are relocated to suitable, similar habitat types within the same catchment, where suitable shaded permanent water is present. Stream information obtained from the Auckland Council GIS viewer and onsite assessments revealed suitable habitats (e.g. high shading and sufficient water levels) to be present within the Stage 1 TSCC, west of the site. The stream reach consists of a permanent channel with deep pools, sufficient shade and a range of fish cover.

Following capture, fish will be transferred into lidded containers of an appropriate volume for the number of fish caught and kept cool. Battery powered oxygen bubblers will be placed within each of the transfer bins to ensure dissolved oxygen concentrations in the water is kept high during the relocation. Additionally, a water conditioner (such as API stress coat) will be added to the water to reduce stress and restore the mucous coat of fish. Water conditioner will be added at concentrations of ml per 19 L of water, or per the manufacturer's instructions. Whilst contained, fish will be monitored and water will be changed every hour. If any individual captured fish shows signs of stress (loss of righting response, exuding excessive mucus, gulping air, and or mouth gaping) the water will be changed to provide more oxygen, or the fish will be moved to the relocation site immediately.

Fish will be visually examined for general health (visual skin lesions or heavy fungal burdens) and if considered unhealthy by an appropriately qualified freshwater ecologist, they will be humanely euthanized in accordance with Section 29 of the MPI Special Permit (689).

In order to reduce predation and injury/death during the relocation, large eels (> 500 mm) will be contained individually to avoid injury to other smaller captured fish. Eels will be separated by size class with individuals 250 – 500 mm kept in separate containers to eels smaller than 250 mm. Banded kōkopu, if present, will also be separated into their own containers.

Captured fish will be securely transported to the relocation site and gently transferred into the downstream reach within two hours of being captured. If large numbers of fish are captured, they will be distributed across multiple release points in the general area to avoid short term overstocking and predation risks.

2.6 Timing of Works

The initial works required by the NFRP will be undertaken no more than one week prior to any stream works commencing within the specified area. As the watercourses subject to the NFRP are intermittent, streamworks should occur during the summer months were the channels are likely to dry, limiting the available fish habitat. Ongoing maintenance of the temporary fish barriers will be undertaken until streamworks are complete within the area.

2.7 Biosecurity

All equipment will be thoroughly cleaned and dried prior to their use. Equipment includes but not limited to; electric fishing machine, waders, fyke nets, gee minnow traps and transfer buckets.

Any pest fish caught will be humanely euthanized, and all euthanized pest fish will be disposed of in a bio secure manner to land, in accordance with MPS Special Permit 689.

2.8 Adaptive Management

Due to the high level of intrinsic variability in any fish recovery and relocation, this plan may be slightly modified by an appropriately qualified freshwater ecologist to ensure fish are recovered in a safe and professional manner, as well as in accordance with the New Zealand Freshwater Fish Sampling Protocols (Joy *et al* 2013).

3 REPORTING

Following the relocation, a short report will be prepared detailing the fish captured (species and number of fish) during the recovery, as well as details on the relocation site. The Auckland Council shall be provided with a copy of the report within five days of completion of dewatering.

Fish records will also be sent to NIWA to be included in the New Zealand Freshwater Fish Database.

4 PERMITS

Bioresearches hold a MPI Special Permit (872) that to allow persons or agencies to take aquatic life and relocate it to a suitable habitat where this is necessary or required to mitigate adverse effects of habitat modification on the aquatic life.

Since the capture and relocation sites are not within a conservation area and the fact that any fish captured will be relocated within the same catchment, no other permits are considered necessary.

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APPENDIX B – LIZARD MANAGEMENT PLAN

Lizard Management Plan:

Takanini Stormwater Conveyance Channel Stage 2 and 3

April 2024

Lizard Management Plan

Takanini Stormwater Conveyance Channel Stage 2 and 3

PREPARED BY: CHARLOTTE GARRETT, B.SC.
LANDSCAPE ECOLOGIST

REVIEWED BY: KATE FEICKERT, P.G.DIP.SC.
SENIOR ECOLOGIST

FOR: **SUNFIELD DEVELOPMENTS LIMITED**

DATE: **18 APRIL 2024**

REFERENCE: BIORESEARCHES (2023). LIZARD MANAGEMENT PLAN. TAKANINI STORMWATER CONVEYANCE CHANNEL STAGE 2 AND 3. WINTON LAND LIMITED

1 INTRODUCTION

Bioresearches were engaged by Sunfield Developments Limited to prepare a Lizard Management Plan for streamworks proposed at 55A Cosgrave Road, Ardmore. The stream works proposed will include the reclamation and construction of approximately 1,800 linear metres of artificial channels.

Some vegetation clearance will be required in order to complete these works. The vegetation consists primarily of hedgerows and maintained pasture along modified stream channels, and native skink habitat may be present within clearance areas. This includes piles of human and organic debris, edges of hedgerows and dense groundcover vegetation, and along stream margins where vegetation is less managed.

Figure 1: Map showing extent of works (green polygon)

According to Department of Conservation and Manukau Ecological District Records, two species of native skinks may occur within the site boundary; the ornate skink (*Oligosoma ornatum)* and the copper skink (*Oligosoma aeneum)* (both classified as At Risk – Declining). Both species are classified as At Risk –

Declining. Geckos are considered to be highly unlikely to be present within the site, given a lack of suitable habitat.

The LMP aims to detail the management measures required to mitigate adverse effects on native lizards associated with vegetation/habitat clearance. The objectives of the LMP are to maintain or enhance the population of each species of native lizard present on the site at which vegetation clearance is to occur, and to ensure that the habitat(s) that lizards are transferred to will support viable populations for all species present pre-clearance.

The LMP includes three phases:

1. Pre-works trapping;
2. During-works destructive searching; and
3. Post-works search of cleared area, and release.

Native reptiles are legally protected under the Wildlife Act 1953, and vegetation and other features that provide habitat for these species are recognized by the Resource Management Act 1991.

1.1 Objectives

The objectives of the LMP are to minimise potential adverse effects on native lizards within the construction footprint, by way of capturing and relocating any indigenous lizards prior to and during vegetation removal, and providing habitat enhancement and pest control, where appropriate. Further, this LMP aims to achieve the following:

- The population of each species of native lizard present on the site at which vegetation clearance is to occur (impact site) shall be maintained or enhanced, at an appropriate alternative site; and
- The habitat(s) that lizards are transferred to (release site) will support viable populations for all species present pre-clearance.

These objectives will be achieved by:

a. Using current best practice to capture native lizards from vegetation in the footprint prior to and during vegetation clearance and relocating any captured individuals to safe and suitable habitats;
b. Applying recognised surveying and monitoring protocols that are to be followed, using the Department of Conservation's (DOC) Natural Heritage Management System's Herpetofauna

Inventory & Monitoring Toolbox and / or using new advances in tools and techniques not yet incorporated into the toolbox;

c. Meeting requirements of the Wildlife Act (WA 1953) and Resource Management Act (1991).

This LMP addresses the following:

- A summary of the affected habitat and species covered by the plan;
- Capture and relocation procedures;
- A summary of the recommended release sites;
- Post-works management and monitoring (where required).

1.2 Statutory Context

Native reptiles are legally protected under the Wildlife Act 1953 (and subsequent amendments), and vegetation and other features that provide habitat for these species are recognised by the Resource Management Act 1991.

Lizards comprise a significant component of New Zealand's terrestrial fauna and 124 taxa are currently recognised (Hitchmough *et al.* 2021). Of these, 96% are classified as 'Threatened', 'At Risk' or 'Data Deficient' under the New Zealand Threat Classification System (Townsend *et al.* 2008; Hitchmough *et al.* 2021).

Statutory obligations require management of populations of protected species where they or their habitats are threatened by land use changes. This LMP may only be implemented under a valid Wildlife Authority, issued by the Department of Conservation ("DOC").

This Lizard Management Plan would be actioned under a valid Wildlife Act Authority (WA 98006-FAU (2022 – 2025)), issued by the Department of Conservation ("DOC"). Details of the project herpetologist, and a lizard management plan checklist, can be found in the tables below.

Table 1: Credentials of project herpetologist

Credentials and Contact Details of Project Herpetologist	
Project Herpetologist	Chris Wedding
Credentials	15 Years (CW) herpetological experience
Wildlife Authority	98006-FAU (Valid to 11 October 2025)
Email	Chris.wedding@bioresearches.co.nz
Contact Number	0274795418

Table 2: Lizard Management Plan Checklist

Project Start-Up	**Required of:**	**Completed**
Lizard Management Plan Approval	Auckland Council	
Approved Lizard Released Sites	Landowner Permission – Auckland Transport	
Demarcation of works footprint	Surveyor/vegetation clearance contractor	
Pre-Works Lizard Management		
Pre-works lizard capture and site preparation	Herpetologist	
Works Lizard Management		
Machine-assisted habitat searches	Herpetologist and clearance contractor	
Post-Works		
Works completion report to client, council and DOC	Herpetologist	

2 HABITAT ASSESSMENT

2.1 Areas of Affected Habitat

The site generally consists of maintained pasture and exotic hedgerows. Several constructed stream channels flow throughout the site.

Primary areas of potential native skink habitat include the edges of hedgerows and constructed stream channels, where groundcover vegetation has become longer and denser. Piles of woody debris and timber are also present in some places, which also may provide refugia for native skinks.

Photo 1: Examples of potential native skink habitat generally occurring within the site

2.2 Lizard Species Covered by Plan

The indigenous herpetofauna of the Auckland Region includes 18 terrestrial taxa, of which 12 are solely confined to the region's mainland (c.f. islands). A further four introduced species are also known to occur in the region (van Winkel *et al.*, 2018).

The table below lists the species recorded within 5 km of the site during the literature search, or otherwise found within the local area (species covered by this plan), and their likelihood to occur within the site.

Table 3: Lizard species within 5 km or otherwise potentially present within the site; corresponding NZ conservation statuses; and likelihood to occur within the site.

Common name	Species name	NZ threat status*	Occurs ≤ 5 km of the site	Likely to occur within site
Mokopirirakau granulatus	Forest gecko	At Risk – Declining		
Naultinus elegans	Elegant gecko	At Risk – Declining		
Dactylocnemis pacificus	Pacific gecko	At Risk – Relict		
Oligosoma ornatum	Ornate skink	At Risk – Declining		✓
Oligosoma striatum	Striped skink	At Risk – Declining		
Oligosoma moco	Moko skink	At Risk – Relict		
Oligosoma aenuem	Copper skink	At Risk – Declining	✓	✓

* Hitchmough *et al.*, 2021; Burns *et al.*, 2018.

The only records within 5 km of the site are the copper skink (*Oligosoma aeneum).* However, just outside the buffered zone, ornate skinks have been recorded and are therefore are considered within this report. Habitat for both species is considered potentially present within the works zone.

No native geckos were recorded within 5 km of the works zone. However, they have been conservatively included as species covered by this plan due to the proximity of the site to the Hunua Ranges. No native gecko habitat is considered present within the site.

2.3 Incidental Discovery Protocol

While native geckos are not considered further for management within this report, an incidental discovery protocol applies should a gecko be discovered prior to or during works.

In the unlikely event that a native lizard is found in the footprint when the herpetologist is not present on-site, this incidental discovery protocol will take effect. The herpetologist will brief project contractors on incidental discovery protocols prior to the start of the works (e.g., at the pre-start meeting).

If a native lizard is observed, the contractor(s) should note down a description of the lizard and its location, cease works in the immediate vicinity of the detection, and promptly contact the project

herpetologist (Chris Wedding, 0274795418). The herpetologist will either attend the site to try capture the lizard or provide advice on how to continue working in the area without risking harm to the lizard.

3 Lizard Salvage and Relocation Protocols

This Plan details three stages of lizard management:

1. Pre-works trapping and habitat searches
2. During-works destructive searching (machine-assisted)
3. Post-works search of clearance zone and release

This Plan requires that all relocated native lizards be released in to habitats that are enhanced, to the satisfaction of the Project herpetologist. To increase carrying capacity of the release site, shelter / refuge provision will be provided to the satisfaction of the Project Herpetologist. Capture and release methods are detailed below. Post-works search will involve the searching of cleared land for any remaining lizards.

3.1 Timing of the salvage and relocation

The lizard salvage and relocation programme must take place within the generally accepted North Island 'lizard salvage season' (**October to April**, inclusive), on days where ambient temperatures range between 12–22°C.

3.2 PHASE 1: PRE-WORKS TRAPPING

A five-day trapping period (set traps Monday, complete Friday) would be undertaken over the week prior to vegetation removal. Traps would target ground cover vegetation within the Project footprint. Traps should be checked daily over this five-day period.

- Stations of lizard traps (four clustered traps per station), would be installed within potential habitats within the Project footprint at least four weeks prior to lizard trapping.
    - Traps would consist of baited (banana) funnel traps and / or pitfall traps, and / or artificial retreats (ARs) shall be installed through the affected vegetation.
- Trapping shall be undertaken concurrently with systematic searches within the Project area in accordance with the Department of Conservation's Biodiversity and Monitoring toolbox for using pitfall traps (Hare, 2012a), artificial retreats (Lettink, 2012), funnel traps (Hare 2012b) and systematic searches, (Hare, 2012c).
- All live traps (funnels, pitfalls) will be embedded in vegetation (pitfalls flush with substrate

surface), and furnished with vegetation to protect any captured lizards from heat and exposure during confinement.

- Live capture traps will be checked no more than 24-hourly while active.
- All native lizards shall be released at the designated release site either:
    - Following temporary captivity until all affected vegetation has been removed, or
    - On the day of capture.

During trap checks, manual searches will be undertaken for lizards throughout the areas of potential habitat.

3.3 PHASE 2: DURING-WORKS MANAGEMENT

Phase 2 will involve the recovery of lizards by a herpetologist(s) during vegetation removal activities. The project Herpetologist is required to be on site during vegetation removal.

Vegetation removal should occur by means of a digger/excavator fitted with a toothed bucket, or root rake attachment; to remove surface groundcover vegetation without harming herpetofauna potentially present (Photo 2). This is termed a 'destructive search.'

Destructive searches will involve coordination between the herpetologist and machine operator to carry out systematic scrapes of surface vegetation, as well as lifting heavy objects (e.g., large logs) so that lizards hiding beneath can be captured.

Recoverable leaf litter substrate, woody debris, potential shelter structures (e.g., logs, rocks) and invertebrate food sources will be collected and transferred to the lizard relocation site(s) by the herpetologist.

Photo 2: Machine-assisted lizard searches. Herpetologist supervising the scraping of terrestrial vegetation

In general, prior to destructive searching:

- No vegetation will be mulched *in situ* by lowering a mulch-head directly onto standing vegetation, unless approved by the project herpetologist. This practice eliminates all opportunities for herpetologists to recover native lizards from the vegetation and does not allow lizards to vacate the vegetation before it is destroyed. In some instances, where standing vegetation has been thoroughly searched by a herpetologist, approval to mulch discrete areas of poor-quality vegetation (e.g., areas of gorse or other vegetation not considered to support native lizards) may be given by the project herpetologist.
- Trees should be felled and left to the side un-mulched, for the project herpetologist to inspect foliage for native herpetofauna after felling. This is unless direction is given by the herpetologist that the trees do not need to be inspected.

Coordination and communication between the herpetologist and vegetation clearance contractors (both managers and manual labourers) is crucial and will ensure compliance with consent conditions, legal protections for wildlife and associated habitats, and to minimise health and safety risks. The herpetologist and vegetation clearance contractor will agree on a suitable methodology at a pre-start meeting.

3.3.1 Lizard capture

Native lizards will be captured and handled by the DOC-authorised herpetologist only (refer section 1.2). All native lizards captured prior to and during vegetation clearance operations will be placed immediately into containment boxes and held temporarily for release. The retention of lizards in captivity for periods longer than one day should be avoided as far as practicable.

It is not anticipated that lizard taxa with conservation statuses higher than 'At Risk' would be encountered on-site. However, if this were to occur, the individual(s) would be captured and held temporarily in a containment box while the Department of Conservation local office is notified, and further advice and instruction is given to the project herpetologist.

3.4 PHASE 3: POST-WORKS

Post-works search of the cleared area will involve the search and recovery of any remaining lizards by the project herpetologist(s) after vegetation clearance and relocation to the approved site. Searches will be completed until the Project herpetologist is satisfied that no habitats remain within the Project footprint or that all affected areas have been thoroughly searched.

Photo 3: Post-works searching of clearance area

4 RELEASE SITE

Direct transfer of salvaged lizards from the impact site to a receiving site is preferred wherever possible and the selection of an appropriate lizard relocation site is crucial to ensuring the best possible outcome for lizard salvage-relocation programmes.

The Department of Conservation's key principles for lizard salvage and transfer guidelines require consideration of the following components when selecting a receiving site(s):

1. The site must be ecologically appropriate and have long-term security;
2. The habitat at the site must be suitable for the salvaged species;
3. The site must provide protection from predators; and
4. The site must be protected from future human disturbance.

4.1 Release Site Description

In consideration of the above principles, the most appropriate release site is recommended within a road reserve opposite 75 Hunua Road, Red Hill, just under 3 km from the site. No current landowner information is available at present (based on GRIP maps), and it is assumed that Auckland Transport likely have ownership of the site.

The site occurs adjacent to a DOC and Auckland Council Reserve, and contains riparian margin habitat.

Riparian margins up to 10 metres are protected under the Auckland Unitary Plan, with vegetation removal within 10m of a native stream a restricted discretionary activity under E.15.4.1. The site is also generally protected from development due to the small size and proximity to Council and DOC reserves.

A mixture of native and exotic species are present within the release site, with the habitat considered of much higher value than the capture habitat on-site. There is potential to enhance the release site using organic debris collected during clearance.

Photo 4: Example of edge habitat at release site

Figure 2: Map showing location of release site in relation to the impact site

5 RELEASE SITE ENHANCEMENT

This Plan acknowledges that the proposed release site may already support the full suite of species covered under this Plan. Displaced lizards have a lower likelihood of survival where the carrying capacity of adjacent habitats is stressed through increased competition for fewer resources. Further, displaced animals have a higher probability of risk of predation, and a rapid increase in lizard numbers in a given area is likely to result in a corresponding increase in predators.

Therefore, to increase the likelihood of survival for relocated lizards, enhancement measures at the release site are required in accordance with Table 4. These measures are designed to be commensurate with the biodiversity values of the habitat that has been lost, with increasing measures required to improve the habitat at the release site, should more lizards be relocated (thus indicating that the lost habitat was of higher biodiversity value).

Table 4. Triggers for management and post-release monitoring provisions.

	Trigger	Management provision	Duration of management
A	• < 10 native lizards	• Immediate relocation • Provision of habitat cover per lizard	N/A
B	• ≥ 10 native lizards	• Pest management required • Provision of habitat cover per lizard • Provision of covenant over release site	3 years
C	• ≥ 20 native lizards	• Pest management required • Provision of habitat cover per lizard • Provision of equivalent habitat restoration planting • Success Monitoring	5 years

The 'habitat cover per lizard', 'pest management', 'restoration planting' and 'success monitoring' enhancement measures are described in the subsections below.

5.1 Habitat Cover per lizard

- All lizards would be released with a small pile of wood (1 pile per individual, Table 4), obtained from release areas or surrounding areas where they are not already providing habitat to lizards.
- Any natural retreat items (logs etc) shall be transferred to the release site area.


Photo 5: Example of stacked branches, logs, ponga trunks, and leaf litter to create supplementary refuges for relocated lizards.

5.2 Pest Control

Pest control shall be initiated at the release site where ≥ 10 native lizards are released. Pest control shall be carried out by an independent pest-control services provider and be operational for a minimum of three years, and up to five years (Table 4). Pest control would be monitored via bait take (bait stations) or kill counter.

While it is acknowledged that reinvasion of pest mammals will be constant over the period of pest management, pest suppression over the period of lizard establishment would reduce predation pressure on relocated and resident lizards.

- Pest control shall be operational within ten working days of the threshold for pest control (above) being triggered.
- Pest control would be achieved over four pulses each year. Each pulse would consist of a four-week period, in August, November, January and April.
- Pest control shall involve maintained rodent bait stations set at 25 x 25 m spacing or humane, self-resetting instant kill traps with a counter (e.g., Goodnature AR24).
- During each pulse period, rodent stations would be maintained with new reset gas cannisters (if kill count greater than 50%) or fresh cereal baits and checked twice during the first week (bait stations), and then once-weekly if bait-take is less than 50%.
- Where bait take remains high (> 50 % take after the second week) during a pulse baiting period, the pest control operator may use an alternative toxin, such as diphacinone or brodifacoum, to achieve control (public notification may be required).

- Bait stations shall be baited with Bromadilone during pulses in August, November, January and April.
- Bromadiolone is an effective single feed toxin and is less labour intensive than diphacinone and lower potential for accumulation of the toxin in the environment than brodifacoum.

5.2.1 Pest Control Monitoring

A report on bait take/replacement and trap captures will be provided to Council and the project herpetologist for each pulse.

5.3 Restoration planting

Where 20 or more lizards are captured and relocated, restoration planting is triggered as an enhancement measure according to Table 4. Restoration planting may include expanding the amount of habitat available, such as by underplanting existing canopy trees with native groundcovers, and/or by buffer planting existing habitat to enhance the value of the release site.

Weed control within restoration planting should be minimised as much as possible, as weedy groundcovers often make good native skink habitat. Planting can occur directly into groundcover with the use of mulch mats surrounding each plant.

Figure 5. Biodegradable plant protection tools: Left- plant guard, Right- square weed mat (Egmont Coir Tuffguard mat, available from: https://www.egmontcommercial.co.nz/product/coir-tree-mats-plant-mat/)

A planting memorandum should be prepared if required by the project ecologist, detailing at a minimum the location of planting, species composition, size of the plants at the time of planting, and the total number of plants required. A brief planting procedure should also be provided.

5.4 Relocation Success Monitoring

Success monitoring would be initiated whereby restoration planting is required to replace the habitats lost (as triggered by 20 or more lizards, and representing very high value habitat). The purpose of the monitoring is to determine success by measuring / identifying:

1. Occupancy by lizards of restoration plantings, as provided for habitat replacement.
2. Occupancy by lizards of other habitat structures, as provided for habitat replacement
3. Recording any trends in numbers and species encountered within the pest managed area and adjacent, non-managed areas.
4. Presence of gravid females or juveniles

Monitoring would consist of a grid of at least 20 artificial retreats, 10 of which would be installed within the pest managed area and 20 within adjacent non-managed area. Locations would provide for coverage of both enhanced and planted habitats.

Artificial Retreats would be installed at least four weeks prior to survey period. Survey period would provide for four retreat checks on fine, non-consecutive days over November-December or March-April, when lizards are most active. Artificial Retreat survey / monitoring would be undertaken in accordance with Lettink (2012).

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APPLICABILITY AND LIMITATIONS

Restrictions of Intended Purpose

This report has been prepared solely for the benefit of Sunfield Developments Limited as our client with respect to the brief. The reliance by other parties on the information or opinions contained in the report shall, without our prior review and agreement in writing, be at such party's sole risk.

Legal Interpretation

Opinions and judgements expressed herein are based on our understanding and interpretation of current regulatory standards, and should not be construed as legal opinions. Where opinions or judgements are to be relied on they should be independently verified with appropriate legal advice.

Maps and Images

All maps, plans, and figures included in this report are indicative only and are not to be used or interpreted as engineering drafts. Do not scale any of the maps, plans or figures in this report. Any information shown here on maps, plans and figures should be independently verified on site before taking any action. Sources for map and plan compositions include LINZ Data and Map Services and local council GIS services. For further details regarding any maps, plans or figures in this report, please contact Babbage Consultants Limited.

Reliability of Investigation

Babbage / Bioresearches has performed the services for this project in accordance with the standard agreement for consulting services and current professional standards for environmental site assessment. No guarantees are either expressed or implied.

Recommendations and opinions in this report are based on discrete sampling data. The nature and continuity of matrix sampled away from the sampling points are inferred and it must be appreciated that actual conditions could vary from the assumed model.

There is no investigation that is thorough enough to preclude the presence of materials at the site that presently, or in the future, may be considered hazardous. Because regulatory evaluation criteria are constantly changing, concentrations of contaminants present and considered to be acceptable may in the future become subject to different regulatory standards, which cause them to become unacceptable and require further remediation for this site to be suitable for the existing or proposed land use activities.

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