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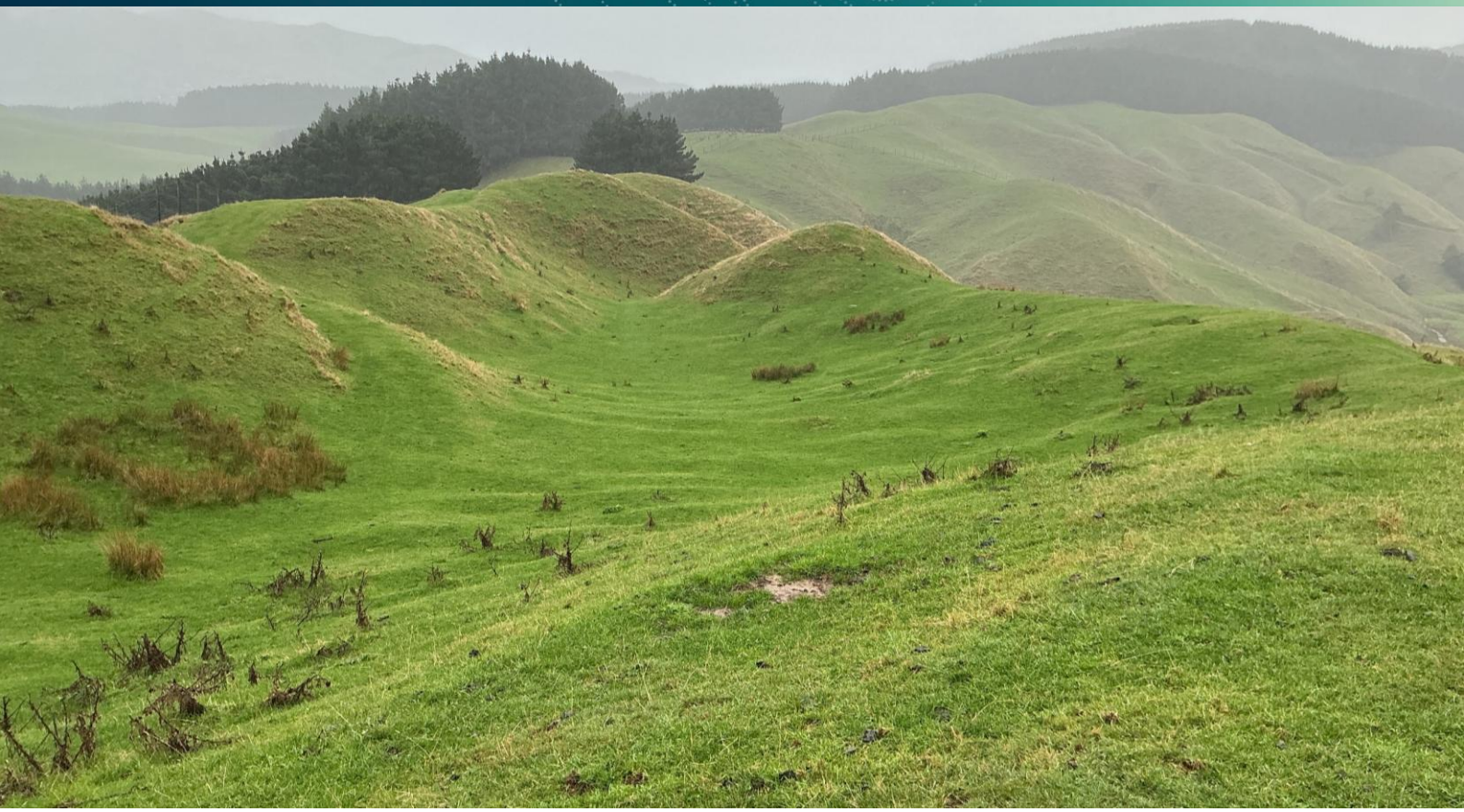

Mt Wellington Station Ecology

Ecological values, effects and effects management

Prepared by Dr Vaughan Keesing
20 November 2025

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Cover photograph: M*t Welcome ridge line and top gully @ BlueGreen Ecology 2025*

Executive Summary

This Ecological Assessment has been completed to understand the ecological values of the site proposed for development. These have included detailed assessments of natural inland wetlands, streams and indigenous terrestrial habitats.

No specific bat or avian surveys have been undertaken either here or in the structure plan, instead relying on expert opinion related to the habitat present. This is because of the nature of the site, currently and historically used as a stock farm with shelter belts and pasture.

In these kinds of environments, surveys for very low abundance lizards are typically unsuccessful and expert opinion and effect management is all that can be relied upon. However, a lizard assessment has been completed for the site, and lizard and fish management plans have been drafted to enable works to manage the species that may be present, in very low numbers given the quality and paucity of onsite habitat.

The streams, terrestrial ecology, and natural inland wetlands across the property are at the very low end of ecological value, and are largely exotic, planted, and / or low flow intermittent stream systems.

The current land management practices have not improved any of these values and conditions and will not do so if they continue to operate.

The level of change associated with the proposed development with regard to aquatic habitat and the loss of natural inland wetland is at the low end of the level of effects, and the residual effects after management (avoidance, minimisation, remedy) have been assessed as less than minor and as such do not require an offset under the effects management hierarchy. Despite the above, an offset is offered for residual natural inland wetland effects in order to achieve a net positive ecological outcome.

There is also vegetation clearance and stream culverting associated with the proposed SH59 intersection (dual lane roundabout required by NZTA) that is within a PCC mapped SNA area. The proposed offsetting for this area is to follow the application of the effects management hierarchy assessment.

The net result in terms of stream habitat, natural inland wetland habitat, and SNA buffer vegetation will be a net gain in the quality of aquatic habitat and the amount and quality of natural inland wetland. There will also be beneficial supporting land use and controls through stormwater quality protection, riparian protection, and removal of farming practices.

The faunal management plans will ensure the existing fish and lizards are rescued and transferred to appropriate habitat.

Ecologically, the proposed development returns a better result for freshwater and terrestrial ecology than the current land use practices and there will be an overall net ecological gain.

Contents

1.0 Introduction

1.1 Adherence to the Expert Code of Conduct

I have read the current Code of Conduct for Expert Witnesses as contained in the Environment Court Consolidated Practice Note (2023), and I confirm that I have complied with it in preparing my evidence. My qualifications as an expert are set out above. I confirm that the issues addressed in this brief of evidence are within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed. I set out below my data collection, information sources, analysis and assumptions that have influenced the opinions I present.

1.2 The Development

Following the development of a structure plan (through the now operative Porirua District Plan) for the wider Muri-Mt Welcome block just east and south of Pukerua Bay, Pukerua Property Group Limited Partnership is now applying for approvals under the Fast-track Approvals Act 2024 for the development of a residential subdivision in the Mt Welcome block. The area to be developed is steep hill and gully farmland and has been a stock farm (currently deer) for many decades (since at least the late 1800's).

The proposed development, as shown in Figure 1, includes gully fill areas, stream crossings, and several wetland gullies that will be developed into retention wetlands.

The retention wetland features will function as post-stormwater treatment habitat areas, being wetland habitat, aquatic habitat and treated stormwater volume detention. The retention wetlands and surrounding gullies will also provide the basis for a wider wetland remediation programme. Excluding the retention wetlands, this wider wetland remediation programme will offset any wetland areas lost through wetland infill of the site.

A separate stormwater system is proposed to collect and treat runoff before it is discharged into the new retention wetlands. This system incorporates rain gardens and forebays, ensuring that only treated water enters the restored wetland network.

A full assessment was therefore required to determine where, what and how much natural inland wetland is present and potentially affected by the proposal to develop this land.

Figure 1. Proposed development and stormwater retention wetland areas (blue) within the site.

1.3 Structure Plan Surveys

During the structure plan process a range of surveys identified a range of classes of stream and wetland which are the only ecological habitat features that are not farmland on the property (aside from pine and macrocarpa shelter belt, exotic wood blocks and a native restoration planting area).

There are no terrestrial indigenous habitats present on the bulk of the property where bulk earthworks are proposed. However, the northwestern area of the site and the SH59 road reserve where works are proposed has several SNAs identified in the PDP including SNA027 Whenua Tapu Highway Forest, SNA029 Pukerua Bay South Bush and SNA225 Pukerua Bay South Bush (North)). Therefore, for the bulk of the site this assessment has focused on the presence and delineation of natural inland wetlands and intermixed intermittent watercourses as those are the features in the landscape with potential ecological values.

This absence of indigenous terrestrial habitat and dominance of pasture habitat largely renders lizard, bat, and bird surveys redundant and reasonable assumptions can be made as to the fauna on the farm due to their unlikeness to be present. The potential for the fauna was assessed through the studies for the Northern Growth Area Structure Plan (BML 2022); these are adopted here but also expanded upon through further site study and an additional herpetologist's expert opinion (Mr Tony Payne).

The Structure Plan Ecology Assessment: Northern Growth Area Plan Variation (Boffa Miskell 2022) concluded that bat studies were not necessary given the long absence in presence of

bats in the area in the records and that potential habitat used by short-tailed bat will remain secure (noting this refers to the older SNA areas with mature large suitable trees).

With respect to birds, the Structure Plan Ecology Assessment identified the Bush falcon as the only threatened species likely to be found in the native and exotic forests in the wider landscape and which may hunt over the property. Multiple at-risk species are also potentially found utilising the native and exotic forests, such as the red-crowned parakeet, yellow-crowned parakeet, kākā and North Island robin. Again, the habitat for these species is the SNA areas and the large pine forest areas on the Muri block north (which is a harvest plantation).

The open pasture and rank grass areas on the Site may provide habitat for one At-Risk species; the New Zealand pipit (At Risk-Declining). Pipits commonly forage in grazed pasture and can breed in rank grass areas like those at the native and exotic forest margins on the site. The potential for effect on this species is best managed by way of pre earthworks site management (i.e. not leaving pastures to go rank before clearing them).

With regard to lizards, seven species were reported in the Structure Plan Ecology Assessment (BML 2022) within 10km of the site, four skink and three gecko. These include, two taxa of ground lizards occupying open dry low vegetation and debris pile species: the northern skink and the copper skink while the other five are forest/shrublands species and reside in the SNA adjacent to the site, not the open farmland of the site. There are standard management methods and Wildlife Act authority requirements to minimise harm to the two taxa that are likely to be present but in low abundance.

The wetland surveys informing the structure plan were not overly detailed in terms of undertaking full (MfE, 2022) wetland delineation and PNRP (2020) definition testing to determine what wet gully's are and are not "natural inland wetland" and what is wet pasture or wetland associated with a deliberately constructed waterbody or a river (as per RMA definition).

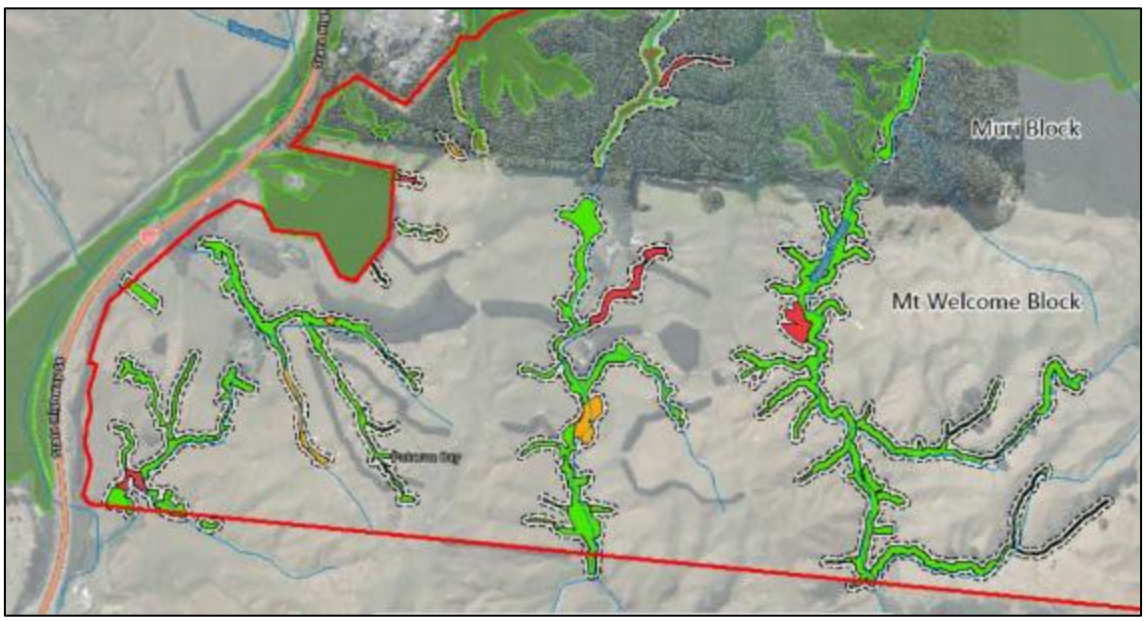


Figure 2. Three classifications were made through rapid assessment and illustrated in the structure plans maps as those being likely natural inland wetland (red), possibly (orange) and unlikely (green).

The following analysis builds on those surveys and predictions to solidify the nature of the numerous gully wetlands.

In addition, the stream network is also confirmed with the reaches identified as ephemeral, intermittent and perennial (Greater Wellington Regional Council, 2021) and if and where there is sufficient water for fish habitat and what type of benthic macroinvertebrate habitat is present.

2.0 Assessment

The proposed development[1] will affect, through vegetation clearance, earthworks, deposition of earth, and potential sediment discharge, natural inland wetlands and streams on the property and SNA vegetation within the SH59 road corridor (NZTA land).

The primary focus therefore of ecological survey and assessment on this property as part of this application has been wetlands and streams as there is little in the way of indigenous terrestrial habitat. That said, the addition of a roundabout at SH59 involves clearance of SNA vegetation (and culverting of a length of stream) and this is described using the literature associated with the SNA and species records from a site visit.

To date no additional bird surveys have been conducted and are not required at this stage to assess impacts or to manage effects. A lizard specific assessment has been completed and forms the basis of the lizard management plan. Effects related to possible fauna at habitat clearances will require a Wildlife Authority with relevant management plans to minimise adverse effects. These draft management plans are appended to this assessment.

2.1 Methods: Wetlands

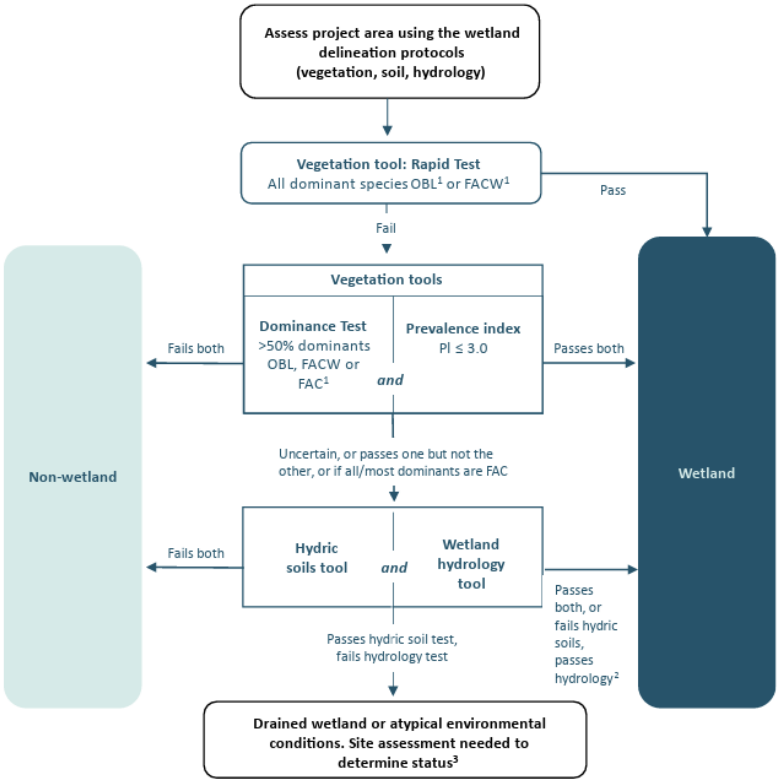
In order to establish how much natural inland wetland will actually be affected by the proposal, several site visits were undertaken between 2023 and 2025 by the author to delineate the wetlands by way of rapid assessment and formal delineation vegetation plots of the features affected (the areas in the maps below).

These assessments and plots have been used to calculate dominance indices, test the pasture exclusion provision, if associated with / caused by a constructed waterbody test and then, if required, prevalence indices, and hydrology.

The assessment follows the guidance of the Ministry for the Environment's 2020 Delineation Protocol and associated by reference guidance related to pasture exclusion (Clarkson B. et al., 2022) and pasture species lists (Cosgrove et al., 2022). The algorithm for the identification of natural inland wetlands is reproduced in Figure 3 below.

The survey involved the author walking all of the gullies applying the rapid wetland assessment as guided by pasture exclusion assessment methodology.

[1] See the substantive application material.



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

Figure 3. Figure 2 of the MfE 2020 delineation protocol to determine natural inland wetland.

2.2 Streams

The streams within the project area have been walked and assessed by the author on several occasions, across both wet and dry seasons. These assessments were undertaken in line with Greater Wellington Regional Council (GWRC) guidance on ephemeral through to perennial streams, and on distinguishing natural or highly modified systems from artificial ones (Greer et al.).

Fish data was collated from existing studies, while macroinvertebrate data was sourced from Boffa Miskell investigations in the main stem of the Kakaho Stream and from two eDNA samples collected in the Taupo catchment, which drains two tributaries.

No dedicated surveys for fish or macroinvertebrates have been undertaken on site, as they are not considered necessary. This is due to the clearly poor ecological condition of the affected wetlands and streams (proposed to be developed as retention wetlands) and the minimal degree of direct stream interaction anticipated from the project (e.g. reclamation activities).

Fish passage is assumed in the perennial and intermittent sections of stream except where eDNA sampling and conditions suggest fish passage does not currently exist.

3.0 Results

3.1 Adjacent SNA, Taupo Stream and Riparian Vegetation

There are no indigenous terrestrial habitats on the property itself, other than the 3000m^2 planted belt of mixed natives along the north side of the access road south of SNA029.

There are however two adjoining SNA (SNA029 & SNA225) and a third, SNA027, on the western side of SH59 which contains the Taupo stream but is not included the GWRC KNE Taupo Swamp site (Figure 4).

The Northern Growth Development Area Structure Plan (PCC 2024) also shows the site to be involved with blue corridors (the streams and gullies as freshwater management areas) and to have a role in one of the ecological connectivity passages (between SNA 029 and 225).

The following are descriptions of the SNA taken from the PCC District Plan mapping GIS layer.

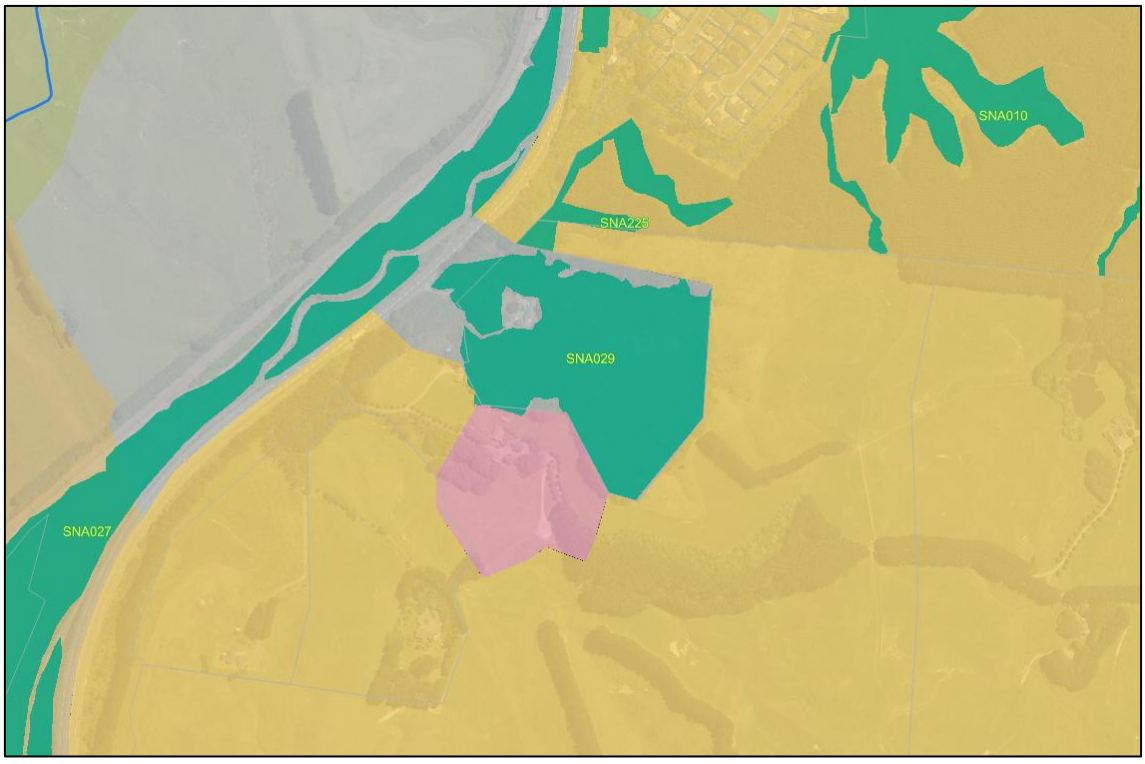


Figure 4. Porirua City Council derived SNA adjacent to the proposed site development area.

SNA 029

This block of fenced tall canopy vegetation contains a representative kohekohe-tawa forest remnant, with podocarp species in the gullies. It includes indigenous vegetation on Acutely Threatened land environments and is mostly protected by the QEII covenant (5-07-763). It provides habitat for a diversity of bird species.

SNA 225

A mixture of ridge and gully seral and maturing indigenous vegetation communities. In the main ridges and steep slopes Kānuka, mānuka, with hangehange, rangiora, horoeka, mingimingi, Olearia solandri and ground ferns. The gullies contain: māhoe and mamaku *Coprosma propinqua*, kawakawa, *Coprosma rhamnoides*, kaikōmako, hangehange rangiora ferns and evidence of the next canopy cover (Kohekohe seedlings). The area is also important as a connecting feature between SNA029 and SNA010 (the next north and east).

SNA 027

A narrow strip of seral broadleaved forest and treeland, which protects the Taupō Stream riparian area and enhances ecological connectivity along the stream. Includes small areas of raupō reedland, including puha (Sonchus kirkii; At Risk-Declining), kānuka (presumably Kunzea robusta; Threatened-Nationally Vulnerable), mānuka (Leptospermum scoparium; At Risk-Declining), and contains indigenous vegetation on Acutely and Chronically Threatened land environments. This site also provides important habitat for indigenous fauna, including barking gecko (Naultinus punctatus; At Risk-Declining), bush falcon (*Falco novaeseelandiae ferox*; At Risk-Recovering).

3.2 Water Catchment Areas

To assist the reader in visualising the areas of stream and wetland, the report refers to the four primary sub catchments named as presented in Figure 5.

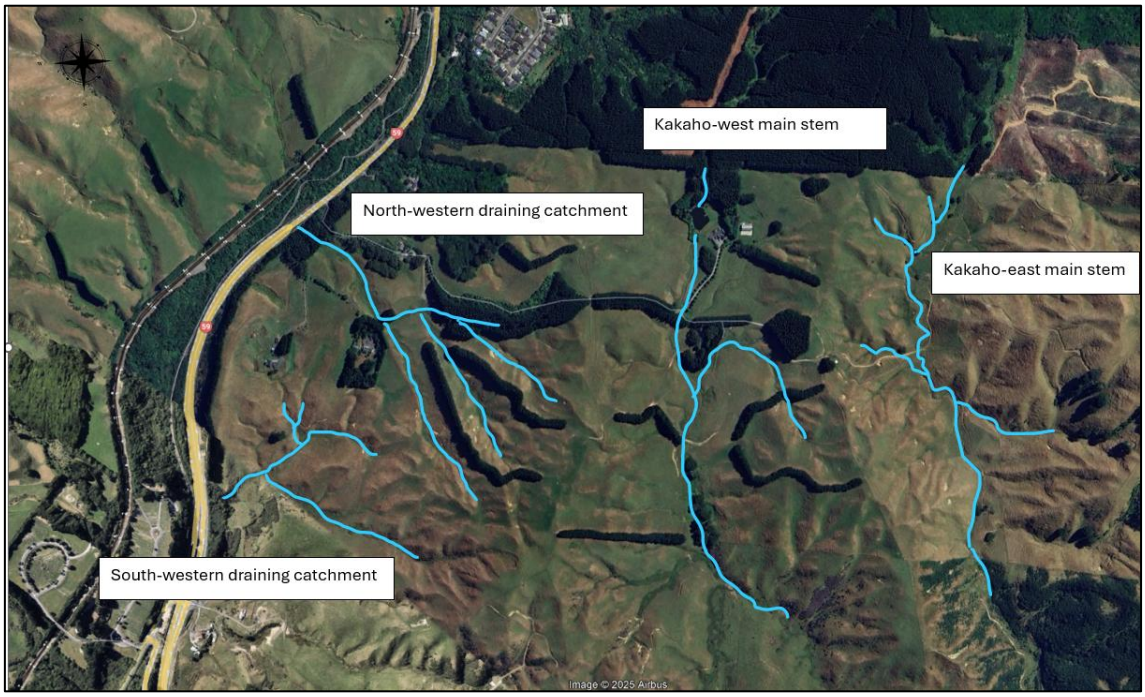


Figure 5. Main water discharging features and paths referred to in this report.

3.3 Wetlands

The author has undertaken five site surveys at different times over the last five years to record and measure the gully features and identify the presence of natural inland wetlands as defined by the NPS FM protocol. As previously mentioned, there are no representative indigenous natural inland wetlands on site, only those exotic wetland assemblages common on farmlands.

62 potential natural inland wetlands were recognised and assessed in the wider site as shown in Figure 6 below. One area was not assessed because it is a derivative of a deliberately constructed water body (a Dam – feature #37) and is excluded under the NPS FM exclusion list for wetland features (Subpart 3 specific requirements, 3.21 definitions).

Following vegetation plots, 10 gullies were excluded as they were dominated by pasture grasses (Yorkshire fog in the main). 16 features were clearly natural inland wetlands with a complex of sedges and rushes and non-pasture wet grasses. 35 areas were natural inland wetlands but were difficult to assess in that the dominant cover was wet grasses (creeping bent and creeping butter cup) or on the edge of acceptable prevalence scores but did have saturated soils. These more difficult areas have been conservatively treated as natural inland wetlands despite the authors disagreement with the inclusion of such features.

The author is confident that the areas and extent of natural inland wetland in this assessment is conservative and represents the maximum amount of natural inland wetland as per the NPS FM defining processes in the area surveyed. It is however noted that all of the features on site are exotic species dominated and are a product of forest clearance and farming.

Due to the hydrology of the gully floors and FACW wet plant species, all natural inland wetlands were considered to contain wet adapted fauna (MfE 2024). The measured sizes of the various features are an average measure based on the extent at the survey periods and as far as those edges could be identified on aerial photography. The extent, however, varies through time due to the weather of the season, and various farming practices such as over sowing, fertiliser use, stock type and densities.

Across the site there are 4.4 hectares of linear gully natural inland as shown in Table 1 below.

Table 1. Measured areas of the various wetland categories surveyed.

Row Labels	Sum of Area (ha)	Sum of other (ha)
Natural inland wetland	4.4	
Artificial wetland		0.078
Wetland excluded by pastural exclusion rule		0.631
Grand Total	**4.4**	**0.71**

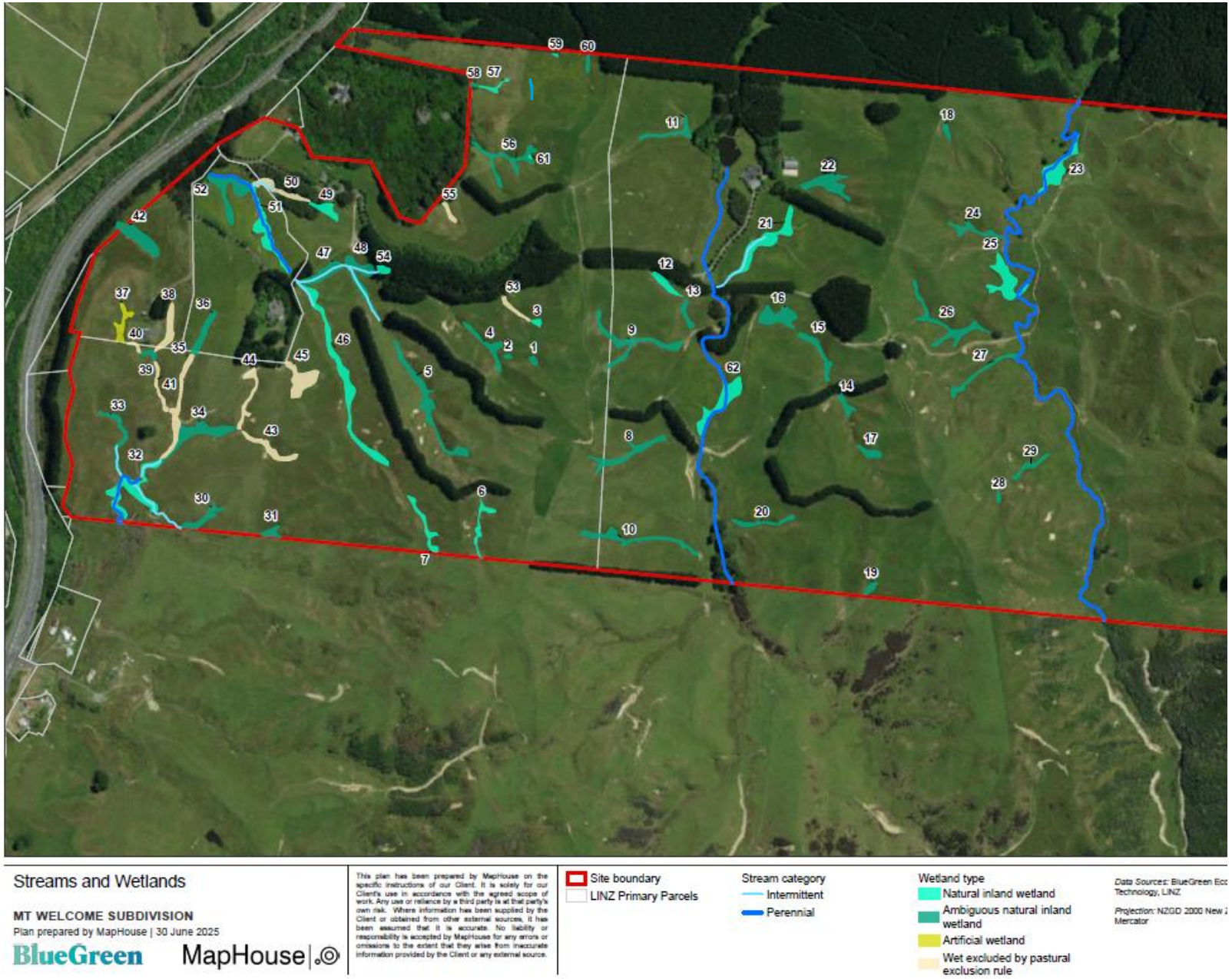


Figure 6. Wetlands mapped across the landscape from rapid and plot deliniations. Streams and their category are also mapped. Additional wetland and stream west of SH59 shown on Figure 16.

The areas within the proposed earthworks or stormwater management areas had their classification supported by plot data and are largely those features in the western, Taupo swamp draining portion of the proposed development. This was done especially where the outcome was not visually obvious or through dominance of pasture species (as per the NPS FM pasture species list). The plots and locations are recorded in Appendix 1.

The following sections provide further detail around the make-up of wetlands.

3.3.1 Northwestern Draining System

The north-western draining gully system drains to Taupo swamp (those west of the first north-south main ridge) and are wet gully floor systems that are predominantly natural inland wetlands. There is a northern draining catchment area (wetlands #1-7, #46-58 and #61 in Figure 6) and a south draining mosaic of gullies (wetlands numbers #30-45).

The patch work of assemblages and the width of the wetlands in the gullies is complex and is defined by the adjacent slopes, amount of side slope slumping, and extent of seasonal water. The size of the features is nevertheless delineated relatively accurately by aerial photography based on vegetation texture and colour following ground survey. The features as a whole, are not indigenous wetland assemblages as the gully floor is, and has been, farmed for decades and includes artificial impoundments.

The wetland species are predominantly Juncus species (J. *effusus, sarcophagus, bufonius, articulatus, planifolis*), Isolepis species (*prolifera, crenua*), *Myosotis laxa*, watercress (*N. officinale*), Callitriche species (C. *Stagnalis*), and wetland pasture species no longer recognised as pasture such as creeping bent (*Agrostis stolonifera*), creeping butter cup, lotus, docks, and Yorkshire fog, Plantago species and clovers. These species grade quickly up the side slopes and transition to predominantly rye grass, sweet vernal and Yorkshire fog, lotus and plantain (pasture).

The areas identified as light green features in Figure 6 are those clearly dominated (all or almost all) by FACW species.

The northern system contains one main stem, being the largest gully in which a perennial flow channel persists, although not a clearly continuous waterway. The stream exists under two culverts, one currently a driveway for an existing house and one an older crossing, before entering a relatively small culvert under SH 59. The area downstream of the driveway culvert is stream under pine. Upstream of the culvert the stream has expanded wet flood plains of Juncus species, creeping butter cup, starwort, watercress, forget me not, as well as Yorkshire fog and pasture species but is a very wet spongy soil.

The main stem further east past the first stream confluence north narrows eastward and passes under a track (culvert) and linear pine planting. Afterwards, the gully continues (#51 in Figure 6) as a wet grass rush and sedgeland but without a stream channel and the amount of water diminished up slope.

Running north is a tributary (#50 in Figure 6) into which the proposed stormwater wetland is to be created. This northern branch has a short perennial tributary prior to the gully entering a pine and gum plantation.

Prior to the forest (#50 in Figure 6), the wet area has several *Carex secta* and raupo up stream of the fence but then as the gully passes under pine, blackberry and bracken and

pasture grasses are dominant in the gully floor and there is a more pronounced stream channel rather than wetland but typically without flow.

Towards the upper end as the feature leaves the plantation there is a *Carex geminata* sward opening into a contained basin of wetland species (Isolepis, Carex, water cress, Juncus, Cyperus and some alder) but clearly natural inland wetland (#49 in Figure 6).

A second north running tributary passes north at a pine block planting intersection (#47, #48, and #54 in Figure 6). This gully system has an arm that enters into a pine belt to the north and a further arm up the hill gully to the south-east (#5 in Figure 6). Prior to these arms, the gully is in creeping bent with Juncus and with Yorkshire fog, and any one plot returns either Yorkshire fog dominance or creeping bent, creeping butter cup and Juncus dominance. As such, this gully has been precautionary labelled as a natural inland wetland. There is a stream channel in which the flows appear perennial. Upstream as the gully enters the pine forest there is a small giant umbrella rush and raupo feature (#54 in Figure 6) which quickly gives way to under pine terrestrial ground cover.

The southeastern arm continues as wet gully floor creeping bent, butter cup and Juncus.

There are two further side tributaries that drain to the forest belt of wetland 54 (features #1, #2, #3 and #4 in Figure 6), feature #3 has a *Carex secta*, *Cyprus ustulatus*, *Isolepis*, kiokio, water cress, Yorkshire fog spring feed upper bowl that narrows to a long wet pasture drainage feature (feature #53 in Figure 6) which has a greater portion of Yorkshire fog and is considered exempt as it is pasture dominated.

3.3.2 Southwestern Draining System

The upper southern gully system has five “arms” draining to the central larger, wider gully floor. There are two separate individual basins #42 and #45 in Figure 6. The basin of #45 has been worked and sown in grasses but has a wet central low area which on occasions has creeping bent and creeping buttercup. Three plots were undertaken in this area to confirm the feature is excluded as pasture dominated, because of a dominance in Yorkshire fog (Appendix 1). However, the feature of #42 is well defined rectangular depression with a dominance of FACW species of which 50% is Yorkshire fog and 50% is wetland indicator species (Isolepis, Juncus etc). With a prevalence score of 2.44 and not 51% pasture it is found as natural inland wetland by the NPS FM process.

The upper arms of the main system (#36, #37, #38, #43 and #44 in Figure 6) are narrow and variously wet and contain, in places, a dominance of wetland plants, but mostly are sufficiently dry as to be dominated by recognised pasture species. Feature #37 is excluded as wetland as it has developed since the creation of a water dam beside the existing dwelling. Features #42, #44 and #38 are pasture dominated. Feature #36 is pasture, however, could not be found to be pasture dominated with an abundance of creeping bent.

The large central area (#34 in Figure 6) is a floating macrophyte mat of soft muds, held up by a culvert to the south that supports a track traversing the gully floor.

The Southern wetlands system (#30, #32 and #33 in Figure 6) includes an eastern gully and a northern draining gully and is beginning to form a stream with bed and bank rather than a gully wetland floor but has lower flood plain wetland edges.

It is fair to say that the species mix described in the north-western draining system above is the species mix common to most of the large gully floor systems on the property and in this particular development area. It is the proportions of the different species that determine if the MfE natural inland wetland delineation process returns a wet pasture or a natural inland wetland. This, in the main, rests on the cover of creeping bent, creeping butter cup, Yorkshire fog and Isolepis.

The Delineation plot data is presented in Appendix 1.

3.3.3 Northern Wetlands

The northern features (#55-61 in Figure 6) are short headwater seepages or drainage features that drain west. Features #57 and #67 have springs near the upper gully end. Features #57 and #58 has a water take at the spring. Feature #59 may also have a spring, while feature #55 is an ephemeral rain collection gully.

Features #59 and #57 have a clear dominant cover of *Isolepis prolifera* and cannot be confused with wet pasture. While the diversity is low and the indigenous component largely restricted to *I. prolifera*, both features, despite modifications have clear FACW species dominance and appropriate hydrology.

Feature #59 is largely *Isolepis prolifera* with small amounts of water forget me not, creeping bent, and Yorkshire fog.

Feature #57, as noted above, is a narrow gully which has a prominence of Isolepis cover in the upper to lower reaches, below which the hydrology changes as the gully enters the SNA bush identified as #58 and the feature is no longer wetland but a stream channel.

Feature #56 is a spring feed seepage that below the spring (#61) is a narrow damp linear gully covered in creeping bent but with Juncus edges in places.

Feature #55 is a short ephemeral rain drainage gully which is often pugged but typically is a mix of creeping bent, sweet vernal and Yorkshire fog.

The following are photographs at different times that illustrate the majority of the features described above. These features have been seen on at least five separate field visits between 2021 and 2025.

Northern western gully, western section and trib (#52)

Northern western gully lower central section (#52)

North western gully, main stem towards track intersection (#51)

Northern western gully downstream to northern arm (#51-52)

Central largest wetland area (#34)

Southern gully (#32)

Lower western central gully (#33)

Upper central western gully (#35,36, 38)

Upper northern-eastern tributary to central system (#44)

Eastern central side tributary (#43)

Western gully

Central Basin

	
Northern feature (#56)	*Headwater #61*

In terms of natural, representative, indigenous wetlands, it is the author's opinion that none of the gully systems or wetland systems on the Mt Welcome property should be considered as "natural" wetlands were that means a wetland that represents an indigenous assemblage in a landform that historically was wetland (i.e. not forest).

None of the features identified in this report are representative assemblages of indigenous wetland species and all of the gullies and slopes were once forested gullies not open sedgelands and all are as they are now due to deforestation and many decades of farming with different intensities of modification. At best, there was once a narrow linear series of Carex or raupo features with dense kiekie and supple jack along the gully floors between tall forest canopy of perhaps pukatea and kahikatea.

As it currently stands, under the processes of the NPS FM and NRP, the exotic wet assemblages that are not dominated by recognised pasture species, are natural inland wetlands. These have been mapped and are considered in the following sections as affected natural inland wetlands.

3.3.4 Central and Eastern Valley System Wetlands (Kakaho)

These are the wetlands of the slopes that drain into the central stream valley (the Kakaho west) and the west slopes of the Kakaho east stream valley. The features labelled #9-13 and #14-22 (excepting #18) and #62 (central) and #24-28 east in Figure 6.

For these mapped areas, the gully heads and depressions that qualified as pasture have been excluded. The areas that were initially difficult to separate between pasture and wetland have been mapped as natural inland wetland. These features are the shallow gully depressions on steep hill slopes with a dominance of creeping bent and scattered Juncus (mostly *J. effusus*).

Following the plots and detailed inspections of the western systems, there was no need to continue to plot these features for the eastern system to determine their status as it was a simple matter to closely examine other areas and identify the same patterns and species as in the plot data within all of the gullies across the property. Below are photographs taken in June 2025 to illustrate the form and cover type of various systems.

Looking into #15

Head of #17

Along ridge between #17 & 19

Feature #10

East valley floor of the kakaho Stream

Head of #28-29

Head of #26

Feature #6

Feature #3

Head of #9

Feature #9, central area

Feature #7

3.4 Streams

The extent of perennial waterway is limited on the property. The gullies are largely wetland or wet pasture and while there are areas of formed channel, most gullies are well vegetated without clear formed channels.

Four "streams" can be identified: the eastern most arm of the Kakaho Stream draining south, the western arm (in the central valley) of the Kakaho Stream also draining south, and two much smaller tributaries to Taupo Stream in the western area of the property, one in the north and one in the south (Figure 6). The linear lengths of these features is indicated in the table below (Table 2).

Table 2 Lengths of stream on the property.

Stream type	Sum of Length (m)
Intermittent	711.96
Perennial	2576.69
Grand Total	**3288.65**

Only partial faunal sampling to ascertain the fish and macroinvertebrate assemblages has been completed for a variety of reasons, such as the perennial systems not generally directly affected except by culvert crossings or through the introduction of a new lake / wetland retention areas which will replace the existing stream habitat. Secondly, partial sampling has only been completed because at survey times, insufficient water has been present in the western two systems to use fish traps, EFM, or to collect standard macroinvertebrate kick net or surba sample protocols. Furthermore, the substrates, macrophyte extent, visual water quality and depths, flows and stream riparian conditions are such that a good prediction of the assemblages is possible with experience and based on sampling undertaken in the lower Kakaho.

The exception is the two small west draining western systems which are described in more detail below based on their habitat qualities and from both a night spotlight and one sample eDNA survey of each system.

3.4.1 Westward Draining Two Tributaries

The waterway edges are unfenced pasture and there are no indigenous plant (riparian or macrophyte) values associated with any of the gully waterways and the substrate and amount of water do not make these systems of much value with respect to macroinvertebrates or fish.

While no macroinvertebrate sampling was undertaken, observation shows a low MCI assemblage common to high organic, soft substrate, high macrophyte slow flow waterways, i.e. MCI Circa. 60, QMCI 2-3, Diptera dominated with damselfly and several beetle but mostly physella and Potamopyrgus snail and orthoclade, copepod and ostracods.

It is informative to note that the only aquatic macroinvertebrates indicated by the eDNA samples in the northwestern draining system were stagnant water semi-aquatic species, i.e. Culex (mosquito), the polluted water tolerant caddis Orthocladiinae., physella snail and

Potamopyrgus snail (macrophyte specialists) and the pea clam (*Sphaerium novaezelandiae*). Indicators of a wetland rather than stream fauna assemblage.

The southern (western) system had, in addition, *Cercyon haemorroidae* (water scavenger beetle), and two other caseless caddis: Polyplectropus and a non-biting midge (Limnophyes). A barely aquatic indicator fauna of low MCI.

Both the northern and central / southern systems indicate extremely low taxa richness with respect to aquatic macroinvertebrates.

Figure 7. Lower reach of the north-western draining system just before entry into the track culvert. This is the widest, largest flow in this catchment above the culvert.

To determine the presence of fish in these poorly connected, limited flow and depth systems, two methods were employed, eDNA sampling and night spotting (following Joy et al 2013). Each method was employed to cover the greatest streamflow areas, i.e. the lowest reaches of the two gullies (the eDNA) and then the night spotting was upstream for as long as there was surface water to view.

It is noted that fish passage up from the Taupo stream has considerable passage difficulties, not least the culverts of SH 59, and the presence of those fish barriers over many years has meant that fish presence up stream in the property and in the upper Taupo stream cannot be expected to be abundant or perhaps even present for some species.

Given the depth and lack of flow and connectivity, other sampling methods are not feasible, although net trapping could occur in the two deeper culvert pools although without much hope of a conclusive outcome.

The night spot inspection was undertaken on the Thursday 22 February 2024. Flows were very low, and the southern system had hardly any surface water present and was virtually nonvisible from the bank. The northern system had a greater amount of surface water and so a longer survey length but still only periodic surface water. The eDNA samples were collected on the 15th of February 2024 at the locations shown in Figure 8 below (red dots).

The spotlight survey was between 9.00 pm and 11:30 pm. The surface water observed was heavy in green algae and most the water had macrophyte growth and no discernible flow. Observation was problematic and while turbidity was low, visual clarity of the water to the bed often unattainable. No fish in any area of any system was seen / recorded. The eDNA results for fish indicated in the northern system the presence of banded kokopu, short fin eel and a very weak indication of long fin eel. In the southern system only a low DNA signal for short fin eel was indicated.

Figure 8 shows the eDNA collection sites (red spots) and spotlight areas (red lines).

The northwestern system, below the eDNA sample, has three culverts under the driveway, the causeway to the west, and under SH 59. The middle of these three culverts currently has a significant fish passage issue (Figure 9). The SH 59 culvert is over 40m (and of small bore) which also possess some passage barrier.

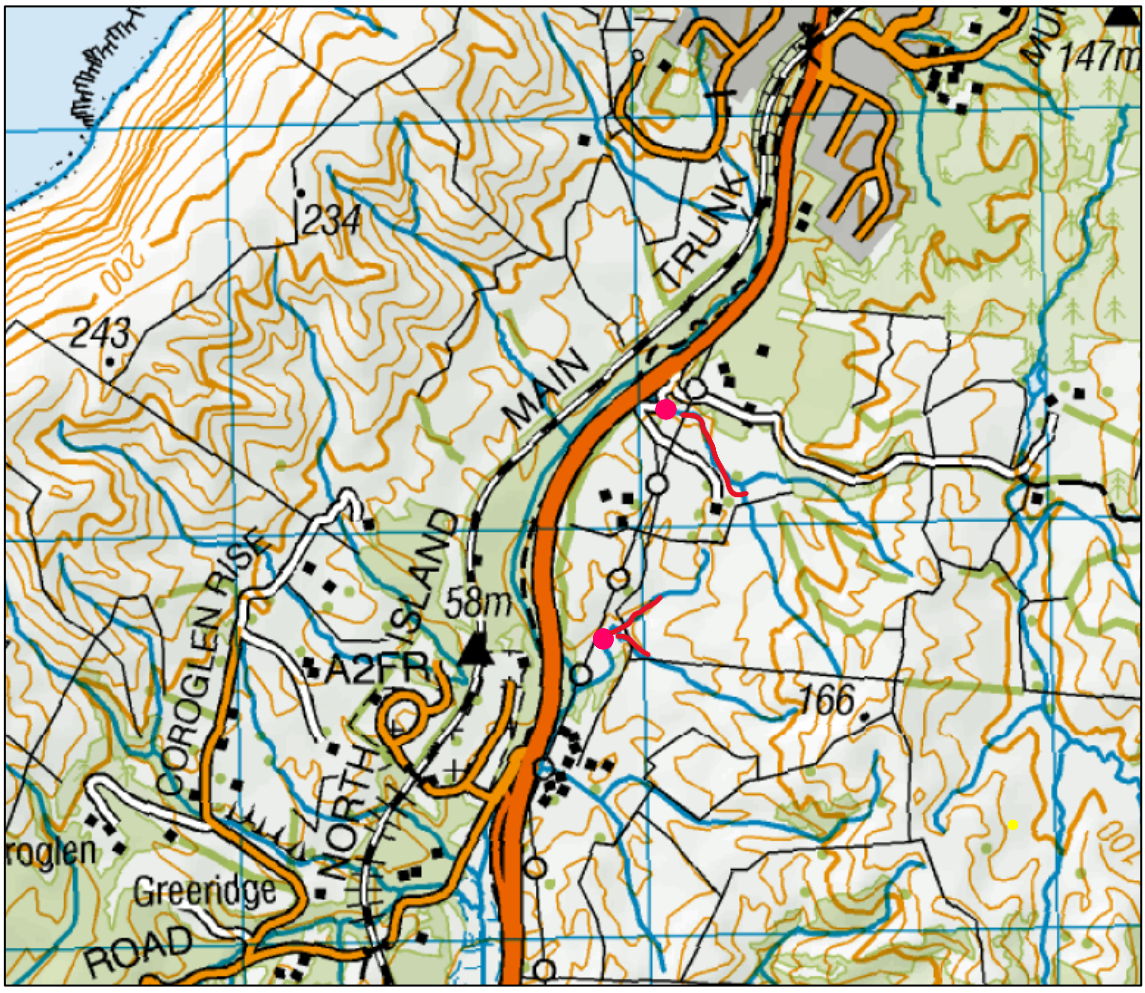


Figure 8. Northwestern eDNA sample and the Southwestern systems eDNA sample site (red dots).

The principal fish passage issue is that the installed ribbed piping is perched well above the lower pool and the pine covered banks are dry, largely non-conducive climbing fish surfaces (Figure 9). And yet above these culverts, the eDNA indicates the presence of banded kokopu and long and short fin eel. It is possible the DNA indication is from several "stranded" old fish and that there has been no recruitment for some time, perhaps years, and it would be very difficult to confirm.

Figure 9. Standing on the middle culvert between SH 59 and driveway.

The two data collection methods are not overly conclusive, but they show that in both systems there are currently some native fish. Whether recruitment is now happening or not cannot be determined, but clearly it has in the past and that there is at least some habitat up both systems for some native fish.

That habitat for fish is, as indicated by the macroinvertebrate data, marginal at best. It is probable that the northern system holds a small remnant fish community associated with the large, created, pool downstream of the upstream culvert as the great majority of the system is damp mud wetland. Further there is an existing fish barrier in the form of the middle culvert pipe connection.

The eDNA results in the southern system only indicates short fin eel, and it is likely this species is only present in the pool below the track culvert and the eastern tributary, which

is the only tributary of the three that has a channel and surface water, the other two being damp wetland areas.

With respect to the northern system, fish passage will need to be corrected for the middle existing culvert between the driveway and SH 59 and passage considered up the new channel and into the upper stormwater management / wetland system. I.e. consideration of a ladder up the retention bund.

For the southern system it is highly likely that only the eastern tributary and to the lower track culvert pool requires fish passage and the central and western tributaries are all largely damp wetlands and surface dry, not downplaying the fact that eel can persist in the damp wetlands. However, to attempt to prove the absence of eel in either system in the absence of reasonable flow would be very problematic.

3.4.2 Kakaho West and East Branches.

The Kakaho catchment has an area 1,470 hectares (Blaschke and Rutherford Environmental Consultants, 2010). The Kakaho Stream is fed by numerous unnamed tributaries and drains into the Pāuatahanui inlet. The Kakaho Stream (upper and lower) appears to have kept its original flow course, apart from the lower 1 km prior to it entering the Pāuatahanui Inlet.

The majority of the landcover adjacent to the stream is highly modified apart from limited remnant pocket of native forest in the upper catchment (the largest of which is in the headwaters on the Muri Block in the large SNA) and recently planted riparian margins on the southernmost reach of the stream at the coastal interface.

On site, both the western and eastern arms are in farmlands and are not generally fenced to exclude stock.

The western arms headwater is largely in pine forest (soon to be felled) and there is a large, created, amenity water body at the northern boundary (a 0.22-ha lake). This water body regulates the flow in the downstream main stem which while not a drainage channel (retaining some of its natural flow path) is highly modified. Under normal flow conditions the stream is around 1m wide and 200mm deep and largely a slow run and small pool system with extensive macrophyte cover with a gravel, cobble and silt bed.

The Eastern arm is larger and fed by a larger sub catchment. With a wetted width closer to 2m and a depth more typically 300-400mm with a more pronounced cobble bottom it is the main aquatic habitat on the property.

3.4.2.1 Hard-bottom Perennial Reaches

The hard-bottom channels contain a mixture of habitat and hydraulic conditions, including pools, runs, and riffles. It is expected these reaches contain an aquatic fauna that includes a relatively (when compared to regional equivalences) sensitive macroinvertebrate taxa, such as Ephemeroptera, Plectoptera, and Trichoptera.

3.4.2.2 Soft-bottom Perennial Reaches

The soft-bottom reaches are typically found in the lower reaches of the tributaries that feed the central hard-bottom channels. Often, these channels have small, isolated patches of hardbottom conditions. Fine sediment depths vary across these channels, and bank slumping is prominent. In many cases, the channels are narrow (<50 cm wide) but deeply incised (>50 cm).

Macrophyte growth was not uncommon in these reaches at the time of survey, with watercress (*Nasturtium officinale*) widely spread. The soft-bottom reaches are likely to support a macroinvertebrate community that is characterised by tolerant taxa such as Gastropoda and Mollusca, with Diptera also prominent. These fish fauna in these channels are unlikely to be as diverse and in lower densities than the hard-bottom perennial reaches.

Figure 10. Landscape photos of the Kakaho east main stems showing the settings.

Figure 11 Landscape photos of the Kakaho west main stems showing the settings.

3.4.2.3 Fish

The New Zealand Freshwater Fish Database (NZFFD) only includes two survey dates form over 40 years ago, including from 1961 and 1979. Across these two surveys, eight freshwater fish species were recorded and an additional two marine wanderer species (Table 3). Boffa Miskell (unpublished, 2021) have also recently surveyed for fish in the lower Kakaho Stream, observing five of these species, with no new species recorded/observed.

Based on the behaviours, life histories, and habitat preferences, it is highly unlikely inanga, giant bully and common smelt are present in freshwater habitats within, or upstream of the Site. Depending on downstream fish passage provision, the remaining five freshwater fish species may be present within the Site and/or frequent the site during periods of migration.

The perennial streams, both hard-bottomed and soft-bottomed, provide variable and suitable habitat for the freshwater fish species that may be present within the Site. It is anticipated the eel population is weighted toward longfin eels, in part due to their better inland penetration.

There is a small likelihood the Threatened - Nationally Vulnerable shortjaw kōkopu (*Galaxias postvectis*) is also present. If so, they are most likely to reside within the remnant indigenous bush in the northeastern corner of the Muri Block (i.e. the SNA).

Table 3: Fish species recorded (p) or likley (x) to be present

Species	Common name	Threat classification	1961	1979	BML 2021	Likely on site
Anguilla australis	Shortfin eel	Not Threatened	p	p	p	x
Anguilla dieffenbachii	Longfin eel	At Risk - Declining	p	p	p	x
Galaxias	Banded	Not Threatened	p			x

fasciatus	kōkopu					
Galaxias maculatus	Inanga	At Risk - Declining	p	p	p	
Gobiomorphus cotidianus	Common bully	Not Threatened		p	p	x
Gobiomorphus gobioides	Giant bully	At Risk - Naturally Uncommon	p			
Gobiomorphus huttoni	Redfin bully	Not Threatened	p	p	p	x

3.5 SH 59 Roundabout Requirements

A roundabout is proposed to be installed at the SH 59 intersection with the site. This roundabout has size and location requirements which consequentially affect the adjacent terrestrial and freshwater systems (the Taupo stream headwater main stem and a side tributary) including one SNA (SNA027) area including its vegetation west of SH59, and one SNA area (SNA029) and its vegetation on the east side of SH 59. (Figure 12).

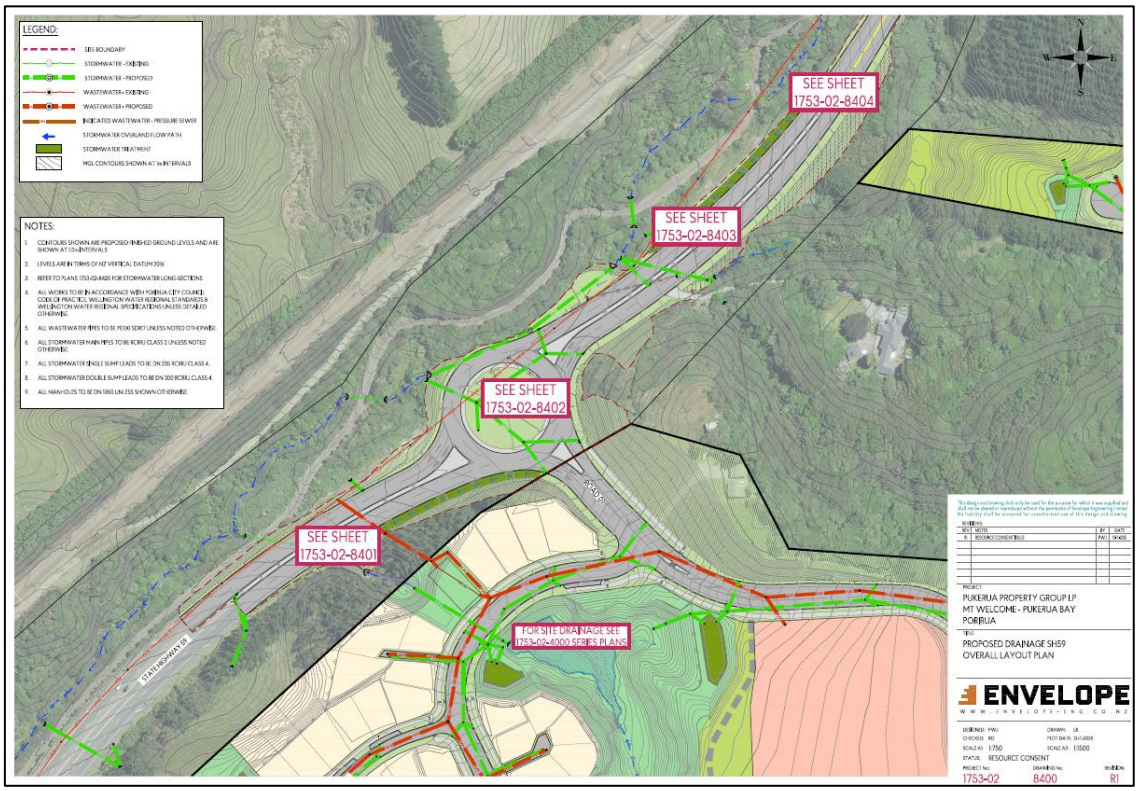


Figure 12. Required SH59 new roundabout position relative to the SNA and Taupo stream.

3.5.1 Taupo Stream

The stream affected by the roundabout is near the upper end of the Taupo catchment outside of the KNE but inside SNA 027 and fed from two small tributaries arising in the farmland hills south of Pukerua Bay. It runs predominantly along the SH59 base of the road

berm, more or less parallel, and this suggests its path may have been modified. The walking track to the west of the roundabout converges with and is culverted over this stream.

The channel at the upper end of the required culverting for the roundabout averages 1m wide with a wetted width (after the previous week of rain) of approximately 250mm. The typical depth is 100mm (shallow) and the flows are generally 0.2m/s in riffles. As the stream progresses downstream (south) the banks widen the substrates are soft sand conglomerations and towards the lower end the stream sits in a 1-1.5m high bank and has a wetted with of 1.5m but still a typical depth of 100-150mm.

Pools are infrequent (10% of the aquatic habitats present) and are commonly small at 1m by 1m and 200mm deep. At the base of the incoming eastern tributary from under SH 59, there is a pool that is 3m by 4m and 300mm deep.

The substrate is predominantly gravels and small cobble, but sediments are more evident the further down the system. Woody debris and course organic matter are common, and shadings near 100%.

Figure 13. Typical stream bed at the lower end of the proposed culvert pipe to facilitate the roundabout.

Generally, the stream has aquatic habitat that is reasonably good quality, at least on the surface, as there are also items of rubbish and road runoff as well as farm runoff. It appears a reasonable benthic habitat for macroinvertebrates, and it is reasonable to expect an MCI approximately 100 and QMCI 4-5.

A shortcoming is that the surrounding vegetation is only around 60 years old and there is no remnant forested stream source of EPT taxa from which recolonisation of a better fauna could have occurred, although it is feasible EPT fauna have flown as adults over the SH 59 from SNA 027.

The track culvert that is present now downstream was constructed between 2000 and 2005. Sometime after that, fish passage up stream would have ended as it was installed incorrectly. Now it has a substantive perched (over hung) and raised (1.8m) lower end which is not passable even by climbing species (Figure 14).

Figure 14. Lower walking track culvert entrance - a fish barrier (inset shows approximate location).

The GWRC KNE record (GWRC [2]) describes the Taupo stream as a stream system that provides habitat for a wide range of freshwater fish species, including a number of threatened species.

Four species of fish classified as threatened have previously been recorded in the KNE site and include, giant kōkopu (Galaxias argenteus; At Risk-Declining), īnanga (Galaxias maculatus; At Risk-Declining), longfin eel (Anguilla dieffenbachia; At Risk-Declining) and bluegill bully (*Gobiomorphus hubbsi*; At Risk-Declining).

Other non-threatened native fish species known to be present within the KNE site include the shortfin eel (Anguilla australis), banded kōkopu (*Galaxias fasciatus*), common bully (*Gobiomorphus cotidianus*), giant bully (*Gobiomorphus gobioides*), redfin bully (*Gobiomorphus huttoni*) and common smelt (*Retropinna retropinna*).

None of these species could gain entrance to the upstream section past the current track culvert and the upstream section is too small and shallow to hold any remnant fish for 20 years. Due to the challenges and modifications present and likely to persist the aquatic habitat has a moderate ecological value.

[2] Key-Native-Ecosystem-Operational-Plan-for-Taup-Swamp-Complex-2020-2025.pdf

3.5.2 Eastern Tributary

The eastern tributary to this area currently passes under SH 59 and its confluence with the main stem forms one of the larger pools below the existing road culvert. This culvert, it is understood, is proposed to be extended up stream by a few meters.

Upstream of SH 59, this tributary emerges into a dense Tradescantia matt over a narrow (200mm) channel set around 1m into the soft substrate. It is largely covered in rubbish and woody debris. 10 meters upstream, the Tradescantia gives way under a dying canopy of Coprosma repens with vine weeds. The substrate is 300-400mm of anaerobic muds and organic matter. The water depth is approximately 100mm and hardly flowing. Further upstream is a small culvert from the true left and the stream continues with less water up the true right arm.

Figure 15. Eastern tributary that passes under SH 59 to join the Taupo Creek.

Even without any sampling or eDNA the substrate and water condition inform the author that this tributary, at least in the lower 50m, is of very poor habitat quality and is of very low value as aquatic habitat.

3.6 Terrestrial Habitat (SNA027).

West Side of SH59

Most of this SNA vegetation was planted and has since planting also arrived naturally. It is around 60 years old and the canopy ngaio, mahoe, karamu, mamaku, Hoheria, kanuka and

five finger appear of that age. In the round, the vegetation is late seral broadleaf forest with few later canopy species (e.g. kohekohe, tawa, miro, totara etc), but signs of kohekohe development are present. Ferns are not abundant but include shining spleenwort, kiokio, sword fern, gully fern and hangehange and kawakawa are common lower tier shrubs. There is extensive Tradescantia throughout the ground cover, but most abundantly around the stream and blackberry is common throughout.

A wetland feature (natural inland wetland) is also present, largely a raupō area with an upper slope in kiokio and a *Carex secta* side arm with manuka edges (Figure 16). It is possible that puha (*Sonchus kirkii*; At Risk-Declining), is also present as it is recorded in the SNA.

This wetland drains to the upper entrance of the track culvert and is within 100m of the works for the roundabout.

The SNA report includes reference here (027) to the presence of barking gecko *(Naultinus punctatus*; At Risk-Declining).

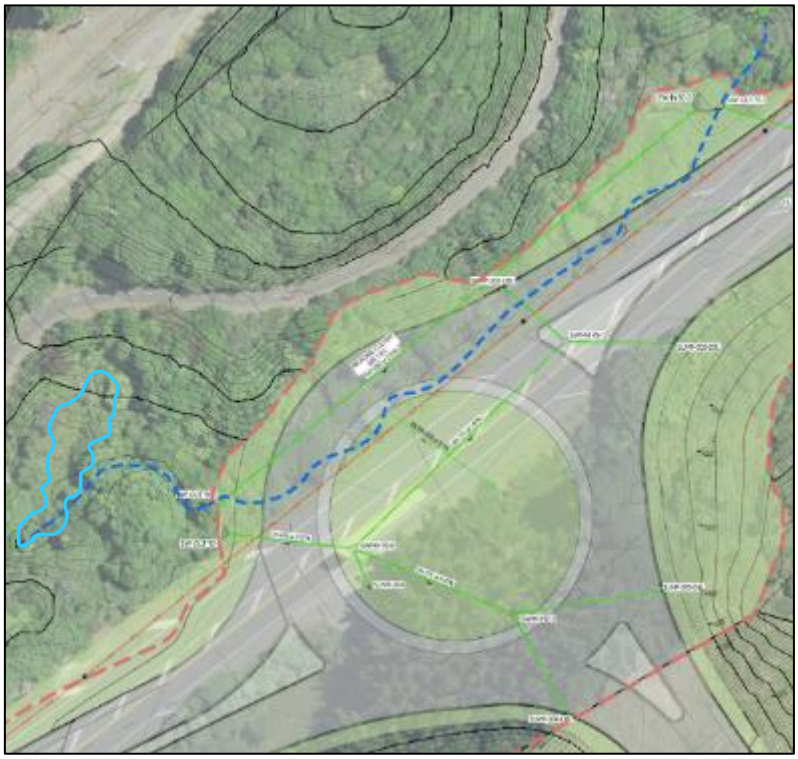


Figure 16. SNA area (027) into which the roundabout will require clearance and stream culverting. The blue area indicating the natural inland wetland. The dashed blue line the approximate location of the Taupo Stream.

East Side of SH59

The eastern side of SH59 contains the main planted pine stands. There is a band of 4m high, common native broad leaved species for some 20m (5m wide) between the driveway (lined with agapanthus) and a southern pine stand, east of which is open grass.

Northwards is also pine stand. Between the road and the pine northward is a gorse basin in which there is an ephemeral “catch pit” area that passes stormwater under SH59

through a small culvert. Northward of that is a further native regenerated stand of shrubs and trees on a raised berm.

Figure 17 Native strip between driveway and southern pine area.

Figure 18. Looking south at the east side of SH 59 between the two driveways.

Most of this vegetation is less than 30 years old as it is barely evident in the 1995 aerial. The native components include mahoe, kanuka, kawakawa, hangehange, mapou, karamu, harakeke, shining spleenwort, as well as gorse, blackberry, fennel, cherry, Lucerne, Tradescantia, and pines. The native band is “backed up” by a taller pine row.

Figure 19. 1995 Retrolens aerial photograph of the entrance to the property. Note no public walkway through SNA 027 as yet and many open areas.

Given the vegetation and stream condition, the author considers that the eastern area by the road should not have been identified and mapped as SNA (SNA029) nor habitat for highly mobile taxa, as it is not representative of an SNA because it is largely weed species, or with rarity, diversity nor any important ecological functions that warrant a significant classification.

4.0 Ecological Values on Site

4.1 Terrestrial

There are virtually no terrestrial ecological values related to indigenous assemblages or habitat on site outside of mapped SNA. Noting that the only indigenous vegetation is that of a band (20m wide, 250m long) of native plants that was planted adjacent to a pine band above the access road and near the SNA and is now around 20 years old.

The SH59 roundabout (off site) will affect SNA 027. SNA are typically of high value although we suggest that the age and condition make this area of moderate value even noting the possible presence of Ngahere gecko and the small raupo wetland (which is outside of the area of effect).

There are a range of birds that fly over or alight on the property, but none are likely to be directly or indirectly affected assuming the current farming practices are maintained up to the bulk earthworks. No shag or other coastal bird roosts have been recognised on the two large macrocarpa on site.

There are a range of pest mammals (rabbit, hare, possum, hedgehog, mustelids, feral cats, mice, and rats) which are present and are a degradation to indigenous species in general.

It is highly unlikely that there are any native skink or gecko other than the northern grass skink and perhaps copper skink (based on a paucity of lizard fauna from Transmission Gulley studies and Muri block studies nearby) and these are most likely to be present in the current gardens and yards of the existing houses and main access way verges, not in the pasture and grazed paddocks, but also perhaps in some shelter belts were woody debris persists.

Ecological values on site outside of mapped SNA relate to natural inland wetland and stream reaches. However, the ecological values of these waterways are limited as outlined below.

4.2 Wetlands

All of the natural inland wetlands are exotic dominated features principally composed of pasture species that do not qualify as pasture (i.e. creeping bent ((Clarkson et al., 2021; Cosgrove et al., 2022)) and in the wettest areas a small number of Juncus, Carex, Eleocharis, water cress, butter cups, starworts, myosotis and Isolepis.

These assemblages do not represent any indigenous sedgeland or marsh (the most likely wetland type (Johnson & Gerbeaux 2004)). They are present on high sediment loads related to farm activity erosion and sediment in-wash. Historically these areas were not wetlands but rather forest drainage ephemeral flow paths, as can be seen in the northwestern SNA channel example.

There are no rare species present. The part of the property under proposed development is recognised as a chronically threatened land environment with less than 10% of that landform holding indigenous vegetation. There are no indigenous communities on this landform and so no rarity related to the LENZ category.

Wetlands are recognised as greatly depleted in the Wellington Region with approximately 3% left (Ausseil et al., 2008), however, the 3% refers to indigenous representative natural wetlands, not exotic induced wetlands (Ausseil et al., 2008). There are no representative indigenous wetlands present which would, if so, be a rare habitat type.

There are no distinctive patterns or high (or even moderate) diversity of fauna or flora or abiotic conditions, no gradients of especially note, or unusual environmental factors.

With respect to ecological context the features (stream and linear wetlands) are headwater ends of sub-catchments which offer no refugia or good condition habitat for aquatic species and wetland birds. They are low diversity, exotic damp gully bottoms, narrow in the main (3-4m) and suffer high levels of modification depending on the farming cycle. They are not corridors or links or connections for any species passing inland or to the coast.

These gullies, however, do have a functional role in mitigating farm run off and are filters (to a degree) and retainers of some sediments and nutrients from farming to downstream receiving environments (Taupo swamp and the Kakaho River and so Pauatahanui inlet). The farm discharge, however, is only filtered and held in a minor way given the gullies are generally only 3-4m wide and short sedges which stock perturbate regularly. Given they are grazed, they discharge often but to the more functional QEII wetland (Taupo Swamp) which is the main wetland coastal stream protection feature of the westward draining systems. The “wetlands” of the property are at the very low end of the scale of wetland functions.

There are existing fish barriers and there are few fish (species or abundance) present and little stable habitat in all but the main stems of the branches of the Kakaho.

Taken as a whole these features have a **low to negligible ecological value** (predominantly exotic and highly modified).

4.3 Streams

4.3.1 On the Property

The intermittent / perennial streams of both the southern and northwestern gully of the two western tributaries are modified, low diversity, low functioning, poor condition without rarity and so are **low value stream systems**.

While there maybe (eDNA indicatorid only) short fin eel and banded kokopu, the abundances are low. It remains possible that long fin eel is present but, if so, in such low numbers its presence would not raise the ecological value even while still being classified as an At Risk Declining species (although that status is currently under debate).

The upper main stems of the Kakaho stream branches are in better condition but still modified in terms of lack of shading, nutrient inputs, stock inputs, bank slumping and increased sedimentation. They retain a semi-representative macroinvertebrate fauna, and likely a partial assemblage of the expected fish fauna, weighted towards long fin eel. It is considered that the east Kakaho retains sufficient condition to be of **moderate value** and the western (being of lesser water quantity and higher modification) as of **low value**.

4.3.2 Upper Taupo Stream (SH 59 Roundabout)

The upper Taupo Stream has a mix of values and detractions. The author considers that it is highly unlikely any fish are retained both because of the low depths and volumes of water and largely (70%) shallow riffle habitat but also in the main it is the long present very perched downstream culvert.

Nevertheless, there are gravels as the main substrate and flows to support a reasonable macroinvertebrate fauna. The true right side is semi natural in form and vegetation cover while the true left is modified and has a thin vegetation cover and considerable weeds. There are numerous rubbish items, and water quality is likely poor due to the discharges from farming d and road stormwater upstream, but these impacts have not completely imbedded the gravels in sediments.

I consider a **moderate** aquatic habitat value an appropriate level of value and that the SEV current is most likely to be 0.6 based on similar examples related to Transmission Gully and open pasture examples we have recently calculated in the area. Without undertaking a stepped through data collection and SEV model run, but considering how the model would interpret the conditions visually assessed, the author is confident that a 0.6 SEV is representative given the existing challenges of farming activities, the road, piping and fish barriers.

5.0 Ecological Effects

5.1 On the Property – Wetlands

The developments design has avoided as much inland natural wetland as practicable. It has focused on an appropriate design that remediates four large gully areas to form stormwater retention devices (lakes) such that each has suitable physical characteristics to be restored into functional fully vegetated wetlands. These retention devices change both existing gully wetland and stream length into lake-wetland features replacing both stream and wetland with (after restoration) better aquatic habitat and wetland.

The development also infills a number of ephemeral headwater sections of some of the gully systems, leaving the intermittent and perennial gully stream corridors unaffected by the development (assuming best-practice earthworks sediment management) but requiring consideration of the flows and quality of discharges of stormwater after development.

The effects of the development include the loss of natural inland wetland and also the change in around 450m of intermittent and perennial stream in the northwestern stream and western main stem of the Kakaho branch and 110m of the Taupo Stream (for the SH 59 roundabout). These areas of change in waterway have the potential to harm a small range of indigenous fish during construction and that potential effect can be simply managed (avoided) through standard fish salvage processes.

The development affects and avoids the areas of natural inland wetland shown in Figure 20. Those wetland features under the schematic plan of development are infilled and those otherwise are avoided.

Figure 20. The mapped surveyed natural wetlands (orange & green features), non-natural wetlands (cream & yellow) and streams (blue lines represent intermittent or perennial stream). Blue polygons represent the new retention wetlands. Figure 16 shows stream and wetland west of SH59.

Area of affected wetland and length of affected stream is as follows in Table 4 below.

Table 4. Affected ecological area measures.

Type	Catchments			
	Taupo	Kakaho East	Kakaho West	Total
Natural wetland under retention areas (sqm)	4900	2000	0	**6900**
Other natural wetlands inflled by earthworks (sqm)	8862	5107	1342	**15311**
Stream length changed to wetland retention area (m)	300	150	0	**450**
Stream area changed to wetland retention area (sqm)	150	150	0	**300**
SNA vegetation clearance (sqm)	1400	0	0	**1400**
Stream length to be culverted (m)	110	0	0	**110**
Stream area to be culverted (sqm)	77	0	0	**77**

In summary, there is 6,900m^2 of natural wetland under the wetland retention areas, 15,311m^2 of natural wetland infilled with earthworks, 450m of stream length changed to wetland retention area, and 300m^2 of stream area changed to wetland retention areas.

Furthermore, for the SH59 roundabout, there is 1,400m^2 of SNA (SNA027 and SNA029) vegetation clearance, 110m and approximately 77m^2 of stream culverting required.

5.2 Magnitude (and level) of the Effect of the Loss of Natural Inland Wetland.

The magnitude of the effect of the loss of gully wetland in each main catchment is considered as a proportion of the similar or better habitat within the Taupo swamp catchments between Plimmerton and Pukerua Bay for the western draining systems, and in the Kakaho west and Kakaho east for those systems.

There is around 40 ha of Taupo swamp and a further approximately 15 ha of gully wetlands at Plimmerton Farm (RMA Ecology 2023). The loss of 0.9 (rounded up) ha of the low value wetland habitat type on the property from a total catchment of around 55 ha of similar or better wetland habitat is a 1.6% loss and is classified as a **low magnitude** of effect. A low magnitude and low value habitat result under the EIANZ (2018) effects protocol as a **very low or less than minor adverse effect** (refer EIANZ Table 10).

In the Kakaho west catchment there are above the west-east tributary confluence (keeping in mind historically when under native forest there were no wetlands in this catchment) some 27,100 m^2 (2.7ha) of natural inland wetland. Although GWRC has mapped a greater amount than this (approximately 4ha), the author uses that larger range and so reflect the wetland SNA in the Kakaho catchment. The magnitude of loss on wetland in this catchment is 0.51ha meaning a loss of between 12.75% and so a Moderate magnitude of effect. As all

wetlands in this catchment are of low value, that magnitude results in a very low level of effect which can be interpreted as a **less than minor adverse effect.**

In the east Kakaho main stem gully the development hardly requires any infill of any hill slope gully wetland (i.e. 0.134 m^2). As with the western tributary, historically the valley bottom was all forested and it is unlikely that it was primarily swamp forest (pukatea and kahikatea – although these species would have been present).

Nevertheless, as the west there is at least 4 ha of natural inland wetland and so 3.4% loss. The magnitude of the effect is at most low and to low value systems (the valley bottom systems are not affected) and so equates to a very low level of effect (**less than minor adverse effect).**

The NPS FM/NES-F and the NRP contain policy directions to avoid the loss of extent and values of natural inland wetlands and that there is no further loss of extent of natural inland wetlands. The NPS IB considers only wetlands within SNA but that also has an avoid loss of extent and values directive. Those statutory documents also contain an 'effects management hierarchy' to respond to the loss of all and any natural inland wetlands. The hierarchy is addressed below.

5.3 On the Property – Streams

While there is only a limited amount of intermittent and perennial stream on the property, there is nevertheless a requirement to extend culverts, replace culverts and add new culverts for crossings and to enable the creation of wetland retention areas (bunding with culverts).

All construction work or earthworks that would "reclaim[3]" (i.e. infill a waterway with no alternative equivalent waterway formed) any perennial or intermittent stream has been strenuously avoided by the design to the utmost extent practicable. There are no instances where an existing stream will be filled in/reclaimed without provision of the same or better extent and value of waterway at that same location.

There will be some grey areas around culvert installation or extension in terms of "reclamation" but in the circumstances it is considered that the culvert extensions or the new culvert required is not a reclamation because the waterway persists but in a changed form and condition / value (usually a loss). However, this is more of a planning rather than an ecology discussion.

Given the highly modified nature of all the waterways requiring extensions or new culverts, and the fact that the existing waterways lack natural meanders, the use of straight culverts does not result in any meaningful loss of stream extent on the property or for the roundabout.

In four locations, perennial/intermittent stream sections are required to be affected through development of retention areas (lakes / wetlands) (Figure 20). In those areas there is not a loss of waterway (stream) as so much a change from a riverine to a lacustrine (lake)

[3] National planning standard: the manmade formation of permanent dry land by the positioning of material into or onto any part of a waterbody, bed of a lake or river or the coastal marine area.

system and the requirement for a fish passage capable pipe or culvert to enable continued water flow (albeit restrained to a degree to maintain the proposed inundated wetland).

The retention areas proposed are designed to contain (except perhaps under the driest annual conditions) permanent water and extensive reedland, rushland and sedgeland wetlands (more than 12,040m^2). Under such a scenario the aquatic habitat potential will be very much greater (70 times more) than the habitat of the current stock pugged, sedimented, highly eroded minimal water depth, channels that currently form the streams (ca. 450m).

Thus, while there will be a change in the waterways habitat type (stream), the amount and quality of aquatic habitat will be greatly enhanced. The magnitude of the effect is **positive**. Intermittent and perennial waterways elsewhere in the development property are not affected (purposefully avoided).

The northern access road above the existing artificial pond will require a culvert crossing of the Kakaho western main stem and at an approximately 3% gradient. An NES-FW compliant (regulation 70) culvert can be designed that completely facilitates expected fish species passage (banded kokopu, short and long fin eel and red fin bully) and meets the other conditions of regulation 70(2) of the NES-FW.

The crossing of the north-western draining system (already with two culverts) will require an extension of the existing culvert, which then passes under SH 59, and a longer road culvert (perhaps an additional 10m), replacing the current track culvert. The extension of the SH 59 culvert is in relation to the road enhancements required (by NZTA) which cause the batter slope to change and so require the culvert to be extended.

It currently exits into a deep pool and should not present any additional fish passage issue or be a reclamation. To balance the longer road culvert (longer than the current), the project will remove an existing old farm culvert (a 600mm 10m long culvert) thus day lighting a length of stream. The replacement of the east most culvert will involve a longer culvert (extending to the east), i.e. into the wetland and through the wetland retention bund.

This new culvert will be designed to regulate the flow out of the retention wetland while meeting the NES-F regulation 70 criteria by being partially buried. It will require fish baffles given that the gradient will be in the order of 6%. This steepness is suitable for climbing native species (with baffles) and to date the only indication is the very low possible presence of eel and banded kokopu, of which, both are very good climbers.

I am confident that in this area the changes promote rather than take away fish passage potential and create a better habitat than currently exists. That is a **positive** magnitude of effect.

The connection between reservoir 1 (northwestern) and 2 will require a 32m culvert, and in this low gradient environment an NES-F compliant (regulation 70) culvert assuring fish passage can be undertaken with little risk although there is very little fish habitat above the proposed culvert, noting that the new reservoir will create much better and more fish habitat than is currently present.

The southwestern draining system has no recorded fish and has an existing fish barrier in the form of a perched track culvert. The retention dam and water flow piping in the south-western system replaces the existing raised track and culvert but does not remove stream. Here fish passage should not be required (given the eDNA evidence) but passage

consideration would enhance the future value of the proposed wetland retention restoration area. Therefore, fish passage has been incorporated into the design (as per the (Kakaho West) retention bund) such that the piping enables climbing fish passage and that is recommended but is also a project benefit.

In addition, the project will upgrade the current track culvert which is a fish passage barrier. In the round, fish habitat and passage will be enhanced in the south-west draining system because of the development.

Overall, the proposed works that affect 450m of stream (approximately 300m^2) results in much more and better quality aquatic habitat (over 12,000m^2). Assuming appropriate stormwater quality controls and management before the water enters the gully wetland and stream systems, I consider this a gain and so a **positive** magnitude of effect to low value systems which will improve in habitat quality and so a net benefit to the stream habitat systems on the property.

5.4 SH 59 Roundabout

The design of the proposed new roundabout will necessitate a new 110m culvert to take the Taupo Stream under the roundabout, and it will also result in around 1400m^2 of vegetation from SNA027 to be cleared. While it is the younger and weeder edge vegetation being removed and so some of the lower quality SNA, it will reduce the width in general of the already narrow (20m-40m) band of vegetation between the public walking track and SH59 and create a new canopy edge.

The NPS IB, in relation to SNA (section 3.10(2) seeks the avoidance (except under some circumstances) of:

a) Loss of ecosystem representation and extent;

b) While there will be an actual loss of SNA 027 area ((approximately. 0.1ha of the 14 ha) there will be no loss of the SNA ecosystem type in the ED or catchment, and the proportional loss is very minor (see below)

c) Interruption to sequences, mosaics or ecosystem function.

   The place and extent of loss does not remove and sequence or remove any part entirely of a sequence, nor measurably reduce the function of the SNA. It does not change or remove the pattern of mosaics.

d) Fragmentation of SNAs or loss of buffers or connections within an SNA;

   The extent of clearance reduces the width of the already narrow SNA (70m to 50m) but does not break or fragment the feature which is already narrow, and no buffer or connection is removed.

e) A reduction in the function of the SNA as a buffer or connection to other important habitats or ecosystems;

   This area of the SNA does not materially buffer any other part of the SNA other than Taupo stream. The clearance of vegetation alone would reduce / remove buffer functions to the stream, but the stream is being piped and so the buffer functions current are technically not lost.

f) A reduction in the population size or occupancy of Threated or At Risk (declining) species that use an SNA for any part of their life cycle.

With the appropriate vegetation clearance protocols to reduce/ minimise loss of gecko and nesting native birds there should be no reduction to a population of any Threatened or At Risk species.

The only aspect of the NPS IB that is challenged is that there is a spatial loss of extent of SNA. The EIANZ consideration of that level of effect follows.

The removal of approximately 1400m^2 of SNA027 represents a reduction of around 1% of the total 14ha SNA027, which equates to a negligible magnitude of effect under the EIANZ (2018) process.

A moderate or even a high value feature suffering a negligible effect is a very low level of effect, albeit a permanent effect. That is to say the SNA as a whole is hardly affected by the reduction, and the feature is already divided by linear pieces of infrastructure (rail, power lines, public track and the road) and the values it still contains will be maintained even with this additional narrowing of the corridor.

However, as per the NPS IB (and PDP), and assuming the roundabout has a planning consent pathway (as specified infrastructure, or as part of the well-functioning urban development) to affect the SNA, the effects hierarchy will need to be engaged such that there is no loss of extent nor values post consented works.

The vegetation clearance on the eastern side of the SH59 is not of ecological concern, is of minor amount, of low value early seral areas of linear native common broadleaf shrub and mostly of pine. I consider the ecological effects to be negligible and I do not see that its clearance necessitates effects management under the NPS IB clause 3.16 which directs that the effects management hierarchy to be applied to significant effects on indigenous biodiversity outside SNAs and there is little indigenous vegetation present under the pines.

The addition of a roundabout on SH 59 will require that the Taupo stream be culverted as there is no room and appropriate gradients to allow a realignment around the roundabout (the preferred option). A 110m culvert is proposed, given that the stream in this location is straight (running along the road lower berm), the stream loss equals the culvert length. This equates (at an average of 0.7m^2 stream area per meter) around 77m^2 of aquatic habitat to be changed into a concrete pipe bottom, which will likely have gravels throughout. There is no avoidance and there is no realistic remedy for this requirement. I do note that currently there is no fish passage into this upper reach and therefore there is no special requirement to make the new culvert fish passage guaranteed (because regulation 70 of NES-F only requires that the culvert must provide for the same passage of fish that would exist without the culvert).

That said, the gradient suggests that an NES-F compliant culvert would not be problematic and so long as a sufficient sized culvert at the current gradient was installed with the required inverted base fish passage in the future would be enabled should lower passage issues be corrected by Porirua City Council.

In terms of offsetting, we suggest that there is sufficient surplus capacity in the new proposed retention wetlands with permanent water to accommodate the requirement of 77m^2 on top of the 70m^2 required for the streams within the retention area now such that those roundabout effects to the Taupo stream can be offset in the new retention wetlands.

5.5 Birds

Effects on indigenous birds are unlikely. On the property this might only be of note where the pastures were not managed until earthworks and NZ pipit had started to nest in the rank grasses. The simple avoidance of that effect is to ensure the pastures remain grazed (or mown) such that pipit are not enabled to breed there.

There are otherwise only shelter belts generally of pine and a small area of still young, planted natives and it is unlikely that native species that would trigger the wildlife act will be nesting and so affected at vegetation felling.

In the SNA 027 to the west of SH59, there is a greater probability that native bird species may nest in the seral broadleaf that has reformed / been planted especially fantail, grey warbler (and so shining cuckoo), tui and bell bird.

While the loss of some 0.1ha of that vegetation is a very minor amount form the wider catchment (and ED) and the magnitude of change therefore negligible, reduction in harm to individual native birds should be considered and achieved by way of a condition that manages the SNA 027 vegetation clearance time (i.e. outside of the common breeding season), and if not, a processes that causes nesting checks prior to vegetation clearance if within the breeding season. These are now standard procedures.

Regardless the number of nests likely encountered in this thin area of the SNA is likely sufficiently low that the effect would be (at a population level) negligible or very low.

5.6 Lizards

A pre-development lizard survey assessing habitat quality and condition was undertaken to assist with the management of effects based on the land use change at the site.

This survey identified 19 areas of habitat which included rough pasture, vegetation margins, ornamental garden, woody debris totalling 0.65 ha (6,476 m^2).

These habitats either surround houses or are within a rural landscape that has been shortly grazed. The habitats are all low value. They are small, fragmented “islands” which are exotic dominant (e.g., rank grass, agapanthus) and overall highly degraded.

There is also one 0.19 ha (1,858 m^2) area of seral broadleaved forest adjacent to SH1 (the SNA) which is of moderate value.

The total area of lizard habitat impacted is 0.83 ha (8,332 m^2).

5.7 Earthworks and Construction Sediment Discharge and Potential Hydrological Reductions in Wetlands.

The author assumes that for both the remaining natural inland wetlands not directly affected by the proposed works, and for the new rehabilitated areas of the retention areas, there is a possibility of sediment discharge escaping controls.

The author considers the risk low, but dependent on site management and supervision. The impacts of such discharges on low and very low value wetland gully systems already receiving considerable stock and farm related sediment discharges is, however, not overly problematic as these wetlands currently manage high sediment loading and recover

rapidly from sediment deposition in the gullies. Because the earthworks are divided into sub catchment areas and each gully (of which there are many) may then only receive a limited amount of the total open earthwork discharge (should defences be overwhelmed).

The author considers that under a heavy rain event and defence failure that the magnitude of a discharge is most likely low (or at the lower end of the scale), noting there are events for which no defence is possible. A low magnitude effect to a low value set of system causes a very low level of adverse effect. It does not matter so much if creeping bent and Juncus effusus and Gylceria wetland is considered a less than minor level of effect from which the exotic vegetated and already pugged sediment gully wetlands will rapidly recover from, i.e. there are few values at risk.

Such an effect, where it was wide scale could in fact be the impetus to cause even greater restoration of wetlands into native vegetated gullies by way of remedial actions to such sediment management failures. This would be an opportunity where an effect to a low value exotic system resulted in a positive ecological outcome.

6.0 Effects management

6.1 SNA / Indigenous Vegetation Removal

Some 1400m^2 of mainly indigenous terrestrial vegetation largely in a SNA feature is required to be cleared to install the SH59 intersection (roundabout). That clearance has been kept to a minimum but cannot be avoided due the need to provide for an appropriately sized and safe functioning intersection.

The vegetation is approximately 60 year old largely planted broadleaf later seral vegetation. In my previous experience on similar projects, a 3:1 area ratio is typical to manage the time lag of restoration revegetation based on a recovery of a reasonable canopy of around 10 years. I have not undertaken an offset model but recommend a 3:1 ratio as this as it is a commonly accepted offsetting ratio (e.g. Transmission Gulley) for later seral type indigenous vegetation.

Proposed offset revegetation (Figure 21) focuses on connecting SNA 029 and 225 and protecting a small wetland area. An area of 4,200m^2 is required at the ECR ratio to be replanted (pink area of Figure 21) which causes the best ecological outcomes with respect to shoring up the edges of SNA 029, filling an inter SNA vegetation gap, and is in keeping with the Porirua District Plan requirement for buffering of SNA (5m) (see Section 9.0). It also positively responds to the Structure Plan requirement to provide an ecological corridor.

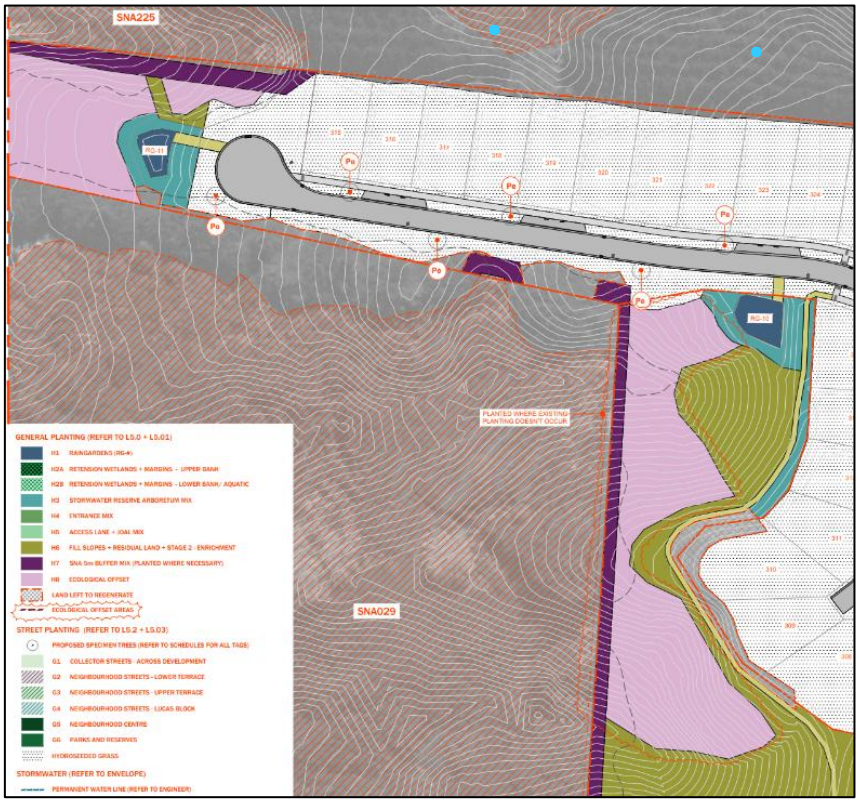


Figure 21. Area (pink) proposed for offset of SNA 027 and east side SH59 indigenous vegetation clearance. Sheet 7 Landscape and Ecology plans.

A full and complete restoration programme for the offsetting areas should be required by conditions with monitoring of success focused on the correct species richness panted in the correct patterns and established to an 80% canopy cover.

A draft restoration programme is included in Appendix 5 (see section 9.0) of this report and responds to the requirements of the PDP APP17 for a planting plan.

The species to be planted should target a kohekohe-tawa end canopy with some totara and miro but the bulk of the planting should be locally common seral broadleaved species (*Coprosma*, *Olearia, Myrsine australis*, ngaio, kanuka and five finger).

The plant size should be no smaller than 1L and the general spacing no more than 1/m^2.

It is likely that a maintenance period of 3 years will be sufficient to see the plants established, but general weed management may be required for 5 years or until the canopy reaches the 80% threshold. Once that threshold has been met and the area is without any problem ecological weeds, then maintenance specific to this restoration can cease as the effect will have been offset.

6.1.1 Lizards

Aside from the roundabout installation effects to SNA 027 and that area as potential lizard habitat, there is minimal lizard habitat on the farm property and what is present is very common and abundant in the ED (rural farming and urban house and garden). The loss of farmland and shelterbelt is considered a negligible change in the amount of that low quality habitat for lizards.

The loss of the SNA area (as already described) is a loss of 0.7% of the local (SNA 027) habitat open to lizards in the SNA and this magnitude of change is considered (at less than 1%) as negligible and despite ngāhere gecko being a high value species the overall effect is very low with regard of habitat loss.

Lizard harm is minimised by way of the lizard management plan (LMP), developed by Mr Payne for the Wildlife Authority, which requires rescue of lizards and translocation of those taxa and individuals to the lizard relocation area on site as shown in the LMP.

6.1.2 Birds

While most of the vegetation on the property to be cleared are pines and general exotics which might involve exotic species of birds, there are some areas of SNA (027) and native shrubs (SH 59 road edge and the planted native area on the property) which may affect indigenous birds.

To avoid harm to nesting native species, the simple solution is to clear tree and shrub vegetation in these areas outside of the breeding season (i.e. August through to March). However, that approach is likely to conflict with lizard management time frames and where this becomes the case there are other management options. The first option being an ornithologists check for nesting natives in vegetation (taller shrubs and trees) desired to be cleared and postponement of clearance until the nest has fledged. If that time frame becomes problematic, then the nesting birds can be translocated via the processes approved in the relevant Wildlife Authority and supporting bird management plan.

6.2 Natural Inland Wetlands Overall Approach

As noted above, ordinarily such low levels of effect are sufficiently minor as to not require management, however, the NPS FM (2020) directs Councils to achieve no loss of extent or value of such natural wetland community types. Value refers to those stipulated in the NPS FM, of which only two relate directly to ecology: ecosystem health, indigenous biodiversity, hydrological functioning, Māori freshwater values and amenity values.

Therefore, in the following I consider the NPS FM effects management hierarchy.

Through discussions with the developers and engineers, as much natural wetland and stream loss has been avoided as practicable while balancing the requirements to consider the Structure Plan's freshwater management areas and corridor functional enhancements whilst still attaining the development the developer requires. This is reflected in the main gullies without fill or development.

This process began in the PDP Structure Plan and now here in this application. It has resulted in changes in the development design and constrained the overburden and infill proposition. This has both minimised and avoided effects to natural inland wetland and stream corridors.

The wetland under the retention areas lost to those features will be remedied (and improved) with 6,900m^2 of current wetland feature affected and (at the 10% AEP wet zone) 12,000m^2 returned. This is through the development of wetland retention areas with front end treatment systems (i.e. treatment prior to the wetlands) and the revegetation of those retention (lake) systems to create / restore natural inland valuable indigenous wetlands from standing water reedlands (raupo) through to Carex sedgelands with appropriate wet feet riparian areas (approximately 5-10m wide).

These areas have been developed so as to function as permanent shallow water wetlands which are fully vegetated but can flood at times. The wetland areas are buffered by in-front treatment devices (rain gardens). The focus being on creating a large indigenous vegetated wetland that can mitigate flooding and still supply an extensive representative wetland habitat (and aquatic habitat expanding the poor quality stream areas that will also be inundated) that is very superior to the current wetland habitat.

There are four areas required to be large retention areas and these sum to around 1.2 of ha of wetland. This means there is much more natural wetland being made as remedy than required to be remedied at those location– i.e. there is at least 5000m^2 surplus wetland being created associated with the retention areas and remedy of wetland lost at those locations. That 0.5ha will (as discussed below) then be put towards the offset for wetland reclamation component of this effects management regime.

The remaining approximately 15,311m^2 (1.53ha) of infilled wetland is effectively the residual effect after remediation and is the amount of wetland loss that requires testing for an offset, i.e. where the residual effect is a more than minor then that effect is required to be offset (NPS FM 2020).

The residual effect amount after the remedy given the low values current, is minor or less than minor (as per the level of effect assessment above). To a degree that is dependent on the scale of the assessment and there has been numerous debates as to the appropriate scale in other cases.

The EIANZ process would suggest that the magnitude is low, and the values are low (or less) and so the residual level of effect (reclamation of 1.5ha) is very low, which is less than minor and so no offset should be required by the NPS-FM effects management hierarchy.

However, in adopting a very cautious approach the applicant has offered an offset approach despite the level of loss being sufficiently low as to not being required by the effects management hierarchy in the NPS-FM.

Acknowledging the low level of low quality wetlands affected which have little or no current pathway to betterment, the author does not see a requirement to run an offset model (such as Maseyk et al., 2018), but instead propose to adopt a 1:1 offset ratio. In saying that, this ratio (1:1) is explored in Appendix 2, with regard to what a biodiversity offset model outcome might generate.

6.3 Wetland Remediation

There are four areas in wetland gullies supported by central streams systems that will be developed into stormwater retention wetlands which, while managing water levels, will be reinstated as indigenous wetland habitats and not designed for contaminant treatment.

The Northern retention wetland is developed from the existing road culvert up gully. It is designed to have persistent shallow water (in which to develop the wetland) but also sized to managed various levels of rain event discharge from an area of the development's impermeable surfaces.

In the diagram below, the pale blue line denotes the area of the obligative wetland species colonisation and in which I recommend being developed as a rush and reed wetland focused on *Manchuria*, *Eleocharis* and raupo. Outside of this will be the transition from FACW towards FAC[4] species (Carex-Juncus). Outside of that will be the riparian terrestrial species buffer, but of species that can better sustain occasional inundation for short periods of time.

The wetland area (at the 10% AEP indication) will be 0.23ha (volume 700m^3). This remedies a loss of approximately. 0.23ha of existing natural inland wetland (albeit exotic dominated) in this valley from the retention area.

[4] See methods for these acronyms

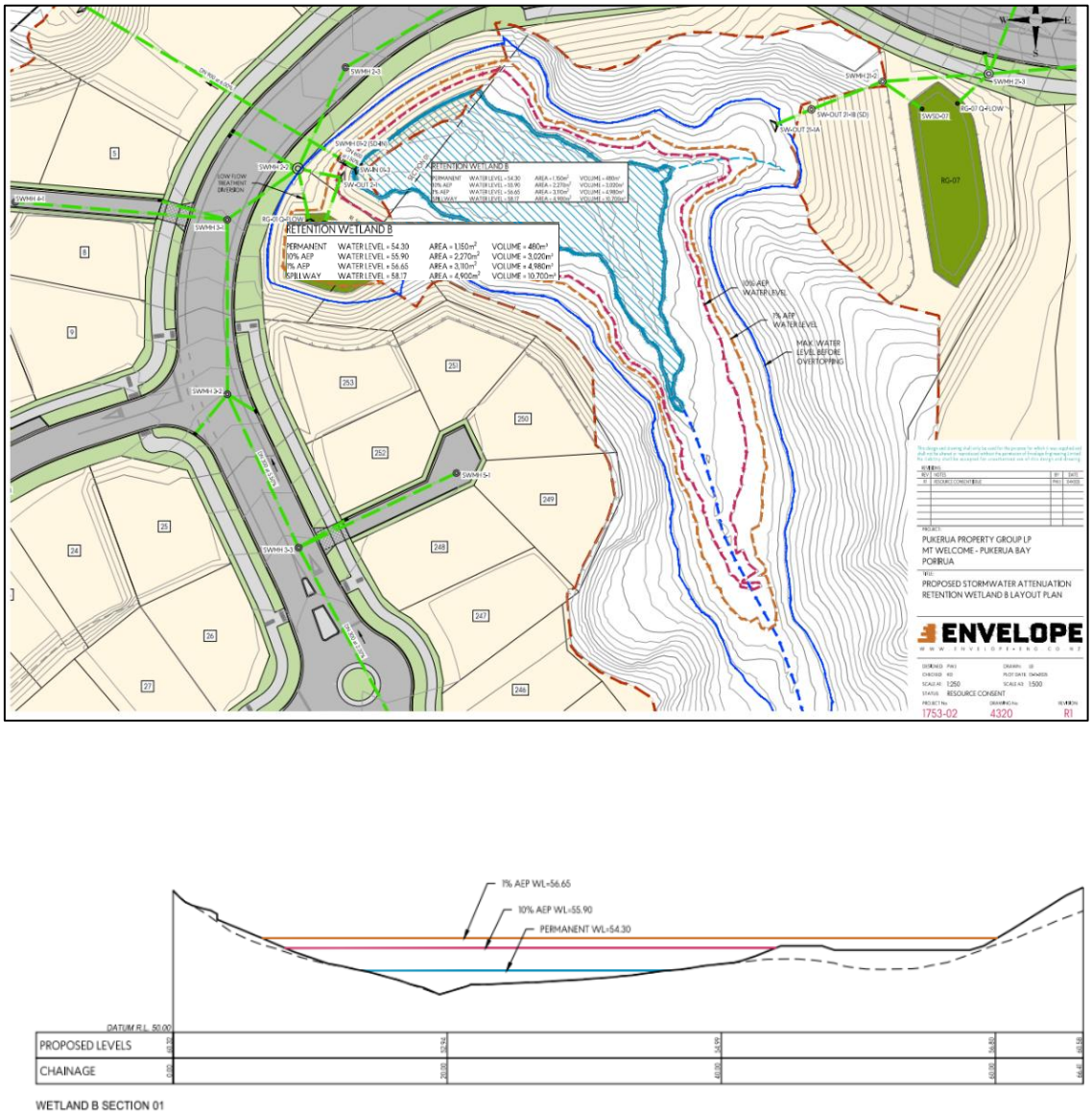


Figure 22. North-western wetland retention basin water prediction areas and side elevation plan.

The north-eastern retention area will have at least 0.19ha of wetland in the form of obligate (pale blue area) and FACW wetland (red dashed out line (10% AEP). This removes an area of Junus creeping bent wetland of around 0.08ha. It is replaced with the same pattern of rush and reedland centrally and sedgeland around the edges.

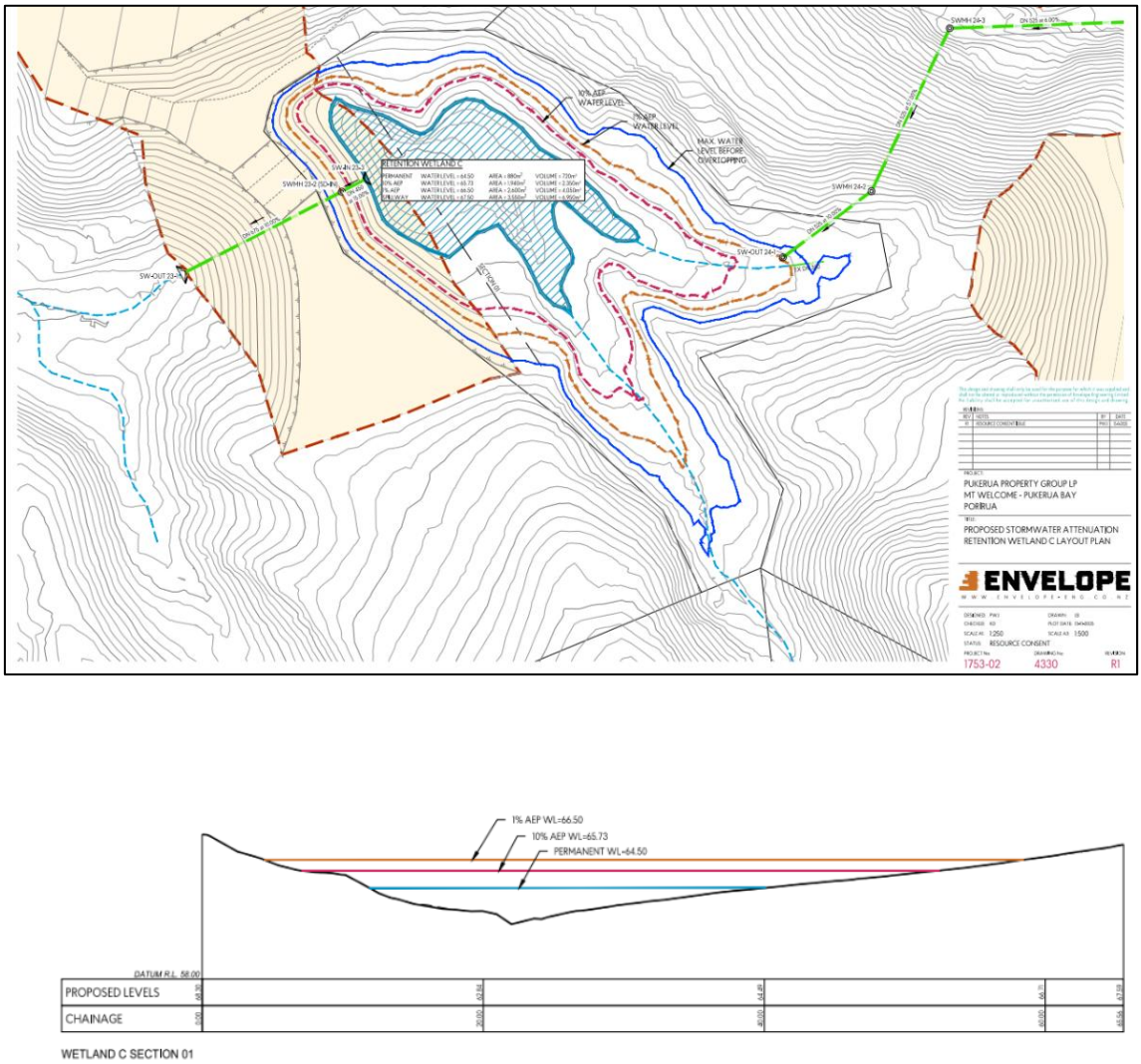


Figure 23 Northeastern smaller retention wetland water prediction areas and side elevation

The central basin of the southwestern gully system is the largest wettest feature on the property currently. It will receive a wetland retention basin of around 0.25 ha (inside the red dashed line) and around 0.18ha of current wetland will be removed in doing this. Again, the central area will be predominantly raupo spreading out into shallower Manchuria, Eleocharis and into sedgelands, rising to harakeke, Coprosma propinqua and manuka.

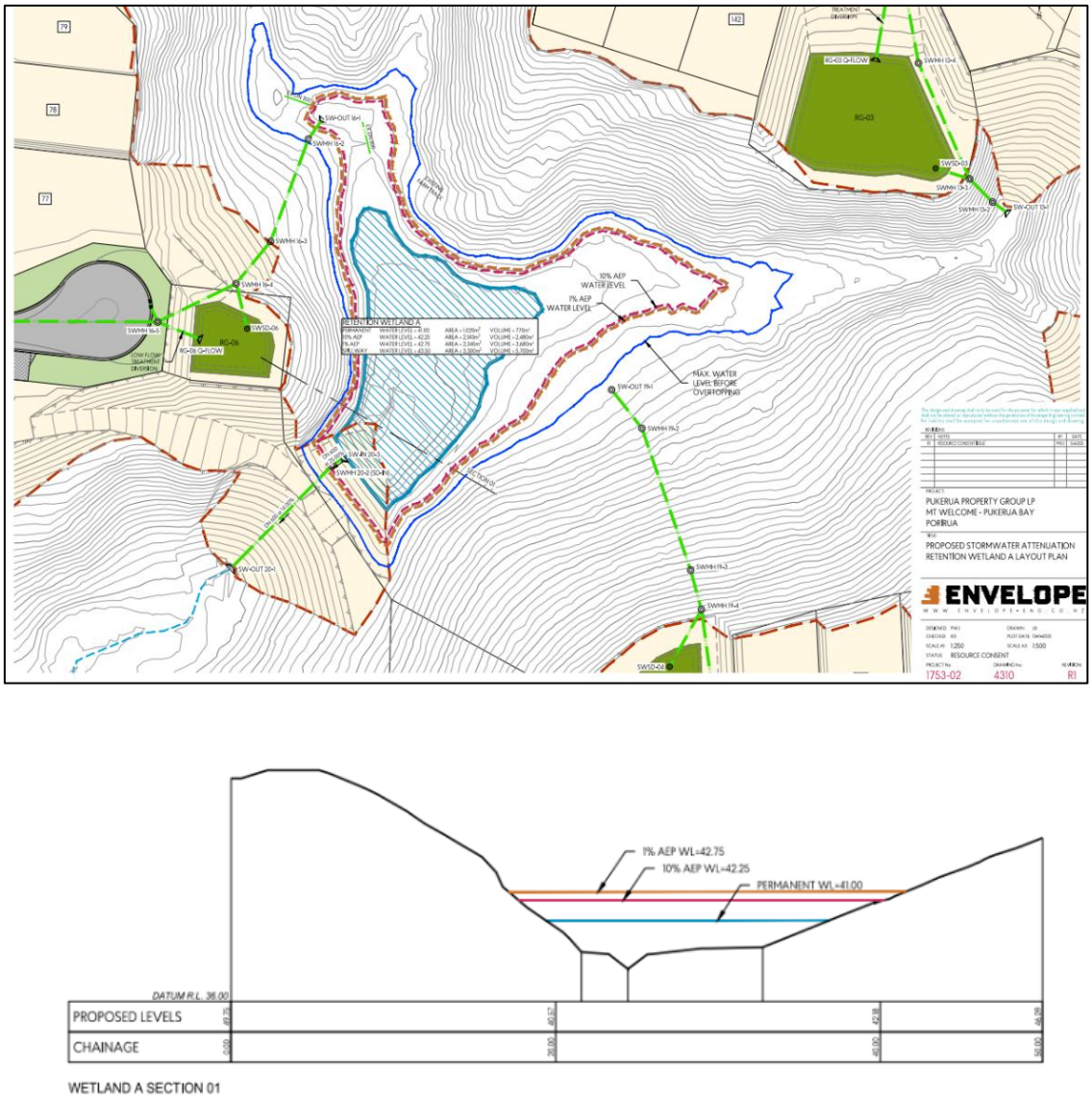


Figure 24 South western retention wetland water prediction areas and side elevation

The eastern most proposed wetland retention area in the Kakaho western main stem gully floor is going to be in the order of 5350 m^2 (0.54ha) at 10% AEP, and 1,840m^2 of permanent water. This replaces approximately 2000 m^2 of rush land and wet exotic and pasture species and 150 linear meters of the main stem of the Kakaho Strem west.

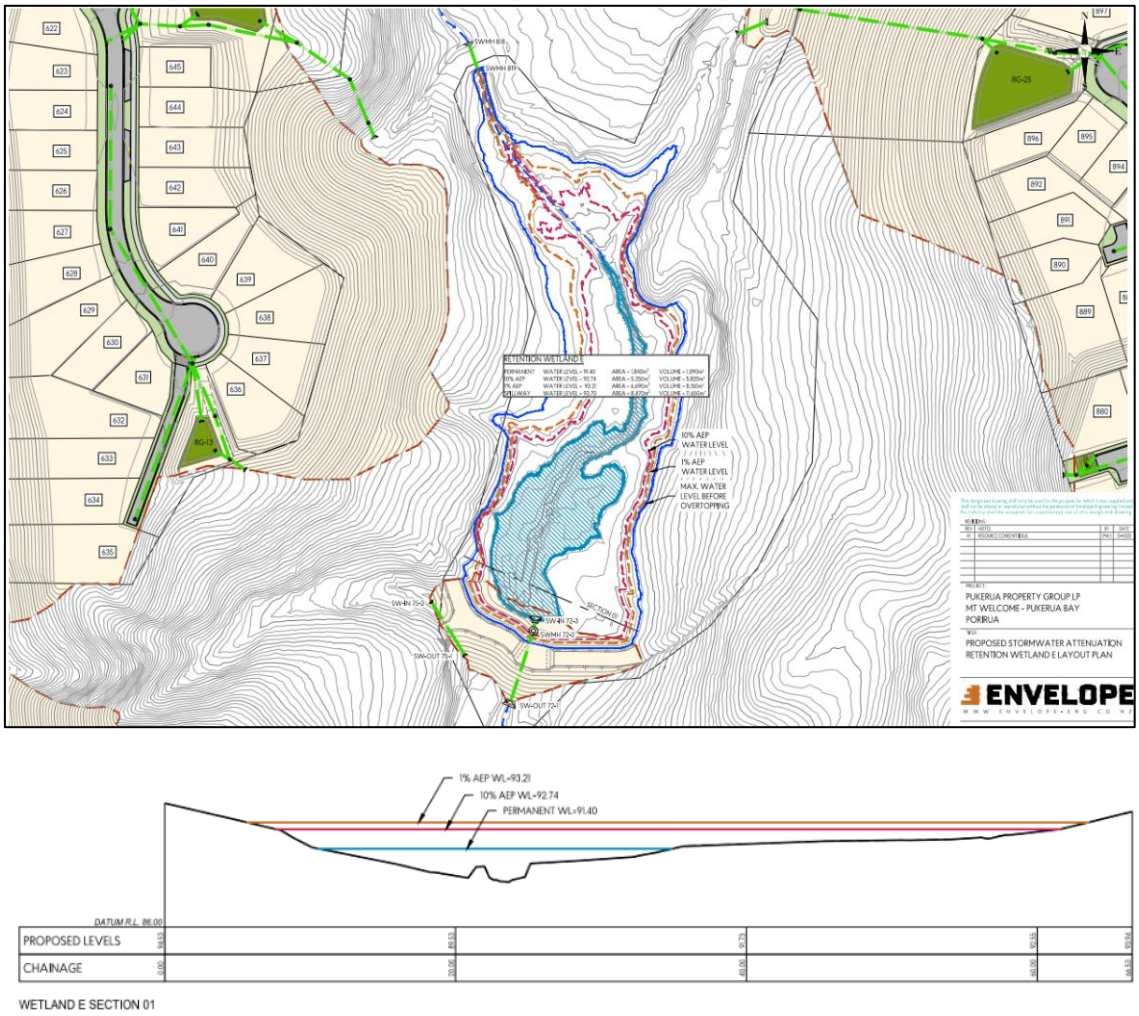


Figure 25 Kakaho west man stem retention wetland water prediction areas and side elevation

The wetland here is also going to represent a reedland centrally connecting outwardly to the shore with a rush land and then into sedgelands. Because it is on a wider flood plain, it is proposed also to have a kahikatea dense outer edge.

In summary this remedial wetland program causes 6,900m^2 of exotic dominated wetland loss being remedied by 12,070m^2, which nearly doubles (increase of 5170m^2) the amount of wetland that will be present post development, and the remedial wetlands will be representative indigenous dominated wetlands of much greater ecological value than the current and affected exotic farm derived features.

6.4 Wetland Offset

The offset is targeted at resolving 15,311m^2 of natural inland wetland outside of the remedial wetlands that is infilled, and which will be offset at a 1:1 ratio. We note that the remedial wetlands and the retention wetlands are much larger than those wetlands being replaced by these features and offer a surplus of just over 0.5 ha.

The surplus 5170m^2 of wetland development in the remediation areas can be counted as part of the offset as it is beyond what is required for full remediation of the development of the retention wetlands. This creates a residual offset requirement for wetland of approximately 10,000m^2 (1 ha).

The basic tenet of the offset is to utilise the surrounding unaffected gullies and basins of the Taupo draining western system which are currently grazed, poor condition, natural wetlands which cannot achieve better indigenous biological diversity without different management and restoration. In doing this, off-site long term benefits are anticipated with regard to water quality entering the Taupo swamp to the west.

To determine the best ecological, the following were considered: the greatest overall benefit in terms of sequences, habitat area, connectivity, water quality functions, and the protection of the Taupo swamp area downstream and the lower Kakaho River.

The following assumes that the proposed stormwater retention wetland can be fully vegetated (in terms of their detention role) and that the lakes are not deeper than 200-300mm normally and have sides that graduate down to that depth. The engineer designs have accommodated this requirement.

The first indigenous wetland restoration area is associated with the lower (southern) wetland gully complex initially identified as natural wetland (although exotic) and the southern most of the retention wetlands (Figure 26). The restoration of these farmed wetlands on the lower portion and development, downstream of the central retention wetland (Figure 26) would supply around 0.51 hectares of wetland. This would have additional terrestrial riparian buffer planting and be associated with the down gradient stream and its riparian enhancement (see stream offset below).

It is noted that the offset described here is for the wider site as a clustered larger wetland rehabilitation is considered much better in terms of values attained, functions attained, and viability into the future than small areas nearer each area of wetland gully loss. This wetland would be a sedge wetland focused on *Carex secta and geminata, Juncus edgariae*, Coprosma *propinqua*, harakeke and Ti koura as the riparian element.

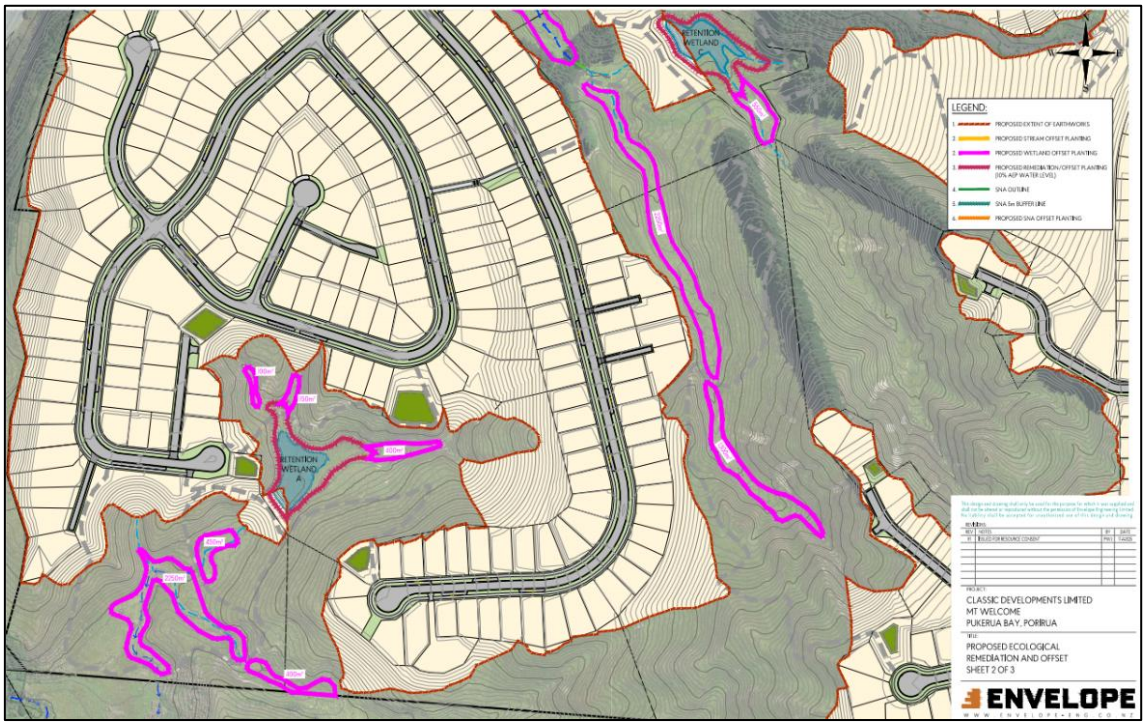


Figure 26. One of the areas for the offset wetland creation / enhancement options. Above and below the south-western retention feature. approximately. 0.51ha.

The second area (Figure 27) is the northwestern draining stream / wetland gully complex up stream of the proposed northern retention wetland (and connected to the second retention pond in this system).

The two gullies proposed offers approximately 0.66 ha and is ideal for the addition of *Carex secta* and *Carex geminata* gully centrally supported by riparian manuka, *C. propinqua*, harakeke and Ti Koura with spot positioned pukatea, swamp maire and kahikatea.

The existing stream can be supported also by some channel improvement and sediment removal enabling better continuity, more pool habitat and the removal of stock and improvement of cover.

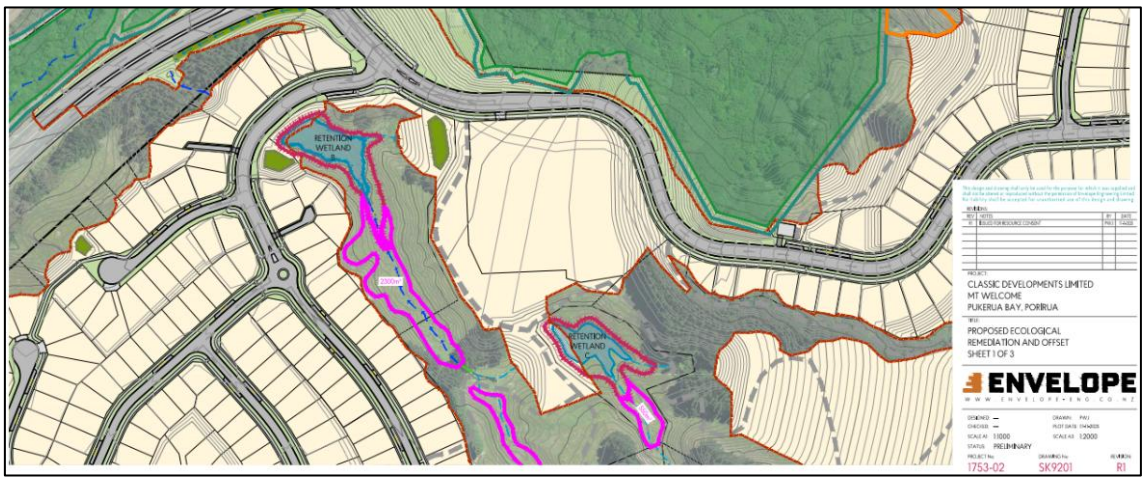


Figure 27. An extension to the north-western retention area moving up the main gully and the adjoining parallel gully north (approximatly.0.66 ha) – see figure above also.

The combination of the two areas and the surplus wetland created in the retention areas equates to 1.6 ha of current poor quality exotic wetlands that will be transformed into indigenous natural wetlands with appropriate fencing, riparian buffer planting, removal of stock and long term protection and maintenance.

The total package is surplus to the offset requirement (based on a 1:1 ratio) and when conditioning, the requirement should reflect the ratio not the total area. It is suggested that the above plans and areas make ecological sense and offer flexibility to the offset plan in terms of gully extents viable in terms of actual widths and ground lengths. I.e. a precautionary approach to ensure the offset can be realised.

In terms of indigenous functional protected future wetland this proposal as opposed to the status quo land use absolutely provides a net gain.

6.5 Streams Effects Management

The stream effects relate to some 450 linear meters on the property (approximately 600m^2), and this is remedied through the creation of the retention wetlands with large areas (>4500m^2) of permeant water. These permanent water features with wetland emergent and rooted vegetation will be substantially better and stable and will provide health aquatic habitats for eel and banded kokopu that far exceed the current pugged eutrophic distributed channel water systems currently present. The amount of quality aquatic habitat under the proposal is a substantive positive ecological outcome.

6.5.1 SNA 027 Culverting for SH 59 Roundabout

Around 110m of Taupo Stream is required to be culverted and the culvert must be offset (further west) than the current bed and so may be viewed as a reclamation. While that culvert does not need, in my view, any specific fish passage requirements given the current absence of passage into the reach, any culvert is required to follow the basis supplied in the NES FM re size, invert and gradients (regulation 70) to allow for fish passage.

The placement of the culvert, because the stream is relatively straight, does not result in a loss of extent of waterway to any notable degree, but does cause a diminishment in value of the aquatic habitat for that 110m. That diminishment of aquatic ecological value is less if the new culvert is sufficiently sized to include baffles that will cause retention of gravels in the bed of the culvert under normal flows. This causes some habitat for the macroinvertebrates already present.

Thus, I calculate that the SEV of the existing stream is around 0.6 (I have not undertaken a formal SEV process but have completed a considerable number of SEVs in the area to have a very good ability to estimate the likely outcome of such a process) and the resultant culvert with a gravel bottom and installed as per the NES-F will have an SEV value of approximately 0.3. Therefore, the diminishment in value will be of the order of 0.3 SEV over 100m.

Where no new channel can be created, the offset must be improvement of existing stream habitat through actions to correct negative modifications such as fish passage and the absence of riparian vegetation etc. For this development, the only plausible stream enhancement options are either the Kakaho East or Kakaho West main stem or in the south-western tributary to the Taupo Stream as these are the only local perennial stable

flowing streams worthy of enhancement. Access to these areas for the applicant is not however, straight forward and requires third party agreements if long areas of either the Kakaho West or Kakaho East are to be used.

Currently, and as is common in farmed landscapes, the unfenced stock affected main stem will have an SEV score of around 0.4 (e.g. HBRC 2010) and a potential gain of 0.2-0.3 from riparian revegetation, exclusion from stock, and the addition of some large woody debris.

Stream offsets because of piping are often calculated using the SEV ECR formulae (Neale et al., 2016; Storey et al., 2011). The calculation assumes that the current SEV should reflect its potential under good management and that there will be a lag time to the increase of SEV values at the mitigation site. This is true where the mitigation is reliant on new riparian vegetation but not where it is in regard to new stream recreation and the attainment of new populations of aquatic organisms. Here the stream replacement of a culvert includes loss of the riparian vegetation too.

The calculation then is ECR = (SEVIp-SEVIi) / SEVMp-SEVMc) X lag multiplier

Where SEVIp = the potential of the impacted stream, SEVIi is the SEV score post impact, SEVMp is the potential of the mitigation stream and SEVMc is its current SEV value.

For the 110 m culverting of the Taupo stream this then is:

ECR = (0.65-0.3) / (0.6-0.4) X 1.5 = 1.75.

That means for every 1m of affected stream, 1.75m of the mitigation stream is required to be enhanced with the enhancements that cause the SEV gains predicted.

This means 193m of perennial stream requires enhancement to offset the 110m culverting of the Taupo stream. Figure 28 below identifies the proposed stream where the enhancement is expected to return the best outcomes on the property.

Figure 28. Taupo stream effects offset location in the lower (below retention wetland) Kakaho West main stem.

The offset enhancement is around 195m of stream and includes an enhancement package along the area indicated above that consists of fencing and riparian revegetation between on average 20m (topography driven) either side of the streams typical wetted width bank targeting the following species at 1m spacing (except for larger trees) and with at least 1L pant sizes. Note that tall woody species should be adjacent to the stream and not just flax and cabbage trees.

Table 5. Proposed riparian vegetation for the western Kakaho revegetation.

Species	Size (L)	Space (m)	proportion
Harakeke	1	2	10
Karamu	1	1	15
manuka	1	1	10
Hoheria	1	3	10
putaputaweta	2	1	10
Ti Kouka	1	1	5
kowhai	2	3	10
Ribbonwood	2	3	20
Five finger	1	1	10
kahikatea	2	3	10

6.5.2 Fish Rescue

For works in any perennial and intermittent stream there is a fish salvage process (Appendix 3) that directs how fish salvaging should be conducted to remove and translocate any fish within any of the waterways (those in retention wetland basin creation areas and culverting).

6.5.3 Bird Nest Avoidance

To avoid harm to any native bird and nest (juveniles) a condition requiring ether clearance to be outside of the native birds breeding season (August to March inclusive) or a process (relatively standard) for vegetation checks within a day or two of proposed clearance – where inside the breeding season - by a qualified ornithologist to ensure no nesting birds are in the vegetation to be cleared. If present clearance must either be postponed until the nest/s have fledged or else a Wildlife Act Authority must be obtained (from DOC) for nest transfer.

6.5.4 Lizard Rescue

As with fish there are now standard lizard rescue protocols to minimise harm to lizards and a draft Lizard management plan (as required by the Wildlife Authority permit to capture and translocate lizards) is prepared in Appendix 4.

6.6 Statutory Checks

6.6.1 NRP Schedule G2

The Operative NRP (2020) has a set of principles (guidance) with respect to developing a biodiversity offset (Schedule G2), however, there it states that "Any biodiversity offsetting proposed to manage adverse effects on biodiversity under Policies P32 and P41 should be designed and implemented with regard to any current guidance or direction from central government in relation to biodiversity offsets." Since the NRP the NPS FM 2020 (amended 2024) and NPS IB 2023 (amended 2024) have been published and share (Appendix 6 and Appendix 3 respectively), principles for biodiversity offsetting, the author focusses on the NPS FM principles below as all three sources have (more or less) the same principles and guidance.

6.6.2 NPS FM

The NPS FM contains directions that there is no further loss of extent for wetlands and to avoid the loss of river extent and values to the extent practicable (policies 6 and 7) and allows for effects on natural wetlands where these are appropriately managed through the effects management hierarchy for well-functioning urban environment (urban) development (clause 3.22).

After an iterative design process (refer sections above) where the best and initially identified natural wetland areas were avoided, the remaining gullies affected that cannot be remedied as they are lost permanently under the development are proposed to be offset. Of the 15,311m^2 to be offset there remains sufficient current gully features in the western systems that are not currently indigenous natural inland wetland but have the potential to be so through assistance.

The NPS-FM and NPS IB offset principles (for the wetland and stream in Appendix 6 of the NPS-FM, and for terrestrial Appendix 3 of the NPS-IB) are as follows and I comment on how and where the proposed sites offsets adheres to these principles:

Principle	Adherence
1. Adherence to effects management hierarchy: An aquatic offset is a commitment to redress more than minor residual adverse effects, and should be contemplated only after steps to avoid, minimise, and remedy adverse effects are demonstrated to have been sequentially exhausted.	The effects hierarchy has been explored, avoidance and minimisation undertaken and remedial works considered were that is feasible (the retention areas) prior to the residual effects, which are small relative to the ED but which, at a sight level and despite their exotic modified nature (at 1.5ha) might not be regarded as less than minor, are set out to be offset.
2. When aquatic offsetting is not appropriate: Aquatic offsets are not appropriate in situations where, in terms of conservation outcomes, the extent or values cannot be offset to achieve no net loss, and preferably a net gain, in the	There is nothing that is being affected that is irreplaceable or vulnerable, the affected wetlands are simple, robust, highly modified, exotic dominated pastural features. There is no component of the values or effects or proposed effects management that

Principle	Adherence
extent and values. Examples of an offset not being appropriate would include where: a. residual adverse effects cannot be offset because of the irreplaceability or vulnerability of the extent or values affected: b. effects on the extent or values are uncertain, unknown, or little understood, but potential effects are significantly adverse: c. there are no technically feasible options by which to secure proposed no net loss and preferably a net gain outcome within an acceptable timeframe.	is unknown or little understood and the effects are not significantly adverse, highly modified natural wetland loss and restoration is a common and successful process in that the methods are well known and well-practiced and it is with certainty that the outcome will be a net gain.
3. No net loss and preferably a net gain: This is demonstrated by a like-for-like quantitative loss/gain calculation, and is achieved when the extent or values gained at the offset site (measured by type, amount and condition) are equivalent to or exceed those being lost at the impact site.	The GIS calculations of loss not remedied have been made (15,311m^2) and the gains checked in the appropriate areas for a 1:1 offset approach. The author has checked via a biodiversity offset model (DOC 2015) -see Appendix 2 this report that a 1:1 offset is appropriate and that modelling confirms a 1:1 offset approach given replacement is proposed to involve an indigenous dominated wetland system of greater species richness than that lost. For streams the SEV model requires a 1:1.75 ECR for stream loss not remedied. The outcome of the offset programs for wetland, stream and terrestrial vegetation) will be a net gain. However, a like for like approach is inappropriate, as it often is, because the features being affected are considerably simpler and more modified and exotic dominated than a representative gully natural wetland. The goal here is to restore a more representative example of fully functional wetlands, the form and diversity of which is informed by early botanic descriptions of such systems nearby (e.g. Ogle 1978).
4. Additionality: An aquatic offset achieves gains in extent or values above	Yes, the proposed offset is additional and achieves gains that are almost impossible on

Principle	Adherence
and beyond gains that would have occurred in the absence of the offset, such as gains that are additional to any minimisation and remediation undertaken in relation to the adverse effects of the activity.	site with the current land uses and local seed sources.
5. Leakage: Aquatic offset design and implementation avoids displacing harm to other locations (including harm to existing biodiversity at the offset site).	No "leakage" will occur and in fact the proposed offset protects lower catchment water quality.
6. Long-term outcomes: An aquatic offset is managed to secure outcomes of the activity that last at least as long as the impacts, and preferably in perpetuity. Consideration must be given to long-term issues around funding, location, management and monitoring.	The wetland restoration will be long term and through conditions managed appropriately and protected legally.
7. Landscape context: An aquatic offset action is undertaken where this will result in the best ecological outcome, preferably close to the impact site or within the same ecological district. The action considers the landscape context of both the impact site and the offset site, taking into account interactions between species, habitats and ecosystems, spatial and hydrological connections, and ecosystem function.	The proposed wetland restoration and retention areas and management is entirely associated with the landform and dynamics of water management on and off site. It also seeks to restore areas mapped as Freshwater Management Areas in the PDP Structure Plan which considered the wider land area.
8. Time lags: The delay between loss of extent or values at the impact site and the gain or maturity of extent or values at the offset site is minimised so that the calculated gains are achieved within the consent period or, as appropriate, a longer period (but not more than 35 years).	The loss of value, such as it is, will be sequential and there will be staged loss and staged restoration such that the gap between the loss and the gain will be minimised. The wetland restoration of such narrow systems can occur very fully within 3-5 years. There will be very little lag time and arguably no real loss of value or function in the interim. Water quality out comes down catchment are the most important aspect and currently the wetland features do not function at all well in that regard. In part this condition has led our thinking on the discount rate in the offset model.

Principle	Adherence
9. Science and mātauranga Māori: The design and implementation of an aquatic offset is a documented process informed by science where available, and mātauranga Māori at place.	Science (publications and analysis of data) and experience in similar restoration has lead this offset, but to date has not involved Mātauranga Māori.
10. Tangata whenua or stakeholder participation: Opportunity for the effective and early participation of tangata whenua or stakeholders is demonstrated when planning aquatic offsets, including their evaluation, selection, design, implementation, and monitoring. National Policy Statement for Freshwater Management 2020 75 11. Transparency: The design and implementation of an aquatic offset, and communication of its results to the public, is undertaken in a transparent and timely manner.	So far there has been no engagement in this space

7.0 Wildlife Authorities

Wildlife act authorities (WAA) (permissions) are required to capture and translocate native species protected by the Act. This includes lizards and birds.

Appendix 4 is a lizard management plan in the format that would normally be brought to DOC for certification.

Fish salvage, where the salvage is into the same catchment and areas were the same species exist does not require permits from DOC and the fish passage issue is not complex, i.e. there is no request for interrupting passage (other than short term while culverts are installed).

A WAA to capture and translocate birds is not applied for here on the assumption that vegetation clearance will occur outside the breeding season or if within the season and nests are indicated by the ecologist, the work stops until the nesting in the vegetation required to be cleared has ended. To move a nesting native species requires a WAA. If, towards the time of clearance, neither of the above actions is feasible then a WAA application would be required to transfer nests prior to clearance.

The permitting of the capture and transfer of native fish is currently somewhat unclear, made especially so since no native fish is a protected species. MPI have on occasion and for substantive capture and transfer numbers and areas of native fish permitted the activity (such as at Transmission Gulley). However, typically it is a resource consent condition and a fish management plan certified by a Regional Council that has enabled that activity.

The purpose of the MPI permits and authorities is primarily in relation to fisheries and related to harvest. For the capture of possibly less than 10 fish in total I consider that a condition of consent and adherence to the draft fish management plan (Appendix 3) is sufficient to ensure proper treatment of native fish on site during construction.

8.0 Offset and Remediation Wetland Basic Requirements

The offset would require the following basics (and I also refer to the details in Blac Ltd landscape report):

8.1 Wetland Gullies

- Pre-planting wetland area preparation – retain grazing until ready to plant and then provide ecological weed suppression just prior to revegetation.
- Wetland plant introduction - eco sourced 1 L plants appropriately hardened and professionally planted (no fertiliser).
- Use contour and hydrology guides to establish the outer wetland planting guidelines (informed by the project ecologist).
- Fencing from stock post-planting and incorporating the riparian areas (at least 5m buffer from wetland edge, or 10m for stream offset planting).
- Weed and pest management for up to 3 years or until the wetland vegetation cover is 80% of any 5m by 5m vegetation monitoring quadrate.
- Planting of a 5m wide buffer of woody indigenous plants at 1m spacing using 1L plant sizes along the northern edge (inside of the fence).

The species for wetland rehabilitation are to be of the following in more or less the proportions indicated. A range of Carex are proposed in the first instance to ensure the micro scale hydrology can be made best use of. The wetland forest species are to be distributed in correct gully edge wettings in clusters of 4-8 plants and at the discretion of the landscape architect and ecologist.

Wetland gullies	Common name	Proportion
Carex secta	purei	10
Carex virgata	toitoi	15
Carex geminata	rautahi	10
Carex lessoniana	Cutty grass	10
Cypress ustulatus	Umbrella sedge	10
Juncus edgariae	wiwi	15
Juncus sarcophagus	Broom rush	5
Isolepis prolifera		15
Eleocharis acuta	Spike sedge	5
Coprosma tenuicaulis	Swamp coprosma	5
Syzygium maire	Swamp maire	100
Laurelia novae-zelandiae	Pukatea	200
Dacrycarpus dacrydioides	Kahikatea	200
Riparian	Common name	Proportion
Leptospermum scoparium	manuka	25
Coprosma propinqua		10

Pseudopanax arborea	5 finger	10
Aristotelia serrata	makomako	10
Carpodetus serrata	putaputraweta	10
Phormium tenax	harakeke	10
Pittosporum tenuifolium	kohuhu	5
Coprosma robusta	karamu	15
Olearia rani	heketara	5

8.2 Water Retention Wetland Creation (Remedy)

Wetland	Common name	Proportion
Machaerina rubignosa	baumea	20
Machaerina articulata	jointed baumea	10
Eleocharis acuta	spike sedge	5
Eleocharis sphacelata	kutakuta	5
Potamogeton cheesemanii	red pondweed	5
Myriophyllum robustum	stout water milfoil	5
Carex secta	purei	20
Astelia grandis	Swamp astelia	5
Schoenoplectus tabernaemontani	kuawa	5
Typha orientalis	raupo	20
Riparian	Common name	Proportion
Leptospermum scoparium	manuka	25
Coprosma propinqua		10
Aristotelia serrata	makomako	10
Carpodetus serrata	putaputaweta	10
Phormium tenax	harakeke	25
Cordyline australis	Ti Koura	15

9.0 Offset and Remediation Terrestrial Basic Requirements.

At least 4200m^2 is required to be revegetated as the offset for SNA 027 effects. In addition, there is a requirement of the northern growth development area in the PDP.

DEV-NG-P2 (5) requires:

a. Creating buffer areas around the edges of Significant Natural Areas identified in SCHED7 - Significant Natural Areas; and

b. Creating ecological corridors in the locations identified on the Structure Plan which will, over time, become dominated by indigenous vegetation, with a sufficient width, scale, and appropriate mitigation of any severance caused by roads, to connect and enhance Significant Natural Areas.

APP17 (of the PDP) has guidance/ rules regarding ecological corridors and SNA buffer areas that include legal protection but also a planting plan. There are specific considerations required of a planting plan which are listed in APP17 (2) a-cc.

Appendix 5 presents a plan of where and how that revegetation / buffer / offset / corridor enhancement should be carried out and as per APP17.

In terms of the buffer of SNA029 the areas indicated in red are those areas on the property which are attached to the SNA vegetation edge and could contribute to the 5m buffer. Other areas are unvegetated for over 5m into the SNA property and this project cannot contribute to the edge buffer by planting on this property.

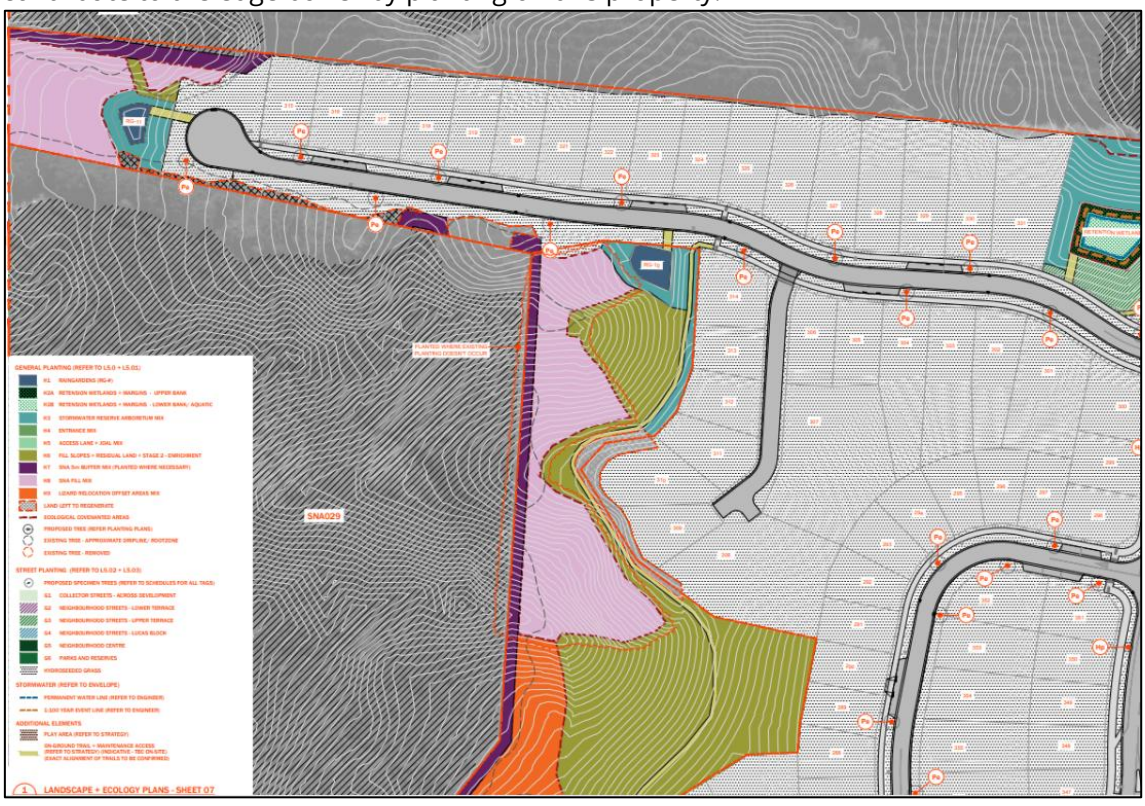


Figure 29. Purple is SNA 029 5m buffer planting, blue is wetland restoration assistance; pink is the SNA offset revegetation.

10.0 Effects Management Summary

The following (Table 6) summarises and clarifies the areas of the three feature types adversely affected, how much in total is affected, what proportion is remedied what must be offset and what those offset ratios are and so the minimum required to for fill the offset.

Table 6. Summary statistics of effects areas and type and the remedies and offsets.

Feature	Total effect area	Area remedied	Remedy area	Area requiring offset	Offset ratio	Offset area required
Natural inland wetland	22,211 m^2	6,900m^2	12,000m^2	15,311m^2	1:1	15,311m^2
Stream	560m (655m^2)	450m (600m^2)	12,000 m^2 (>450m)	110m (55m^2)	1:1.75	193m
Terrestrial SNA	1,400m^2			1,400m^2	1:3	4,200m^2

While the terrestrial offset requirement is 4200m^2 the actual indigenous revegetation of viable habitats will be in the order of 6000m^2, where the PDP requirements in regard to buffering SNA and contribution to corridor functional enhancements are also considered.

Importantly the stormwater discharging to the wetlands is treated and the wetlands are not a treatment devices. The water retention areas will also replace 450m of stream (300m^2) (on the property) and this will be an increase in area and quality of the aquatic habitat (12,000m^2) with a change from a narrow riverine system to a larger palustrine system. Gradients in the current system means the fauna will not be disadvantaged at all by this change in flow pattern.

Off property, the new roundabout requires the culverting of 110m of the Taupo stream and 1400m^2 of SNA vegetation clearance within SNA027 (and SNA029 and road eastern edge. At a 3:1 ratio 4200m^2 is required to be restored and this is to be undertaken in a way and place that also meets PDP rules and objectives related to the North Growth Development area (i.e. SNA buffering and corridor enhancements).

It is assessed that the earthworks component is sufficiently managed that adverse effects are less than minor. It is acknowledged that the current wetland and stream systems are so poor due to the historic land uses that even large amounts of sediment deposition in these systems would not diminish their current values and recovery would be rapid.

It is assumed that discharges related to other contaminants are managed through accepted typical setbacks, fuel bunded areas etc such that the risk of any discharge form the works in very low.

The waterways and wetland post development are protected by stormwater devices and paths and systems that will minimise contamination and are likely to cause a better than current contaminant loading downstream. Noting that to some degree nutrients, bacteria,

E. coli, sediments, etc. are replaced by common metals, oils, and other urban contaminants that escape the treatments.

A small residual effect (loss of natural inland albethey exotic) on wetlands persists post remediation and (at 1.5ha) is a less than minor residual effect when compared to a local catchment wetland extent level. Nevertheless, taking a conservative approach that wetland extent lost, largely upper gully systems, will be offset at a 1: 1 offset ratio.

Two areas are identified for this offset and give the 1.0 ha area required (the other 0.5 ha attained as the surplus wetland created in the retention areas) and are sensible areas from both a landscape and ecology perspective to do in total. The areas use the existing hydrology, and exotic wetland features to enable rehabilitation of indigenous representative wetland gullies and so there is overall a loss in extent of wetland on the property (approximately 25%) but a significant gain in the quality and values and function.

In addition, it is likely that other gains will be made through other requirements of the land not developed. I.e. wider non riparian catchment retirement and plantings, removal of stock, and weed management.

The development process, especially earthworks for the retention wetlands, will be subject to standard fish salvage requirements including the proposed Fish Management Plan (Appendix 3). The damming for retention process must also enable fish passage in the Kakaho West and north-western retention systems.

Monitoring of the earthworks extent should be required to establish if the areas predicted are the actual areas affected. I do not consider monitoring wetland health or hydrology of non-affected wetlands should be a requirement of a consent given the current seasonal and annual variance in wetland extent and condition and because the wetlands are virtually all exotic pastural affected areas now. Experience in such monitoring has proven how wetland monitoring is of little value where there is only low value exotic systems. However, the consent should require a full remedy and offset wetland spatial and temporal plan with monitoring of that process to ensure appropriate creation and success occurs.

11.0 Ecological Monitoring

11.1 Construction

After salvage processes for fish and lizards prior to stream and vegetation modification it is earthwork related sediment discharge that is the primary ecological concern post site preparations. Thus, it is water quality discharge to retained wetland and stream features and “downstream” from the site. I.e. stormwater discharge during earthworks that requires monitoring.

The erosion sediment control team oversee the devices, sizing, placement, maintenance and monitoring for their effectiveness. It is their management and recording of device success (or failure) that determine the discharge magnitude if and were that occurs. Only when excess discharge occurs it becomes the ecologists’ task to consider sediment deposition effects instream and wetlands that receive the discharges. This is a relatively simple process of considering the pre and post discharge sediment amount and distribution and determining if the new deposition may have affected aquatic plant and animal amounts and persistence.

Transport of sediment from earthworks and through management devices and to what downstream distance depends on the amount and velocity of water, the amount of sediment picked up and the size of the sediment particles. Finer material often does not deposit. Large particle sediment deposits after a short distance where velocities are moderated by topography, macrophyte, etc. It is this deposition that usually causes the ecological harm where its cover and depth are such that large areas of plant and animal life a sufficiently buried as to be extinguished.

Because the current wetlands and most stream reaches on site are already heavily sedimented and stock pugged, on site damage is highly unlikely. Downstream (Taupo stream) and the lower Kakaho however still have gravel hardbottom streams and would be affected by a scale of deposition of sediment.

A baseline measure of the stream and wetlands substrate and emergent macrophyte cover should be made at three locations prior to earthworks (Taupo stream prior to the track culvert, Southwest draining stream at the boundary and the Kakaho west stream at the boundary) (Figure 30).

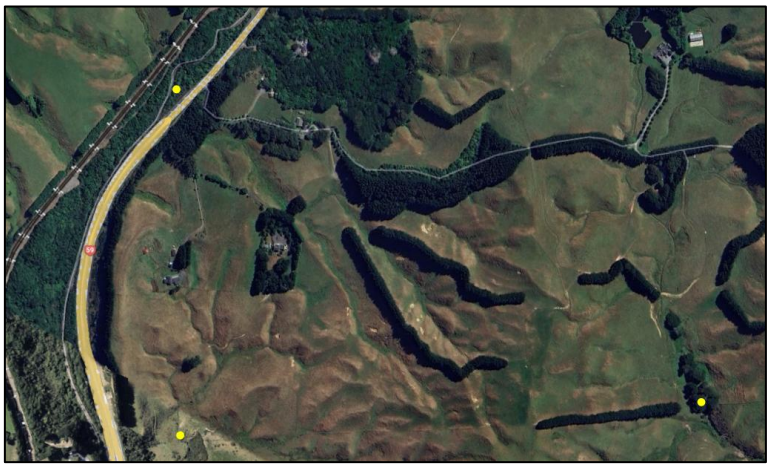


Figure 30. Pre earthworks reaches for base line substrate and macrophyte cover measures.

The only wetland and / or stream monitoring through the bulk earthwork period should come in response to measured failure of sediment management devices and so a sediment discharge of substance to the wetlands and streams.

That monitoring, as is usually the case, will be post event to ascertain the level of deposition and where that deposition has occurred. It will use the data in this report and the baseline measures to assist in determining what area of what vegetation (i.e. wetland) has been buried (extent and value change) and in the perennial stream systems the magnitude of substrate change. The real concerns should be the freshwater systems off site (Taupo wetland and Taupo stream) and monitoring under events with management failure should include monitoring for sediments cover and deposition depths ((Clapcott et al., 2011, SAM2, 6) in the baseline measure places.

Post construction I assume that the efficiency and discharges related to stormwater will be monitored by the project's hydrologist and / or stormwater team again to ascertain that the treatments and peak flow abatements are functioning as predicted. I see no ability to measure adverse effects related to these contaminants or hydrological changes via instream and wetland ecology methods. Species appearances, and assemblage metrics are too low and too variable through single or low abundance one time measures and even with regular abundant measures the cause and effect of changes very typically cannot be determined.

11.2 Offset and Remedy

Prior to earthworks and any vegetation clearances the site should have the project ecologist and surveyor mark out all the areas that can be infilled and all the areas that will be retained for the offset.

In regard to monitoring success of the effects management, once the offset program has been enacted the project ecologist should biannually monitor the progress of the offset wetland development so as to confirm the correct species planting and establishment. This is usually a three year process and / or to 80% wetland vegetation cover of the ground. The process is the same for the remedial wetland areas.

12.0 Conclusion

The streams, terrestrial ecology, and natural inland wetlands across the property are at the very low end of ecological value, largely exotic, planted and /or low flow intermittent stream systems except for the area around the required new roundabout at SH59, which is a later seral native broadleaf forest and the Taupo stream upper reach.

The current land management practices on the property have not and will not, if they are to continue to operate, improve any of these values and conditions.

The level of change of aquatic habitat and the loss of natural inland wetland is at the low end of the level of ecological effects and the ecological effects after management (avoidance, minimisation, remedy) are less than minor and do not warrant an offset. However, an offset is offered and the net result in terms of stream habitat and natural inland wetland habitat is a gain in quality and quantity of aquatic habitat and natural wetland and beneficial supporting land use and controls (stormwater quality protection, riparian protection, removal of farming practices).

The SNA (027) loss of vegetation / habitat is offset on the property by revegetation joining two SNA and supplying lizard habitat and a buffer to SNA 029's northern edge. This compliments the required 5m buffer to SNA 029.

Ecologically the proposed development returns a better result for freshwater ecology and a neutral outcome for terrestrial ecology, and both are an improvement on the current land use practices. Overall, there will be an overall net ecological gain (Figure 31).

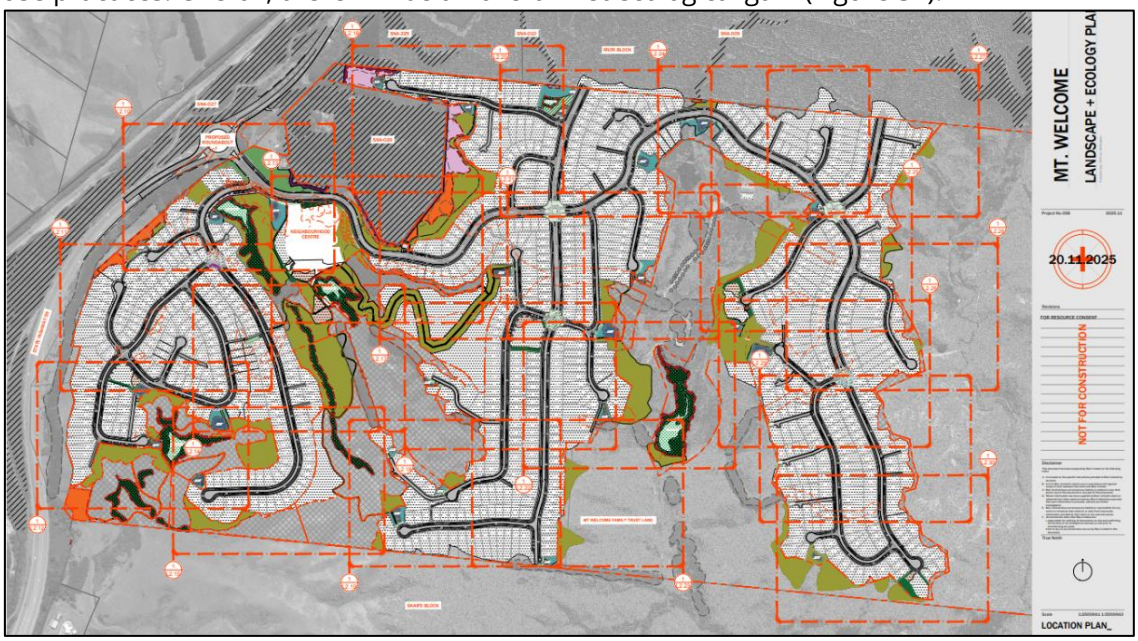


Figure 31. Overview of the inter development restoration treatments (note west kakaho riparian offset not shown).

13.0 References

Ausseil, A.-G., Gerbeaux, P., Chadderton, W. L., Stephens, T., Brown, D., & Leathwick, J. (2008). Wetland ecosystems of national importance for biodiversity: Criteria, methods and candidate list of nationally important inland wetlands. *Landcare Research Contract Report LC0708/158*.

Blaschke and Rutherford Environmental Consultants. (2010). *The Porirua Harbour and its catchment: A literature summary and review*. Prepared for Porirua City Council & Wellington City Council.

Clapcott, J., Young, R., Harding, J., Matthaei, C., Quinn, J., & Death, R. (2011). Sediment assessment methods: Protocols and guidelines for assessing the effects of deposited fine sediment on in-stream values. *Cawthron Institute, Nelson, Newzealand*.

Clarkson B., Denyer, K, & Bartlam, S. (2022). *Pasture exclusion assessment methodolog*. Ministry for the Environment.

Clarkson, B., Fitzgerald, N., Champion, P. D., Forester, L., & Rance, Brian. (2021). *New Zealand wetland plant indicator status ratings 2021* [Data associated with Manaaki Whenua - Landcare Research contract report LC3975 for Hawke's Bay Regional Council. Manaaki Whenua - Landcare Research].

Cosgrove, G., Dodd, M., & James, T. (2022). *National list of exotic pasture species*.

Greater Wellington Regional Council. (2021). *How to determine whether a watercourse is a river, ephemeral watercourse, highly modified river or stream, or artificial watercourse* (Guidance Note). Greater Wellingotn Regional Council.

Hitchmough, R., Barr, B. P., Knox, C., Lettink, M., Monks, J. M., Patterson, G. B., Reardon, J. T., Van Winkel, D., Rolfe, J., & Michel, P. (2021). *Conservation status of New Zealand reptiles, 2021* (New Zealand Threat Classification Series No. 35). Department of Conservation.

Maseyk, F., Ussher, G., Kessels, G., Christensen, M., & Brown, M. (2018). Biodiversity Offsetting under the resource management Act: A guidance document. *Prepared for the Biodiversity Working Group on Behalf of the BioManagers Group*.

MfE. (2022). *Wetland delineation protocols*. Ministry for the Environment.

Neale, M. W., Storey, R., & Quinn, J. L. (2016). *Stream Ecological Valuation: Application to intermittent streams*. Auckland Council.

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

Appendix 1: Vegetation Plot Data

Figure 32. Wetland delineation vegetation Plot locations and labels (#) shown above. Wetlands shown as red - assessed rapid natural inland wetlands, green possible natural inland wetland and white unlikely natural inland wetland, yellow excluded as a natural inland wetland.

Plot Number	Plot 1 (The basin)					
6-letter code	**% Cover**	**Dominant (50/20 rule) Y / N**	**Species Name**	**Common Name**	**Threat Status**	**Wetland Status**
trirep	2	N	*Trifolium repens*	White Clover		FACU
ranrep	5	N	*Ranunculus repens*	Creeping Buttercup		FAC
Hollan	55	Y	*Holcus lanatus*	Yorkshire Fog		FAC
juneff	1	N	*Juncus effusus*	Leafless Rush		FACW
Junsar	1	N	*Juncus sarophorus*	Fan-Flowered Rush	Not Threatened	FACW
Agrsto	25	Y	*Agrostis stolonifera*	Creeping Bent		FACW
Rumobt	1	N	*Rumex obtusifolius*	Broad-leaved Dock		FAC
Calsta	1	N	*Callitriche stagnalis*	Water Starwort		OBL
Mud/bare	10	N				

Number of Dominant Species:	2	**Total Cover:**	101.0
Proportion of Dominant Species that are OBL, FACW, FAC:	2	**Total Cover Points:**	246.0
Dominance Test Score:	**1**	**Prevalence Index Score:**	**2.44**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland**

Plot Number	Plot 2 (The basin)					
6-letter code	**% Cover**	**Dominant (50/20 rule) Y / N**	**Species Name**	**Common Name**	**Threat Status**	**Wetland Status**
Juneff	1	N	*Juncus effusus*	Leafless Rush		FACW
ranrep	1	N	*Ranunculus repens*	Creeping Buttercup		FAC
Trirep	10	N	*Trifolium repens*	White Clover		FACU
Calsta	1	N	*Callitriche stagnalis*	Water Starwort		OBL
Agrsto	30	Y	*Agrostis stolonifera*	Creeping Bent		FACW
Mud	2	N				
taroff	1	N	*Taraxacum officinale*	Dandelion		FACU
Lotped	30	Y	*Lotus pedunculatus*	Lotus		FAC
Hollan	20	Y	*Holcus lanatus*	Yorkshire Fog		FAC
Isopro	1	N	*Isolepis prolifera*	Three Square	Not Threatened	OBL
Hyprad	1	N	*Hypochaeris radicata*	Catsear		FACU

Number of Dominant Species:	3	**Total Cover:**	98.0
Proportion of Dominant Species that are OBL, FACW, FAC:	3	**Total Cover Points:**	265.0
Dominance Test Score:	**1**	**Prevalence Index Score:**	**2.70**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland, But Score is Borderline**

Plot Number	Plot 3 (The basin)					
6-letter code	% Cover	Dominant (50/20 rule) Y / N	Species Name	Common Name	Threat Status	Wetland Status
Hollan	30	Y	*Holcus lanatus*	Yorkshire Fog		FAC
Lotped	5	N	*Lotus pedunculatus*	Lotus		FAC
Ranrep	2	N	*Ranunculus repens*	Creeping Buttercup		FAC
Isopro	2	N	*Isolepis prolifera*	Three Square	Not Threatened	OBL
Agrsto	20	Y	*Agrostis stolonifera*	Creeping Bent		FACW
isocer	5	N	*Isolepis cernua*			OBL
calsta	1	N	*Callitriche stagnalis*	Water Starwort		OBL
myolax	1	N	*Myosotis laxa*	Water Forger-Me-Not		OBL
cenuni	1	N	*Centella uniflora*	Centella		FACW
taroff	1	N	*Taraxacum officinale*	Dandelion		FACU
Mud/water	30	Y				

Number of Dominant Species:	2	**Total Cover:**	98.0
Proportion of Dominant Species that are OBL, FACW, FAC:	2	**Total Cover Points:**	166.0
Dominance Test Score:	**1**	**Prevalence Index Score:**	**1.69**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland**

Plot Number	Plot 4					
6-letter code	% Cover	Dominant (50/20 rule) Y / N	Species Name	Common Name	Threat Status	Wetland Status
Isopro	25	Y	*Isolepis prolifera*	Three Square	Not Threatened	OBL
myolax	1	N	*Myosotis laxa*	Water Forger-Me-Not		OBL
Calsta	2	N	*Callitriche stagnalis*	Water Starwort		OBL
isocer	2	N	*Isolepis cernua*			OBL
Ranrep	2	N	*Ranunculus repens*	Creeping Buttercup		FAC
Juneff	1	N	*Juncus effusus*	Leafless Rush		FACW
Lotped	1	N	*Lotus pedunculatus*	Lotus		FAC
agrsto	35	Y	*Agrostis stolonifera*	Creeping Bent		FACW
Hollan	10	N	*Holcus lanatus*	Yorkshire Fog		FAC

Number of Dominant Species:	2	**Total Cover:**	79.0
Proportion of Dominant Species that are OBL, FACW, FAC:	2	**Total Cover Points:**	141.0
Dominance Test Score:	**1**	**Prevalence Index Score:**	**1.78**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland**

Plot Number	Plot 5

6-letter code	% Cover	Dominant (50/20 rule) Y / N	Species Name	Common Name	Threat Status	Wetland Status
Hollan	20	N	*Holcus lanatus*	Yorkshire Fog		FAC
lolper	70	Y	*Lolium perenne*	Perennial Rye Grass		FACU
trirep	2	N	*Trifolium repens*	White Clover		FACU
juneff	1	N	*Juncus effusus*	Leafless Rush		FACW
lotped	1	N	*Lotus pedunculatus*	Lotus		FAC
plalan	1	N	*Plantago lanceolata*	Narrow-leaved Plantain		FACU
Ranrep	1	N	*Ranunculus repens*	Creeping Buttercup		FAC
Rumobt	1	N	*Rumex obtusifolius*	Broad-leaved Dock		FAC

Number of Dominant Species:	1	**Total Cover:**	97.0
Proportion of Dominant Species that are OBL, FACW, FAC:	0	**Total Cover Points:**	363.0
Dominance Test Score:	**0**	**Prevalence Index Score:**	**3.74**
Dominance Test Result:	**Not Wetland**	**Prevalence Index Result:**	**Not Wetland**

Plot Number	Plot 6					
6-letter code	**% Cover**	**Dominant (50/20 rule) Y / N**	**Species Name**	**Common Name**	**Threat Status**	**Wetland Status**
Isopro	20	Y	*Isolepis prolifera*	Three Square	Not Threatened	OBL
myolax	1	N	*Myosotis laxa*	Water Forger-Me-Not		OBL
Calsta	2	N	*Callitriche stagnalis*	Water Starwort		OBL
isocer	5	N	*Isolepis cernua*			OBL
Ranrep	1	N	*Ranunculus repens*	Creeping Buttercup		FAC
Juneff	1	N	*Juncus effusus*	Leafless Rush		FACW
Lotped	1	N	*Lotus pedunculatus*	Lotus		FAC
agrsto	40	Y	*Agrostis stolonifera*	Creeping Bent		FACW
Hollan	10	N	*Holcus lanatus*	Yorkshire Fog		FAC

Number of Dominant Species:	2	**Total Cover:**	81.0
Proportion of Dominant Species that are OBL, FACW, FAC:	2	**Total Cover Points:**	146.0
Dominance Test Score:	**1**	**Prevalence Index Score:**	**1.80**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland**

Plot Number	Plot 7					
6-letter code	**% Cover**	**Dominant (50/20 rule) Y / N**	**Species Name**	**Common Name**	**Threat Status**	**Wetland Status**
isopro	20	Y	*Isolepis prolifera*	Three Square	Not Threatened	OBL
ranrep	1	N	*Ranunculus repens*	Creeping Buttercup		FAC
hollan	20	Y	*Holcus lanatus*	Yorkshire Fog		FAC

isocer	30	Y	*Isolepis cernua*			OBL
Myolax	1	N	*Myosotis laxa*	Water Forger-Me-Not		OBL
lotped	1	N	*Lotus pedunculatus*	Lotus		FAC
Mud/Water	25	Y				
calsta	1	N	*Callitriche stagnalis*	Water Starwort		OBL
junpla	1	N	*Juncus planifolius*	Grass-leaved Rush	Not Threatened	FACW

Number of Dominant Species:	4	**Total Cover:**	100.0
Proportion of Dominant Species that are OBL, FACW, FAC:	3	**Total Cover Points:**	120.0
Dominance Test Score:	**0.75**	**Prevalence Index Score:**	**1.20**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland**

Plot Number	Plot 8					
6-letter code	**% Cover**	**Dominant (50/20 rule) Y / N**	**Species Name**	**Common Name**	**Threat Status**	**Wetland Status**
Hollan	65	Y	*Holcus lanatus*	Yorkshire Fog		FAC
lotped	2	N	*Lotus pedunculatus*	Lotus		FAC
taroff	5	N	*Taraxacum officinale*	Dandelion		FACU
isocer	2	N	*Isolepis cernua*			OBL
ranrep	2	N	*Ranunculus repens*	Creeping Buttercup		FAC
junpla	1	N	*Juncus planifolius*	Grass-leaved Rush	Not Threatened	FACW
isopro	1	N	*Isolepis prolifera*	Three Square	Not Threatened	OBL
mud	25	Y				
Trirep	1	N	*Trifolium repens*	White Clover		FACU

Number of Dominant Species:	2	**Total Cover:**	104.0
Proportion of Dominant Species that are OBL, FACW, FAC:	1	**Total Cover Points:**	236.0
Dominance Test Score:	**0.5**	**Prevalence Index Score:**	**2.27**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland**

Plot Number	Plot 9					
6-letter code	**% Cover**	**Dominant (50/20 rule) Y / N**	**Species Name**	**Common Name**	**Threat Status**	**Wetland Status**
Isopro	60	y	*Isolepis prolifera*	Three Square	Not Threatened	OBL
myolax	5		*Myosotis laxa*	Water Forger-Me-Not		OBL
Calsta	1		*Callitriche stagnalis*	Water Starwort		OBL
isocer	2		*Isolepis cernua*			OBL
Ranrep	2		*Ranunculus repens*	Creeping Buttercup		FAC
Juneff	5		*Juncus effusus*	Leafless Rush		FACW

Lotped	3		*Lotus pedunculatus*	Lotus		FAC
nasoff	7		*Nasturtium officinale*	Watercress		OBL
Hollan	15		*Holcus lanatus*	Yorkshire Fog		FAC

Number of Dominant Species:	1	**Total Cover:**	100.0
Proportion of Dominant Species that are OBL, FACW, FAC:	1	**Total Cover Points:**	145.0
Dominance Test Score:	**1**	**Prevalence Index Score:**	**1.45**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland**

Plot Number	Plot 10					
6-letter code	**% Cover**	**Dominant (50/20 rule) Y / N**	**Species Name**	**Common Name**	**Threat Status**	**Wetland Status**
Juneff	5	N	*Juncus effusus*	Leafless Rush		FACW
Hollan	95	Y	*Holcus lanatus*	Yorkshire Fog		FAC
Ranrep	1	N	*Ranunculus repens*	Creeping Buttercup		FAC
Lotped	1	N	*Lotus pedunculatus*	Lotus		FAC
Trirep	1	N	*Trifolium repens*	White Clover		FACU

Number of Dominant Species:	1	**Total Cover:**	103.0
Proportion of Dominant Species that are OBL, FACW, FAC:	1	**Total Cover Points:**	305.0
Dominance Test Score:	**1**	**Prevalence Index Score:**	**2.96**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland, But Score is Borderline**

Plot Number	Plot 11					
6-letter code	**% Cover**	**Dominant (50/20 rule) Y / N**	**Species Name**	**Common Name**	**Threat Status**	**Wetland Status**
Isopro	20	Y	*Isolepis prolifera*	Three Square	Not Threatened	OBL
nasoff	7	N	*Nasturtium officinale*	Watercress		OBL
Hollan	40	Y	*Holcus lanatus*	Yorkshire Fog		FAC
lotped	2	N	*Lotus pedunculatus*	Lotus		FAC
isocer	1	N	*Isolepis cernua*			OBL
calsta	1	N	*Callitriche stagnalis*	Water Starwort		OBL
ranrep	1	N	*Ranunculus repens*	Creeping Buttercup		FAC
Mud	30	Y				

Number of Dominant Species:	2	**Total Cover:**	102.0

Proportion of Dominant Species that are OBL, FACW, FAC:	2	**Total Cover Points:**	158.0
Dominance Test Score:	**1**	**Prevalence Index Score:**	**1.55**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland**

Plot Number	Plot 12					
6-letter code	**% Cover**	**Dominant (50/20 rule) Y / N**	**Species Name**	**Common Name**	**Threat Status**	**Wetland Status**
Hollan	50	y	*Holcus lanatus*	Yorkshire Fog		FAC
ranrep	10		*Ranunculus repens*	Creeping Buttercup		FAC
isopro	20	y	*Isolepis prolifera*	Three Square	Not Threatened	OBL
juneff	10		*Juncus effusus*	Leafless Rush		FACW

Number of Dominant Species:	2	**Total Cover:**	90.0
Proportion of Dominant Species that are OBL, FACW, FAC:	2	**Total Cover Points:**	220.0
Dominance Test Score:	**1**	**Prevalence Index Score:**	**2.44**
Dominance Test Result:	**Wetland**	**Prevalence Index Result:**	**Wetland**

Appendix 2: Biodiversity offset model check

The offset model requires a level of impact data. That data comes from the site survey information including the mapped areas of natural wetland to be affected by the earthworks and development and from the 12 vegetation plot data collected and the walking species transects. The wetland function (in this case as a sponge and as a filter affecting the downstream catchment) is an estimate based on the condition and species present in the gullies. I separate out the functions of the areas to be inundated.

	This section captures which elements of biodiversity, and over what area, will be impacted by the proposal					This section is where the change in measure of each Biodiversity Attribute due to the proposed Impact is quantified, and Attribute Biodiversity Value calculated. Inputs are derived from direct measures, existing data or models where available, or expert estimated predictions			
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
2.1	vegetation	2.1a	area	ha	1.53	50	0.61	0	-0.02
		2.1b	indigenous species richness	number	1.53	80	2	0	-0.04
		2.1c	function chanels	percentage	0.5	100	10	0	-0.05
		2.1d	function / ponds	percentage	0.5	100	10	20	0.05
		2.1e	species richness	number	1.53	100	10	0	-0.15

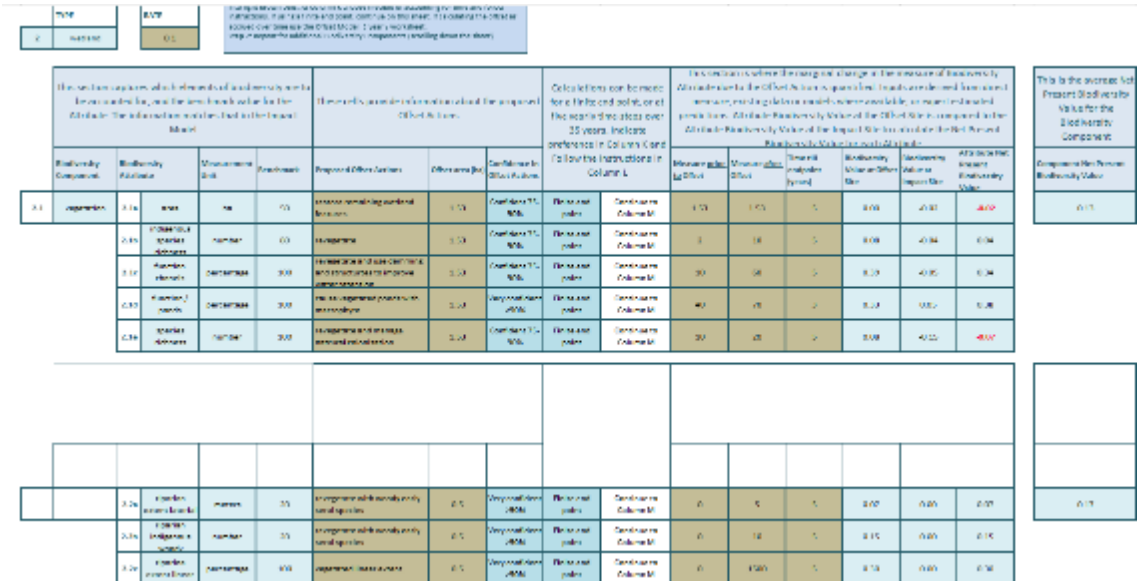
	This section captures which elements of biodiversity, and over what area, will be impacted by the proposal					This section is where the change in measure of each Biodiversity Attribute due to the proposed Impact is quantified, and Attribute Biodiversity Value calculated. Inputs are derived from direct measures, existing data or models where available, or expert estimated predictions			
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
2.2		2.2a	riparian extent lateral	meters	1.53	20	0	0	0.00
		2.2b	riparian indigenous woody species	number	1.53	20	0	0	0.00
		2.2c	riparina extent linear	percentage	1.53	100	0	0	0.00

For the benchmark I use the wetland area of the Taupo swamp catchment, the species richness from publications of wetlands in the Taupo swamp and in three lateral (and similar wetlands) published in Bagnell & Ogle (1981) and in Ogle (1978) and our own botanic records for riparian zones. The functions are assumed 100% because the benchmark is supposed to be a pristine example and therefore must be fully functional. The lateral extent of the riparian benchmark would be continuous, but I arbitrarily chose 20m.

I then engage with the offset component. I have proposed a 10 species revegetation plan in the gullies and a similar species number in the stormwater lakes. The impact model does not have any adverse effect to riparian buffers because there are none, but the offset includes the creation of a 5m wide woody indigenous riparian margin to 50% of the wetland gullies and stormwater lakes (the northern sides). This has biological diversity and functional gains to the wetland and lake features and so must be included in the benefits model.

With a 1.5ha gully restoration and creation of wetland retention lakes all with at least 50% riparian woody buffers to 5m widths, the biological diversity offset gain is considerable (0.17) and

proves the case for the 1:1 ECR. The positive modelled outcome represents a significant gain (where a zero outcome is a no net loss).



This model was run with a small discount factor (0.1) as it is believed the current condition and low value of the wetlands affected and the likely lack in an appreciable lag time to recover / restore better than current wetland value warrant only a 1% discount.

Conclusion

A net gain can be achieved for wetland impacts to 1.53 ha on the property through remediation of 0.9 ha (retention wetlands) and the offset of 1.5 ha of poor-quality low value linear wetlands on the farm by the restoration of 1.5 ha of remaining on site gully wetland with the inclusion of a 5m woody native riparian buffer.

Appendix 3: Fish Management Plan

Introduction

This Fish Management Plan (FMP) has been prepared for Pukerua Property Group LP for their Mt Welcome development which currently includes streams in farmland and an area of Taupo Stream for a new roundabout. The primary focus of this plan is to minimise the potential effects on native fish prior to and during removal of their potential habitats as part of the proposed development. The project area includes two areas of perennial and intermittent stream to be converted into small lakes/wetlands and 110m of culverting required for a roundabout addition to SH 59 in Taupo stream.

The majority of the gullies and water systems on the site are dry wetlands and do not have fish habitat. Those areas which do have intermittent or perennial flows are often isolated by a chain of fish barriers and challenging habitat conditions related to long term historic stock access and minimal aquatic permanent stable habitat.

To date fish studies, suggest very few if any fish are present in the waterways required to be affected. eDNA has indicated very weak signals for long fin eel (At Risk Declining) and banded kokopu in the northwestern tributary. The Southern tributary has several barriers to passage from the Taupo Stream and no eDNA signal or night spotted fish. The upper Taupo Stream has a considerable fish barrier under the public walk track and insufficient water to hold refugia long term for fish persistence in the absence of juvenile access. No fish are expected there.

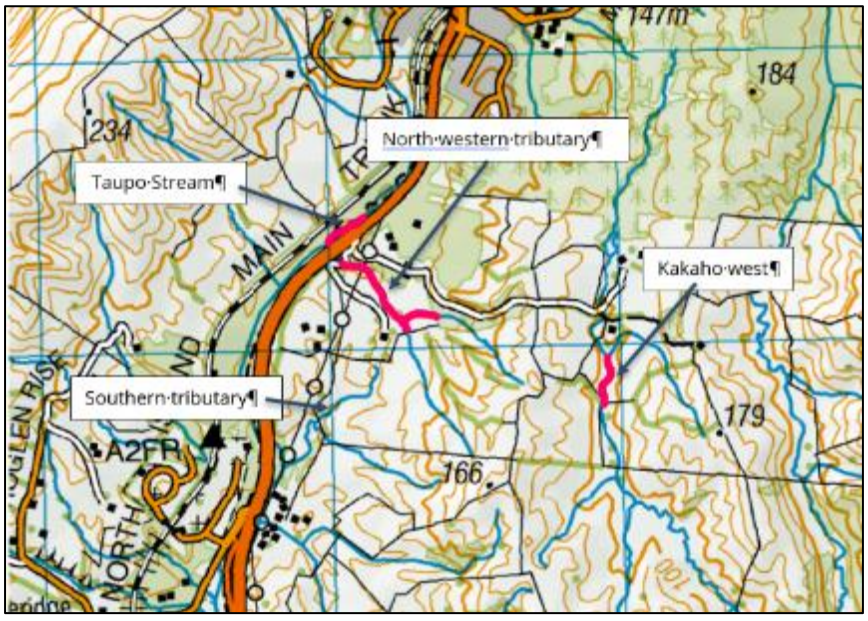


Figure 33. Areas in perennial and intermittent waterways that are impacted and will require fish salvage processes.

Only the Kakaho West mainstem offers reasonable habitat for stable fish populations. Studies downstream suggest banded kokopu, long fin eel, short fin eel and common and red fin bully are likely present.

Fish Rescue Requirements

Around 100m of the Kakaho West main stem will be required to involve fish rescue. The northwestern tributary will require 350m of salvage and the Taupo Stream will require around 120m of salvage.

These are not long or extensive rescues.

How

Screening out of Fish from the Work Areas.

Each area to be de-fished (salvaged) will require exclusion although in most cases there are also ready downstream barriers.

That as it may be in the Taupo stream, the lower extent of the waterway should receive a fence gate style screen with a 5mm mesh cable tied on to the face and the "fence" inserted in grooves either side of the bank and slightly buried into the bed. Such gate arrangements are more resilient to rain events and persist well. A similar fence should be installed 10m up stream of the extent of the culvert installation works.

The same approach will be required in the Kakaho west main stem as well; however, the lower existing culvert orifice can be used to attach the screening device. Upstream some 20m of the extent of the new retention wetland should also be gate screened set into the bank and bed.

These screens prevent ingress of fish into the site of works during the work.

In the north-western tributary we recommend placing the downstream screen across the lower SH59 culvert and attaching here meaning all of the above tributary can be cleared of fish. An upper screen is not required as the intermittent system gives way to non-fish wetland gully habitat (grasses).

De Fishing

The Taupo stream is a 1-2m wide, 100mm deep, 70% riffle with a velocity profile of 0.2-0.3mls. It has few pools and no complex bank habitat or cover items in stream. It is a gravel riffle system in the main and EFM (Electric fishing Machine) fish extraction will be relatively straight forward and very effective. The riffles and runs are too shallow for trapping, and the 4 -5 pools are small at 1m by 2m and 200-300mm deep.

The northwestern tributary is complex in that the majority is <200mm wide and variably shallow but typically <100mm deep. The velocity is typically <0.1m/s and is a long series of broken runs and small deeper run/pools in a pugged bed. There is typically insufficient wetted width or depth to place any form of net trap and insufficient bed access and flow to allow EFM methods. Survey (spotlight and eDNA) strongly suggest no or very few fish are present. There is one larger pool near the confluence between perennial and intermittent flow which has some potential to accommodate fyke nets. It is recommended that as many baited fykes nets as can be arranged will be used to capture fish in this location. Otherwise, this system can only be managed by nighttime spot lighting and hand catching using pre baited areas (i.e. tethered meats as bait) to attract any eel.

At the time of in stream works the final approach is what has become termed a 'muck out'. Here a machine is used to scrap out the top 300-400mm of the muds and waters of the channel and then lay that material aside on a grass surface for the experienced fish expert to view and sort through and rescue any fish.

Fish Handling

Fish handling will be in accordance with Section 3.9 of the New Zealand Freshwater Fish Sampling Protocols (Joy et al. 2013). All native fish captured will be relocated on the day of capture to within 1 hour of capture to suitable habitat.

Rescued fish are to be stored in a lidded 10L bucket which has been half filled with the stream water. Given the species and the minimal time to be spent we have found that even large numbers of fish in such circumstances do not require an oxygen bubbler or a water conditioner (such as API Stress coat). Large eel must be stored separately from all other fish, and an eel bag can be used for each very large specimen (in such cases the bag and ell can be left in the stream while further rescue is undertaken. The buckets are kept in the shade in cool conditions, and the captured fish should be released within an hour of capture.

Relocation (Site of Transfer)

The release involves placing the fish into a suitable nearby and preferably connected waterway with suitable cover and quality. While upstream and the same catchment is preferred, this does depend on suitability of habitat, water quality, likely future disturbance and carrying capacity (in the opinion of the experienced ecologist).

The Taupo stream and north-western fish rescued will be released into the lower Taupo Stream (below the perched public track culvert. The release is best into a large pool, or a reasonable volume run with good depth. The issue here is that while this is the best habitat with the greatest carrying capacity return to the sites will be problematic while the public track culvert barrier remains as it is. That said those fish will be potentially able to return to the site through the lower southwestern system or that the same number of fish as relocated could be reintroduced into the new on site habitat after the wetland retention areas have settled. For the western Kakaho rescue there is good habitat either just upstream or downstream and with no passage barrier issues below the artificial lake currently in the system upstream.

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

Dr Vaughan Keesing (BlueGreen Ecology) and Mr Tim Currie (Boffa Miskell Ltd)

All ecologists listed have conducted multiple successful freshwater fish relocations and have electric fishing licences and have extensive experience in freshwater fish handling and ecology.

Measure of Completion: When to Stop

The extent or time of salvage (i.e. and EFM set of runs and / or a night of baited trapping followed by a set of EFM runs or spot lighting) is governed by the numbers and species caught.

The capture process, once begun, continues repeatedly until no threatened or At Risk taxa are captured and where the capture rate for other species has declined to less than 10% of the average number of the first two capture runs. I use an average of the first wo runs (and not just

the first run) because the second run is often more productive of smaller fish than the first which often removes the larger, dominant fish.

The muck out process is simply a once through as the machine methodically lifts the muddy stream wetland.

Timing of Works

The initial works required by the FMP will be undertaken no more than one week prior to any stream works commencing within the specified area, or if works outside of watercourses results in the reduction of stream flows. Ongoing maintenance of the temporary fish barriers will be undertaken until stream works are complete within the area.

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.

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).

Reporting and Permits

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 Porirua City Council and Department of Conservation will 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.

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.

Appendix 4: Lizard Management Plan

Appendix 5: Terrestrial Offset, SNA buffer, Connectivity and Lizard Transfer Revegetation Plan

Introduction

In undertaking subdivision and housing developments at Mt Welcome Station (currently a farm) an offset for the removal of indigenous vegetation (especially areas of SNA 027) is required an at least of 4200m2, in addition there is a requirement under the northern growth development plan to cause 5m revegetation buffers to any adjacent SNA and to enhance connectivity to other SNA through increased indigenous vegetation in those identified corridors in the NGA structure plan. In addition to assist potential lizard transfers the offset area is to also enable a suitable lizard transfer area. Both the offset and PDP requirements need a planting / / habitat plan.

While the PDP stipulates a 5m band of vegetation as a buffer to an SNA, where it is contiguous with the SNA vegetation, it does not require a certain area for the corridor enhancement. The required offset however, for indigenous vegetation removal does require at least 4200m2 to be revegetated.

APP17 of the PDP requires of this plan the following:

1. The location and species composition identified in the Planting Plan is to achieve the following:
    a. Provide necessary protection and restoration of the Significant Natural Area(s) to ensure its long-term viability, health, and significance;
    b. Facilitate the use of natural regeneration processes to ensure that in the long term these natural regeneration processes take over;
    c. Provide for the protection and restoration of the planted site and provide robust linkages between ecological features; and
    d. Provide a sustainable, potentially significant forest, wetland or shrubland.
2. A planting plan for any revegetation planting must identify the following:
    a. The purpose of the planting;
    b. The ecological district of the site;
    c. The characteristics of the soil (i.e. clay, silt, loam etc.);
    d. Soil drainage;
    e. Topography and slope of the area to be planted;
    f. Location and extent of the area to be planted;
    g. Whether part or all of the site is subject to flooding or high water-tables (some species are intolerant of wet soils);
    h. Exposure of the site to wind, frost, drought, and salt spray;
    i. Aspect of the site relative to the sun;
    j. Which parts of the site might be shaded (to inform decisions about whether to use shade-tolerant or sun loving species);

k. Presence of pest plants and animals;

l. Presence of any threatened species and if necessary, the process for the translocation of threatened species;

m. Stock-proof fencing that should be at least a full seven wire, post and batten fence, planting areas, weed and animal pest control;

n. Extent and species composition of the existing Significant Natural Area and any other indigenous vegetation and habitats on the land subject to subdivision;

o. Distance to any other Significant Natural Area and any other indigenous vegetation and habitats;

p. Site preparation for planting, including stock-proof fencing of areas, weed and animal pest control;

q. Any restrictions on planting, such as existing infrastructure, safety or existing access issues;

r. How revegetation planting will be ecologically linked to an area of contiguous Significant Natural Area(s), any other indigenous vegetation and habitats, and if possible any other additional existing ecological corridors or connections;

s. How revegetation planting will provide robust and high value ecological connections without gaps to the Significant Natural Area(s);

t. How revegetation planting will buffer the Significant Natural Area(s) and ensure long term viability and resilience of the Significant Natural Area(s);

u. Site planting, including species to be planted, sourcing of the plants, size[1] and spacing of plants, and where they are to be planted, requirements for replacement of pest plants with appropriate indigenous species and measures to minimise reinvasion of pest plants;

v. Timing of planting.[2];

w. Density of planting;

x. The source of the plants and the appropriateness for the soil, aspect, exposure and topography;

y. How the planting will reflect the composition of former indigenous vegetation likely to have occupied the site and inclusion of appropriate indigenous species that will enable the natural processes of succession;

z. Measures for the maintenance of planting, including releasing plants, fertiliser[3], plant and animal pest control and mulching[4] and replacement of plants which do not survive, and measures for animal and plant pest control;

aa. Protective measures proposed to ensure the Significant Natural Area(s), any other indigenous vegetation and habitats, and any proposed revegetation planting remain protected in perpetuity;

bbb. Details confirming that revegetation planting is only to be carried out contiguous to the Significant Natural Area(s); and

ccc. Confirmation that the assessment of whether the maintenance of plantings has been achieved shall be undertaken by a suitably qualified independent ecologist according to a quantitative monitoring programme.

This report

Provides the information required by APP17 planting plan such that both the effects offset of the application as well as the PDP required SNA buffer and enhanced connectivity are achieved. While it is a planting plan first and foremost it also considers enabling natural seral processes which will see seed spread and germination and long term progression of a natural regeneration process. While the Ca 5,550m2 of the northern Offset (and buffer) is marginal in size to be a lasting self-managing forest feature, however, it is not a fragment alone but adds to the existing and adjacent 6 ha SNA (029) to which it adds increased resilience and connectivity.

The additional general 5m buffer required by the PDP is problematic in that the buffer is supposed to be a continuation of the SNA vegetation, but the SNA vegetation does not in all cases meet the property boundary. We have indicated (Figure 34) an extent of 450m along the eastern edge where such a buffer will generally be part of the SNA. This adds a further 2250m2 of indigenous revegetation to the SNA. In total a further 12% of area of SNA 029 is added.

Figure 34. Red is SNA 029 5m buffer planting. Blue is wetland restoration assistance; Yellow is buffer and ecological offset revegetation.

General attributes and conditions of the site (as per APP17(2a-z)

AP17 Factor	North corridor	SNA general boundary
The ecological district of the site;	Wellington ED near Foxton ED and may better be represented by Foxton ED	Wellington ED near Foxton ED and may better be represented by Foxton ED
The characteristics of the soil (i.e. clay, silt, loam etc.);	Brown Soils (sandy brown) Clay minerals which are dominantly mica/illite and vermiculite, with allophane in Allophanic.	Brown Soils (sandy brown) Clay minerals which are dominantly mica/illite and vermiculite, with allophane in Allophanic.
Soil drainage;	Imperfectly drained	Imperfectly drained
Topography and slope of the area to be planted;	Gentle eastward facing slopes	A mix of steep gully and face southern and eastern aspects
Location and extent of the area to be planted;	See map	See map
Whether part or all of the site is subject to flooding or high water-tables (some species are intolerant of wet soils);	No flood risk	Gully bases have rain fall associated surface flooding, else low flooding risk
Exposure of the site to wind, frost, drought, and salt spray;	Low exposure given distance from coast and interceding hills and tall forest SNA	Low exposure given distance from coast and interceding hills and tall forest SNA, some frost risk in gullies.
Aspect of the site relative to the sun;	East and north-east -good sun	East and south east with some north faces, low sun
Which parts of the site might be shaded (to inform decisions about whether to use shade-tolerant or sun loving species);	None	South faces of gullies
Presence of pest plants and animals;	Low current presence, pasture, some gorse, rabbits hares and possum - also hedgehogs (re lizards)	Low presence, pasture, rabbits and hares and possums
Presence of any threatened species and if necessary, the process for the translocation of threatened species;	None -rough pasture	None -pasture
Stock-proof fencing that should be at least a full seven wire, post and batten fence, planting areas, weed and animal pest control;	Three sides already with fencing, east side will require fencing	West side completely fenced
Extent and species composition of the existing Significant Natural Area and any other indigenous vegetation and habitats on the land subject to subdivision;	SNA a kohekohe dominant tall forest with tawa and common mix of edge and under canopy broadleaves and divaricate coprosma.	SNA a kohekohe dominant tall forest with tawa and common mix of edge and under canopy broadleaves and divaricate coprosma.

AP17 Factor	North corridor	SNA general boundary
Distance to any other Significant Natural Area and any other indigenous vegetation and habitats;	SNA immediately to the west (SNA225)and within 500m to the north and east (SNA1010). SNA027 200m west.	SNA immediately to the west (SNA225)and within 500m to the north and east (SNA1010). SNA027 400m west.
Site preparation for planting, including stock-proof fencing of areas, weed and animal pest control;	See details below	See details below
Any restrictions on planting, such as existing infrastructure, safety or existing access issues;	None	Several existing house and house lots along the southwestern boundary.
How revegetation planting will be ecologically linked to an area of contiguous Significant Natural Area(s), any other indigenous vegetation and habitats, and if possible any other additional existing ecological corridors or connections;	See map (fig 1)	See Map (fig 1)
How revegetation planting will provide robust and high value ecological connections without gaps to the Significant Natural Area(s);	Attainment of full cover of seral broadleaf indigenous vegetation with later canopy species throughout further joins SNA029-225	Attain an 80% cover of hardy edge broadleaf buffering vegetation in a 5m wide band where it is contiguous with the SNA vegetation
How revegetation planting will buffer the Significant Natural Area(s) and ensure long term viability and resilience of the Significant Natural Area(s);	Buffers (or adds to the exotic shelter buffer) of the northern edge of SNA 029	Buffers much of the eastern edge of SNA 029
Site planting, including species to be planted, sourcing of the plants, size[1] and spacing of plants, and where they are to be planted, requirements for replacement of pest plants with appropriate indigenous species and measures to minimise reinvasion of pest plants;	See table below	See table below
Timing of planting.[2];	In the absence of irrigation suggested is from April-start of October -see details below	In the absence of irrigation suggested is from April-start of October -see details below
Density of planting;	1 at least 1L size plant per meter square	1 at least 1L size plant per meter square
The source of the plants and the appropriateness for the soil, aspect, exposure and topography;	Plants are to be Eco sourced to the Wellington ED, but the site is near the boundary with Foxton ED and either ED as a source is acceptable.	Plants are to be Eco sourced to the Wellington ED, but the site is near the boundary with Foxton ED and either ED as a source is acceptable

Site Preparation

Soil Preparation

Successful plant growth is dependent on:

- a suitable growing medium (soil),
- nutrients,
- sunlight, and
- water.

Of these, water and sunlight levels are largely a result of climate – mitigated by controlling what time of year seedlings are planted. Soil properties and nutrient levels can be manipulated to encourage establishment of desired vegetation.

The physical element of soil that is manipulated relates to compaction. Highly compacted soil strongly inhibits root growth, especially the deeper root growth of taller woody species. Increasing the porosity of the soil allows more space for water to be stored, roots to grow and a greater surface area for nutrient exchange to occur. Therefore, the upper northern slopes of the offset area should prior to planting be reworked (disked, tilled or ripped) by a suitable machine to uncompact the soil. This process also disturbs (opens) the pasture rooting and better enables seed rain (native seeds) from the adjacent SNA to be able to geminate in and develop through the pasture.

Salvaged logs and branches of larger sizes will also be laid throughout the planting area as will small rock piles to increase physical diversity and texture of the environment.

The current vegetative cover is predominantly exotic grass species, which is an indication that the soil is not lacking in nutrients, nevertheless a fertiliser tablet is to be added at the base the hole dug for the planting of woody species. This fertiliser tablet is to be dug 40cm under the soil surface, with a light layer of soil between this and the root ball of the plant (direct contact will burn the plant).

An object of restoration is not only to restore indigenous vegetation species, but the functions of a working ecosystem. Nutrient cycles are one of these functions, which are predominantly driven through the decomposition of organic material at a site. Therefore, a thick layer of mulch (minimum depth of 20cm) should be placed within the planted areas (where slope allows it). Mulch has several benefits in a planting area, firstly it provides a large amount of organic material, providing food for important soil insects and bacteria, it also covers bare soil lessoning the establishment of weeds, it also holds in moisture lessoning the loss of plants in a dry period, and it can utilise on site woody material saving on cost.

The species selected are species which are naturally found in this hill country as referred by the SNA examples nearby. They are species suited to the soil and the local climate and the successional stage with the addition of the potential final canopy species in smaller abundance. While some restoration efforts do not plant immediately this final canopy set of species but

await the early seral cover to grow, we have found that this just sets back the time to get the final canopy established.

This, along with eco-sourcing of the plants, not only recreates a representative ecosystem, but increases the success of planting establishment.

In addition to the mulch each plant will receive a stake and a combe guard, in the main to assist the maintenance program in identifying the plant for weed release, but also as added herbivore protection, wind protection and to enable monitoring of the success of the planted material.

Salvage of Organic Material

The salvage and relocation of habitat or native vegetation destroyed through construction works should be carried out where practicable. This includes logs, root balls, and woody vegetation (including large branches).

Availability of Plant Material

Plant propagation material shall be sourced from as close to the planting site as possible. We emphasis the requirement for the material to be eco-sourced and the material to have records that allow verifiable seed stock (i.e. collection certification and propagation documentation). This increases the ecological values of the site in keeping true to the local population genetics and increases the establishment success of the plantings, as they are more adapted to local conditions.

Plant material for mitigation and general revegetation is required to be eco-sourced from native populations within the wider Wellington or Foxton Ecological Districts.

The collection, storage and propagation of plant material will require specialist skills and local knowledge about locations of species, timing and methods. Seed storage, propagation and growing-on will need to be done off-site in nurseries. Plants may not be available in the numbers and species required for reasons such as seed not being ripe, available or present.

Timing of Planting with Construction Works and Planting Season

Planting in Wellington is generally successful through autumn and winter into early spring as frosts are typically not severe this near the coast and rainfall is frequent. We recommend between April and mid-October.

Where nurseries do not have the stock required then procurement of stock will require a lead-in time. This can be as much as 18 months to obtain seed and propagate plants to meet required grades for planting. Some eco-sourced stock may be available from specialised nurseries that already have seed or plants in stock, but it is unlikely that all the species will be available or in the quantities required.

Plant Condition

All plant material shall be well hardened off and acclimatised to the proposed site conditions prior to delivery to site. Plants shall be free from pests and diseases, materially undamaged, healthy and vigorous.

All plants shall be true to botanical name and grade as specified in the plant schedule. All plants shall be of the size stated and supplied in the container size as specified.

Pre-Planting Pruning

Immediately prior to delivery, all shrubs shall be pruned by skilled staff as necessary to conform to the best horticultural practice appropriate to the type of plant. If removal of excess top foliage is required, the excess material shall be in proportion to the overall plant growth and rootball size, with generally only half or the top third material being removed.

Pruning shall remove all damaged twigs and branches and shall compensate for any loss of roots during planting operations. Pruning shall be carried out without any bruising or tearing of the bark. Operations are to be carried out using sharp clean implements to give a clean sloping cut with one flat face. Ragged edges of bark or wood are to be trimmed with a sharp knife.

Plant Guards

All woody species shall be planted with a combi-guard cell (see Appendix 4). Combi-guards allow smaller grades to be planted with a higher survival rate. Thus, allowing a dense canopy to form quickly, suppressing weed species. Establishment and survival rates are increased by using combi-guards by acting as a mulch mat, preventing browse from rabbits and hares, preventing spray damage, frost damage and the sleeve which the plant sits within also creates a humid environment conducive to plant growth.

Drought Conditions

Should the area undergo a period of drought in the summer season following planting, it is likely to result in death of some plant species.

- The Installer shall be responsible for providing a suitable water supply for watering plants (or water carts if necessary).
- Notwithstanding any prevailing restrictions by the local authority on the use of water for watering any plants, the Installer shall be deemed totally responsible for making any special arrangements which may be necessary to ensure adequate watering of plants for successful establishment.
- The Installer shall bring to the site sufficient water carts, hoses and sprinklers to provide an adequate water supply to the plants at the time of planting.
- In the event of drought conditions, the Installer shall notify the site manager. If water supply is likely to be restricted, the Installer shall inform the site manager without delay and ascertain availability and cost of second class water from other approved sources.
- The Installer shall be responsible for watering all plants as required to ensure their survival over periods of dry weather. In addition to the Defects Liability requirement to ensure the plants survive and grown, the Installer shall undertake additional watering as necessary.
- Watering should not be undertaken during the hot part of the day. Watering nozzles shall be fine rose or sprinkler heads to prevent damage to plants or topsoil scouring around roots.

Workmanship

All materials and construction shall be to a high standard, and workmanship shall be that of appropriately qualified tradespeople performing all labours in the best trade practice.

Plant material, numbers and Setting Out

Site Responsive Approach

A suitably qualified and experienced ecologist must be on site during the set out of plants to ensure the location of plants within a general planted area follow the best hydrological, soil and topographical locations for species. This may include adjustments for localised soil or moisture conditions within a specified treatment mix or where existing soil is present. The overall objective is to plant in a manner and in places where plants will have the best chance of survival and healthy growth. This will be particularly relevant for planting into areas of salvaged material at the base of slopes where soil depths may vary.

The following table (Table 7) shows the species and their proportional mix to be used in both the Offset area and the SNA buffer area. This proportion will then allow total species number required to be calculated based on the actual areas to be planted. We note that the ecological offset must sum to at least 4,200m^2 but figure 1 shows the area to planted is around 5,550 with the buffer edge of the northern edge incorporated into this area as well as improvement to the corner wetland. The SNA buffer from thereon will be in the order of 2,250m^2 but that will depend on accurate survey (which as yet has not occurred). The final actual areas are not overly important and final numbers can be determined based on the proportional abundances dittoed by Table 7.

Based on an area of 7800m^2 at an average of 1 plant per meter square 8,938 plants will be required.

Table 7. Species to be plants, plant spacing, and the area of each to be planted of a vegetation community type.

Species	Spacing (m)	Species Proportion of plants to be planted		
		Offset area	Wetland in offset	SNA buffer
Alectryon excelsus	1	5		
Beilschmiedia tawa	1	2.5		
Brachyglottis repanda	1	2.5		
Carex lessoniana	0.5		30	
Carex secta	0.5		30	
Carex virgata	0.5		30	
Cyperus ustulatus	1		10	
Coprosma areolata	1	2.5		
Coprosma grandifolia	1	2.5		
Coprosma lucida	1	5		20
Coprosma rhamnoides	1	2.5		10
Coprosma robusta	1	5		
Cordyline australis	2	1		
Dysoxylum spectabile	1	5		

Species	Spacing (m)	Species Proportion of plants to be planted		
		Offset area	Wetland in offset	SNA buffer
Elaeocarpus dentatus	2	3		
Griselinia lucida	1	2.5		10
Knightia excelsa	2	5		
Kunzea ericoides	0.75	5		
Melicope ternata	1	10		20
Myoporum laetum	1	5		
Myrsine australis	1	5		10
Olearia paniculata	1	10		10
Pennantia corymbosa	1	1		
Pittosporum tenuifolium	1	5		
Pseudopanax arboreus	1	10		20
Sophora microphylla	1	5		

Planting Generally

All planting shall be performed by experienced workers in accordance with recognised good horticultural practice and under the supervision of a skilled site manager.

All plants shall be placed with the main stem vertical and at such a depth that the soil, when firmed down is at the same height as the earth marks on the stem from the soil level of the container. Loose roots shall be spread out in a natural fashion; the soil being carefully placed under and amongst them to fill all voids and firmed in.

The bottom of each hole shall be pierced to a depth of 200mm with the tines of a fork or similar implement to ensure compactions are loosened for root penetration and free drainage. The sides of the hole shall be roughened to remove any glazing of the surface.

Container grown plants shall have the container removed immediately prior to planting. Care shall be taken to ensure that the root ball is not disturbed during container removal or planting. Any major roots that become accidentally broken off or frayed shall be cleanly cut off from the plant.

Wetland Planting

Plants shall be firmly planted to a depth of 40 to 70mm to anchor the plant so that they are less prone to uprooting and do not float out when water levels are raised. A minimum of 250mm of plant foliage shall extend above the soil.

Planting Work Completion

The work will be deemed complete when all work, materials and processes have been carried out as set out in the plans, drawings and specifications.

Plant Pest and Animal Control

Pest control management plan

Pest Assessment

The Installer will undertake an assessment of plant and animal pests prior to planting. This assessment shall outline the pest populations to be controlled and include a list of pest species (both animal and plant pests) including priority pests from the Regional Pest Management Strategy (RPMS).

Based on this assessment the Installer will prepare a pest management program. It is likely to relate to possum, rabbits, hare and wild goats and pigs. But it must also consider feral cats, rats and mustelids to assist in the protection of transferred lizards.

The area to be controlled will be the full extent of the offset planting area as shown on Figure 34. It is noted that a consequence of the site preparation strategy not to control annual and small stature low / no ecological concern weeds presence a potential increase in maintenance requirements in the first three years of establishment. This is offset by soil stability gains, especially during floods.

Methodology and Programme

A detailed methodology and programme report shall be submitted by the Installer for acceptance by the Site Manager prior to site preparation and planting. The methodology and programme shall address pests identified in the pest assessment using critical path techniques and progress measures, including the following:

a) A plan or map detailing the extent of the site preparation/clearance areas to be managed;
b) Types of chemicals (herbicide, fungicide, baits) that are likely to be used and the times of year that any control operations are likely to occur;
c) Strategies used to avoid contamination of sensitive areas. This could include specific application techniques, no-spray buffer zones, and a list of people who need to be informed of spraying operations.
d) The identity of the person likely to be undertaking the work and confirmation of their current qualifications/ certifications.
e) Weather conditions which may increase potential drift hazard;
f) Indication of agrichemicals to be used that may present a specific hazard
g) A critical path timeline capable of showing progress through the contract period up to the end of the defects liability and maintenance period.

Pest Plant Removal

Pest plant control shall be undertaken during site preparation and prior to planting, with all planting areas being cleared of pest plants prior to planting. Pest plants are as defined in the Regional Pest Management Strategy. Appendix 5 illustrates an acceptable willow and alder control process (as a guide).

Disposal

Unless otherwise specified, the Installer is responsible for the disposal off site all pest plant materials in a safe and legal manner.

Health and Safety

The Installer shall include in the site-specific Health and Safety Plan, details demonstrating compliance with the requirements with the Hazardous Substances and New Organisms Act 1996, the Biosecurity Act 1993, Wild Animal Control Act 1977 and all other relevant legislation.

The Installer shall provide all necessary Health and Safety equipment, and warning signage requirements. The Installer shall hold all licences and approvals required to undertake the full scope of the works.

The Installer shall be responsible for controlling the manner and methods of its operations and shall be directly responsible for the health and safety of its employees while on the site. The Installer must comply with the requirements of the site Health and Safety Plan(s) and the Hazardous Substances and New Organisms Act 1996, and Biosecurity Act 1993, and Wild Animal Control Act 1977.

Other Maintenance actions and timing

The Maintenance Plan shall be prepared by the Installer and identify maintenance operations monthly and shall include, but not be limited to:

- Maintenance monitoring
- Maintenance of trees, shrubs and groundcovers, including staking, trimming, fertiliser application, watering, replacement;
- Pest weed control;
- Litter removal
- Mulch top up

In addition to routine maintenance, the works shall be monitored and responsive maintenance and repairs implemented as necessary. This includes repairs following a storm event, after prolonged dry or wet periods, damage from animal pests

Vandalism

The Installer shall notify the site manager of areas which have, in their opinion, been vandalised or rubbish has been dumped by others.

Any plants vandalised after Practical Completion shall be notified in writing to the site manager. Those plants that fail and are not notified to the manager shall be assumed to have died because of planting operations and shall be replaced at the Installer's expense.

The cost of plants or landscape works deemed to have failed due to theft, wilful damage or vandalism as well as removal of dumped rubbish shall be the Principal's responsibility and expense to rectify.

Completion of maintenance

On completion of the Defects Liability and Maintenance Period (5 years) and prior to issue of the Defects Liability Certificate, the Installer shall undertake / supply the following:

- Repair of all defects to the satisfaction of the Designer (or managers representative) and all maintenance in accordance with the Maintenance Plan and this Specification
- Provide written summary of all maintenance visits, machinery and staff used and weather conditions during defects liability and maintenance visits.

The landscape works may be inspected from time to time by accredited representative of the local authorities in relation to consent conditions. Should such representatives request information in connection to pest weed and animal control, the Installer shall provide the information to them willingly, to the details of their knowledge.