ECOLOGY REPORT FOR

POKENO WEST STRUCTURE PLAN
Helenslee Road and Munro Road
POKENO

FOR: CSR POKENO LIMITED
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Contents

EXECUTIVE SUMMARY

An area of land some 160hectares in extent to the west of the Pokeno urban area has been designated as “under discussion” in the Proposed Waikato District Plan. The site is currently used for semi-extensive agriculture and horticulture with a low density of buildings and infrastructure. The ecological values of the site and the effects of future development of the land for urban use on the ecology of the site is assessed in this report.

Preliminary assessment of the terrestrial and aquatic values of the site was undertaken during December 2017 – February 2018. The current ecological values of the site were found to be generally low to very low with the exception of several small, discrete areas of native vegetation and limited reaches of the Pokeno stream and its tributaries. No specific constraints to development of the site were noted, however more detailed assessments of native fauna and aquatic habitats will be required prior to detailed design.

The removal of livestock and the cessation of cultivation would provide immediate benefits to the water quality values of the streams.

Negative environmental effects due to development of the catchment could be mitigated through the early recognition of environmental issues and impacts and the formulation of an environmentally sensitive design. It is essential that good environmental design supported by hydrological data modelling and appropriate mitigation for ecological effects is part of the initial planning for any development. This is likely to prove more cost effective and more satisfactory ecologically than any retrospective action.

Significant opportunities exist to provide ecological mitigation and biodiversity benefits through the rehabilitation and restoration of the Pokeno Stream and its tributaries. Restoration planting of the riparian margins of streams, wetlands in the upper gullies of the main tributaries and on land surrounding the headwaters of the tributaries would provide significant improvements to the biodiversity values of the site.

Restoration of natural channel characteristics and creation of a variety of aquatic habitats

such as pools, runs and riffles in the mainstem of the Pokeno Stream would significantly improve aquatic habitat values which are currently very low over the reach of the stream where cultivation has occurred. Removal of perched iron culverts and shallow artificial ponds would remove barriers to native fish passage and facilitate access to better quality aquatic habitat in the upper tributaries.

1 INTRODUCTION

An area of land west of Pokeno Village is zoned as "under discussion" in the Proposed Waikato District Plan (Figure 1). The bulk of the area (130ha) is held in one title for 53 Munro Road with seven smaller titles ranging in size from 0.6ha to 7ha approximately, mainly situated along the south western side of Helenslee Road. This report provides an overview of the ecological features of the area under discussion including vegetation and the general ecological values and status of the watercourses. Detailed water quality and stream ecological value (SEV) assessments were not undertaken at this stage, however the ecological report prepared for the Pokeno catchment (Brian T. Coffey & Associates 2008) provides some additional information on the Pokeno Stream that is referenced in this report as detailed in Section 4.

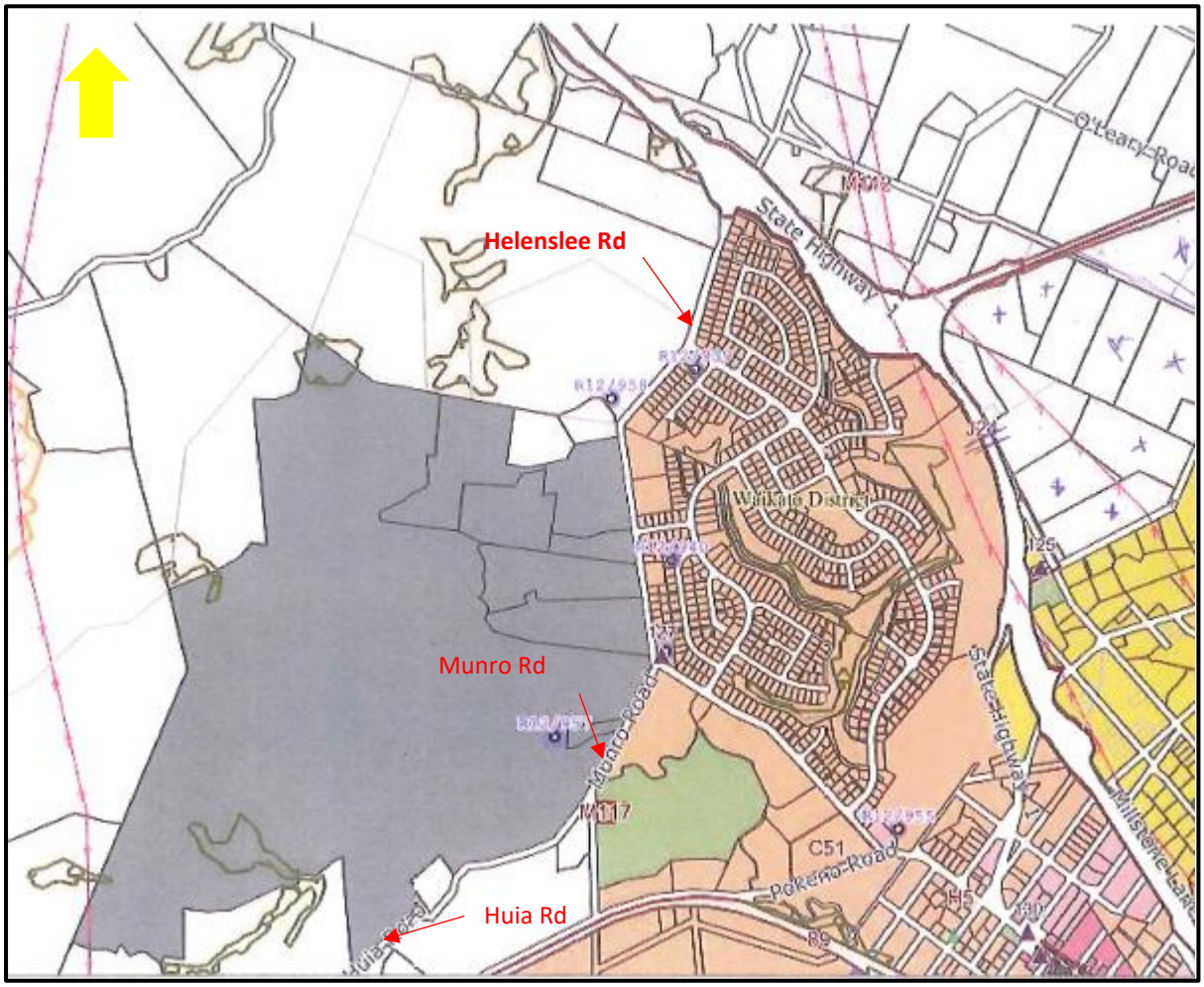

Figure 1 Area zoned "Under Discussion" in the Proposed Waikato District Plan (grey) in relation to the existing Pokeno Village (orange).

2 LANDSCAPE AND ECOLOGICAL CONTEXT

The property lies within the Manukau Ecological District (ED) in the Auckland Ecological Region (Mc Ewen 1987). All native ecosystems in this ED are severely depleted and many remaining ecosystems are dominated by exotic species (Lindsay et al 2009). The original forests of the Manukau ED included the most southerly common occurrence of characteristic northern North Island lowland forest types containing abundant taraire and puriri. Alluvial flats and terraces throughout the ED once supported extensive stands of kahikatea swamp forest, but these have largely been drained and converted to farmland**.** Only 3% of the original area of native vegetation within the Manukau E.D. remains and only 0.4% of native freshwater wetlands remain of which very little is formally protected.
The situation is very similar in the Meremere ED which adjoins the Manukau E.D just to the south of the site. Both of these E.D.s are predominantly comprised of lowlands and consequently the conversion to agricultural use has been almost absolute.
The site forms part of the upper catchment of the Pokeno Stream which drains to the Mangatawhiri Swamp and ultimately to the Lower Waikato River and its wetlands. These are both Sites of Special Wildlife Significance (SSWS) and significant wetlands. The site itself is likely to have originally supported kahikatea floodplain forest on low-lying land close to the Pokeno Stream grading up to podocarp broadleaved forest on more elevated parts of the site.

3 SITE DESCRIPTION

The site includes 53 & 53A Munro Road and 87, 119, 133, 145A and 145C Helenslee Road. The majority of these properties are used for dry stock grazing although at the time of the survey a significant are of maize was being grown on the north eastern side of 53 Munro Road. The grazed land is mainly conventional pasture with some areas of reed land in wetter areas and areas of gorse (*Ulex europaeus*) and barberry (*Berberis glaucocarpa*) in the upper gullies on the western side. Individual large trees, stands of plantation pine and shelterbelts are dotted around the landscape. The contour is variable across the site with low lying flat to gently undulating land on the eastern side to sloping up to steeper rolling

land on the western side at an altitude of 40 -100m a.s.l[1]approximately. Soils are mainly deep, Typic Orthic Granular soils derived from tephra with a clay profile and moderate drainage properties (Landcare research SMap Online).

The upper Pokeno Stream flows for c. 1.1km along the eastern side of the site entering at 145A Helenslee Road and exiting at the Munro Road bridge. Side tributaries of the stream flow down from the more elevated land to the west, forming a series of east facing gullies with low ridges between. An Identified Significant Natural Feature (ISNF) lies along the southernmost stream tributary.

4 SURVEY METHODS

Aerial photographs of the site were viewed and various features were identified for investigation including watercourses and areas of vegetation. The site is part of the Tanetiwhiora catchment which is a sub catchment of the Waikato River. An assessment of the site was carried out on 30 December 2017 and 2/01/2018 following a period of dry weather.

4.1 Existing ecological information for the site

The ISNF that lies on the site is documented in the Protected Natural Areas (PNA) report for the Manukau E.D. (Auckland regional Council 2004). It is described as being some 4ha in area and the vegetation is described as "emergent podocarps over a broken canopy of mapou, mahoe, tawa, putaputaweta and hawthorn".

A report setting out ecological considerations for the Pokeno Catchment Management Plan (Coffey & Associates 2008) provides some high level information on general terrestrial ecology. This report also contains detailed aquatic ecological and water quality data for a sample site (P1) on the Pokeno Stream at the Munro Road Bridge on the south eastern edge of the site.

In general instream aquatic habitat values at Site P1 were found to be "poor" to "fair" based on emergent macrophyte cover, macrophyte clogging of the channel, periphyton enrichment index and accepted indices for native macroinvertebrate communities (MCI[2] ,

[1] Above sea level

[2] Macroinvertebrate community index

QMCI[3] and EPT[4]). Long finned eel (*Aquilla dieffenbachii*), common bully (*Gobiomorphus cotidianus*) and freshwater crayfish (*Paranephrops planifrons*) were caught at the Munro Road bridge location. Long finned eel has a national threat status of 'At Risk - Declining' in the New Zealand Threat Classification System listings (2014).

The general trend identified in the Coffey report was declining water quality and aquatic habitat values at sites downstream of the Munro Road site.

4.1 Botanical values

All areas of terrestrial vegetation were viewed and the species composition and community structure were noted. Pest plants were recorded and the identity of individual large trees standing in open paddocks was established. Vegetation features were mapped onto an aerial photograph of the site. Areas of vegetation referred to in the text (a – f) are shown in Figure 2. Main stream gullies are numbered 1 – 4 from south to north.

4.2 Watercourses and aquatic ecological values

The main Pokeno (Tanetiwhiora) Stream was walked from the Munro Road Bridge to the northern boundary of 53 Munro Road with 145A Helenslee Road. The upper reaches of the stream where it flows through 145A & 145B Helenslee Road were viewed from the shared driveway for these properties. No quantitative data was collected at this stage however. Features noted visually were relative water clarity/silt loading, instream macrophytes, bank profiles and stability, riparian vegetation and shading.

Side tributaries to the main stream were investigated and classified as either permanent or intermittent using the definitions set out in the Auckland Unitary Plan (AUP) and found in Appendix 1 of this report. Other overland flow paths that only contain surface water during and after heavy rain are classified as ephemeral. Stream permanence was assessed at least 48 hours after rain. A map of the main watercourses at the site is found in Appendix 2.

Culverts and crossings were investigated to determine whether they facilitated the passage of native fish such as eels and inanga or posed a significant barrier due to their being perched or overly long.

[3] Quantitative Macroinvertebrate Community Index
[4] Ephemeroptera, Plecoptera & Trichoptera

1. 4.3 Fauna

Incidental observations of birds and mammals were made in the course of the site survey. No targeted searches for lizards or bats were made although their likely presence can be inferred from the habitat that occurs at the site.

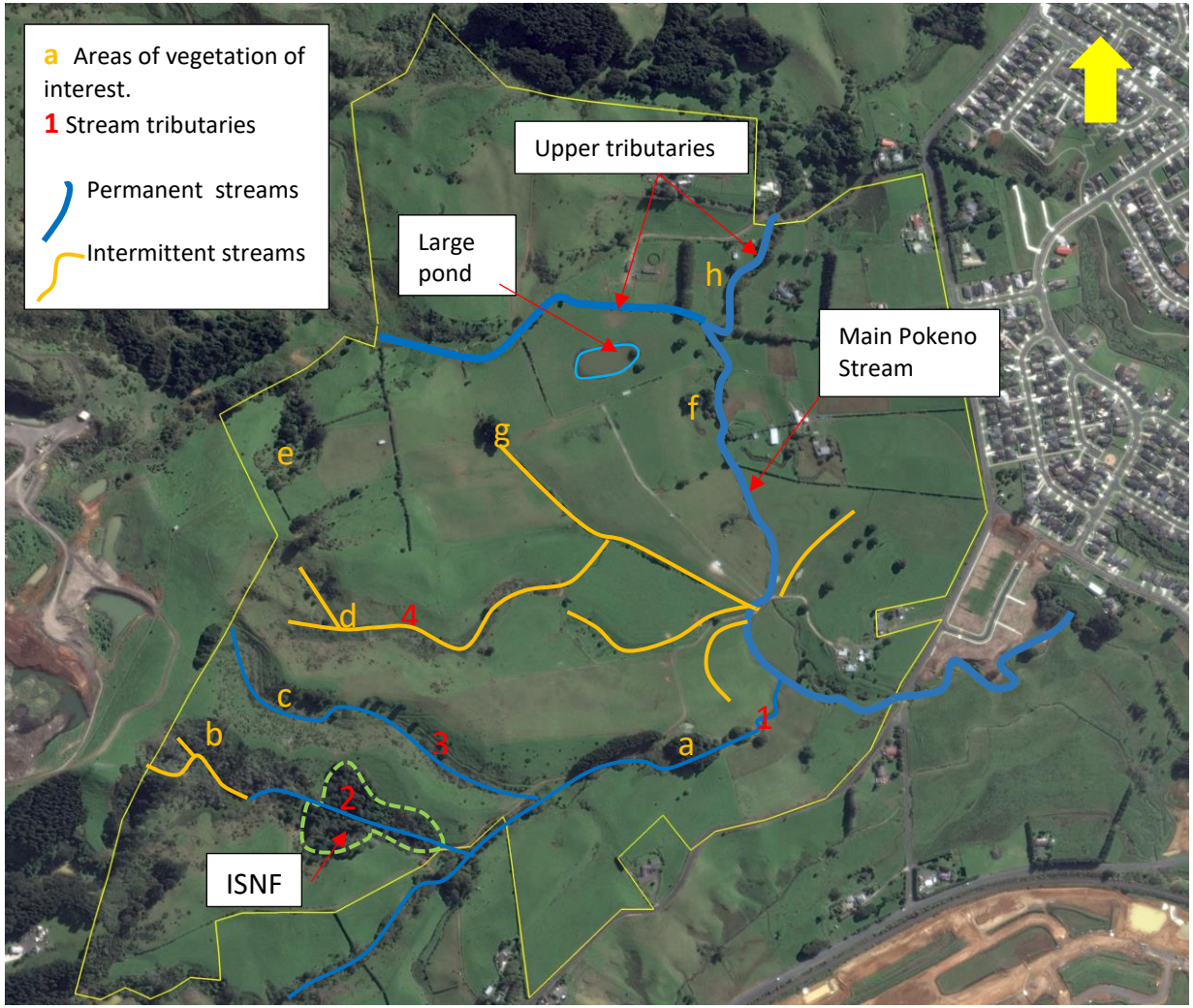

Figure 2 Pokeno West site boundary and location of ecological features

5 RESULTS

5.1 Botanical values

5.1.1 Identified Significant Natural Feature (ISNF)

The fenced ISNF is located on stream gully 2 on the southern side of the site. It occupies c. 2.2ha of the lower part of the gully upstream of an artificial pond above the farm track and beside an old barn. The lower part of the ISNF runs on both sides of the stream in a fairly narrow band that is dominated by a wetland in the bottom of the gully that contains mainly grey willow (*Salix cinerea*). Amongst the willows are a few clumps of native sedge (*Carex secta* & *C. virgata*) and kiokio (*Parablechnum novae-zelandiae*) (Plate 1) and the area is fringed with gorse (*Ulex europaeus*) and woolly nightshade (*Solanum mauritianum*). Other exotic weeds include water purslane (Ludwigia palustris) in the open water and red algae (*Cylindrocapsa*) on the water surface. Several mature totara (*Podocarpus totara*) stand on the true left bank of the stream with a few karamu (*Coprosma robusta*) and mapou (*Myrsine australis*) under them. There are patches of tree fern forest (*Cyathea medullaris*) here also.

Further up the gully area of native vegetation broadens out with tall kahikatea (*Dacrycarpus dacrydioides*), rimu (*Dacrydium cupressinum*) and totara standing mainly on the true left (northern side) of the gully (Plate 2). A dense stand of more than a dozen exotic macrocarpa (*Cupressus macrocarpa*) stand high up on the southern side of the gully within the fenced ISNF. The ISNF also contains mature tanekaha (*Phyllocladus trichomanoides*), tawa (*Beilschmiedia tawa*) and titoki (*Alectryon excelsa*). Native plants present in the understorey include karamu, putaputaweta (*Carpodetus serratus*), mahoe (*Melicytus ramiflorus*), mapou, and cabbage tree (*Cordyline australis*). The edges of the ISNF are surrounded with gorse and the vegetation along the stream is mainly exotic with grey willow (*Salix cinerea*) and gorse being dominant. Barberry (*Berberis glaucocarpa*), Himalayan honeysuckle (*Leycesteria formosa*), poplar (*Populus alba*) and pampas (*Cortaderia selloana*) also have presence here. Possum sign was noted in several places around the edges of the ISNF.

5.1.2 Areas of woody vegetation

a) Area a: Stand of pines with some native trees along watercourse 1: This area of trees is mainly plantation pine (*Pinus radiata*) with several large open grown totara on the

downstream side of the stand. There is little or no understorey vegetation amongst the carpet of pine needles except for privet seedlings (*Ligustrum lucidum*) and a few ferns along the water courses. Two culverts run under the farm track that crosses the stream below a wetland area and the confluence of two stream channels occurs some 70m downstream of the crossing. The wetland has probably been created by the building of the track across the stream. It is infested with grey willow with few native species. Apart from its function of shading the stream the ecological values of the vegetation are low.

b) Area b: Upper gully vegetation on watercourse 2

There is an extensive area of scrubby vegetation (c. 5ha) above the ISNF in the upper gully of watercourse 2 and along the western boundary of the site. This vegetation is mostly exotic, consisting of gorse, woolly nightshade, privet, hawthorn (*Crataegus monogyna*) and barberry (Plate 3). Several groups of pine stand around the head of the gully. A few mature tanekaha and totara stand just outside the SEA to the west. There is a small area of tree fern on the northern side of the gully with scattered mahoe and other common native shrubs. Dead tree fern stems amongst these bear testament to repeated helicopter spraying of the area in 2010, 20113 & 2015 (L. Straiker pers comm). Young totara are occasional amongst the scrub.

A substantial area of grazed wetland (Plate 3) occurs in the upper gully bottom, mostly containing reed sweet grass (*Glyceria maxima*) with grey willow and barberry lower down. A tributary on the northern side contains a small area of native raupo (*Typha orientalis*) however. The ecological values of this vegetation are generally low.

c) Area c: Gully vegetation watercourse 3

Watercourse 3 has an area of grazed wetland in its lower gully which contains mainly exotic rushes (*Juncus effusus*), a few grey willow and water pepper (*Persicaria hydropiper*). The upper gully contains areas of gorse and a dozen or so medium totara are scattered along the northern side of the upper gully. The ecological values of this vegetation is generally low apart from the mature totara which have moderate ecological value.

d) Area d: Gully vegetation watercourse 4

Watercourse 4 contains exotic grazed wetland areas in the upper gully and a stand of

five mature kahikatea in a tight group (Plate 4). In the gully head is gorse and several scattered totara trees. The mature native trees have moderate ecological values as habitat and food for native birds.

e) Area e: Upper western vegetation

Northwest of watercourse 4 are two small areas of vegetation that have a native component. The first of these just north of watercourse 4 contains a large mature totara and several smaller specimens amongst barberry, privet and gorse. A few mature pines and a eucalypt stand at the top of the ridge. The area is grazed with no understorey. Its botanical values are low.

A second small area to the northwest of a farm shed forms a small steep sided basin in a gully head where tall pukatea (Laurelia novaezelandiae), totara, kahikatea, and taraire are found (Plate 5). Amongst these larger trees are found nikau *(Rhopalostylis sapida*),silver tree fern (*Cyathea dealbata*), mamaku (*Cyathea medullaris*), titoki, and rewarewa *(Knightia excelsa*). Large eucalypts (*Eucalyptus* sp.) and pines stand around the edges. This small area of native forest appears healthy and intact although parts of it are grazed. It is more or less contiguous with another larger area of regenerating forest on the neighbouring property to the north and its ecological values are moderate.

f) Area f: Riparian native tree stand

A stand of trees adjacent to the Pokeno stream (Figure 2) contains some two dozen large totara and kahikatea with several titoki. Most of the trees are on the western side (true right) of the stream. These mature trees are providing bank stability and shading to the stream and they will also be providing fruit and nest sites for native birds. Their ecological values are high.

g) Central exotic tree stand

This is a small stand of macrocarpa with no particular botanical value.

h) Shelter belts

Shelterbelt trees on 145A, 145C and 133 Helenslee Road are poplar, pine and willow. Poplars and willows along the upper Pokeno Stream are providing bank stability and shading to the stream. These exotic trees otherwise have not particular botanical values.

5.1.3 Individual trees

There are numerous individual mature native trees dotted about the main block at 53 Munro Road. These are all either totara or kahikatea. They have moderate ecological values as nest sites and food for native birds.

5.1.4 Summary of botanical values

ISNF: This area of mixed native and exotic vegetation is of high ecological value because of the mature native trees it contains and the protected area of wetland that has the potential to be restored to native freshwater wetland. It is however very small at just over 2ha in area. There are significant issues with pest plants however, particularly in the interior of the ISNF along the stream and within the wetland. The lower part of the ISNF currently has relatively low botanical values as it is dominated by grey willow, gorse and barberry.

Areas (a) – (h): The areas of highest ecological value are the small area of native forest on the western edge of the site (e) and the stand of riparian native trees along the Pokeno stream (f). In all other areas (a, b, c, d) only the individual mature native trees have any significant ecological value. Although there are substantial areas of freshwater wetland these are grazed and contain predominantly invasive pest plants such as grey willow and reed sweet grass. Their ecological values are currently low, however there is potential to rehabilitate some of these back to native freshwater wetland. Native freshwater wetland ecosystems are a severely depleted ecosystem type across the Manukau E.D., the wider Auckland Ecological Region and nationally.

Stands of exotic trees and shelterbelts: Exotic trees have low ecological values since they do not generally provide good habitat or food for native fauna. The exception would be large old pine trees which are known to provide roost sites for native long tailed bats (*Chalinolobus tuberculatus*).

5.2 Watercourses and aquatic values

5.2.1 Stream classifications

Watercourses are shown in Figure 2. They include the mainstem of the Pokeno Stream and a number of side tributaries which mainly flow in from the west (true right). The stream definitions given in the Auckland Unitary Plan have been used for stream classification as

they give specific criteria for the determinations of intermittent streams. Overland flow paths that only contain water during and shortly after rain and which do not meet the criteria for an intermittent stream are considered ephemeral and are not considered in this ecological report. Permanent streams generally provide better aquatic habitat than intermittent streams however natural pools and aquatic vegetation in intermittent streams can still provide habitat and refugia for aquatic fauna even at times when the stream is not continuously flowing.

Pokeno Stream

This stream is permanent (perennial) along the entire reach that flows through the site (Figure 2). A confluence of two main tributaries occurs on the boundary of 53 Munro Road with 145A Helenslee Road. Here one tributary flows in from the west along the boundary with 145C Helenslee Road and the other comes down from the north across 145A Helenslee Road. Both of these upper tributaries are permanent. The stream is mostly soft-bottomed (Collier and Kelly, 2005) with a fine gravel and silt substrate and medium sized (up to 300mm diameter on average) boulders of volcanic origin being occasional. Flow rate was good along the mainstem and the two upper tributaries in mid-summer.

Tributary 1

This stream was found to be permanent along the reach that occurs on the site. A farm track crosses the stream near the plantation of pine trees and a culvert (c. 8 -10m long) carries the flow under the track. Above the farm track, a wetland area containing grey willow and other exotic plants has been created by the construction of the track. The stream runs in a narrow, artificially created channel for c. 50m before it re-joins the natural stream bed lower down. Above this confluence the natural stream bed was stagnant.

Tributary 2

This stream originates on the neighbouring property to the west and flows through the ISNF. At its lower end there is a shallow pond which has been created by the construction of a farm track and a 600mm iron culvert (c. 10m long) then flows under the track to the confluence with Tributary 1.

This stream was found to be permanent from the lower end until just above the ISNF where it becomes intermittent as its flow becomes diffuse through an extensive area of wetland in the broad gully bottom. The wetland contained water in midsummer and the presence of

two large patches of raupo indicate it would seldom dry out, even during prolonged dry spells.

Tributary 3

Tributary 3 also originates near the western boundary and is judged to be permanent for the lower half of its length where it flows in a defined channel. Upstream of this point there is no defined channel and a wetland occupies the gully bottom. This stream forms a small pond above the farm track and passes under the track via a 600mm iron culvert to its downstream confluence with Tributary 1.

Tributary 4

Tributary 4 originates near the western boundary of the site, flowing down a broad gully towards the main Pokeno Stream. The upper gully contains areas of grazed wetland of rushes and grey willow. As the stream passes under a farm track at the lower end of the gully the downstream end of the culvert is observed to be significantly perched above the watercourse. This stream is joined by a smaller intermittent watercourse flowing in from the north and then flows southeast via a straightened and significantly altered channel to join the Pokeno Stream. All of this watercourse and its tributaries are judged to be intermittent.

Other watercourses and ponds

Several other minor watercourses flow into the Pokeno stream at various points along the reach that crosses the site, however these are generally quite short and all are judged to be intermittent or ephemeral.

Several more farm ponds occur across the site in addition to those described above that are associated with the main tributaries. These are all small artificial ponds fed by minor tributaries or springs except for a larger shallow pond with an area of c.250m^2 in the centre of the site (Figure 2).

5.2.2 Stream aquatic values

Quantitative data on stream aquatic values was not collected for the purposes of this report, however the ecological report prepared for the Pokeno catchment (Coffey & Associates 2008) gives a good general indication of the types of habitats and stream ecological values that are likely to be encountered within the watercourses on the site.

Pokeno Stream

Riparian vegetation along the mainstem of the Pokeno Stream consists predominantly of

pasture or maize crop along the southern half of the reach that runs through the site. The northern half of the mainstem has a narrow (average 10m on either bank) and discontinuous band of riparian trees and shrubs which provide some shading. Some of this vegetation is comprised of native trees, however much of it is exotic poplars and willows. The two upper tributaries also have a narrow and discontinuous band of vegetation along the banks. The western tributary is open with mainly reed sweet grass along its upper western reach.

Bank stability: The banks of the mainstem of the stream are highly unstable, particularly in the mid and upper parts of the reach and prone to erosion. Areas of bare soil are very common and disruption of the streambank vegetation and bank slumping due to grazing and cropping is very obvious. Severe bank erosion and slumping are apparent along the 500m section of the stream that flows through the cropped area. The upper tributaries are steeply incised with silty unstable banks.

Channel alteration is obvious throughout the cropped area and also upstream of this. The channel of the upper western tributary appears to have been straightened along parts of its length

Macrophytes: Exotic emergent macrophytes are abundant in the lower part of the reach, the predominant species being reed sweet grass, water celery (Apium nodiflorum), and watercress (Nasturtium officinale). Higher up there is less emergent macrophyte cover as the stream is more shaded by overhanging trees and the channel becomes deeper and more steeply incised. Near the confluence of the two upper tributaries and along the western tributary dense patches of a native green alga (Nitella sp.) can be found where the stream is well shaded. This plant is an indicator of moderate to good water quality and is considered to be good quality aquatic habitat (Landcare Research).

Silt loading and water clarity: Silt loading was observed to be very high in the northern part of the mainstem of the stream particularly in the central part within the cropped area after significant rain. Lower down towards Munro Road Bridge silt loading was lower and this is presumed to be a consequence of inputs from less disturbed side tributaries and the broadening of the stream channel with consequent lessening of the water velocity. After at least 48 hours of fine weather the water clarity was considerable better, however it would still generally be considered poor along most of the mainstem. The western tributary was observed to have moderately good water clarity but the northern tributary has similar

issues to the mainstem.

Summary: Aquatic habitat values appeared to be low in the mainstem of the Pokeno Stream with poor water clarity, high silt loading and lack of stream shading over much of the southern part of the reach. In the northern half of the reach stream shading is much better, however water clarity was poor and silt loading was high. This is a soft-bottomed stream in which aquatic habitat diversity appeared to be low with unstable substrate and few pools, instream woody debris, rocks or riffles. Water clarity and shading are better in the top of the mainstem and the upper tributaries with more habitat diversity including pools, runs and a few riffles.

Tributary Streams

Riparian Vegetation

Tributary 1 has good riparian vegetation where it passes through Area a (Section 5.1.2) which is a stand of plantation pines and open grown totara trees. There is little understorey here however and the ground under the trees is mostly bare. Parts of the stream bed here are rocky and the native alga *Nitella* was collected a pool here indicating that aquatic habitat may be of moderate quality. Along other parts of the reach some shading is provided by emergent aquatic macrophytes and grey willow while still other stretches are open with little riparian shading.

Riparian vegetation along Tributary 2 is generally good with > 10m width on either side within the ISNF although some of this is gorse and grey willows. Shading is good on average. In the upper gully scrub vegetation occupies the northern and western side of the gully with mainly pasture on the southern side. Shading of the stream is patchy here as an open area of grazed wetland occupies the gully bottom. Patches of raupo in the upper gullies is good potential habitat for native water birds.

Tributary 3 flows through a grazed gully which is mostly open with few trees. There is a canopy of grey willow in some places and under this can be found native wetland sedges such as rautahi (*Carex geminata* agg.), *C. virgata,* native ferns and other native species. Near the top of this spring-fed watercourse is an area of mostly native wetland which contains dead tree fern trunks. These have probably fallen victim to aerial herbicide spray.

Tributary 4 also flows in a grazed and open gully although there is an area of gorse near the gully head which would provide some filtering of overland flows. A group of several kahikatea trees stand on one bank.

Bank stability and channel alteration

Tributaries 1 – 4 generally have relatively good bank stability apart from pugging caused by stock. The channels are not steeply incised and vegetative cover of grass or other vegetation is present in most cases. Channel alteration is evident at farm track crossings where ponds have been formed on the upstream side of the track and culverts carry the streams under the tracks. Tributary 1 had a debris dam just below **Area a,** but this did not appear to be restricting water flow at the time. Tributaries 1 – 3 do not display significant channel alteration other than this. The lower part of Tributary 4 and several minor watercourses on the eastern side of the site do appear to have been dug out and straightened however.

Macrophytes

Aquatic macrophytes are found in abundance along open, unshaded parts of all of the streams. These are predominantly common exotic species such as reed sweet grass, water pepper, water celery and a range of exotic rushes (*Juncus* spp.). Mercer grass (Paspalum distichum) was noted in Tributary 3 in the pond.

Silt loading and water clarity

Except for the various artificial ponds, water clarity within the tributaries was noticeably better than within the mainstem of the Pokeno Stream. Water emerging from the downstream end of culverts flowing under farm tracks generally appeared to have relatively good clarity and low silt loading. Tributary 3 had heavy growth of iron floc bacteria however.

Ponds

Aquatic values within the shallow ponds found along Tributaries 1, 2 & 3 appeared poor with low water clarity and high levels of algal growth. Due to their openness and shallowness high water temperatures and high diurnal variations in dissolved oxygen levels can be expected particularly over the warmer months. These poor water quality values will also be impacting water quality values downstream of the ponds

Summary

Tributaries 1 – 4 are for the most part, soft-bottomed streams, although small rocks and boulders are evident in some places. Their water clarity appears to be reasonably good in most places except for on-line artificial ponds. Silt loadings appear low to moderate. Iron staining was observed at culverts and downstream of the culverts in Tributary 1 although mats of iron floc bacteria were not observed except in Tributary 3. The iron staining

observed may be due to the corrugated iron culverts that have been used. Stream channels are mainly natural and a range of aquatic habitats are present with pools, runs and wetland areas. Woody debris is present in Tributaries 2 and 3 within the ISNF. The four tributary streams generally have low to moderate aquatic habitat values. Lack of woody riparian vegetation for shading, and pugging of stream banks and channels by livestock are the main contributors to loss of aquatic habitat values for these watercourses. Stock exclusion and riparian restoration planting have the potential to significantly improve both water quality and aquatic habitat values.

5.2.3 Fish passage

Fish species potentially present

Many species of native fish move up and down freshwater streams in the natural course of their lives and two major groups, native eels (Anguilla spp.) and galaxiids or inanga (*Galaxias* spp) are diadromous completing part of their lifecycle at sea and part in inland freshwater streams and rivers. Natural barriers such as waterfalls sometimes prevent native fish from migrating up streams but a far greater problem is manmade structures such as culverts and artificial ponds.

Native fish species recorded by Coffey & Associates (2008) for the Pokeno Stream at the Munro Road Bridge included long finned eel adults and juveniles, common bully and freshwater crayfish. Long finned eel and koura have a National Threat Status of "At Risk – declining". Mosquito fish (*Gambusia affinis*) is a small introduced pest fish that was observed at the site in shallow ponds during the current study.

In addition to these species other native fish species that may be present upstream of the Munro Road Bridge or in the headwaters of the Pokeno Stream to the north include shortfin eel (Anguilla *australis*), and five species of galaxiids (NIWA). Four whitebait species:giant kokopu (*Galaxias argenteus*), banded kokopu (*G. fasciatus*), inanga (*G. maculatus*) and koaro (*G. brevipinnis*) could potentially be present in tributary streams or the upper Pokeno stream where there is good stream shading. Black mudfish (*Neochanna diversus*) live in swamps, drains and forest pools that tend to dry up in summer and may be present in suitable habitat at the site. This species is known to be quite common in the Waikato Region, particularly the Whangamarino Swamp. All of the whitebait species except banded kokopu have National Threat Status of "At Risk – declining" as does the black mudfish.

Barriers to fish passage

Poorly designed or installed structures can pose a barrier to fish migration if:

- The water flow is too high and/or there are no resting places provided within the structure
- There is no low velocity zone or wetted margin provided at the water edge
- Water turbulence is too great (usually because the culvert is too narrow or too steep)
- The crossing is too dark (because the culvert is too long or too small)
- Water depth within the culvert is too shallow
- The river bed within the culvert is too smooth for bottom swimmers (often because the culvert has a concrete or steel bottom and normal bed material has not been able to develop)
- The gradient is too steep
- The bed level of the crossing has been raised (e.g. culvert floor is perched above the streambed)
- Debris has built up and formed a weir
- Scouring has occurred and caused the culvert to become perched (Speirs and Ryan, 2006).

Culverts

The Pokeno Stream is bridged at Munro road and just below the cowshed at 53 Munro Road pose no barrier to native fish migration up and down the stream (Figure 3). Similarly a large corrugated iron culvert some 1.8m in diameter carries the stream under the driveway at the upper end of the site between 145A and 145B Helenslee Road (Culvert 7)The culvert has little slope and is not perched; thus it does not pose a barrier to fish passage. There are no other culverts along the upper Pokeno Stream except for a short (c.3m) section under a farm crossing which is not perched (Culvert 6). No barriers to fish passage were identified along the upper Pokeno stream at the site.

Tributaries 1, 2, 3 & 4 all had culverts on them that ran under farm tracks and small dams (Culverts 1 – 5, Figure 3). Most of these culverts were constructed of 600mm diameter corrugated iron pipe with the transverse corrugations providing a good surface for fish to move over and several had fine gravel inside the pipe which would aid fish passage. All of the culverts were perched on the downstream end with a drop to the stream below of 30 - >50cm. Culvert 2 was not under-cut and this culvert would probably not be a problem to most species but the other four culverts (1, 3, 4 & 5) were undercut. Good climbers such as eels would have no trouble navigating these barriers but some of the galaxiid species would

probably have difficulty with them. Because all of these culverts occurred lower down the tributary streams, access to the better quality aquatic habitat in the upper gullies may be restricted for poorer climbers such as inanga (G. maculatus).

The culverts all sloped gently, were not overly long or too turbulent, however during dry weather the depth of water in them may be very low, restricting fish passage at some times of the year. The upper ends of the culverts were generally level with the stream bed or buried so that fish movement downstream would not be restricted.

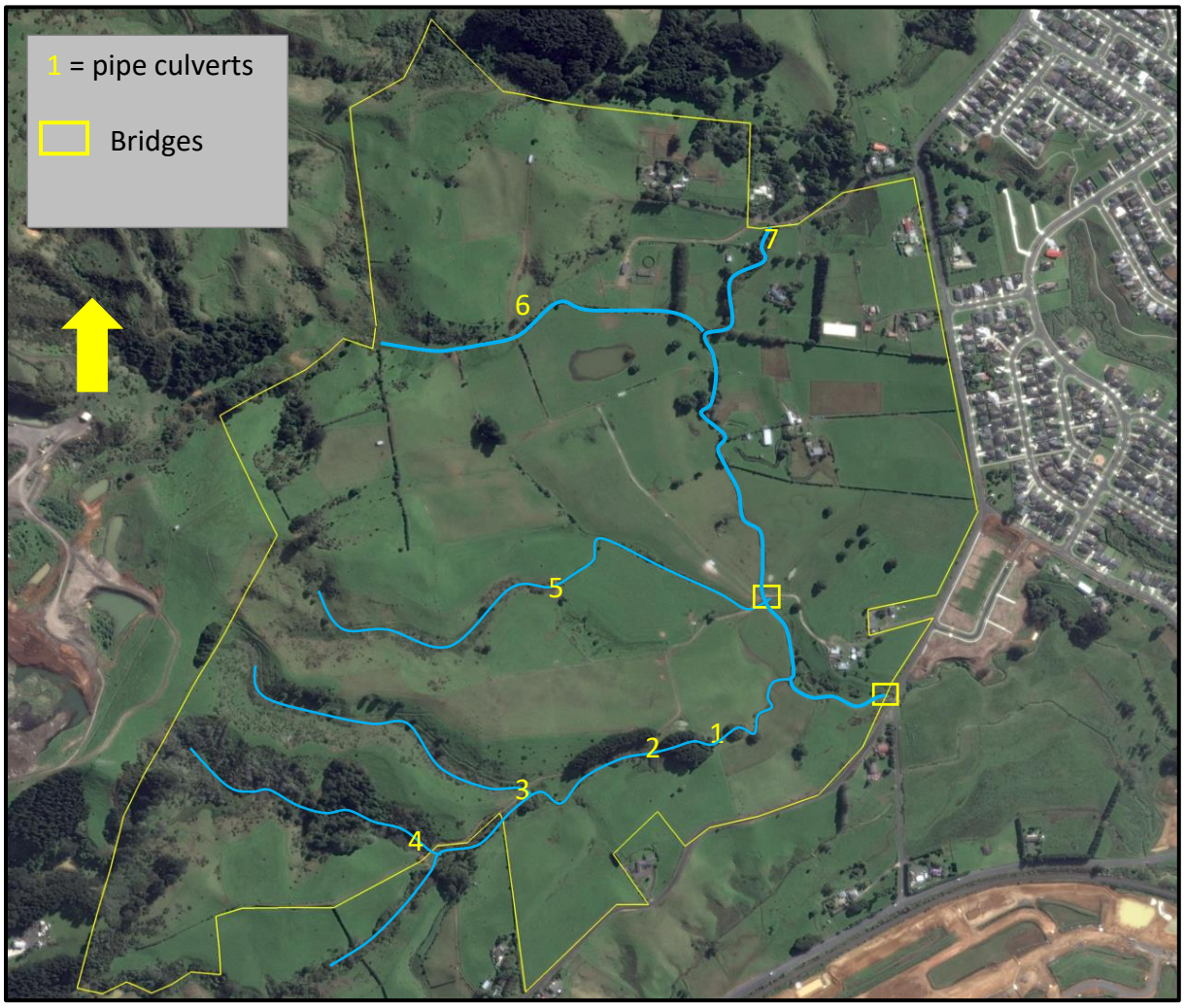

Figure 3: Location of culverts and bridges along the Pokeno Stream and its tributaries.

Barriers to fish passage at the site are generally minor for most species except for the driest months of the year when there may be insufficient water flowing through the iron culverts to allow fish to swim through. Removal or remediation of culverts could be incorporated into the ecological management plan for the site if development occurs.

5.2.3 Wetlands

Small areas of wetland are common throughout the site and there are numerous areas of marshy pasture that is seasonally wet and supports rushes, pasture grasses and moisture tolerant species such as buttercup (*Ranunculus repens*) and reed sweet grass. These areas of marshy pasture are all grazed and their ecological, values are generally very low.

Wetlands occur in association with artificial ponds on tributaries 1, 2 & 3 and in the upper gullies of Tributaries 2, 3 & 4. All of these wetlands are open to grazing except for the pond and wetland that occurs in the lower part of the ISNF in association with Tributary 2. The grazed wetlands are generally dominated by exotic species of plants and are subject to pugging by heavy stock. The aquatic ecological values of these wetlands are currently low, however there are native wetland plant communities present in several locations and there is potential to protect and restore those in the upper gullies.

The wetland associated with the lower part of Tributary 2 occurs around an artificially created pond and it is dominated by grey willow and a range of weedy exotic plants. It is however, mostly fenced into the ISNF and does contain native plants such as sedges, tree ferns, mapou and karamu. It is surrounded by the mature trees within the ISNF on the northern and western sides but there are significant issues with invasive weeds such as gorse and grey willow. The aquatic ecological values here are moderate because it is protected from grazing within the fenced ISNF and it is providing additional habitat types for the natural feature. There is good potential for improvement through weed control and restoration planting.

5.2.4 Summary of aquatic values

The Pokeno Stream and the network of tributaries that feed into it with their associated wetlands are the key ecological feature of the site. Water courses at the site have low to moderate aquatic values based on visual assessment of riparian vegetation, bank stability and channel modification, macrophyte presence and water clarity. Virtually all of the watercourses and wetlands are open to grazing with associated pugging and bank erosion. A substantial reach of the Pokeno Stream is badly affected by bank erosion and channel modification associated with the current maize cropping at 53 Munro Road. Stream shading is minimal for most of the watercourses over most of their length. The upper tributaries and top of the mainstem of the Pokeno Stream is quite well shaded with woody vegetation

however, as are the headwater streams on neighbouring properties to the north of the site and these upper reaches may provide better quality habitat for native aquatic fauna and invertebrates.

5.3 Fauna

5.3.1 Mammals

Grazing ungulates including cattle, horses and sheep were the most visible animals at the site. Numerous hares (*Lepus europaeus*) were sighted in the gully in **area d** and rabbits (Oryctolagus cuniculus) will certainly be present in greater or lesser numbers. Signs of possums (Trichosurus vulpecula) were noted within the ISNF and other pest animals such as), rats (*Rattus rattus* & *R. norvegicus*) and mustelids (*Mustela* spp) that are predators on the nests of native birds will also be present amongst native and exotic scrub and forest. Long tailed bats (*Chalinolobus tuberculatus*) are very small native mammals (8 -14g) that roost in large, old canopy trees (e.g. rimu & totara), either beneath the bark or in cavities. Bats can also find suitable roosts in mature exotic trees such as pine, gum and macrocarpa. They hawk for insects at night along forest edges and above water although they are seldom noticed. Bats have been found in the wider Franklin area in small bush remnants and they could potentially be utilising the site as part of a larger home range, as they are capable of ranging up to 50km in a night. Large native and exotic trees at the site, particularly in the ISNF could provide bat roosts. Long tailed bats have a National Threat status of "Nationally Vulnerable".

5.3.2 Birds

Birds noted at the site included mallard ducks (*Anas platyrhynchos*), white faced heron (*Egretta novaehollandiae*) and pukeko (*Porphyrio melanotus*) as well as the usual range of exotic passerines such as blackbirds, sparrows and starlings that are ubiquitous across human modified landscapes. Wild turkey (*Meleagris gallopavo*), peacock (*Pavo cristatus*) and pheasant (*Phasianus colchicus*) were also seen. Habitat for native birds is currently limited although tui (Prosthemadera novaeseelandiae), native pigeons (Hemiphaga novaeseelandiae), Australasian harrier hawk (*Circus approximans*) and morepork (Ninox novaeseelandiae) could be expected to be visitors to the site. Other likely residents or visitors are fantail (*Ripidura fuliginosa*), kingfisher (*Halcyon sancta*), silvereye (*Zosterops lateralis*) and grey warbler (*Gerygone igata*). None of these bird species are nationally or regionally threatened.

5.3.3 Lizards

Important lizard habitat types include open rough grassland, shrubland and mature native trees, all of which occur at the site.

Open rough grassland and artificial structures can include rough grass areas, including roadside and bush side verges, particularly kikuyu grass and including pampas bushes. These vegetation types provide thick cover and high light levels that are suited to ground-based skinks. Discarded debris within and around these environments often provides good cover for native skinks to refuge under. Areas of rank grass occur in less intensively grazed parts of the farm and around the edges of the **ISNF**.

Shrubland includes low-medium height vegetation, typically including regenerating scrub such as manuka (*Leptospermum scoparium*), kanuka (*Kunzea* spp.), mingimingi (*Leucopogon fasciculatus*) ferns and tree ferns. These environments have medium light levels with some ground cover as well as arboreal (tree-climbing) habitats. **Area b** contains this type of habitat.

Mature trees provide good habitat for tree dwelling geckos. The **ISNF, Areas e & f** and individual large trees contain this type of habitat.

Lizard species that could potentially be present in areas of rough grassland and artificial structures or in shrubland include the copper skink (*Oligosoma aeneum*) and ornate skink (*Oligosoma ornatum*). Green gecko (*Naultinus elegans*) and forest gecko (*Mokopririrakau granulatus*) are typically found in shrubland or mature native trees. Although the copper skink is not threatened, the other three species have a National Threat status of "At Risk-declining".

The likelihood of lizards being present is relatively low due to past habitat modification and ongoing disturbance by grazing livestock.

6 ASSESSMENT OF EFFECTS OF POTENTIAL CHANGES IN LAND USE ON ECOLOGICAL VALUES

6.1 Potential ecological effects of changes to land use

A change in land use from the existing agricultural and horticultural uses to more intensive residential and/or industrial use could be expected to result in the following general environmental impacts:

1. An increase in impervious surfaces associated with buildings and roading infrastructure could be result in alterations to the quantity, quality and rate of flow of stormwater to watercourses within the upper Pokeno Stream catchment.
2. Disturbance caused by earthworks at the site has the potential to affect the water quality of downstream receiving environments such as the lower Pokeno stream and the Waikato River.
3. The removal of grazing livestock and cessation of horticultural activities at the site is likely to have generally beneficial effects on the water quality and aquatic habitat values of the watercourses and wetlands on the site through a reduction in bank disturbance and nutrient inputs.
4. Intermittent and permanent streams may be culverted along all or parts of their length resulting in loss of aquatic habitat and barriers to fish passage.
5. Major modifications to the natural landforms including road construction, extensive retaining walls and stormwater retention devices, particularly close to watercourses can result in loss of connectivity between streams and their catchment. Streams may then become little more than drainage channels despite mitigation measures such as riparian planting.
6 Small areas of native forest (ISNF, Areas e & f), individual mature native trees and areas of mixed native and exotic scrub (Area b) may be removed resulting in loss of habitat for native birds, bats and lizards.
7. There may be a permanent or temporary overall loss of woody vegetation from the site and a reduction in riparian vegetation resulting in a loss of habitat values.
8. Areas of open wetland in the upper catchments of Tributaries 2 & 4 and along Tributaries 1 -4 that have the potential to be restored to greater functionality and naturalness following livestock removal could be lost or modified due to development.

6.2 Assessment of the overall scale of ecological effects

The key ecological values of the site lie mainly with the extensive network of watercourses and small wetlands. Current and historic landuse has resulted in loss of riparian vegetation and destructive modification of watercourses, particularly in the case of the Pokeno Stream. As a consequence aquatic habitat values and water quality are generally poor throughout the site. It does not follow however that the site is destined to remain in a degraded state.

Important elements of the original native aquatic ecosystems are still present or potentially present, particularly native fish and by association native invertebrates. Restoration of native aquatic ecosystems is completely achievable as an integral part of development with good environmental design and management.

Native vegetation at the site is fairly sparse with only a few small areas of mature native trees and a number of individual mature trees scattered about amongst pasture.

General principles for mitigation of the effects of the project on environmental values include the following:

- Alterations in the quantity, quality and rate of flow of stormwater runoff due to the construction of buildings and roading infrastructure are expected to have the greatest effects on the water quality and aquatic habitat values of the site and the overall catchment. Good modelling of stormwater flows and design of the stormwater management system both during construction phase and the operational phase of the development can avoid or mitigate most negative ecological effects. Ultimately there is potential to improve water quality and aquatic habitat values through good stormwater management and restoration of wetlands and riparian vegetation.
- Similarly the effects of earthworks can be managed to avoid negative effects on water quality.
- Landform modification can result in irreversible negative effects on the natural character and the ecological values of the site. Development design that is sympathetic and appropriate to the site can help to maintain and enhance the natural values of the site.
- The scale of effects associated with the modification and culverting of streams, loss of vegetation and wetlands are potentially significant. Recognition of these issues at the outset and incorporation of measures to minimise negative effects on these natural features within the project design can greatly reduce the eventual scale of effects.
- Habitat values for native fauna can be maintained and enhanced through the retention of native vegetation, additional planting of native species and control of mammalian predators such as possums, stoats and rats.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

Negative environmental effects due to development of the catchment can be managed through the early recognition of environmental issues and impacts and the formulation of an environmentally sensitive design. No specific ecological constraints to proposed development of the site have been identified at the preliminary assessment stage, however more detailed fauna and aquatic habitat assessments should be undertaken prior to the detailed design stage. Any development proposal should demonstrate that the ecological values of the catchment will be enhanced through appropriate design and landuse. There should be a commitment to working with the natural landforms and ecological features of the site. This would see for example, steeper areas towards the western boundary being retained as public reserves or developed as lower intensity sites such as "countryside living" or "large lots". The natural hydrology of the site, particularly the lower lying land on the eastern side of the site should also be recognised and maintained with adequate setbacks being provided from streams and riparian planting.

7.2 General ecological recommendations for site development

An ecological management plan should be developed for the site early in the development process by a qualified ecologist and in consultation with engineering and landscape designers. Such a plan would cover but is not limited to the following general recommendations:

1. Ensure stormwater design and management recognises and provides for the maintenance and enhancement of the natural hydrology and stream ecological values for native fauna.
2. Maintain and restore the natural hydrology of the site as far as possible and minimise culverting of streams or channel alteration of natural watercourses. The existing iron culverts should be removed as they are leaching iron into the streams. Bridging of streams is preferable to culverting, however any new culverts should be designed to facilitate fish passage.
3. It is desirable to remove the shallow artificial ponds found on Tributaries 1, 2 & 3 as these are degrading the water quality within and downstream of them.
4. The creation of ornamental lakes and ponds within the proposed development is not

recommended and any stormwater retention structures should be off-line to the streams.

5. Ensure the riparian areas along permanent streams are kept free of disturbance as far as possible and plant these areas with native trees and shrubs. As a minimum a 20m setback from all permanent streams is recommended. In low lying parts of the site along the lower Pokeno Stream this setback will need to be wider.
6. Retain intermittent streams as far as possible and provide a minimum 10m riparian setback from these that is planted with native trees and shrubs.
7. Eradicate invasive pest plants across the site, particularly grey willows, and control animal pests such as possums, rats and stoats to enhance habitat values for native fauna.
8. Employ design that is sympathetic to the natural landforms and avoid major landform modifications such as large retaining walls as far as possible.
9. Retain, protect and enhance the vegetation within the ISNF and **Areas e & f** through fencing, legal protection and weed and pest control. Similarly, as many possible of the mature native trees (mostly totara and kahikatea) found across the site should be retained as they provide a measure of ecological connectivity in the landscape.
10. Retain and restore wetland areas where feasible.
11. Utilise native plants and trees for public amenity planting giving consideration to re-establishing ecological connections and the provision of food and nest sites for native fauna.
12. Plant any artificial stormwater ponds/structures with appropriate native wetland plants to provide additional wetland habitat for native fauna.
13. Provide for specialist management of any native fish, lizards or bats that are detected at the site.
14. Manage any vegetation removal to minimise effects on native birds.

7.3 Specific recommended ecological mitigation

Ecological mitigation should focus on rehabilitation and restoration of the Pokeno Stream and the extensive network of tributaries that feed into it with their associated wetlands and riparian vegetation. Although these are currently in a generally degraded state there are excellent opportunities to restore the aquatic values of the watercourses and the terrestrial ecological values of their riparian margins. Wetlands in the upper gullies of Streams 2, 3 &4

would respond well to physical protection and restoration planting. Stabilisation and planting of the banks of the main Pokeno Stream would significantly reduce sediment inputs and improve aquatic habitat values and downstream water quality values. With specialist input from a suitably qualified freshwater ecologist historic channel alteration and loss of aquatic habitat heterogeneity (a variety of pools, runs and riffles) could be restored as part of detailed stormwater design.

Maintaing permanent watercourses as natural, open channels and providing a good width of native riparian planting would help to maintain and restore the ecological values of the site. The steeper western edges of the site that surround the headwaters of the tributary streams should be rehabilitated through weed removal and native planting.

A site-wide Restoration Plan that seeks to maintain ecological connectivity throughout the site should be developed as part of detailed design. This plan should be developed by a qualified plant ecologist and be taken into consideration when the Landscape Plans are developed to ensure appropriate plants are selected for landscaping.

The expected outcome of such ecological management would be the restoration of aquatic habitats for native fish, an increase in good quality habitat for native terrestrial fauna and an overall increase in areas of native vegetation in the wider landscape. The restored native habitats would also provide significant benefits to the future inhabitants of the development by providing places for passive recreation and enjoyment of the natural environment. Landscape values of the development would also be enhanced.

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9 SITE PHOTOGRAPHS

Plate 1 Lower ISNF with shallow pond and grey willows. Note patches of algae on the pond surface.

Plate 2 Upper ISNF with mature native trees

Plate 3 Area b showing mixed native and exotic scrub and open wetland in the gully bottom

Plate 4 Open wetland in the upper gully of Stream 4 with gorse above.

Plate 5 Area e with mature totara, kahikatea, pukatea and taraire

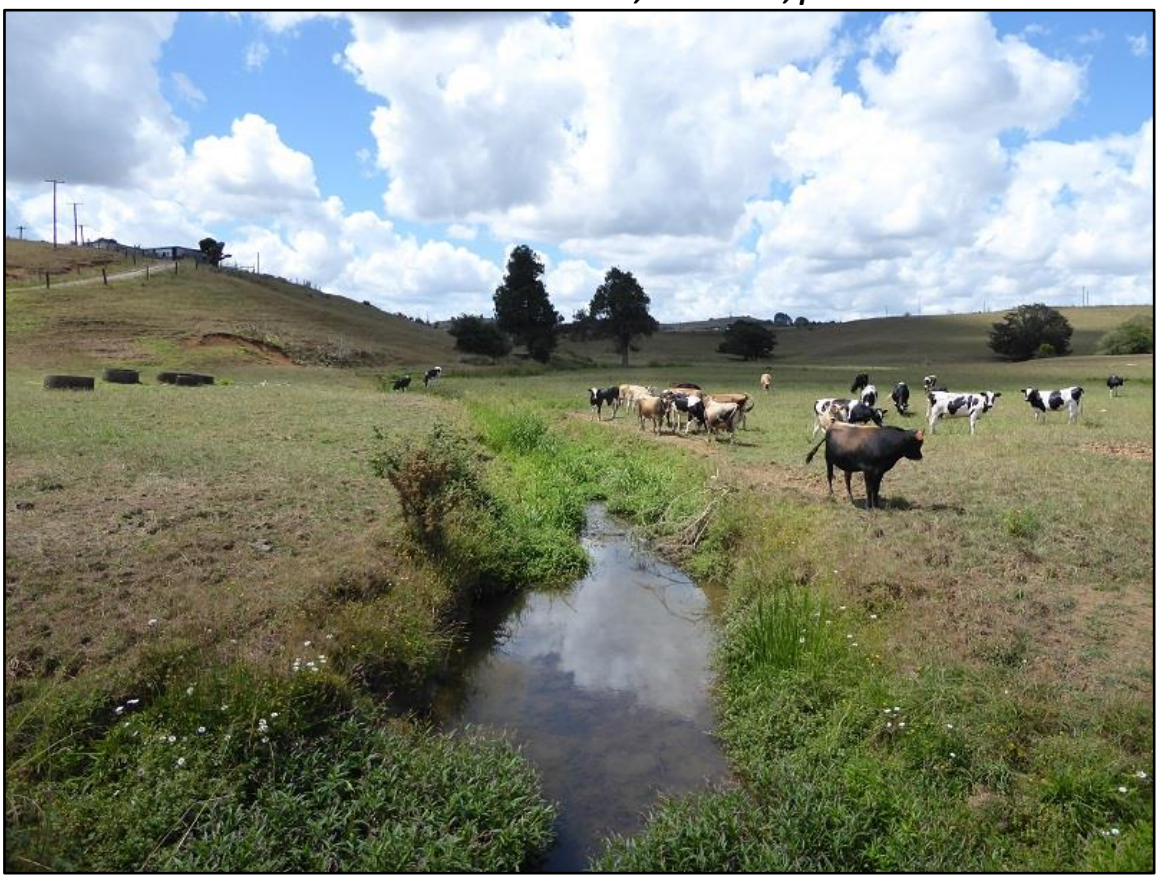

Plate 6 Lower Pokeno Stream view to the south

Plate 7 ***View of the Pokeno Stream along the mid-section at the site showing severe bank erosion and low water clarity.***

Plate 8 ***View of the upper Pokeno Stream showing partial shading, silty erodible banks and low water clarity.***

Plate 9 ***Perched iron culvert on Stream 1 with brown, iron-stained water.***

Plate 10 ***Dammed pond on Stream 3 just above the farm crossing. Note bank erosion caused by cattle and algae on the pond surface***.

APPENDIX 1 STREAM DEFINITIONS AS SET OUT IN THE AUCKLAND UNITARY PLAN CHAPTER J.

Permanent river or stream: The continually flowing reaches of any river or stream

Intermittent stream: Stream reaches that cease to flow for periods of the year because the bed is periodically above the water table. This category is defined by those stream reaches that do not meet the definition of permanent river or stream and meet at least three of the following criteria:

a) *it has natural pools;*
b) *it has a well-defined channel, such that the bed and banks can be distinguished;*
c) *it contains surface water more than 48 hours after a rain event which results in stream flow;*
d) *rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel;*
e) *organic debris resulting from flood can be seen on the floodplain; or*
f) *there is evidence of substrate sorting process, including scour and deposition*.

APPENDIX 2 KEY WATERCOURSES AT THE SITE