Stream Assessment Report

FOR THE PROPOSED DEVELOPMENT AT 6 TEITEI DRIVE OHAKUNE

GILES TAIT - KĀINGA ORA – HOMES AND COMMUNITIES

15 JUNE 2023

www.kahuenvironmental.co.nz
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1 Background

Kāhu Environmental was asked to investigate and assess the presence of natural waterways and type, and to assess ecological values associated with waterways on the site of a proposed residential development at 6 Teitei Drive Ohakune.

The development has three stages, with Stage 1 being assessed within this report. We considered overall ecological values (associated with waterways), connectivity with other waterbodies and the floodplain and the wider catchment context.

The initial scope of field work included the following tasks:

- Full site walk-over and rapid habitat assessments undertaken for the waterways and riparian areas, as well as eDNA samples (to help identify stream inhabitants such as tuna/eels, whitebait species/*Galaxiids* and any stream macroinvertebrates) at key locations. Locations of native and pest plant vegetation was recorded.
- Riffles, runs and pools, stream bed type and form, and in-stream habitat values were recorded.
- Photographs and GPS points of key values were taken.
- Confirm the presence of natural waterways, their permanence (definitions from Horizons 'Essential Freshwater' supporting material[1] and subsequent wetland definitions from schedule E (Horizons One Plan)[2]:

There are several potential wetland areas on site which should be delineated and assessed using the *Wetland Delineation Hydrology Tool for Aotearoa New Zealand*[3] which requires specialist expertise. This was undertaken by Morphum Environmental Ltd and is not covered in this report.

We acknowledge Ngāti Rangi as tangata whenua for this area and the relationship they have with their taonga including waterways, wetlands and whenua in this location.

[1] An **ephemeral waterway** is an area of land with no defined stream bed and which is above the water table at all times. It only flows during, and shortly after, rain events.

An **intermittent watercourse** is where stream reaches cease to flow for some periods of the year because the bed can be above the water table at times.

A **permanent watercourse** has continually flowing reaches of a river or stream.

Both intermittent and permanent streams will have an 'active bed' – this means the bed of a river that is intermittently flowing and where the bed is predominantly unvegetated and comprises sand, gravel, boulders or similar material.

[2] Wetland areas include **permanently or intermittently wet areas**, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions. The presence of water may be permanent, seasonal (ephemeral) or periodical, and is not always present as an open body.

Ephemeral wetlands are usually of moderate fertility and neutral pH, characterised by a marked seasonal high water table, ponding and drying. Change in water levels can be very dramatic to the point of complete drying and fluctuations between aquatic and terrestrial plant species can occur. Ephemeral wetlands are fed by groundwater or an adjacent waterbody. Ephemeral wetlands typically support turf habitat (generally < 3 cm tall). Ephemeral wetlands sometimes support rushland scrub.

[3] Ministry for the Environment. 2021. Wetland delineation hydrology tool for Aotearoa New Zealand. Wellington: Ministry for the Environment.

2 Catchment and wider ecological context

The site is part of the Whangaehu Catchment falls under the Te Waiū-o-Te-Ika Framework (co-governance of the Whangaehu River)[4]. It sits in the southern part of the Tongariro Ecological District identified by the Department of Conservation[5] and Horizons Regional Council[6].

- **Soils and geology:** soils are volcanic in origin and are part of the iconic central plateau. They consist of a combination of acidic soils (ash, pumice) over mostly hard sedimentary (greywacke) or hard volcanic rocks (ignimbrite, lavas)[7]. Maunga Ruapehu, an active stratovolcano, overlooks the site and contains the headwaters of streams and rivers in the area.

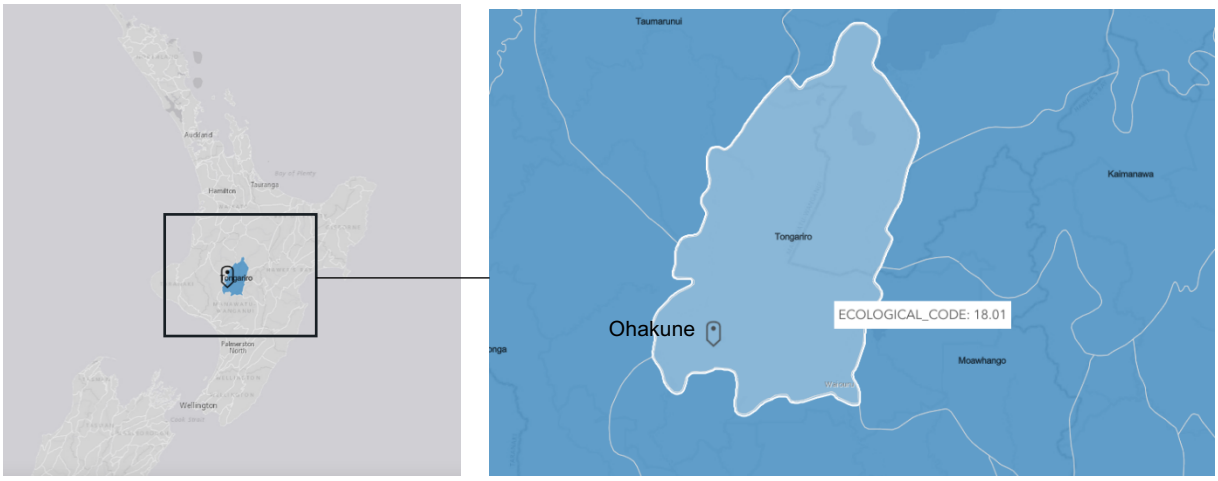

Figure 1 - Location map showing ecological district code (Tongariro). Source: Department of Conservation, open spatial data online[8]

- **Surrounding land use**: to the south and southwest is largely agricultural land use (*Figure 3*), and north of the site a large proportion of the upper catchment is public conservation area (Tongariro National Park or general public conservation land). It is also adjacent to urban zoned land.

[4] Iwi Relationships Quarterly Update, Report no' 19-172, Strategy and Policy Committee, 12 November 2019 https://www.horizons.govt.nz/HRC/media/Media/Agenda-Reports/Strategy-Policy-Committee-2019-12-11/19172%20Iwi%20Relationships%20Quarterly%20Update.pdf

[5] McEwen, WM (Editor), *Ecological Regions and Districts of New Zealand. Third revised edition, Publication No. 5 (Part 2),* 1987. New Zealand Biological Resources Centre, Department of Conservation, New Zealand,

[6] Native Plants for Riparian Margins Tongariro Ecological Area - https://www.horizons.govt.nz/HRC/media/Media/Water/201263Riparian-Planting-Guides-TONGARIRO-Copy.pdf?ext=.pdf

[7] Horizons Regional Council *River Classification of the Manawatu-Wanganui Region 14 to Support the Definition of the Life-Supporting Capacity Value,* 2007.

[8] Link: https://doc-deptconservation.opendata.arcgis.com/maps/edit?content=4f40397b253646f0a2ac6898ff4012c5_0

Figure 2 - Site in foreground, looking northeast to Mt Ruapehu in the distance.

- **Rivers and waterways:** The rivers in the area are cool, clear, and fast flowing, with rock, boulder or cobble beds. Waterways on the site are tributaries of the Mangawhero River catchment and join the awa some 5.5 kms downstream from the site. The Mangawhero then joins the Whangaehu River and flows through a large catchment to the Whanganui coast (*Figure 4*). These headwater streams are particularly important in the catchment context as they act as refuge areas for fish and kōura when pulses of acidic water come down from Maunga Ruapehu's crater lake.

- **Cultural context:** Waterways in the area are deeply important to Ngāti Rangi. This is reflected in numerous objectives in their Taiao Management Plan[9]. All waters within the Whangaehu catchment have statutory recognition under the Ngāti Rangi Claims Settlement Act 2019, and the Te Waiū-o-Te-Ika Framework within that Act. The Framework requires that decision-makers give weight to the intrinsic values of Te Waiū-o-Te-Ika, Ngā Toka Tupua.

[9] Hollei Gabrielsen. *Taiao Management Plan, First Edition* 2014 Published by: Ngāti Rangi Trust

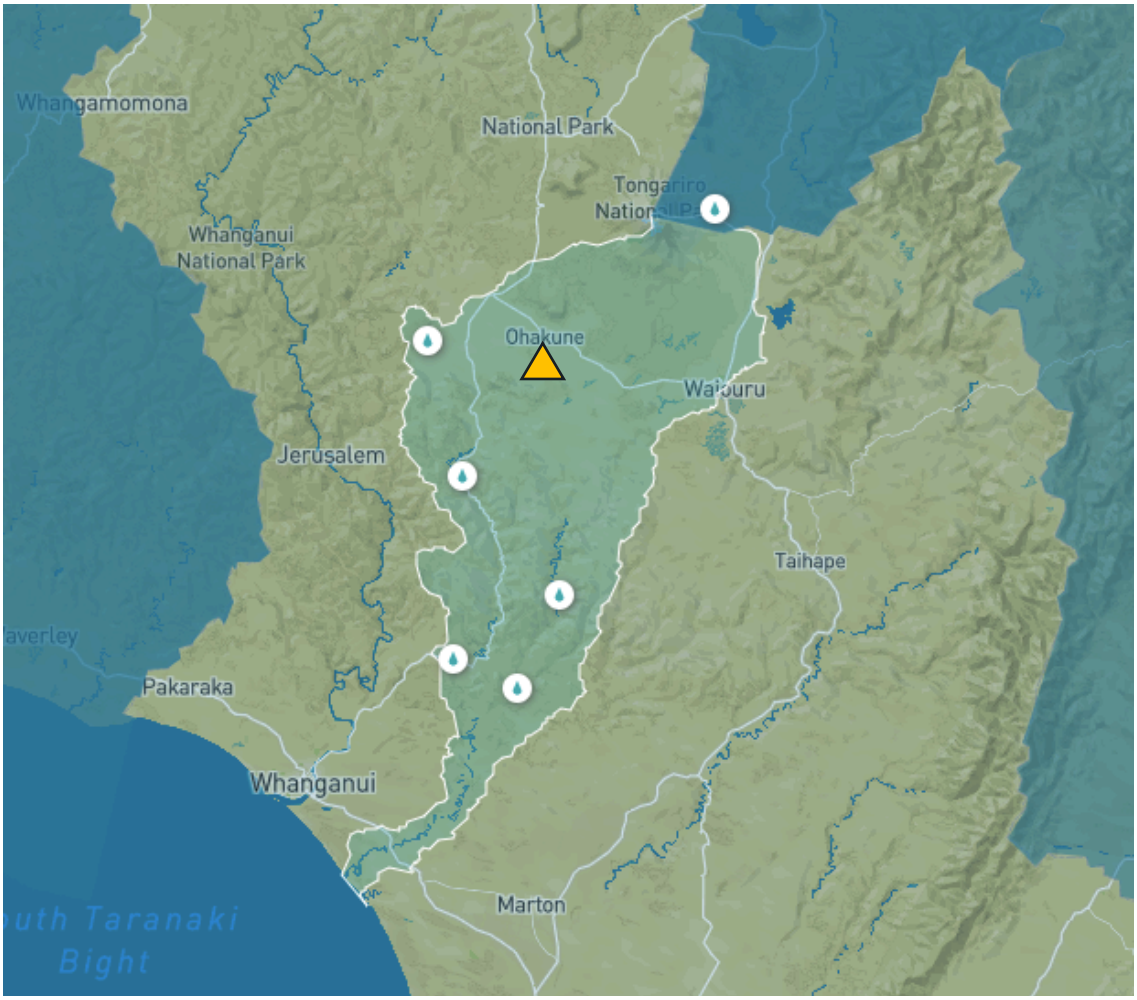

Figure 3 - Map of the extensive Whangaehu catchment within which the site sits (approx. location shown by orange triangle). Source: Land Air Water Aotearoa (LAWA)[10]

- **Historical landscape:** Historically the landcover was a mix of podocarps (native conifers) such as kahikatea, rimu, pukatea, tawa, mataī and totara[11]. Wetland areas were present close by, and their loss has been extensive. *Figure 5* shows historical wetland extent in relation to the development site and the scale of losses.

[10] LAWA - https://www.lawa.org.nz/explore-data/manawat%C5%AB-whanganui-region/water-quantity/surface-water-zones/whangaehu/

[11] Nicholas J.D. Singers and Geoffrey M. Rogers. *A classification of New Zealand's terrestrial ecosystems*. 2014, New Zealand Department of Conservation

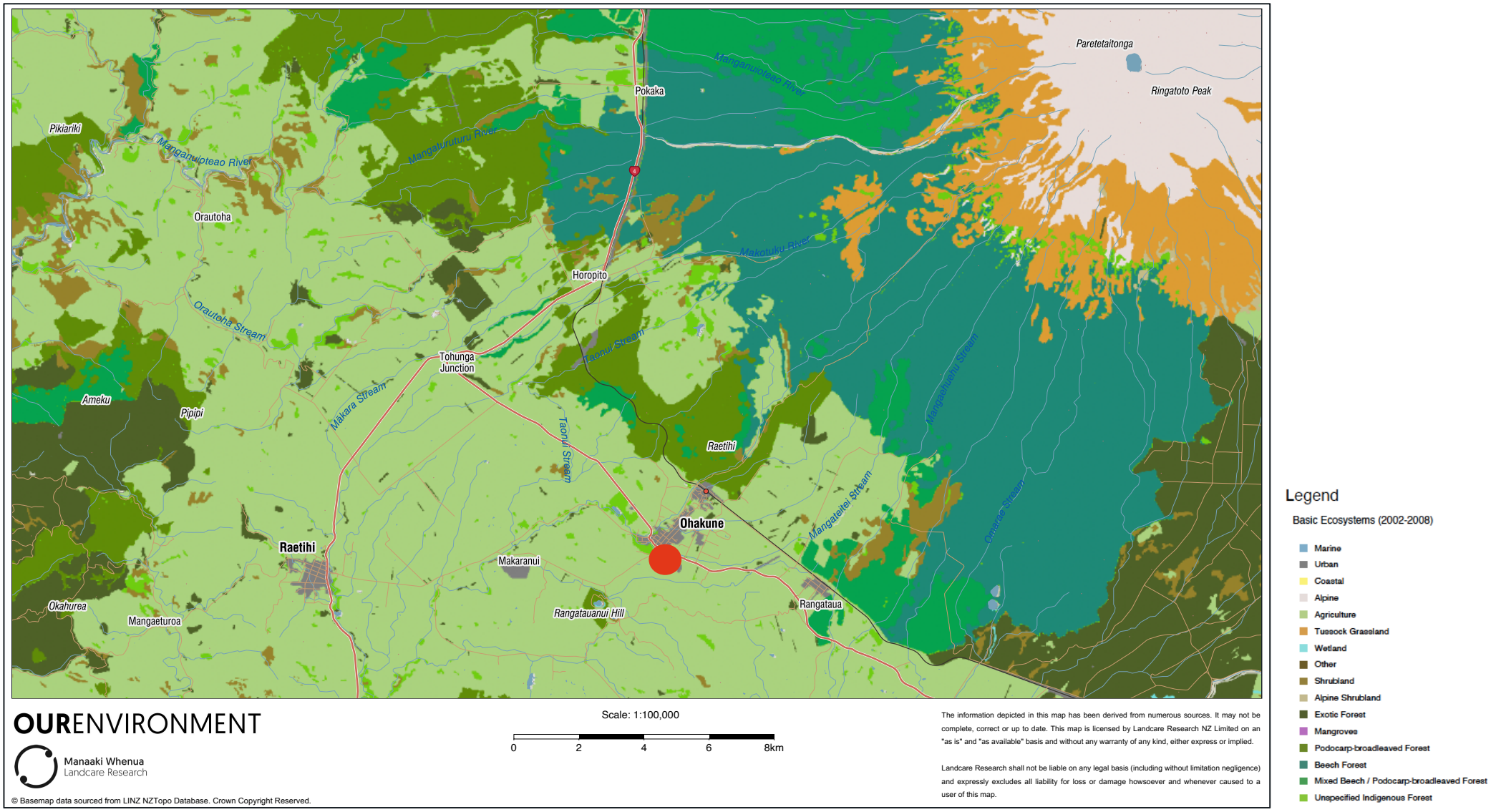

Figure 4 - Landscape map showing surrounding land use types, site location shown as red circle. Source: Manaaki Whenua – Landcare Research, Our Environment mapping portal

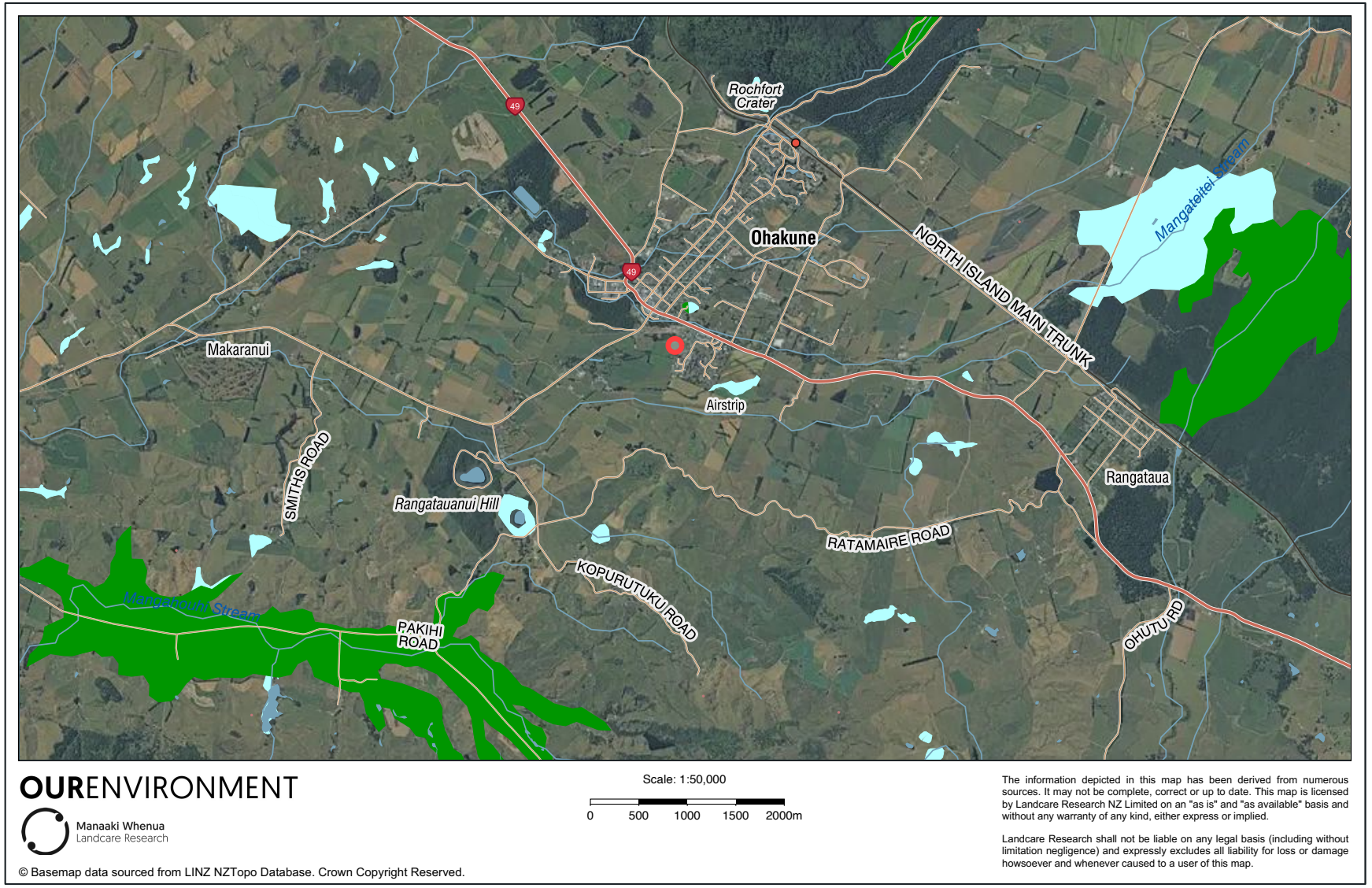

Figure 5 - Map of historical wetland extent, site location shown as red circle. Source: Manaaki Whenua – Landcare Research, Our Environment mapping portal.

3 Site Assessment

3.1 Site description

The site is very close to the Ohakune village, and the northern boundary of the site is adjacent to the Ohakune carrot adventure park. The current land use of the site is large mown paddocks with typical pasture grasses. In the past these paddocks were likely grazed and/or cropped. Morphum Environmental noted that the most recent use was likely to be for hay/silage (noting an old silage pit)[12] and this was confirmed on 30 May 23 when round bales were present in the paddocks.

On the day of our site visit (15 March 2023) it had rained within the 48 hours prior and while overland flow paths were not running, there was evidence that there had been water flowing through recently (wet mud, waterlogged ground).

3.1.1 Waterways

There are several waterways and suspected wetlands around the site. Our initial assessment noted three key waterways and wetted areas (potentially wetlands) (*Figure 6*).

Waterway A – Is part of a functioning wetland but appears to be disconnected hydrologically (in terms of surface water) due to past bunding/spoil placement.

Waterway B – Bisects the development site and flows from east to west. This is classified as an intermittent stream but could be upgraded to permanent (due to bed type(s) and flow regime) but would need to be assessed in the height of summer.

Waterway C – Manmade drainage channel, likely functioning as a stream and with potential for restoration and renaturalisation. Joins Waterway B at the western boundary of the site.

[12] Memo prepared by Andrew Rossaak, Science Team Leader, Morphm Environmental. Subject: Teitei Drive Wetlands and Stormwater. Dated 17 May 2023.

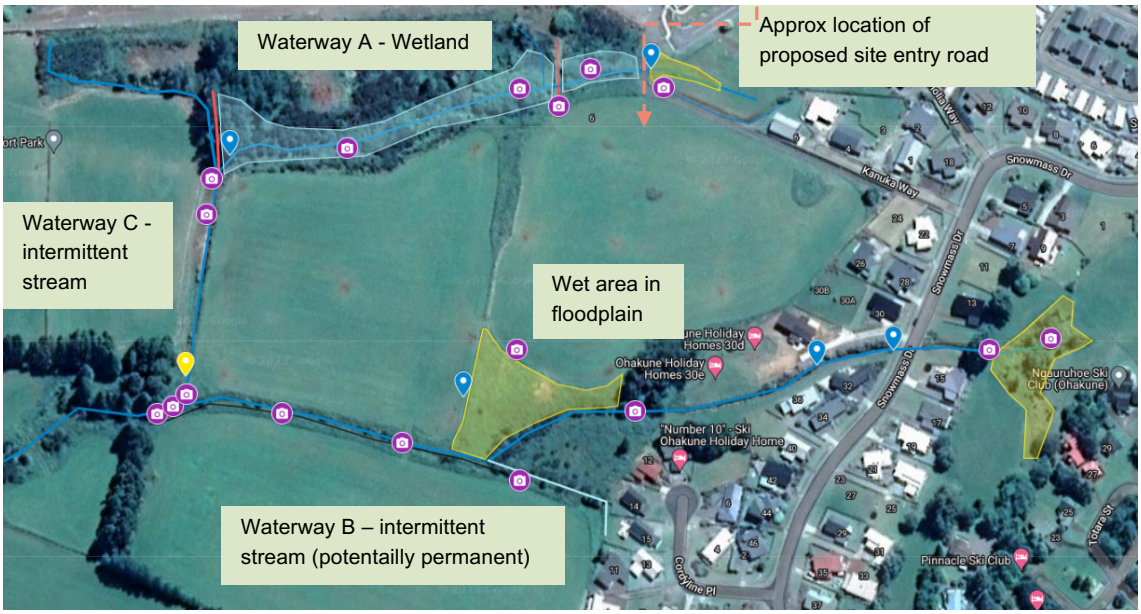

Figure 6 - Map of proposed development site with waterways and wet areas shown in yellow polygons or light blue lines/polygons.

3.2 Assessment methods and results

We used three assessment methods to identify stream type, permanence and stream habitat values.

1) Stream walk – the areas onsite thought to be streams and waterways were walked to better understand flow, bed composition, bank stability, stormwater inputs (if any) riparian margin width and composition. Waterway B was only accessible at two points due to a wide and thick blackberry thatch, and Waterway A was inaccessible at certain points for the same reason.

2) Environmental DNA (eDNA) sampling was undertaken using the standard six-replicate standard freshwater assay supplied and analysed by Wilderlab. This provides information on what species (macroinvertebrates, fish etc), other animals and invertebrate DNA may be present in the waterways.

3) Rapid Habitat Assessment (RHA)[13].

3.3 Key findings

Notes, data and site photos have been recorded on a live Google MyMap that can be found here:
https://www.google.com/maps/d/u/0/edit?mid=1F2gIEx8_lHmzw7tt32m8V7DQURWsnXk&usp=sharing

[13] Robin Holmes, Freshwater Ecologist – Fisheries Management and Biomonitoring. Cawthron https://www.cawthron.org.nz/research/our-projects/rapid-habitat-assessment-protocol/

A screen shot is provided below followed by summary notes for each of the areas assessed.

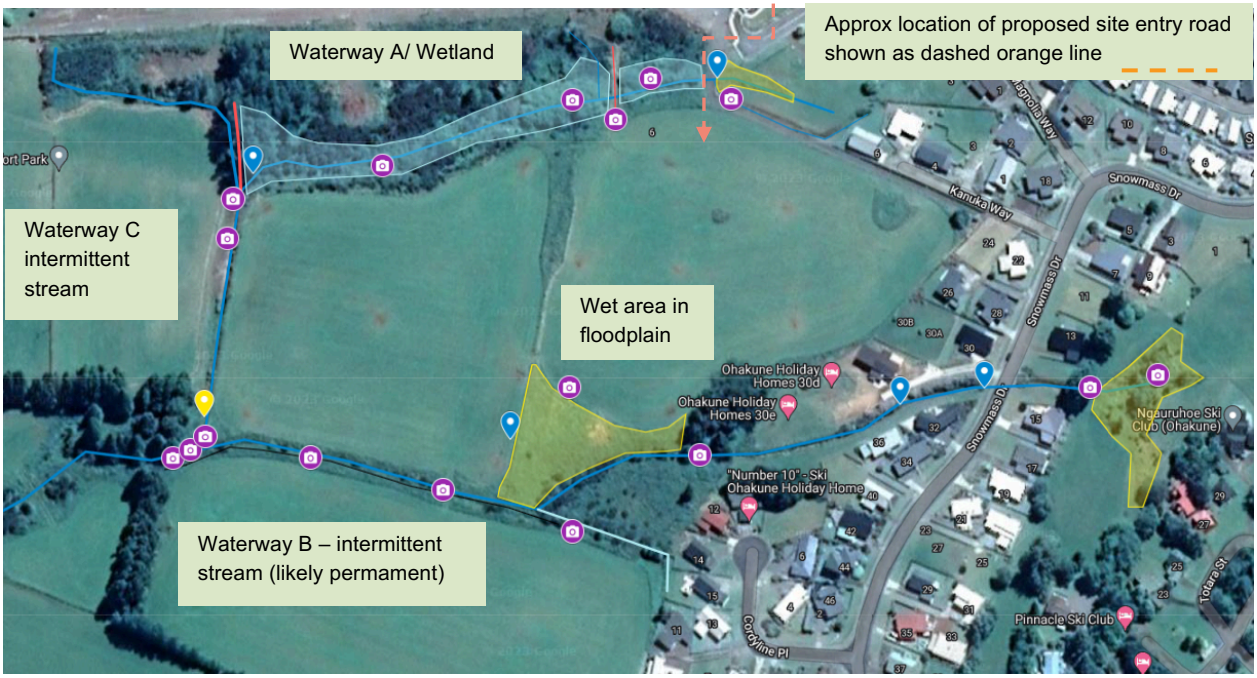

Figure 7 - Site assessment map

3.4 'Waterway A' - northern boundary of site

- This waterway has two initial branches, one an overland flow path (**ephemeral waterway**) and another smaller branch, potentially spring-fed or fed by sub-surface drainage. There is a pipe (novacoil/novaflow or similar) running from this branch connecting to a poorly functioning culvert (under pedestrian pathway from Teitei Dr).
- Water is held up here and over a period of time, seems to have formed a small boggy area with typically water or 'wet feet' tolerant plants such as *Ranunculus* (buttercup). This is shown in *Figure 8* as a small yellow polygon.
- This area has since been viewed by Morphum Environmental Ltd and is deemed likely to be a **wetland** (note this was not fully assessed). If the access road coming into the site cuts through adjacent to this wetland, this may need to be delineated and potentially characterised as a Natural inland Wetland or other wetland type against the NPS-FM and NES-F, and Te Waiū-o-Te-Ika

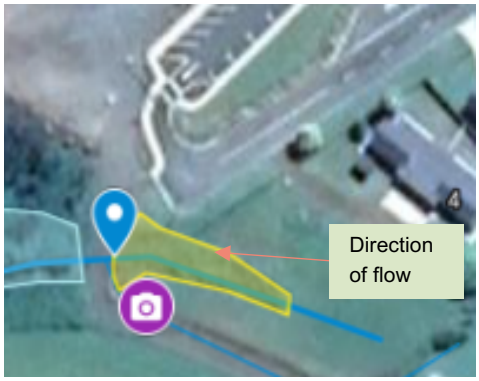

Figure 8 – Zoomed-in map view of ephemeral wet area

Figure 9 - Morphum Environmental's site map outlining discrete wet/boggy areas to assess and delineate.

Photos: Taken (15 March 23)

- The larger reach beyond the footpath and heading downstream (areas 2 and 3 in *Figure 9* and blue polygon in *Figure 10*) has been partly assessed by Morphum Environmental. The section of wetland that may be impacted by Stage 1 of the development is labelled as '2' in *Figure 9*. Morphum have confirmed that this is a **natural inland wetland** in the map provided in their wetland assessment report (Figure 11). The area will also need to be assessed against the NES-F. Large pools of standing water (at least 30cm deep in places) were present under willows and sub-canopy plants.

Figure 10 - Zoomed-in map view of approximate wetland area

Figure 11 - Assessed wetland area on site and location of assessment points. Source: Morphum Environmental

- The wetland area is well shaded (in summer) throughout, with some regenerating natives (including mānuka) but also several weed species such as willows, blackberry and broom.
- Blackberry and wasps limited access to some parts of this area.
- There is no obvious connection (i.e. culvert or confluence) to the modified stream (waterway C) between Rochfort Park (to the west) and the site. This appears to be bunded and cut off (perhaps by the formation of the drain around sports fields) so drainage from here would likely be through soakage to ground and overland flow (confirmed by Cheal in their hydrology report and *pers. comm.* with Ray Kilgour).

Photos of Waterway A - wetland area taken 15 March 23:

3.5 'Waterway B' – bisects development site.

Figure 12- Map view of Waterway B showing floodplain retention area (central yellow polygon) and headwater wetland off Snowmass Dr (yellow polygon on right)

- **Intermittent stream, potentially permanent** – There was good flow at the time of site visit, fed from headwater wetland beyond Snowmass Dr. This stream would flow or have water in pools most of the year and has a developed and largely stable stream bed. Ideally this would need to be reassessed in summer to confirm flow and/or presence of pools.
- There are additional stormwater inputs from Turoa Village.
- The lower reaches (downstream from yellow polygon in *Figure 12*) are very overgrown and almost completely inaccessible due to thatch of blackberry, but some mānuka and other natives are popping up above the blackberry in places.

- In the middle reaches above the culvert, water was held up by the root systems of the large established trees (conifers). This had formed deeper pools of slower flowing water and monkey mist (aquatic weed) has established here where there was more direct sunlight.
- The substrate is a well formed, stable bed of mainly small cobbles, large gravels and bedrock (seen from crossing and below confluence with Waterway C)
- RHA 63/100 – this area scored well due to shade from blackberry. It also has good substrate/habitat for fish and macroinvertebrates (root mats, woody debris, gravels and undercut banks - seen below confluence), and good flow variances (pools, runs, riffles - albeit on a small scale) that could be seen through gaps in the blackberry.
- There is one main crossing/culvert (mid-site) which would be good to assess for fish passage using the Fish Passage Assessment Tool (unable to do this at the time due to lack of access). However, we understand this will likely to be upgraded when forming the roads and pathways for the development.
- We were unable to sample for eDNA from this reach due to inaccessibility and poor sampling conditions.

- There are wetland/wet-feet loving plants present in the large unmown/triangular area adjacent to the stream (shown in *Figure 13* on the MyMap as the larger yellow polygon mid-site). This appears to act as a floodplain/flood water retention area and was assessed by Morphum Environmental for wetland attributes. The vegetation complex was inconclusive in determining wetland status (facultative species). The absence of hydric soils (soil types associated with wetland/inundation) and wetland hydrology confirmed that this area was not a Natural Inland Wetland [14] for NES-F purposes. It may yet have other values and statutory protections which the project will have to clarify.

Figure 13 - Zoomed-in map view of floodplain retention area

[14] Memo prepared by Andrew Rossaak, Science Team Leader, Morphm Environmental. Subject: Teitei Drive Wetlands and Stormwater. Dated 17 May 2023.

Photos of Waterway B, taken 15 March 23

3.6 ‘Waterway C’ – highly modified stream

(Previously labelled ‘Waterway X’ in initial site visit summary memo).

- This is a modified stream running along the western boundary of the site, and does not seem to be connected to 'Waterway A' (wetland)
- Assessed as an **Intermittent stream.**
- It still had some low flow more than 24-48hrs after rain.
- It appears to have been modified to become a steep-sided drainage channel, and now has with native ferns (kiokio) and other species regenerating.
- The stream bed is vegetated (grasses) but with a soft sediment underneath.
- Rapid habitat assessment (RHA) 36/100 – scored better than most ‘highly modified streams’ for shade due to steep sided bank, overhanging vegetation and flow.
- eDNA results show a typical array of species adapted to this type of waterway, including some aquatic macroinvertebrate indicator species including some ‘sensitive’ taxa (Caddisflies). No fish (e.g. tuna/eel) DNA was identified in this reach. Full species list can be found in Appendix A.

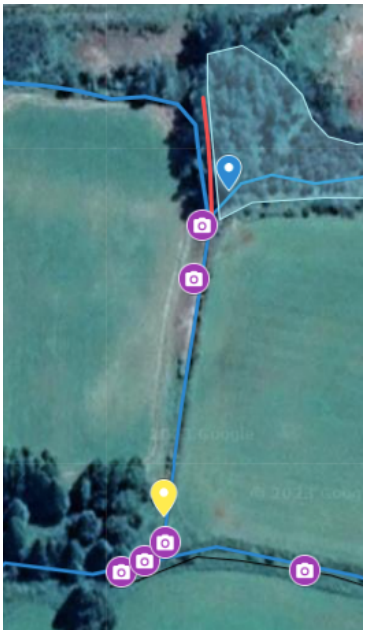

Figure 14 - Zoomed-in map view of ‘Waterway C'

Photos of Waterway C taken 15 March 23

All water, whether running or standing in pools in each waterway was very clear and cool which shows the positive effects of shade (albeit largely from exotic species) and riparian stability (indicating minimal erosion/sedimentation). Both of these aspects are important for aquatic species and overall stream health.

4 Stream assessment – effects management

The EIANZ (2018) [15] effects assessment process considers the magnitude and overall level of the effect against the values affected. Stage 1 of the development affects the stream ('Waterway B') and the identified wetland area along the northern boundary of the site. Referring to the Ecological Impact Assessment (EcIA) EIANZ guidelines has allowed us to record in a standardised way the ecological value and quality of the existing wetland and stream areas, however it does not take into account values and objectives set out by Ngāti Rangi in Te Waiū-o-Te-Ika.

Avoiding any further stream and wetland loss is a key objective in the Ngāti Rangi Taiao Management Plan.

Where stream loss cannot be **avoided**, effects must be **remedied** or **mitigated**.

[15] Ecological Impact Assessment (EcIA) EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems 2nd EDITION May 2018

Effects assessment and management:

Summary

We have assessed the effects of Stage One of the development on streams within Stage One. This is shown in *Figure 14* below.

Figure 15 - Site development overlay with current site conditions underneath, red circles denote areas that will need detailed planning to address effects on streams. Stage 1 shown as yellow dashed line.

Map labels in *Figure 14* are referred to in the following section.

4.1 Waterway B (site one) Assessment

1 Impact Site One: Culverting of the stream (Waterway B) to form roads.

Two sections of stream (Waterway B and a small low-flow tributary) will be culverted to form roads in Stage One of the development.

Potential effects (without mitigation or controls):

Stream Loss

- There will be stream extent loss with associated groundworks/earthworks and disturbance of approximately[16]
    - 58m and 116m2 (based on an average 2m width) for Waterway B and;
    - 25m and 37.5m2 (based on 1.5m average width) for the small tributary.
- Changes to stream flows through creation of impervious areas and riparian habitat loss as a result of road and pavement formation, and culvert installation. Flows after rain events will have higher velocities and therefore more chance of causing stream bed and bank erosion.
- Changes to bed and banks of stream upstream and downstream as part of culvert installation earthworks.

Sediment Release due to instream works

- Uncontrolled sediment release smothering stream bed, filling interstitial spaces and stressing stream life (impacting respiration, ability to forage etc.)

Habitat Disturbance and species mortality

- In-stream habitat loss – loss of low flow pools, riffles and runs (key habitat areas for fish and macroinvertebrates) and connectivity.
- Riparian habitat loss – loss of shade and bank stability allowing sunlight to reach the stream increasing the likelihood of nuisance algae and macrophyte growth (changing in-stream habitat and clogging stream channel).
- Impact on stream life – mortality from in-stream and bankside machine operation, total loss of habitat and niche areas.

Stream values and functions lost at the (impact) site include those that are degraded or lost as a result of the development

Effects Management:

Culvert installation must follow industry best practice guidelines to minimise the impact on both the upstream and downstream receiving environment. The installation of culverts, and the culverts themselves will meet fish passage requirements, flow management requirements and best practice design guidelines. Effects management options include:

[16] Measurements taken from initial stormwater design schemes provided by Cheal

Stream Loss

- Conducting works in summer months where stream flows are low or not flowing and according to industry best practice guidelines.
- Installation of larger diameter culverts, embedded by 25-50% of culvert height with appropriate water depths (150mm for native fish passage) and with elements (such as baffles) to provide flow diversity within the culverts according to the New Zealand Fish Passage Guidelines[17]
- Ecological restoration of up and downstream of impact site.
- Reinstate meanders and some sinuosity downstream by adding large woody elements to recreate or improve flow diversity (pools, riffles, runs).
- Reinstate and rebatter stream banks impacted by earthworks.

Habitat Disturbance and species mortality

- Install a temporary stream bypass during culvert installation to maintain fish passage.
- Plan for and implement an active fish and kōura salvage prior to and during instream works. This should be done in summer when flows are at their lowest (base flow).
- Maintain flow natural in stream at all times.
- Retain native riparian trees where possible.

Sediment Release due to instream works

- Use best practice methods and specifications for sediment and erosion control, and earthworks in and around waterways.
- Replant with ecosourced natives along all riparian areas onsite to a buffer width of at least 10m on each bank for the remainder of Waterway B, upstream and downstream (approx. 250m total)

4.2 Assessment tables

These assessments have been made on the areas effected by Stage 1 of the development and the following tables are derived from the EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems (2018)[18]

[17] Franklin, P & Gee, E & Baker, C & Bowie, S. (2018). New Zealand Fish Passage Guidelines: for structures up to 4 metres.

[18] Ecological Impact Assessment (EcIA) EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems 2nd EDITION May 2018

4.2.1 Waterway B – stream:

Table 1 below provides an assessment of the ecological values of the aquatic habitat and riparian vegetation in the proposed works area using the assessment matters from the Environment Institute of Australia and New Zealand (EIANZ) 2018 Ecological Impact Assessment Guidelines. Considering these factors, the overall stream ecology for Waterway B is given a **moderate value.**

Table 1 - EIANZ assessment summary for Waterway B (stream)

Assessment Matter	Ecological Value (EIANZ, 2018)	Reasoning
Representativeness	**Moderate**	Likely a permanent stream but modified and straightened for past agricultural land use. Now has low flow diversity, but a relatively stable bed and good substrate/in-stream habitat.
Rarity/distinctiveness	**Low**	Unable to ascertain fish species present (not able to sample eDNA), but currently well shaded with some good instream habitat. Riparian biodiversity could be enhanced relatively easily through weed control and restoration.
Diversity and pattern	**Moderate**	Reasonable diversity of in-stream habitat (pools, riffles and runs) in sections of the stream. Stream appears to be straightened and channelised but in low flow situations water naturally meanders. Riparian margins dominated by blackberry and other exotic species, but natives are present
Ecological context	**Low**	First order watercourse (in the Whangaehu River catchment). Now receiving stormwater inputs from neighbouring Turoa Village. Banks have been steepened and straightened to aid in flood flow mitigation when the site was used for agricultural purposes in the past. Upper catchment/headwater streams are important areas to protect and enhance for positive downstream impacts and to the nature of the Whangaehu River (pulses of acidic water) these upstream areas are also important refuge areas for fish and kōura.
Overall	**Moderate**	Stream rates ‘low’ for two of the four assessment matters and ‘moderate’ for two so scores MODERATE overall.

4.2.2 Assessment of levels of effects:

The approach EIANZ use to assess the level of an effect is by using a combination of the magnitude of the effect and the value of the affected ecological component.

The magnitude of effect is a measure of the extent or scale of the impact and the degree of change that it will cause. The scale of magnitude has a range from very high/severe to negligible.

The tables used to assess the levels of effects are in Appendix B from the EcIA guidelines.[19]

The magnitude of effects has been assessed as **moderate** due to the size and scale of the stream and it's interconnectedness with the Whangaehu River. Headwater streams/tributaries act as important refuge areas for fish and kōura during pulses of acidic water from Maunga Ruapehu.

The overall assessment for the level of effects on Waterway B when effects are mitigated are **low,** with a potential net gain if mitigation and offsetting opportunities are fully utilised.

[19] Ecological Impact Assessment (EcIA) EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems 2nd EDITION May 2018

Table 2 – EIANZ Assessment of effects summary table

Ecological component	Ecological value (EIANZ, 2018)	Magnitude of effect and reasoning relative to baseline conditions.	Level of effect (based on proposed methodology and design)	Proposed Effects management	Level of Effect with Mitigation
Stream (Waterway B)	**Moderate**	**Moderate**	**Moderate**		**Low/Potential Net Gain**
Stream Loss		Low flow, modified (channelised) stream with existing stormwater inputs		Ecological restoration upstream and downstream (including remediation) of impact site (i.e. native enhancement planting and maintenance until canopy closure). Adding large woody debris to recreate meanders and flow diversity.	
Habitat Disturbance and species mortality		Good instream fish and macroinvertebrate habitat, and good (albeit naturally low velocity) flow regime		Flow will be maintained and unchanged according to industry best practice standards Active fish and kōura salvage immediately prior to, or when installing culverts Retain native tree species where possible. Installation of larger diameter culverts, embedded by 25-50% of culvert height with appropriate water depths (150mm for native fish passage) and with elements (such as baffles) to provide flow diversity within the culverts	

				according to the New Zealand Fish Passage Guidelines	
Sediment release due to instream works		Substrate consists of cobbles, large gravels with tracts of bedrock which are all subject to smothering and filling of interstitial spaces with sediment. Unchecked sediment release has far reaching and long term effects on stream life, habitat and the receiving environment(s) further down the catchment.		Best practice methods and specifications used for sediment and erosion control, and earthworks in and around waterways. Remove pest plants and plant with eco-sourced natives along all riparian areas onsite to a buffer width of at least 10m on each bank for the remainder of Waterway B, both upstream and downstream (approx. 250m total). Maintain plantings (releasing plants, weed control etc) until canopy closure.	

Ecological enhancement opportunities

- Restore the remaining length of stream (upstream and downstream), removing weed species and planting riparian areas with with eco-sourced native plants. Riparian planting is required within a buffer zone that provides a planted width of at least 10m (this may be wider in places) on each bank for the remainder of Waterway B, upstream and downstream (approx. 250m and upwards of 5000m2). Current riparian shade and instream habitat will not improve to a much higher level due existing shading by blackberry, currently providing excellent shade. However, increasing native riparian biodiversity as an alternative to introduced pest species (such as blackberry) will improve wider ecological values by providing bird, insect and lizard habitat.

- Consider adding Waterway C as an additional offset opportunity – re-naturalise and restore adding meanders/sinuosity, in-stream and riparian biodiversity. There is potential to add 130m (or more) of restored stream length and upwards of 2000m2 using at least 10m wide buffers.

5 Recommendations

General recommendations regarding stream ecology

- Consider streams/waterways as key functional aspects on the site but also as part of the natural amenity of the development. This can weave together social outcomes (connectivity, recreation, visibility, and safety) as well as enhancing ecological outcomes.

- Commission a site-wide **ecological restoration plan** for streams and wetlands, this will help to prioritise the stages of enhancement for riparian areas across the site.

- Keep the proposed setback (designated reserve area of 27.3m width) for 'Waterway B' and extend where possible to incorporate pathways and recreational elements. Fully plant this area with native plants and maintain until canopy closure. Further to this, we recommend:

    - The removal of pest plant species such as blackberry, broom, Japanese honeysuckle and willow and plant with ecosourced native plants.

    - Control monkey mist (aquatic weed) in Waterway B.

- The streams on site (Waterways B and C) have excellent potential through restoration to become high quality habitat areas for tuna/eels and kōura – these are taonga species for mana whenua and good indicators of stream health.

Appendix A – Full eDNA results

eDNA results from **Waterway C** (highly modified, intermittent stream)

ScientificName	Rank	TaxID	CommonName	Group	529608	529617	529616	529619	529613	529609
Cochliopodium kieliense	species	1512276	Amoeba	Amoebae	47	12	0	0	12	0
Vexillifera bacillipedes	species	1105345	Amoeba	Amoebae	0	0	0	5	0	7
Cochliopodium larifeili	species	1017091		Amoebae	0	0	0	5	0	0
Cochliopodium	genus	313557	Amoeba	Amoebae	0	0	0	0	8	0
Tubulinea	phylum	555369		Amoebae	0	7	23	7	57	49
Euamoebida	order	180229		Amoebae	0	0	0	0	16	13
Litoria	genus	8370	Australasian tree frogs	Amphibians	163	0	0	0	0	0
Turdus philomelos	species	127946	Song thrush	Birds	168	0	0	44	0	0
Turdus	genus	9186	Thrush	Birds	0	0	615	0	0	0
Hydra viridissima	species	6082	Hydra	Cnidarians	10	0	5	0	9	4
Acanthocyclops robustus	species	415614	Copepod	Crustaceans	0	0	142	88	210	1823
Paracyclops fimbriatus	species	1606834	Copepod	Crustaceans	0	0	0	5	11	89
Porcellio scaber	species	64697	Woodlouse; Slater	Crustaceans	0	0	0	5	16	28
Arcitalitrus	genus	1238132		Crustaceans	0	0	8	5	32	27
Chydorus	genus	77744		Crustaceans	0	0	4	0	10	26
Cryptocandona	genus	1112805		Crustaceans	0	0	0	0	4	0
Malacostraca	class	6681		Crustaceans	0	0	0	0	21	0
Nitzschia acidoclinata	species	1302829	Diatom	Diatoms	0	10	4	0	0	4
Nitzschia cf. fonticola 2 RT-2009	species	684903	Diatom	Diatoms	0	5	0	0	0	0

Nitzschia	genus	2857	Pennate diatom	Diatoms	0	0	0	0	4	4
Pinnularia	genus	216736	Freshwater diatom	Diatoms	0	0	0	0	4	0
Sellaphora	genus	216740	Diatom	Diatoms	0	0	0	0	0	4
Ascomycota	phylum	4890	Ascomycetes	Fungi	0	0	9	0	9	30
Chrysophyceae sp.	species	1955566		Heterokont algae	0	0	0	0	0	8
Spumella sp.	species	1955568	Golden-brown alga	Heterokont algae	0	0	0	0	0	8
Spumella	genus	89043	Golden-brown alga	Heterokont algae	0	7	23	8	14	32
Oomycota	phylum	4762		Heterokont algae	14	24	17	18	32	147
Ochrophyta	clade	2696291		Heterokont algae	5	5	14	0	39	30
Phaeophyceae	class	2870	Brown algae	Heterokont algae	0	0	0	0	0	14
Bacillariophyta	phylum	2836	Diatoms	Heterokont algae	4	0	0	0	0	0
Psilochorema mimicum	species	697960	NZ caddisfly	Insects	0	7	29	0	71	108
Corynoneura scutellata	species	611450	Non-biting midge	Insects	6	0	16	0	88	93
Liposcelis decolor	species	209926	Booklouse	Insects	0	0	0	0	0	47
Polyplectropus aurifuscus	species	1875897	Caddisfly	Insects	0	0	6	0	22	0
Monomorium antarcticum	species	612165	Southern ant	Insects	0	0	0	0	0	15
Rhopalosiphum padi	species	40932	Bird cherry-oat aphid	Insects	0	0	0	0	5	9
Nearctaphis bakeri	species	1074823	Aphid	Insects	0	0	0	0	8	4
Ectopsocus briggsi	species	322492	Psocopteran fly	Insects	0	0	0	4	0	6

Merophyas divulsana	species	1375107	Lucerne leaf roller	Insects	0	0	0	0	8	0
Oxyethira albiceps	species	697957	Micro caddisfly	Insects	0	0	0	0	0	7
Tuberolachnus salignus	species	96551	Giant willow aphid	Insects	0	0	0	0	6	0
Triplectides cephalotes	species	144281	Caddisfly	Insects	0	0	0	0	6	0
Smittia sp. 8ES	species	1473756		Insects	0	0	0	0	0	6
Rhopalomyia sp. BIOUG23125-E04	species	2381684	Gall midge	Insects	0	0	0	0	6	0
Nezara viridula	species	85310	Southern green stink bug	Insects	0	0	0	0	4	0
Triplectidina	genus	698010	Caddisfly	Insects	0	0	10	0	18	32
Limnophyes	genus	190098	Non-biting midge	Insects	0	5	12	0	23	14
Ectopsocus	genus	239222	Psocopteran fly	Insects	0	0	0	0	0	7
Calliphora	genus	7372		Insects	0	0	0	0	0	6
Limoniidae	family	43823		Insects	0	0	16	0	46	13
Psychodinae	subfamily	41832	Moth flies	Insects	0	0	0	0	4	5
unclassified Limnophyes	no rank	2640025		Insects	0	0	0	0	6	5
Endopterygota	cohort	33392		Insects	0	0	0	0	0	9
Ponerini	tribe	141711		Insects	0	0	0	0	0	5
Lepidoptera	order	7088	Butterflies and moths	Insects	0	0	0	0	4	0
unclassified Pseudolycoriella	no rank	2633934		Insects	0	0	0	0	4	0
Mus musculus	species	10090	House mouse	Mammals	408	651	17	109	180	561
Trichosurus vulpecula	species	9337	Common brushtail possum	Mammals	50	216	32	0	164	10
Canis lupus familiaris	subspecies	9615	Dog	Mammals	195	0	0	0	0	0
Rattus rattus	species	10117	Black Rat	Mammals	104	0	0	0	0	0

Trichoribates incisellus	species	1979928		Mites and ticks	44	0	0	0	0	0
Platynothrus peltifer	species	128015	Mite	Mites and ticks	15	0	0	0	0	0
Acalitus vaccinii	species	1602339		Mites and ticks	0	0	0	0	6	0
Sarcoptiformes	order	83137		Mites and ticks	0	0	0	0	0	5
Potamopyrgus antipodarum	species	145637	Mud Snail	Molluscs	585	2031	23	257	14	14
Physella acuta	species	109671	Left handed sinistral snail	Molluscs	0	10	10	6	52	55
Deroceras reticulatum	species	145610	Grey field slug; Grey garden slug	Molluscs	0	0	0	0	15	40
Potamopyrgus	genus	145636	Mud snails	Molluscs	728	3062	39	437	80	132
Arion	genus	6542		Molluscs	0	0	0	0	28	31
Ophyiulus pilosus	species	118470	Millipede	Other	0	0	0	0	4	10
Chaetonotus	genus	68038	Gastrotrich	Other	9	10	6	5	6	0
Phalangium	genus	118623		Other	0	0	0	4	0	0
root	no rank	1	Unidentified	Other	8355	6073	6919	10597	7669	9171
Metazoa	kingdom	33208	Metazoans	Other	573	377	317	4428	579	430
Arthropoda	phylum	6656	Arthropods	Other	393	33	420	43	321	301
Chordata	phylum	7711	Chordates	Other	550	187	104	182	35	73
Insecta	class	50557	Insects	Other	0	8	28	742	77	141
Mollusca	phylum	6447	Molluscs	Other	29	68	0	0	0	0
Euteleostomi	clade	117571	Bony vertebrates	Other	90	0	0	0	0	0
Eukaryota	superkingdom	2759	Eucaryotes	Other	0	0	5	0	7	42
Annelida	phylum	6340	Annelid worms	Other	0	6	6	0	13	23

Mammalia	class	40674	Mammals	Other	13	0	0	0	0	0
Rotifera	phylum	10190	Rotifers	Other	0	0	0	0	8	0
Rhodophyta	phylum	2763	Red algae	Other	0	0	6	0	0	0
Pancrustacea	clade	197562		Other	0	0	0	0	0	4
unclassified Rhabditida	no rank	331533		Other	0	0	0	0	4	0
Nothocladus ater	species	69142	Red algae	Red algae	0	4	0	0	8	0
Florideophyceae	class	2806		Red algae	5	0	24	21	0	5
Rotaria sp. Rot1	species	764085	Rotifer	Rotifers	0	0	38	23	0	0
Testudinella patina	species	525915		Rotifers	0	0	0	0	13	16
Habrotrocha elusa elusa	subspecies	1548227	Rotefer	Rotifers	18	0	0	0	0	0
Adineta vaga	species	104782	Rotifer	Rotifers	0	0	0	0	0	16
Rotaria rotatoria	species	231624	Rotifer	Rotifers	0	0	0	0	0	11
Adineta steineri	species	433720		Rotifers	5	0	0	0	0	0
Lecanidae	family	96444		Rotifers	0	0	0	0	6	0
Eurotatoria	class	2816136		Rotifers	11	0	7	0	0	10
Tenuiphantes	genus	187192	sheet weaver spiders	Spiders	0	0	0	0	69	4
RTA clade	clade	94020		Spiders	0	0	0	0	5	0
Poduromorpha	order	730331		Springtails	0	0	0	0	0	25
Nais communis/variabilis complex sp. A1	species	1138460	Sludgeworm	Worms	4849	3767	4134	543	190	586
Chaetogaster diastrophus	species	74727	Oligochaete worm	Worms	1055	1332	3708	3647	799	363
Nais communis	species	188228	Sludgeworm	Worms	3072	1285	2219	120	165	96
Lumbricus rubellus	species	35632	Red earthworm	Worms	47	116	382	136	2263	3515
Lumbriculus variegatus	species	61662	Blackworm	Worms	78	98	406	153	1205	2814
Aporrectodea caliginosa	species	302032	Worm	Worms	0	0	0	0	29	222

Limnodrilus hoffmeisteri	species	76587	Redworm	Worms	0	0	14	0	79	28
Eiseniella tetraedra	species	1302610	Squaretail worm	Worms	0	0	0	0	0	48
Cernosvitoviella aggtelekiensis	species	913639	Worm	Worms	0	0	0	0	0	7
Octolasion cyaneum	species	302033	Worm	Worms	0	0	4	0	0	0
Nais	genus	74730	Sludgeworm	Worms	5477	4101	2761	5482	321	233
Lumbricus	genus	6397	Worm	Worms	0	15	0	0	57	67
Chamaedrilus	genus	1628347	Worm	Worms	0	0	0	0	7	0
Lumbricidae	family	6392		Worms	0	0	0	0	31	0
Enchytraeidae	family	6388		Worms	0	0	4	0	0	0
Lumbricus rubellus complex	no rank	1050932		Worms	0	0	29	8	0	48

Appendix B – EIANZ Assessment values and decision tables

Assessment values and decision tables derived from the EIANZ Guidelines for use in New Zealand: terrestrial and freshwater ecosystems.

Table 1 - Assigning value to species, vegetation, and habitats (summarised from EIANZ, 2018)

Value	Species Values	Vegetation/Habitat Values
Very High	Nationally threatened species found in the (Zone of Influence) ZOI[20] either permanently or seasonally	Area rates High for 3 or four attributes (Representativeness, Rarity/distinctiveness, Diversity and pattern, Ecological context). Likely to be national important and recognised as such
High	Species listed as At Risk – Declining, found in the ZOI either permanently or seasonally	Area rates High for 2 of the attributes, Moderate and Low for the remainder, or Area rates High for 1 assessment matters, Moderate for the remainder Likely to be regionally important and recognised as such
Moderate	Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally, or Locally (ED) uncommon or distinctive species	Area rates High for 1 assessment matters, Moderate and Low for the remainder, or Area rates Moderate for 2 or more of the attributes, Low or Very Low for the remainder Likely to be important at the level of the Ecological District
Low	Nationally and locally common indigenous species	Area rates Low or Very Low for majority of assessment matters and Moderate for 1 Limited ecological value other than as for habitat for tolerant native species
Negligible	Exotic species, including pest species having recreational value	Area rates Very Low for 3 matters and Moderate, Low or Very Low for remainder

[20] The Zone of Influence (ZOI) refers to all land, water bodies and receiving environments that could be potentially impacted by the project.

Table 2 - Criteria for describing level of effects (from EIANZ, 2018)

Magnitude	Description
Very High	Total loss of or major alteration to key features of the baseline condition causing a fundamental change or complete loss of the character, composition, or attributes of the site.
High	Major loss or major alteration to key features of the baseline condition causing a fundamental change of the character, composition, or attributes of the site.
Moderate	Loss or alteration of one or more key features of the baseline condition causing a partial change to the character, composition, or attributes of the site.
Low	Minor shift away from baseline conditions. Change may be discernible, but underling character, composition, or attributes of the site will be similar to pre-development.
Negligible	Very slight change from existing baseline condition. Change barely distinguishable.

Table 3 - Criteria for describing level of effects (from EIANZ, 2018)

Ecological Value	Very High	High	Moderate	Low	Negligible
Magnitude					
Very High	Very High	Very High	High	Moderate	Low
High	Very High	Very High	Moderate	Low	Very Low
Moderate	High	High	Moderate	Low	Very Low
Low	Moderate	Low	Low	Very Low	Very Low
Negligible	Low	Very Low	Very Low	Very Low	Very Low
Positive	Net gain	Net gain	Net gain	Net gain	Net gain

6 References

Franklin, P & Gee, E & Baker, & Bowie, S. (2018). *New Zealand Fish Passage Guidelines: for structures up to 4 metres*.

Gabrielsen, H. (2014). *Taiao Management Plan, First Edition,* Published by: Ngāti Rangi Trust

Horizons Regional Council (2007). *River Classification of the Manawatu-Wanganui Region 14 to Support the Definition of the Life-Supporting Capacity Value.*

Horizons Regional Council.12 November (2019). *Iwi Relationships Quarterly Update, Report no' 19-172,* Strategy and Policy Committee, https://www.horizons.govt.nz/HRC/media/Media/Agenda-Reports/Strategy-Policy-Committee-2019-12-11/19172%20Iwi%20Relationships%20Quarterly%20Update.pdf

McEwen, W.M. *Ed* (1987). *ECOLOGICAL REGIONS AND DISTRICTS OF NEW ZEALAND. THIRD REVISED EDITION NEW ZEALAND BIOLOGICAL RESOURCES CENTRE. Publication No. 5 (Part 2).* Department of Conservation, Wellington, New Zealand.

Ministry for the Environment (2021). *Wetland delineation hydrology tool for Aotearoa New Zealand. Wellington*: Ministry for the Environment.

Ngā Toka Tupua o Te Waiū-o-Te-Ika, Ngāti Rangi Claims Settlement Act 2019, S108

Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. (2018). *Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.*

Rossaak, A - Science Team Leader, Morphm Environmental. Memo prepared 17 May 2023. Subject: *Teitei Drive Wetlands and Stormwater.*

Singers, N and Rogers G. (2014). *A classification of New Zealand's terrestrial ecosystems*. New Zealand Department of Conservation

Online references and sources:

Department of Conservation, open spatial data online - https://doc-deptconservation.opendata.arcgis.com/maps/edit?content=4f40397b253646f0a2ac6898ff4012c5_0

Land Air Water Aotearoa (LAWA) - https://www.lawa.org.nz/explore-data/manawat%C5%AB-whanganui-region/water-quantity/surface-water-zones/whangaehu/

Manaaki Whenua – Landcare Research, Our Environment mapping portal - https://ourenvironment.scinfo.org.nz/maps-and-tools/app/

Native Plants for Riparian Margins Tongariro Ecological Area - https://www.horizons.govt.nz/HRC/media/Media/Water/201263Riparian-Planting-Guides-TONGARIRO-Copy.pdf?ext=.pdf

Rapid Habitat Assessment protocol - Robin Holmes, Freshwater Ecologist – Fisheries Management and Biomonitoring. Cawthron https://www.cawthron.org.nz/research/our-projects/rapid-habitat-assessment-protocol/

Disclaimer

We have used various sources of information to write this report. Where possible, we tried to make sure that all third-party information was accurate. However, it's not possible to audit all external reports, websites, people, or organisations. If the information we used turns out to be wrong, we can't accept any responsibility or liability for that. If we find there was information available when we wrote our report that would have altered its conclusions, we may update our report. However, we are not required to do so.

Prepared by:

Rachel Griffiths, BSc, BLA
ECOLOGIST

VERSION	DATE	AUTHOR	REVIEWER	COMMENTS
1				
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