Hauarahi Stream Report

Prepared for Ministry for the Environment
Prepared by Beca Limited

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Contents

Revision History

Revision N°	Prepared By	Description	Date
1	Emily Fensham	Draft for internal review	5/10/2023
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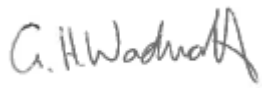
Reviewed by	Gemma Wadworth		18 October 2023
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1 Introduction

The Ministry for the Environment's (MfE) Access to Freshwater Experts Panel (A2E) is a new initiative to provide community groups, regional councils and iwi access to freshwater information and expert advice on freshwater restoration matters.

The project brief for this work was to prepare a report to aid the Western Firth Catchment Group (WFCG) and other stakeholders with restoration efforts along the Hauarahi Stream. It was indicated by WFCG that the priority section of the stream is between the coast at Kaiaua and Toft Road, therefore this section of stream is the focus of this report. The main challenges for the Hauarahi Stream include erosion hotspots and sediment loading, stock access, poor or absent riparian vegetation, fish passage barriers, degradation of inanga spawning habitat and flooding.

This report presents findings from previous reports and observations of current stream conditions to inform recommended monitoring and land management actions.

1.1 Purpose

- The present report will:
- Collate, analyse and present the findings of existing information and data from the Hauarahi Stream and wider catchment.
- Provide recommendations for future monitoring, and suggestions for prioritised land management actions.

1.2 Catchment Description

The Hauarahi Stream is located primarily within the Hunua Ecological District and is a part of the Hauarahi Catchment within the Miranda/ Pūkorokoro area, Firth of Thames. The catchment is approximately 1270 ha in size (Figure 1). Historically, lowland areas were covered by indigenous hardwood forest, kahikatea swamp forest, and mangroves in coastal areas (McEwan, 1987). Currently, two thirds of the catchment is pasture and the remaining one third is native vegetation located primarily within a Queen Elizabeth II National Trust (QEII) block which extends into the Hunua Ranges (Grant *et al.*, 2020). The Hauarahi stream originates from this native bush block and flows east for approximately 7 km, through the town of Kaiaua, towards the Firth of Thames.

The Firth of Thames is listed as an internationally important Ramsar site due to the unique Chenier plain landform which provides roosting and breeding habitat for internationally important and nationally threatened shorebird species including the eastern bar-tailed godwit (*Limosa lapponica baueri*) and the wrybill (*Anarhynchus frontalis*) (Department of Conservation, 2023). Layers of the Chenier plain can be found inland, within the soil profile of the exposed Hauarahi stream riverbanks. Underlying geology within this catchment is comprised of Holocene river deposits (Edbrooke *et al.*, 2014). The primary soil types include gley clayey / gleyed alluvial soils and ultic soils which are prone to waterlogging and are weathered (Manaaki Whenua, 2021).

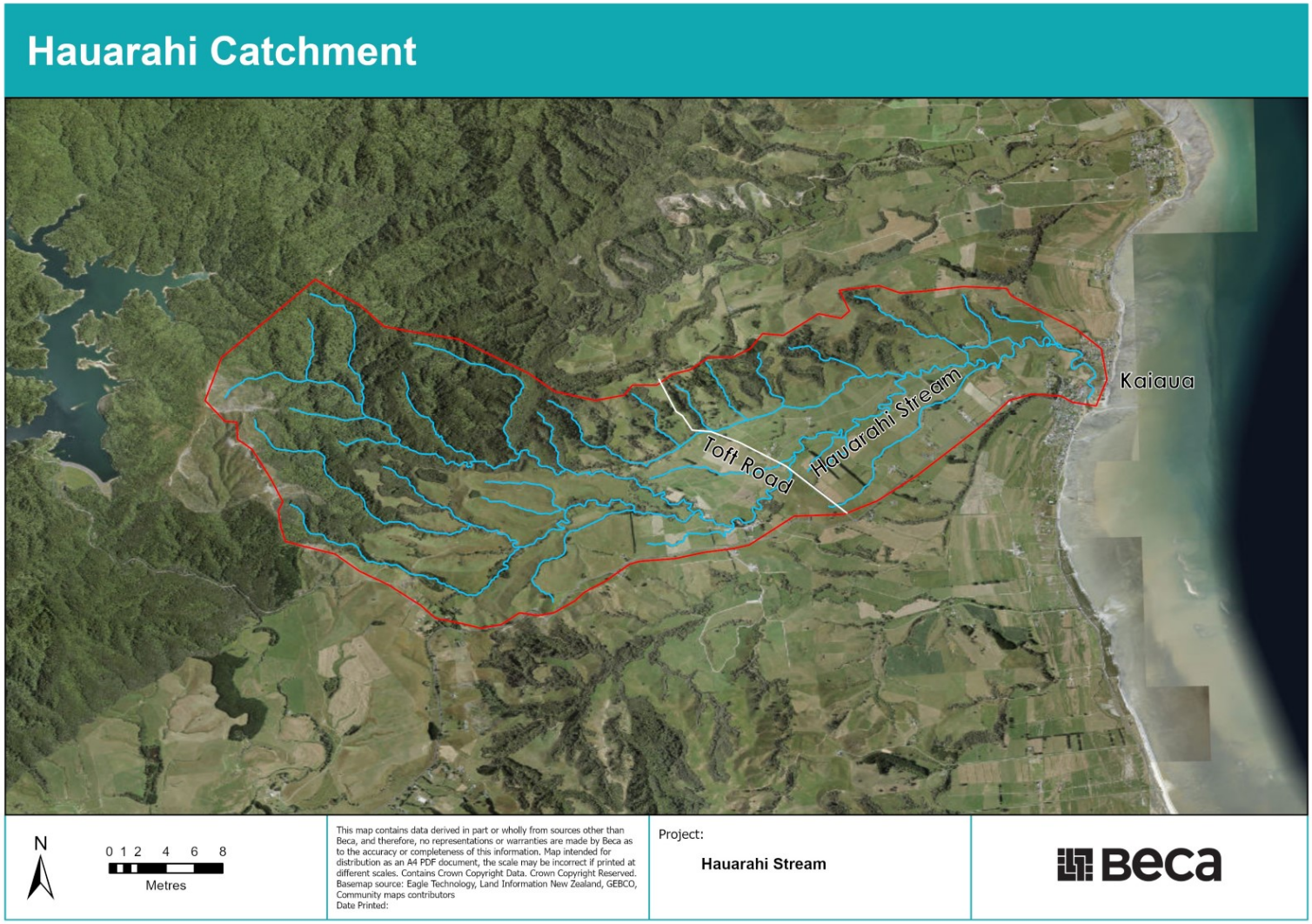

Figure 1. The Hauarahi Catchment boundary and stream network including the Hauarahi Stream.

2 Methodology

2.1 Desktop Review

A desktop-based review and information search was undertaken to assess the current ecological state of the Hauarahi Stream and wider catchment. Information was gathered from the following sources:

- Waikato Regional Council geospatial database and environmental records
- Most recent Google Earth and Land Information New Zealand (LINZ) aerial imagery
- New Zealand Freshwater Fish Database (NZFFD; Stoffels, 2022)
- Western Firth Catchment Group
- Living Waters database

2.2 Field Investigation

To further inform this report, a stream walkover was undertaken on 20 July along the Hauarahi Stream from coast to Toft Road to visually assess the condition of the stream and riparian margins. The following was noted during the walkover:

- Areas of silt sources/ erosion hotspots
- Fish passage barriers
- Fencing
- Areas of invasive and pervasive plant pest species

2.2.1 eDNA sampling

Two eDNA samples were taken by a Western Firth Catchment Group (WFCG) representative from the Hauarahi Stream using a high turbidity eDNA kit with 1.2 µm and 5 µm CA filters on the 20 July 2023. Multi-species tests were undertaken on eDNA samples by Wilderlab Ltd using next-generation sequencing (NGS) to identify all of the species detected in each sample, within broad taxonomic groups. eDNA results were provided by the WFCG and are presented in Section 3.3 below.

3 Information Review

Existing ecological information for the Hauarahi Stream is limited. The WRC only hold limited hydrological data for this stream and requests for additional ecological information (i.e. fauna, water quality) could not be fulfilled. However, a number of reports provided by Living Waters do include some information regarding water quality, hydrology, freshwater fauna and riparian vegetation for the Hauarahi Stream. Information from these reports is summarized below.

A desktop review of the ecological value of five study farms within the Pūkorokoro/Miranda catchment was undertaken by Wildland Consultants Limited (Wildlands) in 2016. Ecological features present on three farms (Bull, Toft, and Thompson farms) connected to the Hauarahi Stream were evaluated. The patches of indigenous forest and scrub within these farms were considered to be of high value due to reasonable native vegetation diversity and the important stepping-stone habitat that these patches provide for birds. Additionally, the Hauarahi Stream was considered to be of high value due to the presence of At Risk freshwater fish species (Goldwater & Rate, 2016).

A field survey of the Hauarahi Stream was undertaken by Living Water in June 2017 (Kendal, 2017). Working with multiple landowners and the local community, the survey documented riparian vegetation, erosion, instream structures and areas of significance along the Hauarahi Stream (findings were presented in Figure 2 below).

The following map reveals that the majority of the Hauarahi Stream is unfenced and has pasture on both sides, allowing stock to access the stream. The survey was undertaken prior to Cyclone Gabrielle.

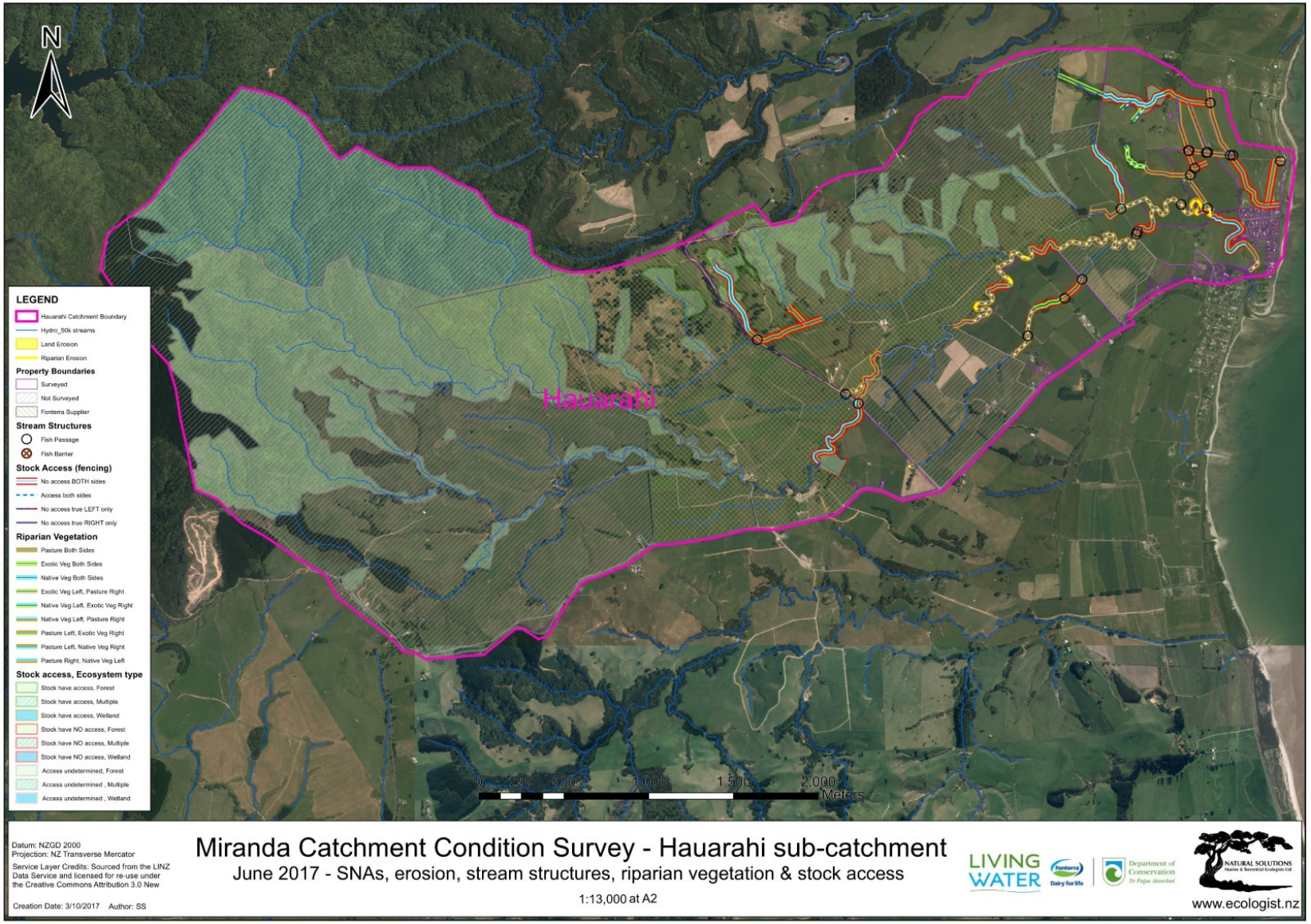

Figure 2. Hauarahi sub-catchment Condition Survey Map - Produced by Natural Solutions Limited, June 2017.

3.1 Hydrology

Waikato Regional Council (WRC) have two discrete manual flow gauging sites within the Hauarahi Stream, located at the Rawests property at 35 Makaewa Road, Kaiaua and at a location near the fire station at 29 Puriri Avenue, Kaiaua. Only 13 points of data have been collected between 1974 and 2020 and flows recorded were either 0.02 m^3/s or 0.0 $3m^3/s$ therefore, no trends or conclusions can be drawn from this data set (see Appendix A for raw data).

3.2 Fauna

Freshwater fish surveys were undertaken in four major watercourses with the Pūkorokoro/ Miranda catchments, including the Hauarahi Stream during November 2001, and April and November of 2012 by Roxburgh & McQueen (Goldwater & Rate, 2016). A total of eleven indigenous fish species, two crustacean species, and high numbers of freshwater mussels (*Echyridella menziesii* and *E. aucklandica*) were found within the surveyed streams.

Inanga (*Galaxias maculatus*) are of particular focus within the Pūkorokoro/ Miranda catchments due to the potential high value breeding habitat that these streams could provide. A fish survey using spotlighting and trapping methodologies was undertaken by Roxburgh and McQueen (2015) within the lower reaches of the Hauarahi Stream and relatively large numbers of inanga were found (~100 individuals). To help maintain/ improve inanga populations within the Hauarahi stream, Living Waters undertook an Inanga Spawning Site Identification Programme in 2018 (Roxburgh, 2018). The Hauarahi stream was assessed as having the least suitable spawning habitat within the catchment due to steep-sided banks, ongoing dredging to maintain boat access into the estuary, lack of vegetation cover and appropriate spawning vegetation types. However, one section of the stream was identified to potentially provide suitable spawning characteristics (Figure 3). Further detail on fish and habitat surveys in the Hauarahi Stream can be found in Roxburgh & McQueen (2015).

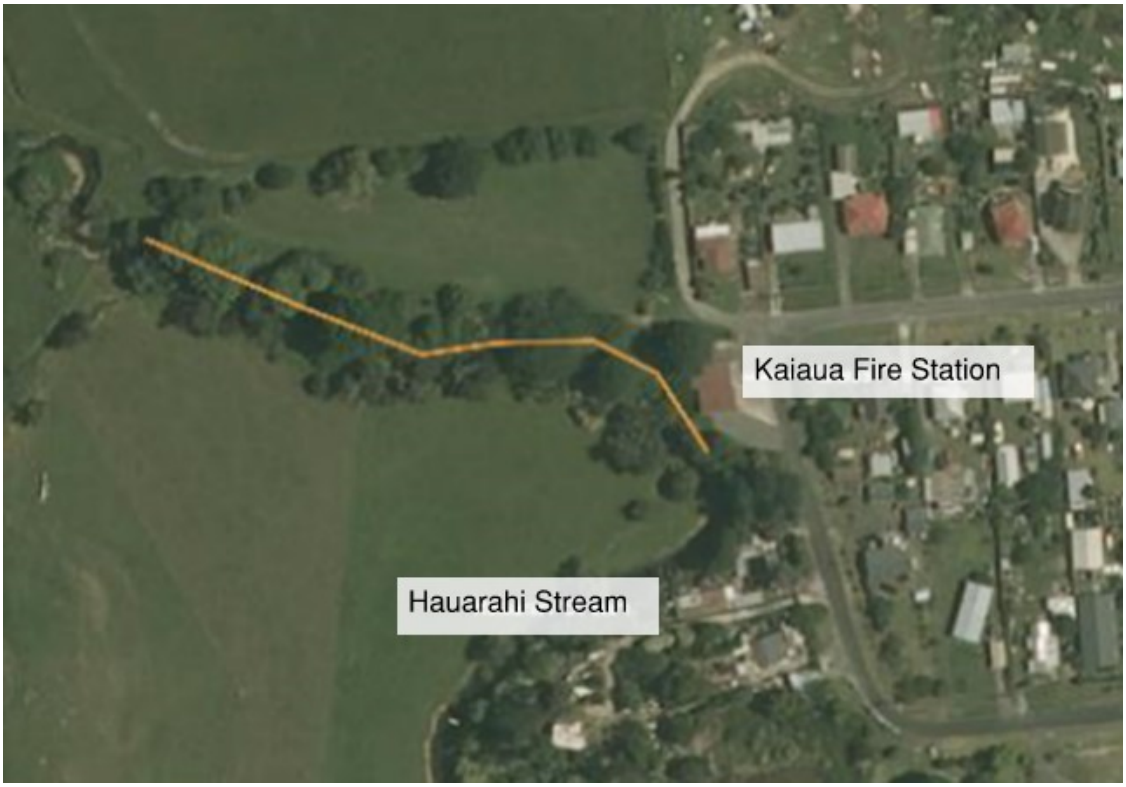

Figure 3. Potential inanga spawning reach in the Hauarahi Stream identified by Jason Roxburgh, Living Matters Limited, 2018.

3.3 eDNA results

Results from the New Zealand Freshwater Fish Database (upper- Hauarahi Stream) and two single eDNA tests collected by Landcare Trust at the Domain and 92 Toft Road during the walkover are provided in the Table below (Table 1).

The Hauarahi Stream supports a diversity of native fish with eleven native species recorded within the stream (Table 1). Of the eleven, four are At Risk – Declining, the longfin eel (*Anguilla dieffenbachia*), Torrentfish (*Cheimarrichthys fosteri*), Inanga (*Galaxias maculatus*) and kākahi (*Echyridella menziesii)*.

Overall, the freshwater fish community within the Hauarahi Stream is assessed as having High ecological value due to the presence of At Risk species.

Table 1. Fish records for the Hauarahi Stream from the New Zealand Freshwater Fish Database and eDNA results. Conservation status assigned using Dunn et al. 2018 and Grainger et al. 2018.

Common Name	Scientific Name	Conservation Status	Source
Longfin eel	*Anguilla dieffenbachia*	At Risk – Declining	NZFFDB, eDNA
Shortfin eel	*Anguilla australis*	Not Threatened	NZFFDB, eDNA
Cran's bully	*Gobiomorphus basalis*	Not Threatened	NZFFDB
Torrentfish	*Cheimarrichthys fosteri*	At Risk – Declining	NZFFDB, eDNA
Banded kokopu	*Galaxias fasciatus*	Not Threatened	NZFFDB
Inanga	*Galaxias maculatus*	At Risk – Declining	NZFFDB, eDNA
Common bully	*Gobiomorphus cotiduanus*	Not Threatened	NZFFDB
Freshwater mussel; kākahi	*Echyridella menziesii*	At Risk – Declining	eDNA
Smelt	*Retropinna retropinna*	Not Threatened	eDNA
Redfin bully	*Gobiomorphus huttoni*	Not Threatened	eDNA
Koura	*Paranephrops planifrons*	Not Threatened	NZFFDB, eDNA

The following marine species were identified within the eDNA samples, kahawai (*Arripis trutta*) and blue fin gurnad (*Chelidonichthys kumu*). Other estuarine species such as grey mullet (*Mugil cephalus*), yellow eye mullet (*Aldrichetta forsteri*), yellowbelly flounder (*Rhombosolea leporine)*, goby (*Favonigobius lateralis*), parore (*Girella tricuspidate),* sand flounder (*Rhombosolea plebeian*), and speckled sole (*Peltorhamphus latus*) are likely to be found in the lower reaches of the Hauarahi with tidal influence.

4 Challenges for the Hauarahi Stream

The existing condition of instream and riparian characteristics of the Hauarahi Stream from the coast to Toft Road (approximately 3km) was assessed during a stream walkover to determine the challenges and opportunities for this stream.

The lower reach extends from the estuary (County Bridge at East Coast Road) to approximately 350m upstream. The stream channel here is wide, hard-bottom and has good connectivity to the flood plain. Due to the proximity to the coast, this area is influenced by tides and saltwater intrusions. The riparian margin is poorly vegetated, however, an approximate 5m wide and 300 m long riparian buffer was planted by the Western Firth Catchment Group in 2020 along the true lefthand bank (TLB). Additionally, flood management in the form of a rock wall has been installed along approximately 75 m of the TLB reducing inundation of adjacent land and properties during high rainfall events. In general, the stream becomes straighter and narrower and riparian planting becomes sparse/ non-existent further upstream to Toft Road (Figure 4).

Figure 4. Stream channel and riparian characteristics from downstream (left) to upstream (right).

The lower stream had good, robust fencing however, fencing was absent along the majority of the mid reach. Areas of permanent fencing had been lost due to bank erosion and/or as a result of recent extreme weather events. Very few areas of the stream had intact permanent or temporary fencing. Intact fencing was noted within areas of the upper reach.

Vegetation within the riparian zone along the mid- upper reaches was patchy and where present, narrow, and sparse. Species includes a mix of native and exotic vegetation such as kanuaka/manuka (*Leptospermum scoparium*), mamaku (*Cyathea medullaris*), puriri (*Vitex lucens*), *coprosma robusta, C. grandifolia*, hangehange, koromiko (*Hebe salicifolia*), 7-finger (*Schefflera digitata*), and mahoe (*Melicytus ramiflorus*). Pest plant species of concern include Japanese walnut (*Juglans ailantifolia*), grey and crack willow (*Salix* sp.), privet (*Ligustrum* sp.), wild ginger (*Hedychium gardnerianum*), *Tradescantia fluminensis*, barbury (*berberis* sp.), and pampus (*Cortaderia selloana*).

Extensive erosion scars (undercutting) as well as areas of active erosion (mass failure and slumping) was observed throughout the mid – upper reaches particularly where banks are high (Figure 5). Some areas of erosion appear to be due to fallen trees which were likely damaged during Cyclone Gabrielle (Figure 6). Fencing has been lost in multiple places due to mass failure. Additionally, three stock accessways through the stream were noted during the walkover, which are likely causing frequent pulses of sediment to enter the stream.

Figure 5. Examples of erosion along the Hauarahi Stream.

Figure 6. Flooding of the Johnstone farm during Cyclone Gabrielle on 23 January 2023 (Image provided by landowner Justin Johnstone).

A series of culverts associated with a ford is located on Makaewa Road (upstream of Toft Road) which is likely to present a barrier to fish passage, particularly for poor climbing species due to accelerated water velocities. This is likely to be preventing the migration of fish species into the high-quality stream habitat upstream of the barrier.

The water within majority of the stream was relatively turbid, areas in the mid-reach which had a high level of sediment. An erosion hotspot coupled with slow flows caused an area of extremely high sediment loading within the mid-reach section (see figure 6 below).

Figure 7. Example of water quality throughout the majority of the stream (left) and extreme sediment loading (right).

Due to the lack of riparian cover, nutrient loading from the surrounding farmland is expected to be high. Additionally, minimal shading throughout the entire stream is likely to cause high water temperatures during the summer months which leads to reductions in available dissolved oxygen for freshwater fauna. The excessive macrophyte and algal mat growth observed throughout the stream is likely to be a result of both high nutrient loading and minimal shading (Figure 8).

Figure 8. Excessive algal mat and macrophyte growth present within shallow, slow flowing section of the Hauarahi Stream.

Overall, the meandering Hauarahi stream does provide reasonable instream habitat for freshwater fauna and has the potential to be of high value. Additionally, the terrestrial landscape has pockets of native vegetation and wetland and seepage habitat, which if supported by further planting, fencing and pest management has the potential to provide high quality terrestrial habitat and contribute to freshwater values. However, the following challenges are present for the Hauarahi Stream (refer to Appendix B for site images):

- Lack of fencing and stock access
- Poor quality and sparse riparian vegetation
- Erosion and sedimentation
- Fish passage barriers

5 Next steps for mitigation, monitoring and opportunities.

The following actions can be implemented to address challenges within the Hauarahi Stream.

- Fencing
- Riparian planting
- Pest plant and animal management
- Remediation of fish passage barriers
- Flood risk management

5.1 Fencing and riparian planting

Fencing the stream to prevent stock access and planting riparian vegetation will result in significant improvement in water quality and the overall condition of the Hauarahi Stream. These actions will reduce sedimentation and nutrient runoff, leading to improving the clarity and instream nutrient levels, providing shading, decreasing macrophyte growth, and create suitable instream habitat for freshwater fauna. Additionally, riparian planting can improve the stability of banksides, attenuate flood levels and pulses of sediment during high rainfall events.

It is estimated that approximately 8,250 meters of fencing is required between the coast and Toft Road. It is recommended that 4 – 5 wire and post fencing is used to reduce debris collection and fencing damage during flood events whist maintain stock exclusion. It is recommended that fencing is constructed around the planted riparian buffer to support the growth and resilience of the buffer. Additionally, stock access points should be limited and where completely necessary, access should be via bridges as opposed to through the stream.

The riparian planting previously undertaken by the Western Firth Catchment Group in the lower Hauarahi Stream reach includes a 5 m riparian buffer, 2 m grassed buffer and wire and post fencing. However, an estimated nine additional hectares is required. It is recommended that this planting plan be implemented along as much as the stream as possible. However, considering the balance of maintaining productive farmland, at the very least, 5 m of native vegetation planting should be undertaken, fenced and maintained. Prior to planting, the site should be prepared by implementing standard weed control techniques for pest plants to enable successful establishment of native species. Plant species selected for riparian planting should be consistent with the Hunua Ecological District and eco-sourced from local nurseries to increase the survivorship rate. Planting should be undertaken during the planting season in May – August and infill and enrichment planting should be undertaken in the following year for at least four years. Suggested riparian species, planting location and spacing information can be found in the Waikato Regional Council's *Native Planting Programme - Planting for soil conservation, biodiversity and water quality* (2020) and Auckland Council's *Streamside Planting Guide* (2021).

It is recommended that any trees which are vulnerable to falling into the stream due to bank instability are removed to reduce sedimentation. Stumps should remain in-situ if an excess of sediment is likely to enter the stream.

During the stream walkover, multiple degraded wetland and seepage areas were observed. It is recommended that specific wetland assessments are undertaken to inform future management of these areas. Management of these areas will also contribute to improving freshwater outcomes (and is consistent with the outcomes sought in the NPS-FM).

5.2 Pest Plant and animal management

Mammalian pests such as mustelids (*Mustela* spp.), rats (*Rattus* spp.), mice (*mus musculus*), possums (*Trichosurus vulpecula*), and hedgehogs (*Erinaceus europaeus*), are likely to be present within the catchment. These species pose a threat to establishing native vegetation through browsing damage and should be target species for pest control. It is recommended to assess pest browsing damage during routine planting maintenance and inspections. Should the damage become an issue at the site, necessary pest control can be undertaken. Resources such as the *From Firth to Forest Strategic plan* (Better Biosecurity Solutions, 2019) can help inform pest eradication methodologies.

It is recommended that management of pest plants primarily involves manual/ mechanical removal and some targeted herbicide use (i.e. cut stump method) for species such as Japanese walnut and pampas. Due to the close proximity of the weed management area to a freshwater body, spraying is not recommended. Further information on weed control practises and advice for managing specific species, can be found in Waikato Regional Council's *Controlling Weeds in Riparian Margins – A guide to restoration projects and other plantings* (Waikato Regional Council, 2012).

5.3 Water quality and flow gauging

To address flooding risk and water quality issues, on-going flow gauging and water quality sampling points upstream and downstream should be established to determine trends in flow, help inform flood risk management, and monitor physical parameters (i.e. turbidity, temperature, dissolved oxygen, etc.) and levels of instream contaminants (i.e. nitrogen, phosphorus, e.coli, etc.).

Initially, appropriate locations for water sampling include within the section of stream running past the fire station (downstream location) and within the headwaters (in the QEII block) as a reference point for good water quality. However, further refinement of water quality sampling regimes and indicator analytes will need be required based on results to target contaminant sources throughout the catchment.

5.4 Flood risk management

Continued work with the Hauraki District council should be undertaken to manage the flood risk within the lower reaches of the Hauarahi stream.

5.5 Fish passage

Fish passage barriers throughout the stream such as the ford present on Makaewa Road should be remedied to improve connectivity between the coast and high value stream habitat within the QEII block. Remediation of fish passage barriers can be undertaken according to the *New Zealand Freshwater Fish Passage Guidelines* (Franklin *et al*, 2022) with Regional Council support.

5.6 Inanga habitat improvements

As identified in Roxburgh & McQueen (2015), there is potential areas suitable for inanga spawning in the lower Hauarahi Stream. Findings and recommendations in this report for improving Inanga spawning in Hauarahi stream include:

- Investigating additional inanga spawning habitat between E1803897 N5890934 and E1803822 N5890960 and;
- Undertake a survey to determine inanga presence and assess habitat suitability in the upstream reaches (above the fish barrier on Makaewa Road).

Planting of suitable inanga spawning habitat (i.e. tall, dense grasses, rushes and flax) within the lower reaches of the Hauarahi stream identified within Roxburgh & McQueen (2015) would enable inanga spawning and overtime increase local populations.

6 Conclusions

The Hauarahi Stream is in a degraded condition primarily due to erosion and sedimentation and the lack of riparian buffers and stream shading. Therefore, fencing and riparian planting are a priority for this stream and if undertaken appropriately, would lead to significant improvements in water quality and freshwater and terrestrial habitat values. Opportunities to undertake water quality and flow gauging monitoring will help to prioritize and refine land management actions and enable the effective use of resources.

Undertaking the recommended mitigation and management options is not only important for improving water quality within the stream and the highly valuable receiving environment (the Firth of Thames) but will also build resilience for landowners and the Kaiaua community and future flooding challenges they may face.

Acknowledgements

Thanks to Dion Patterson (DOC Senior Ranger-Biodiversity) for providing existing information of ecological assessments undertaken in the Hauarahi Stream and the wider catchment. Thanks also to Ric Balfour from Landcare Trust for his involvement in this project and to involved landowners for their co-operation, in particular Justin Johnstone for his active role in supporting this endeavour.

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Appendix A – Flow gauging data

Table 2. Manual flow gauging data collected by WRC between 1974 – 2020 at two locations, Rawests Property and Puriri Road.

Site	Date	Time	Flow (m^3/s)
Rawests Property	21/02/1974	12:15:00	0.03
	6/03/2014	11:23:40	0.02
	28/03/2014	14:51:27	0.02
	2/04/2014	14:14:08	0.02
	15/01/2015	9:03:50	0.03
	26/02/2015	9:07:00	0.02
Puriri Road	4/02/2014	7:30:00	0.03
	17/02/2014	6:42:55	0.03
	25/02/2014	8:11:45	0.03
	28/03/2014	11:11:22	0.03
	2/04/2014	13:47:02	0.02
	15/01/2015	9:41:20	0.03
	26/02/2015	9:42:00	0.02
	28/02/2020	8:20:35	0.02

Appendix B – Site photos

Figure 1. Fencing, grass strip and planting by WFCG.

Figure 2. Pocket of native and exotic vegetation in riparian zone.

Figure 3. Seepage wetland area.

Figure 4. Wetland area.

Figure 5. Erosion scars along TLB.

Figure 6. Stock accessway through the Hauarahi Stream.

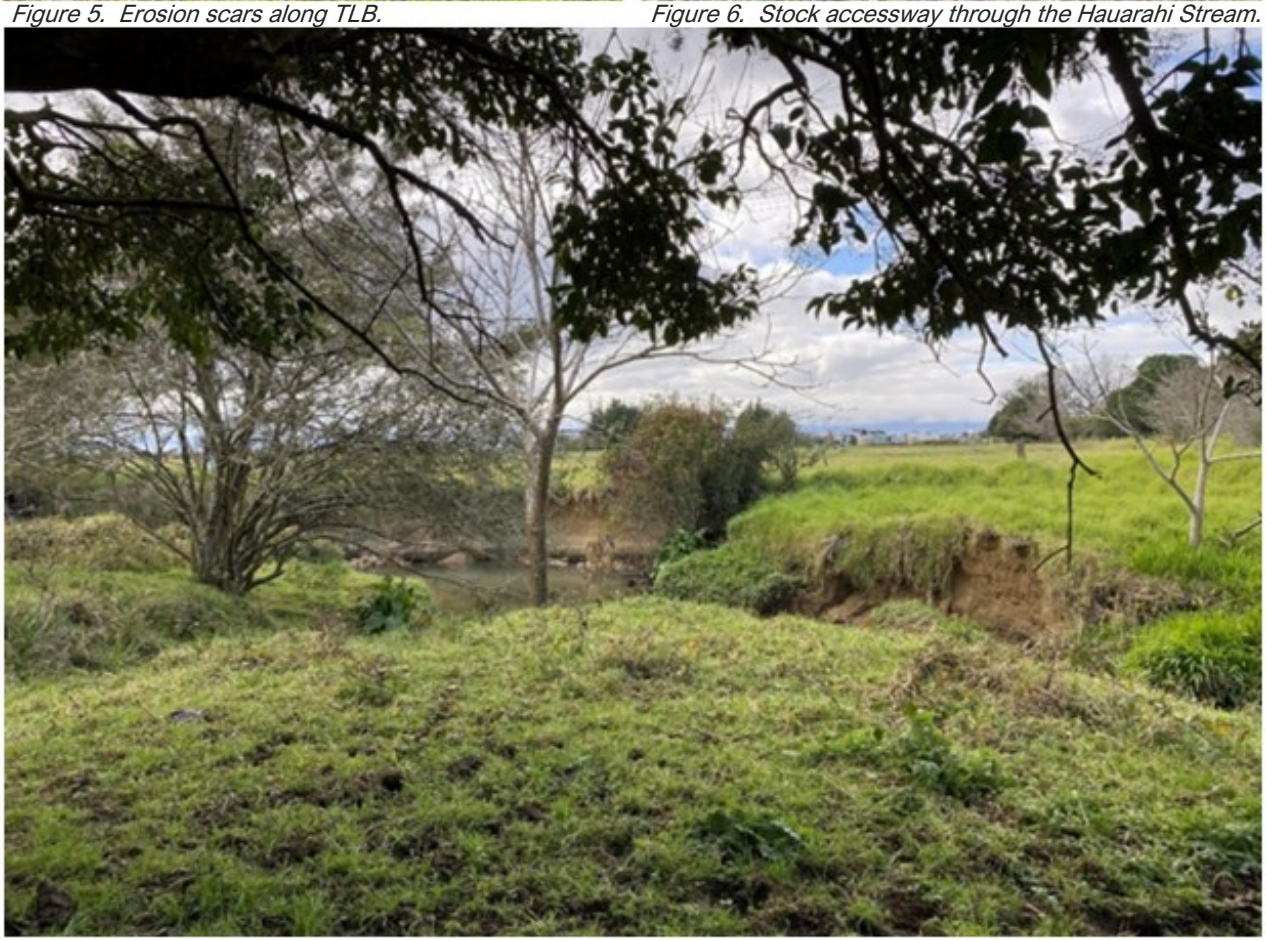

Figure 7. Bank scour and mass wasting along TRB.

Figure 8. Crispy pondweed and other macrophytes in stream.

Figure 9. Green algae on streambed at Toft Road Bridge.

Figure 10. Ford and culverts at Makaewa Road.