Ōtākaro Avon River Corridor Kākahi Survey

September 2025

Prepared for:
Christchurch City Council

Instream Consulting Limited
PO Box 1200
Christchurch 8140

TABLE OF CONTENTS

1. INTRODUCTION

Kākahi (*Echyridella menziesii*), a native freshwater mussel, is classified as an *At Risk* species and holds significant cultural value (Grainger et al., 2018; McEwan et al., 2020). Kākahi have two hinged shells, but unlike their marine relatives, kākahi do not attach to the substrate with byssal threads, instead wedging themselves amongst stones or burrowing into the substrate (Figure 1). Kākahi face a variety of threats from human activities, particularly in urban environments where they are subject to multiple stressors such as water pollution, channel modification, and disturbance from dredging. Until recently, there was little known about the distribution of kākahi in the Ōtākaro Avon River Corridor (OARC), and dedicated kākahi surveys were recommended (Instream Consulting, 2019).

The first dedicated kākahi surveys in the Ōtākaro – Avon River confirmed kākahi presence at multiple locations in the catchment; however, it was concluded that, except for Horseshoe Lake (where kākahi are very abundant), they were sparsely distributed, with very few kākahi downstream of Hagley Park (Instream Consulting, 2020). More recent surveys have found large numbers of kākahi at the Gayhurst Bridge and Avondale Bridge search sites (Instream Consulting, 2025a). Moreover, it is suspected that kākahi distributions extend further downstream, as identified by eDNA detections (James et al., 2024).

The potential impacts of planned OARC projects, particularly stopbank upgrades and ecological enhancement works, on kākahi have been identified as a key area where information is currently lacking. Understanding the location and density of kākahi populations is essential for informing the design and implementation of these activities to ensure they do not negatively affect existing populations. However, kākahi are often undetected during standard invertebrate or fish surveys, due to their partially buried nature and typically patchy distribution. As a result, much of the OARC has not yet been systematically surveyed for kākahi, and their full extent within the corridor remains unknown. This report describes results of a kākahi survey to determine their current distribution and population status within the OARC (Figure 2).

Figure 1: Partially buried kākahi in sediment (left) and marine mussels attached to substrate (right). Arrows indicate kākahi.

2. METHODS

A total of 57 sites were sampled in March and April 2025, including 28 paired left and right bank (n = 56 sites) snorkel surveys throughout the OARC, extending from Fitzgerald Avenue downstream to Pages Road, with an additional survey occurring in Lake Kate Shepard (Figure 2; Table A1). Sampling targeted areas that had not been previously surveyed, including locations where recent eDNA detections had occurred. Site selection was guided by earlier surveys, which found no kākahi between Barbadoes Street (the upstream boundary of the OARC) and Fitzgerald Avenue, thus eliminating the need for further searches upstream of Fitzgerald Avenue. Additionally, Pages Road marked the downstream limit of prior eDNA detections, making it a logical boundary for survey efforts in the lower reaches. Saline conditions also likely limit freshwater mussels further downstream. The starting point between paired site locations were generally located at approximately 300 m upstream of each other to minimise any spatial gaps. The only substantial gap was around the Avon Rowing Club, by Porrit Park, where there were health concerns for snorkellers due to high densities of Canada geese.

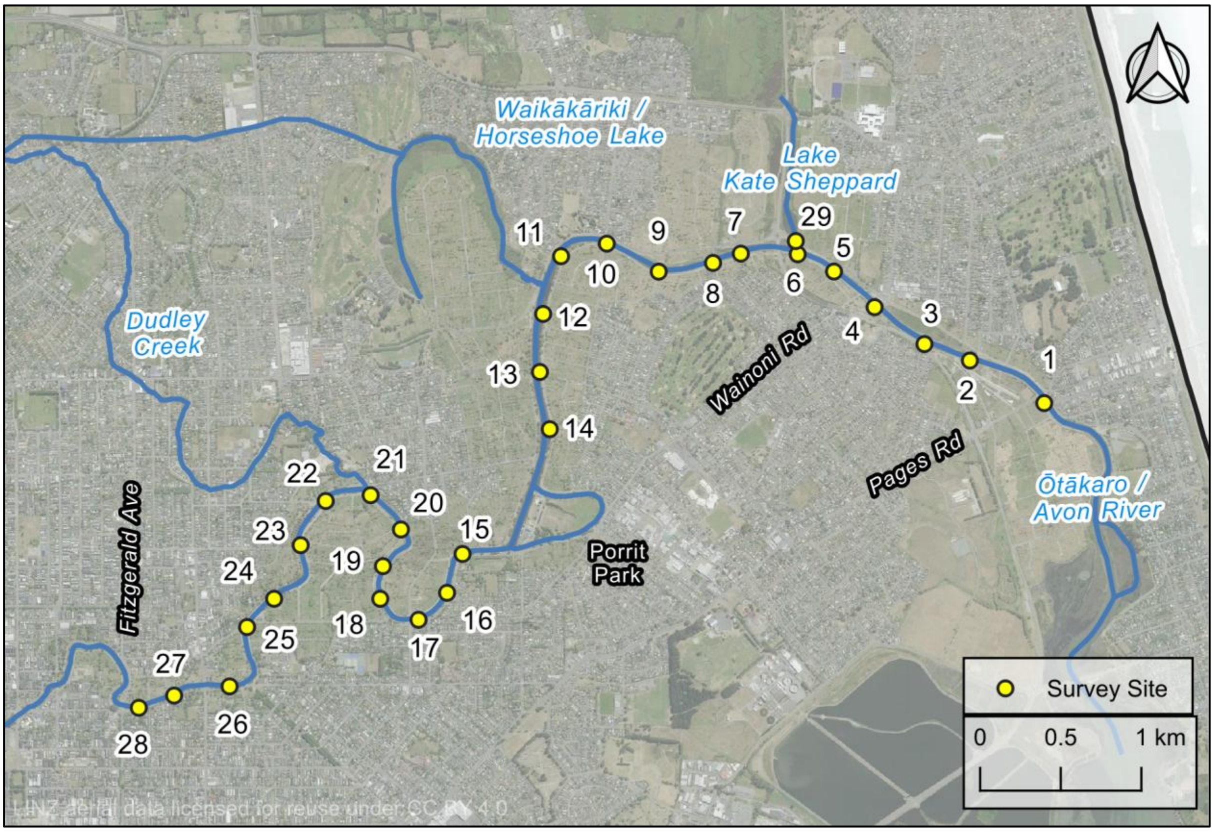

Figure 2: Avon River kākahi survey locations and site numbers.

Snorkel surveys were conducted using the 30-minute timed count method described in version 10 of the Environmental Monitoring Programme for Christchurch City Council's Comprehensive Stormwater Network Discharge Consent. This consisted of two snorkellers conducting kākahi counts using a visual and tactile search at each site for 15 minutes. The search concentrated on areas close to each bank, where OARC activities are concentrated, and where search efficiency is greatest. The GPS location was recorded for the downstream and upstream extent of each search and representative photographs were taken from the bank and underwater. During each survey, the total number of kākahi was recorded along with the estimated dominant substrate, macrophyte cover, and where any kākahi were typically found (e.g., near gabion baskets, or under macrophytes). To minimise disturbance, a small subset of kākahi were measured to identify the size range and typical lengths observed.

Survey data were spatially mapped using QGIS (QGIS Development Team, 2016) and statistical analyses and data visualisation were carried out using R (R Core Team, 2013). A model including an interaction between a linear and quadratic term for macrophyte cover was used to examine the variation in kākahi counts with macrophyte cover. Kakahi counts were log transformed to meet statistical assumptions and survey sites located in and below the outlet of Lake Kate Shepard were excluded from the analysis due to being outside the kākahi distribution.

3. RESULTS AND DISCUSSION

A total of 2,220 kākahi were recorded across 57 sites surveyed within the OARC (Figure 3; see Table A1 for site-specific counts). The lower section of the OARC was notably more tidal, characterised by marine-influenced features such as seagrass patches, estuarine crabs, and marine mussel shells. It was therefore unsurprising that no kākahi were recorded in this more marine-influenced section of the river. The most downstream kākahi observed was located just upstream of the Lake Kate Sheppard outlet, and kākahi were found at all reaches surveyed up to Fitzgerald Avenue, the upstream extent of the survey.

The highest kākahi densities were found between the Avondale Footbridge and the Horseshoe Lake Outlet, where 1,353 individuals were recorded across four paired sites, including 648 at a single pair of sites just upstream of the Avondale Footbridge. It is tempting to attribute these high kākahi densities to a source population in Horseshoe Lake, where high kākahi numbers have been previously (Instream Consulting, 2021), as densities sharply declined immediately upstream of the lake outlet. However, higher kākahi densities were also present around the Snell Place Footbridge through to Gloucester Street and near the confluence with Dudley Creek, where kākahi densities are very low (Instream Consulting, 2025a). This suggests that the dense patches of kākahi in the Ōtākaro River are self-sustaining, rather than solely relying on tributary sources. Upstream of the Medway Footbridge, kākahi were present but in low densities up to Fitzgerald Avenue (Figure 3).

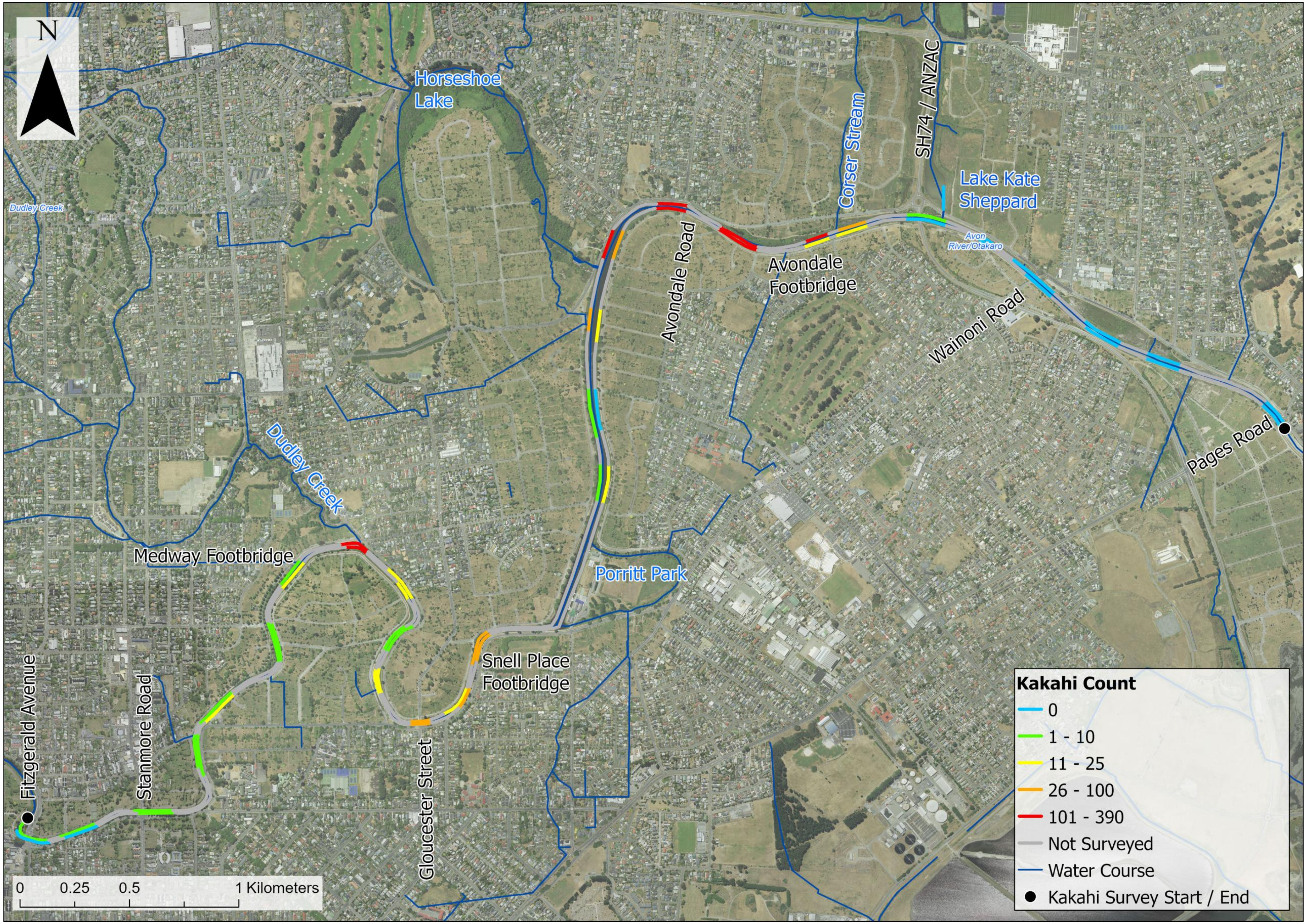

Figure 3: Extent of OARC surveyed for kākahi, with the length of coloured transects referring to distance covered and colour referring to the number of kākahi found.

Kākahi were sporadically observed in a range of substrates, including cobbles, sand, soft sediments, and around man-made structures such as jetties and bridges. Although kākahi were never found within gabion baskets, they were occasionally seen in the soft sediments adjacent to them. Despite these scattered occurrences, kākahi were most commonly found in open sediment patches adjacent to macrophyte margins or root systems, or beneath macrophyte canopies where some water flow persisted (Figure 4). This habitat preference likely explains the observed cubic polynomial (S-shaped; $F_{1,40}$=6.59, P=0.014) relationship between kākahi abundance and macrophyte cover at the site level, whereby counts were variable at low macrophyte cover but highest at around 90% cover before declining as cover approached 100% (Figure 5). It is likely that at 100% macrophyte cover, dense vegetation may restrict access to flowing water, reducing habitat suitability despite high macrophyte presence.

Figure 4: Kākahi were often associated with macrophyte margins and root masses, although they were sometimes found amongst gravels (bottom right). Arrows indicate kākahi.

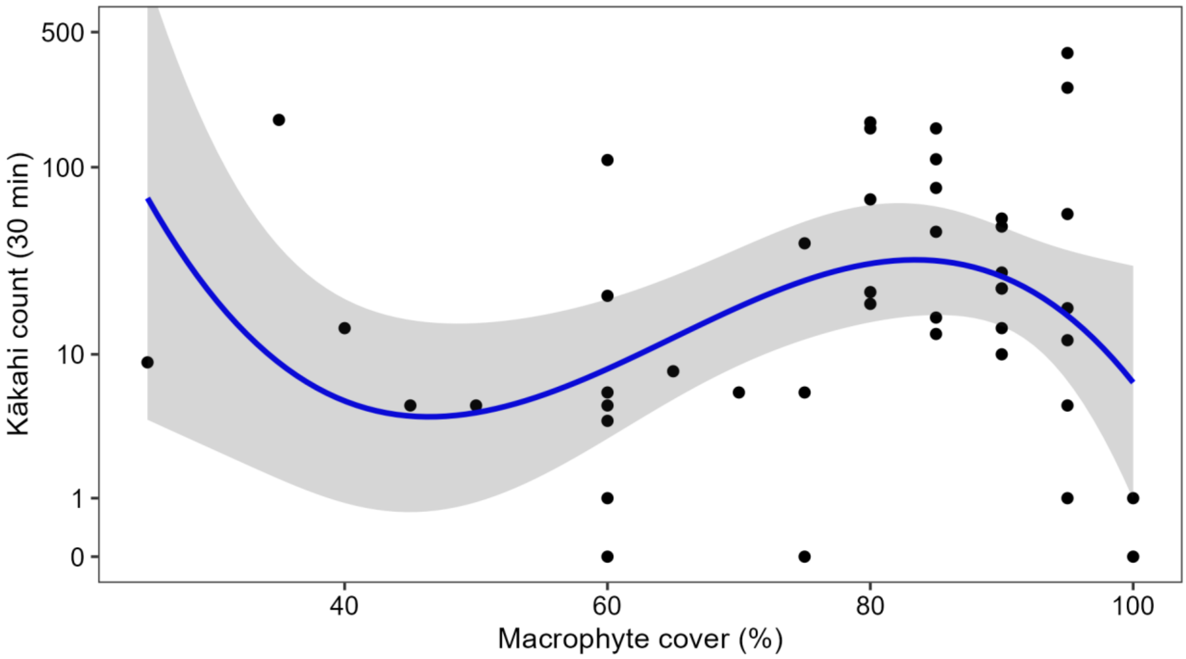

Figure 5: Cubic polynomial (S-shaped) association between kākahi counts and reach macrophyte cover. Line of best fit and error bands show 95% confidence intervals determined from model fits.

At the broader scale, kākahi were frequently recorded in deeper mid-channel areas or along shelf edges (i.e., the steep streambed) in the lower reaches of the OARC, up to the Avondale Road bridge. Beyond this point, they were more sporadically distributed across the banks and in the deeper sections under macrophyte cover and in open soft sediment patches adjacent to macrophytes. Notably, several long sections of the OARC displayed signs of macrophyte removal, likely resulting from barge activity. These disturbed or cleared areas often had kākahi, possibly due to displacement or active movement into these more open habitats.

Kākahi were often fully or partially buried, requiring both visual and tactile methods for effective sampling. Based on a small subset of kākahi measured informally (but not recorded) for observational size calibration, encountered kākahi were generally mature, with the largest (>100 mm) individuals observed around the Avondale Footbridge and few individuals found <45 mm overall.

A diverse fish community was also observed throughout the extent of the OARC sampled, including black flounder (*Rhombosolea retiaria*), longfin eel (*Anguilla dieffenbachii*), shortfin eel (*Anguilla australis*), īnanga (*Galaxias maculatus*), yellow-eyed mullet (*Aldrichetta forsteri*), and brown trout (*Salmo trutta*). Interestingly, despite generally being solitary predators, a group of five adult flounder were found in one small patch together, though no reason for this was evident (Figure A1).

4. CONCLUSIONS AND RECOMMENDATIONS

Dedicated snorkel surveys for kākahi (freshwater mussels) in the lower reaches of the Ōtākaro Avon River Corridor (OARC) have significantly expanded our understanding of their distribution and highlighted the presence of several substantial populations. Our surveys confirmed that kākahi are present from the ANZAC Drive bridge upstream to the Fitzgerald

Avenue bridge, with the highest densities and largest individuals observed in the vicinity of the Avondale Footbridge. While Horseshoe Lake may be a source population contributing to kākahi presence in the lower reaches, additional notable aggregations were identified near the confluence with Dudley Creek and downstream of the Gloucester Street bridge. These findings indicate that the OARC supports multiple, spatially distinct kākahi subpopulations occurring at densities significant at the regional scale, highlighting the need to explicitly consider risks to these populations in any proposed works within the corridor.

Kākahi were encountered in a range of habitat types but were generally associated with macrophytes, either within open sediment patches adjacent to macrophyte beds or beneath macrophyte canopy cover where water flow was present. Downstream of the Avondale Road bridge, the highest densities were recorded in deeper mid-channel sections, while individuals were more sparsely distributed at upstream sites.

Importantly, this work confirms that the lower OARC provides valuable habitat for kākahi and underscores the need for sensitive management practices, particularly where construction or restoration activities are proposed. To support kākahi population resilience and ecological integrity, we recommend the following actions:

- **Monitor Contaminants:** Regularly track levels of heavy metals and contaminants of emerging concern that are known to affect freshwater mussel health and reproduction, such as pesticides, personal care products, pharmaceuticals, flame retardants, plasticisers, and industrial chemicals (Woolnough et al., 2020).

- **Conduct Regular Surveys:** Implement a long-term monitoring programme to track changes in kākahi presence, distribution, and abundance over time within the OARC and within other non-wadable rivers in the Christchurch District (e.g., Ōpāwaho – Heathcote River and Pūharakekenui – Styx River). For instance, kākahi patch dynamics could be monitored through repeat surveys based on the current assessment method, or via a more comprehensive snorkel-based adaptation of the quantitative monitoring approach used in Cashmere Stream (Instream Consulting, 2025b), which would provide greater detail on size distributions and, by extension, insights into recruitment processes.

- **Minimise Habitat Disturbance:** Ensure that any habitat modification (e.g., for flood management or construction) closely mimics natural substrate conditions. For instance, avoid placing coarse ballast or gravel over naturally soft-bottomed habitats.

- **Implement Pre- and Post-Disturbance Surveys:** Conduct baseline kākahi assessments prior to any disturbance, as well as follow-up surveys at both relocation sites and within modified/disturbed reaches. Monitoring should include population metrics such as shell length and, where feasible, employ mark-recapture methods to assess recruitment, survival, growth, and movement.

- **Investigate Microhabitat Use:** Undertake more detailed research into the specific microhabitat features that support high kākahi densities, such as flow dynamics, sediment type, vegetation structure, and substrate stability.

These measures will help ensure that kākahi populations within the OARC are maintained and that any impacts from human activity are appropriately mitigated through informed, ecologically sensitive practices.

5. REFERENCES

Grainger, N., Harding, J., Drinnan, T., Collier, K., Smith, B., Death, R., Makan, T., & Rolfe, J. (2018). Conservation status of New Zealand freshwater invertebrates, 2018. *Department of Conservation New Zealand Threat Classification Series 28*.

Instream Consulting. (2019). Avon River catchment aquatic ecology 2019. *Report Prepared for Christchurch City Council, August 2019*.

Instream Consulting. (2020). Kākahi (freshwater mussels) in Christchurch Waterways. *Report Prepared for Christchurch City Council, September 2020*.

Instream Consulting. (2021). Waikākāriki / Horseshoe Lake Freshwater Ecology. *Report Prepared for Christchurch City Council, July 2021*.

Instream Consulting. (2025a). Christchurch aquatic ecology monitoring 2024. Including the Ōtākaro–Avon River, Wilsons Drain, Cashmere Stream, and Balguerie Stream. *Report Prepared for Christchurch City Council by Instream Consulting, April 2025*.

Instream Consulting. (2025b). Kākahi (Freshwater Mussel) Monitoring in Christchurch 2025. *Report Prepared for Christchurch City Council, March 2025*.

James, A., Dewson, Z., & McKinley, N. (2024). Ōtākaro Avon River Corridor (OARC) Regeneration Plan: Ecological values information review and gaps analysis. *Report Prepared for Christchurch City Council by EOS Ecology. EOS Ecology Report Number CHR01-24007-01, June 2024*.

McEwan, A. J., Dobson-Waitere, A. R., & Shima, J. S. (2020). Comparing traditional and modern methods of kākahi translocation: implications for ecological restoration. *New Zealand Journal of Marine and Freshwater Research*, *54*(1), 102–114.

QGIS Development Team. (2016). QGIS geographic information system. In *Open source geospatial Foundation project*.

R Core Team. (2013). *R: A language and environment for statistical computing*. Vienna, Austria.

Woolnough, D. A., Bellamy, A., Hummel, S. L., & Annis, M. (2020). Environmental exposure of freshwater mussels to contaminants of emerging concern: Implications for species conservation. *Journal of Great Lakes Research*, *46*(6), 1625–1638. https://doi.org/10.1016/J.JGLR.2020.10.001

APPENDIX 1: SITE LOCATIONS AND COUNTS

Table A1: Kākahi sites surveyed in the Ōtākaro - Avon River catchment in 2025. Coordinates mark the downstream limit of east site and were taken from each bank.

Site Code	Easting (NZTM)	Northing (NZTM)	Kākahi Count
1L	1577516	5182565	0
1R	1577489	5182549	0
2L	1577035	5182847	0
2R	1577028	5182813	0
3L	1576764	5182946	0
3R	1576746	5182915	0
4L	1576461	5183171	0
4R	1576437	5183144	0
5L	1576197	5183385	0
5R	1576185	5183365	0
6L	1575966	5183501	1
6R	1575960	5183472	0
7L	1575598	5183502	40
7R	1575607	5183476	16
8L	1575424	5183443	176
8R	1575435	5183418	21
9L	1575103	5183388	390
9R	1575098	5183364	258
10L	1574782	5183569	171
10R	1574776	5183538	159
11L	1574440	5183465	110
11R	1574492	5183460	68
12L	1574332	5183110	46
12R	1574381	5183102	23
13L	1574318	5182739	1
13R	1574361	5182742	0
14L	1574369	5182396	5
14R	1574422	5182387	12
15L	1573868	5181627	57
15R	1573881	5181613	78

Site Code	Easting (NZTM)	Northing (NZTM)	Kākahi Count
16L	1573766	5181372	23
16R	1573785	5181372	54
17L	1573604	5181226	49
17R	1573608	5181205	28
18L	1573387	5181341	13
18R	1573371	5181335	18
19L	1573410	5181528	1
19R	1573387	5181538	10
20L	1573527	5181772	14
20R	1573499	5181765	22
21L	1573322	5181992	109
21R	1573311	5181978	159
22L	1573005	5181955	9
22R	1573033	5181942	19
23L	1572853	5181673	6
23R	1572877	5181668	6
24L	1572694	5181354	5
24R	1572712	5181335	14
25L	1572524	5181160	4
25R	1572545	5181160	6
26L	1572427	5180811	5
26R	1572436	5180792	8
27L	1572071	5180752	5
27R	1572092	5180735	0
28L	1571858	5180676	1
28R	1571873	5180659	0
29 Lk Kate Shepard	1575948	5183554	0

APPENDIX 2: FISH OBSERVATIONS

Figure A1: Unique observation of a group of five black flounder observed in one patch.