Banks Peninsula Fish Passage Assessment and Prioritisation: A Pilot Study

September 2019

Prepared for:
Christchurch City Council

Instream Consulting Limited
PO Box 28 173
Christchurch 8242

TABLE OF CONTENTS

1. INTRODUCTION

1.1. Background

Many of New Zealand's native freshwater fishes are migratory, moving between freshwaters and the sea to complete their life history. Fish passage to and from the sea can be obstructed by natural barriers, such as waterfalls, as well as artificial barriers, including weirs, culverts, tide gates, dams, and pump stations. The degree to which a natural or artificial barrier prevents fish passage depends on the swimming and climbing ability of the fish species and its life stage, as well as features of the structure itself.

It has been a legal requirement to provide for fish passage past built structures since the 1983 Fisheries Regulations came into effect. However, many structures built in waterways prior to 1983 did not provide for fish passage. In recent years, the Department of Conservation has worked to increase awareness of the need to provide for fish passage. New national fish passage guidelines were released in 2018 (Franklin et al. 2018) and they provide design guidance for new structures and for remediation of existing barriers. These new guidelines include new data on fish burst speeds and barrier remediation that supercedes previous guidance, such as the Christchurch City Council's Waterways and Wetlands Design Guide (CCC 2003).

It is estimated that 20-40% of existing structures in waterways impede fish passage, due to impacts of the structures on fall height (e.g., perched culverts), high water velocities, shallow water depths, and the creation of physical blockages (Franklin et al 2018). This is a national average and the proportion of structures impeding fish passage is likely considerably higher in areas where there is steeper topography, such as Banks Peninsula near Christchurch.

For asset managers such as Christchurch City Council (CCC), it is reasonable to assume that all new structures will be designed to allow fish passage. However, for asset managers there remains the question as to how to assess existing structures for fish passage, and also how to prioritise structures for improved passage. To assist with this decision-making process, a new Fish Passage Assessment Tool (FPAT) was launched by NIWA in December 2018. The tool is a free mobile application (or "app") that uses nationally-standardised field methods to assess structures for fish passage. Data collected is uploaded to a national database and structures are prioritised for remediation (Franklin 2018).

1.2. Report Scope

This report describes the results of a pilot study conducted on Banks Peninsula to assess CCC assets using the FPAT app. Additional field data were collected to evaluate the relative ease or difficulty of remediating an identified barrier, plus stream walks were conducted to identify additional natural or artificial barriers along a waterway. The purpose of this work was to assess whether the FPAT app combined with additional site data provides a useful method for identifying and prioritising fish barriers for remediation in the Christchurch district.

2. METHODS

2.1. Field Data Collection

Structure assessments focused on a core list of 20 CCC bridges and culverts on Banks Peninsula that had previously been assessed as being a high or very high priority for remediation (Figure 1). The previous assessments had been carried out by Environment Canterbury staff and the priority assessment was based on the opinion of the assessor (rather than measured data). In addition to the FPAT assessment, stream walks were conducted at a subset of waterways, to identify and assess any additional natural or artificial barriers. It was impractical to undertake stream walks for all waterways, due to time constraints, therefore walks focussed on waterways that had fish records in the New Zealand freshwater fish database and waterways with larger catchments, and therefore a greater potential area of fish habitat. These waterways were: Prices Stream, Wainui Valley Stream, Aylmers Stream, and Narbey Stream. The upstream and downstream extent of each stream walk was marked using a handheld GPS and the stream walk path was then digitised in GIS.

Important assumptions associated with the current version of the FPAT app include:

- Some small streams are not mapped within the app. This means the app cannot calculate fish passage risk for structures on small, unmapped streams.
- The app's barrier risk assessment makes the following assumptions:
    - All bridges are a very low risk, regardless of any field data to the contrary.
    - Dams, pump stations, and flap gates are assumed to have a high to very high risk.
- There is little account taken of potential habitat suitability or quality for fish (other than stream width). In other words, all habitat is equal.
- The prioritisation score does not take into account whether remediation is practical.

Issues with FPAT app instability when working offline meant that field data were recorded on paper in the field. This resulted in some missing data, because no hard copies of the FPAT forms were initially available. This has subsequently been remedied, as the Department of Conservation (DOC) commissioned Instream to prepare hard copy forms that can be used as a backup to the app if any technical issues are encountered. In addition, we understand that the issue with app instability has been fixed by the software developers.

Constructability data were also collected for each site where a structure was assessed using the FPAT tool. Following discussions with CCC engineers, the following constructability data were included: site access for machinery, traffic management requirements, special access requirements (e.g., steep slopes or confined spaces), native vegetation clearance, and geotechnical conditions (Table 1). Constructability categories were given a rank score and the category scores were summed to give an overall constructability score that ranged from 4 (poorest) to 11 (best).

For each waterway, habitat data were also collected using the national rapid habitat assessment protocols of Clapcott (2015). The mobile app "Fulcrum" was used to record the constructability and habitat assessment data in the field, on either a smart phone or a tablet. Fulcrum includes GPS positioning and can be used offline, with data uploaded to cloud-based storage when back in cellular range. A simple form was created within Fulcrum to record both the constructability and habitat data.

Figure 1: Structure assessment sites (yellow triangles) and stream walks (red lines).

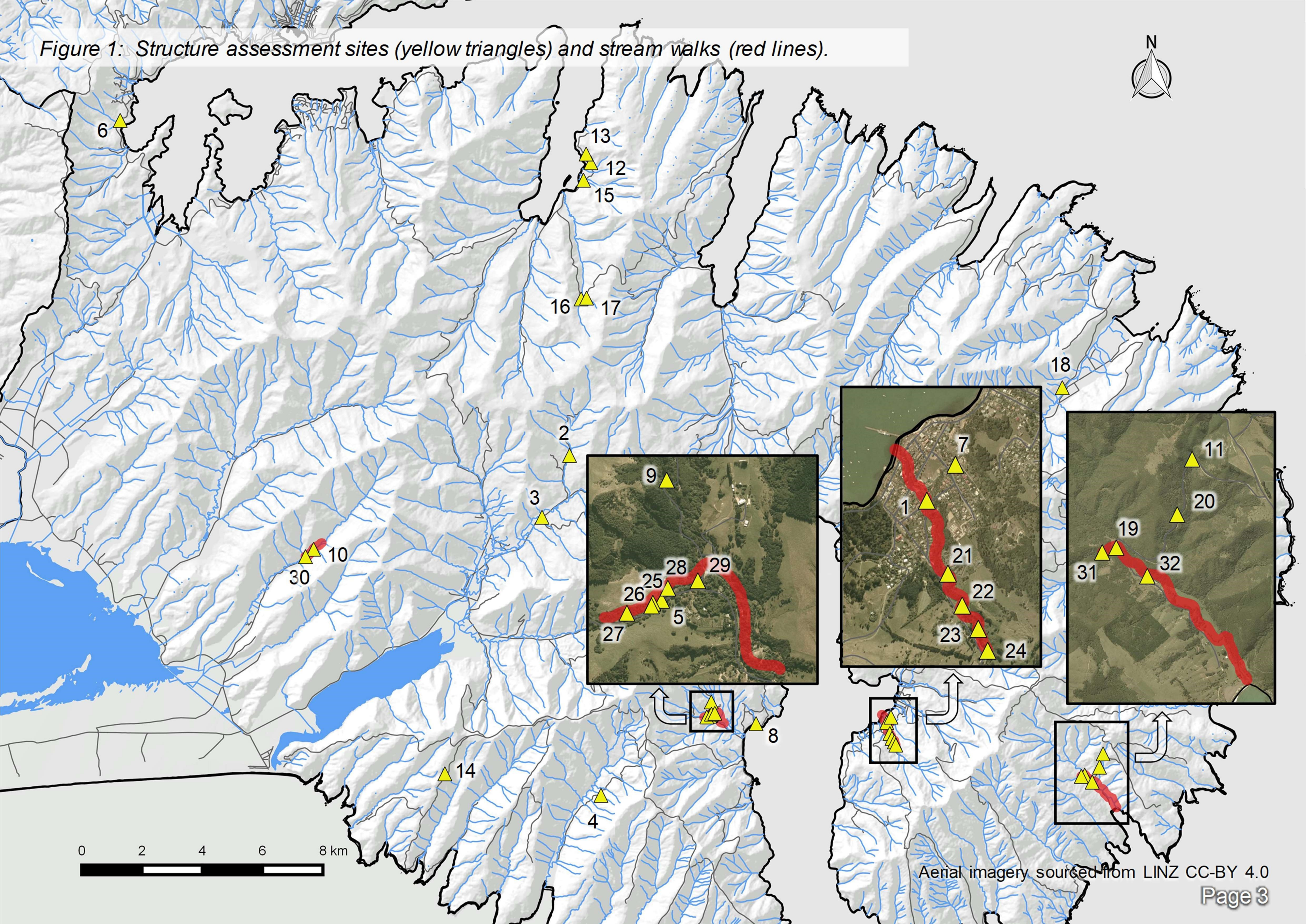

Table 1: Constructability scoring criteria for structures.

Parameter	Options	Score
Site access for machinery	Good (off-road parking)	4
	Fair	3
	Poor (access from road only)	2
	Very poor (no road access)	1
Traffic management required?	No	2
	Yes	1
Special access required? (steep slope or confined space)	No	2
	Yes	1
Native vegetation clearance?	No	3
	Yes, minor (<10 m²)	2
	Yes, major (>10 m²)	1
Geotechnical conditions (no scores)	Bedrock	
	Coarse alluvium	
	Riprap (angular rocks placed on slope)	
	Loess soils	
	Concrete	
	Other	

2.2. Data Analysis

FPAT field data were manually entered into an Excel spreadsheet and then sent to NIWA for entry into the online database. Once the FPAT database was updated (which occurs overnight), the barrier risk assessment and barrier priority scores were copied into an Excel spreadsheet alongside constructability data imported from the Fulcrum app. Data were tabulated and plotted to identify any obvious patterns.

3. RESULTS AND DISCUSSION

3.1. Fieldwork Summary

A total of 32 natural and artificial structures were assessed, including the 20 core sites and an additional 12 structures encountered during the stream walks (Figure 1, Appendix 1). Of the structures assessed, 25 were artificial (mostly culverts) and seven were natural (mostly waterfalls). Four of the 20 core sites were dry and had no residual pools or aquatic habitat upstream that could support fish. Examples of the range of structures assessed are shown in Figure 2 below. Photographs of all the structures and their associated assessment data were provided in electronic form to CCC, and they are available on request.

Figure 2: Examples of the range of structures assessed.

A combined total of 4.8 km of stream length was covered during the stream walks. The distance travelled along each waterway was dictated by the terrain and time available. A total of 16 structures (12 new and four core sites) were assessed on the four waterways where stream walks occurred. On these four waterways, seven of the 16 structures assessed – nearly half – were natural (Table 2). The number of new structures identified during the stream walks ranged from a low of one for Prices Valley Stream to a high of five new structures for Wainui Valley Stream (Table 2). There was an average of 3 structures per km of waterway walked, ranging from 2 per km for Narbey Stream to 6 per km for Wainui Valley Stream. Three of the four streams had a mixture of natural and artificial structures. Prices Valley Stream only had artificial structures, reflecting the lower bed gradient and associated lack of waterfalls or chutes.

Table 2: Summary of structures assessed during stream walks.

	Prices Valley Stream	Wainui Valley Stream	Aylmers Stream	Narbey Stream	Total
Stream Walk Length (m)	750	1,011	1,243	1,824	4,828
Core structures	1	1	1	1	4
New structures					
Artificial	1	2	2		5
Natural		3	2	2	7
Total structures	2	6	5	3	16
Structures per km of waterway assessed	3	6	4	2	3

3.2. Barrier Prioritisation

FPAT structure risk assessments and priority scores were automatically calculated for 27 of the 32 structures assessed (Appendix 1). The remaining five structures were not associated with stream lines in the FPAT application, so only qualitative risk assessments could be made for those structures (see Figure 3 for an example)[1]. Qualitative assessments of risk to fish passage often differed substantially from the FPAT risk assessment, with the qualitative risk assessment generally scoring lower than the FPAT score (Figure 4). Fish passage risk calculated by the FPAT app ranged from very low for a bridge on Aylmers Stream (Site 1) to very high at 11 sites across the study area. When FPAT structure risk data from this study are compared against national data, a lower proportion of low risk sites were surveyed for this study (4% compared to 22% nationally; Figure 4). This reflects the fact that most artificial structures assessed during this survey were culverts, and they generally present a higher risk to fish passage than bridges, which are better represented in the national database.

The highest FPAT priority score of 20 (the maximum possible score) was given to a perched culvert on Church Lane Drain (Site 6) in Governors Bay. The lowest FPAT score of 5 (the minimum possible score is 4) was given to two waterfalls (Sites 26 and 28) and a weir (Site 25) on Wainui Valley Stream (Figure 5). Highest priority sites either had no other structures identified elsewhere on the waterway, or a large proportion of the catchment with no other structures. Given the number of additional structures identified during stream walks, it is likely that priority scores would decrease at some sites if stream walks were undertaken upstream

[1] However, data were collected in the FPAT format and could be uploaded to the FPAT app in the future, if the issue with unmapped streams is resolved.

and downstream of the structures already assessed. That is because stream walks would likely encounter more barriers, which would reduce the value of remediating a single barrier.

Figure 3: Church Lane Drain (Site 6, left) is a perched culvert assessed as presenting a very high risk to fish passage. The culvert on Wainui Valley Stream Branch (Site 9, right) likely presents a similar risk to fish passage, but the stream location was not mapped in the FPAT app, so a risk score was not calculated for the structure.

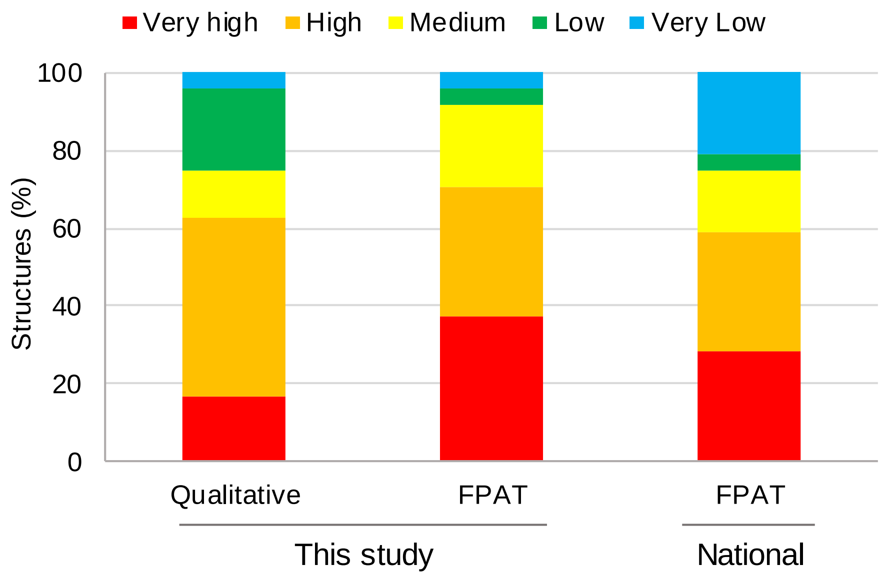

Figure 4: Risk to fish passage for structures, assessed qualitatively by the observer and assessed using the FPAT app. Data for this study are compared to national data from the FPAT app, downloaded from the FPAT website on 25 August 2019. Data from this study excludes dry sites.

Constructability scores ranged from a maximum of 11 (the maximum possible score) at seven sites to a minimum of 4 (the minimum score possible) at one site (Figure 5, Appendix 1). An obvious way of prioritising artificial structures for remediation is to focus on sites that have both the highest FPAT priority scores and the highest constructability scores, which are sites in the upper right hand corner of Figure 5. Inspection of the data indicates that Site 7 (Walnut Stream) has the highest combination of FPAT and constructability scores, and so should be a high priority for remediation. In contrast, Site 6 (Church Lane Drain) has the highest FPAT priority score of 20, but a relatively low constructability score of 7, reflecting comparatively difficult site access (Figure 5). Site 1 on Aylmers Stream also had a constructability score of 7, but it had a lower FPAT score of 12. However, the structure was assessed as a bridge, which automatically resulted in a lower risk to fish passage score and a lower FPAT score; if the structure had been assessed as a culvert, the structure risk would likely have been very high and the FPAT priority score would have increased from 12 to 16.

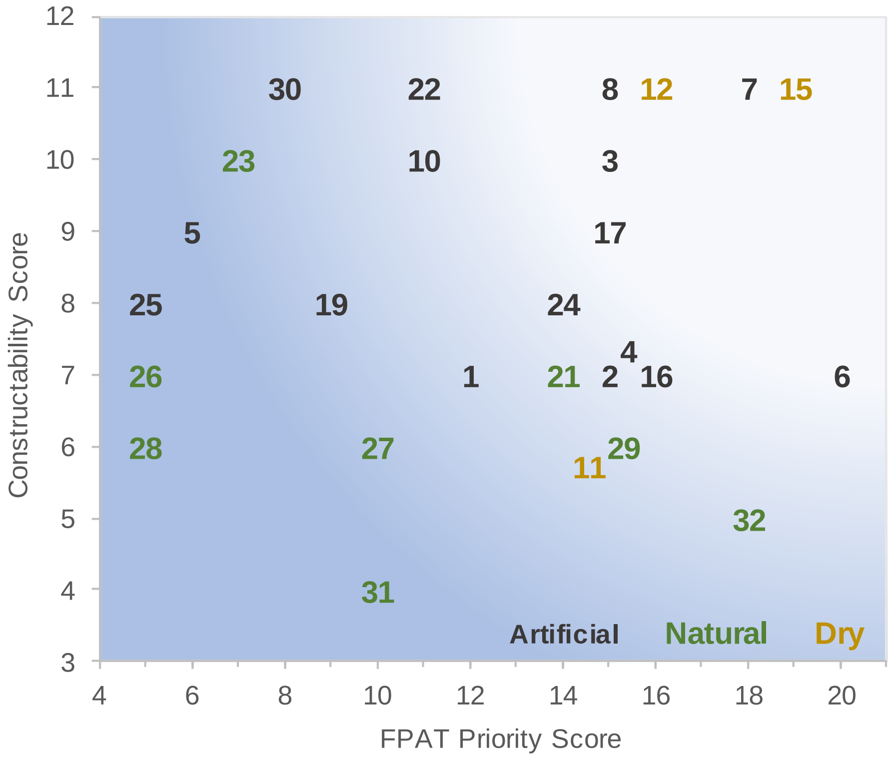

Figure 5: FPAT priority and constructability scores for the structures assessed. Coloured numbers on the plots are site numbers, with the colours indicating structure type (artificial=black, natural=green, dry=brown).

4. CONCLUSIONS AND RECOMMENDATIONS

Based on results of this pilot study, the FPAT app and constructability assessment provide a consistent method that should be useful for identifying and prioritising fish barriers for remediation around Christchurch. When compared with the qualitative assessment of fish passage risk by a field surveyor, the FPAT risk assessment is preferable, because it is more objective and will therefore be more consistently applied by different surveyors. The FPAT app currently includes assumptions that may over-simplify the structure assessment for some structures (e.g., all bridges are assumed to be very low risk). However, this could be remedied over time by including additional structural data into the risk assessment for a wider range of structures (e.g., by including similar data and objective assessments for bridges as for culverts).

Some basic training is recommended for staff undertaking fish barrier assessments, to ensure consistent interpretation of the different data fields. Training would also ensure the appropriate amount and quality of data is provided. This includes taking good quality photographs of the structure and stream environment, completion of non-mandatory fields, and describing the site context and structure in the comments section. Training should include the range of stream and structure types that are likely to be encountered.

Constructability data is currently a subjective measure and it does not consider the scale or type of fish passage remediation that might be required. The prioritisation could be further refined by working with engineers to identify remediation options and associated rough-order cost estimates for remedial works.

Based on this pilot study, we recommend the following:

- **Focus on priority catchments.** Given the large number of fish barriers in a district or region, we recommend focussing on priority catchments first. These are usually catchments with significant natural values that have been recognised by local government as priorities for protection. In the Christchurch district, likely priority catchments would be those already identified by the Banks Peninsula Zone Committee and Sites of Ecological Significance listed in the Christchurch district plan.
- **Conduct stream walks.** Many natural and artificial barriers occur well upstream and downstream of roads. If these more remote structures are not assessed, then FPAT priority scores will be artificially high for the easily accessed sites. Stream walks enable barriers to be assessed from the stream mouth upstream, at least to where it is practical and safe to walk.
- **Reassess known barriers.** The FPAT tool and constructability assessment can be used to assess barriers previously identified, using a consistent method. Stream walks have already been conducted and barriers identified on many of the spring-fed streams in Christchurch, as part of the Christchurch River Environment Assessment Survey (CREAS; McMurtrie & Suren 2008). Reassessing CREAS barriers using the FPAT app and constructability assessment would help prioritise these known barriers for remediation.
- **Use this survey data with caution.** Sites with the highest priority scores in this study partly reflected the fact that stream walk data was lacking for the catchment. We therefore recommend against prioritising sites with high FPAT priority scores, until the catchment has been explored further and potential barriers identified and assessed.
- **Interpret FPAT data with caution.** Any index generated by condensing data down to a single number should always be interpreted cautiously. For the FPAT and constructability scores, that means evaluating other supporting information that may have influenced the assessment or its interpretation. This includes: assumptions made by the FPAT app for certain types of structures; whether there is any potential fish habitat present (flowing water or residual pools); knowledge about the fish species likely to be present; and whether or not other barriers are likely present elsewhere in the catchment that have not been assessed.
- **Training and experience.** People undertaking barrier assessments should have some basic training for barrier assessment, to ensure data quality and consistency across field

surveyors. Training should include the range of stream types and structures the surveyor is likely to encounter. To provide the best quality data, at least one experienced assessor should be in each team undertaking barrier assessments.

- **FPAT app improvements.** Issues with small, unmapped waterways and the simplified assumptions around structures such as bridges could be improved, as discussed above. It would also be useful to have a measure of stream depth upstream or downstream of the structure, to provide additional information on potential fish habitat.
- **Hard copy of the FPAT app.** While app stability will improve with time, there is no substitute for a paper copy backup, in the event of technology issues. DOC's Freshwater Team have an Excel version of the FPAT app that can be printed off and taken into the field. The hard copy form is available from DOC on request and will soon be available to download from the FPAT website.

5. ACKNOWLEDGEMENTS

Thank you to Belinda Margetts and Katie Noakes (CCC Waterways Ecologists) for providing project funding and background data. Neil Andrews (CCC engineer) provided suggestions around constructability, while Jeff Bellamore, Grant Stowell, David Pinkney, and Tim Ayers (CCC engineers) provided feedback on preliminary results. Megan Brown (Instream ecologist) and Fleur van Eyndhoven (graduate ecologist) did the field assessments and stream walks. Thank you also to Paul Franklin (NIWA) for FPAT technical support and Sjaan Bowie (DOC) for funding to create the FPAT field form.

6. REFERENCES

Christchurch City Council (2003). 'Waterways, wetlands and drainage guide'. (Christchurch City Council: Christchurch.)

Clapcott, J. (2015). National rapid habitat assessment protocol development for streams and rivers. Cawthron Institute Report 2649, prepared for Northland Regional Council, January 2015.

Franklin, P. (2018). Fish passage assessment protocol mobile application user guide. Report prepared for Envirolink Tools by NIWA, December 2018.

Franklin, P., Gee, E., Baker, C., and Bowie, S. (2018). New Zealand fish passage guidelines for structures up to 4 metres. NIWA Client Report 2018019HN, April 2018.

McMurtrie, S., and Suren, A. (2008). Field Methodology for the Christchurch River Environment Assessment Survey (CREAS). Report prepared by EOS Ecology for Christchurch City Council, June 2008.

APPENDIX 1: STRUCTURE ASSESSMENT DATA

Label	Site Code	Location	Waterway Name	Easting (NZTM)	Northing (NZTM)	Structure type	Visual risk assessment	FPAT risk assessment	FPAT priority score	Constructability score	Habitat score
Core Sites (selected by CCC)											
1	ECAN1	Akaroa	Almyers Stream	1597005	5148997	Bridge	Very high	Very low	12	7	76
2	ECAN4	Little River	Hikuika Stream	1586461	5157846	Culvert	Medium	Very high	15	7	93
3	ECAN5	Little River	Opuahou Stream Branch	1585551	5155795	Culvert	Very high	Very high	15	10	56
4	ECAN6	Peraki Bay	Peraki Creek	1587526	5146578	Culvert	Very high	Very high	15	7	86
5	ECAN7	Wainui	Wainui Valley Stream	1591164	5149225	Ford with Culvert	High	Very high	6	9	90
6	ECAN8	Governors Bay	Church Lane Drain	1571480	5168925	Culvert	Very high	Very high	20	7	72
7	ECAN9	Akaroa	Walnut Stream	1597147	5149176	Culvert	Low	Medium	18	11	58
8	ECAN12	Wainui	Otutereinga Drain	1592670	5148958	Culvert	Very low	Very high	15	11	
9	ECAN13	Wainui	Wainui Valley Stream Branch	1591182	5149676	Culvert	Very high			6	90
10	ECAN14	Prices Valley	Prices Valley Stream	1577965	5154709	Ford with Culvert	Low	Medium	11	10	78
11*	NIWA1	Hinewai	Narbey Stream Branch	1604187	5147961	Culvert	Very low	Very high	15	6	10
12*	NIWA2	Port Levy	Pickersgill Drain	1587151	5167566	Culvert	Very low	Very high	16	11	10
13*	NIWA3	Port Levy	Unknown	1586993	5167859	Culvert	Very low			11	10
14	NIWA10	Tumbledwon Bay	Tumbledown Bay Creek Branch	1582345	5147275	Culvert	Very high			9	76
15*	NIWA12	Port Levy	Puari Drain	1586907	5166986	Culvert	Very low	High	19	11	41
16	NIWA14	Port Levy	Koukourarata Stream	1586836	5163041	Culvert	High	Very high	16	7	92
17	NIWA15	Port Levy	Koukourarata Stream South	1587015	5163070	Culvert	High	Very high	15	9	53
18	NIWA20	Okains Bay	Opara Stream	1602839	5160107	Culvert	Medium			9	17
19	NIWA21	Hinewai	Narbey Stream	1603577	5147251	Ford without culvert	High	High	9	8	92
20	NIWA22	Hinewai	Narbey Stream Branch	1604067	5147517	Culvert	High			6	74
Additional Sites (encountered during stream walks)											
21	ECAN1.1	Akaroa	Aylmers Stream	1597110	5148634	Natural-rapid	High	High	14	7	89
22	ECAN1.2	Akaroa	Aylmers Stream	1597181	5148475	Ford with Culvert	Low	Very high	11	11	77
23	ECAN1.3	Akaroa	Aylmers Stream	1597261	5148360	Natural-waterfall	Low	Low	7	10	77
24	ECAN1.4	Akaroa	Aylmers Stream	1597308	5148251	Weir	High	High	14	8	77
25	ECAN7.1	Wainui	Wainui Valley Stream	1591131	5149215	Other / Weir	High	High	5	8	92
26	ECAN7.2	Wainui	Wainui Valley Stream	1591126	5149204	Natural-waterfall	High	High	5	7	92
27	ECAN7.3	Wainui	Wainui Valley Stream	1591034	5149177	Other / Natural	High	High	10	6	95
28	ECAN7.4	Wainui	Wainui Valley Stream	1591187	5149271	Natural-waterfall	Medium	Medium	5	6	95
29	ECAN7.5	Wainui	Wainui Valley Stream	1591299	5149299	Natural-waterfall	High	High	15	6	93
30	ECAN14.1	Prices Valley	Prices Valley Stream	1577697	5154464	Ford with Culvert	Low	Medium	8	11	71
31	NIWA21.1	Hinewai	Narbey Stream	1603464	5147213	Natural-waterfall	High	High	10	4	92
32	NIWA21.2	Hinewai	Narbey Stream	1603826	5147022	Natural-rapid	Medium	Medium	18	5	96

Note: * indicates site was dry, with no residual pools upstream that could support fish.