Conservation prioritisation methodology for īnanga spawning sites

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Shane Orchard

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v1	25/06/2019	Draft for feedback	S. Orchard	S. Orchard
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Contents

1. Introduction

Īnanga (*Galaxias maculatus*) is a highly valued diadromous fish that supports a popular recreational fishery (McDowall 1984). However, the species is currently listed in the 'at risk - declining' category of the New Zealand Threat Classification System in recognition of historic declines (Dunn et al. 2018). The need for īnanga conservation is also identified in a wide range of statutory documents at national, regional and local levels. The conservation of spawning habitat is a particular focus of these efforts due to spawning being a critical life stage, and the specificity of locations involved.

In tidal waterways, spawning grounds are found in riparian vegetation just below the elevation of the water level on spring high tides (Benzie 1968). For a large part of their development period this places the eggs in a terrestrial environment where they are vulnerable to a variety of anthropogenic threats (McDowall & Charteris 2006). Examples include disturbance effects associated with mowing, grazing and trampling, flood management activities such as vegetation clearance and dredging, and the construction of retaining walls and other engineering works (Hickford & Schiel 2011; Orchard et al. 2018a).

Conservation prioritisation project

Under the Biodiversity Contingency fund (BCBC), the Department of Conservation (DOC) has funding to work on three migratory freshwater fish – longfin eel, shortjaw kōkopu and īnanga.

The BCBC outlined the following baseline and four year outcomes statements for longfin eel, shortjaw kōkopu and īnanga:

> **Baseline**: Freshwater migratory fish are managed through limited compliance and advocacy functions of the Department, but priority sites in 0 freshwater bioregions are adequately protected.
>
> **Year 4 outcome**: Increased security of 3 migratory fish species (inanga, shortjaw kokopu and longfin eel) by protecting priority sites across all 12 freshwater bioregions
>
> **Benefits**: Migratory freshwater fish protection increases from limited advocacy and compliance (status quo) to a coordinated national programme protecting priority sites across all 12 freshwater bioregions.
>
> **Future State**: All migratory and marine species have a representative network of secure, stable or increasing sub-populations.

A key task in the BCBC work programme involves the provision of guidance for DOC operational staff to assist the identification of priority sites and thus determine where resources should be spatially deployed. To date, a desk top prioritisation exercise has been completed to identify important sites for adult fish (J. Goodman, pers. comm.). However further information on spawning locations needs to be added to the prioritisation framework to help ensure the best possible sites are being worked on to meet the objectives of the BCBC.

2. Project scope and purpose

Ideally a prioritisation exercise would be informed by a nationwide database of comparable records that includes information on the relative importance of different spawning locations. Of particular relevance to this project, a National Īnanga Spawning Database (NISD) was established in the late 1980s following a comprehensive survey of South Island rivers (Kelly 1988). It accumulated 565 records before being discontinued in the early 2000s. Despite some data gaps, a review of the NISD records by Taylor (2002) identified many trends useful for the conservation of whitebait.

In general, most of the NISD entries record the location of spawning sites as point coordinates. There are several other data field that are considered useful for the purposes of this project. They include a field recording threats that were observed at spawning sites, and this information is present for a large number of records. Other useful data fields include the size of spawning areas and the number of eggs found. However relatively few records include these data resulting in patchy spatiotemporal coverage.

Another aspect of the NISD is that is allowed for the recording of adult fish congregations, as well as directly observed spawning events, and spawning sites detected through the discovery of eggs. As a consequence, the records have different degrees of precision in terms of confirmed spawning locations. Observations of shoaling fish that were not physically spawning creates a particular issue since adult īnanga typically spend several days searching riparian vegetation before the actual spawning event (Benzie 1968). The area in which these pre-spawning shoals could have been observed may be relatively large compared to the dimensions of typical spawning grounds (Orchard et al. 2018b).To address this, the Department has reviewed the NISD to remove records that were considered unreliable as confirmed spawning locations (D. West, pers. comm.). This version of the NISD contains 439 records and was utilised as the starting point for the current project.

Other issues include the currency of the NISD records in relation to the potential for changes in the condition of waterways and fish population structures. Many of the records are over three decades old, and in some catchments there has been only a single survey conducted. In addition, the existing records have relatively patchy geographical coverage. For purposes of the current project these aspects were partly addressed through a call for information to identify additional spawning records made by researchers and other observers since the discontinuation of the NISD. However, the primary intention is to develop a workable approach for conservation prioritisation based on existing records to support the current focus of the BCBC fund, and with the primary audience being the operational staff tasked with its implementation. Review of the NISD structure and currency is flagged for future attention and will undoubtedly assist the objective of completing a robust conservation prioritisation. However, a related topic addressing guidance for the prioritisation of spawning site surveys was incorporated within this project.

The scope of the project is as follows:

1. Identification of spawning records
    - prepare and send a call for information to potential data holders.
    - undertake limited data collation to incorporate new data into the NISD with a focus on improve geographical coverage of the dataset to be used for development of the conservation prioritisation methodology.

2. Survey prioritisation
    - Develop draft methodology for guiding decisions on re-survey (and new survey) priority. Data available to inform this evaluation includes adult fish presence/abundance from the New Zealand Freshwater Fish Database (NZFFD) and existing spawning site records.

3. **Conservation prioritisation**
    - Develop draft methodology for assigning conservation priorities to spawning sites.
    - Test/ apply to known spawning sites and compare output with priority sites identified by the Department using adult fish population information.
    - Develop a GIS shapefile layer showing conservation prioritisation results (e.g. the top 3-4 sites) in each diadromous fish unit, derived from the draft methodology. The boundaries of the units are shown in Figure 1.

4. **Summary report**
    - Document the above steps and results in a summary report to inform follow-up work with operational staff. This will include feedback on the draft methodology and results, with the potential to refine the methodology based on the feedback received and/or complete further iterations of the assessment as updated information becomes available from either existing sources or new spawning surveys.

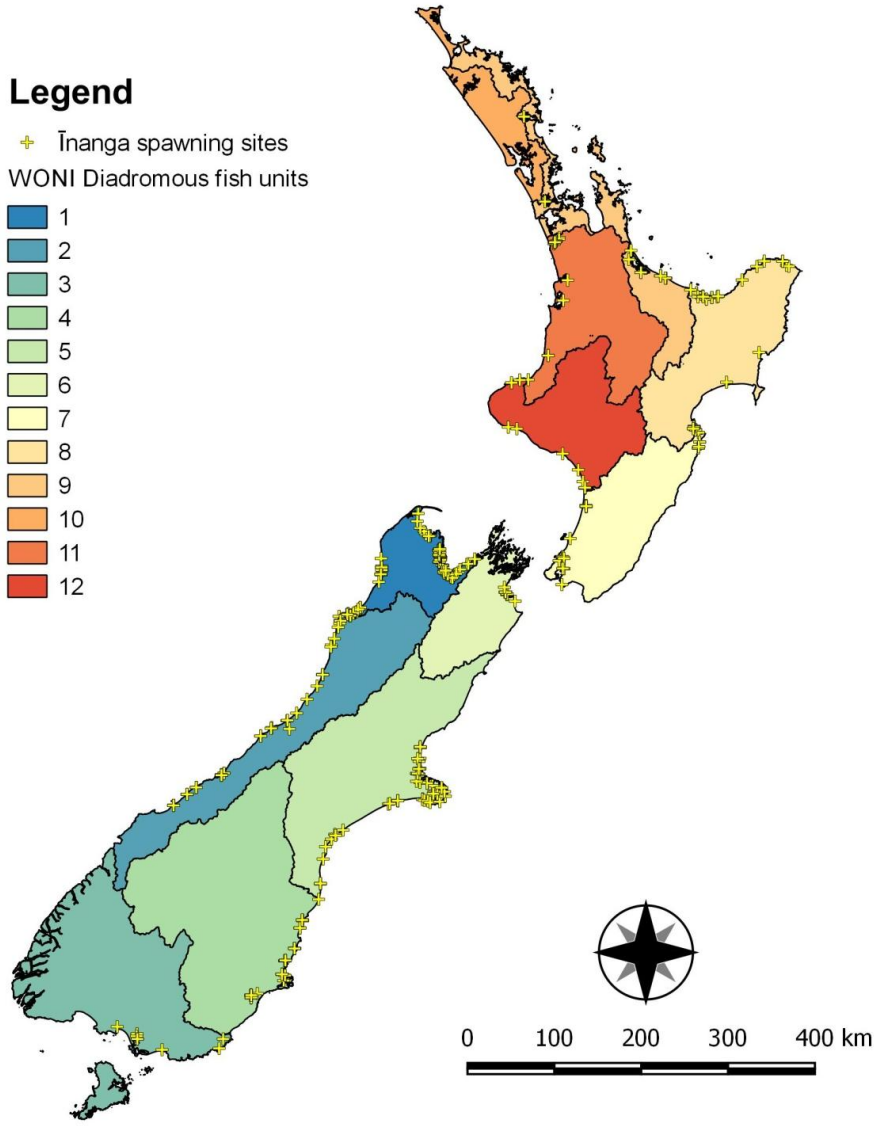

Figure 1. Boundaries of the Waters of National Importance (WONI) diadromous fish units utilised in this assessment methodology.

3. Methodology

3.1 Spawning database update

A call for information was sent to a mail list of 27 external stakeholder contacts identified by the Department. Several replies were received including:

- reports on spawning sites in the Tasman District (James 2013), Southland (Hicks et al. 2013), Wellington (Taylor & Marshall 2016), and Auckland (Studholme & Tweddle 2018).
- information on spawning locations in Nelson (polygon shapefile) and Hawkes Bay (csv file with coordinates).

This information represents relatively recent data on spawning sites not present in the NISD. Spawning site coordinates were available for the additional sites in Tasman, Wellington and Hawkes Bay. Polygon information is available for Nelson. Although coordinates were not provided directly in the reports from Southland and Auckland, they could be digitised from the maps included therein.

Compilation of the above information resulted in the addition of 61 records to the original NISD file supplied by the Department. The resulting file is referred to as the 'updated NISD' for the remainder of this report. The additional records have improved the geographical coverage of the original NISD as follows: Tasman (n=17), Wellington (n=8), Hawkes Bay (n=16), Nelson (n=11), Southland (n=7), and Auckland (n=2). In addition to point coordinates for spawning site locations, other NISD data fields were populated with information useful to the prioritisation exercise (e.g. area occupied by spawning sites and information on threats observed in the vicinity) where present in the original data source. However other NISD data fields remain unpopulated. This task is best done by the original observers (rather than a 3rd party), potentially in association with re-establishment of the NISD. There are also other known spawning site records not addressed in this project, including a large number of sites identified in Christchurch waterways in connection with post-earthquake research (Orchard 2017; Orchard & Hickford 2016; Orchard & Hickford 2018; Orchard et al. 2018a). However, these waterways are well represented in the NISD (Taylor 2002).

3.2 Survey priority

The focus of this section is to provide a decision support tool for operational staff considering the re-survey of catchments where spawning sites have been previously recorded, and for conducting baseline surveys in catchment for which there is no existing spawning record.

3.2.1 Re-survey of catchments with known spawning sites

In this methodology the practical steps involve the use of two decision support parameters derived from the current spawning database. The assessment would be conducted periodically at the bioregional scale.

The first parameter is the 'source population indicator' (SPI). This suggested as a useful way of viewing the importance of a previously recorded spawning site. There are three different data fields within the current database that could be used as the proxy for the SPI; egg numbers, size of the spawning area, and length of the spawning site. However, there are very few records that include egg numbers at the current point in time, despite it being, arguably, the most directly relevant metric for the concept of importance. Overall however, the SPI idea provides the flexibility to utilise the best available data as an indicator within a comparative framework that can be derived from existing information.

Using this approach the SPI has three variables (large, medium, small). The current SPI the highest class calculated for any spawning record from that waterway. As further information becomes available on any of the indicator metrics (length, area, or egg numbers) for spawning sites in the catchment, the SPI class would be updated. Therefore, any evidence of elevated importance would be captured. In the suggested

framework, the breakpoints for spawning site length are conservative. Many sites will be in the medium class and almost none in the large class. This is a deliberate choice as site length records are relatively unreliable as an indicator. For example, historical records likely include sparse or patchy egg distributions and there is a degree of subjectivity in the decision to split or lump eggs patches when measuring spawning sites in field surveys.

Table 1. Source Population Indicator (SPI) derived from a consideration of three metrics present in the spawning database; site length, area and egg numbers. The SPI has three variables (large, medium, small) and is defined as the highest class calculated for any spawning record from that waterway.

NISD† metrics	Definition of SPI
Spawning site length	Large > 100 m Medium = 10-100 m Small < 10 m
Spawning site area	Large < 100 m2 Medium = 10-100 m2 Small < 100m2
Egg number	Large > 100,000 Medium = 10,000-100,000 Small < 10,000

† National Īnanga Spawning Database

The second parameter is the date class. This is a simple reflection of the age of the record (Table 2).

Table 2. Date classes.

Date range	Date class
Recent (2000-2019)	1
10 years+ (1990-1999)	2
20 years+ (prior to 1990)	3

Decision support for re-survey priority

For decision support it is suggested that obtaining updated information on relatively large and productive spawning sites is the highest priority. The currency of the record (date range) is only regarded as a secondary consideration. Following this interpretation operational staff are advised to re-survey all of the catchments for which the spawning records contain evidence of a relatively large source population (SPI = Large), starting with updating the oldest records first. Records indicating a medium size source population are updated next and so on (Table 3).

Table 3. Decision support matrix for re-survey priority.

	Source Population Indicator (SPI)†								
	Large			Medium			Small		
Date range class†	3	2	1	3	2	1	3	2	1
	re-survey priority								

† see Tables 1 and 2 for definitions.

3.2.2 Catchments with no existing spawning records

Alongside the need for periodic re-survey of waterways with known spawning sites it is important to address the lack of historical spawning records in other waterways. An initial list of waterways requiring baseline surveys was identified according to the presence of an adult fish record in the NZFFD and the absence of a spawning site record in the updated NISD.

The workflow is shown in Figure 2.

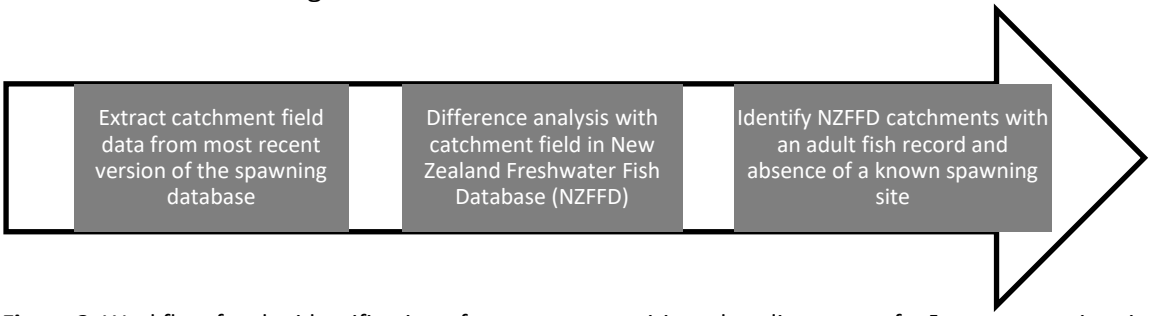

Figure 2. Workflow for the identification of waterways requiring a baseline survey for īnanga spawning sites.

3. Conservation priority

The focus of this section is to provide a decision support tool for operational staff making decisions on the allocation of resources for the conservation of spawning sites.

A methodology has been developed based on the following concepts:

- a 10-class threat classification for spawning sites (Table 4).
- a three-step threat identification process applied to each spawning record using the above threat classes.
- all spawning sites that are assessed as having at least one threat are identified for each diadromous fish unit.
- the results are then ranked, firstly by the highest ranking SPI value for all spawning records on a catchment basis, and secondly (if required) by an arbitrary ranking of threat classes (Table 4). The resultant list determines the conservation priority.

Table 4. Ten-class threat classification for īnanga spawning sites.

Threat class	Rank*
Vegetation clearance activities	1
Road corridors	2
High intensity agriculture	3
Earthworks	4
Armouring	5
Invasive weeds	6
Low intensity agriculture	7
Recreational use	8
Pollution	9
Erosion	10

* Ranks reflect arbitrary decisions on severity of the threat type in relation to spawning success. Other versions are possible. They are utilised as a decision support sub-classification tool for the optional ranking of spawning sites within the conservation prioritisation methodology.

The following sections describe various aspects of the methodology development process.

3.3.1 Analysis of the updated NISD

The following manipulations were applied to the updated NISD (n = 500 records):

- All NZMG records were reprojected to NZTM. New fields were created to retain the old NZMG coordinates in the database where present.
- Diadromous fish unit field added.
- SPI field created with 3 variables + 'unknown'
- Date_class field created with 3 variables + 'unknown'
- LocationError field created to flag coordinates observed to be inaccurate (e.g. a long distance from any apparent waterway).
- ThreatClassObserved field added with 10 variables and populated using information in the threats and notes fields in the original records. If more than one threat was noted, the highest ranking threat class was assigned (Table 4).

3.3.2 Aerial imagery assessment

A desktop visual assessment was been completed for all 500 sites using the most recent LINZ national imagery layer. Results were tabulated into a new field (ThreatClassImagery) with 10 variables (as per Table 4) and 'none'. This creates a second more recent threat assessment in addition to information on threats recorded in the original observation.

3.3.3 Spatial co-occurrence analyses

A selection of mapped land use classes and topographical feature classes associated with potential threats were identified from public data layers available through the Land Information New Zealand portal. These included 14 topographical feature layers, an irrigated land polygon layer, and two LUCAS land use polygon layers (Table 5). In all cases the assumed threats related to either the land use activities that defined the mapped unit (e.g. irrigated land), or maintenance activities assumed to be associated with the mapped feature (e.g. spraying and mowing along road corridors). Proximity buffers were generated to reflect the footprint of these associated activities based on the assumed (average) distance around the feature that might be affected in routine maintenance work (Table 5). A series of intersection analyses were conducted in GIS using combinations of the above land use activities and spawning site radial buffers of 10, 20 and 30 m. The workflow is summarised in Figure 3. Results were tabulated into a new field (ThreatClassIntersect) with 10 variables (Table 4). Where more than one intersection result was obtained only the highest ranking threat class was used to population this field.

Table 5. Source data utilised in exploratory analyses for spatial co-occurrence between īnanga spawning sites and selected land use and topographical feature classes.

Dataset	Provider	File format	Buffer distance applied (m)	Associated threat class*
Irrigated Land	Koordinates	Polygons	-	High intensity agriculture
Drain	Land Information New Zealand	Polylines	10	Vegetation clearance
Canal	Land Information New Zealand	Polylines	10	Vegetation clearance
Embankment	Land Information New Zealand	Polylines	10	Vegetation clearance
Breakwater	Land Information New Zealand	Polylines	10	Vegetation clearance
Road	Land Information New Zealand	Polylines	10	Road corridors
Quarry	Land Information New Zealand	Polygons	10	Earthworks
Landfill	Land Information New Zealand	Polygons	10	Earthworks
Stockyard	Land Information New Zealand	Points	10	High intensity agriculture
Cliff	Land Information New Zealand	Polylines	10	Erosion
Cutting edges	Land Information New Zealand	Polylines	10	Erosion
Slip edges	Land Information New Zealand	Polylines	10	Erosion
Building	Land Information New Zealand	Polygons	10	Vegetation clearance
Tower	Land Information New Zealand	Points	10	Vegetation clearance
Fence	Land Information New Zealand	Polylines	5	Vegetation clearance
LUCAS† land use map, data field "LUCNA_2016"	Koordinates	Polygons	-	various
LUCAS† land use map, data field "SUBNA_2016"	Koordinates	Polygons	-	various

† Land Use and Carbon Analysis System
* see Table 4.

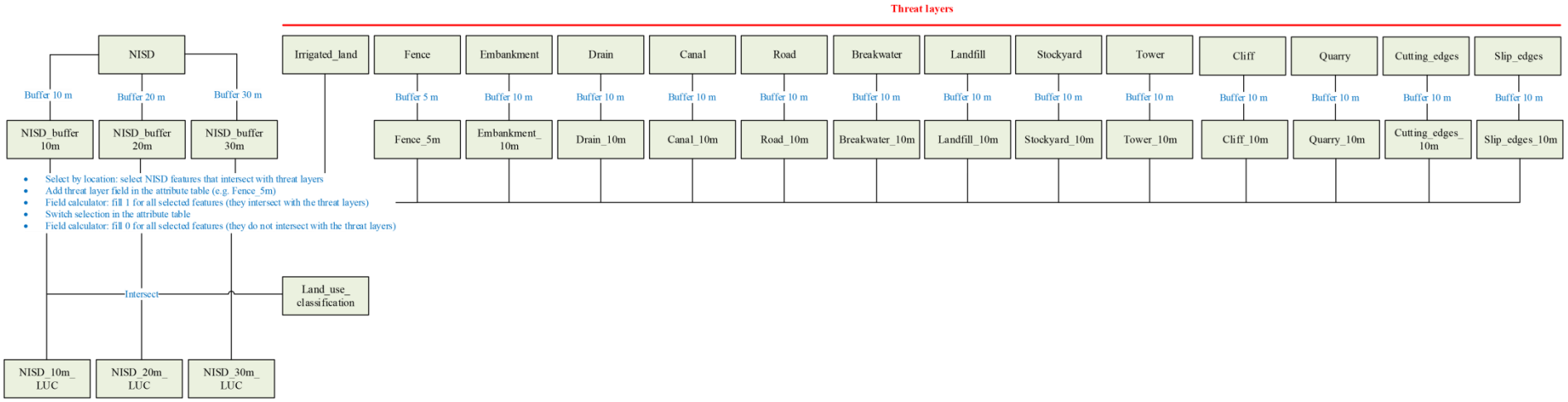

Figure 3. GIS workflow for spatial co-occurrence analyses.

3.3.4 Methodology for conservation prioritisation

Results from the three independent threat assessments were used to derive the conservation prioritisation methodology. Because each of these assessments produced valuable additional data pertaining to the presence of potential threats in the vicinity of spawning sites, the recommended approach combines all data sources. The initial output is a list of all known spawning sites within each diadromous fish unit for which at least one threat has been identified. In deciding which of these sites is more important (i.e. for decisions on the allocation of resources), the SPI is used as the primary ranking tool. Alternatively, the sites can be ranked by the threat class, although this requires arbitrary decisions about which threat classes are the highest priorities for attention. The threat class may also be used as a stand-alone criterion to identify sites that might be the focus of specific conservation or restoration initiatives targeting particular land uses.

To address the objective of identifying priority catchments for conservation investment it is necessary to reduce the results to a single output per catchment. In the examples shown in this report this is done at the ranking stage using the SPI as the primary ranking criteria.

Figure 4 provides an overview of the key steps in the proposed methodology.

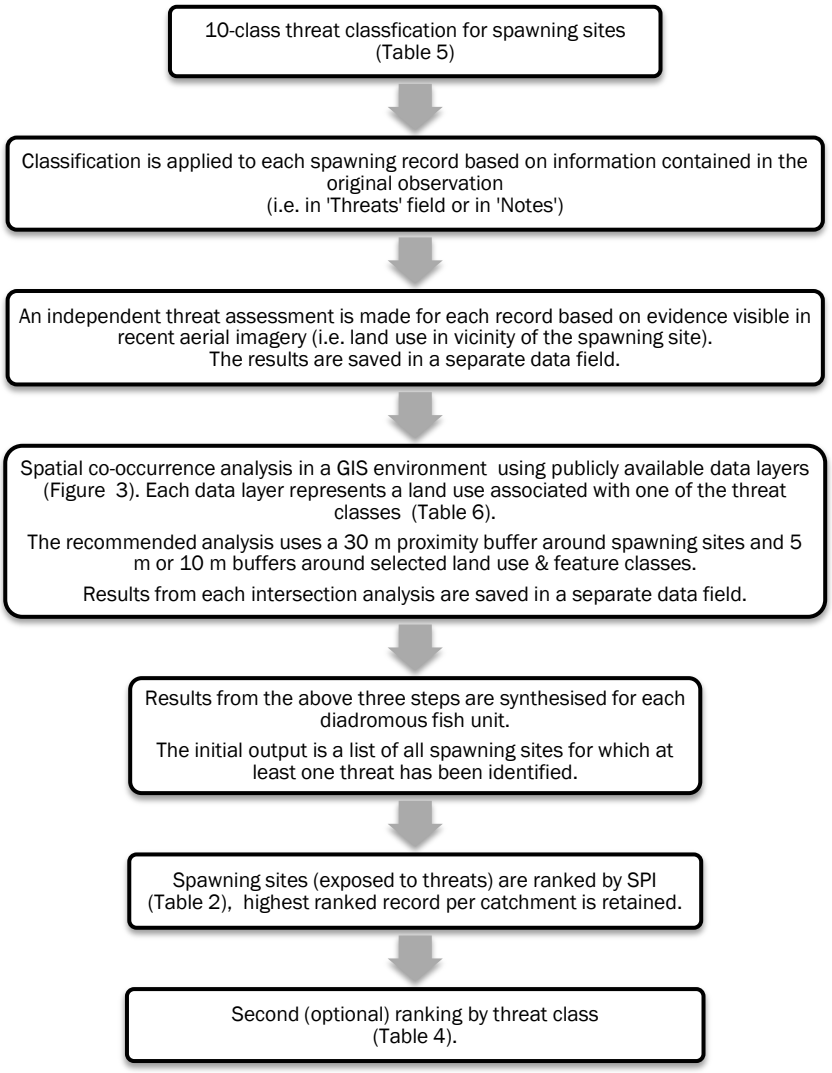

Figure 4. Overview of key steps in the proposed conservation prioritisation methodology.

4. Results and discussion

4.1 Identifying re-survey priorities

4.1.1 Characterisation of NISD using the Source Population Indicator (SPI)

Characterisation of the updated NISD using the SPI shows that very few records fall into the 'large' category, and there are 70 records in the 'medium' category (Table 6). Overall, however, an SPI value can be calculated for only 220 of the 500 spawning records. This suggests that a greater emphasis on recording spawning site metrics associated with relative importance (such as the size and productivity of spawning sites) is required in future surveys. It is also worth noting that there are no known spawning records for diadromous fish unit 10 (Northland's west coast south of Ahipara).

For the time being, the data deficient records create difficulties for decisions regarding re-surveying and conservation priorities. Table 6 shows that most of these records (with regards to SPI information) are more than 20 years old, and there are also a considerable number of records for which the survey date is not recorded. These results suggest that a comprehensive round of re-surveying is needed. Adopting a standardised approach to such surveys will assist in the further development of a nationally consistent dataset. In particular, inclusion of quantitative measures (e.g. Orchard & Hickford, 2018) will increase the number of catchments for which the SPI can be calculated. This will assist both contemporary prioritisation exercises and the monitoring of spawning success over the longer term.

To address the above, it is suggested that obtaining updated information on catchments with 'data deficient' spawning records is a relatively high priority in order to produce baseline information on the relative importance of the locations involved. Decisions on which catchments are the most important to survey first may be guided by measures of the abundance of fish as recorded in the NZFFD. Where these data are unavailable suitable proxies may include a subjective assessment of the extent of suitable īnanga habitat at the catchment scale.

Table 6. Characterisation of the updated NISD by the Source Population Indicator (SPI) and the age of the record. The figures shown are the number of records in each category. See Table 1 for definition of the SPI.

		Age of record			
		20+ years old	10-20 years old	< 10 years old	unknown
SPI	Large	6	0	0	0
	Medium	62	1	7	0
	Small	104	1	39	0
	Data deficient	134	1	29	116

4.1.2 Example results for re-survey priority using the SPI

Using the SPI calculated for 220 records a re-survey priority can be assigned following the decision support matrix in Table 3. An example set of results is shown in Figure 5. The resultant list of re-survey priorities for each diadromous fish unit is provided in Appendix 2.

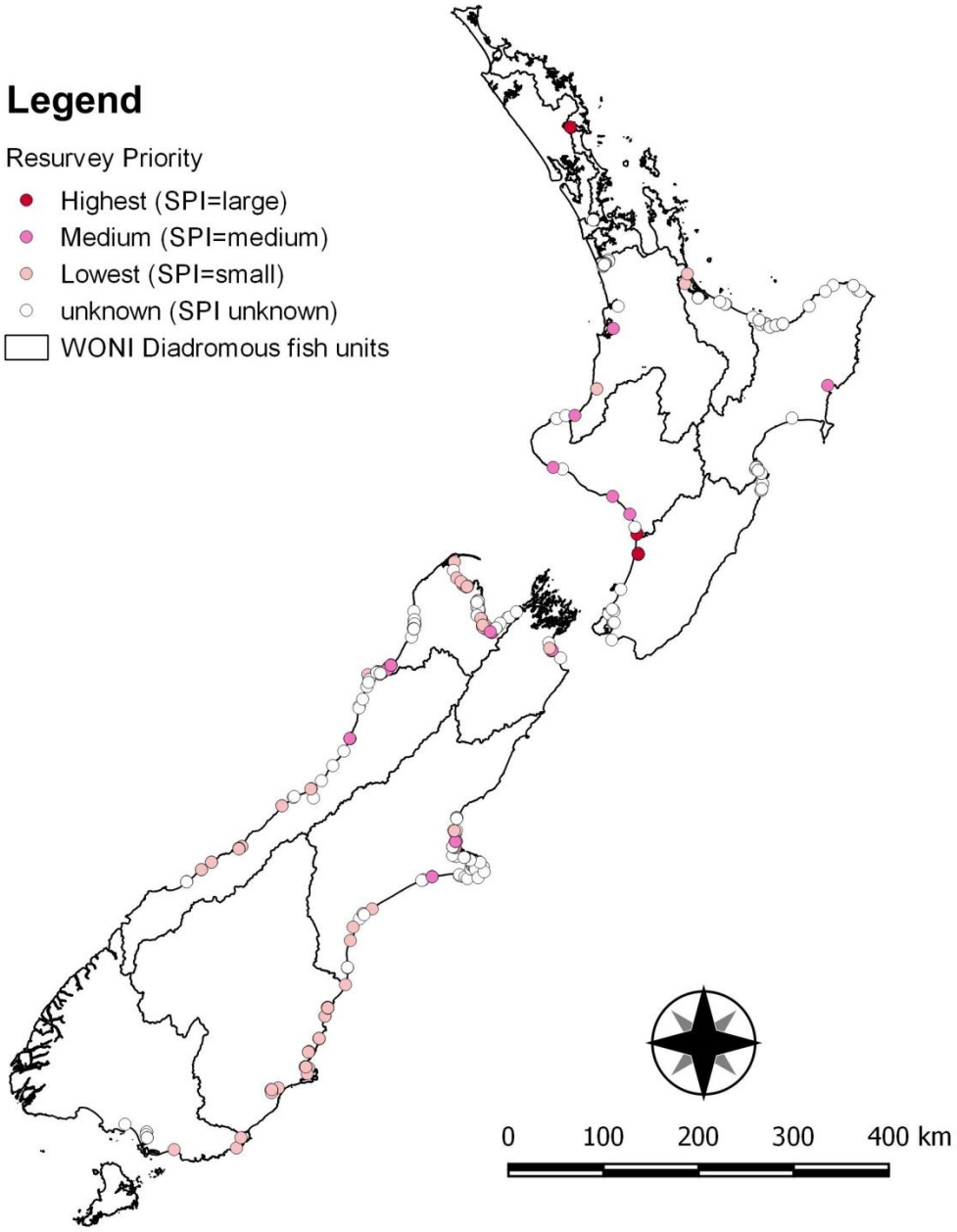

Figure 5. Example results for the assignment of re-survey priority for waterways within each of the 12 diadromous fish units. For clarity, only the SPI category of individual spawning records is presented here. If desired, a further ranking step may be applied to records falling within the same SPI category following the decision support matrix in Table 3. Using this process, the oldest records are the first to be re-surveyed within each SPI class.

4.2 Waterways requiring a baseline survey

Following the methodology in Figure 2 a set of example results was prepared based on the updated NISD and the NZFFD as at 15 May 2019. The output obtained is a list of 84 individual waterways with unknown spawning site status (see Appendix 2).

On a geographical basis a large proportion of these are located in the Marlborough area as the result of a systematic fish surveying effort (Jan Clayton-Green, pers. comm.). In comparison, other regions in New Zealand have received much less survey effort, especially with regard to individual waterways having a coastal connection (e.g. smaller coastal streams). However, these are quite capable of supporting sizeable fish populations in many situations, especially where they provide access to coastal wetlands, lagoons, and other lowland hydrosystems. Overall, despite the apparent geographical biases in the extent of adult fish information this approach is considered to offer beneficial information for the management of spawning sites. At a practical level, īnanga waterways with unknown spawning status provide a convenient focus for operational staff. Improving the geographical spread of the known spawning sites will assist conservation management efforts at the regional level and may present new opportunities for community involvement, especially where communities have a sense of ownership over their local waterways.

Recommendations:

- encourage further adult fish survey baseline work to fill information gaps, to include smaller coastal streams for which a baseline survey is lacking, following a similar approach to that used in Marlborough.
- repeat classification at regular intervals using updated NZFFD and NISD records until confirmed spawning site baseline records are established for all īnanga waterways.

4.3 Conservation prioritisation – example results

4.3.1 Threat classification from information in original records

A total of 161 or 32% of the records contained sufficient information to apply the threat classification for spawning sites (Table 4). The information was usually found in the threats field. In some cases comments are present indicating a potential threat if conditions changed (e.g. if nearby stock were given access to the spawning site). In these cases it was assumed that the same conditions observed have been maintained, and therefore no threat was recorded. A breakdown of these results by threat class is shown in Figure 6.

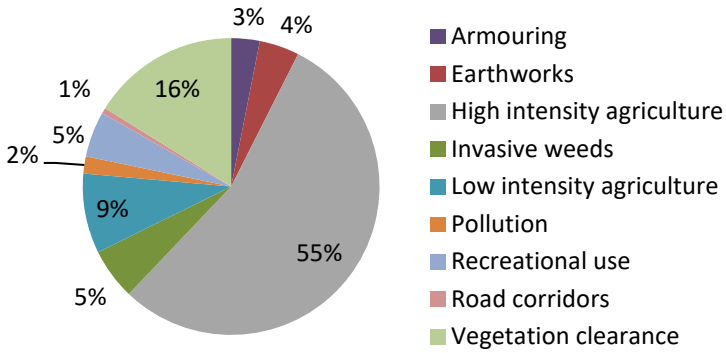

Figure 6. Classification of threats at 161 spawning sites using information contained in the original records.

4.3.2 Threat classification from aerial imagery

The visual threat assessment based on estimated land use types resulted in the assignment of a threat classification to 343 records. These included 125 of the records described in 4.3.1. Of these, 75 records received the same threat classification and 50 were classified differently. However, differences between low and high intensity agriculture and the use of 'road corridors' as a threat class visible in aerial imagery but not recorded as a threat type in the original records account for 15 of the latter. There were 150 records for which land uses in the vicinity showed no obvious signs of potential threats. Seven records were considered to have location errors and were not included in the assessment.

Overall these results demonstrate that the visual threat assessment using aerial imagery is a worthwhile approach given the lack of threat information in the majority of the original records. It generated new data for 218 records that were otherwise lacking information on potential threats in addition to providing an independent and more recent assessment for all records. Despite this, the limitations must be borne in mind and include the potential to misclassify some land use types (for example agricultural land versus mown areas) and the inability to detect some of the classes in the threat classification (e.g. invasive weeds) without further information.

4.3.3 Spatial co-occurrence analyses

Using the 30 m proximity buffer for spawning sites the co-occurrence analyses produced 197 individual intersection results spread across eight of the land use and topographical feature classes (Figure 7). The feature classes for which no spatial co-occurrence was detected were breakwaters, landfill, stockyards, quarries, towers, cutting edges & slip edges. These were removed from subsequent analyses. As expected, use of smaller proximity buffers around spawning sites (10 m and 20m) resulted in less threat detections than the 30 m buffer. Additional intersection results were obtained for the two LUCAS land use

map fields investigated in this analysis. However after comparison of the results with the aerial imagery assessment it was apparent that the intersections with LUCAS land use map polygons were not reliable as an indicator of actual threats in the vicinity of spawning sites. This effect relates to the relatively course scale of the land use mapping units which depict the general land use activity over broad areas but which may fail to record the presence of features such as riparian buffers within an otherwise productive landscape (Newsome et al. 2016). There are also difficulties in equating some of the land use classes with the potential presence of threats. Consequently the LUCAS land use results were removed from subsequent analyses. However the standalone 'irrigated land' polygon layer was retained along with seven topographical feature classes that could be readily equated with potential threats.

The resulting spatial co-occurrence data shown in Figure 7 represents potential threats for 172 spawning records since some the locations concerned return more than one intersection result. However, in comparison to the other threat detection approaches trialled in this project, the spatial co-occurrence methodology detected threats at only two locations for which the other assessments had returned no result. For this reason the 30 m buffer results were retained (Figure 7). The combining the results of all three threat identification approaches were utilised as the dataset for determining conservation priority.

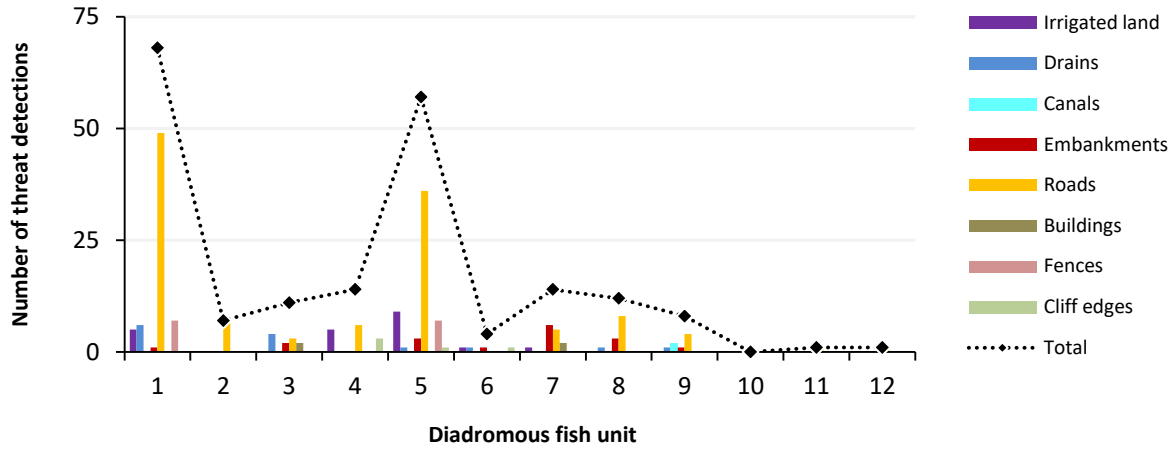

Figure 7. Spatial co-occurrence of potential threats within 30 m of īnanga spawning sites as detected by GIS intersection analyses with a selection of mapped land use and topographical feature classes.

4.3.4 Conservation priority

The proposed conservation prioritisation approach provides a methodology for assigning priority to those sites where threats are likely to be present. For all threat categories combined the above three-step threat identification process resulted in 1308 individual threat detections involving a total of 383 spawning sites. Figure 8 shows the distribution of these results across each SPI class and diadromous fish unit. On this basis there are also 117 spawning records that are assessed as having no evidence of threats in the vicinity. Given the extent of data gaps in the NISD this information is considered to offer a reasonable starting point for development of a conservation prioritisation methodology.

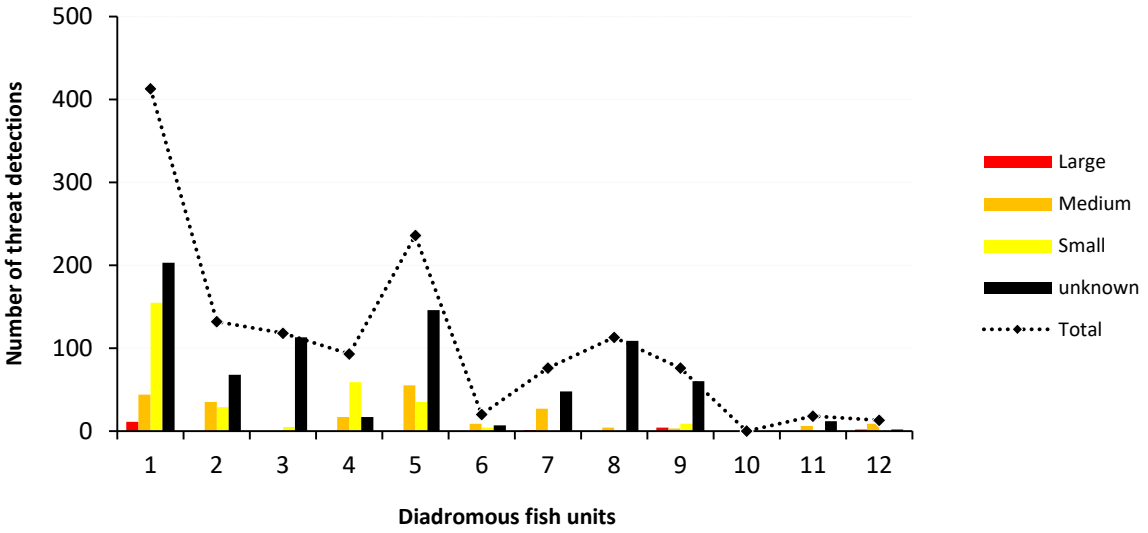

Figure 8. Total number of threat detections (all methods combined) within each SPI class and diadromous fish unit.

Prioritisation examples

Following the proposed methodology (section 3.3.4) the initial output is a list of all known spawning sites within each diadromous fish unit for which at least one threat has been identified. These sites are then ranked by the SPI, and if desired, further ranked by threat class within each SPI category. Figure 9 shows the results of this process for the highest ranked spawning record per catchment. Figure 10 shows the location of the top five catchments in each diadromous fish unit. Full results of this prioritisation example are provided in Appendix 3.

In practice, this approach utilises the SPI and catchment fields in the updated NISD as the primary selection criteria provided that at least one threat has been identified in the vicinity of the spawning site location. There is no discrimination between threats at this first cut stage.

An alternative approach is possible based on the threat classes identified at the location of each spawning record it would require decisions on which threats are most important. For catchments with more than one spawning record (which potentially indicates more than one spawning site) this decision would mean that larger and/or more productive spawning sites may be accorded a lower priority for investment if addressing higher ranked threats at other sites is deemed more important. This is avoided in the recommended approach though remains an option explore further.

Implementation context for prioritisation results

It is important to bear in mind that the implementation context for the results obtained through this methodology is primarily to trigger field investigations. For this reason the concepts underpinning this methodology as a desktop assessment process have a focus on identifying the relative importance of spawning sites and individual catchments. The intention is that any evidence of threats would trigger a field assessment at the location concern to establish the nature of the current threats (if any) and proceed from there to identify an action plan for conservation investment if required.

Potential weaknesses of this approach include the reliance on having accurate threat information. For example, a relatively important spawning site that was exposed to threats in reality may not be picked up as a conservation priority due to deficiencies in the threat information. Although this weakness has been partially addressed by the three complementary threat identification processes included in this methodology it fundamentally requires greater attention to threat assessment at the time spawning site

records are made. The currency of spawning records is also problematic within the database as a whole and this creates additional difficulties for obtaining reliable threat information. However this can be improved by implementing a programme of re-surveying priority sites and catchment.

Identifying catchments in the NISD

Some problems were encountered due to gaps in the 'catchment' field in the NISD that hinder the objective of obtaining consistent results for identifying priority catchments. These include missing data (94 records), use of 'Unnamed' as a catchment descriptor (7 records), and discrepancies in waterway names used between the 'catchment' and 'locality' fields. Typically these issues resulted in additional waterways being identified for prioritisation within the same larger catchment; for example 'Bradshaw's Creek' and 'Buller River'.

For the purposes of this project the approach taken was to complete the analysis based on the original records and manually resolve discrepancies apparent in the outputs. For the future, however, it would be useful to identify standard catchment names and/or provide data entry guidance for the catchment and locality fields within the NISD. This information is important to disseminate to researchers who are actively collecting information in the field to assist the assimilation of their records into the NISD in the future.

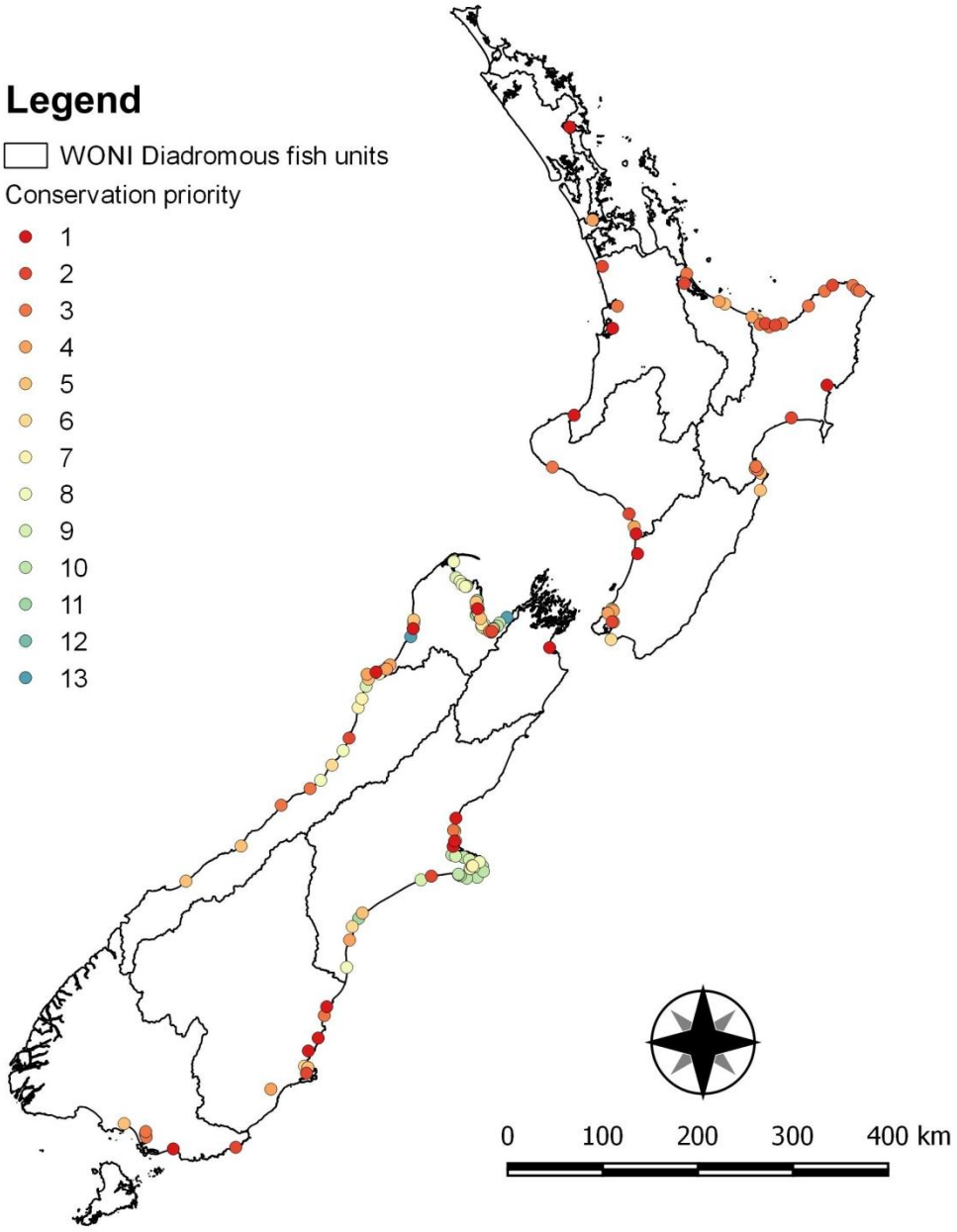

Figure 9. Conservation prioritisation example showing the results of ranking by SPI class followed by threat class for all spawning sites for each diadromous fish unit. Only the top ranking spawning record in each catchment is shown (n = 172).

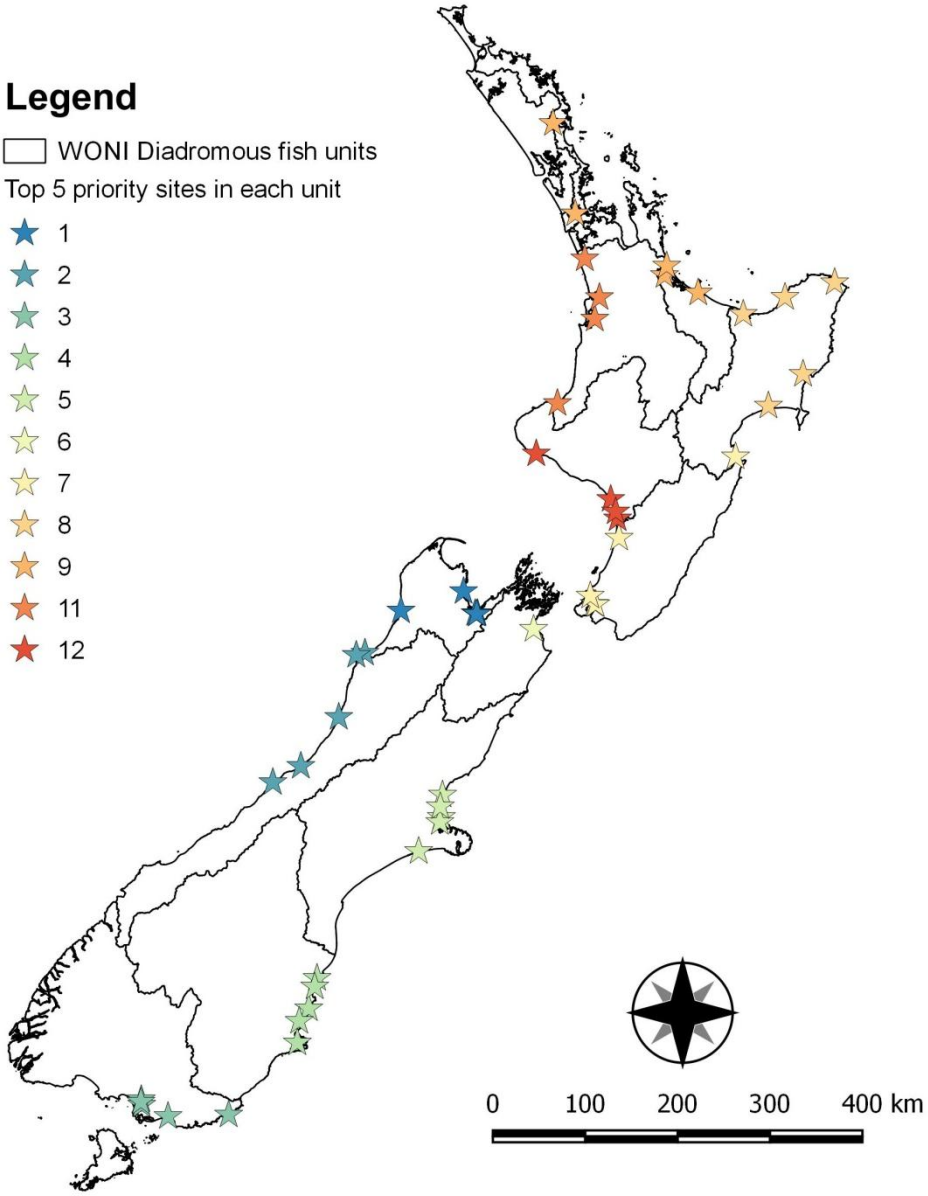

Figure 10. Location of the top five priority catchments within each diadromous fish unit. Note that no īnanga spawning catchments were identified in diadromous fish unit 10, only one in unit 6, and four in units 11 and 12.

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Appendix 1. List of re-survey priorities for each diadromous fish unit derived from the updated National Īnanga Spawning Database (n= 500 records).

DiadUnit	NZTM_X	NZTM_Y	Date_	Region	Catchment	Locality	SPI	Date_class	SPI.Date_class	Resurvey Priority
1	1600812	5451788	3/30/1994	Nelson	Unnamed	Spring-fed stream near mouth of Motueka River	L	3	L3	1
1	1525042	5428004	3/17/1995	West Coast	Granite	North end of Kongahu Swamp	L	3	L3	1
1	1482250	5376633	3/20/1991	West Coast	Buller	Confluence of Martins Creek and Bradshaws Creek	M	3	M3	2
1	1482250	5376633	3/21/1991	West Coast	Buller	Confluence of Martins Creek and Bradshaws Creek	M	3	M3	2
1	1482250	5376633	2/4/1991	West Coast	Buller	Confluence of Martins and Bradshaws Creek	M	3	M3	2
1	1782370	5561994	5/5/1992	Wanganui	Turakina	mainstem	M	3	M3	2
1	1938643	5609165	10/16/1993	Hawkes Bay	Tuki Tuki	Grange Creek, True left bank, near island.	M	3	M3	2
1	1938643	5609165	10/17/1993	Hawkes Bay	Tuki Tuki	Grange Creek, True left bank, near island.	M	3	M3	2
1	1938643	5609165	3/1/1994	Hawkes Bay	Tuki Tuki	Grange Creek, T/L bank opposite island.	M	3	M3	2
1	1498545	5385326	3/29/1994	West Coast	Jones	500m downstream from bridge nearest the sea,t/r	M	3	M3	2
1	1599212	5459685	3/29/1994	Nelson	Otuwhero	Above the main road bridge	M	3	M3	2
1	1496146	5383128	3/30/1994	West Coast	Waimangaroa	Small stream confluence	M	3	M3	2
1	1425748	4961873	3/22/1996	Otago	Shag	Mainstem, just above railway bridge	M	3	M3	2
1	1759276	5434685	4/23/1996	Wellington	Hutt	Sladen Park Boat Ramp	M	3	M3	2
1	1759376	5434685	4/24/1996	Wellington	Hutt	"Black Creek", which runs through Lower Hutt	M	3	M3	2
1	1718402	5681966	3/14/1997	Wanganui	Onaero	Mainstem, t/l bank	M	3	M3	2
1	1791380	5514288	3/26/1997	Wanganui	Manawatu	Whirokino Cut	M	3	M3	2
1	1790277	5537892	1/5/1997	Wanganui	Rangitikei	Tangimoana	M	3	M3	2
1	1415366	4947462	3/16/1998	Otago	Waikouaiti	Orbells	M	3	M3	2
1	1425748	4961973	3/17/1998	Otago	Shag	mainstem; 200m above railway bridge	M	3	M3	2
1	1767389	5787118	4/19/1999	Waikato	Oparau	Waihohonu Stream	M	3	M3	2
1	1574997	5183386	4/20/2004	Canterbury	Avon	Amelia Rogers Reserve, Avondale, Christchurch	M	2	M2	3
1	1611600	5428000	3/19/2013	Tasman Region	Waimea River	200m upstream and 200m downstream of new cycleway bridge	M	1	M1	4
1	1485848	5374833	3/19/1991	West Coast	Orowaiti	McKenna's approx. 1km upstream of railway bridge	S	3	S3	5
1	1483450	5377633	3/19/1991	West Coast	Buller	Floating Basin, near Yacht Club	S	3	S3	5
1	1485848	5374833	4/18/1991	West Coast	Orowaiti	McKenna's approx. 1km upstream of railway bridge	S	3	S3	5
1	1473551	5368338	4/18/1991	West Coast	Okari	2.5km from the sea, approx 1km from lagoon	S	3	S3	5
1	1485848	5374833	4/19/1991	West Coast	Orowaiti	McKenna's approx. 1km upstream of railway bridge	S	3	S3	5
1	1485848	5374833	4/29/1991	West Coast	Orowaiti	McKenna's approx. 1km upstream of railway bridge	S	3	S3	5
1	1473551	5368338	4/29/1991	West Coast	Okari	2.5km from the sea, approx 1km from lagoon	S	3	S3	5
1	1486148	5375033	4/5/1992	West Coast	Orowaiti	T/R 500m downstream from Excelsior bridge.	S	3	S3	5
1	1486348	5375133	4/5/1992	West Coast	Orowaiti	Area on T/L 800m below Excelsior Bridge	S	3	S3	5
1	1287783	5144562	10/2/1993	West Coast	Waita	Side channel less than 200m from mouth	S	3	S3	5
1	1287783	5144562	11/2/1993	West Coast	Waita	Side channel less than 200m from mouth	S	3	S3	5

1	1287783	5144562	10/3/1993	West Coast	Waita	T/R 100m from mouth	S	3	S3	5
1	1486448	5375433	3/29/1994	West Coast	Orowaiti	Immediately upstream from Railway Bridge	S	3	S3	5
1	1414667	4946761	6/4/1996	Otago	Waikouaiti	100m downstream from Orbell Crossing	S	3	S3	5
1	1414667	4946861	7/4/1996	Otago	Waikouaiti		S	3	S3	5
1	1471543	5101392	3/20/1997	Canterbury	Orari	Ohapi Creek confluence	S	3	S3	5
1	1415390	4929362	3/24/1997	Otago	Waitaiti	Purakanui Creek	S	3	S3	5
1	1457858	5070990	4/14/1997	Canterbury	Pareora	Waterway draining swamp into lagoon at mouth	S	3	S3	5
1	1481539	5106794	4/15/1997	Canterbury	Rangitata	Side branch of mainstem, near fishing huts	S	3	S3	5
1	1414767	4946961	7/3/1998	Otago	Waikouaiti	downstream of Orbells Crossing	S	3	S3	5
1	1411688	4930657	3/16/1998	Otago	Waitati	mainstem	S	3	S3	5
1	1340238	4840216	3/18/1998	Otago	Purakanui	mainstem	S	3	S3	5
1	1375930	4901701	3/31/1999	Otago	Taieri	Outlet of Lake Waihola	S	3	S3	5
1	1575397	5183486	4/20/2004	Canterbury	Avon	Corsers Stream, Avondale, Christchurch	S	2	S2	6
1	1619700	5428670	1/4/2012	Tasman Region	Pearl Creek	Tidegate to 50m upstream	S	1	S1	7
1	1611420	5428630	3/19/2013	Tasman Region	Waimea River	200m upstream and 200m downstream of new cycleway bridge	S	1	S1	7
1	1609600	5428725	1/4/2012	Tasman Region	O'Connor Creek	From 700m downstream of SH60 for 150m	S	1	S1	7
1	1572462	5507291	3/13/2012	Tasman Region	Yellow Pine Creek	Upstream of the Pakawau-Westhaven Road bridge	S	1	S1	7
1	1936840	5613770	4/15/1991	Hawkes Bay	Tutaekuri	Mainstem	unknown	3	unknown	8
1	1935840	5610866	4/15/1991	Hawkes Bay	Clive	Karamu Stream?	unknown	3	unknown	8
1	1790577	5538592	4/30/1992	Wanganui	Rangitikei	mainstem	unknown	3	unknown	8
1	1332410	5172676	3/5/1992	West Coast	Manakaiaua	Sam Creek	unknown	3	unknown	8
1	1791280	5513788	6/5/1992	Wanganui	Manawatu	mainstem near loop	unknown	3	unknown	8
1	1976537	5786015	5/15/1992	Bay of Plenty	Waioeka	Otara River, near Memorial Park	unknown	3	unknown	8
1	2071542	5822641	5/15/1992	East Coast	Karakatuwhero	Embayment in vicinity of river mouth	unknown	3	unknown	8
1	2074652	5821344	5/15/1992	East Coast	Awatere	Embayment just below the bridge, T/R side	unknown	3	unknown	8
1	1968228	5784401	5/15/1992	Bay of Plenty	Waiotahi	Just below Toone Road bridge (T/L),& above T/R.	unknown	3	unknown	8
1	1975337	5784912	5/15/1992	Bay of Plenty	Waioeka	Vicinity of mainstem island	unknown	3	unknown	8
1	2041567	5830198	5/21/1992	East Coast	Whangaparoa	Tributaries 200m upstream of mainstem shanty.	unknown	3	unknown	8
1	1467546	5095391	9/3/1993	Canterbury	Opihi	Tributary on T/R bank downstream of Waipopo R	unknown	3	unknown	8
1	1599212	5459785	3/28/1994	Nelson	Otuwhero	Upstream of bridge t/r bank	unknown	3	unknown	8
1	1600412	5461584	3/28/1994	Nelson	Marahau	Marahau stream road bridge, tributary at DoC kiosk	unknown	3	unknown	8
1	1599212	5459785	3/20/1995	Nelson	Otuwhero	ditch 50m upstream of highway bridge t/r	unknown	3	unknown	8
1	1425748	4961973	3/22/1996	Otago	Shag	Mainstem, just above railway bridge	unknown	3	unknown	8
1	1599212	5459785	12/3/1997	Nelson	Otuwhero	Lower reaches	unknown	3	unknown	8
1	1600012	5453987	12/3/1997	Nelson	Riwaka	250-500m from river mouth	unknown	3	unknown	8
1	1696108	5678349	3/14/1997	Wanganui	Waiwhakaiho	Edge of water intake pond below road.	unknown	3	unknown	8
1	1707204	5681857	3/14/1997	Wanganui	Waitara	Lower Mangatiti stream.	unknown	3	unknown	8
1	1599212	5459785	3/21/1997	Nelson	Otuwhero	Lower reaches, incl. wetland	unknown	3	unknown	8

1	1938844	5609266	12/5/1997	Hawkes Bay	Tuki Tuki	Grange Creek	unknown	3	unknown	8
1	1935840	5610866	5/13/1997	Hawkes Bay	Clive	Karamu	unknown	3	unknown	8
1	1791380	5514288	5/13/1997	Wanganui	Manawatu	Whirokino Cut	unknown	3	unknown	8
1	1455276	5040592	10/4/1999	Otago	Waihao	Lower main river	unknown	3	unknown	8
1	1575015	5195015	12/4/2005	Canterbury	Styx	Just upstream of tide gates, both banks	unknown	2	unknown	8
1	1592795	5154583		Canterbury		TL 20m upstream of Christchurch Akaroa Road bridge	unknown	unknown	unknown	8
1	1575908	5166606		Canterbury		110m downstream of Marine Drive bridge	unknown	unknown	unknown	8
1	1571723	5167944		Canterbury		10m upstream of Governors Bay Teddington Road bridge	unknown	unknown	unknown	8
1	1573249	5177743		Canterbury		TR on reach from 100m downstream of rail bridge to Opawa Road Bridge	unknown	unknown	unknown	8
1	1575925	5183933		Canterbury		PRE-EARTHQUAKE All banks in south west corner	unknown	unknown	unknown	8
1	1575466	5183467		Canterbury		Reach from Dixons Reserve to Alloway Street	unknown	unknown	unknown	8
1	1572964	5195949		Canterbury		TR on small reach 15m upstream of stopbank/tide gates	unknown	unknown	unknown	8
1	1576209	5210763		Canterbury		200m reach west of Broad Road bridge	unknown	unknown	unknown	8
1	1524887	5448812		West Coast		Vegetated area on western side of lagoon on TR 100m downstream from swing bridge	unknown	unknown	unknown	8
1	1525661	5437281		West Coast		Grassed areas within bush on TL bank from 140m above road bridge	unknown	unknown	unknown	8
1	1524597	5428726		West Coast		Grassed areas on both banks from 50m below roadbridge to 100m above	unknown	unknown	unknown	8
1	1522358	5418590		West Coast		50m reach on grassy bank on inside (TL) of loop nearest township	unknown	unknown	unknown	8
1	1495935	5383170		West Coast		On both banks of small tribiutary that enters mainstem on TR 200 metres from mouth	unknown	unknown	unknown	8
1	1489940	5378215		West Coast		On TL grassy bank 70m downstream of Utopia Rd bridge	unknown	unknown	unknown	8
1	1486307	5375874		West Coast		50m reach on TL bank below rail bridge	unknown	unknown	unknown	8
1	1486339	5375785		West Coast		25m reach on TL bank underneath Stephens Rd bridge	unknown	unknown	unknown	8
1	1486330	5375337		West Coast		20m reach on TR bank 400m upstream of Stephens Rd bridge	unknown	unknown	unknown	8
1	1486245	5375130		West Coast		20m reach on TR bank 750m upstream of Stephens Rd bridge	unknown	unknown	unknown	8
1	1482234	5376528		West Coast		50m reach on TL bank between Cape Foulwind Rd and Martins Creek Rd bridges	unknown	unknown	unknown	8
1	1482232	5376490		West Coast		5m reach on TR bank between Cape Foulwind Rd and Martins Creek Rd bridges	unknown	unknown	unknown	8
1	1473386	5368926		West Coast		150m reach on TL bank	unknown	unknown	unknown	8
1	1462613	5337225		West Coast		5m reach on TR bank 120m downstream of road bridge	unknown	unknown	unknown	8
1	1462186	5335081		West Coast		50m reach on TL bank 75m upstream of road bridge	unknown	unknown	unknown	8
1	1433365	5268170		West Coast		On TR bank 100m above main road	unknown	unknown	unknown	8
1	1420771	5250495		West Coast		In small tributary that enters mainstem on TL bank at mouth	unknown	unknown	unknown	8
1	1486317	5375321		West Coast	Orowaiti River	20m reach on TR bank 400m upstream of Stephens Rd bridge	unknown	unknown	unknown	8

1	1486230	5375128		West Coast	Orowaiti River	20m reach on TR bank 750m upstream of Stephens Rd bridge	unknown	unknown	unknown	8
1	1482214	5376483		West Coast	Bradshaws Creek	50m reach on TL bank between Cape Foulwind Rd and Martins Creek Rd bridges	unknown	unknown	unknown	8
1	1482224	5376483		West Coast	Bradshaws Creek	5m reach on TR bank between Cape Foulwind Rd and Martins Creek Rd bridges	unknown	unknown	unknown	8
1	1473492	5368872		West Coast	Okari River	150m reach on TL bank	unknown	unknown	unknown	8
1	1473627	5368352		West Coast	Okari River	60m reach on TL bank	unknown	unknown	unknown	8
1	1470945	5360058		West Coast	Nile River	5m reach on TL bank 50m above road bridge	unknown	unknown	unknown	8
1	1466304	5345467		West Coast	Fox River	20m reach on TR bank above road bridge	unknown	unknown	unknown	8
1	1616770	5424280		Tasman Region	Pearl Creek	Between Wakatu Dr and Champion Road extension	unknown	unknown	unknown	8
1	1600180	5461630		Tasman Region	Marahau River	200m upstream and 320m downstream Sandy Bay-Marahau Road	unknown	unknown	unknown	8
1	1600360	5461135		Tasman Region	Marahau Estuary Stream	100m upstream and 300m downstream Sandy Bay-Marahau Road	unknown	unknown	unknown	8
1	1611000	5428725		Tasman Region	Pearl Creek	Tidegate to 50m upstream	unknown	unknown	unknown	8
1	1606250	5430560		Tasman Region	Old Stringer Creek	30-90m downstream Westdale Road	unknown	unknown	unknown	8
1	1943289	5592920		Hawkes Bay	Ocean beach L		unknown	unknown	unknown	8
1	1943204	5593027		Hawkes Bay	Ocean beach U		unknown	unknown	unknown	8
1	1941062	5584928		Hawkes Bay	Waimarama – Puhokio L		unknown	unknown	unknown	8
1	1941086	5585001		Hawkes Bay	Waimarama – Puhokio U		unknown	unknown	unknown	8
1	1935631	5610867		Hawkes Bay	Clive river U		unknown	unknown	unknown	8
2	1790277	5537892	4/28/1992	Wanganui	Rangitikei		L	3	L3	1
2	1600812	5451788	3/31/1994	Nelson	Unnamed		L	3	L3	1
2	1791380	5514288	5/5/1997	Wanganui	Manawatu		L	3	L3	1
2	1482250	5376633	3/3/1991	West Coast	Buller	Confluence of Martins Creek and Bradshaws Creek	M	3	M3	2
2	1482250	5376633	3/19/1991	West Coast	Buller	Confluence of Martins Creek and Bradshaws Creek	M	3	M3	2
2	1482250	5376633	3/31/1991	West Coast	Buller	Confluence of Martins and Bradshaws Creek	M	3	M3	2
2	1691147	5619657	5/21/1991	Wanganui	Kaupokonui	Mainstem	M	3	M3	2
2	1498545	5385326	2/22/1992	West Coast	Jones	500m downstream from bridge nearest the sea, t/r	M	3	M3	2
2	1762260	5583690	4/17/1992	Wanganui	Kai Iwi	Lower reaches mainstem	M	3	M3	2
2	1482350	5376633	4/18/1992	West Coast	Buller	Bradshaws Creek, immediately downstream of highway bridge.	M	3	M3	2
2	1791180	5515388	4/5/1992	Wanganui	Manawatu	Whirikino cut/loop confluence	M	3	M3	2
2	1574798	5183586	3/30/1993	Canterbury	Avon	Avondale Bridge site	M	3	M3	2
2	1599212	5459585	8/4/1993	Nelson	Otuwhero	backwater just above road bridge	M	3	M3	2
2	1938643	5609165	12/14/1993	Hawkes Bay	Tuki Tuki	Grange Creek, T/L bank opposite island.	M	3	M3	2
2	1938643	5609165	12/15/1993	Hawkes Bay	Tuki Tuki	Grange Creek, T/L bank opposite island.	M	3	M3	2
2	1599212	5459685	3/30/1994	Nelson	Otuwhero	Above the main road bridge	M	3	M3	2
2	1685384	5405697	3/31/1994	Nelson	Wairau	Confluence of small creek and Roses overflow	M	3	M3	2
2	1494546	5380329	3/31/1994	West Coast	Whareatea	Rapid Creek confluence	M	3	M3	2

2	1573098	5177588	4/28/1994	Canterbury	Heathcote	Opawa road bridge	M	3	M3	2
2	1790777	5538592	3/20/1995	Wanganui	Rangitikei	Tangimoana	M	3	M3	2
2	1573098	5177588	3/4/1995	Canterbury	Heathcote	Opawa road bridge	M	3	M3	2
2	1573098	5177588	4/20/1995	Canterbury	Heathcote	Opawa road bridge	M	3	M3	2
2	1791480	5513788	4/20/1995	Wanganui	Manawatu	Loop Drain	M	3	M3	2
2	1791380	5514288	4/21/1995	Wanganui	Manawatu	True left bank of mainstem	M	3	M3	2
2	1574698	5183286	3/19/1996	Canterbury	Avon	Avondale Road Bridge, T/R bank.	M	3	M3	2
2	1434212	4996480	3/19/1996	Otago	Kakanui	Waiareka Creek, 2km upstream mainstem confluence	M	3	M3	2
2	1574797	5192582	4/29/1996	Canterbury	Avon	Avondale Road Bridge	M	3	M3	2
2	1686583	5402198	12/3/1997	Nelson	Wairau	Opawa River	M	3	M3	2
2	1434613	4995780	4/29/1997	Otago	Kakanui	Waiareka Creek near Kakanui confluence	M	3	M3	2
2	2028113	5707852	1/5/1997	East Coast	Waipoa	Whatatuna Stream	M	3	M3	2
2	1375925	4904702	3/29/1999	Otago	Taieri	Outlet of Lake Waipori	M	3	M3	2
2	1452440	5299564	4/25/1990	West Coast	Grey	Eastern tributary, Cobden Is	S	3	S3	3
2	1332410	5172676	4/27/1990	West Coast	Manakaiaua	Sam Creek	S	3	S3	3
2	1485848	5374833	3/3/1991	West Coast	Orowaiti	Mckenna, approx. 1km upstream of railway bridge	S	3	S3	3
2	1473551	5368338	3/20/1991	West Coast	Okari	2.5km from the sea, approx 1km from lagoon	S	3	S3	3
2	1485848	5374833	3/20/1991	West Coast	Orowaiti	McKenna's approx. 1km upstream of railway bridge	S	3	S3	3
2	1473551	5368338	3/21/1991	West Coast	Okari	2.5km from the sea, approx 1km from lagoon	S	3	S3	3
2	1482350	5376633	7/3/1992	West Coast	Buller	Bradshaws Creek, immediately downstream of highway bridge.	S	3	S3	3
2	1485848	5374833	4/19/1992	West Coast	Orowaiti	200m downstream from Excelsior Road bridge.	S	3	S3	3
2	1471853	5373937	4/19/1992	West Coast	Wall	Bay,10m above culvert.	S	3	S3	3
2	1482150	5376633	8/2/1993	West Coast	Buller	Bradshaws Creek at road bridge	S	3	S3	3
2	1498045	5384227	9/3/1993	West Coast	Jones	Stony Stream	S	3	S3	3
2	1298691	5153568	3/15/1993	West Coast	Moeraki	mainstem ?? data very sketchy	S	3	S3	3
2	1573098	5177588	4/18/1994	Canterbury	Heathcote	Opawa road bridge	S	3	S3	3
2	1599512	5459685	2/21/1995	Nelson	Otuwhero	80 m upstream on t/r bank	S	3	S3	3
2	1412289	4930458	12/2/1996	Otago	Waitati	Orokonui Stream	S	3	S3	3
2	1411688	4930657	7/3/1996	Otago	Waitati	Above estuary	S	3	S3	3
2	1273106	4835259	3/18/1996	Southland	Mataura	Lower river	S	3	S3	3
2	1684984	5405497	3/20/1996	Nelson	Wairau	Roses overflow	S	3	S3	3
2	1574797	5192582	3/25/1996	Canterbury	Avon	Avondale Road Bridge	S	3	S3	3
2	1431822	4986778	4/29/1996	Otago	Waianakarua	Mainstem, near mouth	S	3	S3	3
2	1684984	5405497	11/3/1997	Nelson	Wairau	Roses overflow	S	3	S3	3
2	1434613	4995680	4/29/1997	Otago	Kakanui	Kakanui river mainstem, above Waiareka conf.	S	3	S3	3
2	1425748	4961873	4/30/1997	Otago	Shag	mainstem t/l, 200m upstream of railway bridge	S	3	S3	3
2	1425948	4962074	7/5/1997	Otago	Shag	downstream of main highway bridge, t/r bank	S	3	S3	3
2	1431722	4986678	4/6/1997	Otago	Waianakarua	Approx. 400 m upstream of mouth	S	3	S3	3

2	1414667	4946861	7/3/1998	Otago	Waikouaiti	downstream of Orbells Crossing	S	3	S3	3
2	1382922	4906813	3/29/1999	Otago	Taieri	Mainstem, downstream of SH1 bridge	S	3	S3	3
2	1375424	4904801	3/29/1999	Otago	Taieri	Outlet of Lake Waipori	S	3	S3	3
2	1375925	4904502	3/29/1999	Otago	Taieri	Outlet of Lake Waipori	S	3	S3	3
2	1605975	5433060	1/4/2012	Tasman Region	Nile Creek	0-70m upstream SH60	S	1	S1	4
2	1538815	5140199	3/28/1990	Canterbury	Rakaia	Boat Creek, Rakaia Lagoon	unknown	3	unknown	5
2	1525643	5438699	3/30/1990	West Coast	Oparara	Northern farm drains	unknown	3	unknown	5
2	1525842	5437199	3/30/1990	West Coast	Oparara	Farm drains	unknown	3	unknown	5
2	1482150	5376633	3/30/1990	West Coast	Buller	Bradshaws Creek	unknown	3	unknown	5
2	1329108	5170675	4/27/1990	West Coast	Makawhio	groundwater drain	unknown	3	unknown	5
2	1329308	5170075	4/27/1990	West Coast	Makawhio	backwater of mainstem	unknown	3	unknown	5
2	1702447	5617463	5/21/1991	Wanganui	Waingongoro	Mainstem	unknown	3	unknown	5
2	1498745	5385726	4/18/1992	West Coast	Jones	500m downstream from bridge nearest the sea, t/r	unknown	3	unknown	5
2	1873477	5821889	4/21/1992	Bay of Plenty	Wairoa	Farm drains	unknown	3	unknown	5
2	2031261	5823366	5/15/1992	East Coast	Waiokaha	Near mouth	unknown	3	unknown	5
2	2010256	5806099	5/15/1992	East Coast	Haparapara	Vicinity of River Mouth	unknown	3	unknown	5
2	2066620	5828544	5/22/1992	East Coast	Wharekahika	Just below road bridge, true right side	unknown	3	unknown	5
2	1498045	5384227	10/3/1993	West Coast	Jones	Stony Stream	unknown	3	unknown	5
2	1298691	5153568	10/3/1993	West Coast	Moeraki	Trib. entering mainstem on t/r	unknown	3	unknown	5
2	1548611	5143799	11/3/1993	Canterbury	Ellesmere	Waikewai Creek	unknown	3	unknown	5
2	1298691	5153568	11/3/1993	West Coast	Moeraki	Trib. entering mainstem on t/r	unknown	3	unknown	5
2	2066620	5828544	5/15/1994	East Coast	Wharekahika	Hicks Bay - East Cape	unknown	3	unknown	5
2	1599212	5459785	2/20/1995	Nelson	Otuwhero	80 m upstream on t/r bank	unknown	3	unknown	5
2	1599212	5459785	3/3/1995	Nelson	Otuwhero	40 m t/r bank	unknown	3	unknown	5
2	1599212	5459785	3/21/1995	Nelson	Otuwhero	Wetland on t/r bank	unknown	3	unknown	5
2	1412131	5230479	4/13/1995	Otago	Waitati	Orokonui Stream	unknown	3	unknown	5
2	1218485	4859264	2/21/1996	Southland	Aparima	Bend above Gummies bush road bridge	unknown	3	unknown	5
2	1548611	5143799	3/15/1996	Canterbury	Ellesmere	Waikewai Creek	unknown	3	unknown	5
2	1434212	4996480	3/19/1996	Otago	Kakanui	Lower reaches	unknown	3	unknown	5
2	1599212	5459785	3/20/1996	Nelson	Otuwhero	Lower reaches, incl. wetland	unknown	3	unknown	5
2	1599212	5459785	3/21/1996	Nelson	Otuwhero	80 m upstream from bridge, t/r side	unknown	3	unknown	5
2	1425848	4961973	3/22/1996	Otago	Shag	Mainstem, just above railway bridge	unknown	3	unknown	5
2	1411688	4930857	5/4/1996	Otago	Waitati	Mainstem	unknown	3	unknown	5
2	1411688	4930657	5/4/1996	Otago	Waitati	Mainstem	unknown	3	unknown	5
2	1455237	5041148		Canterbury		Vegetated area on True Right (TR) in hapua 400m north of Waihao Box	unknown	unknown	unknown	5
2	1472500	5100074		Canterbury		Vegetated area on True Left (TL) 300m upstream of culvert to oxbow	unknown	unknown	unknown	5
2	1579305	5145504		Canterbury		Just below footbridge 200m upstream of beach	unknown	unknown	unknown	5
2	1581488	5144450		Canterbury		Below road bridge, 45m upstream of beach	unknown	unknown	unknown	5

3	1601585	5450625		Tasman Region	Moon Creek	Thorpe Street to 300m upstream	unknown	unknown	unknown	5
3	1600365	5452570		Tasman Region	Ferrer Creek	0-200m upstream tidegate	unknown	unknown	unknown	5
4	1600965	5451190	3/19/2013	Tasman Region	Motueka River	100-600m downstream SH60	M	1	M1	1
4	1604460	5440260	1/4/2012	Tasman Region	Tasman Valley Stream	50-170m downstream Kina Beach Road	M	1	M1	1
4	1617680	5425184	1/4/2012	Tasman Region	Orphanage Creek	2-50m upstream Wakatu Drive (SH6)	M	1	M1	1
4	1601530	5447725	1/3/2013	Tasman Region	Thorpe Drain	0-300m upstream Old Wharf Road	S	1	S1	2
4	1600127	5453416	3/21/2013	Tasman Region	Little Sydney Creek	Tidegate to 200m upstream - in 3 directions	S	1	S1	2
4	1599590	5454140	3/21/2013	Tasman Region	Wai-Atua Creek	0-900m upstream of new cycleway bridge	S	1	S1	2
4	1600660	5456895	3/21/2013	Tasman Region	Kaiteriteri Creek	0-50m downstream 80 Martin Farm Road	S	1	S1	2
4	1608290	5433585	1/4/2012	Tasman Region	Seaton Valley Stream	300-400m upstream Toru St causeway	S	1	S1	2
4	1603885	5440565	1/4/2012	Tasman Region	Field Creek	120-200m upstream Aporo Road	S	1	S1	2
4	1601550	5447425	1/3/2013	Tasman Region	Thorpe Drain	0-300m upstream Old Wharf Road	S	1	S1	2
4	1601820	5450785	3/20/2013	Tasman Region	Moon Creek	Thorpe Street to 300m upstream	S	1	S1	2
4	1600130	5453420	3/21/2013	Tasman Region	Little Sydney Creek	Tidegate to 200m upstream - in 3 directions	S	1	S1	2
4	1599735	5454195	3/21/2013	Tasman Region	Wai-Atua Creek	0-900m upstream of new cycleway bridge	S	1	S1	2
4	1600710	5456880	3/21/2013	Tasman Region	Kaiteriteri Creek	0-50m downstream 80 Martin Farm Road	S	1	S1	2
4	1575225	5488520	3/21/2013	Tasman Region	Onekaka River	650m downstream Shambala Rd	S	1	S1	2
4	1582595	5480195	3/14/2013	Tasman Region	Takaka River	80m downstream SH60	S	1	S1	2
4	1586392	5477973	4/14/2013	Tasman Region	Motupipi River	Similar to 2012 but a bit further upstream and downstream	S	1	S1	2
4	1586392	5477973	1/4/2012	Tasman Region	Motupipi River	150m upstream of Abel Tasman Drive	S	1	S1	2
4	1588307	5478757	1/4/2012	Tasman Region	Motupipi Estuary – East Arm Tributary		S	1	S1	2
4	1603880	5440497	1/4/2012	Tasman Region	Ellis Creek	280m upstream of Boyle Street downstream, 30m downstream of Stoffregen footbridge	S	1	S1	2
4	1618799	5427596	1/4/2012	Tasman Region	Poormans Stream	20m downstream Wakatu Drive (SH6)	S	1	S1	2
4	1619738	5428359	4/19/2012	Tasman Region	Jenkins Creek		S	1	S1	2
4	1599355	5444670		Tasman Region	Blue Creek	100m upstream Moutere Highway to 500m downstream	unknown	unknown	unknown	3
4	1601280	5447735		Tasman Region	Woodland Drain	0-300m upstream Old Wharf Road	unknown	unknown	unknown	3
4	1601250	5451010		Tasman Region	Doctor Creek	300-600m upstream Thorpe Street	unknown	unknown	unknown	3
4	1601210	5451965		Tasman Region	Spring Creeks on TLB	0-200m downstream stopbank	unknown	unknown	unknown	3
4	1599240	5459710		Tasman Region	Otuwhero Stream	100m downstream and 170m upstream Sandy Bay-Marahau Road	unknown	unknown	unknown	3
4	1608190	5433555		Tasman Region	Aranui Creek	300-400m upstream Toru St causeway	unknown	unknown	unknown	3
4	1599880	5444820		Tasman Region	Moutere River	Jubilee Bridge to 700m downstream	unknown	unknown	unknown	3
4	1599900	5444900		Tasman Region	Blue Creek	100m upstream Moutere Highway to 500m downstream	unknown	unknown	unknown	3
4	1601270	5447435		Tasman Region	Woodland Drain	0-300m upstream Old Wharf Road	unknown	unknown	unknown	3
4	1601120	5452150		Tasman Region	Spring Creeks on TLB	0-200m downstream stopbank	unknown	unknown	unknown	3
4	1600720	5452060		Tasman Region	Spring Creeks on TLB	0-200m upstream tidegate - in 3 directions	unknown	unknown	unknown	3
4	1600440	5452760		Tasman Region	Ferrer Creek	0-200m upstream tidegate	unknown	unknown	unknown	3

4	1599835	5453910		Tasman Region	Riwaka River	120-250m upstream of cycleway	unknown	unknown	unknown	3
4	1599445	5459535		Tasman Region	Otuwhero Stream	100m downstream and 170m upstream Sandy Bay-Marahau Road	unknown	unknown	unknown	3
4	1600675	5461510		Tasman Region	Marahau River	200m upstream and 320m downstream Sandy Bay-Marahau Road	unknown	unknown	unknown	3
4	1754668	5444680	4/17/2016	Wellington	Porirua Stream mainstem		unknown	unknown	unknown	3
4	1754668	5444680	4/17/2016	Wellington	Kenepuru Stream; Porirua Stream		unknown	unknown	unknown	3
4	1571284	5497216	3/21/2013	Tasman Region	Aorere River		unknown	1	unknown	3
4	1242334	4852151	11/25/2013	Southland	Waihopai River		unknown	unknown	unknown	3
4	1242444	4852275	11/25/2013	Southland	Waihopai River		unknown	unknown	unknown	3
4	1242120	4849424	11/25/2013	Southland	Otepuni Creek		unknown	unknown	unknown	3
4	1744958	5921624	5/9/2018	Auckland	Henderson Creek		unknown	1	unknown	3
4	1744958	5921624	6/7/2018	Auckland	Henderson Creek		unknown	1	unknown	3
4	1617442	5424472	3/5/2015	Nelson	Saxton Creek		unknown	1	unknown	3
4	1617740	5425166	3/5/2015	Nelson	Orphanage Stream		unknown	1	unknown	3
4	1617583	5425178	3/5/2015	Nelson	Orphanage Stream		unknown	1	unknown	3
4	1618763	5427596	3/5/2015	Nelson	Poorman Valley Stream		unknown	1	unknown	3
4	1619792	5428368	3/5/2015	Nelson	Jenkins Creek		unknown	1	unknown	3
4	1635567	5441514	3/5/2015	Nelson	Wakapuaka River		unknown	1	unknown	3
4	1637398	5442175	3/5/2015	Nelson	Unnamed Stream		unknown	1	unknown	3
4	1645851	5448370	3/5/2015	Nelson	Whangamoa River		unknown	1	unknown	3
5	1482250	5376633	1/4/1991	West Coast	Buller		M	3	M3	1
5	1525643	5438299	5/15/1991	West Coast	Oparara		M	3	M3	1
5	1498545	5385326	2/21/1992	West Coast	Jones		M	3	M3	1
5	1434612	4996580	3/29/1999	Otago	Kakanui		M	3	M3	1
5	1604470	5440115	1/4/2012	Tasman Region	Tasman Valley Stream		M	1	M1	2
5	1408833	5240679	9/2/1989	West Coast	Waitaha		S	3	S3	3
5	1483450	5377633	10/2/1989	West Coast	Buller		S	3	S3	3
5	1376428	5220684	10/2/1989	West Coast	Waitangitaona		S	3	S3	3
5	1271771	5130250	11/3/1989	West Coast	Turnbull		S	3	S3	3
5	1376428	5220484	4/27/1990	West Coast	Waitangitaona		S	3	S3	3
5	1485848	5374833	4/3/1991	West Coast	Orowaiti		S	3	S3	3
5	1485848	5374833	5/3/1991	West Coast	Orowaiti		S	3	S3	3
5	1485848	5374833	6/3/1991	West Coast	Orowaiti		S	3	S3	3
5	1473551	5368338	1/4/1991	West Coast	Okari		S	3	S3	3
5	1574698	5176789	4/19/1991	Canterbury	Heathcote		S	3	S3	3
5	1485848	5374833	4/30/1991	West Coast	Orowaiti		S	3	S3	3
5	1525443	5437099	5/13/1991	West Coast	Oparara		S	3	S3	3
5	1525842	5437199	5/13/1991	West Coast	Oparara		S	3	S3	3
5	1525543	5438599	5/15/1991	West Coast	Oparara		S	3	S3	3

5	1483450	5377633	2/21/1992	West Coast	Buller		S	3	S3	3
5	1857637	5840073	8/5/1992	Bay of Plenty	Uretara		S	3	S3	3
5	1860817	5852085	8/5/1992	Bay of Plenty	Waiau		S	3	S3	3
5	1414767	4946961	7/4/1996	Otago	Waikouaiti		S	3	S3	3
5	1414767	4946861	7/4/1996	Otago	Waikouaiti		S	S	S3	3
5	1375926	4903601	3/29/1999	Otago	Taieri		S	3	S3	3
5	1609400	5428460	1/4/2012	Tasman Region	O'Connor Creek	From 700m downstream of SH60 for 150m	S	1	S1	4
5	1606310	5430500	1/4/2012	Tasman Region	New Stringer Creek	15-50m downstream private	S	1	S1	4
5	1605980	5433140	1/4/2012	Tasman Region	Dominion Valley Stream	50-100m downstream	S	1	S1	4
5	1608200	5433645	1/4/2012	Tasman Region	Seaton Valley Stream	300-400m upstream Toru St causeway	S	1	S1	4
5	1581649	5482875	1/4/2012	Tasman Region	East Onehau Salt Marsh Tributary	Upstream of driveway #39 off Fraser Road	S	1	S1	4
5	1614826	5425202	4/25/2015	Tasman Region	Borck Creek	560-585m downstream Lower Queen St	S	1	S1	4
5	1617380	5424475	1/4/2012	Tasman Region	Saxton Creek	~100m upstream Main Road Stoke	S	1	S1	4
5	1873476	5821989	4/21/1988	Bay of Plenty	Wairoa	Banks of 5 small drains, 3km above Road bridge	unknown	3	unknown	5
5	1445738	5285068	4/30/1988	West Coast	Taramakau	Feeder Creek into estuary	unknown	3	unknown	5
5	1873476	5821989	5/17/1988	Bay of Plenty	Wairoa	Banks of 5 small drains, 3km above Road bridge	unknown	3	unknown	5
5	1976737	5785916	5/17/1988	Bay of Plenty	Otara	1.25km above conf with Waioeka R.	unknown	3	unknown	5
5	1571799	5177688	9/2/1989	Canterbury	Heathcote	Wilsons Road Bridge	unknown	3	unknown	5
5	1571799	5177688	10/2/1989	Canterbury	Heathcote	Wilsons Road Bridge	unknown	3	unknown	5
5	1525642	5434001	10/3/1989	West Coast	Karamea	Bakers Creek	unknown	3	unknown	5
5	1525642	5434001	11/3/1989	West Coast	Karamea	Bakers Creek	unknown	3	unknown	5
5	1571799	5177688	11/3/1989	Canterbury	Heathcote	Wilsons Road Bridge	unknown	3	unknown	5
5	1389131	5230483	2/28/1990	West Coast	Poerua	Mainstem, t/r bank	unknown	3	unknown	5
5	1525443	5437299	3/30/1990	West Coast	Oparara	Farm drains	unknown	3	unknown	5
5	1574698	5176789	4/20/1991	Canterbury	Heathcote	Aynsley Terrace Reserve	unknown	3	unknown	5
5	1498745	5385726	2/21/1992	West Coast	Jones	50m above bridge	unknown	3	unknown	5
5	1788075	5546493	7/5/1992	Wanganui	Unnamed	south end of bombing rang	unknown	3	unknown	5
5	1579368	5146238		Canterbury		TR 45m upstream of beach	unknown	unknown	unknown	5
5	1585706	5143705		Canterbury		TR on small reach 100m upstream of beach	unknown	unknown	unknown	5
5	1588557	5141800		Canterbury		TL 20m upstream of beach	unknown	unknown	unknown	5
5	1592595	5152636		Canterbury		TL 25m upstream of Wainui Main road bridge	unknown	unknown	unknown	5
5	1409468	5241137		West Coast		In small tributary that enters mainstem on TR bank at mouth	unknown	unknown	unknown	5
5	1455241	5041138		Canterbury	Waihao River	Vegetated area on True Right (TR) in hapua 400m north of Waihao Box	unknown	unknown	unknown	5
5	1592554	5152565		Canterbury	French Farm Bay Stream #1	Small creek near to Bantry Lodge road, 25m upstream of culvert	unknown	unknown	unknown	5
5	1606369	5155174		Canterbury	Le Bons Stream	160m reach on TR (including side stream) 400m upstream of lower Le Bons Bay Road bridge	unknown	unknown	unknown	5
5	1602874	5160001		Canterbury	Opara Stream, Okains	100m reach upstream from Schoolhouse Road bridge	unknown	unknown	unknown	5

					Bay					
5	1573078	5177618		Canterbury	Heathcote River	TR on reach from 100m downstream of rail bridge to Opawa Road Bridge	unknown	unknown	unknown	5
5	1575920	5183601		Canterbury	Lake Kate Sheppard	PRE-EARTHQUAKE All banks in south west corner	unknown	unknown	unknown	5
5	1574439	5183306		Canterbury	Avon River (multiple sites)	Reach from Dixons Reserve to Alloway Street	unknown	unknown	unknown	5
5	1606315	5430575		Tasman Region	Old Stringer Creek	30-90m downstream Westdale Road	unknown	unknown	unknown	5
5	1605815	5432000		Tasman Region	Trafalgar Creek	0-60m upstream SH60	unknown	unknown	unknown	5
5	1608280	5433575		Tasman Region	Aranui Creek	300-400m upstream Toru St causeway	unknown	unknown	unknown	5
5	1601120	5452150		Tasman Region	Spring Creeks on TLB	0-200m upstream tidegate - in 3 directions	unknown	unknown	unknown	5
5	1599300	5453600		Tasman Region	Riwaka River	120-250m upstream of cycleway	unknown	unknown	unknown	5
5	1601600	5450915		Tasman Region	Doctor Creek	300-600m upstream Thorpe Street	unknown	unknown	unknown	5
5	1601250	5451660		Tasman Region	Motueka River	100-600m downstream SH60	unknown	unknown	unknown	5
5	1760153	5449077	4/21/2016	Wellington	Horokiri Stream		unknown	unknown	unknown	5
5	1760958	5447568	4/21/2016	Wellington	Pauatahanui Stream		unknown	unknown	unknown	5
5	1935792	5610898		Hawkes Bay	Clive river L		unknown	unknown	unknown	5
6	1616760	5424325	1/4/2012	Tasman Region	Reservoir Creek		M	1	M1	1
6	1614880	5425250	5/14/2014	Tasman Region	Borck Creek		S	1	S1	2
6	1473568	5368352		West Coast		60m reach on TL bank	unknown	unknown	unknown	3
6	1472828	5364885		West Coast		10m reach on TL bank 60m above confluence	unknown	unknown	unknown	3
6	1760886	5434209	4/13/2016	Wellington	Hutt River, Waiwhetu Stream		unknown	unknown	unknown	3
6	1757649	5413919	4/14/2016	Wellington	Wainuiomata River		unknown	unknown	unknown	3
6	1942255	5605315		Hawkes Bay	Maraetotara L		unknown	unknown	unknown	3
6	1942255	5605383		Hawkes Bay	Maraetotara U		unknown	unknown	unknown	3
7	1375726	4904101	3/23/1998	Otago	Taieri		S	3	S3	1
7	1375226	4904000	3/23/1998	Otago	Taieri		S	3	S3	1
7	1603845	5440780	1/4/2012	Tasman Region	Field Creek		S	1	S1	2
7	1580305	5484165	3/21/2012	Tasman Region	Puremahaia Stream		S	1	S1	2
7	1375825	4904501	3/23/1998	Otago	Taieri		unknown	3	unknown	3
7	1594469	5155797		Canterbury		TL 2m upstream of Christchurch Akaroa Road bridge	unknown	unknown	unknown	3
7	1595350	5155496		Canterbury		TL 50m upstream of Seafield Road bridge	unknown	unknown	unknown	3
7	1597005	5154325		Canterbury		TL 10m upstream of Christchurch Akaroa Road bridge	unknown	unknown	unknown	3
7	1597474	5152388		Canterbury		TL 20m upstream of end of Old French Road	unknown	unknown	unknown	3
7	1600413	5142788		Canterbury		Western stream, 40m downstream of Flea Bay Road bridge	unknown	unknown	unknown	3
7	1607363	5149534		Canterbury		150 m reach 650m upstream of beach	unknown	unknown	unknown	3
7	1602935	5160073		Canterbury		100m reach upstream from Schoolhouse Road bridge	unknown	unknown	unknown	3
7	1591540	5162579		Canterbury		170m upstreamof Wharf Road Bridge	unknown	unknown	unknown	3
7	1585128	5165576		Canterbury		115m reach upstream from Fernlea Point Road bridge	unknown	unknown	unknown	3
7	1584750	5165626		Canterbury		Small creek in Port Levy, 100m east of Purau Port Levy	unknown	unknown	unknown	3

						Road, 145m upstream of Wharf Road bridge			
7	1599475	5444370		Tasman Region	Moutere River		unknown	unknown	unknown	3
7	1600690	5461340		Tasman Region	Marahau Estuary Stream		unknown	unknown	unknown	3
7	1769572	5473025	4/17/2016	Wellington	Waikanae River		unknown	1	unknown	3
7	1759106	5449847	4/21/2016	Wellington	Kakaho Stream		unknown	1	unknown	3
7	1243212	4846236	11/25/2013	Southland	Kingswell Creek		unknown	1	unknown	3
7	1624126	5431165	3/5/2015	Nelson	Maitai River		unknown	1	unknown	3
7	1626633	5435066	4/28/2015	Nelson	Oldham Creek		unknown	1	unknown	3
7	1621674	5429507	7/27/2018	Nelson	Pipers Reserve		unknown	1	unknown	3
8	1434613	4995680	3/4/1998	Otago	Kakanui		M	3	M3	1
8	1426048	4961774	4/2/1999	Otago	Shag		M	3	M3	1
8	1717606	6038887	2/19/1999	Northland	Otaika		M	3	M3	1
8	1415366	4947462	2/27/1999	Otago	Waikouaiti		M	3	M3	1
8	1687183	5403098	3/24/1999	Nelson	Wairau		M	3	M3	1
8	1687183	5403098	3/24/1999	Nelson	Wairau		M	3	M3	1
8	1329308	5170075	3/26/1990	West Coast	Makawhio		S	3	S3	2
8	1329108	5169875	3/26/1990	West Coast	Makawhio		S	3	S3	2
8	1745473	5713888	3/21/1996	Wanganui	Mokau		S	3	S3	2
8	1745673	5713689	3/21/1996	Wanganui	Mokau		S	3	S3	2
8	1431722	4986678	3/4/1998	Otago	Waianakarua		S	3	S3	2
8	1573098	5177588	4/30/1998	Canterbury	Heathcote	Opawa Road bridge	S	3	S3	2
8	1415390	4929462	2/27/1999	Otago	Purakaunui	Mainstem	S	3	S3	2
8	1411688	4930657	2/27/1999	Otago	Waitati	Waitati River	S	3	S3	2
8	1453489	5021893	2/27/1999	Otago	Waitaki	Waitaki River	S	3	S3	2
8	1412289	4930458	2/27/1999	Otago	Urokomu	Urokomu Stream	S	3	S3	2
8	1344516	4851429	4/3/1999	Otago	Catlins	Owaka River	S	3	S3	2
8	1413999	4923161	5/3/1999	Otago	Otago Harbour	Reservoir Creek	S	3	S3	2
8	1415366	4947362	3/28/1999	Otago	Waikouaiti	downstream of Orbells Crossing	S	3	S3	2
8	1949502	5786276		Bay of Plenty	Waiaua	Either side of the Waiau Road bridge	unknown	unknown	unknown	3
8	1956109	5787086		Bay of Plenty	Ohiwa	Tunanui Stream	unknown	unknown	unknown	3
8	1956411	5786086		Bay of Plenty	Ohiwa	Waiotane Stream	unknown	unknown	unknown	3
8	1756170	5863803	9/9/1983	Waikato	Waikato	Okahu Stream well upstream of mouth	unknown	3	unknown	3
8	1960621	5782587	3/31/1987	Bay of Plenty	Nukuhou	Opposite old dairy factory	unknown	3	unknown	3
8	1968228	5784401	4/18/1987	Bay of Plenty	Waiotahi	Waiotahi ValleyRoad,300mbelow-600m above bridge	unknown	3	unknown	3
8	1968228	5784401	4/29/1987	Bay of Plenty	Waiotahi	Waiotahi ValleyRoad,300mbelow-600m above bridge	unknown	3	unknown	3
8	1939976	5795872	4/30/1987	Bay of Plenty	Rangitaiki	200m downstream of SH2 bridge, T/R bank	unknown	3	unknown	3
8	1757766	5866206	5/17/1987	Waikato	Waikato	At mouth of Pakau Stream tributary, site 13	unknown	3	unknown	3
8	1763455	5872116	5/17/1987	Waikato	Waikato	Site 42, T/R bank of Waikato	unknown	3	unknown	3

8	1763359	5870116	5/17/1987	Waikato	Waikato	Site 33, T/L bank of Waikato	unknown	3	unknown	3
8	1759464	5867509	5/17/1987	Waikato	Waikato	Sites 18,19 T/L bank of Waikato	unknown	3	unknown	3
8	1759064	5867308	5/17/1987	Waikato	Waikato	t/l bank of mainstem, site 17	unknown	3	unknown	3
8	1758764	5867108	5/17/1987	Waikato	Waikato	Small stream at site 16. t/l bank.	unknown	3	unknown	3
8	1757068	5865105	5/17/1987	Waikato	Waikato	Unnamed stream, well up from mouth	unknown	3	unknown	3
8	1757467	5865905	5/17/1987	Waikato	Waikato	Near mouth of Pakau stream	unknown	3	unknown	3
8	1757566	5866006	5/17/1987	Waikato	Waikato	At mouth of Pakau Stream, site 13	unknown	3	unknown	3
8	1571799	5177688	11/2/1989	Canterbury	Heathcote	Wilsons Road Bridge	unknown	3	unknown	3
8	1571799	5177688	2/15/1989	Canterbury	Heathcote	Wilsons Road Bridge	unknown	3	unknown	3
8	1271571	5130050	11/3/1989	West Coast	Turnbull	Collyers Creek, sites 7 & 8	unknown	3	unknown	3
8	1271671	5130050	11/3/1989	West Coast	Turnbull	Collyers Creek, sites 5 & 6	unknown	3	unknown	3
8	1525642	5434001	12/3/1989	West Coast	Karamea	Bakers Creek	unknown	3	unknown	3
8	1525642	5434001	3/13/1989	West Coast	Karamea	Bakers Creek	unknown	3	unknown	3
8	1452440	5299564	1/3/1990	West Coast	Grey	Eastern tributary of Cobden I	unknown	3	unknown	3
8	1452440	5299464	2/3/1990	West Coast	Grey	Eastern tributary of Cobden I	unknown	3	unknown	3
8	1329108	5170675	3/26/1990	West Coast	Makawhio	Groundwater drain	unknown	3	unknown	3
8	1525642	5434001	3/26/1990	West Coast	Karamea	Bakers Creek	unknown	3	unknown	3
8	1525642	5434001	3/26/1990	West Coast	Karamea	Bakers Creek	unknown	3	unknown	3
8	1482150	5376633	3/29/1990	West Coast	Buller	Bradshaws Creek	unknown	3	unknown	3
8	1525643	5438898	3/30/1990	West Coast	Oparara	Northern farm drains	unknown	3	unknown	3
8	1599212	5459785	3/21/1996	Nelson	Otuwhero	100 m upstream from bridge	unknown	3	unknown	3
8	1425848	4962073	3/22/1996	Otago	Shag	Mainstem, just above railway bridge	unknown	3	unknown	3
8	1574798	5183586	6/4/1998	Canterbury	Avon	Avondale Bridge area (t/l bank)	unknown	3	unknown	3
8	1773851	5814230	4/28/1998	Waikato	Raglan harbour	Maunurima stream	unknown	3	unknown	3
8	1683685	5411696	3/23/1999	Nelson	Wairau	Pukaka Drain	unknown	3	unknown	3
8	1697124	5393830		Canterbury	Awatere River	5m reach in northern hapua on TL bank	unknown	unknown	unknown	3
8	1524633	5428569		West Coast	Granite Creek	Grassed areas on both banks from 50m below roadbridge to 100m above	unknown	unknown	unknown	3
8	1486336	5375803		West Coast	Orowaiti River	50m reach on TL bank below rail bridge	unknown	unknown	unknown	3
8	1486335	5375761		West Coast	Orowaiti River	25m reach on TL bank underneath Stephens Rd bridge	unknown	unknown	unknown	3
8	1243159	4846261	11/25/2013	Southland	Kingswell Creek		unknown	unknown	unknown	3
8	1243169	4846259	11/25/2013	Southland	Kingswell Creek		unknown	unknown	unknown	3
9	1576097	5209576	1/22/1988	Canterbury	Ashley	Benzies Creek, Saltwater Creek	M	3	M3	1
9	1548611	5143799	3/14/1989	Canterbury	Ellesmere	Waikewai Creek	M	3	M3	1
9	1574798	5183586	4/21/1989	Canterbury	Avon	Avondale Bridge	M	3	M3	1
9	1452340	5299564	3/28/1990	West Coast	Grey	Eastern tributary, Cobden Is	M	3	M3	1
9	1452240	5299764	3/29/1990	West Coast	Grey	Western drain, Cobden Is	M	3	M3	1
9	1576197	5210775	1/22/1988	Canterbury	Ashley	Saltwater Creek mainstem	S	3	S3	2
9	1426048	4961774	12/2/1998	Otago	Shag	mainstem	S	3	S3	2

9	1412289	4930458	2/24/1998	Otago	Waitaiti	Orokonui Stream	S	3	S3	2
9	1375425	4904701	3/23/1998	Otago	Taieri	Lake Waipori Outlet	S	3	S3	2
9	1375926	4903601	3/23/1998	Otago	Taieri	Waipori R mainstem	S	3	S3	2
9	1434613	4995880	3/4/1998	Otago	Kakanui	Waiareka Creek	S	3	S3	2
9	1588062	5478302	1/4/2012	Tasman Region	Gibson Creek	20m upstream and 4m downstream of Bob Butt's Footbridge	S	1	S1	3
9	1587652	5478392	1/4/2012	Tasman Region	Kite Creek	Upstream of Bob Butt's Footbridge	S	1	S1	3
9	1576197	5210775	1/26/1988	Canterbury	Ashley	Saltwater Creek mainstem	unknown	3	unknown	4
9	1571799	5177688	2/20/1989	Canterbury	Heathcote	Wilsons Road bridge	unknown	3	unknown	4
9	1571799	5177688	12/3/1989	Canterbury	Heathcote	Wilsons Road Bridge	unknown	3	unknown	4
9	1526442	5433001	3/13/1989	West Coast	Karamea	Small creek, near mainstem	unknown	3	unknown	4
9	1548611	5143799	5/4/1989	Canterbury	Ellesmere	Waikewai Creek	unknown	3	unknown	4
9	1525642	5434001	5/4/1989	West Coast	Karamea	Bakers Creek	unknown	3	unknown	4
9	1548611	5143799	10/4/1989	Canterbury	Ellesmere	Waikewai Creek	unknown	3	unknown	4
9	1548611	5143799	12/4/1989	Canterbury	Ellesmere	Waikewai Creek	unknown	3	unknown	4
9	1390031	5231483	2/15/1990	West Coast	Wanganui	Oneone R, below footbridge	unknown	3	unknown	4
9	1574798	5183586	2/27/1990	Canterbury	Avon	Avondale Bridge	unknown	3	unknown	4
9	1452440	5299564	2/28/1990	West Coast	Grey	Eastern tributary of Cobden I	unknown	3	unknown	4
9	1524542	5428603	3/28/1990	West Coast	Karamea	Blackwater Creek	unknown	3	unknown	4
9	1537016	5139499	3/28/1990	Canterbury	Rakaia	Mathias Creek	unknown	3	unknown	4
9	1525042	5428104	3/29/1990	West Coast	Karamea	Kongahu Drain, tributary Granit	unknown	3	unknown	4
9	1525042	5428104	3/29/1990	West Coast	Karamea	Granite Creek	unknown	3	unknown	4
9	1434713	4995580	4/2/1998	Otago	Kakanui	Waiareka Creek confluence downstream 300m	unknown	3	unknown	4
11	1573498	5195981	3/20/1988	Canterbury	Waimakariri	Kaiapoi R	S	3	S3	1
11	1573498	5195881	4/17/1988	Canterbury	Waimakariri	Kaiapoi R mainstem	S	3	S3	1
11	1606290	5430465	1/4/2012	Tasman Region	New Stringer Creek	15-50m downstream private	S	1	S1	2
11	1605900	5433030	1/4/2012	Tasman Region	Nile Creek	0-70m upstream SH60	S	1	S1	2
11	1606030	5433100	1/4/2012	Tasman Region	Dominion Valley Stream	50-100m downstream	S	1	S1	2
11	1960621	5782587	1/4/1987	Bay of Plenty	Nukuhou	Opposite old dairy factory	unknown	3	unknown	3
11	1968228	5784401	2/4/1987	Bay of Plenty	Waiotahi	Waiotahi ValleyRoad,300mbelow-600m above bridge	unknown	3	unknown	3
11	1575797	5196381	2/22/1988	Canterbury	Ashley	Main branch Saltwater Creek	unknown	3	unknown	3
11	1976737	5785916	2/22/1988	Bay of Plenty	Otara	1.25km	unknown	3	unknown	3
11	1899905	5816428	2/23/1988	Bay of Plenty	Kaituna	2km upstream of cut	unknown	3	unknown	3
11	1576097	5209576	3/19/1988	Canterbury	Ashley	Benzies Creek, Saltwater Creek	unknown	3	unknown	3
11	1947692	5791579	3/20/1988	Bay of Plenty	Whakatane	Opposite the mill, on the T/R bank	unknown	3	unknown	3
11	1899905	5816428	3/20/1988	Bay of Plenty	Kaituna	2km upstream of cut	unknown	3	unknown	3
11	1976737	5785916	3/20/1988	Bay of Plenty	Otara	1.25km above conf with Waioeka R.	unknown	3	unknown	3
11	1906917	5813037	3/23/1988	Bay of Plenty	Waihi Estuary	Pongakawa Canal, at confluence with Pukehina	unknown	3	unknown	3
11	1906916	5813137	3/23/1988	Bay of Plenty	Waihi Estuary	Pukehina Canal, 50m upstream of Pongakawa	unknown	3	unknown	3

11	1906216	5813236	3/23/1988	Bay of Plenty	Waihi Estuary	Kaikokopu Canal	unknown	3	unknown	3
11	1899905	5816428	4/18/1988	Bay of Plenty	Kaituna	2km upstream of cut	unknown	3	unknown	3
11	1976737	5785916	4/19/1988	Bay of Plenty	Otara	1.25km above conf with Waioeka R.	unknown	3	unknown	3
11	1982568	5670359	4/19/1988	Bay of Plenty	Wairoa	t/r bank from boat ramp to opp. Awatere stream.	unknown	3	unknown	3
11	1947692	5791579	4/20/1988	Bay of Plenty	Whakatane	Opposite the mill, on the T/R bank	unknown	3	unknown	3
11	1947692	5791579	4/21/1988	Bay of Plenty	Whakatane	Opposite the mill, on the T/R bank	unknown	3	unknown	3
11	1605865	5432025		Tasman Region	Trafalgar Creek	0-60m upstream SH60	unknown	unknown	unknown	3
11	1936914	5613714		Hawkes Bay	tutaekuri backwash Awatoto drain L		unknown	unknown	unknown	3
11	1936904	5613819		Hawkes Bay	tutaekuri backwash Awatoto drain U		unknown	unknown	unknown	3
11	1936695	5612832		Hawkes Bay	Ngaruroro Backwash L		unknown	unknown	unknown	3
11	1936372	5612799		Hawkes Bay	Ngaruroro Backwash U		unknown	unknown	unknown	3
12	1717806	6038887	12/4/1997	Northland	Otaika	Below Otaika loop road	L	3	L3	1
12	1614880	5425250	1/4/2012	Tasman Region	Borck Creek	40m downstream furthest downstream driveway bridge to 100m upstream	M	1	M1	2
12	1460550	5085989	3/26/1997	Canterbury	Washdyke Creek	Channelised section near lagoon	S	3	S3	3
12	1425748	4961873	3/27/1997	Otago	Shag	mainstem, 200m upstream of railway bridge	S	3	S3	3
12	1375825	4904501	4/4/1997	Otago	Taieri	Lake Waipori outlet	S	3	S3	3
12	1425948	4962074	7/5/1997	Otago	Shag	downstream of main highway bridge, t/l bank	S	3	S3	3
12	1684284	5405397	4/3/1998	Nelson	Wairau	Roses Overflow, near Morgans Road	S	3	S3	3
12	1414667	4946761	7/3/1998	Otago	Waikouaiti	mainstem, island	S	3	S3	3
12	1375325	4904501	3/23/1998	Otago	Taieri	Waipori R mainstem	S	3	S3	3
12	1375730	4901301	3/23/1998	Otago	Taieri	Lake Waipori Outlet	S	3	S3	3
12	1375825	4904701	3/23/1998	Otago	Taieri	Waipori R mainstem	S	3	S3	3
12	1941797	5586840		Hawkes Bay	Waimarama Waingongoroa L		unknown	unknown	unknown	4
12	1941859	5586820		Hawkes Bay	Waimarama Waingongoroa U		unknown	unknown	unknown	4
12	1938644	5609261		Hawkes Bay	Tukituki River the Grange L		unknown	unknown	unknown	4
12	1938613	5609077		Hawkes Bay	Tukituki River the Grange U		unknown	unknown	unknown	4
12	1243211	4846243	11/25/2013	Southland	Kingswell Creek		unknown	unknown	unknown	4

Appendix 2. List of waterways requiring baseline surveys identified according to the presence of an adult fish record in the New Zealand Freshwater Fish Database (as at 15 May 2019) and the absence of a spawning site record in the updated National Īnanga Spawning Database.

Catchment	Locality
Arapawa Is	Unnamed Stream Ruapara Bay
Boundary C	Boundary Creek
Clarence R	Clarence River
Clova B	Totaranui Stream tributary
Clova B	Unnamed stream Manaroa
Clova B	Unnamed stream Otatara Bay
Conway R	Conway River
Crail B	Unnamed stream Wet Inlet
Crail B	Unnamed stream Elie Bay
Crail B	Unnamed stream Hopai Bay
Croisilles Hbr	Ruataniwha Stream
Croisilles Hbr	Pouawhariki Stream
Croisilles Hbr	Hapiata Stream
Croisilles Hbr	Kaimiko Stream
Croisilles Hbr	Castor Stream
D'Urville I	Unnamed stream Lucky Bay
D'Urville I	Unnamed stream Mill Arm
D'Urville I	Unnamed stream Wharairiki Bay
D'Urville I	Unnamed stream Punt Arm
D'Urville I	Unnamed stream Smylies Arm
D'Urville I	Unnamed stream Wells Bay
D'Urville I	Leebody Creek
D'Urville I	Unnamed stream Greville Harbour
D'Urville I	Unnamed lake
D'Urville I	Unnamed Stream Catherine Cove
Endeavour In	Unnamed stream Big Bay
Endeavour In	Unnamed Stream Endeavour Inlet
Flaxbourne R	Flaxbourne River
Hurunui River	Hurunui River
Irongate S	Irongate Stream
Kahutara R	Kahutara River
Kaikoua Pen	South Bay
Kenepuru Snd	Unnamed stream Goulter Bay
Kenepuru Snd	Unnamed stream Waitaria Bay
Kenepuru Snd	Unnamed stream Kenepuru Head
Kie Kie C	Kie Kie Creek

Kowhai River	Kowhai River
Lyell C	Lyell Creek
Maitai R	Maitai River
Middle C	Middle Creek
Mororimu S	Mororimu Stream
Motunau R	Motunau River
Oaro R	Oaro River
Ohau S	Ohau Stream
Omihi S	Omihi Stream
Ote Makura S	Ote Makura Stream
Pelorus R	Pelorus River tributary
Pelorus Snd	Unnamed stream Kaiuma Bay
Pelorus Snd	White Pine Creek
Pelorus Snd	Unnamed stream Maori Bay
Pelorus Snd	Unnamed stream Chance Bay
Pelorus Snd	Unnamed stream Nydia Bay
Pelorus Snd	Omahakie Stream
Pelorus Snd	Unnamed stream Te Kopi
Pt Underwood	Unnamed stream Hakana Bay
Pt Underwood	Unnamed stream Hakahaka Bay
Queen Charlotte Snd	Graham River
Queen Charlotte Snd	Unnamed stream Ship Cove
Queen Charlotte Snd	Unnamed stream Ngakuta Bay
Queen Charlotte Snd	Unnamed stream Umungata Bay
Queen Charlotte Snd	Unnamed stream Bottle Bay
Queen Charlotte Snd	Unnamed stream Kumutoto Bay
Queen Charlotte Snd	Unnamed stream Hitaua Bay
Queen Charlotte Snd	Unnamed stream Kahikatea Bay
Queen Charlotte Snd	Unnamed stream Monkey Bay
Queen Charlotte Snd	Waikawa Stream
Queen Charlotte Snd	Unnamed stream Ahuriri Bay
Queen Charlotte Snd	Unnamed stream Mistletoe Bay
Queen Charlotte Snd	Unnamed stream Thompson Bay
Rakautara S	Rakautara Stream
Robin Hood B	Stace Creek
Taipare B	Unnamed stream Taipare Bay
Tennyson In	Unnamed stream Tuna Bay
Tennyson In	Unnamed stream Harvey Bay
Tennyson In	Unnamed stream Ngawhakawhiti Bay
Tennyson In	Unnamed stream Duncan Bay

Tennyson In	Unnamed stream Matai Bay
Tennyson In	Unnamed stream Deep Bay
Tirohanga Stream	Tirohanga Stream
Waihi Creek	Waihi Creek
Waima R	Waima River
Waitata Rch	Unnamed stream Waiona Bay
Wakapuaka R	Wakapuaka River
Whangamoa River	Whangamoa River

Appendix 3. Assignment of conservation priorities for each diadromous fish unit derived from the updated National Īnanga Spawning Database (n= 500 records).

DiadUnit	NZTM_X	NZTM_Y	Date_	Region	Catchment	Locality	SPI	ThreatClass	ThreatRank	ConsPriority
1	1525042	5428004	3/17/1995	West Coast	Granite	North end of Kongahu Swamp	L	High intensity agriculture	3	1
1	1600812	5451788	3/30/1994	Nelson	Unnamed-Nelson	Spring-fed stream near mouth of Motueka River	L	High intensity agriculture	3	1
1	1617680	5425184	4/1/2012	Tasman Region	Orphanage Creek	2-50m upstream Wakatu Drive (SH6)	M	Vegetation clearance	1	2
1	1614880	5425250	4/1/2012	Tasman Region	Borck Creek	40m downstream furthest downstream driveway bridge to 100m upstream	M	Road corridors	2	3
1	1616760	5424325	4/1/2012	Tasman Region	Reservoir Creek	Between Wakatu Dr and Champion Road extension	M	Road corridors	2	3
1	1498545	5385326	2/21/1992	West Coast	Jones	500m downstream from bridge nearest the sea, t/r	M	High intensity agriculture	3	4
1	1494546	5380329	3/31/1994	West Coast	Whareatea	Rapid Creek confluence	M	High intensity agriculture	3	4
1	1604470	5440115	4/1/2012	Tasman Region	Tasman Valley Stream	50-170m downstream Kina Beach Road	M	Low intensity agriculture	7	5
1	1525643	5438299	5/15/1991	West Coast	Oparara	Butterfly Creek. Site "4"	M	Low intensity agriculture	7	5
1	1599212	5459585	4/8/1993	Nelson	Otuwhero	backwater just above road bridge	M	Low intensity agriculture	7	5
1	1618799	5427596	4/1/2012	Tasman Region	Poormans Stream	20m downstream Wakatu Drive (SH6)	S	Vegetation clearance	1	6
1	1617380	5424475	4/1/2012	Tasman Region	Saxton Creek	~100m upstream Main Road Stoke	S	Vegetation clearance	1	6
1	1605980	5433140	4/1/2012	Tasman Region	Dominion Valley Stream	50-100m downstream	S	Road corridors	2	7
1	1619738	5428359	4/19/2012	Tasman Region	Jenkins Creek		S	Road corridors	2	7
1	1600660	5456895	3/21/2013	Tasman Region	Kaiteriteri Creek	0-50m downstream 80 Martin Farm Road	S	Road corridors	2	7
1	1606290	5430465	4/1/2012	Tasman Region	New Stringer Creek	15-50m downstream private	S	Road corridors	2	7
1	1605975	5433060	4/1/2012	Tasman Region	Nile Creek	0-70m upstream SH60	S	Road corridors	2	7
1	1619700	5428670	4/1/2012	Tasman Region	Pearl Creek	Tidegate to 50m upstream	S	Road corridors	2	7
1	1601530	5447725	3/1/2013	Tasman Region	Thorpe Drain	0-300m upstream Old Wharf Road	S	Road corridors	2	7
1	1599735	5454195	3/21/2013	Tasman Region	Wai-Atua Creek	0-900m upstream of new cycleway bridge	S	Road corridors	2	7
1	1603880	5440497	4/1/2012	Tasman Region	Ellis Creek	280m upstream of Boyle Street downstream, 30m downstream of Stoffregen footbridge	S	High intensity agriculture	3	8
1	1603845	5440780	4/1/2012	Tasman	Field Creek	120-200m upstream Aporo Road	S	High intensity agriculture	3	8

				Region						
1	1601820	5450785	3/20/2013	Tasman Region	Moon Creek	Thorpe Street to 300m upstream	S	High intensity agriculture	3	8
1	1586392	5477973	4/14/2013	Tasman Region	Motupipi River	Similar to 2012 but a bit further upstream and downstream	S	High intensity agriculture	3	8
1	1580305	5484165	3/21/2012	Tasman Region	Puremahaia Stream	~150m downstream of Battery Road	S	High intensity agriculture	3	8
1	1582595	5480195	3/14/2013	Tasman Region	Takaka River	80m downstream SH60	S	High intensity agriculture	3	8
1	1572462	5507291	3/13/2012	Tasman Region	Yellow Pine Creek	Upstream of the Pakawau-Westhaven Road bridge	S	High intensity agriculture	3	8
1	1485848	5374833	3/3/1991	West Coast	Orowaiti	Mckenna, approx. 1km upstream of railway bridge	S	High intensity agriculture	3	8
1	1581649	5482875	4/1/2012	Tasman Region	East Onehau Salt Marsh Tributary	Upstream of driveway #39 off Fraser Road	S	Low intensity agriculture	7	9
1	1588062	5478302	4/1/2012	Tasman Region	Gibson Creek	20m upstream and 4m downstream of Bob ButtÔÇÖs Footbridge	S	Low intensity agriculture	7	9
1	1600127	5453416	3/21/2013	Tasman Region	Little Sydney Creek	Tidegate to 200m upstream - in 3 directions	S	Low intensity agriculture	7	9
1	1588307	5478757	4/1/2012	Tasman Region	Motupipi Estuary East Arm Tributary		S	Low intensity agriculture	7	9
1	1609400	5428460	4/1/2012	Tasman Region	O'Connor Creek	From 700m downstream of SH60 for 150m	S	Low intensity agriculture	7	9
1	1575225	5488520	3/21/2013	Tasman Region	Onekaka River	650m downstream Shambala Rd	S	Low intensity agriculture	7	9
1	1608200	5433645	4/1/2012	Tasman Region	Seaton Valley Stream	300-400m upstream Toru St causeway	S	Low intensity agriculture	7	9
1	1525642	5434001	3/10/1989	West Coast	Karamea	Bakers Creek	unknown	Vegetation clearance	1	10
1	1624126	5431165	5/3/2015	Nelson	Maitai River		unknown	Vegetation clearance	1	10
1	1626633	5435066		Nelson	Oldham Creek		unknown	Vegetation clearance	1	10
1	1617740	5425166	5/3/2015	Nelson	Orphanage Stream		unknown	Vegetation clearance	1	10
1	1621674	5429507		Nelson	Pipers Reserve		unknown	Vegetation clearance	1	10
1	1618763	5427596	5/3/2015	Nelson	Poorman Valley Stream		unknown	Vegetation clearance	1	10
1	1599835	5453910		Tasman Region	Riwaka River	120-250m upstream of cycleway	unknown	Vegetation clearance	1	10
1	1601280	5447735		Tasman Region	Woodland Drain	0-300m upstream Old Wharf Road	unknown	Vegetation clearance	1	10
1	1600412	5461584	3/28/1994	Nelson	Marahau	Marahau stream road bridge, tributary at DoC kiosk	unknown	Road corridors	2	11
1	1599475	5444370		Tasman Region	Moutere River	Jubilee Bridge to 700m downstream	unknown	Road corridors	2	11
1	1486336	5375803		West Coast	Orowaiti River	50m reach on TL bank below rail bridge	unknown	Road corridors	2	11

1	1601210	5451965		Tasman Region	Spring Creeks	0-200m downstream stopbank	unknown	Road corridors	2	11
1	1486339	5375785		West Coast	Stephens Road	25m reach on TL bank underneath Stephens Rd bridge	unknown	Road corridors	2	11
1	1525661	5437281		West Coast	WC unnamed1	Grassed areas within bush on TL bank from 140m above road bridge	unknown	Road corridors	2	11
1	1599355	5444670		Tasman Region	Blue Creek	100m upstream Moutere Highway to 500m downstream	unknown	High intensity agriculture	3	12
1	1489940	5378215		West Coast	Deadmans	On TL grassy bank 70m downstream of Utopia Rd bridge	unknown	High intensity agriculture	3	12
1	1601250	5451010		Tasman Region	Doctor Creek	300-600m upstream Thorpe Street	unknown	High intensity agriculture	3	12
1	1495935	5383170		West Coast	WC unnamed3	On both banks of small tribiutary that enters mainstem on TR 200 metres from mouth	unknown	High intensity agriculture	3	12
1	1608190	5433555		Tasman Region	Aranui Creek	300-400m upstream Toru St causeway	unknown	Low intensity agriculture	7	13
1	1600365	5452570		Tasman Region	Ferrer Creek	0-200m upstream tidegate	unknown	Low intensity agriculture	7	13
1	1600360	5461135		Tasman Region	Marahau Estuary Stream	100m upstream and 300m downstream Sandy Bay-Marahau Road	unknown	Low intensity agriculture	7	13
1	1606250	5430560		Tasman Region	Old Stringer Creek	30-90m downstream Westdale Road	unknown	Low intensity agriculture	7	13
1	1599240	5459710		Tasman Region	Otuwhero Stream	100m downstream and 170m upstream Sandy Bay-Marahau Road	unknown	Low intensity agriculture	7	13
1	1605815	5432000		Tasman Region	Trafalgar Creek	0-60m upstream SH60	unknown	Low intensity agriculture	7	13
1	1635567	5441514	5/3/2015	Nelson	Wakapuaka River		unknown	Low intensity agriculture	7	13
1	1522358	5418590		West Coast	WC unnamed2	50m reach on grassy bank on inside (TL) of loop nearest township	unknown	Low intensity agriculture	7	13
2	1482250	5376633	3/3/1991	West Coast	Buller	Confluence of Martins Creek and Bradshaws Creek	M	High intensity agriculture	3	1
2	1452340	5299564	3/28/1990	West Coast	Grey	Eastern tributary, Cobden Is	M	Earthworks	4	2
2	1408833	5240679	2/9/1989	West Coast	Waitaha	Ounatai Lagoon	S	Vegetation clearance	1	3
2	1376428	5220684	2/10/1989	West Coast	Waitangitaona	Small 'island' in mainstem	S	Vegetation clearance	1	3
2	1471853	5373937	4/19/1992	West Coast	Wall	Bay,10m above culvert.	S	Road corridors	2	4
2	1332410	5172676	4/27/1990	West Coast	Manakaiaua	Sam Creek	S	High intensity agriculture	3	5
2	1473551	5368338	3/20/1991	West Coast	Okari	2.5km from the sea, approx 1km from lagoon	S	High intensity agriculture	3	5
2	1271771	5130250	3/11/1989	West Coast	Turnbull	Collyer Creek, site 3	S	High intensity agriculture	3	5
2	1433365	5268170		West Coast	WC unnamed5	On TR bank 100m above main road	unknown	Vegetation clearance	1	6
2	1482234	5376528		West Coast	Bradshaws Creek	50m reach on TL bank between Cape Foulwind Rd and Martins Creek Rd bridges	unknown	Road corridors	2	7
2	1466304	5345467		West Coast	Fox River	20m reach on TR bank above road bridge	unknown	Road corridors	2	7

2	1462186	5335081		West Coast	WC unnamed4	50m reach on TL bank 75m upstream of road bridge	unknown	Road corridors	2	7
2	1445738	5285068	4/30/1988	West Coast	Taramakau	Feeder Creek into estuary	unknown	High intensity agriculture	3	8
2	1420771	5250495		West Coast	WC unnamed6	In small tributary that enters mainstem on TL bank at mouth	unknown	High intensity agriculture	3	8
2	1470945	5360058		West Coast	Nile River	5m reach on TL bank 50m above road bridge	unknown	Low intensity agriculture	7	9
3	1273106	4835259	3/18/1996	Southland	Mataura	Lower river	S	High intensity agriculture	3	1
3	1340238	4840216	3/18/1998	Otago	Purakanui	mainstem	S	Low intensity agriculture	7	2
3	1243159	4846261		Southland	Kingswell Creek		unknown	Vegetation clearance	1	3
3	1242334	4852151		Southland	Waihopai River		unknown	Vegetation clearance	1	3
3	1242120	4849424		Southland	Otepuni Creek		unknown	Road corridors	2	4
3	1218485	4859264	2/21/1996	Southland	Aparima	Bend above Gummies bush road bridge	unknown	High intensity agriculture	3	5
4	1434212	4996480	3/19/1996	Otago	Kakanui	Waiareka Creek, 2km upstream mainstem confluence	M	High intensity agriculture	3	1
4	1425748	4961873	3/22/1996	Otago	Shag	Mainstem, just above railway bridge	M	High intensity agriculture	3	1
4	1415366	4947462	3/16/1998	Otago	Waikouaiti	Orbells	M	High intensity agriculture	3	1
4	1413999	4923161	3/5/1999	Otago	Otago Harbour	Reservoir Creek	S	Vegetation clearance	1	2
4	1431822	4986778	4/29/1996	Otago	Waianakarua	Mainstem, near mouth	S	High intensity agriculture	3	3
4	1375825	4904501	4/4/1997	Otago	Taieri	Lake Waipori outlet	S	Invasive weeds	6	4
4	1415390	4929462	2/27/1999	Otago	Purakaunui	Mainstem	S	Low intensity agriculture	7	5
4	1415390	4929362	3/24/1997	Otago	Waitaiti	Purakanui Creek	S	Low intensity agriculture	7	5
4	1411688	4930857	4/5/1996	Otago	Waitati	Mainstem	unknown	Low intensity agriculture	7	6
5	1576097	5209576	1/22/1988	Canterbury	Ashley	Benzies Creek, Saltwater Creek	M	Vegetation clearance	1	1
5	1574798	5183586	4/21/1989	Canterbury	Avon	Avondale Bridge	M	Vegetation clearance	1	1
5	1573098	5177588	4/28/1994	Canterbury	Heathcote	Opawa road bridge	M	Vegetation clearance	1	1
5	1548611	5143799	3/14/1989	Canterbury	Ellesmere	Waikewai Creek	M	Low intensity agriculture	7	2
5	1573498	5195981	3/20/1988	Canterbury	Waimakariri	Kaiapoi R	S	Vegetation clearance	1	3
5	1457858	5070990	4/14/1997	Canterbury	Pareora	Waterway draining swamp into lagoon at mouth	S	Road corridors	2	4
5	1471543	5101392	3/20/1997	Canterbury	Orari	Ohapi Creek confluence	S	High intensity agriculture	3	5
5	1460550	5085989	3/26/1997	Canterbury	Washdyke Creek	Channelised section near lagoon	S	Pollution	9	6
5	1575925	5183933		Canterbury	canty unnamed 7	PRE-EARTHQUAKE All banks in south west corner	unknown	Vegetation clearance	1	7

5	1595350	5155496		Canterbury	Seafield Road	TL 50m upstream of Seafield Road bridge	unknown	Vegetation clearance	1	7
5	1575015	5195015	4/12/2005	Canterbury	Styx	Just upstream of tide gates, both banks	unknown	Vegetation clearance	1	7
5	1592595	5152636		Canterbury	ChCh Akaroa Road1	TL 25m upstream of Wainui Main road bridge	unknown	Road corridors	2	8
5	1594469	5155797		Canterbury	ChCh Akaroa Road2	TL 2m upstream of Christchurch Akaroa Road bridge	unknown	Road corridors	2	8
5	1602935	5160073		Canterbury	Schoolhouse Road	100m reach upstream from Schoolhouse Road bridge	unknown	Road corridors	2	8
5	1455276	5040592	4/10/1999	Otago	Waihao	Lower main river	unknown	Road corridors	2	8
5	1575908	5166606		Canterbury	Marine Drive	110m downstream of Marine Drive bridge	unknown	High intensity agriculture	3	9
5	1537016	5139499	3/28/1990	Canterbury	Rakaia	Mathias Creek	unknown	High intensity agriculture	3	9
5	1591540	5162579		Canterbury	Wharf Road	170m upstreamof Wharf Road Bridge	unknown	High intensity agriculture	3	9
5	1579368	5146238		Canterbury	canty unnamed 1	TR 45m upstream of beach	unknown	Low intensity agriculture	7	10
5	1579305	5145504		Canterbury	canty unnamed 2	Just below footbridge 200m upstream of beach	unknown	Low intensity agriculture	7	10
5	1581488	5144450		Canterbury	canty unnamed 3	Below road bridge, 45m upstream of beach	unknown	Low intensity agriculture	7	10
5	1585706	5143705		Canterbury	canty unnamed 4	TR on small reach 100m upstream of beach	unknown	Low intensity agriculture	7	10
5	1588557	5141800		Canterbury	canty unnamed 5	TL 20m upstream of beach	unknown	Low intensity agriculture	7	10
5	1607363	5149534		Canterbury	canty unnamed 6	150 m reach 650m upstream of beach	unknown	Low intensity agriculture	7	10
5	1597005	5154325		Canterbury	ChCh Akaroa Road3	TL 10m upstream of Christchurch Akaroa Road bridge	unknown	Low intensity agriculture	7	10
5	1585128	5165576		Canterbury	Fernlea Point	115m reach upstream from Fernlea Point Road bridge	unknown	Low intensity agriculture	7	10
5	1600413	5142788		Canterbury	Flea Bay	Western stream, 40m downstream of Flea Bay Road bridge	unknown	Low intensity agriculture	7	10
5	1592554	5152565		Canterbury	French Farm Bay Stream	Small creek near to Bantry Lodge road, 25m upstream of culvert	unknown	Low intensity agriculture	7	10
5	1606369	5155174		Canterbury	Le Bons Stream	160m reach on TR (including side stream) 400m upstream of lower Le Bons Bay Road bridge	unknown	Low intensity agriculture	7	10
5	1602874	5160001		Canterbury	Opara Stream, Okains Bay	100m reach upstream from Schoolhouse Road bridge	unknown	Low intensity agriculture	7	10
5	1584750	5165626		Canterbury	Port Levy	Small creek in Port Levy, 100m east of Purau Port Levy Road, 145m upstream of Wharf Road bridge	unknown	Low intensity agriculture	7	10
5	1571723	5167944		Canterbury	Teddington	10m upstream of Governors Bay Teddington Road bridge	unknown	Low intensity agriculture	7	10
5	1592595	5152636		Canterbury	Wainui Main Rd	TL 25m upstream of Wainui Main road bridge	unknown	Low intensity agriculture	7	10
5	1467546	5095391	3/9/1993	Canterbury	Opihi	Tributary on T/R bank downstream of Waipopo R	unknown	Recreational use	8	11

6	1685384	5405697	3/31/1994	Nelson	Wairau	Confluence of small creek and Roses overflow	M	High intensity agriculture	3	1
7	1791380	5514288	5/5/1997	Wanganui	Manawatu	Whirokino Cut	L	High intensity agriculture	3	1
7	1759276	5434685	4/23/1996	Wellington	Hutt	Sladen Park Boat Ramp	M	Vegetation clearance	1	2
7	1938643	5609165	10/16/1993	Hawkes Bay	Tuki Tuki	Grange Creek, True left bank, near island.	M	Road corridors	2	3
7	1760886	5434209	4/13/2016	Wellington	Hutt River, Waiwhetu Stream		unknown	Vegetation clearance	1	4
7	1754668	5444680	4/17/2016	Wellington	Kenepuru Stream		unknown	Vegetation clearance	1	4
7	1760958	5447568	4/21/2016	Wellington	Pauatahanui Stream		unknown	Vegetation clearance	1	4
7	1754668	5444680	4/17/2016	Wellington	Porirua Stream mainstem		unknown	Vegetation clearance	1	4
7	1938644	5609261		Hawkes Bay	Tukituki River the Grange		unknown	Vegetation clearance	1	4
7	1942255	5605315		Hawkes Bay	Maraetotara		unknown	High intensity agriculture	3	5
7	1941062	5584928		Hawkes Bay	Waimarama Puhokio		unknown	High intensity agriculture	3	5
7	1760153	5449077	4/21/2016	Wellington	Horokiri Stream		unknown	Low intensity agriculture	7	6
7	1759106	5449847	4/21/2016	Wellington	Kakaho Stream	105 m upstream of Grays Rd; eggs found on both banks	unknown	Low intensity agriculture	7	6
7	1757648	5413918	4/14/2016	Wellington	Wainuiomata River mainstem		unknown	Low intensity agriculture	7	6
8	2028113	5707852	5/1/1997	East Coast	Waipoa	Whatatuna Stream	M	High intensity agriculture	3	1
8	1956109	5787086		Bay of Plenty	Ohiwa	Tunanui Stream	unknown	Vegetation clearance	1	2
8	1982568	5670359	4/19/1988	Bay of Plenty	Wairoa	t/r bank from boat ramp to opp. Awatere stream.	unknown	Vegetation clearance	1	2
8	2074652	5821344	5/15/1992	East Coast	Awatere	Embayment just below the bridge, T/R side	unknown	High intensity agriculture	3	3
8	2010256	5806099	5/15/1992	East Coast	Haparapara	Vicinity of River Mouth	unknown	High intensity agriculture	3	3
8	2071542	5822641	5/15/1992	East Coast	Karakatuwhero	Embayment in vicinity of river mouth	unknown	High intensity agriculture	3	3
8	1960621	5782587	3/31/1987	Bay of Plenty	Nukuhou	Opposite old dairy factory	unknown	High intensity agriculture	3	3
8	1976737	5785916	2/22/1988	Bay of Plenty	Otara	1.25km	unknown	High intensity agriculture	3	3
8	1936840	5613770	4/15/1991	Hawkes Bay	Tutaekuri	Mainstem	unknown	High intensity agriculture	3	3
8	1936914	5613714		Hawkes Bay	tutaekuri backwash Awatoto drain		unknown	High intensity agriculture	3	3
8	1949502	5786276		Bay of Plenty	Waiaua	Either side of the Waiau Road bridge	unknown	High intensity agriculture	3	3
8	1976537	5786015	5/15/1992	Bay of Plenty	Waioeka	Otara River, near Memorial Park	unknown	High intensity agriculture	3	3
8	2031261	5823366	5/15/1992	East Coast	Waiokaha	Near mouth	unknown	High intensity agriculture	3	3
8	1968228	5784401	4/2/1987	Bay of Plenty	Waiotahi	Waiotahi ValleyRoad,300mbelow-600m above bridge	unknown	High intensity agriculture	3	2

8	2041567	5830198	5/21/1992	East Coast	Whangaparoa	Tributaries 200m upstream of mainstem shanty.	unknown	High intensity agriculture	3	2
8	2066620	5828544	5/22/1992	East Coast	Wharekahika	Just below road bridge, true right side	unknown	High intensity agriculture	3	3
8	1935840	5610866	4/15/1991	Hawkes Bay	Clive	Karamu Stream?	unknown	Armouring	5	4
8	1947692	5791579	4/21/1988	Bay of Plenty	Whakatane	Opposite the mill, on the T/R bank	unknown	Low intensity agriculture	7	5
9	1717806	6038887	4/12/1997	Northland	Otaika	Below Otaika loop road	L	High intensity agriculture	3	1
9	1857637	5840073	5/8/1992	Bay of Plenty	Uretara	Roadside drain	S	Road corridors	2	2
9	1860817	5852085	5/8/1992	Bay of Plenty	Waiau	Fork of drain & mainstem	S	High intensity agriculture	3	3
9	1744958	5921624	9/5/2018	Auckland	Henderson Creek		unknown	Vegetation clearance	1	4
9	1899905	5816428	2/23/1988	Bay of Plenty	Kaituna	2km upstream of cut	unknown	Vegetation clearance	1	4
9	1939976	5795872	4/30/1987	Bay of Plenty	Rangitaiki	200m downstream of SH2 bridge, T/R bank	unknown	Vegetation clearance	1	4
9	1906917	5813037	3/23/1988	Bay of Plenty	Waihi Estuary	Pongakawa Canal, at confluence with Pukehina	unknown	High intensity agriculture	3	5
11	1718402	5681966	3/14/1997	Wanganui	Onaero	Mainstem, t/l bank	M	High intensity agriculture	3	1
11	1767389	5787118	4/19/1999	Waikato	Oparau	Waihohonu Stream	M	High intensity agriculture	3	1
11	1756170	5863803	9/9/1983	Waikato	Waikato	Okahu Stream well upstream of mouth	unknown	Vegetation clearance	1	2
11	1773851	5814230	4/28/1998	Waikato	Raglan harbour	Maunurima stream	unknown	Recreational use	8	3
12	1790277	5537892	4/28/1992	Wanganui	Rangitikei	Unnamed stream	L	High intensity agriculture	3	1
12	1782370	5561994	5/5/1992	Wanganui	Turakina	mainstem	M	Recreational use	2	2
12	1691147	5619657	5/21/1991	Wanganui	Kaupokonui	Mainstem	M	High intensity agriculture	3	3
12	1788075	5546493	5/7/1992	Wanganui	Unnamed-Wanganui	south end of bombing rang	unknown	Recreational use	8	4