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Chapter 3
River Values Assessment System (RiVAS) – The method

Ken Hughey (Lincoln University
Kay Booth (Lindis Consulting)
Mary-Anne Baker (Tasman District Council)

Peer reviewed by:
John Hayes and Chris Arbuckle

3.1 Background

The Foundation for Research Science and Technology funded five short-term Envirolink projects designed to develop a 'useable' system for regional councils to assess the significance of in- and out-of-stream river values in New Zealand. This resulted in the development of the River Values Assessment System (RiVAS) tool.

There were seven main phases to the overall project (see also Figure 3-1):

(a) A national planning workshop to agree on values to be examined, host councils, suggested lead consultants and timelines. This workshop was held in Wellington on 21 August 2008.

(b) Development of a RiVAS, together with the agreed terminology. This chapter describes the method and terminology that support RiVAS.

(c) Application of the method to salmonid angling to provide an exemplar.

(d) Application of the method (with reference to the salmonid angling template) to the other river values at selected host councils.

(e) A second national river values workshop to receive results, identify and resolve issues, and provide directions for future development of the tool.

(f) Application and further refinement of the tool for prioritising the river values within one region, namely Tasman District Council.

(g) Production of a set of guidelines and case examples to be supplied to all councils in New Zealand.

A steering group was developed as part of the overall project: Mary-Anne Baker (Project Chair, Tasman District Council), Ken Hughey (Project Manager, Lincoln University), Neil Deans (Fish and Game NZ, Nelson/Marlborough), and Murray McLea (Greater Wellington Regional Council)[1]. Each stage of the project involved 'sign off' from this group and advice provided to the wider project participants (including most regional councils, Ministry for the Environment, Ministry of Agriculture and Forestry and Department of Conservation).

3.2 Purpose

This section provides guidance for parties assessing the significance of river values and represents phase (b) and part of (f) of the overall project.

3.2.1 Purpose of RiVAS

To outline an explicit and standardised method to develop assessment criteria and significance thresholds for multiple in- and out-of-river values. The method can be applied to national and

1 John Hayes, Cawthron Institute, Nelson, was part of the initial steering group that proposed the method and trialled it on salmonid angling in Tasman District.

regional planning under the RMA (e.g., to generate lists of rivers graded by relative importance for different uses which, in turn, provides information to guide water management decision making for a range of policy interventions/actions) and for other appropriate purposes (e.g., as advocacy tools).

3.2.2 Ethical use of RiVAS

Given the level of voluntary and expert input made by multiple stakeholders in some of the value assessments (e.g., kayaking with multiple lay experts) to this process it is expected that these users will be consulted in any application of the RiVAS methodology results for regional water plans or resource consent applications. The application of the methodology does not, in and of itself, constitute such consultation.

3.2.3 Aim of RiVAS

The RiVAS tool (and its underlying method) uses a multi-criteria analysis (MCA) approach and aims to:

1. Establish criteria to assess the river value;
2. Identify significance thresholds for these criteria (to identify their importance) and additional factors pertinent to rating the significance of the river value;
3. Outline a means to determine the significance of a river for a specific river value;
4. Define terms in order to provide a common language for practitioners and decision-makers.

The intention was to define a method that has applicability for all river values. The method, while operating under a standard framework has the capacity to facilitate variation in its implementation to accommodate the particular characteristics of each river value. However, once applied for a specific river value (e.g., whitewater kayaking), the expectation is that the method developed *for that river value* will become the standard approach to significance assessment for New Zealand rivers with respect to that value. Thus, the eight river values tested as part of method development and then subsequently applied again in Tasman District should now be considered to have a reasonably standard[2] approach for assessment. The project steering group is of the view that no more than three trial applications should be necessary before a particular value application method is confirmed[3].

The method outlined here results from refinements to a draft methodology that was first tested via application to salmonid angling within the Tasman District (project phase c: 2009). Some changes were made to the method before continuing testing with seven other values. The method was refined slightly from the case study applications for the various river values that form part of the initial value investigations (project phase d: 2009/10), and for a few values during the Tasman District Council application (see Table 3-1 for a summary of the key method steps as now confirmed after at least two applications for almost all values).

The method is intended to provide a means to inform decision-makers as to the significance of particular values, using a consistent approach. It does not (without further development and evaluation) extend to the exercise of prioritising between different river values.

The first applications of RiVAS have been to:

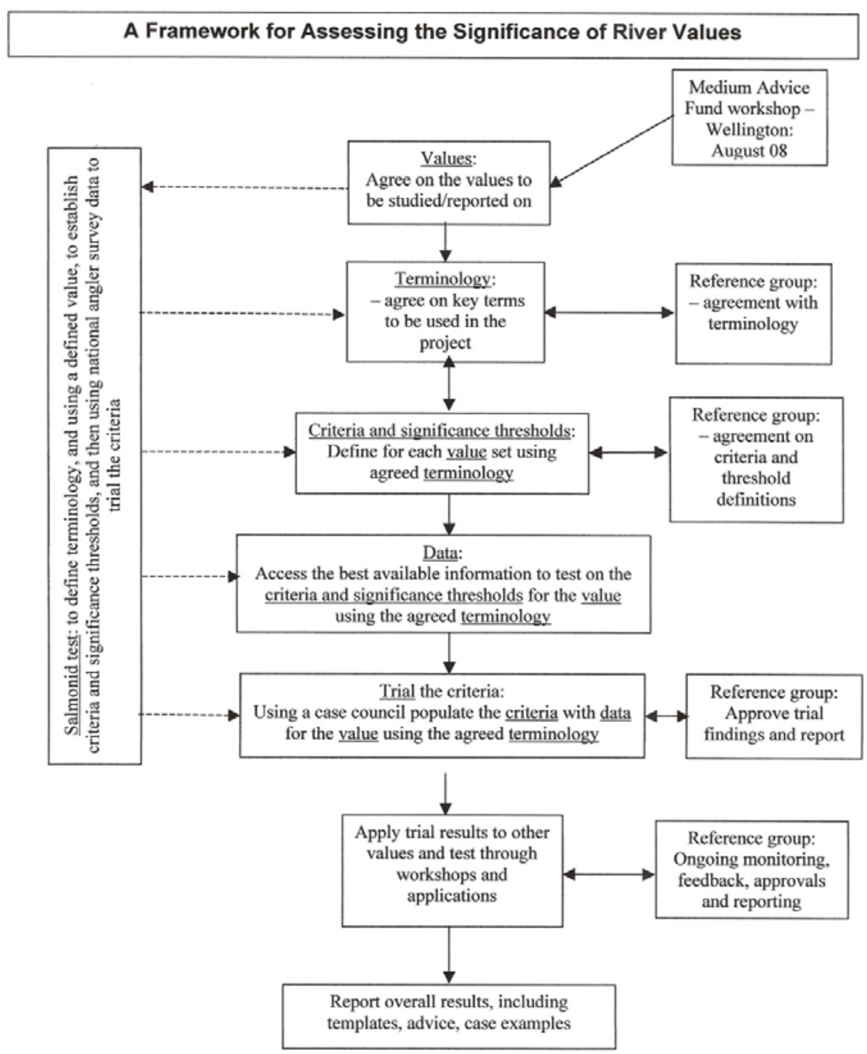
- Salmonid angling – Tasman District Council and Marlborough District Council
- Irrigation – Canterbury Regional Council and Tasman District Council

2 This wording might at first sight appear somewhat ambiguous. The idea however, is to allow further applications of the method to continue on the eight values trialled already – changes can still be made in light of lessons from such applications, but only after full review of the project steering group, or its subsequent equivalent.

3 Three is obviously somewhat arbitrary, but changes to any subsequent application then might imply a need to ‘redo’ the previous applications with obvious policy and resource implications.

- Native birdlife – Canterbury Regional Council and Tasman District Council
- Whitewater kayaking – West Coast Regional Council and Tasman District Council
- Swimming – Manawatu-Wanganui Regional Council and Tasman District Council
- Natural character – Marlborough District Council and Tasman District Council
- Tangata whenua – Southland Regional Council
- Hydro – Bay of Plenty Regional Council and Tasman District Council[4]
- Native fisheries – Wellington Regional Council.

Figure 3-1
Project overview



3.3 Underpinning criteria, assumptions and limitations of the method

In order to be *practical*, the method works within the constraints of available information. The following criteria have been followed in developing the method:

4 Work on both the hydro and native fish applications continues. The former has been constrained by issues associated largely with 'whole of industry' engagement. The latter has proved challenging due to a range of scientific issues including 'competing', albeit largely complementary models/approaches/world views.

1. Consistent – The same basic framework is used for all river values (e.g., recreation, irrigation, biodiversity), with adaptation within the framework as required;
2. Transparent – All steps in the method are defined explicitly;
3. Holistic understanding of values – A comprehensive description of a value's attributes is provided. Attributes are identified from the literature (see Smith 2009) and via a National Expert Panel;
4. Representative – The attributes chosen for each river value do not bias the assessment or scoring for any *specific* river or type of river;
5. Quantitative – The selected representative attributes are measured using *numerical or categorical* indicators wherever possible. Where quantitative data are not available, a proxy is used, that is, the judgment of an Expert Panel – appointment of expert panels is a fraught process with great care required;
6. Adaptive – When quantitative indicators are unavailable, data requirements are recorded. A river value research strategy may be compiled from this information across all river values;
7. Standardised – While the assessment criteria are based on neutral or quantitative data as much as possible, the determination of significance is by nature judgmental. The method standardises this judgmental process by setting significance thresholds and importance weightings. Factors influencing judgments are recorded – written documentation is used to avoid a 'black box' result, which is open to criticism;
8. Tiered significance – The method recognises national and regional and local significance or, in some cases, high, medium and low significance. International significance is not addressed as the method is targeted at national and regional level decision-making. Nevertheless, there is room in the method for recording matters of international significance;
9. Focused – Most rivers may be treated as single entities but larger rivers may need to be subdivided into two or more segments where their character alters. Sometimes smaller rivers may need to be aggregated to represent like values;
10. Iterative – As the Expert Panel progresses through the steps, decisions taken within previous steps may be reconsidered. Furthermore, the application of the method to a particular river value can be revised as new data become available;
11. Incorporates 'well-beings' – Attributes which represent the river value are chosen with consideration to the four well-beings (social, economic, environmental, cultural). This helps decision-makers consider the implications for each well-being of their decisions. Not every river value assessment will express each well-being.

3.3.1 Assumption

Research by its very nature contains inherent assumptions and limitations and it is important they are addressed explicitly. During application of the method to whitewater kayaking there was considerable debate about the extent to which these were being explicitly acknowledged by the tool developers and project teams. As a result of ongoing discussions the following statement was agreed and is now intended for inclusion in all RiVAS reports, or should alternatively be cross-referenced in any such reports.

"The RiVAS methodology was designed to account for the relatively scarce availability of both up-to-date and relevant data to assess significance (e.g., the lack of a recent and comprehensive survey of freshwater recreation). An expert panel approach which uses the 'best available information' to populate and score the attributes within the RiVAS framework is a viable means of doing this."

3.3.2 Limitations

Multi Criteria Analysis has existed in a formal sense since the 1970s and is now widely used as a decision support tool in a wide range of forums. However, as with any methodology, it has limitations. Consistent with the expression of an overarching assumption about the project it was agreed that limitations particularly relevant to RiVAS should be outlined and reconciled as far as the science of MCA and its implementation can permit. These matters are below:

- *Expert Panels*

The use of expert panels and the need for subjective decision-making by them is challenging. The method includes criteria to guide the appointment of panel members and to ensure credibility these criteria must be complied with. Despite these criteria, deficiencies inherent in the use of expert panels exist, including the need for oversight and consistency of application. This limitation is managed, and its effect minimised, by complying with the expert panel selection criteria. Ideally a national body will 'take up the reins' and apply the RiVAS nationally in a coordinated manner, thus reducing any expert panel bias.

- *Correlation between attributes*

There are likely to be, despite best attempts to reduce this, relationships between some of the primary attributes, known technically as correlation. The smaller the list of primary attributes, the less likely this is to occur, but when it does occur, results may be influenced. The RiVAS method requires 6-10 primary attributes to adequately encompass the various aspects of each river value. The balance between providing an adequate number/diversity of attributes and minimising their correlation is challenging, and some correlation is almost unavoidable. The method separates attributes as far as possible and weighting attributes can be used to explicitly address attributes with, or suspected to have, such relationships.

- *Weighting Attributes*

Attributes can be weighted in the RiVAS methodology (i.e., adjusted to recognise their greater 'contribution' to explaining the relative importance of the river value). The default in the method is to apply equal weighting to attributes but this may not be correct. The challenge is there is little data about the relative importance of the attributes. Without empirical data, this problem cannot easily be resolved. However, the method does consider and allow for attributes to be weighted. Weighting attributes should be considered when the framework is applied to a new value and should be addressed explicitly.

- *Thresholds*

For some values (e.g., native birdlife and to an extent native fish), criteria already exist to identify national importance, and these have been applied where appropriate. Examples of such criteria include definitions of threatened and endangered species and thresholds of nationally important populations. These criteria need to be applied in the context of the Resource Management Act (RMA) 1991 Part II requirements[5]. For other values, including recreation, natural character and abstractive uses, there are no nationally relevant significance criteria so the threshold tests are not so clear. For these values, relevant RMA interpretations have been used, e.g., water bodies defined as outstanding in water conservation orders (WCO) for particular values are accorded nationally important status. As there is no consistency in the criteria used between each WCO deliberation, the selected thresholds need to be tested and, where necessary (after approval of an ongoing project steering group or similar), amended as the method is applied within and between councils.

5 For example where Part II S6(c) refers to 'The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna', the emphasis is on habitat – in development of criteria this emphasis has to be met. Thus, in the development of criteria the presence of significant populations of 'threatened or at risk species' is assumed to also signify the presence of significant habitat.

- *Connectivity between rivers*

The method involves developing river specific rankings. However, rivers may occur as clusters, for two reasons. In some circumstances, a series of rivers in relatively close proximity are attractive because of their proximity to each other, e.g., the Buller region for kayaking. RiVAS addresses these situations by entering the cluster similar to a single river (i.e., a row in the spreadsheet – see Appendix 6A-4 in chapter 6 herein for example). Individual rivers within the cluster will be separately listed in the spreadsheet. Alternatively, a set of rivers may have similar attributes suggesting they can be treated as 'the same' for the purposes of the exercise (e.g., rivers within Abel Tasman National Park for the value Natural Character). In this instance, individual rivers would not be separately listed.

- *Comparative Grades*

In developing the method, 'raw' indicator data has been converted to comparative (normally) 1-3 (low to high relative significance) scores which are then aggregated to give a total relative significance or importance score. An alternative system of 1-5 scores could also be used and has been used in limited situations. The 1-3 scoring, however, does adequately differentiate across the range of attributes in most cases. It provides a less complicated approach that also reflects the three-grade system in the ultimate ranking (i.e., national, regional and local). The appropriateness of this grading for particular indicators is reviewable, but it appears that after two or a maximum of three applications of the method for a particular value that the attributes and their criteria do not need revising.

- *Mathematical issues*

MCA type analyses assume that all the values lie in what is effectively our 'normal mathematical world', i.e., that all values lie in a comparable and (effectively) linear 'space'. This may not always be true – values may lie in a logarithmic or other non-linear spacing, there may be gaps or big jumps between different states of a value, or the differences between states may not even be comparable in an ordinal manner. There is also the 'apples and oranges' problem when comparing two different values, in that they may not be comparable within our understanding or interpretation of the world, despite having been scored on a similar numerical scale. Mathematical manipulation of values makes further assumptions about the nature and ordinality of the values, and their comparability. While we cannot know the degree to which this underlying assumption is true, and it does not undermine the value of MCA in laying transparent the heuristic behind a decision, it is important that the assumption underlying MCA is understood.

3.4 Definition of terms

River value A river-related tangible resource (e.g., birdlife), activity (e.g., salmonid angling or kayaking), or resource use (e.g., irrigation).

River value category A specific type or style of the river value (e.g., whitewater kayaking, flatwater kayaking; wilderness fishery, lowland fishery).

River segment Subdivision of a river into different portions based on significant changes in its geomorphologic character or use characteristic.

Assessment criteria Part 1 of the method. Identifies *primary attributes* and their associated *indicators* as the means to assess the river value.

Determination of significance Part 2 of the method. Identifies *importance thresholds* and *relative weightings* for each primary attribute. Summing the threshold scores gives a river significance score and ranking.

Attribute One facet of the river value. Taken collectively, attributes *describe* the river value. For example, salmonid angling includes the attributes of level of use, anticipated catch rate and perceptions of scenic attractiveness. Where possible, at least one attribute should be identified for each of the four 'well-beings', i.e., social, economic, environmental, cultural, identified in the Local Government Act 2002.

Primary attribute Those key attributes that are considered to best *represent* the river value under consideration: a subset of the comprehensive listing of all attributes for the river value. The ultimate set of attributes used in applying the method.

Indicator A measure of a primary attribute defined using SMARTA criteria, i.e., indicators that are specific, measurable, achievable, relevant, timely, and may be already in use.

Indicator threshold The threshold applied to an indicator to determine high, medium and low relative importance for that indicator. Thresholds, where possible, are quantitatively defined (e.g., <1,000 angler days per annum = relatively low importance).

Indicator threshold score Relative importance for each indicator is translated to a threshold score to allow mathematical calculation. Typically, except for the application to Natural Character, High importance = 3; Medium importance = 2; Low importance = 1; No importance = 0. For Natural Character the scores range from 5 to 1.

Weighting score The relative contribution of the primary attribute to the river value. Equal weightings may apply – this is the default position.

River significance score The resulting score for each river. This is the sum of the indicator threshold scores for each primary attribute (multiplied by their weighting score where weightings are not uniform).

Significance ranking Rivers are ranked based on their significance scores and labelled as significant at the national, regional or local level (or High, Medium, Low importance for values that are already considered nationally important under the RMA, e.g., tangata whenua and natural character values).

Expert panel The group of people (3-5) considered expert in their understanding of the river value (such as scientists and other river value experts) which form a panel to score indicators of each primary attribute for a specific river value.

3.5 Establish Expert Panel and identify peer reviewers

The method is predicated upon an Expert Panel (3-5 people), and these panels operate either as a:

(a) 'National' Expert Panel which initially identifies and develops the assessment criteria for a particular river value and tests it in a host region; or

(b) 'Regional' (or Local) Expert Panel which applies the value-specific criteria developed in (a) above in their respective regions.

Panel members will normally be scientists and other river value experts, e.g., recognised kayaking expert/lay experts, resource economist, council manager with a responsibility for the river value. When establishing a National Expert Panel, the relevant Ministries (e.g., MfE or MAF), government departments (e.g., DoC), and national level non-government organisations (e.g., Irrigation NZ, Fish and Game NZ) should be consulted on the membership of the panel. The credibility of this group is very important, so members should be selected carefully[6].

The Regional (or Local) Expert Panel applies the relevant method to the river value under consideration, making the necessary judgements where data are insufficient.

It typically takes a Regional Expert Panel for a particular value, one-two days to apply the method to their region. Panel members should be selected to ensure that collectively the panel has the necessary expertise and local knowledge to apply the process in the region. It may be that a single panel is able to fulfil both roles (National Expert Panel and Regional Expert Panel).

The defensibility of the method is contingent upon the credibility of the expert panel(s). Therefore, the composition of the panel(s) should be clearly documented including a justification for the members chosen (members' relevant experience and expertise provided).

When the method is applied to a new river value, the resulting attributes and indicator thresholds should be peer reviewed by at least two people who are regarded as being experts in that value.

3.6 Outline of the method

The method comprises three parts:

- Part 1 - applies the assessment criteria
- Part 2 - assesses significance
- Part 3 - considers future data.

Each part is divided into a series of steps (Table 3-1). More detail for each step is provided below the table. Appendix 3-1a and b, for the purposes of illustration, provides a notional and simplified application of the method to salmonid angling and irrigation respectively.

This is written for two forms of application: first, the national level exercise which develops the attributes, thresholds, etc, for a given river value, and then the regional applications of the method. The National Expert Panel addresses every step in their application of the method for a specific river value (using 'dummy' data for Steps 6 onwards for testing purposes). The Regional Expert Panel addresses Step 1 (confirms the list of rivers that has been prepared in advance), confirms Steps 2-5 (i.e., affirms the work of the National Expert Panel) and applies Steps 6 onwards to their region for a given river value.

Table 3-1
Method summary

Step		Purpose
PART 1: ASSESSMENT CRITERIA		
1	Define river	<u>The river value may be subdivided into categories </u>to ensure the method is applied at a

6 Simple terms of reference for panel members include: producing brief documented evidence of expertise that can be included in value assessment reports; willingness to contribute expert knowledge from their field of expertise; understanding of and willingness to work in a multi-criteria context. Panels should operate under Chatham House rules and members are specifically asked to represent the national interest and not their personal or organisational interests.

Step		Purpose
	value categories and river segments	meaningful level of detail Rivers are listed and may be subdivided into segments or aggregated into clusters to ensure that the rivers/river segments being scored and ranked are appropriate for the value being assessed A preliminary scan of rivers in the region is undertaken to remove those rivers considered to be of 'no' or less-than-local level significance for the value being considered
2	Identify attributes	All attributes are listed to ensure that decision-makers are cognisant of the various aspects that characterise the river value
3	Select and describe the primary attributes	A subset of attributes (called primary attributes) is selected A synopsis is provided for each primary attribute to inform decision-makers about its validity and reliability
4	Identify indicators	Indicator(s) are identified for each primary attribute using SMARTA criteria. Quantitative criteria are used where possible.
PART 2: DETERMINATION OF SIGNIFICANCE		
5	Determine indicator thresholds	Thresholds are identified for each indicator to convert indicator raw data to 'not present', 'low', 'medium', 'high' (scores 0-3)[7]
6	Apply indicators and indicator thresholds	Indicators are populated with data (or data estimates using an expert panel) for each river A threshold score is assigned for each indicator for each river
7	Weight the primary attributes	Primary attributes are weighted. Weights reflect the relative contribution of each primary attribute to the river value. The default weighting is that all primary attributes are weighted equally
8	Determine river significance	A river significance score is calculated: If unequal weightings have been applied to the primary attributes, then multiply the threshold score by the weighting for each primary attribute, and sum the calculations If weightings are equal, then indicator threshold scores are summed Order all rivers by their significance scores to provide a list of rivers ranked by their significance for the river value under examination Assign significance (national, regional, local) based on a set of criteria (a simple Decision Support System which operates as part of the overall RiVAS tool – see below)
9	Outline other relevant factors	Factors which cannot be quantified but influence significance are outlined to inform decision-making
PART 3: METHOD REVIEW		
10	Identify information requirements	Data desirable for assessment purposes (but not currently available) are listed to inform a river value research strategy (such a strategy might result from a value or values which are clearly data deficient, and be recommended to appropriate organisations for consideration and determine future information requirements)

7 The most common scale will be 1-3 indicating that in many cases there will always be some 'presence' of the indicator for this primary attribute. The Natural Character value Expert Panel adopted a 1-5 scale (confirmed subsequently by a second application in Tasman District). This is not ideal although a simple translation of scores, e.g., by means of 1-2 to 1, 3 to 2, and 4-5 to 3, could be undertaken (and has been trialled) to 'normalise' the Natural Character application.

3.7 Assessment criteria

Part 1 of the method comprises Steps 1-4 in Table 3-1 Method summary. Much of this part is relevant only for the National Expert Panel. Regional Expert Panels will be expected to apply the steps, not change the identified attributes and indicators.

3.7.1 Step 1: Define river value categories and river segments

Output

(1) The river value is subdivided into more refined categories where necessary (e.g., kayaking can be divided into whitewater kayaking; flatwater kayaking).

(2) All rivers within the region are listed, with long rivers subdivided into two or more segments where necessary (e.g., in Marlborough the Upper Wairau, Lower Wairau – divided at Wash Bridge). The number of segments a river is divided into should be as low as possible and should mark distinct differences in river geomorphology or river use. Rivers can also be grouped in a cluster if they are similar across most primary attributes and therefore likely to have the same significance rating, or if the river value requires all rivers in the group to realise the value (e.g., if a rare bird species relies on different rivers for different life stages, or a kayaking experience is only highly valued because there are several rivers in an area). It is possible to list both a whole river and river segments, and a cluster of rivers plus the individual rivers in the cluster, if their significance is different. This should be kept to a minimum, however, or the workload for the expert panel will become unmanageable.

(3) A preliminary scanning exercise is undertaken to remove rivers of 'no' or less-than-local significance for this value. Criteria are needed for this step (e.g., for native birds, a list of rivers with no known significant presence of native birds; and for whitewater kayaking, a list of lowland streams of no value for the sport) – this step should occur iteratively with the process being developed in part 2 of the method.

Rationale

Without further refinement into categories, the river value may be too heterogeneous for the method to be applied meaningfully. Similarly, the river may also require subdividing for the assessment to be meaningful. While it is advantageous to have consistency across all river values – the same list of rivers (and segments) used for every value within the region – it may not be sensible or practical to do so. For instance, swimming will have identifiable pools only in some river segments whereas angling may be an entire river. Removal of rivers through a preliminary scanning process reduces the size of the task.

Who

Expert Panel (host council, scientist/s, expert users, others). Host council should provide initial list of rivers to assess.

Notes

(1) While it is tempting to further refine the river value into different categories or subdivide the river into additional segments, be circumspect. Each additional category or river segment increases the workload considerably and may result in issues later in the process (e.g., in the whitewater kayaking river value, the numbers of users will be split across the separate river segments reducing the magnitude of use for that river). River segments remain separate throughout the method – they are not 'added together' at any stage. The method is repeated separately for each river value category, so the work load substantially increases.

(2) For recreation values, the principles of the Recreation Opportunity Spectrum apply to any consideration of categorising the river value (i.e., consider the different styles of activity which

require different settings to provide the types of experiences being sought, such as whitewater c.f. flatwater kayaking).

(3) List the rivers with names and identifier numbers. Use a recognised list of rivers, such as the Ministry of Works (Anon., 1956[8]) list. Links to the River Environment Classification system could be investigated further.

(4) Segment rivers on the basis of geographical and/or use characteristics. Segments should be commonly recognised by users, where applicable.

(5) If a similar exercise has been done for another river value in the region, preferably use the same list of rivers (i.e., where possible, match rivers and their segments across all river values within the region).

(6) Nested sites may need to be identified – e.g., a set of rapids, a swimming hole. These should not be identified as a river segment – but highlighted as specific sites on a river or river segment. Specific geographic definition is important for 'small' sites such as swimming holes.

3.7.2 Step 2: Identify attributes

Output

Attributes which attach to the river value are listed comprehensively.

Rationale

Attributes are identified (including, where relevant, at least one for each of the four 'well-beings' identified in the Local Government Act 2002: social, economic, environmental, cultural) that describe the nature of the river value. The list should be as comprehensive as possible to provide a holistic 'picture' of the river value.

Who

Expert Panel

Notes

(1) Wherever possible, an accepted research/planning framework should be used to structure the list and indicate attributes. For recreation values, use the Recreation Opportunity Spectrum. Economic frameworks may apply for some other river values (e.g., irrigation). Where no framework exists, the Expert Panel will identify attributes based on their professional judgment. Individual attributes may also be suggested within the research literature (see Smith, 2009).

(2) Think broadly and comprehensively when defining attributes. If in doubt, list it. Do not be concerned about pragmatism (that the list is too long or data are not available) - those considerations are addressed in later steps.

(3) When devising the list of attributes, consider the following factors: quality, rarity, diversity, representativeness, substitutability, connectivity, use levels, social, cultural and economic benefits.

(4) Some attributes may be contingent upon others (inter-related). Note as appropriate and try to avoid, in the next step, closely related primary attributes. Attributes may be nested, and it may be necessary to 'drill down' to a greater level of detail in order to adequately describe the river value.

3.7.3 Step 3: Select and describe primary attributes

Output

Attributes which will be used to represent the river value are selected and described (including the validity and reliability of each attribute). These are called primary attributes.

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8 Anon. (1956). *Catchments of New Zealand.* Soil Conservation and Rivers Control Council, Wellington.

Rationale

The method used to select the primary attributes must be practical, be able to be implemented, be explicit and defensible. Pragmatically, all attributes cannot be considered, therefore a subset of attributes is chosen. If the river value under consideration (e.g., kayaking) has been divided into categories (e.g., whitewater and flatwater kayaking), the same primary attributes should be applied to all river value categories.

Who

Expert Panel

Notes

From the list of attributes outlined in Step 2, select those 'primary' attributes considered most important. These will be used to *represent* the river value within the assessment. Document the basis for selection. Keep the list of primary attributes short (5-10), to ensure the method is practical to implement and easily transferable.

For each selected primary attribute, discuss its validity and reliability, including its strengths and weaknesses, in representing the river value.

3.7.4 Step 4: Identify indicators

Output

Indicators which will be used to measure the primary attributes are listed.

Rationale

The indicators used to score each primary attribute should allow a cost-effective, and where possible, a quantitative assessment. This increases the practicality and objectivity of the method. A key component of this step is the availability of data. Estimates from the Expert Panel are required where and when data are deficient.

Who

Expert Panel. Where many data exist, heavy reliance will be placed upon the scientist(s) on the Expert Panel to advise and interpret data. Where few data exist, all members of the Expert Panel will play an equal role (to provide surrogate estimates).

Notes

Choose the single most relevant indicator for each primary attribute (i.e., only one indicator per primary attribute). Decisions must be based on the availability of data and relevance of the data. If data are deficient, the best available information and/or an Expert Panel will be used to estimate data (see Step 6). Use SMARTA criteria to select the indicator.

When choosing indicators, return to the list of factors provided in Step 2, that is: quality, rarity, diversity, representativeness, substitutability, connectivity, use levels, economic benefits. Make sure, in-so-far-as possible, that indicators reflect the four well-beings.

Identify and document the data sources used and the reliability of the data.

3.8 Determining significance

Part 2 of the method determines significance via a five-step process as outlined in Table 1.

1. Importance thresholds are determined for each indicator (Step 5).

2. Indicators and their thresholds are applied using available data or data estimates made by the Expert Panel (Step 6) to convert data to scores.
3. Primary attributes are weighted to represent their relative contribution; however, weightings may be equal. Where weightings are other than equal, it is important to record the reasoning (Step 7).
4. Threshold scores are calculated for each primary attribute and summed for each river to provide a ranked list of rivers for the river value under examination. Rivers are then identified to be of national, regional or local significance based on a simple Decision Support System (Step 8).
5. Consideration is given to other factors which are relevant to the assessment (Step 9).

As with Part 1, most of Part 2 is relevant for the National Expert Panels. However, regional expert panels should be aware of the overall process before entering at Step 6.

3.8.1 Step 5: Determine indicator thresholds

Output

A list of high/medium/low thresholds for each indicator which describe divisions to represent relative importance. Thresholds are defined quantitatively where possible (e.g., >5,000 angler days p.a. = high relative importance).

Rationale

Definition of relative importance is a judgmental exercise. The use of thresholds (to quantify the assessment) and the Expert Panel to undertake this exercise (use of best available knowledge) increases the robustness of the approach. Any existing data will inform the Expert Panel's assessment.

Who

Expert Panel

Notes

Use data (where available) and the Expert Panel's judgment to identify thresholds between high/medium and medium/low for each indicator. Think about the relativity between low – medium – high importance that the data thresholds imply.

Example: Salmonid angling 'level of use' thresholds are: high relative importance is >5,000 angler days p.a. while low relative importance is <1,000 angler days p.a. – an implied ratio of 5:1 re high:low importance (high is five times more important than low for this attribute). While still a subjective judgement, the 5:1 ratio was recognised by the national Expert Panel as adequately reflecting the relativity between high and low importance.

3.8.2 Step 6: Apply indicators and their thresholds

Output

- Step 6a: Indicators are populated with data (or data estimates developed by the Expert Panel).
- Step 6b: A threshold score is assigned by applying the indicator thresholds to these data.

Rationale

The method makes the significance assessment process explicit. The Expert Panel is used to overcome data deficiencies.

Who

Expert Panel

Action

- Step 6a: Populate each indicator with data. Where no data are available or data are not robust, the Expert Panel estimates data for each indicator.

- Step 6b: Apply the thresholds to each indicator and assign a score: high relative importance = 3; medium relative importance = 2; low relative importance = 1; 'no' importance = 0.

Notes

(1) A spreadsheet is used for these (and subsequent) calculations.

(2) Scores will normally range from 1-3, except in cases where the indicator for the attribute can itself score a zero, i.e., the indicator is not present. For example, for native birdlife a zero score would be used where there is no presence of threatened or at-risk species, or where there is no presence of toilet facilities at a swimming site.

(3) Consideration of 'potential' use. As applied in this report and to date, the method provides for consumptive uses (i.e., irrigation and hydro) to consider potential future uses, but non-consumptive uses do not (i.e., they cannot consider restoration potential). There has been considerable debate about this issue (although in application it has been consistent with previous attempts to prioritise values on a river-by-river basis). On the one hand it was argued that to not do so puts consumptive uses at an advantage. The counter view, and it remains as such in the method applied here, is that while such is true it would not be helpful to have potential reflected in rankings as it is extremely difficult to measure in many cases, e.g., salmonid angling is based on the National Angling Survey and how could this possibly measure potential use, etc, except from a limited historical context?

A potential approach that may meet both needs, i.e., an evaluation of the importance of existing values and of 'restoration' potential importance where the two differ, exists. This would involve supplementing the existing approach for non-consumptive uses with a similar assessment specifically for potential (including use and restoration), e.g., the Pukaki River for native birds or salmonid angling – existing importance is low but potential is for high for both if there was an appropriate managed flow restored in the river. Knowing both of these potential scores is valuable, i.e., it is the integral of the difference between actual and potential. Such information could provide a measure of cost utility if a scale/measure of utility (better than national, regional and local - although that is a start) could be developed. The cost of achieving the potential can likely be measured in dollar terms – for the Pukaki River, the net present value of power foregone in providing a flow for native birds has previously been calculated (Hughey, unpubl. data) and the same could be done for salmonid angling. RiVAS+ is being trialled in 2011 to explore the utility of this approach, as a complement to RiVAS.

(4) Difficulty with measurement may cause some primary attributes to drop out.

(5) If there is an international commitment or value (e.g., internationally designated protected area or species), this presents a case for extremely high importance (recorded as high importance), and in such cases, Step 8 will indicate national significance. However, use or demand for a river value by international people does not by itself indicate extremely high importance (nor necessarily national significance in Step 8). Document any internationally recognised factors considered in the assessment of indicators.

(6) Document data deficiencies and ensure they are incorporated in Step 10.

(7) Collating regional assessments into one national assessment is problematic because Regional Expert Panels may be using different frames to suit their region. In other words, national assessments are best done by a single Expert Panel (perhaps in liaison with Regional Expert Panels).

3.8.3 Step 7: Weighting the primary attributes

Output

Weightings for the primary attributes.

Rationale

The weighting is a measure of the relative contribution of each attribute to the river value. For example, 50% of the total weights may be given to 'rapids' for whitewater kayaking indicating a 50% weighting of that attribute. An attribute with a weight of 2 contributes twice as much to the final score as an attribute with a weight of 1.

Who

Expert Panel

Action

Determine the primary attribute weightings via the Expert Panel. These may be equal.

If unequal weights are chosen, identify the weighting given to each attribute and record these in the spreadsheet (1, 2, 3, etc). The multiplier that achieves a 50% weighting will of course differ depending on the number of primary attributes and their relative weights.

Where several weighting combinations are tested, provide a comparative evaluation of their usefulness, including a synopsis of the results.

Notes

(1) This step could be used as a sensitivity analysis. The default is equal weighting for each attribute. However, different weighting combinations could be tested to assess the robustness of the rankings. The salmonid angling case study tested three weighting regimes but chose to keep all attributes of equal weight (see salmonid angling chapter). But, in all cases, weighting should be guided by the experience of the expert panel in evaluating the relative importance of specific attributes for a value. Irrigation provides such an example, i.e., where a significant soil moisture deficit is indicated, a weighting is applied to emphasise both the size of the resource from a supply perspective, and size of the irrigated area from a demand perspective. The weighting selected is that when the soil moisture deficit threshold for a river is two (medium) or three (high), then the threshold scores for both size of resource and irrigated areas are weighted to power of three. For all rivers, the key secondary attributes of soil moisture deficit, reliability and presence of an alternative supply are all weighted +50%. The other attributes were not weighted.

3.8.4 Step 8: Determine river significance

Output

- Step 8a: A significance or importance[9] score for every river, ranked by significance for the river value under consideration.

9 Whether to use 'significance' or 'importance' has been debated in the context of both the method generally but also in terms of RMA application. In brief, because 'significance' is a term with specific meaning and application in the RMA it is recommended here that in general the default term should generally be 'importance'. Where the results of the applied method are then translated directly into an RMA application then consideration can be given to using either 'significance' or 'importance'. Both terms are used in the applications reported herein but care is required in their subsequent interpretation and use in policy and planning contexts.

- Step 8b: The list is re-ordered into rivers of national, regional and local significance (or high, medium or low importance) via application of a simple Decision Support System, i.e., a set of criteria and heuristics for assigning these rankings.

Rationale

- Step 8a: The sum of the threshold scores (weighted by relative importance) for each primary attribute will provide a river significance score. Every river will receive a significance ranking within the list of rivers.
- Step 8b: Using Expert Panel assessment, structured around specified decision support criteria, rivers are identified as nationally, regionally or locally significant (or high, medium or low importance) (see Action step 8b below).

Who

Expert Panel

Action

- Step 8a: If primary attribute weightings are equal, then sum the threshold scores. If the primary attribute weightings are not equal, then first multiply each threshold score by its weight and then sum the resulting weighted scores for each river. All rivers are ranked based on their score.
- Step 8b: The decision support criteria define those rivers that qualify for national, regional and local (or high, medium or low) importance, based on the river significance scores. All rivers that are assessed fall into one of these significance levels. These criteria are:

  National significance is defined by satisfying one of the following three criteria:

  1. A 'trigger' attribute exists which suggests national significance, e.g., presence of a nationally significant native bird population (i.e., at least 5% of the total population) of a 'threatened or at-risk' species, which records a high significance score.

  Criterion 1: Identified trigger attribute = 3.

  2. An attribute exists which appears to 'predict' significance (e.g., % anglers from overseas, using the assumption that international anglers choose the 'best rivers' to fish). In combination with relatively high significance scores across many of the remaining attributes, a high score for this attribute suggests national significance.

  Criterion 2: Identified 'predictor' attribute = 3, plus 25% or more of the other attributes = 3.

  3. The set of significance scores is consistently high – the river performs well across many attributes of the river value.

  Criterion 3: 50% or more of the attributes = 3.

  Local significance is defined by satisfying both of the following two criteria:

  1. The identified 'trigger' attribute does not score highly.

  Criterion 1: Where a trigger attribute < 3.

  2. Where the 'predictor' attribute score is low, and is matched with relatively low significance scores across many of the remaining attributes, this suggests local significance.

  Criterion 2: Identified 'predictor' attribute < 3, + all other attributes < 3.

  Regional significance is defined by default – being neither national nor locally significant.

An alternative approach has been employed for some river values (e.g., whitewater kayaking). Instead of using decision support system criteria, the Regional Expert Panel has decided that particular points in the ranked list provide natural cut-off points between rivers of high/medium and medium/low importance.

Notes

(1) Percentage thresholds (i.e., 25%, 50%) are approximate - the resulting number of attributes may need to be rounded up or down to a whole number (will depend on the number of attributes, e.g., in the case of a value with 5, 7, or 9 primary attributes).
(2) These national and local significance criteria are intended to provide consistency across river values. However, if there are compelling reasons to do so, the significance criteria may be adjusted to better fit the river value. These exceptions and there explanation should be clearly documented.
(3) Step 8a provides approximate significance ranking for the list of rivers. This allows the Expert Panel to review the data in a coherent form for Step 8b (significance identification). Further interpretation of the data may indicate if the use of trigger and predictor attributes is appropriate. In the salmonid angling example, the attribute '% overseas anglers' closely matched the ranked list and suggested this was a powerful predictive attribute for salmonid angling in the Tasman District.
(4) The method is based upon assessment by river value. It does not attempt to compare significance across values, e.g., comparing irrigation values with native birdlife values. The relevant decision-makers will need to make this comparison. Further research is required in this topic area.
(5) The method does not 'add together' river segments. Once separated, they remain separate throughout the process, although an entire river can be assessed separately from its component segments. Similarly, river value categories (e.g., whitewater c.f. flatwater kayaking) are presented as separate sets of results. A potential weakness of the method would occur if values were constantly being further subdivided, e.g., whitewater kayaking into Grade 4-5 paddlers and those Grade 3 or less. The number of categories should be limited to those that are useful for management and policy development.

3.8.5 Step 9: Outline other factors relevant to the assessment of significance

Output

Attributes which are relevant to the significance assessment but *cannot be measured* (and are not included as primary attributes) are identified and described.

Rationale

Some attributes do not lend themselves to the style of assessment outlined in this method as they cannot be easily quantified; however, any discussion of significance would be incomplete without their consideration. While these attributes sit outside the scoring process, they should be identified and discussed so that they can be taken into account by decision-makers.

Action

Review the initial comprehensive list of attributes from Step 2. Identify any attributes pertinent to assessment of significance that are not covered adequately within the method. This should consider the following factors: quality, rarity, diversity, representativeness, substitutability, connectivity, use levels, economic benefits.

Example

'Potential future recreational use' whereby a river may become a recreation resource (in the future) owing to new technology or other changes. A good example is the development of plastic kayaks, which dramatically expanded the type of rivers that could be kayaked (see the salmonid angling chapter for other examples). This attribute cannot be encompassed by the method as it cannot be measured; however, it is worthy of consideration by decision-makers.

For consideration

Attributes associated with the river's *context* (e.g., rarity of the recreation opportunity or habitat type) could be handled in two ways: included as an attribute in Step 2 and/or Step 3 (e.g., native birdlife value), or identified in Step 9 (e.g., salmonid angling value). When the attribute is a primary attribute (i.e., listed in Step 3) then the rarity 'count' is included in the quantitative significance assessment. The 'best' approach for considering these types of attributes will be determined following completion of the case studies and included in the final project guidelines (phase e). Feedback is sought from the case study teams.

3.9 Method review

Part 3 consists of one step and provides information for future assessments.

3.9.1 Step 10: Review assessment process and identify future information needs

Output

Information desired for future assessments is identified.

Rationale

It is likely that many assessments will have issues with data availability. This step accounts for future decision-making, identifying future research needs. It also provides an opportunity for reflection of what has been learnt about the river value and its measurement (lessons for next time).

Action

List data required to adequately measure primary attributes.

Notes

This list will 'fall out of' Step 6, that is, as you identify existing data for indicators, by default you will identify data deficiencies.

3.10 Outputs

Part 1 of the method (assessment criteria) will produce:

1. Classification of the river into segments and the river value into categories, where appropriate (Step 1);
2. A list of attributes (Step 2);
3. A list of primary attributes with a short explanation of why each was chosen (Step 3);
4. A list of indicators for the primary attributes (one indicator per attribute) explicitly checked against SMARTA criteria (Step 4).

Part 2 of the method (determination of significance) will produce:

1. A list of indicator thresholds (Step 5);
2. Data for each indicator for each river (Step 6a);

3. A threshold score for each indicator for each river (Step 6b);
4. A list of weightings for each primary attribute (Step 7);
5. A significance score for each river (Step 8a);
6. A list of rivers ranked by their significance or importance scores and either, using a Decision Support System, identified as significant at the national, regional or local level, or, using cut-off points, identified as being of high, medium or low importance for that river value (Step 8b);
7. A discussion of other factors pertinent to the assessment of significance (Step 9).

Part 3 (method review) will produce:
1. A description of future information requirements (Step 10).

It is suggested that these outputs are presented in spreadsheet form for transparency (see salmonid angling, chapter 5, for illustration).

Appendix 3-1a
The method in action (Excerpt from Tasman salmonid angling)

Step 1: Define river segments			Step 6A: Apply indicators and thresholds									Step 6B: Apply indicators and thresholds											
River code	Reach	River	Angler days (n) (NAS 2007/8,2001/2,1994/6)	Travel distance (km) (NAS 2007/08,2001/2,1994/6)	Overseas anglers (%) (NAS 2007/8,2001/02,1994/6)	Perception catch rate (0.0-1.0) (FGNZ 2008)	Perception fish size (0.0-1.0) (FGNZ 2008)	Water quality (0.0-1.0) (Expert Panel)	Perception scenic attractiveness (0.0-1.0) (FGNZ 2008)	Perception wilderness (0.0-1.0) (FGNZ 2008)	Perception importance (0.0-5.0) (NAS 1979)	Angler days score	Travel distance score	Overseas score	Perception catch rate score	Perception fish size score	Water quality score	Perception scenic score	Perception wilderness score	Perception importance score	Sum Weights 1	Rank1	River significance
21048	**0**	**Sabine River**	**208**	**108.2**	**45%**	**0.27**	**0.55**	**1.00**	**0.82**	**0.65**	**4.21**	**1**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**24**	**1**	National
21060	**0**	**Travers River**	**342**	**105.3**	**43%**	**0.37**	**0.44**	**1.00**	**0.81**	**0.74**	**4.06**	**1**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**3**	**23**	**2**	National
21013	**0**	**D`Urville River**	**560**	**113.2**	**39%**	**0.09**	**0.41**	**1.00**	**0.64**	**0.77**	**4.18**	**1**	**3**	**3**	**1**	**2**	**3**	**3**	**3**	**3**	**22**	**3**	National
21027	**0**	**Maruia River**	**1109**	**119.9**	**39%**	**0.32**	**0.25**	**1.00**	**0.68**	**0.20**	**3.84**	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**22**	**3**	National
21009	**1**	**Buller River**	**1470**	**170.5**	**59%**	**0.57**	**0.21**	**0.90**	**0.52**	**0.18**	**3.78**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**2**	**22**	**3**	National
21017	**0**	**Gowan River**	**267**	**110**	**81%**	**1.00**	**0.10**	**0.90**	**0.50**	**0.35**	**3.33**	**1**	**3**	**3**	**3**	**1**	**3**	**3**	**2**	**2**	**21**	**6**	National
21028	**0**	**Matakitaki River**	**1037**	**78.2**	**49%**	**0.20**	**0.36**	**1.00**	**0.64**	**0.18**	**3.54**	**2**	**2**	**3**	**2**	**2**	**3**	**3**	**1**	**2**	**20**	**7**	National
21011	0	Cobb River	106	106.7	0%	0.50	1.00	1.00	0.96	0.54	3.22	1	3	1	3	1	3	3	3	2	20	7	National
21026	**0**	**Mangles River**	**479**	**103**	**45%**	**0.28**	**0.17**	**0.60**	**0.61**	**0.22**	**3.69**	**1**	**3**	**3**	**2**	**1**	**2**	**3**	**2**	**2**	**19**	**9**	National
21035	**0**	**Owen River**	**519**	**85.9**	**68%**	**0.33**	**0.45**	**0.90**	**0.50**	**0.28**	**2.93**	**1**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**1**	**19**	**9**	National
21095	0	Fyfe River	17	541.2	0%			1.00				1	3	1	1	2	3	3	3	2	19	9	Regional
21068	0	Waingaro River	29	220.5	0%	0.00	1.03	1.00	0.53	0.83	1.00	1	3	1	1	3	3	3	3	1	19	9	National
21073	**0**	**Wangapeka River**	**911**	**46.7**	**44%**	**0.18**	**0.48**	**1.00**	**0.73**	**0.49**	**3.76**	**1**	**1**	**3**	**1**	**2**	**3**	**3**	**2**	**2**	**18**	**13**	National
21054	2	Takaka River	638	76.5	0%	0.33	0.53	0.80	0.53	0.00	3.04	1	2	1	2	3	2	3	1	2	17	14	Regional
21042	**0**	**Riwaka River**	**304**	**46.7**	**44%**	**0.14**	**0.09**	**0.90**	**0.54**	**0.20**	**3.51**	**1**	**1**	**3**	**1**	**1**	**3**	**3**	**2**	**2**	**17**	**14**	National
21007	**0**	**Baton River**	**222**	**36**	**36%**	**0.23**	**0.19**	**0.90**	**0.73**	**0.15**	**3.29**	**1**	**1**	**3**	**2**	**1**	**3**	**3**	**1**	**2**	**17**	**14**	National
21004	**0**	**Aorere River**	**845**	**116.9**	**10%**	**0.17**	**0.12**	**0.90**	**0.56**	**0.48**	**2.91**	**1**	**3**	**2**	**1**	**1**	**3**	**3**	**2**	**1**	**17**	**14**	Regional
21002	0	Anatoki River	17	100.7	0%	0.00	0.25	1.00	0.58	0.25	2.50	1	3	1	1	2	3	3	2	1	17	14	Regional
21030	**1**	**Motueka River**	**1642**	**33.9**	**39%**	**0.35**	**0.11**	**0.80**	**0.32**	**0.10**	**3.84**	**2**	**1**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**16**	**19**	Regional
21050	0	Speargrass Creek	19	149.9	0%	0.00	1.50	0.90	0.00	0.00	3.00	1	3	1	1	3	3	1	1	2	16	19	Regional

Colour coding
Blue rows - reliable data
Green rows - less reliable data
Red typeface - data checked by Expert Panel and may have been adjusted

Set of weightings used to test rankings									
Weights 1	1	1	1	1	1	1	1	1	1
Weights 2	2	1	1	1	1	1	1	1	2
Weights 3	1	1	1	1	1	1	1	1	3

e.g. Weights set 3 gives 3x relative contribution to 'Perception importance' attribute

Step 6A > Step 6B
Data for each indicator are tested against the thresholds (identified in Step 5) and translated into an indicator threshold score (1, 2, 3). E.g., Sabine River has 208 angler days p.a. (Step 6A). This is <1,000 days (the lower threshold) and therefore the Sabine River is of relatively low importance for angler days. In Step 6B it scores 1.

River ranking vs. significance
River rankings do not exactly match river significance (national, regional, local) owing to specific Decision Support System criterion. E.g., Howard River is assessed as nationally significant because it has a high score (3) for *% overseas anglers* plus it achieves a high score (3) for two other attributes

Appendix 3-1b
The method in action (Excerpt from Canterbury irrigation)

River	Attributes and indicators											Conversion to threshold values										Ranking and scores		
	Feasibility of	Feasibility of	Reliability	Reliability (Storage)	Size of	Soil moisture	Irrigable area	Receiving	Alternative	Socio		Feasibility of	Feasibility of	Reliability	Reliability	Size of	Soil moisture	Irrigable area	Receiving environment	Alternative	Socio	Aggregate	Ranking	Significance
	Expert ranking	Expert ranking	MALF/Mean %	Annual vol m3	Mean annual [10]	Rainfall[11] (mm)	Irrigable area (ha)[12]	Rank 1 - 5[13]	Bypass [14]	Ranking[15] from		3 = 3	3 = 3	>40% = 3,	>3000=3, <100	>70 = 3,>5 = 2,	>1700 =	> 100000 = 3, >	Rank 5 = 1, 3 and 4 = 2, 1 and	> 60% = 1, >	Direct transfer	Sum	See note [16]	See note below[17]
Waitaki	3	3	53	11668	370	500	212596	2	0	2		3	3	3	3	3	3	3	3	3	2	29	81.5	National
Rakaia	2	3	43	6402	203	700	270000	2	30	2		2	3	3	3	3	3	3	3	3	2	28	80.5	National
Rangitata	2	2	42	3154	100	700	270000	2	30	2		2	2	3	3	3	3	3	3	3	2	27	79.5	National
Waimakariri	2	2	32	3784	120	700	141000	3	20	2		2	2	2	3	3	3	3	2	3	2	25	77	National
Sth Ashburton	3	3	39	347	11	700	270000	2	30	2		3	3	2	2	2	3	3	3	3	2	26	60	Regional
Waiau	3	1	26	3059	97	900	54206	1	0	2		3	1	2	3	3	3	2	3	3	2	25	59	Regional
Hurunui	3	3	30	2302	73	600	63716	3	0	2		3	3	2	2	3	3	2	2	3	2	25	59	Regional
Opihi	3	3	24	189	6	600	105012	4	10	2		3	3	2	2	2	3	3	2	3	2	25	59	Regional
Opuha	3	3	27	315	10	600	105012	4	10	2		3	3	2	2	2	3	3	2	3	2	25	59	Regional
Ashley	3	3	18	378	12	700	141000	3	10	2		3	3	1	3	2	3	3	2	3	2	25	58.5	Regional
Orari	3	2	28	347	11	600	105012	4	10	2		3	2	2	2	2	3	3	2	3	2	24	58	Regional
Nth Ashburton	2	2	32	284	9	700	270000	2	10	2		2	2	2	2	2	3	3	3	3	2	24	58	Regional
Clarence	3	1	2	227	7	90	165	1	0	3		3	1	2	2	3	3	1	3	3	3	2	52	Local

10 From Canterbury Strategic Water Study

11 Average Annual Rainfall (mm) over irrigable area (nearest rainfall site)

12 From Canterbury Strategic Water Study. Some areas assigned by expert opinion

13 With 1 being low risk and 5 being high risk (expert assessment)

14 Bypass solution ranking from % of irrigable area (maps from CSWS)

15 Socio-economic benefit -ranking 1 (low) - 3 (high) Expert assessment

16 Irrigated area and size of resource cubed, reliability soil moisture and alternative supply +50%, remainder aggregated. Weighting for irrigable area and size of resource only applies if Soil Moisture deficit is >1, otherwise they receive a 50% weighting.

17 National - irrigated area 3, size of resource 3, soil moisture deficit 2 or greater. Local - resource size = 1, irrigated area = 1 or no soil moisture deficit. Remainder regional

River	Attributes and indicators											Conversion to threshold values										Ranking and scores		
	Feasibility of	Feasibility of	Reliability	Reliability (Storage)	Size of	Soil moisture	Irrigable area	Receiving	Alternative	Socio		Feasibility of	Feasibility of	Reliability	Reliability	Size of	Soil moisture	Irrigable area	Receiving environment	Alternative	Socio	Aggregate	Ranking	Significance
	Expert ranking	Expert ranking	MALF/Mean %	Annual vol m3	Mean annual [10]	Rainfall[11] (mm)	Irrigable area (ha)[12]	Rank 1 - 5[13]	Bypass [14]	Ranking[15] from		3 = 3	3 = 3	>40% = 3,	>3000=3, <100	>70 = 3,>5 = 2,	>1700 =	> 100000 = 3, >	Rank 5 = 1, 3 and 4 = 2, 1 and	> 60% = 1, >	Direct transfer	Sum	See note [16]	See note below[17]
			6	1	2	0	3															4		
Hope	3	1	33	1419	45	1200	54206	1	0	1		3	1	2	2	2	3	2	3	3	1	22	38	Regional
Ahuriri	2	3	38	757	24	500	24000	4	0	1		2	3	2	2	2	3	2	2	3	1	22	38	Regional
Hakataramea	3	1	18	189	6	500	8077	2	0	1		3	1	1	2	2	3	2	3	3	1	21	36.5	Regional
Pareora	3	2	13	126	4	600	41000	2	0	2		3	2	1	2	1	3	2	3	3	2	22	31.5	Local
Selwyn	3	3	23	95	3	700	5000	5	20	2		3	3	2	1	1	3	2	1	3	2	21	31	Local
Waipara	3	2	4	95	3	600	60000	3	10	3		3	2	1	1	1	3	2	2	3	3	21	30.5	Local
Tengawai	3	2	14	126	4	600	41000	3	0	2		3	2	1	2	1	3	2	2	3	2	21	30.5	Local
Maerewhenua	3	1	22	95	3	500	74000	2	0	1		3	1	2	1	1	3	2	3	3	1	20	30	Local
Waihao	3	1	9	126	4	600	41000	4	10	2		3	1	1	2	1	3	2	2	3	2	20	29.5	Local
Cust	3	1	24	32	1	700	1000	3	20	2		3	1	2	1	1	3	1	2	3	2	19	23	Local
Okuku	3	1	14	158	5	700	1000	3	0	2		3	1	1	2	1	3	1	2	3	2	19	22.5	Local
Halswell	3	1	67	32	1	700	1000	5	100	2		3	1	3	1	1	3	1	1	1	2	17	20.5	Local
Kaituna	3	1	5	32	1	700	1000	5	80	3		3	1	1	1	1	3	1	1	1	3	16	18.5	Local
Avon	3	1	72	63	2	700	0	5	0	2		2	1	3	1	1	3	1	1	1	1	15	18.5	Local