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Ranking New Zealand river values – a novel approach to managing the 'chalk and cheese' problem

Ken F.D. Hughey
Faculty of Environment, Society and Design, Lincoln University. New Zealand
e-mail: ken.hughey@lincoln.ac.nz

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Ken F.D. Hughey, Faculty of Environment, Society and Design, PO Box 84, Lincoln University, Lincoln 7647, New Zealand. Email: ken.hughey@lincoln.ac.nz

Summary

In New Zealand, regional councils have the task of sustainably managing rivers and their flows. In trying to achieve this task they face enormous challenges including the need to allocate flows amongst often highly disparate in- (e.g., angling, kayaking, native fish and birds) and out-of-river (e.g., irrigation and hydro energy) values/needs. To aid in this task these councils need to know which rivers or parts of rivers are relatively more or less important on national, regional and local bases, for particular values. This task becomes even more challenging given limited information availability for many values, and no overarching policy or decision framework. In this paper I report on a FRST-funded (and less than 1-year long) project which has addressed these challenges. A multi-criteria and expert panel based methodology has been developed and applied to a wide range of values to produce lists of rivers by value, ranked according to their national, regional and local importance. The methodology is described and example applications given. The need to 'buy-in' multi- and, ultimately, interdisciplinary participation is emphasised as well as a range of ongoing implementation challenges and further needs.

Key words: River values, prioritisation system, irrigation and birdlife, New Zealand

1. Introduction

Hearing panels at multiple levels of local and central government, the Environment Court, and local and central government generally, have for decades been seeking an objective method for ranking the comparative value of rivers for the range of in- and out-of-stream uses. Historically, Teirney et al. (1982) for recreational trout and salmon fisheries, and Egarr and Egarr (1981) for whitewater kayaking, identified lists of rivers and streams for their relative importance for these values. More recently, the relative importance issue was addressed under the Water Programme of Action, part of the Labour Government's 2003 Sustainable Development Programme of Action, run by Ministry for the Environment (MfE). The programme identified the need for the Department of Conservation (DoC) to identify water bodies of national importance (WONI) and a list of water bodies that would protect the full range of freshwater biodiversity values. In a complementary way MfE (2004) listed water bodies important for recreation, and MfE and MAF (2004) produced lists of waters of national importance for: the biodiversity dimension of natural heritage; geodiversity and geothermal features; recreation; irrigation; energy; industry and domestic; and tourism. But, despite much work in this context there remains no objective framework that clearly identifies the criteria upon which importance is determined for specific values, or which allows for comparison between values. In this paper I describe the FRST-funded[1] river values project and how it provides a tool that enables regional

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[1] Prioritising River Values - FRST Envirolink Grant 612-TSDC41

councils to rank rivers by value, and others to use the tool within appropriate contexts for a variety of purposes.

2. Background and need

There are multiple situations within the Resource Management Act 1991 (RMA) for consideration of relative importance, e.g.,
- Policy Statements: draft National Policy Statement (e.g., 'Identify notable values of outstanding freshwater resources')
- Regulations: National Environmental Standard - Ecological flows draft (the technical process involves assessing aquatic values and their relative significance)
- Orders: Water Conservation Orders (outstanding amenity or intrinsic values, habitat, fishery, wild, scenic or other natural characteristics, scientific or ecological value, recreational value)
- Plans: Regional and District.

While each of these needs has been addressed to some extent all such attempts have used different methods, often relying on a high degree of subjectivity. Typical of the outputs produced are:
- Schedules of water bodies to be managed for specified purposes
- Schedules that list values of water bodies.

Most often the lists are water quality and discharge management related, the language used is very variable, and there is little or no connections between regional and national value. Even in the MfE and MAF (2004) 'Potential Water Bodies of National Importance' report, which provides lists of rivers across multiple values, there is no unifying methodology and no clear thresholds for the different levels of importance.

With the demands on freshwater being increasingly contested (see for example MfE 2007) there is a call for a prioritisation tool that:
- works regionally but also has national level application potential
- will work with the best available information
- is user friendly
- when applied, provides defensible (e.g., Environment Court) results.

Tasman District Council (TDC) is in the process of reviewing its Regional Policy Statement – they need to know which water bodies are more or less important for particular values but have no tool to do this. In 2008 TDC approached Envirolink (a FRST funding source for designated councils) for assistance. Based on this approach the Foundation provided the following support, over 3 stages:
- small advice project (2008 – review the scope of the opportunity);
- medium advice project (2008/09 – a national workshop to firm up need, finalise values and begin work on methodology and salmonid trial application);
- tools project (2009 – multiple values, national workshop, council applications) – this is a very short term project, i.e., February-August 2009.

3. Study approach

We first established a project steering group: myself, Mary-Anne Baker (TDC), Murray McLea (Greater Wellington RC), John Hayes (Cawthron Institute), Neil Deans (Fish and Game Nelson-Marlborough). The steering group met and decided a course of action, namely we:
- Initiated a literature review (see Smith 2009) – who had tried this before across a range of in- and out-of-stream values and what lessons could be learnt? There was some work within values, e.g., whitewater kayaking (Egarr and Egarr 1981), birdlife (O'Donnell and Moore 1983, O'Donnell 2000), and recreational angling (Teirney et al. 1982), and of course more recently in the WONI project. This review showed that no one, it seems, had developed a system to look objectively/ quantitatively or in a standardised way across a range of values.
- Given the above finding we then much debated and developed a draft methodology (see Hughey et al. 2009) and undertook a trial with salmonid fisheries in TDC (see Booth et al. 2009).

Based on a successful application to salmonids we decided to then apply the draft methodology to a range of other values at selected councils, a planned national workshop to test and verify the approach, and a proposed full trial at TDC.

The values being tested, the host regional council, and current progress are:
Salmonids – Tasman: done
Irrigation – Canterbury: criteria developed; under peer review
Birdlife – Canterbury: criteria developed; draft completed
Native fish – Wellington: in progress
Iwi – Southland: in progress
Natural character – Marlborough: criteria developed; draft underway
Swimming – Manawatu: September
Whitewater kayaking – West Coast: October.

4. Methods

Smith's (2009) review of the literature was informative – no system had been developed that provided a standard approach for ranking river values. However, notwithstanding this conclusion it was clear that considerable good research, at a high level of detail, was occurring in some areas, e.g., DoC's Freshwater Environments of New Zealand approach, and Fish and Game New Zealand's ongoing national angling surveys. But, some values, e.g., swimming, irrigation and natural character, have no integrated databases or systems for prioritisation, while other values, e.g., kayaking and bidlife, have databases of mixed spatial and temporal quality.

Two complementary approaches appeared most likely to address a context of: the paucity of reliable information; lack of an existing method, a short timeline, and limited resouces, i.e.,
- A multi-criteria driven, standardised numeric scale approach, and
- An expert panel based approach.

Both approaches are built on the need to use the best available information, and to fill the gaps with expert judgement.

Given variable data and lack of a standardised approach we built our method around the key attributes of river values, populating these where possible with real data, and then converting this information to numeric scales for ranking values. The use of expert panels and best available information as the cornerstones of the project, also required us to use carefully controlled quality/peer review processes.

Ultimately we developed the following (see Hughey et al 2009 for detailed explanation of each of the processes and steps):

A. Define the value to be evaluated, e.g., birdlife, irrigation
B. Establish (and carefully justify) the expert panel and choose (and carefully justify) peer reviewers. The expert panel must be capable of considering the national level and application at a regional scale, the members (scientists, consultants, policy makers or lay people) must be nationally respected for their expertise, and ultimately be able to produce work that can be tested at the Environment Court.
C. Assessment criteria
    Step 1: define river value categories, i.e., kayaking can be subdivided into flat water and white water; and river segments;
    Step 2: identify all of the value's attributes – economic, social, environmental, and cultural, depending on what is appropriate;
    Step 3: select and describe primary attributes – reduce to a list of 10 or less, for manageability;
    Step 4: identify indicators – choose objective/ quantitative over subjective; evaluate each against SMARTA[2] criteria – the main aim is to quantify where possible with a majority of indicators represented by scientifically defensible data.
D. Determining significance
    Step 5: determine indicator thresholds – quantify these where possible and think nationally: at the national level it is advised to use criteria set in legislation or determined in the Environment Court, e.g., the 5% level for a national important population of a 'threatened or at risk' bird species;
    Step 6: apply indicators and their thresholds – convert all to 1=low; 2=medium; 3= high, e.g., for birdlife a species achieving the 5% threshold is accorded a '3';
    Step 7: weight the primary attributes – preferably equal weighting, but otherwise as needed. This part of the process needs to be considered very carefully by the expert panel and subject also to peer review;
    Step 8: determine river significance – sum total and determine overall importance, e.g., in relation to water conservation order criteria. Also in this case a set of decision support criteria can be identified such that a particular indicator might be so important that if it achieves a '3' then the river is automatically of national important, e.g., the 5% threshold for 'threatened and at risk' species;
    Step 9: outline other factors relevant to the assessment of significance, e.g., there may be particular legal or policy issues surrounding the river that need to be noted such as a Water Conservation Order.
E. Method review
    Step 10: review assessment process and identify future information needs, e.g., survey needs
F. Display Outputs

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[2] SMARTA = Specific, Measurable, Achievable, Relevant, Timely, Already in use

Figure 1 shows how the overall approach is integrated.

Figure 1: Project overview (Source: Hughey et al., 2009)

A Framework for Assessing the Significance of River Values
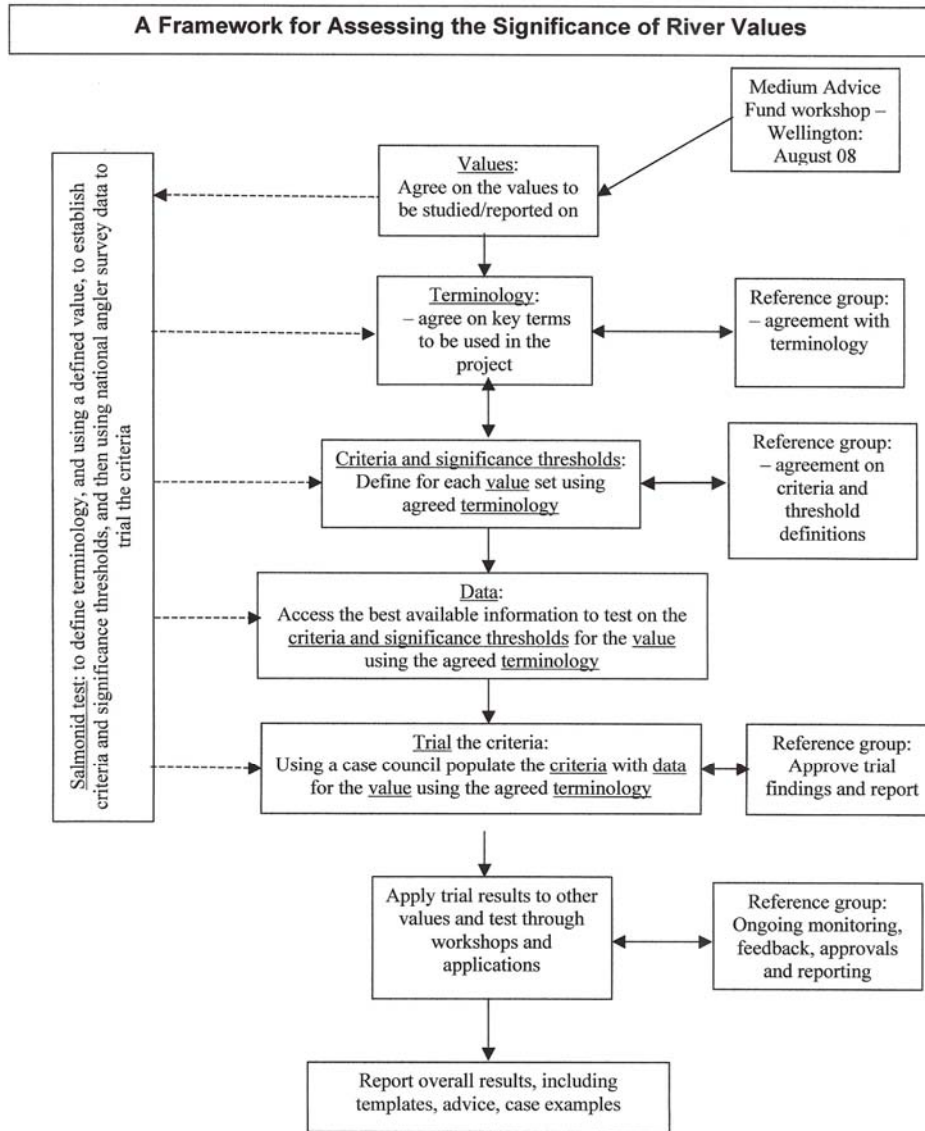
5. Results – application to irrigation and birdlife in Canterbury

Two of the value prioritisation applications are being developed and applied in Canterbury. Irrigation (Table 1) (Harris and Mulcock in prep.) and birdlife (Table 2) (Hughey et al. in prep.) are both well advanced andt are included here because of their potential to develop potentially comparable findings across the same set of rivers. Key points to note when interpreting these two tables are:
   - The irrigation expert panel identified 10 primary attributes whereas only six were identified for birdlife;

- For birdlife the ultimate importance evaluation was based on the sum or raw scores and/or whether or not the river was defined a species stronghold for a 'threatened or at risk' species;
- For irrigation the ultimate evaluation of importance was based on three approaches (Harris and Mulcock in prep: 6) for defining significance using trigger attributes, predictor attributes or aggregates of attributes as set out below:
    • National significance is defined by the combined presence of a large water resource (>70 cumecs), a large potentially irrigated area (>100,000 ha), and a soil moisture deficit (Score >=2).
    • Local significance is defined by the presence of either a small resource (> 5 cumecs), a small irrigated area (>5000 ha) or no significant soil moisture deficit (Score = 1).
    • The remaining rivers not defined as nationally or locally significant are by default regionally significant.
- Their ranking approach reflects that while there are other significant issues for suitability of a resource for irrigation, there is the potential to manage these other issues - for example reliability can be modified by storage. However the absence of water and irrigable land cannot be changed. We therefore consider that these should be the major drivers of determining the significance of the resource for irrigated agriculture.
- Four of the 10 irrigation attributes were evaluated by the expert panel, but only one of the six for birdlife, i.e., the remaining data in both cases were objective and quantitative.

Table 1: Decision support framework for irrigation (Source: Harris and Mulcock 2009 in prep.)

Rivers	Primary Attributes and indicators											Conversion to threshold values										Aggregate	Ranking ROR weighted	
	1. Technical feasibility of abstraction (Expert ranking)	2. Technical feasibility of storage (Expert ranking)	3. Reliability (ROR) (MALF/Mean 4%-72%)	4. Reliability (Storage) (Currently annual volume)	5. Size of resource (Strategic Water study)	6. Soil moisture deficit (Rainfall average over irrigable area)	7. Irrigable area (Irrigable area)	8. Receiving environment (Rank 1-5 with 1 being low risk and 5 being high risk (expert assessment))	9. Alternative supply (Bypass solution ranking from % (maps from CSWS))	10. Socio economic benefit (Ranking from 1 (low, Mackenzie)- 3 (Waipara) (high, Expert assessment))		1. Technical feasibility of abstraction (3 = 3)	2. Technical feasibility of storage (3 = 3)	3. Reliability (ROR) (>40% = 3, >20%=2, <20%=1)	4. Reliability (Storage) (>3000=3, <100 = 1)	5. Size of resource (>70 = 3, >5 = 2,)	6. Soil moisture deficit (>1700 = 1, >1200 = 2)	7. Irrigable area (> 100,000 ha = 3, > 5000 ha = 2)	8. Receiving environment (Rank 5 = 1, 3 and 4 = 2, 1 and 2 = 3)	9. Alternative supply (> 60% = 1, > 30% = 2)	10. Socio economic benefit (Direct transfer (3 = 3))	Sum	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.	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
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
Waiau	3	3	39	347	11	700	270000	2	30%	2		3	3	2	2	2	3	3	3	3	2	26	60	Regional
Sth Ashburton	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
Orari	3	3	24	189	6	600	105012	4	10%	2		3	3	2	2	2	3	3	2	3	2	25	59	Regional
Nth Ashburton	3	3	27	315	10	600	105012	4	10%	2		3	3	2	2	2	3	3	2	3	2	25	59	Regional
Opihi	3	3	18	378	12	700	141000	3	10%	2		3	3	1	3	2	3	3	2	3	2	25	58.5	Regional
Opuha	3	2	28	347	11	600	105012	4	10%	2		3	2	2	2	2	3	3	2	3	2	24	58	Regional
Ashley	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	26	2271	72	900	1653	1	0	3		3	1	2	2	3	3	1	3	3	3	24	52	Local
Hope	3	1	33	1419	45	1200	54206	1	0	1		3	1	2	2	2	3	2	3	3	1	22	38	Regional
Hakataramea	2	3	38	757	24	500	24000	4	0%	1		2	3	2	2	2	3	2	2	3	1	22	38	Regional

Ahuriri	3	1	18	189	6	500	8077	2	0%	1		3	1	1	2	2	3	2	3	3	1	21		36.5	Regional
Maerewhenua	3	2	13	126	4	600	41000	2	0%	2		3	2	1	2	1	3	2	3	3	2	22		31.5	Local
Pareora	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
Selwyn	3	2	14	126	4	600	41000	3	0%	2		3	2	1	2	1	3	2	2	3	2	21		30.5	Local
Tengawai	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
Avon	3	1	24	32	1	700	1000	3	20%	2		3	1	2	1	1	3	1	2	3	2	19		23	Local
Cust	3	1	14	158	5	700	1000	3	0	2		3	1	1	2	1	3	1	2	3	2	19		22.5	Local
Okuku	3	1	67	32	1	700	1000	5	100%	2		3	1	3	1	1	3	1	1	1	2	17		20.5	Local
Halswell	3	1	5	32	1	700	1000	5	80%	3		3	1	1	1	1	3	1	1	1	3	16		18.5	Local
Kaituna	3	1	72	63	2	700	0	5	0%	2		2	1	3	1	1	3	1	1	1	1	15		18.5	Local

Table 2: Decision support framework for birdlife on selected Canterbury rivers (Source: Hughey et al. 2009 in prep.)

River	PRIMARY ATTRIBUTES						SCORING OF PRIMARY ATTRIBUTES						Sum Weights 1	Rank1	Overall evaluation of importance
	1. Relative distinctiveness (Subj)	2. Amount of Habitat (Obj)		3. Numbers (Obj)	4. Breeding guilds (Obj)	5. Number of threatened or at risk' species present (Obj)	6. Proportion of 'threatened or at risk' populations (Obj/Subj)	1. Relative distinctiveness of habitat	2. Amount of Habitat	3. Numbers	4. Breeding guilds	5. Number of threatened or at risk' species	6. Species strongholds			
	INDICATORS							INDICATOR THRESHOLDS								DSS: If column 6, population thresholds (threatened spp >5%) = 3; or total score is 15 or more = national importance; if all columns 1-5 are 2 or less and column 6 is 0; or the total score <10 = local; otherwise regional
	1= Habitat or species widely represented in NZ; 2= Habitat or species rarely represented in NZ; 3= Habitat or species not represented in other regions in NZ	2a. ha for braided river birds	2b. km for mainly single channel bird rivers	3. Number of native wetland birds	4. Ranges from 0-8, e.g., a= open-water divers; b= deep water waders	5. Range: 0-12, e.g. blue duck (BD), black stilt (BS), wrybill (WB)	6. Range: 0-12, e.g., blue duck (BD), black stilt (BS), wrybill (WB)	1= low; 2= medium; 3= high	1=<4999ha and/or 5-10km; 2=5000-9999ha and/or 11-30km; 3 = >10000ha and/or >30km	1= <999 individuals; 2= 1000-4999 individuals; 3= >5000 individuals	1-4 = low = 1; 5-6= medium = 2; 7-8= high = 3	1=1; 2-3= 2; 4 or more = 3	1 or more > 5%, or 3 or more 1-4.9% = high = 3; 2 at 1-4.9% = medium = 2; 1 at 1-4.9% = low; None >1% = 0	Standard	
Waiau	3	7412		4408	a,b,c,d,e,f,g,h	B-FT, B-BG, BDo, WB, BlSh	B-FT; B-BG (>5%); BDo	3	2	2	3	3	2	15	7	National
Waimak-ariri	3	14342		3896	a,b,c,d,e,f,g,h	WB, B-FT, BDo, B-BG, CT, BlSh	B-FT (>5%); B-BG; WB (10%); BDo	3	3	3	3	3	3	18	1	National
Avon	2		c.30	1500	a,b,d,f,g,h	BlSh, B-BG, R-BG, BlSh		2		2	2	1	0	7	13	Local
Kaituna	1		c.10	200	a,b,d,f,g,h	SCG, BlSh		1		1	2	1	1	6	17	Local
Rakaia	3	32102		4842	a,b,c,d,e,f,g,h	WB, B-FT, BDo, B-BG, W-FT, CT, BlSh	B-FT; B-BG; WB (30%); Bdo, W-FT	3	3	3	3	3	3	18	1	National
Waitaki - Lower	3	8104		6636	b,c,d,e,f,g,h	B-FT, B-BG, BDo, BlSh	B-FT (8%); B-BG; Bdo	3	3	3	3	3	2	17	5	National
Waitaki - Upper	3	30000		8407	a,b,c,d,e,f,g,h	BS, WB, B-FT, BDo, CT, BlSh	BS (100%); B-FT (15%); B-BG; WB (20%); Bdo	3	3	3	3	3	3	18	1	National

Finally, Table 3 demonstrates a comparison of the two data sets. Four Canterbury rivers are considered of national importance for irrigation and seven for birdlife; notably all four nationally important for irrigation are also rated the same for birdlife, with obvious policy implications.

Table 3: Comparative ranking of Canterbury rivers for irrigation and birdlife

Canterbury river	Irrigation ranking		Birdlife ranking
Waitaki	National		National
Rakaia	National		National
Rangitata	National		National
Waimakariri	National		National
Waiau	Regional		National
Sth Ashburton	Regional		National
Hurunui	Regional		National
Orari	Regional		Regional
Nth Ashburton	Regional		Part Ashburton
Opihi	Regional		Regional
Opuha	Regional		Regional
Ashley	Regional		Regional
Clarence	Local		Regional
Hope	Regional		Part Waiau
Hakataramea	Regional		Part Lower Waitaki
Ahuriri	Regional		Part Upper Waitaki
Maerewhenua	Local		Part Lower Waitaki
Pareora	Local		Local
Waipara	Local		Local
Selwyn	Local		Local
Tengawai	Local		Part Opihi
Hapuka	Not sign		Local
Kowhai	Not sign		Local
Kahutara	Not sign		Local
Conway	Not sign		Local
Waihao	Local		Not sign
Avon	Local		Local
Cust	Local		Not sign
Okuku	Local		Not sign
Halswell	Local		Not sign
Kaituna	Local		Local

6. Discussion and conclusions

The multi criteria based DSS has been applied to irrigation and to birdlife in Canterbury and 'works', i.e., it provides a comparable set of rankings against criteria that define national, regional and local importance. Another advantage of the tool is its cost-effectiveness: each trial application has cost in the order of $10-20,000, and assuming the criteria are transferable then it is likely that subsequent regional applications would cost in the order of $2-5,000 per value. But, in making the tool work a number of questions have arisen and issues around best practice raised.

Questions yet to be resolved include:

- Given the method works and resource investment is relatively light then how do we ensure all councils participate and thus national lists of important rivers across the range of values are generated, e.g., why would West Coast Regional Council want to undertake an assessment of rivers for irrigation potential? This is a bigger issue in some of the relatively resource and science rich regions where they may view themselves as already having superior systems or the capacity to develop such systems.
- To what extent should rivers be divided for evaluation purposes, e.g., into sub catchments or reaches (e.g., around swimming holes such as Pelorus Bridge) and how are such reaches or rivers then ranked for this value?
- How do environmental managers use the results from these rankings to develop flow management guidelines and/or deal with competing water allocation demands, especially when rivers such as the Rakaia have multiple national level rankings?

Best practice issues include:

- How to ensure project teams follow the methodology in a consistent and robust fashion – we have one project where this has not occurred and considerable additional effort (and thus cost) is being invested to correct the situation;
- Clarifying defensible sets of threshold criteria, especially those for national and local importance (i.e., what remains is of regional importance). In some cases, e.g., for birdlife, the nationally important criterion of 5% of the national population being on one river is well established in Environment Court decisions. But, in other cases, e.g., for irrigation, socio economic benefit is characterised by much debate between economists and others and thus remains as a subjective evaluation. Despite this issue, having a range of attributes and indicators, so long as consistently applied, leads to a reasonable level of confidence in the final output and outcomes.
- Ensuring the teams are truly of national standing is a considerable challenge in some cases, e.g., in one instance we have had scientists and others competing on either side of the development fence who cannot work together – in this circumstance we plan to use the competing scientist as a peer reviewer.
- In any region every river should be listed and subjected to a preliminary scanning exercise to reduce the size of the task, i.e., based on the best available information which rivers are relatively of no importance for this value? Such an exercise allows the final output to be contextualised within the full suite of rivers in the region.

Acknowledgements

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