Irrigation in Gisborne District:
Application of the River Values Assessment System (RiVAS)

Prepared by:
Simon Harris

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Executive Summary

The River Values Assessment System (RiVAS) was applied to the irrigation value in Gisborne District. An expert panel used the system to rank rivers from high to low in terms of their relative potential for providing water for irrigation. Eight river sections were analysed and of these one, the Waipaoa, was considered of regional significance with the rest being of local significance.

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Chapter 1
Introduction

1.1 Purpose

This report describes an application of the Rivers Values Assessment System (RiVAS) for irrigation as described by Harris and Mulcock (2010) to the Gisborne district.

1.2 Rivers Values Assessment System: the Method

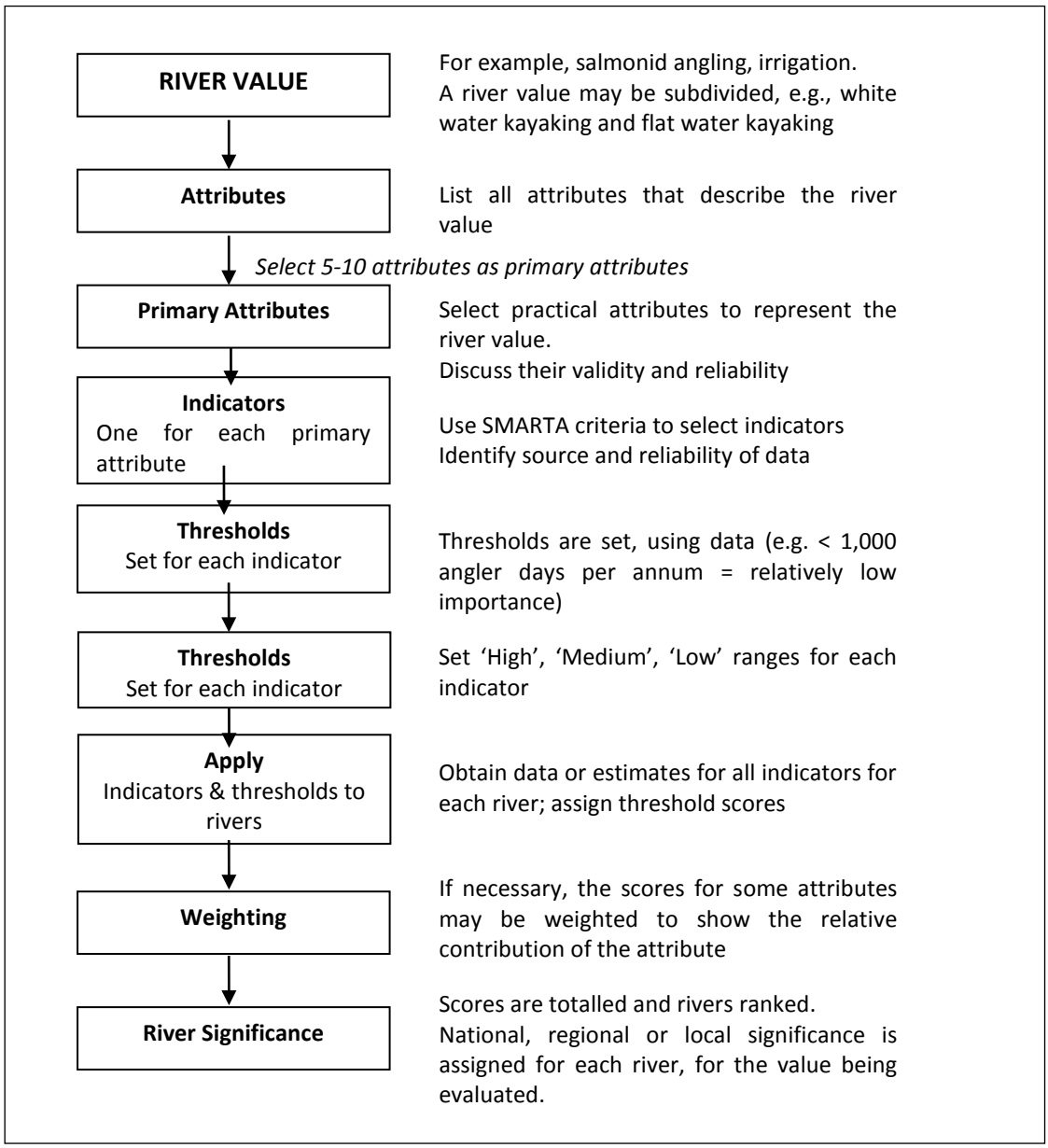
RiVAS aims to outline assessment criteria and significance thresholds for river values, for application within national and regional planning under the Resource Management Act (RMA). It involves the development of attributes and indicators in conjunction with an expert panel. RiVAS for irrigation was developed in conjunction with a group of experts on irrigation and water resource management and tested in a case study setting of the Canterbury region. Figure 1 provides a summary of the RiVAS process.

It is intended that RiVAS is applicable to all river values[1]. Hughey et al. (2010) anticipate that the implementation of the method may be varied to accommodate the particular characteristics of each river value, but that once applied for a specific river value (e.g., irrigation) the method for that value will be consistent across New Zealand.

Details of the RiVAS method as applied to irrigation are given in 'Irrigation in Canterbury Region: Application of the River Values Assessment System (RiVAS)' (Harris and Mulcock 2010). This report is available at: http://www.lincoln.ac.nz/Documents/LEaP/LEaPNo24/Chap-9-Irrigation.pdf.

1 **River value** A river-related tangible resource (e.g. birdlife), activity (e.g. salmonid angling), or resource use (e.g. irrigation) *(Hughey et al. 2009)*

Figure 1
Summary of RiVAS Method
(from Hughey et al., 2010)



Chapter 2
Application of the Method

2.1 Establish an expert panel and identify peer reviewers

The National Expert Panel which developed the method for irrigation was Dr Terry Heiler (Irrigation NZ), Murray Doak (MAF), Simon Harris (Harris Consulting) and Claire Mulcock (Mulgor Consulting). Lynda Weastell (ECan) contributed to the development of the attributes and indicators, but did not participate in the Canterbury case study. Ken Hughey sat in on part of the panel deliberations and provided guidance on application of the methodology.

An Expert Panel of Dennis Crone - Water Conservation Team Leader GDC, Paul Murphy - Senior Water Conservator GDC, Peter Andrew – AgFirst Consultants, John Moroney – MAF, Stephen Helm – Sunrise Coast/Cedenco and Tim Rhodes – Wi Pere Trust assisted by Simon Harris, met on 1 November 2011 in Gisborne to undertake the RiVAS process.

2.2 Defining categories for the river value and river segments

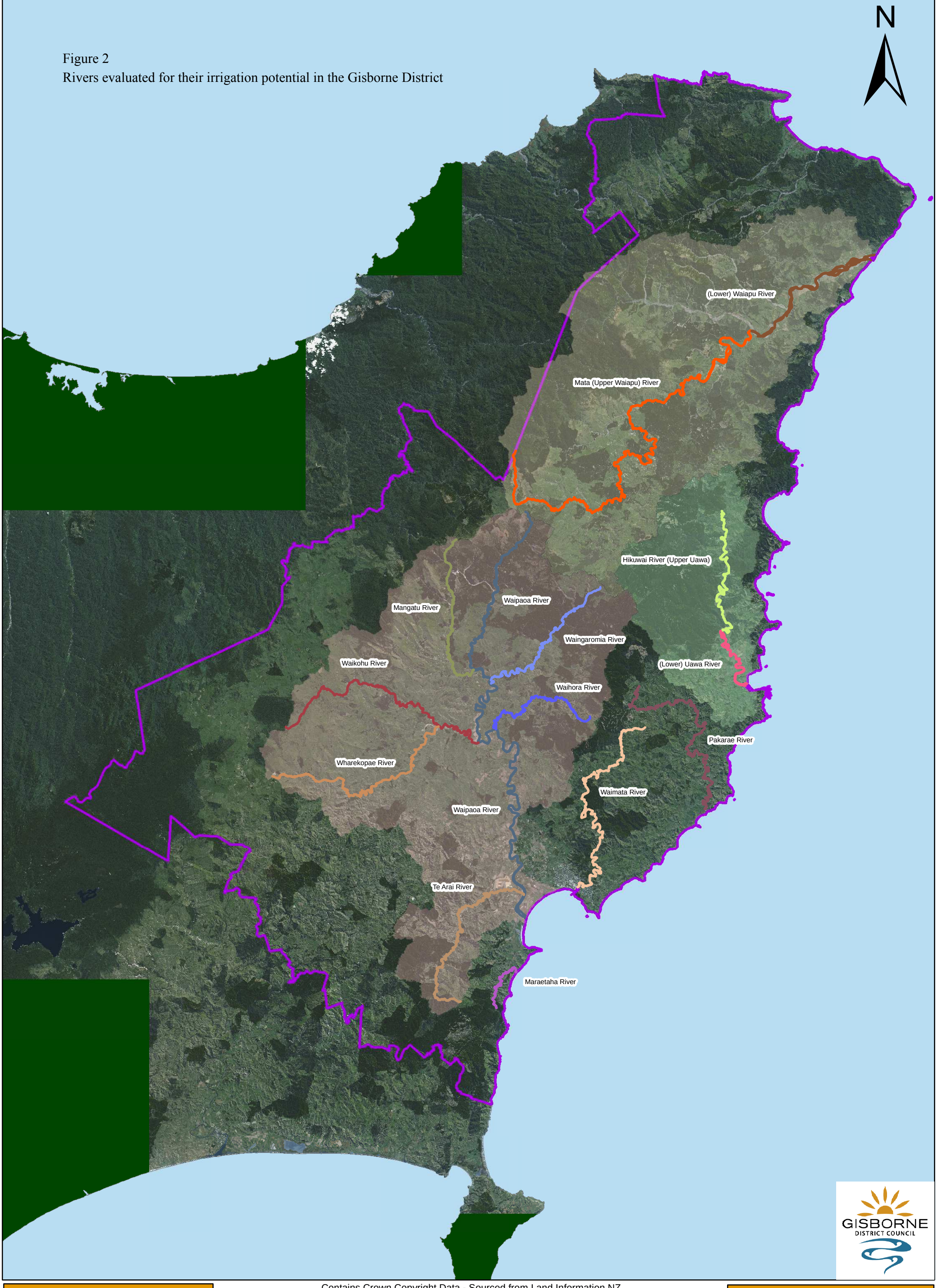
RiVAS enables assessments to be undertaken for categories[2] of river values or for individual river segments. No categories were identified for irrigation, and therefore the assessment for irrigation was developed with no sub-categories.

Consideration was given to segmenting rivers where there are major differences in upper and lower catchment attributes relating to irrigation. For example: one or more of: mean annual rainfall greater than 1200 mm; average slope greater than 15 degrees; altitude greater than 600 m. In the original case study of Canterbury, because of the transportability of water, and because of the need to make the method nationally applicable, the panel decided that it was not necessary to use river segments.

In the Gisborne case the group initially segmented the major rivers (Waiapu, Uawa, and Waipaoa) into two or more reaches. In the final assessment these rivers were aggregated together to better reflect the value of the river overall, since individual segments may not have been regionally significant, but aggregated together they were (see Figure 2).

2 **River value category**: A specific type or style of the river value. For example recreational values can be categorised into: whitewater kayaking, flatwater kayaking; wilderness fishery, lowland fishery.

Figure 2
Rivers evaluated for their irrigation potential in the Gisborne District



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2.3 Attributes, scoring and weighting

The attributes are the facets of the river value that, taken collectively, describe that river value. For example, salmonid angling includes the attributes of level of use, anticipated catch rate, perceptions of scenic attractiveness, etc. The attributes, scoring and weightings developed for irrigation as per the Harris and Mulcock report were used directly in the Gisborne case study. These are described in Table 1 below.

Table 1
Summary of Attributes, Indicators, Thresholds and Threshold Scores for Irrigation

Attribute	Description	Indicator	Thresholds
Technical feasibility of abstraction	How hard it is to get water from the water source	Expert ranking (range 1 - 3)	Used directly (3 = 3)
Technical feasibility of storage	Difficulty of storage of water from the source	Expert ranking (range 1 - 3)	Used directly (3 = 3)
Reliability (ROR)	MALF/Mean flow	Expert assessment pending availability of data	>40% = 3 >20% = 2 <20% = 1
Reliability (Storage)	Annual volume	Annual volume million m^3 (range: 32 - 11,000)	> 3000 = 3 >=100 and <= 3,000 = 2 <100 = 1
Size of resource	Mean flow	Mean annual flow cumecs (range 1 - 370)	>70 = 3 > 5 = 2 <= 5 = 1
Soil moisture deficit	A measure of the degree to which irrigation is likely to be demanded. Measured by rainfall across irrigated area in catchment.	Expert assessment pending data on soil moisture deficit modeling over irrigable area	<=1,200 = 3 > 1,200 = 2 >1,700 = 1
Irrigable area	Area that can be irrigated from the river.	Irrigable area ha (range 1,000 – 40,000)	> 100,000 ha = 3 > 5,000 ha = 2 <= 5,000 = 1
Receiving environment	The sensitivity of the location to the effects of irrigation.	Rank 1 - 3 with 3 being low risk and 1 being high risk (expert assessment)	Rank 1 and 2 = 3 Rank 3 and 4 = 2 Rank 5 = 1
Alternative supply	Typically groundwater available that could supply the irrigable area.	Bypass solution*: Ranking using % (based on expert assessment and available GIS information from catchment studies)	<=30% = 3 > 30% = 2 > 60% = 1
Socio economic benefit	Estimate of returns able to be gained from the irrigated area.	Expert Ranking from 1 (low) to 3 (high)	Used directly (3 = 3)

* Alternative supply: where a proportion of the irrigable area can be supplied from groundwater this is considered to reduce the demand from the river i.e. little groundwater available gives the river a 'high' score (3).

The indicators were weighted in order to reflect the importance of that indicator in determining the significance of a river for irrigation. 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. Table 2 summarises the weightings.

Table 2
Primary Attributes and Weighting

Primary Attribute	**Weighting**
Supply Attributes	
Technical feasibility of abstraction	Not weighted
Technical feasibility of storage	Not weighted
Reliability (Run of River)	Weighted + 50%
Reliability (Storage)	Not weighted
Size of resource	Weighted to the power of 3 where a soil moisture deficit is present i.e. score = 2 or 3
Demand Attributes	
Soil moisture deficit	Weighted + 50%
Irrigable area	Weighted to the power of 3 where a soil moisture deficit is present i.e. score = 2 or 3
Receiving environment	Not weighted
Alternative supply	Weighted + 50%
Socio economic benefit	Not weighted

The total weighted scores developed in step 7 are then used to order the rivers according to their value for irrigation. To determine national, regional or local significance for irrigation three 'trigger' attributes are applied: size of water resource, potentially irrigable area and soil moisture deficit.

- *National significance* is defined by the combined presence of a large water resource (>70 cumecs; i.e. Score = 3), a large potentially irrigated area (>100,000 ha; i.e. Score = 3), and a soil moisture deficit (Score >=2).

- *Local significance* is defined by the presence of either a small resource (< 5 cumecs; i.e. Score = 1), a small irrigated area (<5000 ha; i.e. Score = 1) or no significant soil moisture deficit (Score = 1).

- The remaining rivers not defined as nationally or locally significance are, by default, *regionally significant*.

This ranking approach reflects the fact that while there are other significant issues for suitability of a resource for irrigation, there is 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. It is appropriate that these are the major drivers of determining the significance of the resource for irrigated agriculture.

2.4 Application to Gisborne

The scores for each attribute are shown in Appendix 2 and the rankings generated using the river. Because the rainfall profile in the Gisborne district differs from that of the Canterbury region where the method was developed, there was concern that rainfall did not accurately reflect the potential for summer drought in the study area. This is particularly true because of the potential for major rainfall events at any time of year that skew the results, despite not really affecting the impact of high Potential Evapotranspiration (PET). However assessment of the rainfall data suggests that the 1200mm cut-off reasonably reflected the areas where irrigation was required. The measure was used with some expert adjustment, so the final score for soil moisture deficit is a data based expert score.

Alteration was also made to the assessment of run of river reliability. The group was concerned that the statistic of Mean Annual Low Flow (MALF) and Mean flow did not take into account the fact that the river had a very large range in flows, which meant that the annual mean flow would be skewed to the high side. As for soil moisture, the group considered the answers provided by a MALF and Median flow, to be slightly less skewed than MALF and Mean Flow, and determined that the data was providing a reasonably good indicator of reliability for run of river systems. In practice data on MALF was only available in the Waipaoa catchment, and all other rivers were scored low on reliability because of the huge variability in flows, and the low summer flow situation.

The rivers in the Waipaoa Catchment were aggregated together for the final assessment on significance, because the whole catchment is closely linked. The aggregated results show that the Waipaoa/Te Arai catchment is a regionally significant resource, with all others of low significance. The Waipaoa catchment has the majority of irrigable land in the district, and the catchment supports significant activity in other parts of the economy through processing and flow on economic impacts. This assessment of medium significance is entirely appropriate.

Other resources are considered low, largely because of the small size of the resource available and therefore limited area that can be supplied. It is worth noting however that the definition of local socio-economic benefit does not in any way assess the magnitude of the local benefit. In particular for the Waiapu catchment there is a reasonable amount of irrigable land available, and additional irrigation would have a very significant local socio-economic benefit because of the isolated nature of the local community and fewer economic opportunities available. Thus its importance should be considered to be at the higher end of the “low significance” category.

2.5 Other Factors relevant to the Assessment of Significance in Gisborne

Irrigation in the Gisborne district supports a number of very high value land uses, particularly process crops and fresh vegetable production. Furthermore there are a number of isolated communities with few opportunities for employment. The impact of irrigation on the local community in the Gisborne district is probably proportionately higher than many other regions in the country. While this does not change the significance rating within the irrigation value, it should be taken into consideration when comparing across values for rivers in the district.

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Appendix 1
Significance Assessment Calculations for Gisborne Rivers

River section	Attributes and indicators: Feasibility of abstraction	Feasibility of storage	Reliability (ROR)	Reliability (Storage)	Size of resource	Soil moisture deficit	Irrigable area	Receiving environment	Alternative supply	Socio economic benefit
	Expert ranking (1 - 3)	Expert ranking (1 - 3)	MALF/Mean %	Annual vol (M m3)	Mean annual flow[i] (m3/s)	Rainfall[ii] (mm)	Irrigable area (ha)[iii]	Rank 1 - 5[iv]	Alternative supply[v] %	Ranking[vi] from 1 - 3
Waiapu - Upper (US Makarika)	3	2	5%	129297600	4.1	2	200	1	0%	2
Waiapu - Lower	3	2	5%	494074512	15.667	2	3000	1	0%	3
Uawa - Hikuwai	3	2	5%	30558384	0.969	2	500	1	0%	2
Uawa - Lower	2	3	5%	37843200	1.2	3	4000	1	0%	3
Waipaoa	3	3	10%	1.217E+09	38.6	3	23000	2	0%	3
Maraetaha	2	3	5%	6370272	0.202	3	1500	1	0%	3
Waimata	3	2	5%	15768000	0.5	3	100	1	0%	3
Pakarae	2	3	5%	6307200	0.2	3	1500	1	0%	2

River section	Conversion to threshold values: Feasibility of abstraction	Feasibility of storage	Reliability (ROR)	Reliability (Storage)	Size of resource	Soil moisture deficit	Irrigable area	Receiving environment	Alternative supply	Socio economic benefit	Ranking and scores: Aggregate	Ranking (weighted)	Significance
	3 = 3	3 = 3	>40% = 3, >20%=2,<20%= 1	>3000=3, <100 = 1	>70 = 3,>5 = 2,	>1700 = 1,>1200 = 2	> 100000 = 3, > 5000 = 2 ha	Rank 5 = 1, 3 and 4 = 2, 1 and 2 = 3	> 60% = 1, > 30% = 2	Direct transfer (3 = 3)	Sum	See note below[viii]	See note below[viii]
Waiapu - Upper (US Makarika)	3	2	1	3	1	3	1	3	3	2	22	25.5	Local
Waiapu - Lower	3	2	1	3	2	3	1	3	3	3	24	33.5	Local
Uawa - Hikuwai	3	2	1	3	1	3	1	3	3	2	22	25.5	Local
Uawa - Lower	2	3	1	3	1	3	1	3	3	3	23	26.5	Local
Waipaoa	3	3	1	3	2	3	2	3	3	3	26	41.5	Regional
Maraetaha	2	3	1	1	1	3	1	3	3	3	21	24.5	Local
Waimata	3	2	1	3	1	3	1	3	3	3	23	26.5	Local
Pakarae	2	3	1	3	1	3	1	3	3	2	22	25.5	Local

Red text show where no data were available and all estimates were expert panel based.
Shaded columns show the attributes that have been weighted to obtain the total score

[i] Expert opinion and various prefeasibility studies
[ii] Average Annual Rainfall (mm) over irrigable area (nearest rainfall site)
[iii] From GIS
[iv] with 1 being low risk and 5 being high risk (expert assessment)
[v] Alternative supply ranking from expert opinion
[vi] Socio-economic benefit -ranking 1 (low) - 3 (high) Expert assessment
[vii] 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.
[viii] High (National) - irrigated area 3, size of resource 3, soil moisture deficit 2 or greater. Low (Local) - resource size = 1, irrigated area = 1 or no soil moisture deficit. Remainder medium