NIWA
Taihoro Nukurangi

Towards a framework for regional freshwater planning for the Gisborne District Council

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Prepared for

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Executive Summary

Gisborne District Council (GDC) has engaged NIWA to provide advice on a number of issues which will help them in the development of a regional water plan and other freshwater management tools. For this particular medium Envirolink advice grant (732-GSDC58), the objectives were to:

1. Identify methods for carrying out assessments of amenity, recreational and economic values of rivers, which will be used in developing minimum flows and water levels of the Waipaoa River freshwater resource and associated groundwater system.

2. Outline how these methods, along with ecological methods identified in separate Envirolink advice grants, may be combined into a matrix to assess environmental, social and economic values in determining minimum flows.

This report is the output from this advice grant, which has been developed based on a workshop with GDC and a literature review of existing guidance and best practice elsewhere in New Zealand.

An important first step in this project was the workshop in Gisborne on 14 and 15 July 2009, where the authors met with GDC staff and discussed a range of issues relating to environmental flow setting and regional water plan development. The workshop provided a useful exchange of contextual and technical understanding between GDC and NIWA. The work programme devised at this workshop (Appendix 1) is a key output from the current advice grant. This work programme forms a framework to help structure and prioritise the investigations necessary to develop a regional water plan, and provides a guideline for NIWA and GDC to work together in these areas.

The literature review conducted to achieve the project objectives looked first to the national framework for the setting of minimum flows. The main Resource Management Act (RMA) drivers for regional planning and setting environmental flows are given in section 30. Environmental flows are made up of: i) flows for ecological values; ii) flows for tangata whenua values; iii) flows for recreational values; and iv) flows for amenity and natural character values. National guidance for setting environmental flows is given in the Ministry for the Environment's (1998) *Flow guidelines for instream values*, and these guidelines provide the basis for much of the discussion of environmental flow setting contained in this report.

Methods for setting flows for the four types of instream values can be found in a variety of sources. GDC already has projects underway for each of the first two types of values (ecological and tangata whenua, see Appendix 1). Consequently, and to achieve objective 1 above, this report focuses on providing sources of information and methods for the latter two (recreation and amenity and natural character values).

To achieve the second objective above, this report also provides an overview of how information for all four types of instream values might be brought together and balanced alongside the out-of-stream values (i.e. the economic benefits that arise from use of any abstracted water). The balancing of values is not usually an easy process, but "Balancing among different values is resolved through consultation and decision-making process specified by the RMA." (Robb and Bright 2004, p42.10). This report discusses some of the steps that could be carried out in order to develop a regional plan for water that balances the instream and out-of-stream values in a way that best serves the Gisborne community. We discuss the use of a conceptual matrix to balance these values by first identifying the values and then determining the community's desired levels of protection of those values.

We recommend that GDC:

1. Continue to implement the work programme for development set in July 2009, as outlined in Appendix 1. In particular, we recommend undertaking (or continuing existing) work to determine flow requirements for the four components of instream values:

    (a) Ecological values – continue with work funded through CIF and envirolink advice grant to determine flow requirements for ecological values of key Gisborne water bodies (surface water and groundwater).

    (b) Tangata whenua values – continue with work funded through envirolink advice grant to determine tangata whenua values and associated flow requirements for key Gisborne water bodies.

    (c) Recreational values – consider seeking advice from a recreation expert to assess the recreational values and associated flow requirements for key Gisborne water bodies.

    (d) Amenity and natural character values – consider seeking advice from a landscape expert to assess the amenity and natural character values and associated flow requirements for key Gisborne water bodies.

2. Undertake an assessment to explore the balance between minimum flows, allocation rates and reliability of supply for out-of-stream uses, using the LowFAT tool or similar. NIWA can provide assistance with this if required.

3. Either seek advice from an appropriate consultant, or itself carry out, an economic assessment of the out-of-stream uses of water for the Gisborne district. The outputs from step 2 will be a useful input to this.

4. Seek advice from NIWA on the use of the REC to assist with designing spatial management units that can be mapped for use in a potential regional water plan.

5. Seek advice where appropriate in developing and proposing a regional plan for water. Steps involved may include:

   (a) Determine significance of instream and out-of-stream values

   (b) Through appropriate process and public consultation, decide on proposed appropriate levels of protection for those values, achieving the proposed best balance of values for Gisborne district

   (c) Propose specific objectives for the regional plan for water that reflect the proposed best balance of values for Gisborne district.

   (d) Design policies, rules and other methods to incorporate flows and water levels to achieve the proposed objectives.

   (e) Publicly notify the proposed plan, receive submissions and amend proposed objectives, policies and rules as appropriate based on submissions.

6. Consider ways in which both water quality and water quantity can be included in one regional plan for water for the Gisborne district.

7. Continue to liaise with colleagues in other councils over developments in water resource planning, to ensure that the process followed is grounded and guided by lessons learned from those other councils.

1. Introduction

Gisborne District Council (GDC) currently allocates freshwater through provisions of its Transitional Regional Plan and section 14 of the Resource Management Act 1991 (RMA) in the absence of a regional water plan. In 2008, Gisborne District Council commissioned NIWA via two Envirolink Small Advice Grants from the Foundation for Research Science and Technology (FRST), to provide advice on managing ecological flows (for rivers) and water levels (for groundwater) in the District, with specific regard to the Proposed National Environmental Standard on Ecological Flows and Water Levels (NES) document released for public discussion in March 2008 (MfE 2008). The resulting report, *Implications of the Proposed National Environmental Standard on Ecological Flows and Water Levels for the Gisborne District* (Norton 2009) included a number of recommendations, including that GDC begin work towards producing a regional water plan.

As a result of the recommendations in the Norton (2009) report, GDC has requested NIWA to provide advice on a number of issues which will help them in the development of freshwater management tools. For this particular advice grant from FRST, GDC has requested NIWA to:

1. Identify methods for use in assessment of amenity, recreational and economic values in researching and developing minimum flows and water levels of the Waipaoa River freshwater resource and associated groundwater system.

2. Outline how these methods, along with ecological methods identified in separate Envirolink advice grants, may be combined into a matrix to assess environmental, social and economic values in determining minimum flows.

The aim of this work is to collate existing research on best practice elsewhere in New Zealand and recent developments in water allocation assessment, to provide guidance so that GDC can pursue a robust process to identify and research minimum flows and water levels for use in developing freshwater management tools.

This report will first describe outcomes from a workshop held with GDC in July 2009, where steps required in a robust process to develop freshwater management tools for Gisborne were discussed. The report will then discuss environmental flow setting in New Zealand, before looking at methods for assessing the different values of water, and discussing the potential processes for balancing such values. Finally we will make some recommendations for next steps that GDC may wish to undertake as they progress with the development of freshwater management tools.

2. Workshop outcomes

The authors travelled to Gisborne on 14 and 15 July 2009 to participate in a workshop with GDC staff (Kerry Hudson, Paul Murphy, Keriana Wilcox, Lynette Brown, Dennis Crone, Trevor Freeman). At the beginning of the workshop, GDC and NIWA staff visited a number of sites in and around Poverty Bay to gain an appreciation for the water resources in this part of the district, where most demand for water resources is located.

Following the field visit, discussions began regarding previous work carried out for GDC (Norton's 2009 report *Implications of the Proposed National Environmental Standard on Ecological Flows and Water Levels for the Gisborne District*). From this topic, a wider ranging discussion began regarding GDC's planned work in the water resources area, including a number of approved or potential applications for Envirolink advice grants. A work programme was devised (see Appendix 1), with work falling into two streams:

1. work to prepare GDC for when/if the proposed NES for ecological flows and water levels comes into action; and

2. work to undertake relevant investigations to enable GDC to develop freshwater management tools including, ultimately, a regional plan for freshwater.

As part of these discussions, the current advice work was discussed in the wider context of environmental flow setting in New Zealand (see section 3 below and Figure 2 in particular). It was agreed that in that broader context of information requirements for managing water resources using environmental flows, economic considerations of out-of-stream value lay at the margins of the scope for this report. As a result, methods to look at economic considerations are only briefly covered in this report.

A number of other topics were discussed. These included:

Discussion on water body classifications

NIWA staff outlined the River Environment Classification (REC) system. The REC classifies different reaches of river, based on 6 categories (climate, source of flow, geology, landcover, network position, valley landform) so that catchments with similar sets of physical attributes can be grouped together. This can serve as a useful starting point for developing 'units' that can be managed with different objectives, policies and rules in a regional plan (e.g. Snelder and Hughey 2005). It is acknowledged that values vary spatially in a way that is different to groupings based

solely on physical attributes. However, physical attributes undoubtedly influence the way rivers can be managed; for example understanding the way that flow duration curves vary between REC river classes can help the minimum flow setting process. Thus it is important to consider both physical attributes and spatial variation in values when developing spatial frameworks for management. The benefit of starting with the REC is that it is GIS based and can be used to map every section of river in New Zealand. It was suggested that GDC could rework an existing Envirolink medium advice grant application into a small advice grant application, to enable NIWA to run a workshop on using classification systems, the REC in particular, and how this could be implemented in Gisborne freshwater management tools.

Sky to sea

NIWA staff outlined their 'sky to sea' view, a checklist to make sure all aspects of water resource systems are considered when considering surface water allocation: climate, hydrology, river geomorphology, instream habitat, ecology (periphyton, macrophytes, invertebrates, fish, birds), wetlands, lakes, coastal geomorphology, and water quality.

Water quality

The benefit of including water quality and quantity together in a regional water plan for Gisborne was discussed. A regional water plan could thus refer to (and replace or update if necessary) the existing GDC land management practices contained in the Combined Regional Land and District Plan, and discharges to land and water as managed by the regional Discharges Plan, in addition to water allocation issues.

Funding

There was some discussion of how Envirolink funding might be applied for as well as using GDC funds and funds secured from MAF's Community Irrigation Fund (CIF).

Overall outcomes

Overall the workshop was a successful two days, providing a useful exchange of contextual and technical understanding between GDC and NIWA. The work programme (Appendix 1) devised at this workshop is a key output from the current advice grant. This work programme forms a framework to help structure the investigations necessary to develop freshwater management tools, and is a guideline for NIWA and GDC work in these areas.

3. Managing water resources

3.1. Resource Management Act provisions

The framework for managing water resources in New Zealand is the Resource Management Act 1991 (RMA). Of particular relevance to the topics discussed in this report, the RMA requires regional councils[1] to carry out certain functions, specified in section (s) 30 of the RMA. This includes:

- s30(1)(a) - the establishment, implementation, and review of objectives, policies, and methods to achieve integrated management of the natural and physical resources of the region

- s30(1)(e) - the control of the taking, use, damming, and diversion of water, and the control of the quantity, level, and flow of water in any water body, including—

    - (i) the setting of any maximum or *minimum levels or flows* of water:

    - (ii) the control of the range, or rate of change, of levels or flows of water…

- s30(1)(fa) - if appropriate, the establishment of rules in a regional plan to allocate any of the following:

    - (i) the taking or use of water (other than open coastal water)…

- s30(4) A rule to allocate a natural resource established by a regional council in a plan under subsection (1)(fa) or (fb) may allocate the resource in any way, subject to the following:

- (a) the rule may not, during the term of an existing resource consent, allocate the amount of a resource that has already been allocated to the consent; and

- …

[1] Where we have used the term regional councils here we implicitly include Gisborne District Council's unitary functions to manage regional natural and physical resources for the Gisborne region.

- (c) the rule may allocate the resource in anticipation of the expiry of existing consents; and

- (d) in allocating the resource in anticipation of the expiry of existing consents, the rule may—

    - (i) allocate all of the resource used for an activity to the same type of activity; or

    - (ii) allocate some of the resource used for an activity to the same type of activity and the rest of the resource to any other type of activity or no type of activity; and

- (e) the rule may allocate the resource among competing types of activities; and

- (f) the rule may allocate water, or heat or energy from water, as long as the allocation does not affect the activities authorised by section 14(3)(b) to (e).

Some of these section 30 functions (e.g. s30(1)(fa) and s30(4)) were added by the RMA 2005 amendments, and have altered the focus for regional councils from 'controlling' water activities to more actively 'allocating' water resources.

Also of relevance to the topics we shall discuss in this report, the RMA outlines matters of national importance (s6), so that people exercising functions and powers under the RMA in relation to managing the use, development, and protection of natural and physical resources (i.e. regional councils), have to *recognise and provide for* certain matters, including (amongst others):

- (a) the preservation of the *natural character* of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development; and

- (b) the protection of *outstanding natural features and landscapes* from inappropriate subdivision, use, and development.

(Italics denote authors' emphasis added).

The RMA also (s7) outlines 'other' matters that must be *given regard to*[2], and these include (full list follows):

(a) kaitiakitanga:

(aa) the ethic of stewardship:

(b) the efficient use and development of natural and physical resources:

(ba) the efficiency of the end use of energy:

(c) the maintenance and enhancement of *amenity values*:

(d) *intrinsic values of ecosystems*:

(e) [Repealed]

(f) maintenance and enhancement of the quality of the environment:

(g) any finite characteristics of natural and physical resources:

(h) the protection of the habitat of trout and salmon:

(i) the effects of climate change:

(j) the benefits to be derived from the use and development of renewable energy.

The above RMA provisions (and for example see MfE 1998a) clearly show that there is a role for regional councils in managing a region's water resources, and as part of those functions one of the key steps (s30(1)e)i) is the setting of minimum flows (or environmental flows) (for rivers) and water levels (for groundwater, lakes and wetlands). The purpose of setting such flows is to ensure there remains enough residual flow in the river to maintain instream values at a given level after any abstractions. The following sections of the report discuss methods for flow setting in more detail.

3.2. Setting environmental flows

In 2008, the Ministry for the Environment (MfE) published the *Proposed National Environmental Standard (NES) on Ecological Flows and Water Levels*. This proposed NES (MfE 2008, p2):

[2] Note that 'give regard to' for s7 matters is of lesser importance than the 'recognise and provide for' of s6 matters.

1. "sets interim limits on the alteration to flows and/or water levels in those rivers, wetlands and groundwater systems for which there are no limits set in a proposed or operative regional plan…[and]

2. provides a process for selecting the appropriate technical methods for evaluating the ecological component of environmental flows and water levels."

The NES includes a useful discussion regarding the setting of environmental flows, and differentiates 'ecological' flows (the subject of the NES and of Norton et al. 2009) from the wider definition of 'environmental' flows (Figure 1). Environmental flows and water levels are the minimum required in a water body to provide for a given set of values (MfE 2008).

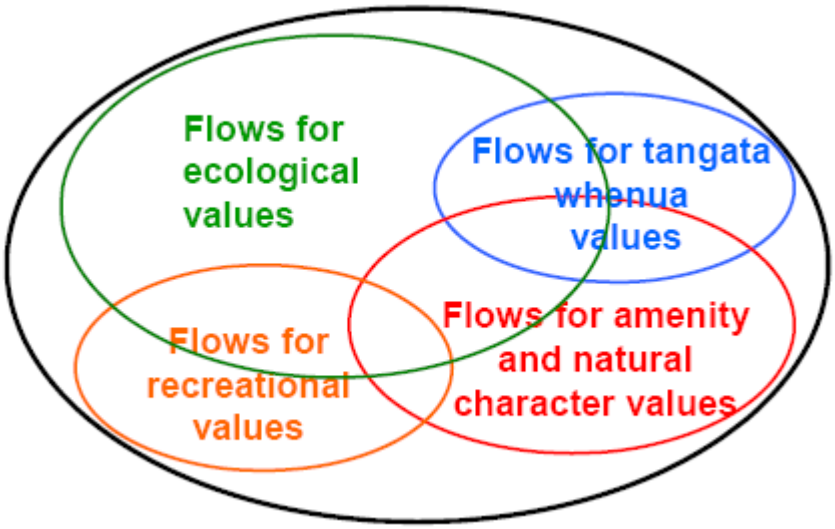

Figure 1: Proposed NES (MfE 2008) diagram to illustrate the four components required in environmental flow setting.

Figure 1 defines four possible components to be considered in the setting of minimum environmental flows, and demonstrates the overlap that can be found between these. As part of the workshop described in section 2 above, this figure was used to discuss the wider work programme for GDC to develop a regional plan for water. All four components were discussed, and work has been planned to address each one (see Appendix 1). This report focuses mainly on two components shown in Figure 1, flows for amenity and natural character values, and flows for recreation values. Flows for ecological values and tangata whenua values will be considered in other projects that are currently in progress (Appendix 1).

National guidance for the setting of environmental flows is contained in MfE's (1998 a and b) *Flow Guidelines for instream values* (in two volumes). The *Flow guidelines*

provide a consistent approach to setting minimum flows and other flow requirements in rivers (MfE 1998a). Volume A covers the principles of hydrology and hydraulics, discusses various instream values, and sets out the process by which flow requirements are determined and given practical effect. Volume B provides technical and background information, including information on technical assessments for biological values, recreational values, landscape values and Maori values.

3.3. The importance of identifying values

As implied by Figure 1 and the full title of the MfE *Flow guidelines*, the key to setting environmental minimum flows is to first understand the *values* of the water resource.

Figure 2 shows the decision-making process for setting flow regimes as advocated by the MfE's (1998a) *Flow guidelines*. This process can be followed for setting environmental flows in RMA regional plans for water.

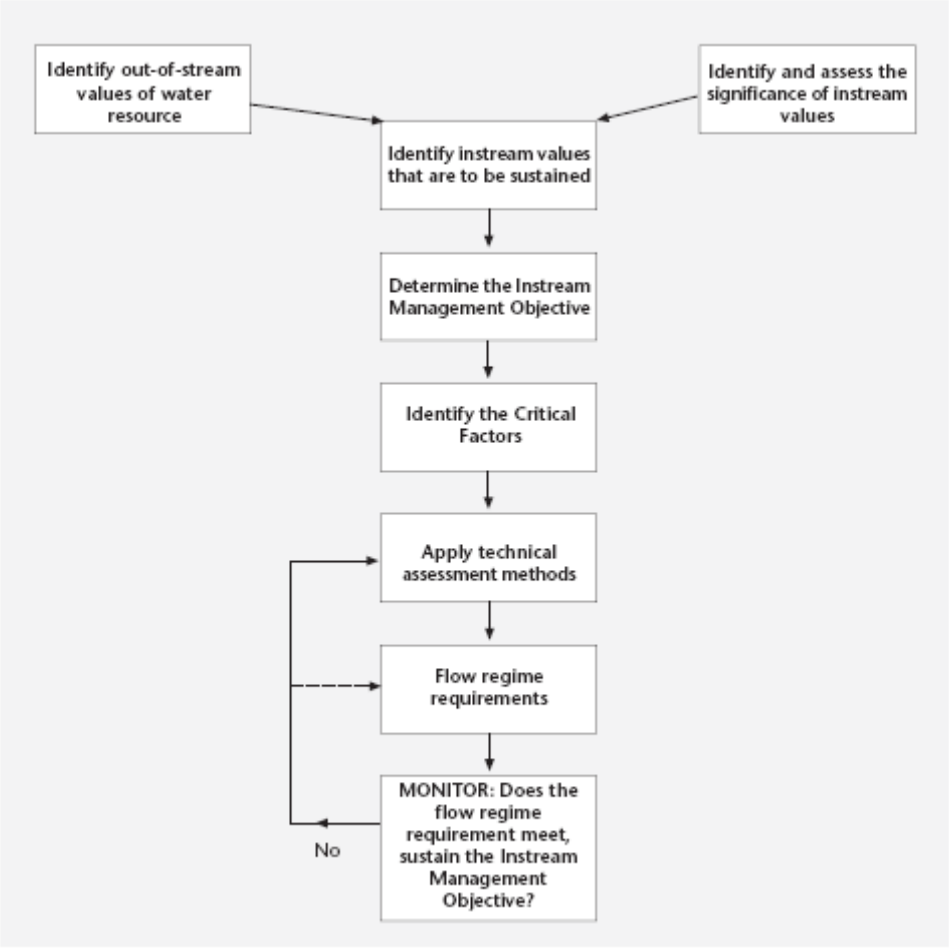

Figure 2: The decision-making process advocated by MfE's (1998a) *Flow guidelines*.

Figure 2 shows that the first step in this process is to identify the instream and out-of-stream values of the water resource. Values can be defined as "a tangible resource (e.g. birdlife), activity (e.g. salmonid angling), or resource use (e.g. irrigation)" (Hughey et al. 2009). The first two of the examples in the above definition are instream values (i.e. the values require a certain amount of water to be retained within the water body) as would be habitat for fish, whereas the third is an out-of-stream value (i.e. the water is used outside the water body, for e.g. development uses; Robb and Bright 2004). The out-of-stream values (upper left box of Figure 2) are usually easy to define in terms of economic value. The upper right box (instream values) includes all four components of environmental flow setting described in Figure 1.

Once identified, the significance of instream and out-of-stream values then needs to be assessed. The process advocated in the *Flow guidelines* includes the identification of values that are to be sustained, and the setting of management objectives in order to maintain that value at existing or otherwise defined levels of protection (see section 5 for further discussion on this point). Following this assessment of significance and objective setting, a variety of technical methods can be used to set appropriate flows or water levels to meet that management objective. These assessment methods are discussed further in the following section. The assessment of significance of values and the balancing of instream and out-of-stream uses and values is discussed further in section 5 of this report.

4. Methods

Methods for setting minimum flows for the four types of instream environmental values highlighted in Figure 1 are discussed below. These are the methods that are applied mid-way through the process shown in Figure 2. We note that comprehensive flow setting processes may include the development of a 'flow regime' that includes flow variability such as small flood flows to flush fine sediments downstream or larger 'channel maintenance' floods. The sections below focus mainly on the setting of minimum flow requirements for the relevant values.

4.1. Ecological values

MfE's (1998a) *Flow guidelines* include discussions regarding ecological values of rivers and other water bodies. The most recent information on setting flows or water levels for ecological values is contained in the *Proposed National Environmental Standard (NES) on Ecological Flows and Water Levels* (MfE 2008). Details on methods for setting ecological flows and levels can be found in the companion document to the proposed NES (Beca 2008). Another comprehensive reference for habitat methods is *A guide to instream habitat survey and analysis* (Jowett et al. 2008).

In the workshop (section 2), NIWA and GDC identified some work activities to be carried out to address the setting of minimum flows for ecological values (see Appendix 1). The work that GDC is undertaking with NIWA via a medium advice grant 'Identify ecological minimum flows for the Waipaoa and Te Arai catchments using river-specific instream habitat survey methods' (FRST Envirolink medium advice grant 871-GSDC76; see Appendix 1) will be a fundamental step in the consideration of ecological values for Gisborne water bodies. Because flow-setting for ecological values will be considered in that work we will not discuss these methods here but refer the reader to the above documents.

4.2. Tangata whenua values

MfE's (1998a) *Flow guidelines* include some useful discussions regarding Maori values of rivers and other water bodies. Water is very highly valued by Maori (e.g. Tipa and Tierney 2003; Robb and Bright 2004), for a wide variety of both practical (e.g. navigation, mahinga kai) and spiritual (e.g. ritual) uses. Maori values of water include physical and spiritual matters entwined together, and for example an important part of Maori belief is that each water body has its own life force or mauri, where a water body with healthy mauri will support a healthy ecosystem. Sections 6, 7 and 8 of the RMA provide for consideration of Maori values with regard to water management. Inclusion of Maori communities in decision-making about environmental flows, and enabling tangata whenua to exercise kitiakitanga, is a vital part of regional water management (Jowett and Mosley 2004).

In the workshop (section 2), NIWA and GDC identified some work activities to be carried out to address the setting of flows for tangata whenua values. The work that GDC is undertaking with NIWA via a medium advice grant 'Maori freshwater body values' (FRST Envirolink advice grant 870-GSDC75; see Appendix 1) will be a fundamental step in the consideration of Maori values for Gisborne's water bodies, as part of regional freshwater management. Because flow-setting for tangata whenua values will be considered in that work we will not discuss this issue further here.

4.3. Recreational values

MfE's (1998a) *Flow guidelines* include discussion regarding recreational values of rivers and other water bodies, from which some of the following overview is taken. Recreational values can be grouped into four categories:

1. those that involve paddling or floating down a river such as rafting, kayaking, canoeing, tubing, drift diving etc

2. consumptive activities such as angling and whitebaiting

3. site-specific activities such as swimming, paddling etc, and

4. motorised activities such as jet boating.

There are a number of sources of information on recreational values of water bodies. These include (but are not limited to):

- national, regional and local recreation groups or associations (e.g. for kayaking or jet boating)
- local authority and DoC planning staff
- DoC recreation strategies
- Water Conservation Order hearing proceedings
- Fish & Game national angler surveys and/or local studies
- New Zealand water safety council
- national, regional and local tourism organisations
- published tour guides for angling, kayaking, rafting etc.

It is often useful for recreation assessments to be undertaken after, or at least be partially informed by, any ecological assessment carried out. This is because flow recommendations for e.g. fish habitat are useful inputs to a recreation assessment (e.g. angling or whitebaiting).

It is possible to use instream habitat methods (such as IFIM[3]), that have been developed to understand habitat requirements of e.g. fish, to determine flow requirements for certain recreational uses (Jowett and Mosley 2004). With sufficient information regarding the width, depth or velocity 'preferences' of the activities of interest (such as angling or rafting), a preference curve can be constructed to show at what flows the 'best' recreational outcome is experienced. Such models can then be used to quantify what loss in recreation experience or opportunity would result from changes in flow regimes.

Work in New Zealand has already been carried out to establish instream hydraulic conditions (widths, depths and velocities) that will generally support recreational activities, and these are listed in Table 9 of MfE's *Flow guidelines* (1998a, p138) and in a modified format as Table 43.3 of Jowett and Mosley (2004, p43.9). This

[3] IFIM is instream flow incremental methodology (see Jowett et al. 2008).

information can be used as a starting point for assessing flows required to maintain identified recreational values. However local knowledge and judgement is essential to ensure that this information is appropriately applied for the Gisborne district.

In the workshop (section 2), NIWA and GDC identified some work activities to be carried out to address the setting of flows for recreational values. We recommend that advice is sought from an experienced recreation expert to assist GDC to develop an assessment of recreational values and associated flow requirements for Gisborne water bodies.

4.4. Amenity and natural character values

MfE's (1998a) *Flow guidelines* include discussion regarding landscape values of rivers and other water bodies, which includes natural character. In addition to the RMA s6 matters of natural character and outstanding natural features and landscapes, RMA s7 requires the consideration of amenity values. Amenity values include 'those natural or physical qualities and characteristics of an area that contribute to people's appreciation of its pleasantness, aesthetic coherence, and cultural and recreational attributes'(RMA s2).

Flowing water is an important element of the landscape (Jowett and Mosley 2004), and the term 'riverscapes' is used to discuss river landscapes in particular (Mosley 2004; Boffa Miskell 2009). Natural character (which is not defined in the RMA) is normally characterised along a continuum from high to low (MfE 1998a).

Mosley (2004) includes a table (Table 8.3, p8.9) of characteristics relevant to amenity and natural character issues, which includes landscape setting, river margins and floodplain setting, channel character and water character amongst other elements. All of these characteristics might be referred to in assessing river amenity and natural character values. The relationship between flow and landscape value is subjective (Jowett and Mosley 2004), and as such assessments of the significance of these values are most often carried out by surveys of lay people (who need to be representative of community) or an expert panel (who need appropriate experience).

The most recent guidance on 'riverscape' assessments is contained in Boffa Miskell's (2009) *Riverscape and flow assessment guidelines*. This document aims to 'update and expand on the landscape components of the 1998 MfE *Flow guidelines'* (Boffa Miskell 2009, p8). Boffa Miskell's *Riverscape guidelines* begin with a history of riverscape assessment and research, describe riverscape values (natural character, amenity values, landscape values), and then move on to describe assessment approaches and outline a recommended Riverscape Assessment Methodology.

The assessment methodology is an eight step process, and Boffa Miskell recommend using all eight steps for all assessments of different levels (scales), while acknowledging some of the steps will require more detail where 'important rivers may be affected by substantial flow alterations' (Boffa Miskell 2009, p24). The eight steps are:

1. Scope 'landscape' as an instream value and water allocation issue
2. Select an appropriate level of riverscape assessment approach
3. Develop a brief
4. Prepare river landscape descriptions
5. Analyse and characterise river landscape
6. Evaluate river landscape
7. Describe, illustrate and evaluate modelled flow changes
8. Integrate findings with other instream values.

The *Riverscape guidelines* provide details of what to do at each of the eight steps to deliver a robust assessment, through a mixture of desktop and field investigations.

As illustrated by the eight steps above, it is often useful for such assessments to come after, or at least be partially informed by, any ecological assessment. This is because flow requirements for things like ecosystem health, fish, birds, water quality etc are useful inputs to amenity and natural character assessments.

In the workshop (section 2), NIWA and GDC identified some work activities to be carried out to address the setting of flows for amenity and natural character values. We recommend that advice is sought from an experienced landscape expert to assist GDC to develop an assessment of amenity and natural character values and associated flow requirements for Gisborne water bodies.

4.5. Out-of-stream values

While the above sections have focussed on the instream values, the process for flow setting illustrated in Figure 2 requires out-of-stream values to be identified (top left hand box).

As discussed in section 3 above, out-of-stream values are related to the activity for which the water resource is used. For example, Robb and Bright 2004 define development values and uses (modification of flows by damming, diversion and taking), and abstractive values and uses (removal of water from a freshwater system). Examples of the former include hydroelectricity generation, examples of the latter include drinking water supplies, industrial uses and irrigation.

So far in the report, we have described the need for the setting of minimum flows, to ensure that instream values can be sustained at a certain level. In order to look after out-of-stream values, two further aspects of flow setting need to be considered. The difference between the minimum flow and the total flow in the river is the amount of water potentially available to be allocated to out-of-stream values, once needs for flow variability, flushing flows and floods are taken into account. This flow is usually referred to as the allocation limit. An understanding of this allocation limit allows managers and individual water users to know how much water they are able to take and use. But, as the amount of water in the river varies through time, this total allocation limit is not available to be used all the time. This is the second factor that is important in flow setting, an understanding of the reliability of supply. For instance, during periods of low flow, if the river is at the minimum flow for instream values then water takes must cease. Normally water bodies are managed such that as flows fall below the 'management flow' (minimum flow plus allocation limit), water takes are restricted (in volume, rate or timing) so that minimum flows are observed. There is a relationship between the minimum flow and reliability of supply – if the minimum flow is set at a low level reliability is high, and vice versa. It is necessary to understand the amount of water available to out-of-stream uses, and the reliability of that supply, in order to work out what the economic use of that water might be.

It is possible to explore scenarios of minimum flows and reliability of supply, in order to understand the potential balance between minimum flows and reliability of supply. One tool for this analysis is the Low Flow Analysis Tool (LowFAT; Snelder et al. 2001). The LowFAT tool produces comparative flow and reliability statistics and graphs to enable different scenarios of minimum flow and abstraction rates to be compared. We recommend that GDC consider undertaking such an analysis, using the LowFAT tool or similar, with NIWA assistance as appropriate. Such an analysis will inform any economic assessment of out-of-stream uses.

Out-of-stream values are usually relatively easy to define in terms of economic value. For example with hydroelectricity, an estimate can be made of the monetary value of power produced with a given volume of water. For irrigation, estimates can be made of the monetary value of different crops, given the volumes of water required to irrigate and grow such crops.

We recommend that GDC seek advice from an appropriate consultant about carrying out an economic assessment of the out-of-stream uses of water for the Gisborne district, or does an assessment itself if possible.

4.6. Integrating assessments of instream and out-of-stream values

Once all four types of instream values and out-of-stream values and their associated flow requirements have been identified, the next step is to 'determine which combinations of values provide the greatest net benefit to the community' (Robb and Bright 2004, p42.1). This involves balancing values, weighing positive and negative effects and making value judgements. This process is not easy. GDC will not be in a position to undertake this step until the projects are completed for each of the four types of instream values, and the economic benefits of out-of-stream use are quantified. However it is useful to consider the next step at this stage, as part of the overall framework for developing freshwater management tools. The balancing of values is described in section 5 below.

5. Balancing values

> *"Balancing among different values is resolved through consultation and decision-making process specified by the RMA." (Robb and Bright 2004, p42.10).*

In section 4, we discussed assessments to determine instream and out-of-stream values, i.e. the upper left and right-hand boxes in Figure 2. The next steps in that process are to determine significance of values, decide which instream values are to be sustained, and then determine the instream management objective (see MfE 1998a p90-93). We will discuss these steps below in the order shown in Figure 2.

It is important to appreciate from the outset that science or technical methods can help identify values, identify options for different levels of protection for those values, and determine the river flows and water levels that will provide those various levels of protection. However, selecting which values need to be protected and at what level of protection (i.e. defining the instream management objectives) involves value judgements (possibly trade-offs between instream and out-of-stream values) that need to be made by the regional authority. Ideally these value judgements will be made in a transparent way, taking account of the range of views in the community, through a regional plan development process.

We note that we (the authors) are scientists with experience in developing and applying water resource management tools, and interacting with council planning

staff. The following discussions reflect a blend of the available guiding literature, recent research developments and our theoretical appreciation of the planning process. We anticipate that GDC will apply this information as just one part of the input needed alongside the expertise and local experience of GDC's own planners in preparing regional freshwater management tools.

5.1. Back to basics: the purpose of the RMA

s5 of the RMA states its Purpose as follows:

(1) The purpose of this Act is to promote the sustainable management of natural and physical resources.

(2) In this Act, sustainable management means managing the use, development, and protection of natural and physical resources in a way, or at a rate, which enables people and communities to provide for their social, economic, and cultural wellbeing and for their health and safety *while*—

(a) sustaining the potential of natural and physical resources (excluding minerals) to meet the reasonably foreseeable needs of future generations; and

(b) safeguarding the life-supporting capacity of air, water, soil, and ecosystems; and

(c) avoiding, remedying, or mitigating any adverse effects of activities on the environment.

The use of the word *while* in the middle of this section implies the balancing which is fundamental to sustainable resource management (MfE 1998a, p54).

This RMA s5 requirement, and the s30 functions for councils outlined in section 3 above, provide the legislative basis for regional planning. Part 5 of the RMA is explicit about process and content for regional plans (s63 to s70), and GDC already has in-house planning expertise to undertake planning activities. National guidance for these topics exists: guidance relating to development of water allocation plans is available on the Quality Planning website (http://www.qualityplanning.org.nz/plan-topics/water-allocation.php); and Figure 2 of this report shows the pathway suggested in the MfE (1998a) *Flow guidelines* for flow setting for instream values.

5.2. Establishing significance

As discussed previously, the first steps in Figure 2 require the identification of instream and out-of-stream values. The next step (still in the top right-hand box of Figure 2) is to establish the significance of the instream values.

The MfE (1998a) *Flow guidelines* discuss Part II of the RMA to determine significant values and priorities, as well as suggesting reference to other statutory provisions and consulting with relevant communities of interest. Until very recently, determining whether values are nationally, regionally or locally significant has been problematic. For example, a project that aimed to establish national significance of recreation values was undertaken by MfE as part of a wider programme of work (Waters of National Importance or WONI). MfE (2004) published a discussion document regarding water bodies with potentially nationally significant values for recreation. The document outlined 105 freshwater bodies (not just rivers) with potentially nationally significant values for recreation, and discussed the methodology it had used to derive this list. The methods included: a targeted survey of recreationalists, a phone survey of wider general public, and a literature review of existing information including Water Conservation Order proceedings, Fish & Game angler surveys, and DoC records of rivers valued for certain uses such as whitebaiting.

Of significant interest to GDC's work on developing freshwater management tools, is a FRST funded Envirolink tools project, *Developing a significance classification framework for water body uses and values*, managed by Dr Ken Hughey of Lincoln University. This project is due to produce pilot examples of a method for establishing the significance (national, regional or local) of a number of values. The range of values included in the project (and the councils helping to develop and pilot the method) include: salmonid fisheries (Tasman District Council), natural character (Marlborough District Council), swimming (Horizons Regional Council), irrigation (Environment Canterbury), birdlife (Environment Canterbury), Iwi values (Environment Southland), kayaking (West Coast Regional Council) and native fish (Greater Wellington Regional Council).

The outcome of this work should be a robust methodology, enabling councils to consistently rank the significance of different values. This methodology will also help councils in setting objectives through the act of balancing values. To put it simply, in order to balance values, councils need to know what is on each side of the scales and preferably have an idea of the weight (significance) of each thing on each side of the scales. The significance classification method aims to provide the 'weight' to be assigned to different values.

5.3. Determine values that are to be sustained

By following the processes discussed so far in this report, a series of instream (ecological, recreational, amenity and natural character, and tangata whenua) and out-of-stream[4] (development and abstraction) values will have been identified. Water managers must then decide how to balance these – to choose those instream values that will be either maintained or targeted for special levels of protection, possibly at the expense of other values.

A conceptual illustration of this for a water quantity example is given in Figure 3. The horizontal axis shows flow, while the vertical axis shows an ecological state, which in this case is weighted usable area, a measure of available instream habitat, for longfin eels and adult brown trout. Each curve shows the way in which useable habitat varies for the species, and it is clear that the longfin eels have optimum habitat at lower flows than the adult brown trout. Decision making would require balancing of the different flow requirements for the different species, depending on which species may be more highly 'valued'.

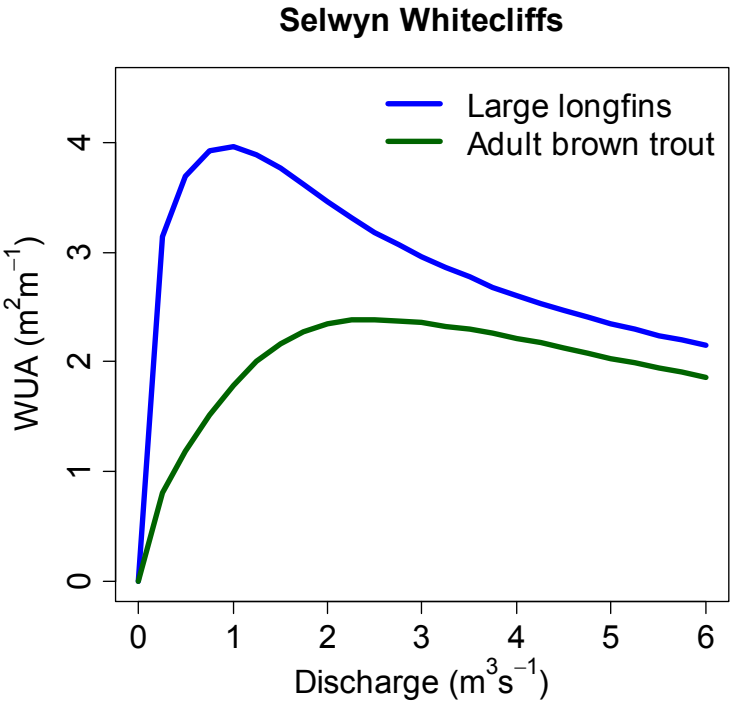

Figure 3: Example of a habitat versus flow relationship for two fish species.

[4] We note that the MfE (1998a) *Flow guidelines* don't discuss out-of-stream values in its discussion of this process.

A conceptual illustration of this for a water quality example is given in Figure 4. The horizontal axis shows resource use, in this case nutrient concentration, while the vertical axis shows environmental state using the example of algae building up on a stream bed. Figure 4 shows that with increasing resource use, environmental state will degrade. In the example, two levels of protection are shown. With a small amount of resource use (A), the environmental state can be protected at a 'high' level; greater use of the resource (B) is likely to lead to a more degraded environmental state.

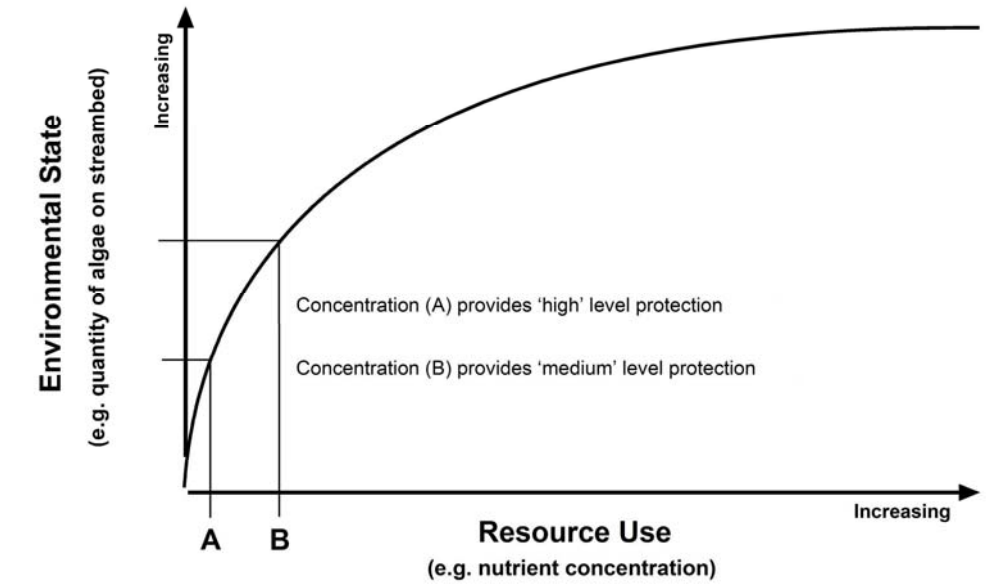

Figure 4: Conceptual illustration of a typical response of an environmental state to a resource use

Different instream values may require different flow regimes or water levels to sustain them. For some instream values, the flow regimes will be complementary and for instance setting a flow regime to sustain a species that requires higher flows (such as trout) will often provide for species that require lower flows. Some instream values will have conflicting flow regime requirements. For example, rafters and kayakers often prefer high or even flood flows but in many cases high flows are sub-optimal for native fish habitat. As a further example, it may often be favourable to maintain fresh events in summer to flush periphyton growth and thus maintain good benthic habitat and angling conditions, but fresh events in early summer can adversely affect nesting riverbed birds.

Water managers need to decide which values take prominence and consider the risks that certain values won't be sustained at high levels. The level of risk (of degradation or loss of a value) helps a manager to identify a level of protection that a value should be given. Again the MfE (1998a) *Flow guidelines* point to Part II of the RMA to

determine significant instream values and priorities, as well as suggesting reference to regional policy statements, plans and water conservation orders to help 'weigh' values. Technical work can be undertaken to develop a series of relationships or curves such as shown in Figures 3 and 4, and then these relationships can be used to help understand the consequences for the environment and resource use of choosing certain levels of protection.

One way of visualising this process is with a conceptual matrix, as shown by Figure 5. This matrix shows that instream and out-of-stream values first need to be identified (as in section 4 above). Technical work can be undertaken to assess the instream ecological, tangata whenua, recreation, and amenity and natural character values of a water body (or series of water bodies). Technical work can also be carried out to assess the economic values of out-of-stream water use. As discussed in section 4.5, the balance between minimum flows and flow reliability is key to the economic (out-of-steam) uses of water. Once these studies have been carried out, the significance of these values needs to be assessed. The outcomes of the Envirolink tools programme on assessing the significance of values (discussed in section 5.2) may help this process. At that point, water managers have information at hand in terms of minimum flows required to maintain values which enables them to populate the matrix shown in Figure 5. Each column would identify flows to maintain a certain level of protection, and various scenarios of outcomes given certain minimum flows can be explored.

	Possible levels of protection				
Values	**Low**		**Mid**		**High**
Ecological e.g. trout, native fish	?	?	?	?	?
Tangata whenua e.g. mahinga kai	?	?	?	?	?
Recreation e.g. swimming	?	?	?	?	?
Amenity & natural character e.g. outstanding landscapes	?	?	?	?	?
Economic e.g. irrigation use	?	?	?	?	?

Figure 5: **Conceptual matrix for balancing instream and out-of-stream values** (Note: this conceptual matrix is purposely blank at present. Values with which to populate the matrix will come from the recommended series of analyses).

For instance, habitat availability curves derived for certain fish species can be used to identify flows at which 100% of habitat is protected - a highly valued fish species may warrant such a high level of protection - or some other lower levels of habitat protection. In the matrix, the consequences of choosing such a flow on other values

can be understood. In other words, the matrix can illustrate alternative options and be used to justify the choice of any particular option.

5.4. The importance of objectives

Once the values are identified and assessed, and desired levels of protection are determined, water managers can determine what the MfE (1998a) *Flow guidelines* call Instream Management Objectives (IMOs). Figures 3 and 4 illustrate how this process works. Once levels of protection of an environmental state are chosen on the vertical axis, the resource use level necessary to achieve that becomes clear (i.e. by using the technical relationships such as shown in Figures 3 and 4).

IMOs should be specific as to levels of protection and be worded such that flow regime requirements can be derived. The *Flow guidelines* define IMOs as either maintaining instream values (providing existing levels of protection for existing values) or protecting targeted instream values (providing an adjusted flow regime to enhance or preferentially maintain a targeted value).

IMOs can be expressed as objectives[5] or policies in regional policy statements or plans. Flow regime requirements that result from those IMOs can be specified as rules in regional plans.

At a recent workshop on water allocation, plan objectives were discussed in a paper by Steve Markham of Tasman DC as follows: "[Objectives are] the stated intended outcomes for the water body following delivery of management methods, expressed in terms of values to be realised or risks attenuated, and either in broad meaning or in SMART[6] terms." "Objectives are in concept a values-based resolution of the variance between any water body values and risks."

In setting objectives in plans, s32(3) of the RMA requires councils to undergo a process to evaluate:

(a) the extent to which each objective is the most appropriate way to achieve the purpose of this Act; and

(b) whether, having regard to their efficiency and effectiveness, the policies, rules, or other methods are the most appropriate for achieving the objectives.

[5] Refer to MfE (2003) if in doubt as to meaning of these planning terms.
[6] SMART = Specific, Measurable, Achievable, Relevant, Timebound.

The evaluation must also include (s32(4)) a cost benefit analysis and risk analysis of not acting in the face of uncertain or insufficient information. This s32 process requires councils to have considered alternatives in setting objectives for IMOs and flow requirements. Building a matrix of information such as shown conceptually in Figure 5 may assist with this process.

5.5. Developing freshwater management tools for Gisborne district

Having discussed the planning and policy aspects of the process in Figure 2, we now consider what all of these things mean for GDC in developing freshwater management tools. The balancing of values as described above takes place as part of the regional planning process, and has varied from region to region to date as councils have developed regional plans dealing with water allocation. The balancing process is not an easy one, and is subject to ongoing research (e.g. a FRST funding application by Cawthron and Landcare Research, Mary-Anne Baker pers com.). What is important is that GDC embark on a process that is fit for purpose for a council of its size and level of water resource issues.

Based on the above discussions, our recommendation is that GDC follow a process based on the MfE (1998a) *Flow guidelines* process (as shown in Figure 2) but note the importance of including out-of-stream values in the weighing process as shown in the conceptual matrix of Figure 5. The work programme developed at the NIWA and GDC workshop in July 2009 includes workstreams to carry out various assessments as part of that process (Appendix 1 tasks 5-11). We also refer GDC to a report by Jowett and Hayes (2004) that has given similar advice to Environment Southland on the development of water quantity conditions in their Regional Water Plan.

The steps that could be carried out by GDC include:

- Identify minimum flows to sustain values for the four components of environmental flows illustrated in Figure 1. Work to do this is already identified in Appendix 1 (tasks 5-9).

- Undertake an assessment using the LowFAT tool to explore the balance between minimum flows and reliability of supply for out-of-stream uses.

- Identify out-of-stream values and carry out an economic assessment of the out-of-stream uses of water for the Gisborne district. Work to do this is already identified in Appendix 1 (task 10).

- List values with competing or conflicting flow regime requirements, whether instream or out-of-stream.

- Identify the relative significance of these values (e.g. national, regional and local or high, medium and low).

- Decide on appropriate levels of protection for those values, achieving the best balance of values for Gisborne district, using a process similar to that conceptualised in the Figure 4 matrix to guide these value judgements.

- Once levels of protection are proposed, set proposed specific objectives for the regional plan for water and design rules to incorporate minimum flows and water levels to achieve those levels of protection into the regional plan for water.

- Notify the proposed plan, receive submissions and amend proposed objectives, policies and rules as appropriate based on submissions.

The decision regarding levels of protection required to maintain existing or target specific values is best done through a consultation process as part of developing a regional plan for water management. The conceptual matrix shown in Figure 4 may assist this process. We suggest that GDC talk to the Gisborne community about options for management objectives for key water bodies. One way of doing this is to develop a number (2-4) of scenarios that outline alternatives for management objectives and demonstrate the consequences to the instream and out-of-stream values of choosing one over another. An expert panel workshop to help populate a matrix such as shown in Figure 5, and refine possible scenarios as a basis for consultation, may be a sensible way to proceed. The LowFAT type of analysis discussed in section 4.5 will assist this process.

We note that due to the scope of the current advice grant, this report focuses on water quantity issues and environmental flow setting. GDC must also think about how to include water quality issues into a single regional plan for water for Gisborne district.

As discussed in section 2, NIWA staff have discussed with GDC the possibility of using the REC to develop management units (catchments with similar sets of attributes) that can be managed with different objectives, policies and rules in a regional plan. The potential workshop to give GDC advice on this (Appendix 1 task 11), and work to define suitable management units for the Gisborne district, would be a key first step to the above process.

6. Conclusions and recommendations

A workshop and subsequent literature review has confirmed a work programme for GDC to undertake in order to develop regional freshwater management tools.

We recommend that GDC:

1. Continue to implement the work programme for development as outlined in Appendix 1. In particular, we recommend undertaking work to determine flow requirements for the four components of instream values:

   (a) Ecological values – continue with work funded through CIF and envirolink advice grant to determine flow requirements for ecological values of key Gisborne water bodies (surface water and groundwater).

   (b) Tangata whenua values – continue with work funded through envirolink advice grant to determine tangata whenua values and associated flow requirements for key Gisborne water bodies.

   (c) Recreational values – consider seeking advice from a recreation expert to assess the recreational values and associated flow requirements for key Gisborne water bodies.

   (d) Amenity and natural character values – consider seeking advice from a landscape expert to assess the amenity and natural character values and associated flow requirements for key Gisborne water bodies.

2. Undertake an assessment to explore the balance between minimum flows, allocation rates and reliability of supply for out-of-stream uses, using the LowFAT tool or similar. NIWA can provide assistance with this if required.

3. Either seek advice from an appropriate consultant, or itself carry out, an economic assessment of the out-of-stream uses of water for the Gisborne district. The outputs from step 2 will be a useful input to this.

4. Seek advice from NIWA on the use of the REC to design management units for use in a potential regional water plan.

5. Seek advice where appropriate in developing and proposing a regional plan for water. Steps involved may include:

   (a) Determine significance of instream and out-of-stream values

(b) Through appropriate process and public consultation, decide on proposed appropriate levels of protection for those values, achieving the proposed best balance of values for Gisborne district

(c) Propose specific objectives for the regional plan for water that reflect the proposed best balance of values for Gisborne district.

(d) Design policies, rules and other methods to incorporate flows and water levels to achieve the proposed objectives.

(e) Publicly notify the proposed plan, receive submissions and amend proposed objectives, policies and rules as appropriate based on submissions.

6. Consider ways in which both water quality and water quantity can be included in one regional plan for water for the Gisborne district.

7. Continue to liaise with colleagues in other councils over developments in water resource planning, to ensure that the process followed is grounded and guided by lessons learned from those other councils.

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Appendix 1: Work programme

Notes for table:

SAG = Small Advice Grant

MAG = Medium Advice Grant

MALF – mean annual low flow

Gw = groundwater

CIF = Community Irrigation Fund (Ministry of Agriculture & Forestry)

REC = River Environment Classification

Short Term: Prepare for NES		NIWA to do	GDC to do
1.	***SAG - MALF Te Arai River*** *Year 1*	Check data Calc MALF Check relationship between weir and d/stream	Supply Te Arai record Aerial photo of Te Arai Provide any spot gaugings – flow, date, profile
2.	***SAG – MALF Waipaoa River*** *Year 1*	Compare NIWA data with GDC record Check reliability issues and any differences between 2 recorders Calc MALF	Supply record Provide any spot gaugings – flow, date, profile Corrections/relationship between Kanakanaia record and Matawhero (from Greg)
3.	***SAG – GW recharge estimates*** *Year 1*	Review the 2 main gw refs Review existing gw info	Provide all gw data and any other info Bore monitoring data? Any data re relationships between bores and river flow e.g. Bob & Dave Any reports discussing gw, recharge etc (Other than Gordon 2001, Barber 1998 which Ned already has?) e.g. late 1980s, 1991, 1994 reports?
4.	***MAG – matrix for considering values*** *Year 1*	Circulate notes from July workshop Draft report – aim for 31 October 2009	

Medium/long term: Develop Regional Plan		NIWA to do	GDC to do
5.	***Flow setting (rivers)*** *Year 1* CIF milestone 3 and 4 - 11.6k+2k=13.6k plus $20k MAG ref 871-GSDC76	Consider use of 6 bullet (from Ned's 2009 report) methods to recommend ecological flows for Waipaoa and Te Arai rivers	Provide data: Fish surveys (Paul) WQ data from Te Arai and Waipaoa (DO, temp, ss, nutrients, e coci) Estimate permitted use volume (summer/winter) for both catchments Any ss info e.g. ratings (Greg?) Historic mouth closure (Waipaoa at sea) – does it ever happen? What is the risk?
6.	***Level setting (aquifers)*** *Late year 1 or year 2* CIF milestone 5 - 11.6k plus Possible application for a $20k MAG	Use outputs from SAG gw to identify methods for defining ecological water levels for 5 aquifers	Unclear until SAG complete
7.	***Tangata Whenua values ID*** *Year 1* Includes quantity and quality Pilot scheme for Year 1 that can then be expanded after process tested	Charlotte or team to progress	MAG application lodged Keriana – please keep Helen & Ned in the loop about plans developed with Charlotte and her team…
8.	***Recreation*** Includes quantity and quality		e.g. Rob Greenaway and associates (Nelson)
9.	***Amenity and natural character*** Includes quantity and quality		e.g. Boffa Miskell (Alan Rackham/Yvonne Pfluger)
10.	***Economics***		Internal or consultant – assess $ value of current sw and gw takes – i.e. farm gate value e.g. AgriBusiness group – Stu Ford
11.	***Water body classifications*** - using REC or similar framework to develop management units in regional plan	None for now	GDC could rework the application into a SAG or MAG for a day workshop on using classification systems, and the REC