Ministry for the Environment
Manatū Mō Te Taiao

PROPOSED
National Environmental Standard
>> on Ecological Flows and Water Levels

DISCUSSION DOCUMENT



New Zealand Government

Cover photos: Janet Hunt (centre) and Ministry for the Environment (left, right)

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Members of a working group

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Executive Summary

In April 2006, the Minister for the Environment and the Minister of Agriculture and Forestry jointly released the implementation package for the Sustainable Water Programme of Action. The package aims to improve the sustainable management of freshwater, to protect our freshwater resources into the future, and to acknowledge the fundamental importance of water to all New Zealanders.

By developing a strategic and nationally consistent approach to managing our freshwater resources, the government is seeking to achieve three key national outcomes:

- improve the quality and efficient use of freshwater by building and enhancing partnerships
- improve the management of the undesirable effects of land use on water quality
- provide for increasing demands on water resources and encourage efficient water management.

Recognising the importance of establishing environmental flows[1] and water levels is a critical part of effective water management. Therefore, the government is proposing to develop a National Environmental Standard (NES) under the Resource Management Act 1991 (RMA).

Objectives of the proposed NES

The proposed national environmental standard is intended to complement and enhance the existing Resource Management Act process for establishing environmental flows and water levels through regional plans. The proposal has been developed in response to a key challenge in water management identified by regional councils and others.

To contribute to the policy outcome of 'provide for increasing demands on water and encourage efficient water management', the specific objectives for the proposal outlined in this document are:

- **Objective 1** – To ensure that all resource consent decisions on applications to take, use, dam and divert water from rivers, lakes, wetlands and aquifers are made in the context of a clear limit on the extent to which flows and water levels can be altered.
- **Objective 2** – To ensure that all resource consent decisions on applications to take, use, dam and divert water from rivers, lakes, wetlands and aquifers are made in the context of a clear specification of available water.
- **Objective 3** – To reduce conflict and provide consistency on the appropriate technical methods used to assess the ecological component of environmental flows and water levels.

[1] The term 'environmental flow' is used (as an alternative to 'minimum flow') because of the recognised ecological and cultural importance of flow variability.

The preferred option to address these problems is to develop a national environmental standard that:

- sets interim limits on the alterations 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 (or other statutory instrument)[2]
- provides a process for selecting the appropriate technical methods for evaluating the ecological component of environmental flows and water levels.

The proposed national environmental standard will apply to all waterbodies but the effect of the NES on any individual water resource will vary according to existing regional plan provisions.

What the proposed NES does not address

The objectives of the proposed national environmental standard do not attempt to address all issues associated with environmental flows and water levels. It addresses those issues that are most appropriately addressed through regulation, leaving practice and wider policy issues to be addressed through other complementary parts of the Sustainable Water Programme of Action. Thus, while the proposed NES should assist the decision-making process, the determination of appropriate environmental flows and water levels remains a regional council decision, with any national policy direction given through a National Policy Statement (NPS).

Consultation on the Sustainable Water Programme of Action has highlighted issues around environmental flow and water level decisions, in particular, how various social, economic and cultural factors are provided for in decisions. The proposals set out in this discussion document do not provide guidance to decision-makers on the weighting to give ecological values, or how to incorporate social and economic values into environmental flow decisions. Neither does the proposal set standards for ecological protection nor does it provide methods for assessing other values (eg, recreational).

Assessment of alternatives

When compared to the status quo, national direction through a national policy statement, legislative amendment, or the proposed national environmental standard is best able to meet the objectives in a cost-effective, timely and nationally consistent way. There is a loss of local decision-making in relation to water bodies for which there are currently no environmental flows set, but the interim limits would be over-ridden when environmental flows and water levels were established through the community processes required as part of developing a regional plan.

[2] Such as a Water Conservation Order or a National Environmental Standard.

Costs and benefits

The potential costs and benefits of the proposed national environmental standard can be considered to occur in four main areas: environmental outcomes; the regulatory process; effects on resource users; and effects on the wider public.

A preliminary cost-benefit analysis indicates that regional councils, water users and the wider public would all experience a net benefit from the implementation of the proposal. Many of the potential costs and benefits (particularly those associated with community values and environmental outcomes) are relatively intangible. A partial quantification of costs and benefits was undertaken for the preliminary analysis. It concentrates on the costs and benefits associated with regulatory processes. The overall net benefit of the proposal over the first 10 years is estimated at $14 to $36 million, assuming a 10% discount rate. A further, more detailed analysis will be undertaken after consultation on this discussion document.

Submissions

The Ministry for the Environment welcomes public feedback on the proposal outlined through public submissions. Guidelines for making a submission are found in Section 8 of this document.

1 Introduction

1.1 Background

In 2005, the government held meetings and hui throughout New Zealand to discuss freshwater management issues and how well the present management framework was dealing with them. Through this process, it became clear that people want to see greater consistency and clarity in the way increasing demands on water resources are managed across the country in order to provide for people's aspirations for freshwater.

In April 2006, the Minister for the Environment and the Minister of Agriculture and Forestry jointly released the implementation package of the Sustainable Water Programme of Action: to improve the management of freshwater, to protect our freshwater resources into the future, and to acknowledge the fundamental importance of water to all New Zealanders.

By developing a strategic and nationally consistent approach to managing our freshwater resources, the government is seeking to achieve three key national outcomes:

- improve the quality and efficient use of freshwater by building and enhancing partnerships with local government, industry, Māori, science agencies and providers, and rural and urban communities
- improve the management of the undesirable effects of land use on water quality through increased national direction and partnerships with communities and resource users
- provide for growing demands on water resources and encourage efficient water management through increased national direction, working with local government to identify options for supporting and enhancing local decision-making, and developing best practice.

Recognising the importance of establishing environmental flows[3] and water levels is a critical part of effective water management. Therefore, the government is proposing to develop a National Environmental Standard (NES) under the Resource Management Act 1991 (RMA). The proposed standard would set interim limits on alterations to flows and water levels in catchments where there are currently no such limits set, and would direct the selection of technical methods for evaluating the ecological component of an environmental flow or water level.

This proposal is intended to complement the existing regional planning process and to facilitate effective management of New Zealand's water resources in a cost-effective and expedient manner. This proposal forms part of the implementation package for the Sustainable Water Programme of Action. Other national environmental standards are also being developed alongside a potential National Policy Statement (NPS) to address water quality and managing increasing demands for water.

[3] The term 'environmental flow' is used (as an alternative to 'minimum flow') because of the recognised ecological and cultural importance of flow variability.

1.2 Purpose of this document

This discussion document:

- explains the relationship between ecological flows and the wider concept of environmental flows and water levels, and outlines how both are implemented under the Resource Management Act (Section 2)
- sets out resource management issues associated with ecological flows and water levels (Section 3)
- provides information on the alternatives considered and the rationale for choosing the preferred option (Section 4)
- provides the details of the proposal (Section 5)
- provides a preliminary assessment of the costs and benefits of the proposal (Section 6)
- seeks submissions on the proposal, its rationale and its associated costs and benefits.

Consultation as part of the Sustainable Water Programme of Action identified three key problems associated with ecological flows and water levels:

1. There remain some water bodies, principally small streams and groundwater systems, for which no specific environmental flows and water levels have been determined. The lack of an established environmental flow increases the potential for ecological (and other) values to be adversely impacted by water abstraction. Many of these water bodies are likely to come under increasing development pressure as major surface and groundwater resources reach full allocation.
2. In some cases, environmental flows and water levels do not clearly define available water. This situation results in uncertainty for existing and potential users, and for wider public interests on whether the consent process will avoid adverse impacts on the ecological (and other) values of freshwater systems and on continued security of supply for water users.
3. The existing process for evaluating the impacts of alternative flows and water levels on ecological values is costly and contentious. Debate regarding the selection and application of technical methods has overshadowed the more important resource management decision regarding the appropriate level of protection given to the values attributed to a water body.

The preferred option to address these problems is to develop a national environmental standard that:

- sets interim limits on the alterations 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 (or other statutory instrument)[4]
- provides a process for selecting the appropriate technical methods for evaluating the ecological component of environmental flows and water levels.

[4] Such as a Water Conservation Order or a National Environmental Standard.

The objectives of the proposed national environmental standard do not attempt to address all issues associated with environmental flows and water levels. It addresses those issues that are most appropriately addressed through regulation, leaving practice and wider policy issues to be addressed through other complementary parts of the Sustainable Water Programme of Action. Thus while the proposed national environmental standard should assist the decision-making process, the determination of appropriate environmental flows and water levels remains a regional council decision, with any national policy direction given through a national policy statement.

Consultation on the Sustainable Water Programme of Action has highlighted issues around environmental flow and water level decisions; in particular, how various social, economic and cultural factors are provided for in decisions. The proposals set out in this discussion document do not provide guidance to decision-makers on the weighting to give ecological values, or how to incorporate social and economic values into environmental flow decisions. Neither does the proposal set standards for ecological protection, nor does it provide methods for assessing other values (eg, recreational).

If government recommends a national environmental standard following consultation on this document, a regulatory impact assessment will be required. This discussion document contains, and invites comment on, the substantive elements of a Regulatory Impact Assessment.

1.3 What is an NES?

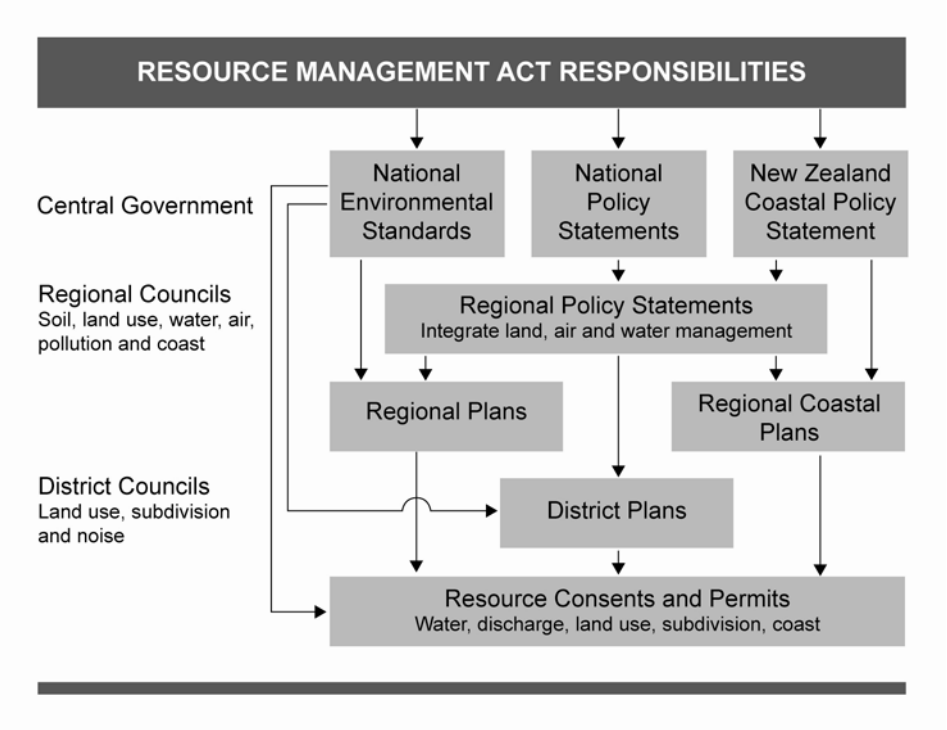
National environmental standards are regulations issued under the Resource Management Act by central government that prescribe technical standards, methods or requirements for environmental matters. Each local or regional council must enforce the same standard, although it can impose stricter standards if the NES explicitly allows for this.

National environmental standards may cover, but are not limited to:

- contaminants
- water quality, level or flow
- air and soil quality
- noise
- standards, methods or requirements for monitoring.

National environmental standards may specify qualitative or quantitative standards, standards for discharges, classification methods, methods and processes to implement standards, as well as exemption and transitional provisions. NESs can apply nation-wide or only to specific areas. Figure 1 illustrates the role of NESs in the overall resource management policy framework.

Figure 1: Policy framework for natural resource management in New Zealand



1.4 Process for developing an NES

An outline of the process for developing a national environmental standard, including the informal and formal submission process, is shown in Figure 2. The notification of this discussion document forms part of the formal submission process.

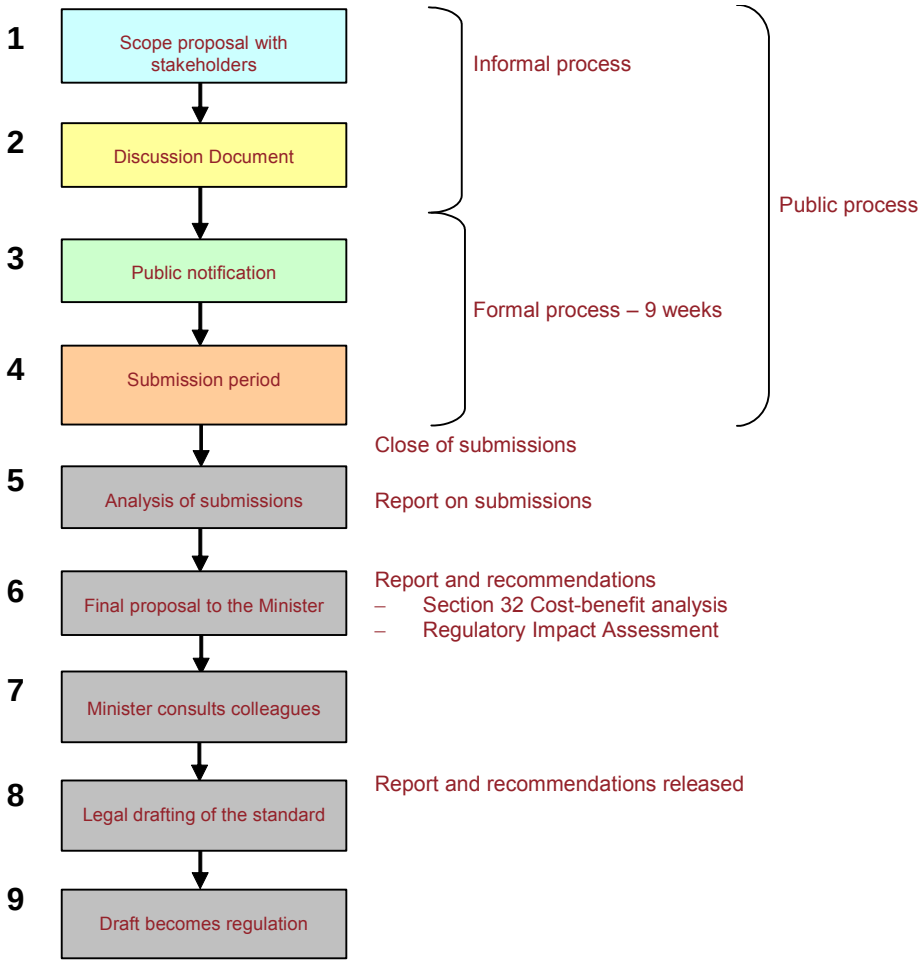
The process of developing a national environmental standard differs from the statutory plan and resource consent process in that there are no hearings, appeal provisions or First Schedule consultation. However, the RMA requires that the Minister provide an opportunity for the public and iwi authorities to comment on the proposed NES. That opportunity is provided through submissions on this discussion document.

The submission period is your opportunity to make a formal submission on the proposed national environmental standard. A sixteen-week submission period is provided to enable people to have formal submissions first approved by councils, committees or boards. Details on how to make a submission are given in Section 8.

To help you formulate a submission, throughout the document, questions are posed on aspects of the proposed national environmental standard for your consideration. These are highlighted by individual boxes and also combined in Section 8.2. However, you are welcome to provide feedback on any aspect of the proposed NES.

At the end of the submissions process, a report on the submissions, a formal evaluation (conducted according to section 32 of the RMA) and recommendations for the national environmental standard will be prepared by the Ministry for the Environment for consideration by the Minister for the Environment. The Minister will then make final recommendations to the Governor-General before the Standard comes into force.

Figure 2: Development process for a national environmental standard



2 Ecological Flows and Water Levels in the Context of Environmental Flows and the Resource Management Act

The scope of the proposal set out in this document is limited to ecological flows and water levels. To assess and comment on the proposal and its scope, it is important to understand the wider context of environmental flows and water levels, of which ecological flows are a component. This section of the document describes the resource management framework for environmental flows and water levels by:

- highlighting the importance of environmental flows and water levels to freshwater management
- providing definitions for: environmental flows and water levels; ecological flows and water levels; and available water
- outlining the current process for determining environmental flows and water levels under the Resource Management Act
- describing how environmental flows and levels are implemented
- outlining the technical methods currently used to assess the ecological component of environmental flows and water levels.

While this section concentrates on the wider context of environmental flows and water levels, the proposed national environmental standard addresses some specific issues around the ecological component of environmental flows only. This section is added to assist submitters to understand the boundaries of the proposal.

2.1 Importance of environmental flows and water levels

Water is an integral part of the natural and physical environment. Lakes, rivers, streams, wetlands and aquifers have significant environmental, social and cultural values for New Zealanders. Consumptive uses of water[5] also provide essential services for the economic and social wellbeing of the country. Water is used for human and stock drinking, firefighting, urban water supply, industry, electricity generation and irrigation.

[5] 'Consumptive uses' refers to any use of water that alters the flows and/or levels in a water body on either a temporary or permanent basis, including situations where water is stored and later released downstream.

Environmental flow and water level decisions are made in a context of environmental, social, cultural and economic values. The broad objectives for an effective water allocation system are to develop a decision-making process that makes provision to protect water ecosystems and to provide for existing and future uses of water, while optimising environmental, social, cultural and economic outcomes for the community. Within any water allocation framework, setting environmental flows and water levels is a critical first step.

Environmental flows and water levels provide for a given set of ecological, cultural, recreational and amenity values associated with a particular water body. The flows and levels are established through regional planning processes that determine how much water must stay in a river, lake, wetland or groundwater system, and how much water is available for consumptive uses. Having an environmental flow or water level set ensures that the amount of water needed to sustain a given set of values is clearly specified and the total amount of water available for development uses is also clear, so that decisions can be made about how the available water should be used.

2.2 Defining key concepts

2.2.1 Environmental flows and water levels

The definition of **environmental flows and water levels**[6] used in this document is the "the flows and water levels required in a water body to provide for a given set of values which are established through a regional plan or other statutory process". Environmental flows and water levels may provide for ecological, tangata whenua, cultural, amenity, recreational, landscape, natural character and other values associated with water.

Decisions on the setting of environmental flows and water levels involve consideration of natural, community and development values associated with a water body and how these relate to flow and/or level. Environmental flow decisions determine how much water will stay in a water body, but that decision is influenced by existing and potential demands for water. Decisions are made within the framework of the RMA, national and regional policy statements, and the objectives and policies of relevant regional plans.

Figure 3 illustrates the components of a simplified environmental flow or water level. The values provided for, and the level of protection afforded to each, will depend on the characteristics of an individual water resource and be determined by the outcomes of the decision-making process outlined in the Section 2.3. As shown in the figure, several of the individual values provided for may overlap to a significant degree and it is typically the case that provision for ecological values forms a significant component of the final environmental flow and water level. However, additional flows or higher water levels might be required to provide adequately for these other values.

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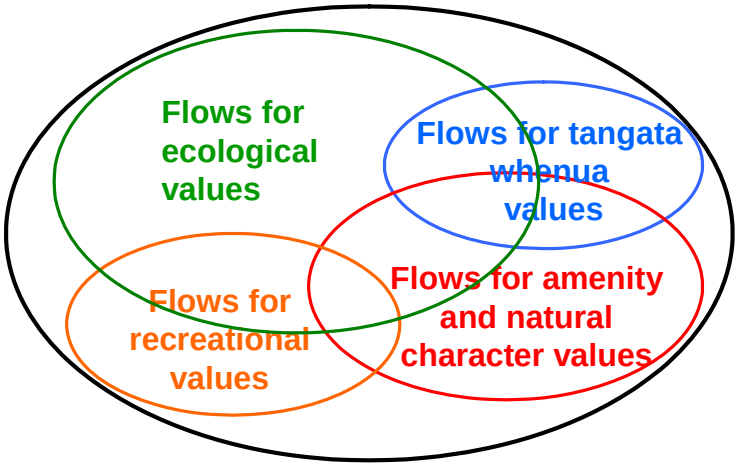
[6] The 2006 Cabinet Paper that sets out the suite of actions within the Sustainable Water Programme of Action uses the term 'environmental flows'. For some water bodies, particularly lakes and groundwater systems, environmental requirements can relate to water level as well as to flow. In this discussion document, the term 'environmental flows and water levels' is used.

Figure 3: Components of an environmental flow or water level



2.2.2 Ecological flows and water levels

Ecological flows and water levels are a component of the overall environmental flow and water level, and are established to provide for the ecological values attributed to a particular water body. In the context of the proposed standard, ecological flows and water levels are defined as "the flows and water levels required in a water body to provide for the ecological function of the flora and fauna present within that water body and its margins".

2.2.3 Available water

In order to provide a level of certainty for existing and potential resource users about the amount of water available for allocation, environmental flows and water levels must clearly define the total amount of water available for consumptive uses. This is the amount of water that is not required to maintain the environmental flow or water level defined for a particular water body.

For clarity, this document uses the term **available water** to mean "the total quantum of water that can be allocated from a resource for consumptive use, including both existing and potential authorised uses". It includes uses for reasonable stock and domestic water supplies provided by the RMA section 14(3), as well as small-scale abstractions permitted by regional plans.

Because environmental flows and water levels cater for natural variability in water systems, the volume of available water may vary seasonally and possibly between years.

These definitions, and definitions of some other hydrological terms used in this document, are presented in Appendix 1.

2.3 Decisions on environmental flows and water levels

Consultation on the Sustainable Water Programme of Action has highlighted issues with environmental flows and water levels, including how various social, economic and cultural factors are considered and provided for. The proposal set out in this discussion document, because it concentrates on ecological aspects only, does not address those wider issues. However, the following discussion on environmental flows is provided to help submitters understand the context of the proposed national environmental standard and its boundaries.

Decisions on environmental flows and water levels are usually made as part of a regional plan process. Existing approaches to setting environmental flows are contained in proposed and operative regional plans. Eleven out of 16 councils currently have operative regional plans to address freshwater issues, the remainder having proposed plans.

An environmental flow decision incorporates both quantitative and qualitative information on values and on the potential impacts of these values on changing flows and water levels. No matter how comprehensive and robust the information, decision-makers will always be required to make a judgement on the extent to which each value will be provided for and how conflicting values will be addressed. The judgement is made using the framework set out in Part II of the Resource Management Act, national policy statements, regional policy statements and regional plans.

The process of developing a regional plan involves significant consultation and community involvement, with the resulting plan development, submission and hearing processes often taking several years. Regional and national policy statements can also provide guidance on the resolution of environmental flow and water level issues. This consultative process is assisted by a clear decision-making framework and the application of relevant technical methodologies. The overall aim is to determine the most appropriate way of managing a region's water body for a given set of ecological, cultural, social and economic values associated with alternative uses of the resource.

Environmental flows and water levels have also been set through decisions on resource consents (particularly when a regional plan does not specify environmental flows) or via a water conservation order.

In the setting of environmental flows and water levels, there are three distinct elements:

- a robust scientific methodology for assessing the 'ecological needs of freshwater ecosystems' over a range of flow and seasonal conditions
- methods for assessing how other values (including recreational, amenity and tangata whenua values) change over a range of flow and seasonal conditions
- a clear approach to assessing the extent to which an environmental flow or water level will provide for natural and development values attributed to a water body by Māori and the wider community.

The proposals outlined in this discussion document concentrate on ecological flows and water levels and, therefore, on only the first element listed above.

Appendix 2 contains an overview of the technical part of the approaches to environmental flows currently adopted by each regional council. Appendix 3 contains a fuller explanation of environmental flow decisions.

It is important to note that in some cases where the in-stream values are very high and/or the community wishes to see a higher level of protection for a water body, there may be no, or very little, consumptive use and the majority of the flow may be protected in its natural state.

2.4 Implementation of environmental flows and water levels

Environmental flows and water levels are implemented by rules in regional plans and resource consent conditions that place controls on the taking, damming, diversion and use of water. These decisions are guided by regional policy statements, regional plans and water conservation orders. Guidance could also be provided by a national policy statement.

Environmental flows and water levels must take account of the natural variability in water systems. As a result, a combination of numbers may be required to provide for the values associated with an individual water body rather than a single number. In some applications, the term 'environmental flow or level regimes' is used to better indicate that environmental flows and water levels need to reflect and respond to the natural variability in water systems.

The range of measures required to implement the environmental flows and water levels will depend on physical characteristics of the water resource, the nature and magnitude of water demand and, most importantly, the significance of the values of the water body and its connected environments (eg, groundwater and downstream ecosystems).

The complexity of environmental flows and water levels should match both existing knowledge of the physical characteristics of the resource as well as the availability of relevant, on-going monitoring information. For example, there is little to gain from setting a complex environmental flow and water level in a river system with little or no flow- or water-use monitoring. In systems where there is a possibility of storage and likely capacity to take water at high river flows, or there is potential for off- or on-stream storage, a more complex regime is warranted.

Environmental flows for **rivers and streams** are usually described with a combination of measures such as minimum flows,[7] allocation caps, flow sharing[8] and limits on abstraction during higher flows and floods. Environmental flows usually include two parts – a threshold or minimum flow and a cap or limit (an allocation limit) set on the amount of water that can be

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[7] A minimum flow limits the amount of abstraction during low river flows. A minimum flow determines when consent holders have to reduce, and ultimately stop, abstracting. Minimum flows are applied slightly differently throughout New Zealand, depending on local circumstances and the location of flow recorder sites.

[8] Flow sharing is usually used at medium to high river flows, in combination with a minimum flow or other measures for managing low flows. Under flow sharing, a fixed proportion of the natural flow can be removed; the rest must remain in the river. A 50/50 sharing is the mostly commonly used. Flow sharing is a coarse approach to providing for flow variability and more complex approaches, such as specific flushing flows, are used when a more detailed analysis of the role of flow variability is available.

taken. The allocation limit can vary with time and flow. The allocation limit provides for the ecological and habitat components that are related to flow variability and maintaining a range of flows in a river or stream. The allocation limit is linked to the minimum flow – as the allocation limit increases, the minimum flow is reached more often.

As the level of allocation from a river increases, environmental flows and water levels usually become more complex. Complex environmental flows for rivers can include provision for low flows, channel-forming / maintenance flows, wetland inundation flows, flushing flows for removal of vegetation or fine sediments, and groundwater recharge flows.

Groundwater environmental flows and water levels can be set as limits to the amount of water that can be taken, and provide a means of maintaining spring flow, aquifer pressure and recharge flows to rivers or wetlands. Groundwater trigger water levels (or pressures) are also used for preventing salt-water intrusion or adverse pressure gradients.

For lakes and wetlands, environmental flows and water levels usually specify permitted ranges in water levels and rates of fluctuation. Water level fluctuations are particularly critical for ecological values and they control the distribution of organisms in most wetlands and the littoral zone in lakes. The timing and duration of the connectivity of wetlands to their parent water-body controls the migration of fish and feeding cycles of birds.

Environmental flows or water levels, although possibly developed following a generic methodology, will be specific to an individual water body.

2.4.1 Resource consents and environmental flows and water levels

Regional plans also adopt a variety of approaches to deal with resource consent applications that would, if granted, lead to established environmental flows and/or water levels being exceeded (or breached). While some regions classify such applications as being for discretionary activities, others deem them to be for non-complying activities. This difference in activity status can make a significant difference to the potential outcomes of the resource consent process and the resulting effectiveness of environmental flows and water levels developed through the regional plan process.

In practice, applicants have been successful in applying for a water permit even where the permit would breach allocation limits set in a plan and even where further abstraction is a non-complying activity.

Classification of activities in district and regional plans

If an activity is described as a **discretionary activity**, resource consent is required. The resource consent may be granted with or without conditions, or it may be declined. The activity must comply with the standards, terms, or conditions, if any, specified in the plan or proposed plan. [See section 77B(4) of the RMA.]

If an activity is described as a **non-complying activity**, resource consent is required. The resource consent may be granted with or without conditions or it may be declined. Resource consent for non-complying activities may only be granted if the adverse effects of the activity on the environment will be minor or the application is for an activity that will not be contrary to the objectives and policies of the relevant plan and/or proposed plan (depending on circumstances). [See sections 77B(5), 77B(6), and 104D of the RMA.]

If an activity is described as a **prohibited activity**, no application may be made for the activity and no resource consent may be granted. [See section 77B(7) of the RMA.]

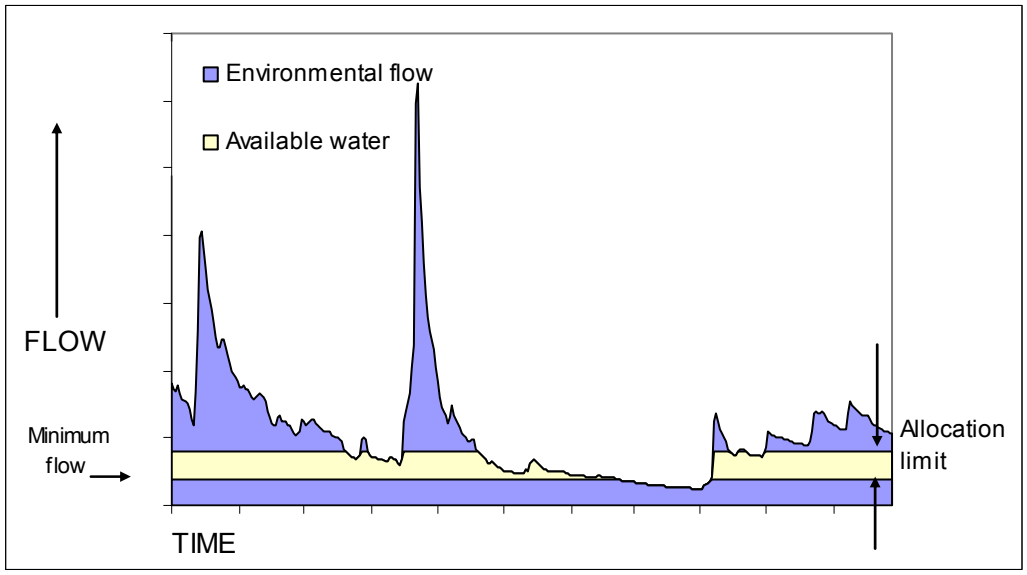
2.5 Examples of environmental flows applied to a river

Figures 4 and 5 illustrate environmental flows applied to river flow. The figures illustrate how specifying the environmental flow also determines the available water. The same concept applies to groundwater, lakes and wetlands, where the variable may be water levels or flow and the timescales, particularly for groundwater, may be years rather than days. The illustrations could apply to each component of environmental flows or water levels – flows could be those that provide for ecological, recreational, cultural and other values. The discussion below, therefore, relates to both ecological flows and the wider concept of environmental flows.

Figure 4 illustrates a very simple environmental flow which is defined by:

- a minimum flow specifying when abstraction must cease or be reduced
- a single allocation limit specifying the quantum of available water, which is over time except when it must be reduced to ensure that the minimum flow is not breached.

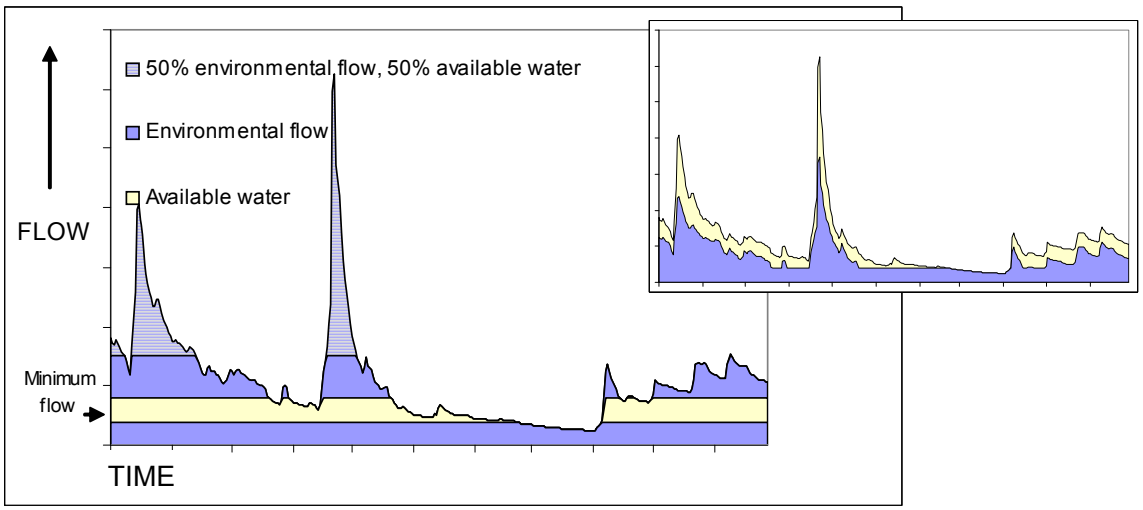
Figure 4: Illustration of a simple environmental flow



The example given in Figure 4 does not illustrate one common feature of many environmental flows and water levels – that some water will be taken even when a river is below its minimum flow. Water taken under section 14(3)b or 14(3)e of the RMA (ie, water taken for human and stock drinking and firefighting). This is often exempt from minimum flow restrictions, because this type of abstraction is a permitted activity in a plan and some resource consents (these usually specify water for community supplies of human and stock drinking). Guidance on exemptions is usually contained in regional plans.

In Figure 5, a further measure (flow sharing) is introduced at higher flows – this approach enables more water (compared to Figure 4) to be taken when river flows are high. The smaller box to the right shows the same arrangement but with all the environmental flow components plotted together. The effect of flow sharing on maintaining flow variability is evident. Flow sharing is not the only, nor necessarily the best, way to provide flow variability and has been included as one example of a commonly used approach.

Figure 5: Illustration of an environmental flow and available water



2.6 Technical methodologies used for setting ecological flows and water levels

Regional councils use a variety of approaches for establishing ecological flows and water levels. Approaches range from a detailed modelling-based assessment of the potential impacts of water use scenarios, to simpler approaches based on historical data. Environmental flows and water levels may also be applied at a range of scales, from generic (default) regional approaches to water body-specific management plans.

At the current time, there are no specific guidelines on which technical methods to use, and how, for establishing environmental flows and water levels through the resource consent or regional plan processes. The 1998 Ministry for the Environment publication *Flow guidelines for instream values* lists several methods for the determination of environmental flows and water levels for surface water bodies, but does not prescribe their application to any particular physical setting. As a result, individual regional councils determine ecological flows and water levels in a manner suited to both the physical characteristics of individual water resources and their communities.

The key methods for establishing ecological flows and water levels implemented by councils are default hydrological methods (eg, based on a proportion of the mean annual (seven-day) low flow, or MALF) and instream habitat methods (ie, the Instream Flow Incremental Method IFIM or WAIORA[9]). Modelling methods have generally been used on larger rivers and streams because these water bodies have more information available on water flows and values. Councils have noted the difficulty of determining ecological and environmental flows where there are minimal data (on water flows and ecological values), especially in areas with many smaller streams.

[9] WAIORA is a computer-based model (Water Allocation Impacts on River Attributes) that calculates whether a water abstraction or discharge could have adverse impacts on dissolved oxygen, total ammonia, water temperature and habitat for aquatic life. The model is available from NIWA.

3 How Could National Direction Address Issues with Ecological Flows and Water Levels?

3.1 Problem statements

3.1.1 Resource consent decisions are being made on water bodies for which there is no environmental flow or water level in place

Existing RMA provisions do not require regional councils to establish environmental flows and water levels for all water bodies. Nor is there any environmental baseline set for water quantity in the RMA, in comparison with water quality, for which sections 70 and 107 of the Act set baselines for the control of discharges.

Despite there being no legislative requirement, environmental flows and water levels are currently in place for most groundwater and surface water resources across New Zealand. However, there remain some water bodies, principally small streams or groundwater systems, for which no specific environmental flows and water levels have been determined. The lack of an established water management framework increases the potential for ecological (and other) values associated with these water bodies to be adversely impacted by water abstraction. These water bodies generally include those with relatively low levels of demand or those for which insufficient information exists to define an environmental flow or level. Many regional plans also provide limited guidance on how to deal with the impacts of water abstraction on wetland areas.

One of the principles of the Sustainable Water Programme of Action is that 'clear environmental limits will be set for water quality and the quantity available for allocation'.[10] The water quantity aspect would be achieved by having environmental flows and water levels set through regional plans on a catchment-basis, with an appropriate community process for every water body. Time and resource requirements mean that this is difficult to achieve on all water bodies in the short term, and councils sensibly concentrate on catchments with high demand and important values. This raises the question of what happens to other water bodies in the mean time.

[10] April 2006 Cabinet Paper. Available at http://www.mfe.govt.nz/issues/water/prog-action/cabinet-paper-implementation-package.html.

While water bodies that do not have environmental flows and water levels set in a regional plan may not be exposed to a high proportion of demand nationally, they are commonly attributed high ecological, cultural or recreational values owing to their relatively undeveloped status. In addition, with future water demand forecast to increase across New Zealand, many of these water bodies are likely to come under increasing development pressure as major surface and groundwater resources reach full allocation.

In the absence of an established environmental flow or water level, limited guidance is available to assist the resource consent decision-making process. This may result in decisions about environmental flows and water levels being made on an ad hoc basis, with limited regard for the cumulative effects on a wider whole-catchment scale. This obviously increases the potential for adverse environmental effects to result from water abstraction and may lead to over-allocation of a resource.

3.1.2 Existing environmental flows and water levels do not always clearly define the available water

In some cases, existing environmental flows and water levels in regional plans do not clearly define the amount of available water. This situation applies to a relatively small number of streams that, although having a minimum flow specified in a regional plan, do not have an allocation limit defined, and so there is no upper limit placed on abstraction.

A lack of specified allocation limits increases the potential for ecological (and other) values to be adversely impacted by further abstraction. It does not offer any guarantee to wider public interests that further allocation of water via the resource consent process would not cause adverse impacts on the values attributed to a particular water resource. In addition, this situation results in uncertainty for both existing and potential resource users regarding access to water and continuing security of supply.

3.1.3 The existing process for setting ecological flows and water levels is costly and contentious

In many regions, the process of establishing environmental flows and water levels through the regional plan process has proved costly, time consuming and contentious. Development of specific provisions relating to water quantity can be hampered by the lack of information to characterise a resource and a lack of clarity around which technical methods are most appropriate for assessing the potential impacts of water abstraction. A national approach to selecting methods for determining ecological flows and water levels addresses one of the challenges for water management identified by regional councils.

Existing methods for determining ecological flows and water levels are already well developed and suitable for application in most hydrological settings. However, there is concern about the uncertainty in existing methods because not all responses of aquatic ecosystems to changing flows are fully understood. Caution is required in the use of methods, and the limitations of each method need to be acknowledged. As a result, regional councils and entities seeking consents are faced with the difficulty of deciding which methodologies are appropriate in particular circumstances, and then applying the chosen methodologies correctly and consistently.

A further difficulty noted is extending the commonly used habitat-based assessment methods to address flow variability and thus provide for the important ecosystem functions that require a range and patterns of flow. The application of technical methods to date has largely concentrated on setting low flows for invertebrate, fish and bird species.

A particular issue for practitioners is the need to clearly distinguish the technical tools used to generate and assess management options from the fundamental resource management decisions required. Technical methodologies used to assess individual components of the resulting environmental flow and water level do not, in themselves, pre-determine what a particular water body's values should be or how any conflicts between such values should be resolved. Nor do they prescribe the appropriate weight to be given to environmental values compared with the social and economic values associated with water use.

A great deal of time can be spent arguing about an appropriate method for setting environmental flows, because flows cannot be 'standardised' in the same way that a water quality standard can. The water quality requirements for trout can be described relative to a specified and measurable level of contaminant, but trout requirements cannot be related to a given flow applicable in all rivers. Any ensuing technical debate can overshadow the more important resource management decisions regarding the appropriate level of protection to give to a waterbody.

Challenges faced by councils and other stakeholder interests include:

- the long timeframes required to collect and analyse robust and defensible data
- the selection of technical methodologies appropriate to particular water bodies and the debate that may arise
- the consistent and transparent application of selected methodologies
- uncertainties in the data used to inform the decision-making process
- increasingly polarised stakeholders
- increasingly contentious hearing and appeal processes.

Question 1 – Problem statements and issues

Do you agree with the problem statements and the three key problems that were identified as benefiting from national direction?

3.2 Policy objectives

The overall objective for a proposal to address ecological flows and water levels is to meet the relevant outcome of the Sustainable Water Programme of Action in a nationally consistent and cost-effective manner.

The relevant outcome of the Sustainable Water Programme of Action is to:

> *Provide for growing demands on water resources and encourage efficient water management through increased national direction, working with local government to identify options for supporting and enhancing local decision-making, and developing best practice.*

Environmental flow and water level decisions by regional councils provide certainty to environmental interests, community interests and water users on:

- the extent that freshwater ecological (and other) values are provided for
- the amount of water available to meet existing and future demands on water resources.

In the absence of set environmental flows and water levels, national direction can provide that certainty. This approach will ensure appropriate protection of the values associated with the relevant water bodies until a more detailed assessment and consultation with the community is completed.

National direction can also provide consistency in the methods used to determine ecological flows and water levels. Regional councils have requested clarity on which ecological methods are appropriate for a given situation. Assessing the 'needs of freshwater ecosystems' is often the starting point for decisions about environmental flows and water levels, and there are a large number of technical methods for making that assessment. Specification of methods that reflect current scientific understanding would increase certainty to environmental, community and development interests on the process of determining ecological flows and water levels. This would help narrow some of the debate that arises during the regional planning process and allow environmental flow and water level decisions to be made in a more cost-effective and expedient manner, given the availability of existing methodologies. In that way, national direction on the appropriateness of technical methods would improve the management of increasing demands for water.

To contribute to the policy outcome outlined in italics above, the specific objectives for the proposal outlined in this document are:

- **Objective 1** – To ensure that all resource consent decisions on applications to take, use, dam and divert water from rivers, lakes, wetlands and aquifers are made in the context of a clear limit on the extent to which flows and water levels can be altered.
- **Objective 2** – To ensure that all resource consent decisions on applications to take, use, dam and divert water from rivers, lakes, wetlands and aquifers are made in the context of a clear specification of available water.
- **Objective 3** – To reduce conflict and provide consistency on the appropriate technical methods used to assess the ecological component of environmental flows and water levels.

4 The Options

4.1 Preferred option: an NES that sets interim limits and technical methods for ecological flows

The preferred option is a national environmental standard that has two elements:

- interim limits on the alterations 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 (or other statutory instrument)[11]
- a process for selecting the appropriate technical methods for evaluating the ecological component of environmental flows and water levels. The proposed national environmental standard endorses the use of simple methods if there is low demand for water and more sophisticated methods as the amount of allocation demand increases. The process would apply when new environmental flows and water levels were added to a plan, where existing ones were reviewed or where the interim limits are breached.

Full details of the option are outlined in Section 5. However, it should be noted that, while the proposed national environmental standard may assist the decision-making process, the determination of appropriate environmental flows and water levels remains a regional council decision, except where an interim limit is required.

4.1.1 Interim limits to alterations to flows and water levels

The interim limits are the preferred way to meet policy objectives 1 and 2 (see previous page). The interim limits on alterations to environmental flows and water levels will ensure that regional councils have time to respond in situations where there are rapid increases in the demand for water in a water body for which there is no environmental flow or water level currently defined in a regional plan. The limits will provide clear protection for ecological (and other) values from any adverse effects of water abstraction. The limits should enable regional councils to avoid over-allocation of the resource and should avoid the degradation of natural values until a thorough assessment of the potential impacts of water use has been undertaken.

The inclusion of interim limits on alterations to flows and water levels within a national environmental standard is intended to put limits in place in a more cost-effective and expedient manner than would the regional plan process. It should minimise debates around the need for and justification of default flows and water levels. As demand increases, the proposed NES will mean that resource consent decisions addressing the cumulative effect of applications will not be made on an ad hoc basis for those water resources where no environmental flow and water level is currently defined in a regional plan. The ad hoc approach has been described as the 'salami syndrome', and it leads to justifiable concerns about the level of protection for ecological and other values. As more of the water resource is taken, that which remains is less resilient to change and may be less valued.

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[11] Such as a water conservation order or a national environmental standard.

The establishment of interim limits allows resource consent applicants to clearly see the amount of water that could be granted, subject to meeting the tests of the RMA. It will provide some certainty to new applicants on the availability of water when resources are under less demand pressure. It also provides certainty to existing resource consent holders on how much more water can be allocated prior to specific provisions being included in a regional plan.

The concept of an interim limit is not uncommon. Some regional councils have already established 'default' environmental flows and water levels through their regional plans (refer Appendix 2). The rationale of a default is to have some measure in place that protects values and allows some taking of water until there is sufficient demand for water-monitoring data and/or information to justify a catchment-specific environmental flow.

4.1.2 Technical methods for assessing flows for ecological values

The technical methods part of the preferred option meets policy objective 3 (section 3.2). A national environmental standard that specifies techniques for establishing ecological flows and water levels would provide consistency in the methods applied and reduce debate about the selection of appropriate methods and associated data requirements. The NES aims to significantly reduce the need for the same technical debate over methodologies to be repeated in separate plan and/or consent decisions.

The proposal is limited to the ecological component of environmental flow and water level decisions. The proposed national environmental standard relates only to ecological flows and water levels for two reasons:

- Assessing the 'needs of freshwater ecosystems' is often the starting point for environmental flows and water levels decisions, and there are a large number of technical methods for making that assessment. Regional councils have requested clarity on which methods are appropriate for a given situation. Recreational values are perhaps the only other type of value for which a range of proven methods exist.
- Other values provided for in environmental flows often rely on ecological values. For example, mahinga kai and angling both need healthy fish populations and ecosystems. Often the flows and levels set to protect ecological values will go some way to protecting other natural values, although additional flows or higher levels will be necessary in some cases to provide for values other than ecological values. Methods for assessing these other values that complement this proposed standard are identified in Section 7 of this discussion document.

4.2 Status quo

This option would involve no national direction and would rely solely on regional plans, water conservation orders and resource consent applications to address the issues with ecological flows and water levels. The existing dominant mechanism is regional plans, where an ecological flow assessment is carried out to support environmental flow and water level decisions.

Continuing the existing RMA process through regional plans will see proposed plans become operative over time, and reviews will be initiated of those plans not later than 10 years after they

become operative. This review process provides an opportunity for the adequacy of existing environmental flows and water levels to be considered via the plan review process. Alternatively, regional councils may initiate changes (or variations) in existing regional plans under section 65 of the RMA at any time, to add or amend environmental flows and water levels, to address specific resource management issues.

Given the time and resources invested in developing existing environmental flows and water levels, regional councils may be reluctant to embark on additional regional plan development processes, to establish additional resource-specific or default environmental flows and water levels for all water bodies, outside of already programmed regional plan reviews.

Several proposed and operative regional plans already include default environmental flows and water levels, particularly for surface water. These default environmental flows and water levels essentially establish interim limits that, depending on specific plan provisions, cap allocation until sufficient information is available to support the granting of additional resource consents. In those locations, objective 1 and 2 have already been achieved. However, in other locations, the status quo cannot be guaranteed to meet objectives 1 and 2.

Existing methods for determining the ecological component of environmental flows and water levels are relatively well developed and suitable for most hydrological settings. However, considerable debate commonly occurs over the selection and application of these methods in both the resource consent and regional plan processes. This can result in significant costs and lengthy delays for regional plans to advance through often contentious hearing and environment court processes. A similar situation occurs in the resource consent process, where debate may occur regarding the selection and application of particular methodologies to advance or rebut individual resource consent applications. In resource consent and regional plan hearings, the Environment Court is often called upon to decide on complex arguments about the selection, application and merits of particular technical assessment methodologies. These arguments are commonly exacerbated by uncertainties in information available to inform the decision-making process. Objective 3 would not be achieved under the status quo.

4.3 A national directive to set environmental flows

Another option to ensure that environmental flows and water levels are established for all water bodies is for central government to establish a national directive using either existing policy instruments – most likely a national policy statement – or legislative change. Such a directive would require regional councils to develop environmental flows and water levels for all water bodies within a nominated timeframe, but would leave their exact form, content and the choice of technical methods to the discretion of individual regional councils.

Regional plans are required to give effect to any relevant policies or objectives contained in a national policy statement. Inclusion of specific provisions requiring environmental flows and water levels for all water bodies in a national policy statement or national environmental standard would require regional councils either to develop a comprehensive list of environmental flows and water levels in a regional plan schedule or to develop default environmental limits that would apply to water bodies for which a specific environmental limit was not already established (or a combination of these approaches). Depending on the timeframe specified, this would require regional councils either to consider the addition or

change of environmental flows and water levels as part of existing plan review processes, or to initiate a plan change process under section 65 of the RMA.

The main benefit of the using a national directive to require the setting of environmental flows and water levels is that it would ensure that environmental limits are established for all water bodies within a nominated timeframe, while enabling individual regional councils to develop environmental flows and water levels in a form and manner specific to their individual regions.

This option would meet policy objectives 1 and 2, but not in as expedient or cost-effective a manner as the preferred option. It would not meet objective 3.

4.4 National guidelines on technical methods

A national guidance document on the setting of ecological flows and water levels could be produced by central government. The guidance could be in the form of the technical document referenced by the proposed national environmental standard (or a modified version of it). The guidelines would not have any statutory weighting but could be used to inform the resource consent and regional plan processes at the discretion of individual regional councils.

Overall, a national guideline document for the setting of ecological flows and water levels would essentially provide an updated version of the existing Ministry for the Environment 'Flow guidelines for instream values', extended to include groundwater, lakes and wetlands and to address flow variability. This approach would provide national guidance on the selection and application of technical methods and promote a nationally consistent approach to the ecological component of environmental flows and water levels.

The lack of statutory weighting for a guideline document means that it would provide limited assistance for the resource consent process, with the selection and application of technical methods likely to be debated through the hearing process. Regional councils would be free to adopt the recommended guidelines as part of future plan reviews or to support changes (or variations) to existing regional plans. The lack of statutory weighting for the methods contained in a guideline document increases the potential for the selection and application of methods by a regional council to be challenged during the regional plan or resource consent process (which would not occur should the proposed national environmental standard be implemented).

The use of national guidelines would assist in, but cannot guarantee, objective 3 being met. This option would not meet objectives 1 and 2.

4.5 An alternative NES

A further alternative is a national environmental standard that has a broader scope than the preferred NES option. Under this option, the methods part of the standard would be extended beyond ecological methods. Such a document would provide direction for the selection and application of technical methods covering the full range of ecological, recreational, tangata whenua, cultural and amenity values associated with water. It would provide greater guidance for the development and application of environmental flows and water levels in the regional plan and resource consent process. This option would meet objective 3.

The major disadvantage of this option is that, aside from the ecological (and possibly recreational) components of environmental flows and water levels, methods for the other components are not sufficiently developed to allow their incorporation in, or reference to, a national environmental standard in the short to medium term. Delaying the development of an NES until technical methods are available for all components of environmental flows and water levels would result in the continuation of the status quo, at least over the medium term.

4.6 A comparison of the options

Table 1 summarises the five options evaluated against the three policy objectives and the criteria of cost-effectiveness, expediency, consistency and provision for local decision-making. Analysis of the potential options indicates that the proposed national environmental standard meets all the criteria considered, except the one relating to local decision-making in the setting of interim limits on alterations to environmental flows and water levels.

Table 1: Comparison of options

	Status quo	Proposed NES	National directive	National guidelines	Alternative NES
Interim limits					
Objective: Ensure all consent decisions are made in context of clear limits	×	✓	✓	×	✓
Objective: Ensure available water is specified for all water bodies	×	✓	✓	×	✓
Cost-effectiveness[a]	n/a	✓	×	~	✓
Expediency[a]	n/a	✓	✓[b]	~	×
Consistency and transparency in development and implementation of interim limits[a]	n/a	✓	×	✓	✓
Provision for local decision-making	✓	×	✓	✓	×
Technical methods					
Objective: National consistency in selection and application of technical methods for determining ecological flows and water levels	×	✓	×	✓	✓
Reduction of conflict regarding selection and application of technical methods[a]	n/a	✓	×	~	✓
Cost-effectiveness[a]	n/a	✓	×	~	✓
Expediency[a]	n/a	✓	✓[b]	~	×
Flexibility to incorporate new or updated methods	✓	✓	✓	✓	✓
Provision for local decision-making	✓	✓	✓	✓	✓

✓ = substantially achieves criteria; × = unlikely to achieve criteria; ~ = no change from status quo.

a Compared to the status quo.

b Provided that the requirement to establish environmental flows and water levels is time-bound.

Although the proposed national environmental standard does not meet one of the criteria on local decision-making, it does endorse local decision-making because the interim limits would be over-ridden when environmental flows and water levels were established through the community processes required as part of developing a regional plan. In effect, there is a trade-off that results in less local decision-making, in the short term, in order to provide the protection of values through interim limits specified at a national level and that are put in place quicker than a regional plan process can achieve.

An alternative national environmental standard is the only other option considered that would satisfy the stated policy objectives. However, the effective implementation of this option is limited in terms of expediency owing to current limitations in methods available to assess the components of environmental flows and water levels related to a comprehensive range of values (eg, recreational, cultural, tangata whenua and aesthetic). The delay required to develop the appropriate technical assessment methods significantly restricts the efficacy of this option to address the policy objectives in the short term.

Question 2 – Assessment and evaluation of alternatives

Do you consider that all available options have been covered? Do you have comments on the assessment and evaluation of alternatives?

5 Proposal for an NES on Ecological Flows and Water Levels

The proposed national environmental standard is intended to complement and enhance the existing Resource Management Act process for establishing environmental flows and water levels through regional plans. The proposal has been developed in response to one of the challenges identified by regional councils.

The proposed national environmental standard will apply to all water bodies, but the effect of the standard on any individual water resource will vary according to existing regional plan provisions.

The proposal includes interim limits that will apply to all water bodies that are not covered by environmental flows and water levels established through a regional plan process. The proposal will also specify which methods are appropriate for determining the ecological component of environmental flows and water levels. These methods will be triggered when applications for resource consent that would breach the interim environmental flows and/or water levels are considered or when such an environmental flows and/or water levels are reviewed, added to or changed in a regional plan. The methods will ensure that the process is transparent and consistently applied.

5.1 Proposed interim limits

The proposed national environmental standard establishes interim limits on alterations to flows and water levels that will apply to water bodies for which there are no environmental flows or water levels specified in a proposed or operative water plan. The interim limits will apply until an alternative is established through the regional plan process.

The interim limits on alterations to flows and water levels all clearly establish a limit to the amount of available water.

An interim limit to alteration of water levels for lakes has not been included. Natural lakes, as opposed to controlled or artificial lakes, are not a major source of water for taking and diversion. A common (or standardised) measure of lake size and relative level variation is not available.

The proposed national environmental standard establishes interim limits on alterations to flows and water levels derived from expert scientist and regional council staff experience with many existing environmental flows and water levels. The interim flows and water levels are also intended to accommodate other values, such as recreational, natural character, and cultural flows. While there is some differentiation between river size and groundwater type, the interim limits are generalised across very different water-body types, so they are set at a level that caters for most water bodies. Water bodies were not further differentiated because these interim limits are intended to be in place only until a regional council has the time and resources to develop its own default or catchment-specific limits. At that stage, local knowledge and expertise can address and respond to differences among rivers and systems.

5.1.1 Proposed interim limits for groundwater

For shallow, coastal aquifers (predominantly sand)

An allocation limit of, whichever is the greater of:

- 15% of the average annual recharge as calculated by the regional council
- the total allocation from the groundwater resource on the date that the standard comes into force less any resource consents surrendered, lapsed, cancelled or not replaced.

For all other aquifers

An allocation limit of, whichever is the greater of:

- 35% of the average annual recharge as calculated by the regional council
- the total allocation from the groundwater resource on the date that the standard comes into force less any resource consents surrendered, lapsed, cancelled or not replaced.

For groundwater that is shown to be connected to adjacent surface water, the environmental flow or water level set for the surface water body will also apply to the management of groundwater takes.

5.1.2 Proposed interim limits for wetlands

Wetlands are ecosystems that have been identified nationally[12] as a national priority for biodiversity because they are greatly diminished in extent and considered rare and threatened ecosystems. Wetlands are not a major source of water for consumptive use, but even small changes in the amounts of water can affect their ecosystem values. A very conservative approach has been used for wetlands. The interim limit essentially prevents any increase in the abstraction of water from a wetland unless provision is made in a regional plan.

For all wetlands

- No change in water levels, beyond the water level variation that has already been provided for by existing resource consents on the date the Standard comes into force.

5.1.3 Proposed interim limits for rivers and streams

To meet the requirements to clearly establish a limit on the available water, the interim flows for rivers and streams specify:

- a minimum flow – a flow at which the abstraction of water ceases

[12] http://www.mfe.govt.nz/issues/biodiversity/initiatives/private-land/work-programme.html#national 15 February 2008.

- an allocation limit – a limit on the amount of water that can be abstracted from the resource that will ensure that flow variability is maintained and the river is not held at its minimum flow for excessive periods of time.

If an existing environmental flow in a plan meets one requirement but not the other, then the interim provisions shall apply to the requirement not addressed by the plan.

For rivers and streams with mean flows less than or equal to 5 m^3/s

A minimum flow of 90% of the mean annual low flow (MALF) as calculated by the regional council and an allocation limit of, whichever is the greater of:

- 30% of MALF as calculated by the regional council
- the total allocation from the catchment on the date that the national environmental standard comes into force less any resource consents surrendered, lapsed, cancelled or not replaced.

For rivers and streams with mean flows greater than 5 m^3/s

A minimum flow of 80% of MALF as calculated by the regional council and an allocation limit of, whichever is the greater of:

- 50% of MALF as calculated by the regional council
- the total allocation from the catchment on the date that the Standard comes into force less any resource consents surrendered, lapsed, cancelled or not replaced.

Question 3 – The need for interim limits

Do you support the need for, and introduction of, interim limits set through a national environmental standard?

Question 4 – The interim limits

Do you have comments on the numbers for the interim flows and water levels? Are there sufficient divisions of rivers and streams and groundwater systems?

Question 5 – Time bound

The proposal does not set a time limit for how long the interim limits will apply. There is some concern that this will not encourage catchment-specific or regional default flows to be set. Do you think the interim flow and water levels should apply for only a limited period?

Question 6 – Inclusion of existing consents within allocation limits

As currently structured, the interim allocation limits include all existing consents. Implementation of the limits will, therefore, not require claw-back of existing consents to meet the interim allocation limit. Claw-back is an option allowed when an environmental flow is set through a regional plan. How do you think the situation, where the amount of water allocated to existing consents exceeds the numeric interim limit, should be addressed?

5.2 Methods for determining ecological flows and water levels

The Ministry for the Environment commissioned scientists from five agencies to develop a process for selecting appropriate methods for determining ecological flows and water levels. The outcome of this work is contained in the technical document *Draft guidelines for the selection of methods to determine ecological flows and water levels* (Beca 2008), released for public consultation along with this document. It is intended that the document will be referenced in the national environmental standard and form the basis for the selection and application of methods to determine ecological flows and water levels.

An executive summary of the technical document is included in Appendix 4. Full copies are available from the Ministry for the Environment's website www.mfe.govt.nz/ or can be obtained by emailing standards@mfe.govt.nz or telephoning 04 439 7400.

The technical document concentrates on aspects of determining ecological flows that require scientific expertise and judgement. Other parts of ecological flow decisions, such as the level of protection to provide, are not included.

The technical document builds on a previous report – *Flow Guidelines for Instream Values* (MfE 1998). It extends the previous report's approach to wetlands, lakes and groundwater, and provides a decision matrix for the selection of methods. The matrix requires information specific to a water body on:

- the potential / allowable demand and the degree to which that demand could alter flows or water levels
- the ecological value of the water resource.

Simple assessment methods would apply where only minor hydrological change to a resource with low ecological value was envisaged, but sophisticated methods (including computer modelling) would be necessary for major alterations to a water resource with high ecological values. The process would apply when new ecological flows and water levels were added to a plan or where existing ones were reviewed.

The proposed national environmental standard caps the amount of water that can be allocated from a water body if sufficient technical assessment of the effects on ecological values has not occurred.

The proposed national environmental standard purports that the approach set out in the technical document be used:

- on those water bodies for which no environmental flows and/or water levels are set in a plan, and a resource consent application would breach interim flows and water levels set in the standard
- when an existing environmental flow or water level is reviewed and/or changed in a plan
- when a new environmental flow or water level is added to a plan.

The technical document will be 'incorporated by reference' in the proposed national environmental standard. Incorporation by reference means that the technical document is formally part of the NES. The RMA allows for documents referenced in national environmental standards to be updated, provided that the NES flags that possibility. It is proposed that the NES state that the technical document can be updated to reflect any new methods or to remove existing methods that are no longer appropriate.

A variation to that approach would be to allow new methods to be used in plan and consent processes provided that the ones set out in the technical document were also applied. The downside of that latter option is that it dilutes the focus of the Standard, and could result in debate about the appropriateness of new methods on a case-by-case basis, rather than new methods being selected as a result of a single decision made as part of implementing the national environmental standard. That variation is not the preferred option set out in this document, but one of the questions below seeks views on how new methods are incorporated.

Question 7 – The need for an NES on the selection of technical methods

Do you support the aim to provide consistency in the selection of methods for assessing ecological values? Does consistency need to be provided in a national environmental standard or would guidance documents be sufficient?

Question 8 – The approach outlined in the technical document

Do you have any comments on the approach outlined in the technical document *Draft guidelines for the selection of methods to determine ecological flows and water levels*?

Question 9 – The inclusion of new methods if they become available

How should new and emerging methods be incorporated into the process outlined in the proposed Standard?

5.3 In what situations will the proposed NES apply?

The interim limits will apply only to those water bodies for which there is no environmental flow or water level set through the regional plan process, or to those that have an environmental flow or water level set in a plan that does not clearly specify the available water.

The proposed standard is intended to apply to the setting of environmental flows and water levels set on or after the date the Standard comes into force. It would exclude consent or plan processes that had already reached a notifiable state (or for which a decision not to notify had been made).

Where an existing environmental flow or water level in a regional plan does not completely define available water, then the interim limits in the national environmental standard will apply until the water plan is amended. For example, for rivers and streams with only a minimum flow specified in a regional plan, the interim allocation limit in the NES will apply until a catchment-specific allocation limit is set, but the minimum flow from the plan would prevail.

The potential application of the proposed national environmental standard is outlined in Table 2.

5.3.1 Situations where the interim minimum flow may not be appropriate

There are some existing regional plans and water conservation orders in which a minimum flow is not specified either in the plan or on some resource consents. These situations include:

- waterbodies for which a high level of protection of natural values is achieved by allowing only a very small or minor amount of allocation. For these water bodies, a minimum flow is deliberately not seen as necessary to protect environmental values.
- community public and stock health water bodies, as resource consents for them are often exempt from minimum flows.

The national environmental standard should also address situations in which minimum flows are currently set via consents rather than through a plan framework. In some of these cases, applying the interim minimum flow to a new or replacement consent will achieve little change in river flow because of the operation of existing consents. This situation occurs in catchments with high levels of allocation, with long-term consents that have many review or expiry dates, and with no minimum flows set in proposed or operative regional plans.

It is proposed that these issues around minimum flows be addressed in the final standard by discussions with regional councils regarding catchments or types of use that should be exempt from the interim minimum flow requirements for one of the reasons outlined above. For such catchments, the regional council would be allowed a specified amount of time to establish an appropriate environmental flow regime via a plan change or variation.

5.3.2 Situations where the interim limits are breached

The proposal as currently stated allows applications to be made for resource consents that would breach the interim limits. The Standard would require that such applications be considered to be for non-complying activities, and it would require that the applicant use the process set out in the technical document to assess ecological values.

Another option is to disallow any applications (ie, classify them as being for a prohibited activity) until an environmental flow or water level is included in an operative or proposed regional plan. Under this option, an applicant who wanted to apply for more water than allowed under the interim limits would either have to initiate a plan change or wait for one to occur. There is not necessarily an incentive to instigate a full data gathering and analysis process.

Concerns have been raised about the use of 'non-complying' activity status, particularly in the absence of a strong planning framework. There is a perception that it is easy for an applicant to gain approval to abstract slightly more water because the effects of that individual application are unlikely to be considered more than minor. Concerns arise because of the cumulative effect of many such applications, the potential to undermine the environmental limits and, more importantly, the ecological and other values that the limit is intended to protect.

Question 10 – NES approach to breaches

How do you think the national environmental standard should address applications for resource consents that breach the interim limits?

Question 11 – Application of the NES to existing and replacement consents

How should the national environmental standard apply to existing and replacement resource consents in each of the situations outlined in Table 2?

Table 2: Potential application of the proposed national environmental standard

Situation		Interim limits	Methods for determining ecological flows and water levels
Application to resource consent decisions			
Resource consent applications for a water body for which environmental flows or water levels have not been set in a proposed or operative water plan or water conservation order.	New application	The interim limits of the proposed NES will apply.	If the application breaches the interim limits, the application must be assessed using the methods in the technical document and it will be considered as being for a non-complying activity.
	Application for a replacement resource consent	The interim minimum flows specified by the NES will apply.	Application for a minimum flow lower than the interim limits must be assessed using the methods specified in the technical document, and it will be considered as being for a non-complying activity.
Resource consent applications for a water body that has incomplete environmental flows or water levels set in a proposed or operative regional plan or water conservation order.	New application	The interim limits of the proposed NES will apply.	If the application breaches the interim limits, the assessment methods in the technical document will apply to the application. Activity status would be as required by the relevant regional plan.
	Application for a replacement resource consent	The minimum flow provisions of the interim limits will apply if a minimum flow is not set in the relevant plan.	Application for a minimum flow lower than the interim limits must be assessed using the methods in the technical document. Activity status would be as required by the relevant regional plan.
Application for a resource consent that falls within an environmental flow and water level regime that is set in a regional plan or water conservation order.	New and replacement consents	No effect.	No effect.
Application for a new resource consent that will exceed environmental flows and/or water levels set in a regional plan.	New and replacement consents	No effect.	The application must be assessed using the methods in the technical document. Activity status would be as required by the relevant regional plan.
Application to regional plans			
The establishment or amendment of an environmental flow or water level in a regional plan.		No effect.	Amendments, reviews or additions to environmental flows and water levels in proposed or operative water plans must follow the methods in the technical document

5.4 How will the NES affect existing resource consents?

The proposed national environmental standard will not directly impact on existing resource consents during their currently specified term. The proposal does not require the alteration of existing consent conditions even when they are not consistent with the proposed NES interim limits.

Once existing consents expire, an application for a new consent is required for the activity to continue. The interim allocation limits have been deliberately set in a way that includes all existing resource consents. Applications for replacement consents cannot, therefore, trigger a breach of the interim allocation limits. Compliance with the interim limits (or an environmental flow or water level in a plan) does not guarantee a consent will be granted. For rivers, streams or connected groundwater systems, the proposal could affect some replacement consents, but only if the consent is from a river or stream where a minimum flow has not been set by a plan. In that case, the interim minimum flow will apply.

There is one situation where existing consent will be indirectly affected by the methods part of the proposed national environmental standard. If a council reviews or adds an environmental flow or water level to a plan, it must assess the effect of flows on ecological values using the methods outlined in the technical document. If a council then applies the environmental flows or water levels to existing consents by consent review under section 128 of the RMA, existing consent holders may be affected. However, it is the council's planning processes that initiate the review, not the NES. Whether or not, and how existing consents are reviewed to effect new environmental flows is a decision made through regional plans, not through the proposed NES.

The process of changing a plan or the subsequent consent review will address the application to existing consents. All the national environmental standard does is standardise the technical methods for providing ecological information for the plan process.

The proposed national environmental standard is not intended to replace the existing regional planning process. Technical methodologies applied to the assessment of individual components of environmental flows and water levels do not, in themselves, pre-determine the level of protection that values should be accorded, nor how any conflicts between values will be resolved. While the proposed NES may assist the decision-making process, the determination of appropriate environmental flows and water levels remains a regional council decision, except where an interim limit is required.

5.5 How will the NES affect existing regional plans?

It is not the intent of the standard to trigger the review of existing environmental flows and water levels specified in proposed or operative regional plans. However, if a review of an existing environmental flow or water level does occur, then the methods part of the proposed national environmental standard would apply to the ecological aspects on the decision. The Standard would also apply to adding new environmental flows or water levels (either catchment-specific or default limits) for rivers, groundwater systems or wetlands to an existing plan.

6 Preliminary Evaluation of Costs and Benefits of Preferred Option

This section provides a preliminary assessment of the likely costs and benefits associated with the proposed national environmental standard over the first 10 years (SKM 2008). Section 32 of the Resource Management Act includes the requirement that an evaluation must be undertaken to examine the extent to which each objective of an NES is the most appropriate way to achieve the purpose of the RMA, and that this evaluation must take into account the benefits and costs of the final standard. This more detailed analysis will be undertaken after consultation on this discussion document and prior to finalising a proposed regulation (standard) for approval by the Minister for the Environment. Submissions on this preliminary assessment will help inform the final analysis.

The potential costs and benefits of the proposed national environmental standard can be considered to occur in four main areas. These are:

- environmental outcomes
- regulatory process
- effects on existing and potential resource consent holders
- effects on the wider public.

6.1 Environmental outcomes

The objectives of the proposed standard are to have clear environmental limits in place and improve practice in ecological assessments. The major benefits of the proposed standard will, therefore, be improved environmental outcomes.

The only environmental cost associated with the proposal is a risk that a concentration on ecological methods could be interpreted as placing a lesser emphasis on other components of an environmental flows such as recreational and cultural values. That is not the intention of the proposal.

Potential environmental benefits resulting from the implementation of the proposed national environmental standard include:

- increased awareness of the need for, and role of, environmental flows and water levels
- greater protection of ecological values through improved selection of assessment methods
- reduced potential for over-allocation and unintended degradation of ecological and other values, particularly in catchments for which environmental flows and water levels are not set in a regional plan
- reduced potential for water allocation via the resource consent process to result in cumulative impacts at the catchment scale
- appropriate consideration is given to ecological values in the determination of environmental flows and water levels
- increased robustness of ecological assessment in highly allocated catchments.

Improvements in the management of water resources and environmental flows will be highly valued by New Zealanders. Values arise from direct use of a water body for recreation or scenic appreciation, but also from spiritual beliefs and experience, cultural identity and history. Some of these values attributed to freshwater can be quantified – such as the average dollar spent by anglers per day – whereas other are intangible. For example, people may value the knowledge that a river system is preserved even though they may never visit the site. Freshwater resources are also valuable to the tourism and recreational industries, and as part of the many benefits attributable to the country's clean green image (MfE 2001).

6.2 Effects on the regulatory process

Because it is an instrument under the Resource Management Act, the proposed national environmental standard will have an effect on regulatory processes, ie, on resource consent decisions and plan preparation, review and variation.

Potential costs associated with the development and implementation of the national environmental standard include:

- costs to central government in the development of the proposal and in providing supporting guidance
- costs to central government to review the effectiveness of standard and technical guidance
- costs to regional councils for the development of processes and procedures to implement the proposed national environmental standard
- increased costs for regional councils to undertake the detailed assessments and methodologies required by the technical document in highly allocated catchments.

Potential benefits associated with the development and implementation of the national environmental standard include:

- increased consistency in water management at a national level
- reduced administrative time and resources expended in supporting the resource consent process
- expedient response to emerging water allocation issues for water bodies for which no environmental flows or water levels are set in a regional plan
- identification and prioritisation of water bodies for monitoring, and the technical assessment that is required to support the development of environmental flows and water levels through the regional plan process
- reduced time and resources expended in supporting the ecological component of environmental flows and water levels through the regional plan process, including a reduction in the scope of resulting appeals.

6.3 Effects on existing and potential resource consent holders

The cost to resource consent applicants will depend on whether or not an application breaches an environmental flow or water level set in a plan or the interim limits set through the proposed national environmental standard. Different levels of public interest in a resource, and the level of opposition / support will also influence whether some of the benefits of the proposed NES are realised by consent holders. Some resource consent applicants will face increased costs, others will face reduced costs.

Potential costs to resource users associated with the proposed standard include:

- additional costs to meet the assessment requirements (ie, to comply with the technical methods) for consents that exceed interim limits
- additional costs to meet the assessment requirements (ie, to comply with the technical methods) for consents that exceed environmental flows and water levels established in a regional plan
- opportunity costs if resource users delay applying for resource consent until the regional plan process is complete.

Potential benefits include:

- increased certainty and transparency in the resource consent process
- reduced assessment requirement and processing cost for replacement resource consents, for water bodies for which no environmental flow and water level is set in a regional plan, and the application falls within the interim limits
- because of the availability of standardised methods, reduced processing costs for resource consent applications for abstraction that exceeds interim limits or an environmental flow and water level set in a regional plan
- consistency of assessment requirements for entities that seek resource consent in multiple regions.

6.4 Effects on the wider public

Potential costs to the wider public associated with the proposed national environmental standard include:

- a reduced ability to influence the selection and application of technical assessment methodologies for individual water bodies
- risk that the weighting placed on the ecological component of environmental flows during the development of a regional plan may be to the detriment of alternative values (ie, recreational, cultural, tangata whenua, aesthetic).

Corresponding benefits may include:

- certainty that the appropriate environmental limits are in place
- greater focus on the application of appropriate management interventions to protect the values associated with a water body rather than on the debate surrounding the selection and application of technical assessment methods
- increased consistency and transparency in the resource consent and regional plan decision-making processes
- reduced time and resources expended submitting applications for resource consents, and plan changes and variations.

6.5 Summary of the costs and benefits

Table 3 summarises the potential benefits and costs associated with implementation of the proposed national environmental standard to the resource consent and regional plan processes, and identifies how these are likely to be distributed between the four groups considered.

Table 3: Summary of costs ('c') and benefits ('b') associated with the proposed NES

Major costs and benefits associated with the resource consent and regional plan processes	Regional councils	Central government	Resource users	Wider public
Development and periodic review of proposed NES		c⇧		
Implementation of the proposed NES	c⇧	c⇧		
Establishment of interim limits for all water bodies	b⇧	b⇧	b⇧	b⇧
Guidance for resource consent process, including the assessment required to support resource consent applications	b⇧		c⇧⇩[a]	b⇧
Applications for resource consent that fall within interim limits	b⇧		c⇩	b⇧
Renewal of existing resource consent applications	b⇧		c⇩	
Applications for resource consents that exceed interim limits or an environmental flow and water level specified in a regional plan	b⇧		c⇧	b⇧
Certainty and transparency in the resource consent process	b⇧	b⇧	b⇧	b⇧
Guidance for the selection and application of technical methods for determining ecological flows and water levels	c⇩	b⇧	c⇩	b⇧
Technical assessment required to support regional plan variation or change	c⇩		b⇧	b⇧

Notes

⇧ = increased; ⇩ = decreased, relative to the status quo.

a May increase or decrease costs for resource consent applications, depending on existing regional council requirements.

Question 12 – Benefits and costs of preferred option?

Have the range of benefits and costs of the proposed national environmental standard been identified? Are the costs and benefits identified in this document accurate? Do you have other information you would like to see included in the cost-benefit analysis that will occur after submissions are received and analysed?

6.6 Partial quantification of the costs and benefits

To assist with evaluation of the proposal, some of the costs and benefits outlined in Table 3 have been quantified. Because many of the potential costs and benefits (particularly those associated with community values and environmental outcomes) are relatively intangible, the assessment does not cover all of the entries in Table 3 and is only a partial quantification of the proposal.

Increased regulatory costs and cost saving from the proposed national environmental standard are the most straightforward part of the proposal to quantify. This preliminary quantification is, therefore, focused on those costs and benefits associated with regulatory processes.

The major aspect of the proposal that is not quantified concerns the environmental benefits. The total value of New Zealand's rivers, lakes, wetlands and groundwater resources to New Zealand is not known. Sharp and Kerr (2005) summarise a variety of regional studies undertaken to quantify the various environmental values associated with freshwater resources. They conclude that New Zealand residents can place a high value on the protection of the natural environment. An example they cite is a net present value in the order of $60 million to Canterbury households arising from the protection of flows in the Waimakariri River. The value of New Zealand's freshwater bodies will be very large but the extent to which this proposal improves or protects that value has not been quantified.

The following other costs and benefits are not quantified:

- benefits to the wider public and consent holders of increased certainty and transparency in the resource consent and regional plan processes
- increased national consistency
- opportunity costs if resource users delay applying for resource consents until regional plans processes are in place
- greater focus during decision-making on values and the appropriate levels of protection rather than on the debate about technical methods.

To quantify the benefits and costs, some assessment must be made of the number of resource consent and regional plan decisions that will be influenced by the proposed national environmental standard once it comes into force. A partial assessment of the benefits and costs has been made using the ranges and the mid-point of those ranges given in Table 4.

Table 4: Quantification of some cost and benefits associated with the proposed NES

	Description	Cost or benefit	Unit
Central government cost	Development of the NES	$550,000 to $1,1500,000	One-off
	Periodic review of the NES and providing guidance material	$100,000 to $200,000	Per review
Regional councils cost	Revised processes as a result of implementing the NES	$20,000 to $100,000	Per region
	Additional costs for assessments in highly allocated catchments	$100,000 to $300,000	Per water body
Regional councils benefit	Reduction in the costs of consent processes	$500 to $2,000	Per consent
	Ability to better avoid over-allocation and reduce the cost of clawing-back water	$0 to $50,000	Per water body
	Prioritisation of catchments	$0 to $20,000	Per region
	Reduction in the conflict over which methods to use	$50,000-$300,000	Per plan change or variation
Consent holders costs	Increased assessment requirements if interim limits are exceeded	$0 to $10,000	Per consent application
Consent applicant costs	Increased assessment requirements if limits in plan are exceeded	$0 to $80,000	Per consent application
Consent applicant benefits	Reduced costs if within the interim limits	$1,000 to $4,000	Per consent application
	Reduced processing costs if outside the interim limits	$0 to $5,000	Per consent application
	Reduced processing costs if outside the limits in plan	$0 to $10,000	Per consent application
Wider public benefits	Reduced cost of submissions	$1,000 to $3,000	Per submission

Assumptions about the number of resource consent applications are based on trends in resource consent numbers and allocated volumes over the period 1999–2007 (Lincoln Environmental, 1999; Aqualinc 2006). It was assumed that, within the next 10 years:

- 40% of existing consents will expire and applications for replacement consents will be made for them (780 consents per year)
- the number of new resource consents applied for each year will stay constant over the next 10 years (1000 consents per year)
- of the resource consent applications for new takes, 20% will be on water bodies for which no environmental flow or water level is set in a proposed or operative regional plan, and half of these (100 resource consents per year) will be for takes that exceed the interim limits
- 2% of resource consent applications for new takes will exceed environmental flows and water levels set in regional plans (20 consents per year)
- all consents that exceed environmental flows or water levels will be publicly notified (120 consents per year).

Other assumptions used in the cost-benefit analysis include that every regional plan will be subject to review over the next 10 years and that an average of one plan change per region will be initiated over this period. It is also assumed each regional plan review or variation process will attract an average of 50 submissions from interested parties. One review of the national environmental standard and technical guidance is assumed to occur within 10 years of the Standard becoming operative.

The net present value of benefits and costs on the basis of the assumptions listed above is contained in Table 5. The low and high estimates are based on either end of the ranges given in Table 4. Overall, the proposal would results in a net benefit in the range of $14 to $36 million over the 10 years following implementation of the Standard. While this range should be considered indicative only, it does show that the proposed national environmental standard is likely to have a positive net present value. The benefits are likely to increase if other non-use values associated with the proposal, including existence values, are taken into consideration.

Table 5: Summary of quantified costs and benefits (over 10 years at 10%)

Group	Present value benefits ($ million)		Present value costs ($ million)	
	Low	High	Low	High
Regional councils	7.1	27.1	1.4	4.8
Central government			0.7	1.5
Resource users	6.6	22.8	0	13.5
Wider public	2.6	9.5		
Total	16.3	59.4	2.1	23.9

The analysis shows significant benefit to regional councils resulting from the proposed national environmental standard. This benefit is largely realised through reduced administration costs for processing resource consent applications and a reduction in the costs associated with selecting and applying the technical methods to determine the ecological component of environmental flows and water levels in the regional plan development process. The analysis also shows significant benefits for the wider public through a reduction in the scope and detail of submissions, both on individual resource consent applications as well as on regional plan reviews and/or changes.

For resource users, the analysis indicates that the benefits derived from the clear specification of assessment requirements and a reduction in hearing costs outweigh the costs to undertake additional technical assessment according to the methods specified in the technical document. However, at the high end of the range, there could be substantial costs to resource users that may, if benefits are at the low end, outweigh the costs to resource users as a collective.

Question 13 – Quantification and analysis

Do you have any comment on the assumptions used in the analysis? Do you have any comment on the partial quantification of costs outlined in this section? Do you have information that would be useful for the full analysis?

7 Future Actions to Complement the NES

The proposed national environmental standard addresses the ecological component of environmental flows and water levels. The working group stressed the need for other work on the complementary parts of decisions about environmental flows and water levels.

Work that would assist the overall implementation of this standard includes:

- carrying out applied science on interim limits to alterations of water levels for lakes and wetlands. This work would assist in describing the degree of hydrological alteration used in the technical document
- developing / providing monitoring guidance on the requirements for evaluating whether, once ecological flows and water levels are in place, the ecological values are being protected to the level predicted, and providing a feedback mechanism for reviewing and varying regional plan provisions. Guidance could apply to monitoring adherence to resource consent conditions, plan effectiveness and state of the environment monitoring
- implementing science programmes to evaluate the appropriateness of ecological flows and water levels at achieving the stated outcomes and levels of protection, preferably using a classification system to increase the applicability of results across all water bodies
- developing methods to reflect uncertainty in the information given to decision-makers around ecological flows
- developing standardised methods for estimating average annual recharge of groundwater.

Work to address the technical tools used to assess the other components of environmental flows and water levels includes:

- developing an equivalent technical document on recreational methods
- developing and testing methods for determining the other components of environmental flows (eg, landscape, tangata whenua, cultural and amenity values), and ultimately the technical documents on these components.

Work to address other issues around decisions about environmental flow and water level includes:

- developing methods for responding to uncertainty within decision-making frameworks
- providing guidance on how to structure environmental flow and water level decisions that are clear about the values provided for and the process used to address ecological, economic, social and cultural benefits and costs
- developing consistent approaches to responding to the potential impacts of future climate variability or climate change on the availability of water resources.

8 What Next?

8.1 Making a submission

Anyone can make a submission on the proposed national environmental standard discussion document. Please include the following information:

- your name and postal address, phone number, fax number and email address (if applicable)
- the title of the proposed national environmental standard you are making the submission about
- whether you support or oppose the proposed national environmental standard
- your submission, with reasons for your views
- any changes you would like made to the proposed national environmental standard
- the decision you wish the Minister for the Environment to make.

You must forward your submission to the Ministry for the Environment, PO Box 10362, Wellington, or by email to standards@mfe.govt.nz, in time to be received by 5 pm, 31 July 2008.

Note: your submission is public information and is subject to release under the Official Information Act 1982. Please clearly indicate if any of your comments are commercially sensitive or if, for some other reason, you consider they should not be disclosed.

8.2 Questions

Your submission can address any issue relating to the proposed national environmental standard discussion document. The Ministry for the Environment particularly welcomes specific comment on benefits and costs of the proposal, and on the following questions, which have been highlighted in boxes throughout this discussion document:

Question 1 – Problem statements and issues
Do you agree with the problem statements and the three key problems that were identified as benefiting from national direction?

Question 2 – Assessment and evaluation of alternatives
Do you consider that all available options have been covered? Do you have comments on the assessment and evaluation of alternatives?

Question 3 – The need for interim limits
Do you support the need for, and introduction of, interim limits set through a national environmental standard?

Question 4 – The interim limits
Do you have comments on the numbers for the interim flows and water levels? Are there sufficient divisions of rivers and streams and groundwater systems?

Question 5 – Time bound
The proposal does not set a time limit for how long the interim limits will apply. There is some concern that this will not encourage catchment-specific or regional default flows to be set. Do you think the interim flow and water levels should apply for only a limited period?

Question 6 – Inclusion of existing consents within allocation limits
As currently structured, the interim allocation limits include all existing consents. Implementation of the limits will, therefore, not require claw-back of existing consents to meet the interim allocation limit. Claw-back is an option allowed when an environmental flow is set through a regional plan. How do you think the situation, where the amount of water allocated to existing consents exceeds the numeric interim limit, should be addressed?

Question 7 – The need for an NES on the selection of technical methods
Do you support the aim to provide consistency in the selection of methods for assessing ecological values? Does consistency need to be provided in a national environmental standard or would guidance documents be sufficient?

Question 8 – The approach outlined in the technical document
Do you have any comments on the approach outlined in the technical document *Draft guidelines for the selection of methods to determine ecological flows and water levels*?

Question 9 – The inclusion of new methods if they become available
How should new and emerging methods be incorporated into the process outlined in the proposed Standard?

Question 10 – NES approach to breaches
How do you think the national environmental standard should address applications for resource consents that breach the interim limits?

Question 11 – Application of the NES to existing and replacement consents
How should the national environmental standard apply to existing and replacement resource consents in each of the situations outlined in Table 2?

Question 12 – Benefits and costs of preferred option?
Have the range of benefits and costs of the proposed national environmental standard been identified? Are the costs and benefits identified in this document accurate? Do you have other information you would like to see included in the cost-benefit analysis that will occur after submissions are received and analysed?

Question 13 – Quantification and analysis
Do you have any comment on the assumptions used in the analysis? Do you have any comment on the partial quantification of costs outlined in this section? Do you have information that would be useful for the full analysis?

8.3 What happens to submissions?

The Ministry will prepare a summary of the submissions, which will be available through the Ministry's website. Hardcopies of the summary will be sent to all submitters and made available on request. The Ministry will then prepare a report on the submissions. This report, together with the recommendations on the proposal for national environmental standard, will be considered by the Minister for the Environment.

9 References

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SKM. 2008. *Benefits and Costs of the Proposed National Environmental Standard on Ecological Flows and Water Levels*. Report to Ministry for the Environment. Christchurch: Sinclair Knight Merz.

Note: The present publication may be cited as:

MfE. 2008. *Proposed National Environmental Standard on Ecological Flows and Water Levels – Discussion Document*. Wellington: Ministry for the Environment.

Appendix 1: Definitions

Term	Definition
Available water	The total quantum of water that can be allocated from a resource for consumptive use including both existing and potential authorised uses. It includes uses for reasonable stock and domestic water supplies provided by the RMA section 14(3), as well as small-scale abstractions permitted by regional plans.
Ecological flows and water levels	The flows and water levels required in a water body to provide for the ecological function of the flora and fauna present within water bodies and their margins.
Environmental flows and water levels	The flows and water levels required in a water body to provide for a given set of values which are established through a regional plan or other statutory process.
MALF	The mean annual seven-day low flow.
Consumptive uses	Consumptive uses refers to any use of water that alters the flows and/or levels in a water body on either a temporary or permanent basis, including situations where water is stored and later released downstream.
Flow sharing	Flow sharing is a method usually used at medium to high river flows, or in combination with a minimum flow or other measures for managing low flows. Under flow sharing, a fixed proportion of the natural flow can be removed; the rest must remain in the river. A 50/50 sharing is the mostly commonly used. Flow sharing is a coarse approach to providing for flow variability and more complex approaches such as specific flushing flows are used when a more detailed analysis of the ecological role of flow variability is available.
Minimum flow	A 'minimum flow' limits the amount of abstraction during low river flows. A minimum flow determines when consent holders have to reduce, and ultimately stop, abstracting. Minimum flows are applied slightly differently throughout New Zealand, depending on local circumstances and location of flow recorder sites.
WAIORA	A computer-based model (Water Allocation Impacts on River Attributes) that calculates whether a water abstraction or discharge could have adverse impacts on dissolved oxygen, total ammonia, water temperature and habitat for aquatic life. The model is available from NIWA.

Appendix 2: Existing Approaches to Ecological Flows

Council	Surface water	Groundwater
Northland Regional Council *(Operative plan)*	Design minimum flow is set at MALF for streams with MALF ≤ 300 L/s. Otherwise, it is set at Q5 unless the water body has a high ecological value; then MALF becomes the design minimum flow. Flow correlation method used to estimate design minimum flow (Q5) in catchments with no long-term record. In all instances, lower minimum flows can be set if the adverse effects of the take can be demonstrated to be avoided.	The schedule in the Regional Plan specifies aquifers with high actual / potential demand. In some sensitive aquifers, groundwater level triggers for reducing takes are imposed.
Auckland Regional Council *(Proposed plan)*	Regional plan provides for the setting of minimum flows in high-use rivers and streams. No minimum flows are scheduled in the regional plan. However, ARC uses key documents to set minimum flow requirements: *Flow guidelines for instream values* (MfE 1998) and *Guidelines for setting stream flow regimes in the Auckland Region* – draft (ARC 2000). The plan also uses the WAIORA (Water Allocation Impacts on River Abstraction) modelling tool to identify the effect of actions to meet its objectives.	Regional plan provides for the setting of aquifer levels and water availability in high-use aquifers. Schedule 2 includes water availability (m^3/year) for 22 aquifers and groundwater levels in three aquifers. Takes are restricted where Schedule 2 groundwater levels drop below the set level.
Environment Waikato *(Proposed water allocation variation notified October 2006)*	The proposed plan variation establishes more policies to prioritise water allocation and restrictions on water takes. Minimum flow trigger is a percentage of Q5, but will be assessed on a case-by-case basis for specified catchments. Allocatable flows are 5% of Q5 for upland catchments, and 5–30% of Q5 for others.	Proposed plan variation establishes sustainable yields for aquifers and prioritises restrictions on water takes. No specific method is stated for establishing sustainable yields.
Environment Bay of Plenty *(Proposed plan)*	Minimum flows are determined through IFIM and RHYHABSIM[13] to protect specific ecological values. The plan also uses *Flow guidelines for instream values* (MfE 1998) for other values. Otherwise, the default instream minimum flow requirement is 90% of the Q5 seven-day low flow, with a default allocation limit of 5% of the Q5 seven-day low flow.	Aquifers are being mapped to assist in developing sustainable yields.
Gisborne District Council *(Operative plan)*	Minimum flows are set based on a minimum level at a river gauging site at the northern areas that are irrigated. When the level drops, monitoring begins.	Triggers are on large aquifers.
Taranaki Regional Council *(Operative plan)*	Default minimum flow will provide two-thirds of the habitat at MALF. It is a guideline only – flow will go under or over it, depending on the values and community. This method was found to be the most robust method for the region and is based on scientific work.	The water plan seeks to limit the taking of groundwater to the sustainable yield of the aquifer.

[13] Instream Flow Incremental Method; River Hydrologic Habitat Simulation

Council	Surface water	Groundwater
Manawatu Wanganui (Horizons) Regional Council *(Draft plan, replaces previous operative plan)*	Decisions made on a case-by-case basis, considering habitat requirements and chemical parameters. It is an integrated approach, using IFIM. The default primary allocation is 20% of MALF. The allocation is supplementary when the river is above its median flow and no more than 10% of the flow taken at any one time. A 'default' minimum is still under consideration.	Guidance regarding the sustainable yield is provided in the Council's technical publication *Groundwater allocation methodology: Horowhenua and Manawatu* (Horizons Regional Council 2004). The sustainable yield is based on 50% of the land surface recharge.
Hawkes Bay Regional Council *(Operative plan)*	Minimum flows are established on a case-by-case basis for surface water takes. The Council uses IFIM. It has used New Zealand-derived habitat curves for native fish and is collaboratively developing an East Coast-specific habitat curve for trout.	The plan does not have developed sustainable yields or volumes of allocation for any aquifer systems.
Greater Wellington *(Operative plan)*	Fourteen rivers in the region have comprehensive management regimes that set minimum flows. A case-by-case assessment of minimum flow requirements is carried out. Guidance states that historical flow methods can be used in rivers with a MALF $\leq$1000 L/s, and IFIM can be used in bigger rivers. Allocation is primarily habitat-based (two-thirds habitat protection).	The water plan specifies safe yields for all aquifers. It states that 'daily safe yields are based on the estimated sustainable yield of the aquifer system which are calculated from annual water balance information. These yields are, therefore, conservative estimates based on the precautionary approach'. A conceptual model of aquifers is being developed to help refine the assessment of availability. A detailed hydrogeological model has been developed for the Lower Hutt groundwater system, to set a sustainable yield and minimum water level. For other aquifers, where there is no detailed model or the recharge mechanism is well understood, the sustainable yield is based on the water balance approach or calculated aquifer throughflow.
Marlborough District Council *(Operative plan)*	Sustainable flow regimes are set for rivers in the Plan. No specific information is available on how minimum flows are set.	A throughflow approach was used to set sustainable yield limits. Models exist for some aquifers.
Nelson City Council *(Operative plan)*	Surface water default allocation limits are used. For specified rivers, this is 10% of the one-in-five-year mean low flow for rivers with high ecological values. 33% of the one-in-five-year mean low flow is used for rivers from which water is abstracted. For unspecified rivers, the limit is 10% of the one-in-five-year mean low flow.	There are no aquifers within Nelson City.

Council	Surface water	Groundwater
Tasman District Council *(Operative plan)*	The Plan is to have regard to *Flow guidelines for instream values* (MfE 1998) when establishing minimum flow regimes. Integrated surface and groundwater models are used where required to establish links, and modified IFIM methods are used for surface water triggers. An allocation limit based on a 1:10-year security of supply standard (35% reduction in a one-in-ten-year drought) forms part of how allocation limits are set. Minimum flows and triggers for rationing of water takes are specified for high-use catchments based on the previous paragraph. For smaller rivers where there is insufficient information or where abstractive pressures are less, the established thresholds for abstractive allocation are based on the five-year, seven-day low flow and the significance of the rivers or streams.	Water plan seeks to establish the sustainable yield of aquifers. Detailed integrated hydrogeological models including river interactions where applicable have been used to determine limits of abstraction for key groundwater systems on the same security of supply standard as river systems where applicable. The five-year, seven-day low flow is the default as a trigger for other river / aquifer interrelated systems.
West Coast Regional Council *(Proposed plan)*	Where more than 20% of any stream has been allocated, a minimum flow will be applied to any new consent for taking water. In the absence of detailed hydrological information, a minimum flow based on 75% of the MALF will apply. Lower minimum flows can be set if the adverse effects of the take can be demonstrated to be avoided.	The plan does not have sustainable yields or volumes of allocation for any aquifer systems.
Environment Canterbury *(Operative catchment regional plans)* *(Water Conservation orders)* *(Proposed plan NRRP)*	Three operative catchment regional plans. Each apply different methods to set flow and allocation (generally have included IFIM approach). Flow and allocation regimes included in three water conservation orders. Waitaki Regional Plan recognises allocation and minimum flow provisions of the Ahuriri WCO. NRRP recognises Rakaia WCO and is to be amended to recognise the Rangitata WCO (finalised since the NRRP was notified). Some flow and allocation regimes are set in the NRRP and more are being introduced into NRRP via variations following specific catchment investigations and consultation. Flow requirements are determined for different values and judgement applied to establish overall water management regime including flow and allocation. IFIM approach often used also expert panel approach. Guided by *Flow Guidelines for Instream Values (*MFE 1998*)*. Where water management regime has not been developed, a default 'A' allocation limit set by flow equalled or exceeded 85% in January / February less the minimum flow. Supplementary or 'B' allocation – guidance given that 'B' allocation can start once river flows exceed an amount equal to minimum flow plus half the 'A' allocation. The minimum flow used in the default situation is that which has been established in the catchment to date via the resource consent process.	Proposed plan contains interim limits. Variation 4 sets allocation limits as annual volumes in the NRRP. Initial estimate is 50% of the annual average land-surface recharge or, if insufficient information is available, then 15% of the average annual rainfall is used. Once limits have been calculated using these formulas, adjustments have been made to them based on other available information (eg, required low land stream inflows).

Council	Surface water	Groundwater
Otago Regional Council *(Operative plan)*	Site and catchment-specific scientific approach – predominantly IFIM – for all rivers. Catchment Specific Allocation limits are set in schedule 2A of the water plan. Where no specific limit is set a default primary allocation of 50% of seven-day MALF or the consented seven-day take as at February 1998 less any consented surrendered, lapsed or not replaced after 28 February 1998 is used. Further allocation is available as *Supplementary allocation* and is based on 50/50 flow sharing. Supplementary minimum flows are set to allow water harvesting at moderate to high flows.	An aquifer-specific approach is used. Allocation limits are set using different methods for each aquifer. There are restriction levels on key reference bores within some aquifers. There are 25%, 50% and 100% restrictions on groundwater use within seven aquifers.
Environment Southland *(Proposed plan)*	The plan groups rivers using the 'Source of Flow' level in the River Environment Classification (REC). For each group of rivers, critical values are identified that are used as the basis for determining minimum flows and levels. The concept of critical values is that by providing sufficient flow to sustain the most flow-sensitive value, the other significant values will also be sustained. The Plan contains a staged management approach to surface water allocation as follows: • where less than 10% of the mean annual low flow is allocated, the default minimum flow is the mean annual low flow and the take or diversion is a restricted discretionary activity • where 10% to 30% of the mean annual low flow is allocated, a minimum flow derived from generalised habitat models for the critical value species applies and the take or diversion is a discretionary activity • where greater than 30% of the mean annual low flow is allocated, a minimum flow derived from an instream habitat analysis for the critical value species applies and the take or diversion is a non-complying activity.	Incorporates a staged management approach to various aquifer types based on the level of risk of adverse environmental effects. The level of risk is directly related to the sensitivity of the hydrological setting to adverse effects and the level of resource development expressed as a percentage of annual land-surface recharge. Riparian or terrace aquifer: 25% of the mean annual land surface recharge (stage 1). Confined aquifer: pumping results in no more than a 25% reduction in the potentiometric head at a distance 250 metres from the bore (stage 1). Riparian or terrace aquifer: greater than 50% of the mean annual land surface recharge (stage 3). Lowland aquifer: greater than 15% of the mean annual land surface recharge. Confined aquifer: pumping results in greater than a 50% reduction in the potentiometric head at a distance 250 metres from the bore.

Appendix 3: Environmental Flows and Water Levels

The process of setting environmental flows and water levels

The process of setting environmental flows and water levels is undertaken by regional councils under the Resource Management Act (RMA). This process requires community participation and allows stakeholders to make submissions on the form and content of proposed provisions. The process also provides a right of appeal to the Environment Court against decisions made by council.

The setting of environmental flows or water levels requires a judgment to be made by a regional council on the management interventions required to provide for the values attributed to a water body, taking into account both natural and development values. This judgement is made in accordance with the priorities set in Part II of the RMA, national policy statements, regional policy statements and regional plans, and is informed by technical and subjective assessment of the likely consequences of changes to water flows or water levels to the values attributed to the water body.

Regional plans adopt a wide range of approaches to setting environmental flows and water levels for surface and groundwater resources. Approaches vary significantly in terms of the technical assessment methods used and may be applied at scales ranging from catchment-specific plans to more generic (or default) regional approaches. Regional plans also differ significantly between individual regions with regard to the specific provisions relating to the management of lakes, wetlands and hydraulically connected groundwater.

The role of science

Science plays an important role in the process of setting environmental flows and water levels. Science has a particular application in characterising the physical attributes of a water body and providing assessments of how changing flows or water levels may impact on these features. However, not all attributes of a water body can be readily assessed in quantifiable terms, particularly those more subjective values.

Determination of an appropriate environmental flow or level, therefore, has to incorporate both quantitative and qualitative information on the potential impacts of changes to flows or water levels on values associated with the water body. Science can help provide information on the relationships between flows and values. However, the decision-making process also requires a judgement to be made on the extent to which individual values are provided for in the final environmental flows or water levels adopted, especially where there may be conflict between these values.

It is important that the quantifiable and measurable parameters of a water body are clearly presented, separately from more subjective measures, so that all interested parties and decision-makers can see and understand what the final flow limits have been based on.

Dealing with uncertainty

One of the major challenges facing councils in determining appropriate environmental flows and water levels is dealing with the uncertainties inherent in many of the data used to inform the decision-making process. This uncertainty results from a combination of the variability inherent in natural hydrological systems, scientific error in technical assessment methodologies, and the subjective nature of the assessments required to quantify potential impacts of altering the flows and/or water levels on values associated with a particular water body (eg, impacts on landscape, amenity and cultural values).

Methods for dealing with uncertainty include:

- clearly identifying uncertainties in information and methodologies used in the decision-making process and recording how these were considered in that process
- adopting an approach to setting environmental flows and water levels that reflects uncertainty and potential cumulative effects where limited information is available to describe the physical characteristics of the resource
- developing a flexible management approach whereby the volume of available water changes as more information becomes available
- providing an adaptive mechanism that allows for environmental monitoring information (including impacts on associated natural values) to be incorporated into a review of environmental flows and water levels.

Determination of appropriate environmental flows and water levels also has to take into consideration future uncertainty associated with the potential impacts of both climate variability and climate change. Both factors should be taken into account, particularly where information on historical flows and water levels is used to inform the decision-making process.

The catchment context

Environmental flows cannot be set without consideration of the management of the surrounding existing and future catchment. If a catchment is intact and has high water quality, then the in-stream environment is more robust and the amount of water taken can have a lesser effect than in a very modified catchment. Mitigation in the form of catchment land-use changes (eg, provision of tall shading riparian vegetation and other improvements to water quality) can make a water body more robust to changes in flow, and when calculating the environmental flow, it may be possible to take more water. When setting environmental flows it is, therefore, best practice to integrate decisions with land-use and water quality management so that all potential effects of future use can be considered holistically.

Challenges in practice

Consultation with regional councils undertaken as part of the Sustainable Water Programme of Action identified a number of challenges in the development and timely inclusion of environmental flows and water levels in regional plans. These include:

- some decision processes have become very litigious, resulting in long timeframes to collect and analyse robust and defensible data, consult with polarised stakeholders and go through contentious hearing and Environment Court processes
- limitations on financial resources as well as the availability of appropriate technical skills and experience
- a lack of defendable scientific data and other information that often requires years of collection to be statistically valid. Even what is considered good science and adequate data may still be contested by stakeholder experts in hearings and court
- outcomes of resource consent and environment court processes that deliver outcomes not entirely consistent with policies and objectives in regional plans
- a historical focus on minimum flows rather than environmental flows, which means that some existing plans provide limited guidance about how to address environmental flows when demand for water is high. This results in limited protection for instream values if demand should increase, and a lack of assurance that key ecosystem function is safeguarded
- the lack of consistent methods for responding to the potential impacts of future climate variability or climate change on the availability of water resources
- the lack of flexibility in existing planning instruments that prevent implementation of adaptive approaches. Such approaches would enable environmental flows and water levels to be adjusted over time as knowledge increases.

A particular issue for practitioners is the need to clearly distinguish the technical tools used to generate and assess options from the fundamental resource management decisions required. A great deal of time can be spent arguing about an appropriate method for setting environmental flows, because flows cannot be 'standardised' in the same way that a water quality standard can. The water quality requirements for trout can be described relative to a specified and measurable level of contaminant, but trout requirements cannot be related to a given flow applicable in all rivers. The national environmental standard aims to reduce significantly the need for technical debate to be repeated countless times in separate plan and/or consent decisions. However, this debate should not be confused with two, more important resource management questions, which are: What environmental values should be sustained? and: What level of protection is appropriate, given all the interest in a water body?

Another issue is the need for a more flexible, responsive system for water allocation. In particular, the development of many water resources in recent years has proceeded at a faster rate than corresponding rules and policies can be developed through the regional plan process. As a result, some water resources do not have adequate environmental flows and/or water levels in place, resulting in resource consent decisions being made on an ad hoc basis rather than at a catchment scale.

Appendix 4: Executive Summary and Recommendations from: *Draft Guidelines for the Selection of Methods to Determine Ecological Flows and Water Levels* (Beca 2008)

Introduction

The Ministry for the Environment (MfE) is assessing the need for a National Environmental Standard (NES) on methods for establishing ecological flows and water levels for rivers, lakes, wetlands, and groundwater resources. As a part of this process, MfE sought scientific guidelines for selecting appropriate methods for determining ecological flows and water levels. Beca Infrastructure Ltd (Beca) was commissioned to coordinate the 'capture' of this advice from some of New Zealand's top experts on the science of assessing the ecological requirements for ecological flows and water levels. This executive summary documents which approach the expert group recommends to be taken in selecting an appropriate method. The full report provides the underlying logic behind the recommendations.

It should be noted that this report relates only to method selection for establishing ecological flow requirements. **Ecological** flows are defined here as "the flows and water levels required in a waterbody to provide for the ecological integrity of the flora and fauna present within waterbodies and their margins". This report offers no guidance on the process of how to set **environmental** flows (defined as "the flows and water levels required in a waterbody to provide for a given set of values which are established through a regional plan or other statutory process") or the management implications of environmental flow decisions.

Methodology

Beca facilitated a two-day workshop in Christchurch on 19–20 December 2006. The workshop participants:

(i) listed the ecological management objectives/values relating to the ecological flow/level of the river, lake, wetland or groundwater resource being considered, together with factors that might affect the ability to achieve that objective

(ii) listed the technical methods applicable to the setting of ecological flows and water levels for the type of water body under consideration and debated the pros and cons of each method

(iii) developed a matrix of methods applicable depending on the significance of the values perceived for the water resource under consideration, and the degree of hydrological alteration being considered for that water resource.

Subsequent to the workshop, lead writers – for each of: rivers, lakes and wetlands, and groundwaters – drafted documents intended to support the recommendations. Each of these documents was reviewed by three members of the workshop team as well as by the Department of Conservation (in the case of rivers and lakes) before being consolidated by Beca.

Recommendations: rivers

It is proposed that the approach to selecting technical methods to determine the ecosystem flow requirements of rivers be based initially on the risk of deleterious effects on instream habitat according to the species present and natural mean stream flow (Table 1). The risk of abstraction decreasing available habitat depends on stream size and the species present in the stream, with higher risks of deleterious effects in small streams than in larger streams and rivers.

Table A4.1: Assessment of risk of deleterious effects on instream habitat according to fish species present and natural mean stream flow (and generic application to other values/management objectives°)

Mean flow (m^3/s)	Inanga,* upland bully, Crans bully, banded kopopu*	Roundhead galaxias, flathead galaxias, lowland longjaw galaxias, redfin bully,* common bully*	Salmonid spawning and rearing, torrentfish,* bluegill bully*	Adult trout+
<0.25	High	High	High	High
<0.75	Moderate	High	High	High
<5.0	Low	Moderate	High	High
<15.0	Low	Low	Moderate	High
15–20	Low	Low	Low	Moderate
>20	Low	Low	Low	Low

* Access to and from the sea is necessary.

\+ Access to spawning and rearing areas is necessary.

° Actual degree of impact will depend on the degree of hydrological alteration whether or not the level of risk is high or low.

Note: The data in the column for 'Salmonid spawning and rearing, torrentfish, bluegill bully', may be generically applied to invertebrates and riverine bird feeding (eg, wading birds, blue duck, black fronted tern).

The extent to which abstraction affects the duration of low flows is a useful measure of the degree of hydrological alteration. A high degree of hydrological alteration is assumed to occur when abstraction increases the duration of low-flow conditions to 30 days or more, with moderate and low levels of hydrological alteration corresponding to increases of about 20 days and 10 days, respectively.

The degree of hydrological alteration for a river can be determined, first by determining the risk based on mean flow and species present (Table 1), then using Table 2 to determine how the total abstraction (in terms of mean annual low flow, MALF) affects the degree of hydrological alteration for the stream and its risk category and its baseflow characteristics. In Table 2, a high baseflow river is one where the low flows are relatively high compared to the mean flow, such as in rivers with frequent freshes, rivers with their sources in hilly or mountainous areas or rivers fed from lakes, or springs. A low baseflow river is one where the low flows are very much lower than the mean flow, such as occurs in rain-fed rivers in areas that are not subject to orographic rainfall. Further details are given in the supporting document.

Table A4.2: Relationship between degree of hydrological alteration and total abstraction expressed as % of mean annual low flow for various risk classifications (Table A4.1) based on stream size and species composition

Risk of deleterious effect						Degree* of hydrological alteration
Low risk and high baseflow	Low risk and low baseflow	Moderate risk and high baseflow	Moderate risk and low baseflow	High risk and high baseflow	High risk and low baseflow	
<20%	<15%	<15%	<10%	<15%	<10%	Low
20–40%	15–30%	15–30%	10–25%	15–30%	10–20%	Medium
>40%	>30%	>30%	>25%	> 30%	>20%	High

* Abstraction of more than 40% of MALF, or any flow alteration using impoundments would be considered a high degree of hydrological alteration, irrespective of region or source of flow.

Once the degree of hydrological alteration is determined, Table 3 lists the technical methods that should be used to assess ecological flow requirements. One or more of the methods listed within each cell of Table 3 should be used to assess ecological flow requirements for the given combination of degrees of hydrological alteration and significance of instream values. In situations with high instream values, two or more methods from each cell should be used, because the risks to stream ecology of making an incorrect ecological flow decision are greater. The methods within each cell are not listed in hierarchical order and the choice of method(s) depends upon the perceived ecological problem affected by the flow regime. Specific recommendations of the use of each of the methods are given in the supporting document.

Hydrological alteration of rivers involves an examination of a number of hydrological statistics, including flow variability of the system, which affects the quality of instream habitat, and the connectivity of rivers with riparian wetlands, springs and groundwater. Potential critical factors include magnitude and duration of low flows or levels, timing, frequency and magnitude of floods and the inundation (as referenced to water level) of wetlands, surface–groundwater exchange, and maintenance of fish passage. This requires knowledge of the pattern and ecological significance of water level variation in wetland and groundwater systems.

Table A4.3: Methods used in the assessment of ecological flow requirements for degrees of hydrological alteration and significance of instream values

Degree of hydrological alteration	Significance of instream values		
	Low	**Medium**	**High**
Low	Historical flow method Expert panel	Historical flow method Expert panel	Generalised habitat models 1D hydraulic habitat model Connectivity/fish passage Flow duration analysis
Medium	Historical flow method Expert panel Generalised habitat models	Generalised habitat models 1D hydraulic habitat model Connectivity/fish passage	1D hydraulic habitat model 2D hydraulic habitat model Dissolved oxygen model Temperature models Suspended sediment Fish bioenergetics model Groundwater model Seston flux Connectivity/fish passage Flow variability analysis
High	Generalised habitat models 1D hydraulic habitat model Connectivity/fish passage Periphyton biomass model	Entrainment model 1D hydraulic habitat model 2D hydraulic habitat model Bank stability Dissolved oxygen model Temperature models Suspended sediment Fish bioenergetics model Inundation modelling Groundwater model Seston flux Connectivity/fish passage Periphyton biomass model	Entrainment model 1D hydraulic habitat model 2D hydraulic habitat model Bank stability Dissolved oxygen model Temperature models Suspended sediment Fish bioenergetics model Inundation modelling Groundwater model Seston flux Connectivity/fish passage Periphyton biomass model Flow variability analysis

Recommendations: lakes and wetlands

Lakes

The distribution and occurrence of healthy lake littoral habitats and communities vary with lake size, depth and water clarity. The risk of changing lake levels decreasing available habitat or adversely affecting communities depends on the lake bed profile (bathymetry), substrate type, water clarity, wave action as well as size and depth. The risks of deleterious effects are greater in shallower systems than in deep water bodies. Within a lake level range, impacts arise from changing seasonality in levels and the proportion of time spent at different levels (level duration).

It is proposed that for lakes, the risks for a potential change to lake level may be defined as follows:

- **Low**. Less than 0.5 m change to median lake level in lakes greater than 10 m depth, and less than 10% change in annual lake level fluctuation in lakes greater than 10 m depth; and less than 10% change in median lake level and annual lake level fluctuation in lakes less than 10 m depth; and, patterns of lake level seasonality (relative summer vs winter levels) remain unchanged from the natural state.
- **Medium**. Between 0.5 and 1.5 m change to median lake level and less than 20% change in annual lake level fluctuation in lakes greater than 10 m depth; and between 10 and 20% change in median lake level and annual lake level fluctuation in lakes less than 10 m depth; and, patterns of lake level seasonality (relative summer vs winter levels) show a reverse from the natural state.
- **High**. Greater than 1.5 m change to median lake level, and greater than 20% change in annual lake level fluctuation in lakes greater than 10 m depth, and more than 20% change in median lake level and annual lake level fluctuation in lakes less than 10 m depth; and, patterns of lake level seasonality (relative summer vs winter levels) show a reverse from the natural state.

The risks for a potential change to lake level must also be defined in relation to seasonal and inter-annual level variability as determined by the methods shown in Table 4 below and documented in full in the main report.

Once the risk of potential change to lake level has been established (degree of hydrological alteration) the technical methods that should be used to assess level requirements should be selected from Table 4. One or more of the methods listed within each cell of Table 4 should be used to assess ecological flow and level requirements for the given combination of degrees of hydrological alteration and significance of instream values. In situations with high lake values, two or more methods from each cell should be used, because the risks to ecology of making an incorrect ecological flow decision are greater. The methods within each cell are not listed in hierarchical order and the choice of method(s) depends upon the perceived ecological problem affected by the flow regime. Specific recommendations of the use of each of the methods are given in the supporting document.

The proposed categorisation of risks associated with potential changes in lake levels are based on the professional judgement/experience of lake experts within this team. We recommend that work be commissioned to provide scientific justification for this categorisation and provide an

equivalent of MALF (and other flow statistics) based on level duration curves. Profiles of level duration demonstrate graphically and quantitatively the lake level regime, however there is currently no easy way to use these in a general rule-based format as they are calculated from absolute altitude. It will be possible to convert these to a relative level based on variance from a mean (or median) lake level. In this way curves between lakes could be compared and a general set of rules on level duration derived.

Table A4.4: Methods used in the assessment of ecological flow and water level requirements for degrees of hydrological alteration and significance of lake values

Degree of hydrological alteration	Lakes: Significance of values		
	Low	Medium	High
Low	Historical time series analysis Expert panel	Historical time series analysis Expert panel	Habitat analysis in drawdown zone Water balance models Species-environment models Residence time vs water quality modelling
Medium	Historical time series analysis Expert panel	Habitat analysis in drawdown zone Water balance models Species-environment models Residence time vs water quality modelling	Bank stability and geomorphology analysis Wave action assessment Water level and ramping rates Water clarity assessments Temperature modelling Processes-based water quality models Groundwater/surface water interaction
High	Habitat analysis in drawdown zone Water balance models Species-environment models Residence time vs water quality modelling	Bank stability and geomorphology analysis Wave action assessment Water level and ramping rates Water clarity assessments Temperature modelling Processes-based water quality models Groundwater/surface water interaction	Bank stability and geomorphology analysis Wave action assessment Water level and ramping rates Water clarity assessments Temperature modelling Processes-based water quality models Groundwater/surface water interaction Hydrodynamic water quality models

Wetlands

The distribution and occurrence of healthy wetlands varies with size and depth and connectivity to other hydrological systems. The risk of changing wetland levels decreasing available habitat or adversely affecting communities depends on the depth and the bathymetry and the dominant species present. Wetlands are generally shallow with wide littoral ephemeral areas that are dependent on a number of different flow-dependent variables. Therefore risks to wetlands are perhaps greatest compared with any other freshwater ecosystem. The risks of deleterious effects are greater in shallower than in deepwater wetlands, and wetlands without permanent connections to freshwater sources. The effect of changing inflows and/or outflows and therefore changing levels depends not only on the magnitude of change but also the timing, periodicity (hydroperiod) and duration of the levels.

It is proposed that for wetlands the potential risk of ecological change associated with changes in levels may be defined as follows:

- **Low**. Less than 0.2 m change in median water level; and, patterns of water level seasonality (summer vs. winter levels) remain unchanged from the natural state (summer relative to winter).
- **Medium**. Greater than 0.2 m and less than 0.3 m change to median water level; and, patterns of water level seasonality show a reverse from the natural state (summer relative to winter).
- **High**. Greater than 0.3 m change to median water level; and, patterns of water level seasonality show a reverse from the natural state (summer relative to winter).

The risks for a potential change to wetland level must also be defined in relation to seasonal and inter-annual variability in hydroperiod as determined by the methods shown in Table 5 below and documented in full in the main report.

Once the risk of potential change to wetland level has been established (degree of hydrological alteration) the technical methods that should be used to assess level requirements should be selected from Table 5. One or more of the methods listed within each cell of Table 5 should be used to assess ecological flow and level requirements for the given combination of degrees of hydrological alteration and significance of wetland values. In situations with high wetland value, two or more methods from each cell should be used, because the risks to ecology of making an incorrect ecological flow decision are greater. The methods within each cell are not listed in hierarchical order and the choice of method(s) depends upon the perceived ecological problem affected by the flow regime. Specific recommendations of the use of each of the methods are given in the supporting document.

Table A4.5: Methods used in the assessment of ecological flow and water level requirements for degrees of hydrological alteration and significance of wetland values

Degree of hydrological alteration	Wetlands: Significance of values		
	Low	Medium	High
Low (< 20 cm change)	Historical water level records Expert panel Remote delineation of site and catchment Wetland record sheet (MfE methodology)	Historical water level records Expert panel Remote delineation of site and catchment Wetland record sheet (MfE methodology)	Detailed local delineation Wetland hydrological condition assessment and model change (MfE methodology) Species-environment models Habitat assessment Water quality modelling
Medium (20–30 cm change)	Historical water level records Expert panel Remote delineation of site and catchment Wetland record sheet (MfE methodology)	Detailed local delineation Wetland hydrological condition assessment and model change (MfE methodology) Species-environment models Habitat assessment Water quality modelling	Full ecohydrological assessment Groundwater /surface water interaction Process-based water quality models Microtopographic survey
High (> 30 cm change)	Detailed local delineation Wetland hydrological condition assessment and model change (MfE methodology) Species-environment models Habitat assessment Water quality modelling	Full ecohydrological assessment Groundwater /surface water interaction Process-based water quality models Microtopographic survey	Full ecohydrological assessment Groundwater /surface water interaction Process-based water quality models Microtopographic survey

Recommendations: groundwater

Typically, knowledge of groundwater systems is less certain than knowledge of surface waters. Therefore, the approach for groundwater differs slightly from the approach for rivers, lakes and wetlands. A 'cumulative approach' to groundwater methods application is used in response to uncertainty and the unknowns associated with groundwater systems. A 'cumulative approach' to methods application follows the typical groundwater investigation process whereby simple models are used to build more complex models.

It is proposed that for groundwaters the potential risk for changes in levels may be defined as follows:

- **Low**: Less than 10% of average annual recharge
- **Medium**: 11% to 25% of average annual recharge
- **High**: Greater than 26% of average annual recharge.

Once the risk of potential change to groundwater levels has been established (degree of hydrological alteration) the technical methods that should be used to assess level requirements should be selected from Table 6. One or more of the methods listed within each cell of Table 6 should be used to assess ecological flow requirements for the given combination of degrees of hydrological alteration and significance of the resource values. The methods within each cell are not listed in hierarchical order and the choice of method(s) depends upon the perceived

ecological problem affected by the flow regime. Specific recommendations of the use of each of the methods are given in Chapter 4.

Potential changes to flow regimes relate to the percentage allocation of aquifer recharge. It is acknowledged that these allocation thresholds from low to high may vary depending on the nature of the groundwater system. However the recharge percentages as presented, provide a conservative approach to groundwater allocation in most circumstances. 'Significance of values' should be used as the main criterion for determining methods most suitable for water level requirements when the relationship between groundwater allocation and the potential change to the flow regime is uncertain (eg, in deep confined aquifer systems where recharge and discharge are not well defined.

Table A4.6: Methods used in the assessment of water level requirements for degrees of hydrological alteration and significance of groundwater values

Potential degree of hydrological alteration from groundwater allocation	Groundwater: Resource values and their relative significance		
	Low (not sensitive)	Medium	High (extremely sensitive)
Low (up to 10% of recharge)	Conceptual model / simple water balance Historical levels	Conceptual model / simple water balance Historical levels Expert panel Detailed water balance	Detailed water balance Time series analysis Analytical models Numerical quantity models – steady state Numerical quantity models – transient Numerical quality models – transport
Medium (11–25% of recharge)	Conceptual model / simple water balance Historical levels Expert panel	Detailed water balance Time series analysis Analytical models Numerical quantity models – steady state	Numerical quantity models – steady state Numerical quantity models – transient Numerical quality models – transport Consolidation models
High (over 25% of recharge)	Detailed water balance Time series analysis Analytical models Numerical quantity models – steady state Numerical quantity models – transient Numerical quality models – transport	Numerical quantity models – steady state Numerical quantity models – transient Numerical quality models – transport Consolidation models	Numerical quantity models – steady state Numerical quantity models – transient Numerical quality models – transport Consolidation models