

Water Allocation

A Transferable Rights Framework

To

Sustainably Allocate

New Zealand's Fresh Water Resources

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Authors Note

In 2003 I was asked by Meridian Energy Limited to undertake a literature review of water policy, both within NZ and around the world, and then develop a ten year view on how New Zealand's water policy could develop. In July & August 2003 I developed the conceptual model encapsulated in this paper, and that work was then built on and enhanced by Meridian and their advisers and was promulgated publicly in various forums such as the government's water program of action. In 2005 I pursued other business interests and I have not worked for Meridian or any other water interests since then.

I wrote this paper in early 2009 as an independent contribution to the developing debate over Water Allocation. My motivation is primarily to ensure NZ protects its' environment and grows its' economy by ensuring entitlements are secure, investment incentives are protected and unnecessary costs and conflicts are avoided. My objective is for New Zealand to create a regulatory framework that is environmentally sustainable, that will enable economic growth and that will be as enduring as the frameworks for managing land (i.e. land registry, surveying system, regional plans, transfer procedures, etc). This paper seeks to promote these objectives.

I would like to acknowledge and thank Meridian and their advisers for the contribution they have made to the public debate on water policy over the years and those who have more recently provided advice and encouragement. Any errors or omissions remain my responsibility.

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Water Allocation: A Sustainable Transferable Rights Framework

Introduction

1. Water is a key resource underpinning our future economic growth. As areas of water scarcity increase, evidence continues to mount that there are significant shortcomings in our existing arrangements for the allocation of water. It is, therefore, timely to review current arrangements to ensure they better direct water to its most efficient use while also protecting the environment.
2. This paper proposes a system of tradable rights, established and regulated by legislation, managed by Regional Councils, with national coordination of the transition to the proposed arrangements.
3. It is argued that the proposed system would:
 - effectively protect the environment
 - increase efficiency of use and grow the economy
 - prevent or reduce costly conflict
 - avoid the imposition of unnecessary cost

The Outcome

4. The proposed framework, once the transition was completed, would create an environment that better serves the community. This is summarised in the following paragraphs.
5. The environmental, social and cultural requirements for river flows (together 'the environmental baselines'):
 - are reserved. Water allocations can only be exercised when inflows exceed these requirements
 - are evaluated, determined and changed in the same manner as at present
 - can be as simple or as complex as the Regional Council determines
 - would be defined by a default environmental baselines regime where no other authority exists (e.g. Regional Plan, Water Conservation Order). The default environmental baselines (not part of this proposal) would be defined within a National Environmental Standard.
6. Regional Councils would:
 - establish environmental baselines for a catchment as and when warranted by increasing demand in that catchment

- no longer be required to address the water allocation framework when developing or reviewing their regional plans
- continue to grant water allocations up to an allocation limit in the same way as they grant resource consents for water use today
- continue to authorise water 'use' activities and water 'take' infrastructures in the same way they do today
- in catchments where water is scarce, appoint a Catchment Monitor to scale (using formulae defined in legislation) water allocations to match the available water (both in any particular year and during any particular week), and to manage the transfer processes

7. Users:

- would enjoy more certainty over their right to access their water allocation. The water allocation definition and the rules to protect environmental baselines could only be changed by legislation. However, the environmental baselines themselves may be varied and users' water allocations accordingly may be effectively decreased. Furthermore water allocations may only be used for authorised activities, i.e. those for which resource consent has been granted
- could transfer all or part of their water allocation to other existing or potential users, either temporarily or permanently
- would be assured of a certain known percentage of the available water (which equals current inflows less environmental baselines) at any point in time
- would enjoy exclusive benefit from their investments in storage whether these be in-stream or out-of-stream, and whether or not the natural water course is subsequently used for transporting the water

8. The New Zealand economy would benefit from:

- the sustainable allocation of all fresh water resources
- reduced regional planning costs for regulators, communities and users
- increased dynamic efficiency of water use at low cost
- increased investment and, therefore, economic growth as a result of the increased certainty for users
- catchment regulatory and coordination costs reflecting the scarcity value of water in each catchment

9. The key features of the proposal are presented in the following sections:

- The proposed framework
 - Why legislation?
 - Water allocations
 - Environmental baselines

- Water available for allocation
- Public water supply
- Generation
- Storage
- Users annual allocation limit
- Rationing available water
- Rationing formula
- Transfer of water allocations
- Term
- Transitional arrangements
 - Ascertaining the environmental baselines
 - Converting the existing rights
 - Developing the Catchment Management System
- Role of Regional Councils
- Who pays
- Conclusion
- Appendix A contains a simple worked example

THE PROPOSED FRAMEWORK

Why legislation?

10. Legislation is required to achieve the objectives of certainty for users and reduced transaction and planning costs. Any such legislation would most appropriately be introduced by way of an amendment to the Resource Management Act (RMA).
11. A national water allocation framework defined in legislation is required to provide certainty to investors by removing the risk of the water allocation definition changing. Changing the definition of a right to use water could alter the nature of that right to such an extent that its utility to the existing user could be compromised. Some of the ways this could occur are:
 - by changing from a 'priority' to a 'scaling' rationing system which would reduce the reliability of supply for some users to the average reliability for all users in the catchment
 - by changing from 'scaling' to 'priority' system which could reduce the reliability of supply for current or potential users to the extent they effectively have little or no access anymore
 - by changing the size of any 'blocks' of water set aside for each type of use which could make it impossible to get an existing consent renewed as there may be insufficient water allocated to that type of use

- by defining some uses as non-consumptive and allocating the same water to other uses which could create conflict between users such as a generator who may wish to store the water upstream in summer for winter generation, and an irrigator who has rights to that water and wants it released from the dam during summer
12. Any uncertainty arising from a risk of re-definition would reduce new investment. Fewer, potentially valuable, development schemes would get funding and economic growth would be constrained.
 13. Legal processes may provide protection from significant impacts on existing rights but these can be expensive and time-consuming. Users may also have to engage in various stages of the Regional Planning process to ensure they become aware of potential threats to their rights. These costs could be avoided through careful design of the water allocation framework within legislation.
 14. Legislation of a national water allocation framework would also reduce on-going costs. Regional Councils would not have to implement or review a water allocation framework in the regional plan which would significantly reduce overall planning costs for the Regional Council, users and the community. All users, local authorities and advisers throughout New Zealand would be working within a single framework which would result in better understanding, and lower costs, for all parties.

Water Allocations

15. A 'water allocation' would define the amount of water (in cubic metres p.a.) a user is authorised to use. Each user would be required to take that water by way of an authorised water take structure and use that water for an authorised activity (e.g. irrigation). A 'water allocation' as proposed by this paper would govern the amount of water only; existing RMA procedures would continue for the take structures and the activities for which the water is to be used.
16. Each water allocation would be registered to a specified person (the user or holder) and at a specified take location.
17. A water allocation would be required to take any fresh water whether from a stream, river or lake or other surface water or ground water including all aquifers.

18. The water allocations would be transferable so they can be transferred to more value enhancing uses. The framework has been designed to allow transfers to occur easily and at very low cost.
19. Water allocations would have the same legal status as resource consents. They are neither real nor personal property.

Environmental Baselines

20. The term environmental baselines is used in this paper to mean all the water that would be required to meet the environmental, cultural and social needs for water.
21. The framework assumes that the environmental baselines for a catchment would be determined using existing relevant RMA processes. The framework takes any environmental baselines regime and:
 - sets the maximum amount of water that can be allocated to users in the catchment
 - rations take requests in any period to ensure that takes do not impinge on the environmental baselines.
22. The process of determining what the environmental baselines should be for any particular river or catchment is a complex task which should be based upon an appropriate scientific assessment of the in-stream values and include consultation with local Iwi, various interest groups and local communities. However, it will probably always involve an element of discretion. Furthermore, these assessments would need to be reviewed over time as scientific knowledge improves, experience is gained and social and cultural values evolve, i.e. the community should retain the right to change the environmental baselines by due process.
23. An environmentally sustainable framework must be based on the premise that, no matter what the environmental baselines are determined to be from time to time, they shall always be provided for first. Accordingly, all water allocations would be defined as shares of the available inflow after provision for the environmental baselines.
24. A definition of the right to use that does not change if environmental baselines are changed, significantly increases the certainty for users and makes the impacts on users of any proposed changes clear and predictable. This would improve the investment climate and, therefore, the economic return the community as a whole would gain from use of the resource.

Water Available for Allocation

25. The total volume available for allocation from a catchment in a mean year would be the mean year annual inflows into that catchment less the volume required for the environmental baselines where the river meets the sea. This volume would be the maximum amount of water that can be taken in a mean year without impinging on the environmental baselines.
26. No matter how simple or complicated the environmental baselines are for a particular catchment, it will always be possible to determine from it the volume of water required to maintain the environmental baselines where the river meets the sea. This volume of water (B in the formula outlined in paragraph 38) is not available for allocation to users and is therefore a key input in determining how much water is available for allocation in a catchment.
27. The volume available for allocation, as defined in the previous sections, would establish the maximum the Regional Council may allocate to users in any catchment. Once this volume had been allocated to users it would be illegal to grant any further allocations. This would prevent existing consents being 'watered down' by the granting of additional consents for a resource which is already fully allocated. Once this limit has been allocated, the only way to obtain a water allocation would be by transfer from an existing user.
28. If at some future date the volume required for the environmental baselines where the catchment meets the sea is increased, then the water available for allocation is reduced. If this results in more water allocations than available water then the effect is essentially that all users' water allocations have been reduced (although nominally water allocations would remain unchanged).

Public Water Supply

29. Public water supply entities would need to hold sufficient water allocations to serve their customers. Industrial and commercial users would access water either through the public water supply system or by investing in their own take infrastructure. Where industrial or commercial users access water through the public water supply system they could either hold their own water allocations and pay the supply authority a fee for delivery, or the supply authority could hold the water allocations and manage efficiency of use.

Generation

30. Generators would need appropriate resource consents, but not water allocations, to generate from other users water allocations and the water comprising the environmental baselines without impinging on that water's natural flow. Generators would need water allocations, just like any other user, to 'take' water from the inflows for storage.
31. Generators can contract with other users to facilitate co-operative use of the same water. For example, a generator who holds water allocations may contract with a downstream irrigation user so the water can be used for irrigation after its generation potential has been used.

Storage

32. The framework protects investments in storage from free-riders by defining the water allocation as 'a share of the inflow'. Users have the right to take a proportionate share of the current inflow irrespective of what is already held in storage.
33. Users with storage would be able to ask for their share of the inflow one week, and use the water previously stored the next week. Where the water course is used to deliver the water from the storage to the end user then this water is not available for other users to share – just as it would not be if the delivery mechanism was a privately built pipe. For example, when a dam is constructed up-stream, and water released into the river channel for abstraction downstream near the irrigation use.
34. This 'inflows' definition also prevents dam owners from storing water allocated to downstream users. They would be obliged to let those users' share of the current inflows pass through the dam unimpeded.

Users Annual Allocation Limit

35. Each user would be allocated a volume of water to use during a mean inflow year, e.g. 1 million m³ p.a. This is their water allocation.
36. The 'water year' would be from July 1st to June 30th to avoid the peak demand period over summer. All usage, measured as a volume, would be recorded and when a user had used their entitlements their takes would stop. At the end of each water year unused allocations would be foregone and users' accounts reset in accordance with the units they hold. Note: water held in storage, which had previously been taken, would not be foregone.

37. Because water allocations are defined based on the average year inflow volume, all water allocations would need to be scaled up or down depending on the current year's inflow, i.e. if this year inflows provide 20% more available water than average, then all water allocations would be scaled up by 20%.
38. The scaling factor to be applied monthly to all water allocations would be defined in the legislation. It is:

$$\frac{A - B}{C - B}$$

expressed as a percentage, where

- A is the year-to-date inflow volume (i.e. the volume of water that has flowed into the catchment so far this year).
- B is the year-to-date environmental baselines volume (i.e. the volume of water required to provide for the environmental baselines so far this year).
- C is the mean year year-to-date inflow volume (i.e. the volume of water that would have flowed into the catchment so far this year if it were a 'mean year'.
- B would be calculated based on the environmental baselines regime
- C would be obtained from historical records
- A would be determined from flow measurements and abstractions records for the current year.
39. Accordingly, in a catchment which is fully allocated, the sum of the users' allocations would add up to the available water in that year. The catchment management authority would not be required to exercise discretion; all scaling is based on measurements and calculations.

Rationing Available Water

40. In those catchments where water is scarce enough to warrant the effort, a Catchment Management System (CMS) would be required. This would be a simple system, supported by appropriate IT and managed by the Regional Council as Catchment Monitor (CM), to coordinate takes by users to maximise utilisation of the available inflows.

41. For the CMS a timetable would be established by the Regional Council. This is likely to be a weekly (e.g. Wednesday to Wednesday) schedule something like:

| | |
|--------------------|--|
| Tuesday noon: | <ul style="list-style-type: none"> • Cut-off for requests for takes for the following week specifying the take location. |
| Tuesday Afternoon: | <ul style="list-style-type: none"> • CM forecasts inflows for the week and inputs into CMS • Users input requests into the CMS (via internet) • The CMS evaluates 'take requests' and determines if the environmental baselines will be impinged. If so it applies the rationing formula to reduce 'take requests'. The output is authorised 'take requests' for each user. |
| Tuesday 4pm: | <ul style="list-style-type: none"> • Authorised requests notified to users by fax, email, etc. |
| Wednesday Noon: | <ul style="list-style-type: none"> • Users adjust take rates by adjusting their take infrastructure • Users record previous week's usage and notify CM via fax, email or web. |

42. User requests could have simple options attached such as:
- 100 l/s, but if less then none
 - Between 100 l/s and 200 l/s, or
 - Whatever is available
43. Such requests would be used to adjust for any variation in inflows from the forecast made by the Catchment Monitor. For example, a request for 'whatever is available' could be authorised to take all water above a certain flow rate as measured on a suitable gauge. The flow rate would be determined to provide for the other users and the environmental baselines. That user would adjust takes during the week to utilise any extra flows.

Rationing Formula

44. The rationing formula would be defined in the legislation as a key component of the definition of water allocations.
45. The only water takes that can be adjusted to ensure the environmental baselines are not impinged at a particular site in the catchment are those upstream of that site. Scaling back a take downstream of a site could not have any effect on the amount of water at that site.

46. The formula that would be applied to all water 'take requests' is:

$$T_i = a_i / b \times (c - d - e)$$

Where:

- T_i is the revised volume for a particular Allocation Holder;
- a_i is the annual Allocation of a particular up-stream Allocation Holder requesting a take in the relevant period;
- b is the sum of all annual Allocations of those upstream Allocation Holders who have requested a take in the relevant period (being the sum of all a_i Allocations);
- c is the expected inflow for the relevant period above the relevant location;
- d is the flow required for public water supply take requests upstream of the location in question;
- e is the flows required to maintain environmental baselines at the relevant location.

47. Take requests for public water supply are fulfilled first and in their entirety wherever possible. This preferred treatment (in effect a priority allocation rather than a scaled allocation) would reduce the need for investment in water storage for public water supply.

48. Take requests from ground water that has a low degree of hydraulic connection with the surface water would be met second, and in their entirety wherever possible.

49. The rationing formula is applied to all other take requests to ensure the environmental baselines are protected. The rationing formula may need to be applied several times to ensure that the environmental baselines at various points within the catchment are protected.

50. The use of the "sum of all annual Allocations of those upstream Allocation Holders *who have requested a take*" as 'b' in the formula effectively creates a zero cost transfer mechanism. The transaction costs are reduced by allowing the available water in any week to be shared by those users who actually want water that week, i.e. if a user does not want their share that week they simply do nothing.

Transfer of Water Allocations

51. Water allocations could be transferred to another person and/or to another location.
52. Once the framework was in place in a catchment, transfers within that catchment could take place very simply. Users would agree the number of water allocation units to be transferred, and the location they would be transferred to, and notify the Catchment Monitor. The Catchment Monitor would ensure any constraints on the water allocations were not breached and then register the transfer.
53. Transfers could be temporary (e.g. for a week), or permanent. The parties involved would make arrangements that suited them. Existing contract law would govern these trades so that they would be as flexible as possible, and only as sophisticated as the particular situation warranted. But in many cases no formal agreement would be required at all. Some users will not ask for water, making more water available for others if they want it.
54. Transaction costs would be minimised as the units are uniform. Uniformity means that all users would have good information about the reliability of any and all units so everyone could easily evaluate what they were trading. Trading would not need to occur on a weekly basis as all users would have an assured minimum proportionate share of the available resource. If they wanted to get a higher proportion guaranteed, they could obtain more units from any other user. The uniform definition broadens the market and makes pricing more competitive and efficient.
55. Users could also increase their reliable supply of water by investing in storage to hold excess supply for future periods of short supply. The trade-offs between investing in storage or investing in more units should be easy to evaluate as the cost of both options could be accurately estimated.

Term

56. The framework proposes that water allocations would be indefinite because:
 - the environmental baselines can be adjusted without changing the water allocations,
 - to encourage investment the water allocation term needs to at least match the economic life of the relevant asset (e.g. storage dam, irrigation equipment),
 - resource consents for activities are reviewed by the community at least every 35 years,

- efficiency of use would be driven through win-win arrangements created through water trading,
 - the costs of any robust renewal review could be substantial and the benefits appear to be negligible,
 - if the water was needed for a more significant purpose then processes would exist to acquire it.
57. For all these reasons individual periodic review of allocations would only increase costs to all parties without corresponding benefits to anyone.
58. Water allocations should be subject to similar compulsory acquisition processes as land, e.g. those used by authorities to build new roads, so existing holders cannot hold up major projects.
59. The framework could be implemented with a review of the legislation required after 10 years to ensure any issues were considered and addressed appropriately.
60. If, for whatever reason, a term was implemented then the various review issues would have to be addressed.

TRANSITIONAL ARRANGEMENTS

61. Transition involves completing three tasks:
- ascertaining what existing environmental baselines are in place in each catchment
 - converting all existing users' water rights into the new framework
 - developing a Catchment Management System
62. To achieve the three tasks central government could appoint and fund a Water Resources Commission (WRC). This Commission would be focused on ascertaining the environmental baselines and converting the existing resource consents on a catchment by catchment basis. Local representation and knowledge could be incorporated by asking the Regional Council and local Iwi to nominate one or two representatives to work with the Commission for each catchment. Once the catchment was converted, on-going management would be handed over to the relevant Regional Council. The Commission would also develop the CMS, going live and managing a catchment until the system and procedures have been successfully tested and embedded. Once these three tasks were completed for all catchments the Commission would be disbanded. Ongoing support of the CMS could be managed by an appropriate government agency such as the Ministry for the Environment.

Ascertaining the Environmental Baselines

63. The environmental baselines for each catchment would be determined by the WRC from the existing consent conditions and any existing Regional Plans or other authorities (e.g. Water Conservation Orders). The objective of this process would be to ascertain what environmental baselines have been established for that catchment. This may be straight-forward where Regional Plans and Water Conservation Orders are in place, but in cases where the environmental baselines are provided for within individual resource consent conditions this may require careful and thorough enquiry.
64. Any changes in the environmental baselines would have to be referred to the Regional Council for the completion of the relevant Resource Management Act process. The WRC would be restricted to ascertaining what the existing baselines are. If there are no environmental baselines in place then the WRC would implement a default regime which could be defined in a RMA National Environmental Standard or the water allocation legislation.

Converting the existing rights

65. At the implementation of the new framework existing use rights, with their variety of definitions and conditions, would have to be amended to fit into this framework. This would involve:
 - legally stripping from every resource consent all aspects that relate to the amount of water that can be taken and how takes are to be reduced to protect environmental baselines, while leaving all other aspects of the resource consent intact.
 - replacing the stripped items with water allocations for each user and the water allocation framework which will protect the environmental baselines.
66. The Water Resources Commission would:
 - consider all the rights to use water in each catchment as a whole, the particulars of each right individually, and determine how each user's existing rights can best be reflected within the new framework on a 'no windfall gains, no windfall losses' basis.
 - conduct public and user consultation (hearings).
 - issue a determination which would assign water allocations to each existing user. These allocations may be with or without constraints on transfer to protect other existing rights.
67. Determination of the amount of water available would be based on the long run average inflows less the flows required to maintain the environmental

baselines at the river mouth. All existing entitlements would be added up and, unless the water has been over-allocated, each user would get the same number of units as at present. This would mean that each user will get exactly the same volume of water in an average inflow year as at present. They will get more in a high inflow year and less in a low inflow year¹.

68. If there are insufficient units then all users' shares would be scaled back proportionately. This process would not diminish existing rights as these were effectively diminished when the catchment was over allocated. It would simply be converting the right as it stands on the conversion date.
69. If there are excess units then some of these could be allocated by the Commission to existing users to increase reliability of supply to reflect those users' existing situation, and any remainder retained by the local authority for meeting the needs of any future applicants.
70. Some allocations granted to users may be granted with constraints or caveats. These caveats would exist in order to protect other existing rights, e.g. a common constraint on a water right would be against moving a take location from below a hydro generation station to above it. If such a constraint existed, then the approval of the generator would be required before any such transfer could take effect. The purpose of the constraints would be to protect and reflect all existing rights, whilst otherwise maximising the opportunities for transfer to other users.
71. A gold rush could be prevented while the process is undertaken by clearly signalling a cut-off date prior to the announcement of the policy, i.e. a policy change is signalled and all applicants are on notice that new consents after that date are subject to available water in that catchment under the new framework. A recommended policy is: "All rights granted prior to a specified date will be treated equally, and those granted after that date shall be considered in order of application date and all shall be subject to there being sufficient water. Renewals of existing rights will be treated as existing rights as those users should not be penalised because their rights happened to require renewal at this particular time." Clearly, it would be important to signal this policy as early as possible so users and applicants know where they stand.

¹ Low inflows do not necessarily correlate with droughts as for many New Zealand catchments the major inflows are derived from alpine rather than coastal rainfalls.

Developing the Catchment Management System

72. A Catchment Management System (CMS) would comprise a registry function and a standard model incorporating the scaling and rationing rules. It would take inputs from each catchment regarding its population of users, catchment geography, take locations and environmental baselines. All transfers of water allocations would be processed through the catchment registry, and each week's forecasted inflows and take requests would be entered and processed to ensure that environmental baselines are protected. Actual weekly takes would be reported to the system. A standard IT system would be developed for use by all catchments, i.e. one system design, with 'copies' tailored for each catchment. The CMS would take advantage of the internet to allow these inputs from diverse sources to come together in a timely and cost effective way.
73. The CMS could be planned and designed in parallel with the Water Resource Commissions' determination of the water allocation for each existing user and the environmental baselines for each catchment, a process that would help ensure that the detailed design of the system reflects and serves the various catchments.

ROLE OF REGIONAL COUNCILS

74. There would be little change to the role of the Regional Councils after the transition was complete. The benefits for Regional Councils of the proposed framework would include:
 - regional plans would no longer be required to address the water allocation framework as this would have been done by the legislation.
 - ongoing costs of managing water allocation would be lower.
 - their communities will benefit from reduced conflict and higher economic growth.
75. The WRC would complete the transition activities reducing the associated costs for Regional Councils. Regional Councils would still work with the WRC and participate in the transition process for their region.
76. Once the catchments were converted, management would be handed back to the Regional Council for:
 - allocating any remaining water up to the allocation limit
 - on-going operation of the catchment management system including the catchment registry

WHO PAYS

77. The Government would pay the transitional costs: funding the Water Resources Commission and the development of the Catchment Management System (CMS). The users would be levied to pay for the on-going costs of the Catchment Monitor and the CMS. The cost of processing transfer applications would be so low they might even be free. Where they are not, then the users would pay.
78. Regional Council costs would reduce (at least as far as water allocation is concerned) as regional plans and consent processes are simplified.

CONCLUSION

79. Substantial benefits could arise if New Zealand were to implement a stable water allocation framework that would:
 - effectively protect the environment
 - increase efficiency of use and grow the economy
 - reduce or prevent costly conflict
 - while avoiding any imposition of unnecessary cost
80. This paper has outlined a framework that could be implemented to achieve these objectives.
81. Reforming the present frameworks will get more difficult every year as demand across more catchments approaches, or exceeds, available water and therefore more users believe they have rights that should not be abrogated by regulatory reform. Halfway measures may lead to increasing conflict, suboptimal growth and possibly damage to our environment.
82. The time has come for New Zealand to address these problems. With sound leadership and the constructive engagement of relevant interest groups New Zealand has the opportunity to create a regulatory framework that is environmentally sustainable, that will enable economic growth and that will be as enduring as the frameworks for managing land². This paper seeks to promote these objectives.

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² land registry, surveying system, regional plans, transfer procedures, etc.

APPENDIX A: AN EXAMPLE

83. A (simple) catchment has the following characteristics:

| | |
|--|----------------|
| Mean year flow volume where river meets the sea | 200 units p.a. |
| High inflow year volume | 240 units p.a. |
| Low inflow year volume | 160 units p.a. |
| Environmental baselines volume where river meets the sea | 100 units p.a. |

84. The water available for allocation in the catchment is 100 units p.a. being the mean year flow volume less the environmental baselines volume (refer paragraph 25). The Regional Council can grant water allocations up to that amount and no more. For this example catchment 10 users have been granted water allocations of 10 units p.a. each

| | |
|---|----------------|
| Water Allocations Granted: 10 users have 10 units p.a. each | 100 units p.a. |
|---|----------------|

85. The water allocations are scaled each year to reflect that years inflow conditions. In a high inflow year (240 units of inflow) the final scaling factor would be 1.4 (or 140%). Using the formula in paragraph 38, the inputs are:

- A 240 is the year-to-date inflow volume
- B 100 is the year-to-date environmental baselines volume
- C 200 is the mean year year-to-date inflow volume

$$\frac{A - B}{C - B} \text{ is } \frac{240 - 100}{200 - 100} = 1.4 \text{ or } 140\%$$

86. Therefore each of the 10 users is entitled to use 14 units that year (10 x 140% = 14)

87. Similarly, in the low inflow year the scaling fact would be 0.6, and each user would be entitled to use 6 units that year. Thus a user who wanted to be assured of access to 6 unit's p.a., no matter what the inflow conditions, should apply for or acquire water allocations for 10 units.

88. As water is scarce in this catchment the Regional Council would have decided to implement a Catchment Management System. Each of the ten users would request an amount of water they would like to take the following week. The Catchment Monitor would estimate the inflows and process the requests through the Catchment Management System. Assuming the inflows expected are 4 units and the environmental baseline requires 2 units – there will be 2

units available for users. If users' requests total less than this amount – all requests would be approved.

89. Assume 5 users request takes of 0.2 units each upstream of point A, the inflows expected at point A are 1.5 units, and the environmental baselines requirement at point A is 1 unit. If all users requests are approved unchanged then the environmental baseline is forecasted to be impinged as $1.5 - 5 \times 0.2 = 0.5$ units which is less than the 1.0 units required for the environmental baseline.
90. In this circumstance those take requests up-stream of point A are rationed using the formula described in paragraph 46. The formula, and the inputs given the examples assumptions, is:

$$T_i = a_i / b \times (c - d - e)$$

Where:

- T_i is the revised volume for a particular Allocation Holder;
- a_i is the annual Allocation of a particular up-stream Allocation Holder requesting a take in the relevant period – in this case each holds 10 units;
- b is the sum of all annual Allocations of those upstream Allocation Holders who have requested a take in the relevant period (being the sum of all a_i Allocations) - in this case $10+10+10+10+10 = 50$;
- c is the expected inflows for the relevant period above the relevant location – in this case 1.5;
- d is the flows required for public water supply take requests upstream of the location in question - in this case 0;
- e is the flows required to maintain environmental baselines at the relevant location - in this case 1.

91. The formula is therefore:

$$T_i = 10_i / 50 \times (1.5 - 0 - 1)$$

$$T_i = 0.1$$

92. As in this example all 5 of the relevant users hold 10 units, they each get rationed to 0.1 units for the coming week. The environmental baselines are provided for and all of the available water is utilised.

93. If only 3 of the 5 users wanted water in the coming week the formula result would be:

$$T_i = 10_i / 30 \times (1.5 - 0 - 1)$$

$$T_i = 0.1667 \text{ (or } 1/6) \text{ units}$$

94. Each of the three users who wanted more water that week gained access to an extra 0.0667 units with zero transaction costs. The users who were entitled to it simply did not ask for it that week so the water was available to those who did want it.

95. If one of our example users acquires 10 units from another user they would hold 20 units. The rationing formula applied to them from paragraph 91 would then be:

$$T_i = 20_i / 50 \times (1.5 - 0 - 1)$$

$$T_i = 0.2$$

96. If they acquired the extra units as a temporary transfer for one week they have doubled their access to water for that week. If the transfer was until the end of the water year, they have doubled their access to water for that year. If the transfer was permanent, they have doubled their access permanently – or until they transfer some water allocations to another user.

97. As demand increases in the catchment (from say 100 units to 110 units) the increased demand could be met by developing the cheapest storage option of all options available to all the users – providing the units released to alternative users were valued sufficiently to fund the storage investment. The storage would improve reliability and allow, for example, 20 units to suffice where 30 were previously required – releasing 10 units for a new user, with the price paid for the trade funding the storage investment. All users would be satisfied and the most efficient option for providing the water required would be utilised. Investment incentives would be simple, direct and efficient.