Outflow from a dam

Economic benefits for Nelson City of the proposed Waimea Community Dam

NZIER report to Nelson City Council

20 April 2015

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Key points

If the Waimea Dam were to be built, Nelson City can expect to share some of the benefit from the growth in irrigated production and associated business in the Nelson-Tasman region. This report assesses how large that benefit might be and what would it be worth Nelson City Council contributing towards the Dam.

The report deconstructs the modelling used in the 2014 NZIER Waimea Dam Economic Assessment prepared for Nelson Economic Development Agency to identify impacts on Nelson and Tasman separately. That report presents estimates of non-augmentation scenarios without the Dam, with low and high reduction in water availability due to the Tasman Resource Management Plan (TRMP).

In 2013 the Nelson-Tasman region had a combined GDP of $3.8 billion, of which 2.1 billion (56%) was attributable to Nelson City. The value to Nelson City of activities flowing in from the Waimea Plains is estimated to be between $14.8 million and $18.4 million per year.

Without augmentation by the Waimea Dam, if the TRMP results in 20% or 35% cuts in water allocation, Nelson City would lose $4 million or $9 million respectively in annual GDP. The Waimea Dam would eliminate those losses and enable further production increases from existing irrigable land and new irrigated area, with flow on effects to Nelson City of $11.4 million per year. On these estimates the Dam would benefit Nelson City's GDP by $15.4 - $20.4 million per year.

In addition to these economic gains, Nelson residents would share in the benefit of enhanced environmental flows in the Waimea River. Although there are no reliable figures on the recreational use of the Waimea River by Nelson and Tasman residents, the relative size of Nelson's population and its proximity suggests Nelson residents are likely to comprise a substantial share of recreational users of the river.

The planned allocation of 5% of Waimea Dam capacity for Nelson City to cover regional growth would provide enough water to cover extreme changes to allocations that currently support Nelson's water supply. It would provide additional headroom for meeting future demand growth and enable use of other existing sources to be relaxed if needed for environmental quality purposes. The cost of the Dam-augmented Waimea water per cubic metre would be comparable to the cost of water from Nelson's current sources, but transporting it into the Nelson reticulation system would entail additional cost. Reaching agreement with TDC to use its existing pipes and facilities would be less costly than Nelson installing stand-alone facilities.

Contributing to the 5% capacity for future water would primarily serve water supply and could be recovered through the existing targeted rates and fees for collecting funding for NCC's water supply services. The amounts per year would be in the vicinity or 2-3% of current annual expenditure on water supply in the annual plan.

The cost of the 30% of Dam capacity for environmental flows could be allocated between Nelson and Tasman in proportion to the recreation use made by their respective residents. This is unknown but if Nelson were attributed up to 50% of recreational benefit it could face annual cost contributions equivalent to 7% of its current annual spending on environment. These can be recovered via a general rating or charge instrument as the benefit is potentially accessible to all Nelson ratepayers.

The table below summarises the options when considering whether Nelson City should contribute to the Waimea Dam. If the Dam does not proceed there is likely to be periodic rationing of water in the Waimea valley during low flows, such that current levels of primary production (and the corresponding processing and marketing activity in Nelson) could not be sustained, with annual non-augmentation costs of $4m-$9m loss of GDP in Nelson's territory. Residents and industry in South Nelson supplied by TDC would face periodic conservation measures, there might be pressure to reduce consented takes from the Roding and South Nelson residents might agitate for connection to more secure supply from the Nelson network, which would involve some capital cost for NCC.

If the Dam does proceed there will be a benefit to Nelson City from the avoidance of the non-augmentation costs of periodic rationing, and additional benefit from new irrigated production. However, the Dam may not obtain sufficient funding without some contribution from Nelson. If NCC covers the cost of capacity for future growth, this would involve a capital cost of about $3.5m, but it may not be able to access that water unless it reaches agreement to channel this through TDC's facilities, or builds its own well-field and pipeline at an estimated capital cost of about $14m. If NCC contributes to the capacity for environmental flows on the basis of recreation benefits, the capital cost could be $3.6m-$12m depending on the attribution.

Summary of potential futures without and with the Waimea Dam

Without the Dam	Potential value implications $m	Consequences
Periodic TDC rationing in low flows		Conservation measures for South Nelson customers
Non-augmentation costs from reduced processing/wholesaling of Waimea primary produce	$4m-$9m loss per year in Nelson GDP	Reduced incomes in Nelson city
Pressure on Roding extraction limit and consenting constraint		Minor restraint on NCC supply
Potential linking of NCC network to South Nelson	Capital cost of $3.5 million	
With the Dam	**Potential costs $m**	**Consequences**
Avoidance of periodic TDC rationing		Less disruption in South Nelson
Restoration of non-augmentation losses	Nelson GDP benefits by $4m-$9m per year	
GDP gain from processing/ serving new irrigated production	Nelson GDP benefits by $11.4m per year	
Cost of Dam's growth capacity	Ca. $3.5m capital cost	Potential cost to NCC
NCC Access to growth volume	Ca. $14m capital cost	NCC Well-field and pipeline
NCC share of environmental cost	In the range of $3.6m - $12m capital cost	Varies with allocation method.
Benefit to Nelson residents in enhanced recreation opportunity		Not quantified, but could break even with small increase in use

Source: NZIER

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1. Introduction

Nelson City Council has approached NZIER to build on its previous work on the Waimea Dam for Nelson Economic Development Agency and for Tasman District Council on how to pay for the dam, to identify the economic benefits to Nelson City of the proposed Waimea Community Dam. This is to assist Nelson City Council's deliberations on whether or not to contribute to the dam's construction and operation.

Specifically, Nelson City Council is seeking answers to the following questions:

1. What is the current dollar value to the Nelson City economy of activities on the Waimea Plains?
2. What would be the reduction in value from changes in the water management regime as contained in the Tasman Resource Management Plan (TRMP), should the proposed dam not proceed?
3. What is the increase in value for Nelson that would result from the proposed dam proceeding?
4. What is the opportunity value to Nelson City of a fourth potable water source on the Waimea Plains e.g. the advantage in economic or environmental terms of drawing less from the Maitai and Roding Rivers?
5. What method or formula can be used to establish an appropriate dollar value of any contribution by Nelson City towards the Waimea Dam?

1.1. Background

The Waimea River is formed by the confluence of the Wai-Iti and Wairoa rivers in Tasman District and it serves a major horticulture centre in the district. In 2001 a drought led to the Waimea almost running dry, after which a new water management plan was investigated by TDC and subjected to a Commissioners' hearing that made recommendations for ensuring minimum environmental flows in the river. A Waimea Water Augmentation Committee was also set up to investigate alleviation of drought risk, looking at 18 different options before selecting a preference for a dam in the Lee Valley in the hills south-east of Brightwater.

Under the new regional water management plan, without the dam all abstractors in the Waimea catchment face reductions in their allocations and rationing during periodic shortages, creating substantial costs for non-augmentation of water supply. The Waimea (Lee Valley) Dam has been designed to eliminate these reductions and avoid rationing in all but the most severe and infrequent droughts, while also raising the sustainable environmental flow above the minimum suggested by the Commissioners. That and the provision for future growth in both new irrigated area and improved reliability for existing irrigators suggest potential benefits far outweigh the costs of the dam, currently expected to be around $60-$80 million.

However, funding the dam has proved problematic. An initial plan to create a co-operative company fell through because of inability to get sufficient people to subscribe to it: our subsequent work shows the margins on some established land uses are not sufficiently large to cover a contribution to the costs of the dam, and there is a sizable proportion of lifestyle properties that are not being run on a

commercial basis. TDC is currently considering funding the dam's construction from rates, using the Public Works Act to secure land and spreading contributions across general rates (for the public good aspects of environmental flow enhancement), water allocation charges (for current users) and targeted rates on capital values (for those who could benefit from future use), but this too looks difficult to sell, because of the uneven benefit to different land uses. An NZIER report to TDC suggested ways to differentiate charges among users according to the margins on different land uses.

Another alternative is involvement of Crown Irrigation Investment Limited (CIIL), which has funding to invest in community irrigation schemes that are expected to contribute economic benefits to New Zealand, including both direct benefits and wider downstream benefits. CIIL is not intended to displace private investment and will not be a majority funder of any scheme, as this implies the commercial economics of the scheme is weak. Nor will it be a long term investor, withdrawing at an appropriate time after the barriers to private investment have been overcome. No application for such funding has yet been made with respect to the Waimea Dam, and it is not clear how far such funding would cover the shortfall on current commitments.

2. Nelson's interest in the Waimea Dam

Nelson City is the largest commercial centre in the Top of the South region and located close to the Waimea catchment, so will be affected by changes in its neighbouring district. TDC has identified about 5% of the dam's capacity as being provided to serve future regional growth, and is seeking contributions from Nelson City for this and possibly other benefits flowing from the dam, e.g.:

- Avoidance of the non-augmentation cost of not having the dam, which would reduce the production, incomes and expenditure emanating from the irrigated production
- Benefit of enhanced production enabled by the dam, including:
  - Indirect impact of processing, servicing horticultural activity by businesses and employees from within Nelson City
  - Induced impacts of additional household spending arising from this direct impact
- Potential benefits (if any) from enhanced environmental flows in the Waimea River, e.g.:
  - Benefits to Nelson residents of improved recreation opportunities in the Waimea
  - Benefits from improved water quality and quantity flowing into Tasman Bay

Nelson City, however, is not immediately in need of water augmentation. It obtains its water from:

- Water extraction from the Maitai River South Branch, which combined with the Maitai Dam provides about 60% of the city's current foreseeable needs
- A dam on the Maitai River North Branch, built in the 1980s by NCC
- Water extraction from the Roding River which provides almost 40% of the city's current needs.

The Maitai River is wholly within Nelson City's territory, but the Roding River, although sourced in Nelson, flows into the Tasman District as a tributary of the Lee (and hence part of Waimea). Both rivers' consents are due for renewal in 2017 and if allocations are cut, the Waimea Dam would be more beneficial for NCC than if allocations remain the same. Such benefits, however, are subject to NCC being able to access water from the Waimea, which comes at a cost to NCC in securing consents and building its own extraction infrastructure, or coming to an agreement with TDC over using its facilities.

This report proceeds by:

- Outlining the water supply and demand situation for Nelson City and some of the issues arising from potential cuts

- Identifying from NZIER's regional model of the Nelson-Tasman region the share of economic activity that could accrue to Nelson City if the Waimea Dam were built
- Examining the value to Nelson City of a fourth potable source of water being available on the Waimea Plains
- Describing a method for establishing an appropriate dollar value of any contribution by Nelson City towards the Dam.

3. Supply and demand for water in Nelson City

Nelson City Council abstracts between 7.2 million and 8.5 million cubic metres of water a year for its reticulated water services. It supplies between 5 and 6 million cubic metres to customers, the difference from abstractions of 2.2-2.5 million cubic metres per year being unaccounted for water losses, leakages or uses in the reticulation system. Tasman District Council also supplies water to South Nelson City for residential and industrial activities, including large use by the Alliance meat processing plant and the ENZA apple packing plant. TDC supplies about 9% of Nelson's total demand, as summarised in Table 1.

Table 1 Supply of water in Nelson City

Cubic metres per year

Water supplied by	**NCC**	**TDC**	**Total**
To user groups:			
Residential	2,900,000	50,000	**2,950,000**
Small industrial	2,100,000	70,000	**2,170,000**
Large industrial		365,000	**365,000**
Total	5,000,000	485,000	**5,485,000**
Residential	52.9%	0.9%	**53.8%**
Small industrial	38.3%	1.3%	**39.6%**
Large industrial	0.0%	6.7%	**6.7%**
Total	91.2%	8.8%	**100.0%**

Source: NZIER from NCC documents

Recent years' abstractions by Nelson City from its rivers are summarised in Table 2.

Table 2 Annual abstractions by Nelson City Council

'000 cubic metres per years ending June

	Maitai	Roding	**Total**
2008	4,592	3,974	**8,566**
2009	4,696	2,908	**7,604**
2010	4,995	2,977	**7,972**
2011			**na**
2012	4,119	3,221	**7,340**
2013	4,722	2,734	**7,456**
2014	4,508	2,815	**7,323**

Note: 2011 figures unavailable due to meter malfunction

Source: NZIER from NCC documents

Volumes have been stable over the past 7 years, with if anything a slight decline in demand with industrial users becoming more frugal in their water use.

As is apparent from Table 3, there is headroom between actual extractions and maximum extraction, partly to allow for peaks in demand. The maximum extractions, however, are only achievable during high river flows. The Maitai sources are being used a little harder than the Roding, with 48% of the Maitai's maximum being utilised in 2013-14 compared to 35% of that of the Roding, as is to be expected with the Maitai Dam providing a degree of storage control that is lacking on the Roding. There appears to be some scope to increase abstractions from both the Maitai and the Roding Rivers.

Table 3 Monthly abstractions and allocated maximum abstractions

Cubic metres per month

	Monthly total extracted			*Monthly maximum extraction*		
2013-14	***Maitai***	***Roding***	**Total**	***Maitai***	***Roding***	**Total**
July	336,000	239,000	**575,000**	803,520	682,000	**1,485,520**
August	367,000	212,000	**579,000**	803,520	682,000	**1,485,520**
September	330,000	226,000	**556,000**	777,600	660,000	**1,437,600**
October	403,000	172,000	**575,000**	803,520	682,000	**1,485,520**
November	355,000	286,000	**641,000**	777,600	660,000	**1,437,600**
December	421,000	273,000	**694,000**	803,520	682,000	**1,485,520**
January	443,000	241,000	**684,000**	803,520	682,000	**1,485,520**
February	361,000	309,000	**670,000**	725,760	616,000	**1,341,760**
March	458,000	225,000	**683,000**	803,500	682,000	**1,485,500**
April	418,000	173,310	**591,310**	777,600	660,000	**1,437,600**
May	298,000	247,686	**545,686**	803,500	682,000	**1,485,500**
June	318,000	211,125	**529,125**	777,600	660,000	**1,437,600**
	4,508,000	2,815,121	**7,323,121**	9,460,760	8,030,000	**17,490,760**
	62%	38%	100%	54%	46%	100%

Source: NZIER from NCC documents

The same pattern emerges when looking at average daily abstractions and the maximum allowable daily abstractions: on average over the year 48% of the Maitai's maximum abstractions is being used and 38% of the Roding's. Pipeline capacity on the Roding is set at the maximum daily abstraction of 22,000 cubic metres, but the capacity of pipelines from the Maitai ranges from 17,000 to 37,000 cubic metres (compared to its maximum daily allowable take of 25,920 cubic metres). Nelson City has capacity to treat 40-50,000 cubic metres per day, considerably higher than recent daily abstractions of around 24,000 cubic metres. Consenting issues aside, there does not appear to be any shortage of water from current sources for foreseeable demands in the future.

3.1. Issues arising

The issue faced by NCC is whether, and how much, to contribute to the building and operation of the Waimea Community Dam? This depends on what are the benefits for NCC that can be identified from the dam, and also on other risks to the current water supply arrangements.

Amongst these risks are:

- TDC is entitled to receive the lesser of 909m^3 or 1/15 of the allowable extraction from the Roding (1467 m^3) of which it currently takes only a small fraction: if TDC took its full entitlement this would amount to over 330,000 m^3 per year, offsetting 2/3 of what TDC currently supplies NCC
- In the absence of the Waimea Dam being built, the Tasman Resource Management Plant (TRMP) provides for rationing cuts in abstraction that will affect TDC's water supply plant at times of low river flows. This may lead to conservation measures for residents and industries in South Nelson who are currently supplied by TDC, which is a sporadic inconvenience for them in the short term but in the longer term could increase calls for their supply to be linked to the Nelson network, and increase TDC's interst in securing supply for its own residents
- A NCC report to Council on 20 November 2014 states that the environmental health of the Roding and Maitai Rivers is expected to figure highly in submissions on the reconsenting of abstraction from both rivers in 2017. This may lead to the possibility that the maximum allowable take from the rivers will be reduced, lowering the headroom on current supply.
- That report also identifies a number of economic costs for the Council and its residents/ratepayers that may arise under different circumstances e.g.:
  - A $3-4 million construction cost to extend the Nelson reticulation system into Nelson South, so it can be supplied by the NCC system
  - A cost estimated at $14.7 million in 2008 to build infrastructure to enable Nelson City to access the Waimea aquifers directly and take advantage of the augmentation provided by the proposed Waimea Dam, should it be built – this may range between $10-$15M depending on how much of TDC's existing infrastructure could be used
  - New subdivisions and building in the areas of South Nelson supplied by TDC pay development contributions to TDC, which to date have amounted to approximately $900,000.

The Waimea Dam is currently planned to provide 13M cubic metres of storage that would eliminate water restrictions and allocation cuts envisioned in the TRMP, except in the most extreme dry years. It is currently expected to cost $60-80 million to build and $500,000 in annual operation cost. Around 30% of this storage is to enable a higher minimum flow to be maintained, and the current plan is to allocate costs of the dam divided between 70% to extractive users and 30% to environmental flows to be covered by ratepayers.

NCC is not currently a direct abstractor from the Waimea Plains aquifers, but it has been identified as a potential beneficiary/partner in funding on the basis of:

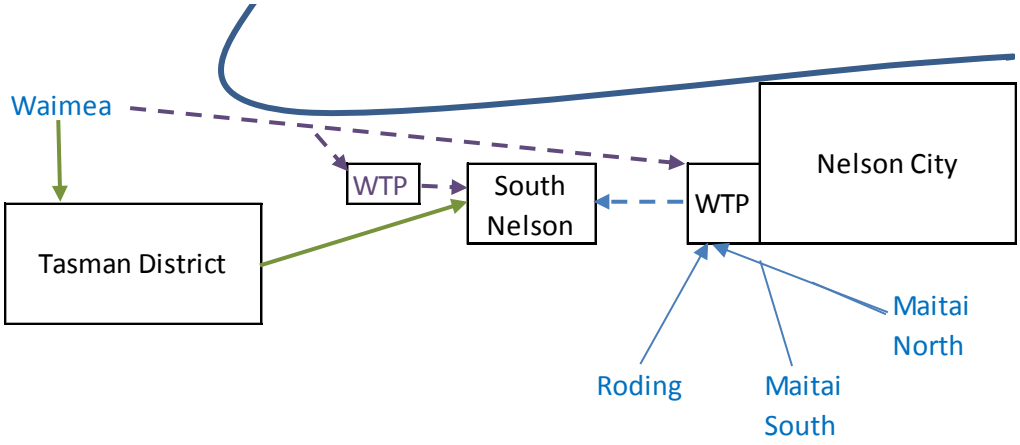
- Being a water user (for water supplied by TDC to Nelson South and to provide cover for emergencies, as NCCdoes not have adequate reticulation to provide fire-fighting flows)
- As a player in the wider regional economy
- As a beneficiary of the environmental and amenity values of the Waimea river and its tributaries.

NCC currently uses about 1.8% of Waimea water (excluding Roding extraction) but its share of the Dam might rise to include part of all of the 5% allowance for future growth in regional demand, should it so wish.

The supply situation can be summarised in the schematic diagram in Figure 1. Nelson City receives water from predominantly three sources feeding its own Water Treatment Plant and reticulation network, but South Nelson is supplied water by TDC. If that supply were at risk and Nelson wanted to supply South Nelson directly, it would need to supply new pipelines into the area, at an estimated capital cost of $3-$3.5 million. The security of this supply would depend on continuing access to the full current volumes of Roding water extraction. If the Waimea Dam proceeds and Nelson needs to access new water from the Waimea aquifers, it could develop its own well-field and pipeline facilities to directly supplement its supply, at a capital cost of around $10-$14 million, and some additional operating cost on pumps. If that water were to service South Nelson it might require less capacity in the pipes but would require additional treatment before supplying to consumers, so the capital cost would be little changed. Alternatively NCC could continue to use TDC's water treatment plant and pipelines into South Nelson, if a suitable agreement could be reached.

Figure 1 Water supply into Nelson City

Current water supply (solid arrows) and potential future supply flows (dashed arrows)



Source: NZIER

3.2. Risks to existing supply

While the NCC paper to councillors considers that another water source is not required to the existing three to maintain supply, the Council is still interested in what value the Waimea Dam would bring to Nelson City. The way to consider this is to consider what would happen in the absence of the Dam proceeding, and compare this against the situation in which the Dam is built.

3.2.1. Without augmentation of Waimea water

The TRMP provides for a range of rationing cuts in water abstractions if water levels fall below critical flow thresholds. It is difficult to predict when these would be incurred in future, but if recent flow records are a guide, Waimea consent holders would face 20% rationing cuts on some days in all years, and 50% cuts on some days in most years. They would also face some downward adjustment to overall allocations under the terms of the TRMP.

The NZIER Economic Impact Assessment of the Waimea Dam (2014) modelled this by a lower level assumption of 20% cut in allocation, and a higher level assumption of 35% reduction, in the absence of augmentation by the Waimea Dam.

The cuts are deepest for irrigation extraction, while residential and industrial users on the Tasman Water Supply system face lesser reductions. In such circumstances there is some risk that tightening water conditions in Tasman will affect the long term supply into Nelson through causes such as:

- Lobbying to restrain the extraction of water from the Roding (which feeds into the Lee and Waimea catchment)
- Increase in Tasman's take-up of its water entitlement from the Roding, which could be up to 330,000 m^3 per year
- Reduction in Tasman's willingness to supply water into south Nelson, which could be up to 485,000 m^3 per year.

These effects may be restrained by contractual supply arrangements and may not all happen at once. Although it is unlikely that consent commissioners would severely restrict a city's access to its water supplies, they may decide on some lowering of allocation to nudge the city towards improving its water management and reducing the unaccounted for volumes.

The first bullet (lobbying to restrain extraction) might result in some tightening of consented takes from the Roding. Applied to the 2013-14 abstractions by way of illustration, an assumed reduced take of 4% from the Maitai and Roding would equate to a 7% reduction in Nelson's annual delivered supply[1].. If the other two bullets eventuated in full (TDC taking its entitlement from the Roding, and ceasing to supply water to South Nelson), in a worst case outcome, water available for Nelson would be reduced by 815,000 m^3, about 15% of Nelson's delivered supply and 10% of its maximum allocation. The combined effect of all these impacts would be a 22% reduction in delivered supply and 15% reduction in abstraction.

[1] Of Nelson's 7.3M m^3 abstracted in 2013/14, a reduction in abstraction of 0.32M m^3 (4%) equates to approximately 7% of the 4.8M m^3 (after unaccounted for water and losses) delivered by NCC that year.

Some reductions could be managed by absorbing the headroom in current allocation, and the volume reduction could also be addressed by tightening up on the amount of unallocated water. However, there could still be qualitative differences in water supply, an increase in the frequency of water use restrictions in Nelson City, and potentially some risk of reduced water pressure for firefighting purposes.

Beyond the direct water supply impacts, Nelson City will also face economic consequences from reduced water availability and production in Tasman District reducing the jobs and incomes from cross-border workers, reduced activity for processing and packing produce from Tasman in Nelson, and reduced spending in the city from those who lose income, in both Nelson and Tasman districts.

3.2.2. With water augmentation by Waimea Dam

The Waimea Dam is intended to eliminate the need for water restrictions and rationing cuts in all but the most extreme and infrequent dry years. It will therefore enable business as usual (avoidance of non-augmentation cuts) and provide for growth in production across the Waimea catchment, allowing both increased output from existing irrigated area and extension of irrigation onto previously dry land.

The effects on Nelson City are likely to come from an increase in the spending, jobs and incomes in the city associated with the additional production relative to the without augmentation scenario. This stems both from produce and business that crosses the border into Nelson for additional services and value added in the city; and from Nelsonians who supply labour or goods to water-supported activities in Tasman District.

The direct effect on water supply in Nelson is likely to be:

- Reduced political lobbying to restrain extraction from the Roding
- Reduced pressure for Tasman to increase its uptake of Roding water
- Reduced pressure for Tasman to cease supplying South Nelson.

3.2.3. Recreation and amenity

A third of the Waimea Dam's capacity is being provided to enable higher minimum flows in the Waimea River for environmental purposes. A benefit of this is enhanced recreational opportunities and amenity for TDC residents and non-residents alike.

Although environmental effects are often not traded in markets they still have economic value. One approach is to view the environment as a collection of natural assets delivering a number of services of value: provisioning services (e.g. sufficient water), regulatory services (such as waste assimilation and nutrient recycling), cultural services (such as creating settings valued for their amenity, recreational or cultural uses) and supporting services (e.g. general ecosystem functioning that supports other service flows).[2]

Economic values for such non-market effects can be inferred in various ways such as:

[2] Millennium Ecosystem Assesment (MEA 2005) Ecosystems and Human Well-being: Synthesis. Island Press, Washington DC

- The avoidable tangible costs caused by environmental effects on activities: for example, a river's curtailment of losses caused by droughts
- The cost of the next best alternative means of providing the same services as the environment (e.g. cost of alternative supply of water other than in situ natural sources and flows)
- Values inferred from the price of associated marketed goods (e.g. the "revealed preference" approaches such as inferring a value premium in prices of property close to clean waterways, or estimating demand for recreation sites from analysis of people's travel costs to use them)
- Estimating public willingness to pay to secure environmental outcomes from market research techniques that question a sample of those affected – the "stated preference" approach which depends on clear articulation of an environmental change to which those surveyed can respond.

The stated preference methods can capture different components of total economic value, including the value of a resource in its current use, the value of retaining it for future use, and the value of keeping it in existence for non-use motivations (e.g. as a bequest for future generations, or retaining some natural feature, such as a rare species, for its own sake).

A practical approach to estimating economic value of improved environmental flows in rivers would start with identifying the improvement in the environmental services obtained from improved flows, quantify the scale of those effects on the things that people value and then attach monetary or other measures of value. For instance, recreation benefit can be estimated from the number of new recreation visits enabled by the improved flow and attaching a dollar value to these visits for each type of recreation activity.

Over a hundred non-market valuation studies of willingness to pay for environmental attributes are recorded on the New Zealand Non-market Valuation Database at Lincoln University. Of these, 47 concern recreation and 12 relate to water-based recreation but most are site-specific, with results which vary with methods used and contextual factors. A recent review of freshwater valuation studies in New Zealand concluded there is a lack of data for many freshwater non-market values, and notably missing are specific values of Maori customary uses of water.[3] It found the most frequently studied water-based activities are fishing, whitewater kayaking and multi-sport activities, and it reports some wide ranges of values.

Some researchers use results of non-market valuation studies in one setting to infer value applied in similar settings elsewhere – a process known as "benefit (or value) transfer". But this depends on the values being estimated in similar situations and derived from reliable studies with sufficient details of their implementation with which to control for the variable contextual factors that influence the result. Reliable estimates of non-market values for environmental flows in the case of augmenting Waimea river flows do not exist and would be costly and time-consuming to obtain.

The economic value of augmented flows will be a composite of tangible effects (value for irrigation, replenishment of aquifers) and less tangible components (retention of habitat for biodiversity, fishing or swimming). The non-market component will have a

[3] Marsh & Mkwara (2013) Review of freshwater non-market valuation studies, Department of Economics, Waikato University http://www.waikatoregion.govt.nz/PageFiles/30275/2997672Review_of_Freshwater_Non-Market_Value_Studies.pdf

mix of use and non-use value, but there is little evidence in New Zealand of how big they might be.

A recent report on the application of the RiVAS river assessment system to Tasman District rivers found the Waimea to be a river of regional significance for swimming, angling and natural character, of local significance for native birds and moderate significance for kayaking.[4] The Roding River also has regional significance for natural character, and a similar assessment probably applies to the sections in Nelson City.

Regional significance implies people come from across the region to use the river, including residents of Nelson City. Although Tasman District had a population of 47,154 in the 2013 Census, about half of them live outside the Waimea catchment and further from the river than the 46,437 residents of Nelson who are within about 20 kilometres from the river. The value of the Waimea to Nelson residents for recreation will be some function of their willingness to pay to use it for recreation, as reflected in the costs they incur in travel expenditure and time to access it and the availability (or otherwise) of suitable substitutes for freshwater recreation. Both the Roding and Maitai are used for recreation, with Nelson City undertaking a major rejuvenation project on the Maitai River to enhance its environmental, recreational and flood protection features. So it is likely that a substantial proportion of recreational use of the Waimea will be by Nelson residents, although there are no quantified estimates of what that proportion might be.

Beyond the freshwater settings, there could also potentially be gains in the coastal environment from increased freshwater outflow from the Waimea. But we have discovered no evidence of the significance, if any, of this effect.

3.3. The value of an additional water source for Nelson City

According to its Annual Plan, Nelson City budgeted $12.7 million expenditure on water supply in 2014/15, just over a third of which was for capital works and the balance on operations. This includes the full water supply system, including the reticulation network. To consider the value of an additional water resource for Nelson City it is useful to isolate the value of its existing sources.

The costs of procuring water (excluding reticulation) are summarised in Table 4. These are proposed costs for 2015/16 and the figure for treatment plant membranes is an average of renewal cost plus new capital expenditure for the next ten years. This suggests the costs of the headworks alone – dam and extraction facilities and piping upstream of the treatment plant – are quite low at 4 or 5 cents per cubic metre, compared against the total volume abstracted or the total volume of delivered supply (after loss or unaccounted for water). These figures do not include insurance, electricity, staff time, radio telemetry and a number of small costs that cannot readily be broken down, so the cost per cubic metre will be understated.

[4] Cawthron Institute (2012) Valuing our waters – a case study in Tasman District, Report to Ministry of Science and Innovation

Table 4 Current cost of Nelson's water sources

Item	Basic operations	Renewals	Combined
Headworks	216,000	60,000	276,000
Treatment Plant	1,600,000	246,000	1,846,000
Treatment membranes		500,000	500,000
Totals	1,816,000	806,000	2,622,000
	Combined cost	**Headworks only**	**Treatment plant**
Cost/cubic metre extracted	$0.33	$0.04	$0.30
Cost/cubic metre delivered	$0.48	$0.05	$0.43

Source: NZIER, using figures supplied by Nelson City

This is similar to the cost of water procurement that Nelson City could face if it agrees to fund 5%[5] of the Waimea Dam cost to cover future regional water growth. Table 5 shows the annual operating cost and annualised capital cost of the Waimea Dam according to current low, medium and high estimates of what it may cost to build. It also presents Nelson City's proposed 5% share of capacity to provide for future regional growth, the volume this would make available and the cost per cubic metre extracted. Whichever capital cost is used, the cost per cubic metre is about 4 cents. A higher discount rate of 8% (currently the Treasury's default rate for public infrastructure investment) would increase this cost a little to 3.8, 4.4 and 5.0 cents per cubic metre across the three capital cost options.

To uptake this water Nelson City would face additional costs in transporting it from the Waimea to its treatment plant. If building a new well-field and pipeline from the Waimea aquifer cost $10 million, annualised on the same basis as the Dam in Table 5 this would add cost of around $820,000 or 10 cents per cubic metre. If the well-field and pipeline cost $15 million, the added annual cost would rise to $1.23 million or 15 cents per cubic metre. If an arrangement can be reached to transport water via TDC's pipes and facilities at lower cost that would be a more economic option. If there are operational or security reasons for Nelson having a stand-alone well-field and pipeline, the difference between the cost of that option and the alternative cost of using TDC facilities is the effective cost of operational security.

[5] The figure of 5% is the estimated share of storage capacity provided in the Waimea Dam design to allow for regional growth, as identified by Tasman District Council.

Table 5 Cost of water from Waimea Dam

Item	Low cost	Medium cost	High cost
Capital cost of dam	$60,000,000	$70,000,000	$80,000,000
Annualised over 25 years at 6.5% rate	$4,918,889	$5,738,704	$6,558,518
Annual O&M	$500,000	$500,000	$500,000
Total annual cost	**$5,418,889**	**$6,238,704**	**$7,058,518**
Nelson's 5% share	$270,944	$311,935	$352,926
Nelson's volume cubic metres/year	8,034,000		
Cost/cubic metre extracted	$0.034	$0.039	$0.044

Source: NZIER from data in Waimea Dam Economic Assessment 2014

From the perspective of water supply, the proposed allocation of 5% of Waimea Dam capacity to Nelson City would more than cover the maximum potential loss of water should current risks to Nelson's water supply materialise. However, total cover requires the ability to access and transport Waimea water to Nelson if required, and that could come at a high cost.

The Waimea water also provides for growth in regional demand in Nelson's industries and residential expansion. The rate at which growth occurs and stimulates demand for the water is uncertain, and given the current supply situation this may mean that Waimea water would not be needed to support growth until some years hence. That has the disadvantage that capacity must be bought in the Dam before it is needed, but it also has two countervailing advantages. One is that the costs of infrastructure to bring water into Nelson can be deferred until nearer the time when it is needed. The second is that, to the extent that Waimea water can be brought into Nelson via TDC's facilities, it may be possible to relieve use of other sources and provide extra water in the Maitai and Roding for environmental improvements.

Detailed forecasts of water demand in the City are beyond the scope of this report. But we note that provision of capacity before it is needed means that the Dam would provide substantial headroom over current needs, which both provides the security buffer and scope to use water of a temporary basis for other purposes if required.

4. Inter-district split of benefits of Waimea Dam

Aside from the direct value of enhanced water supply for its consumption, Nelson City has an interest in the completion of the Waimea Dam from the indirect effect of additional business, spending and incomes in Nelson associated with growth in irrigated production in Tasman District. This section examines the split between Nelson and Tasman District of potential benefit identified in NZIER's 2014 Waimea Dam Economic Assessment prepared for Nelson Regional Economic Development Agency.

4.1.1. Value to Nelson city of current activities in the Waimea plains

Table 6 shows our estimates of the value of economic activities in the Waimea Plains. As per our 2014 report, we have calculated these estimates by using the gross margins per hectare of each crop type times the currently irrigated area by land use type (i.e., 3,800 hectares) in the Waimea catchment. Our estimates indicate that economic activities in the Waimea Plains directly contribute $45.2 million per year to the Nelson-Tasman economy; about 91% of this value is due to apple farming.

Table 6 Estimated gross margins (in the Waimea area)

Incorporation of vegetables and floriculture into existing irrigated areas

Activity	Hectares	Units	$ Yield / ha	Price $/unit	Gross margins	Total $m / year
Pasture	1300	Stock units	12	102	663	0.9
Apples	1480	Tce[1]	3,750	23	27,898	41.3
Kiwifruit	70	Trays	12,000	9	24,575	1.7
Grapes	490	Tonnes	9	1,800	487	0.2
Berries	60	tonnes	20	2,000	12,800	0.8
Vegetables[2]	400				800	0.3
Total	**3800**					**$45.2**

Note [1] Tray carton equivalents (average 18 kg). [2] Vegetables & floriculture: We use a standard margin of $800/hectare for all vegetable crops, which are too numerous to be itemised here.

Source: NZIER; Waimea Dam Economic Assessment Report (NZIER 2014)

The absence of data on economic flows at the area unit level makes it difficult to assess the likely economic value of cross-boundary dependence between farming activities in the Waimea Plains and the processing industries in Nelson city. While such estimates could easily be inferred from using input-output multipliers, with typical flow-on effects ranging between 1.5 and 3 times the direct effect of a sector in a regional economy, these multipliers are known to overstate the extent of

impacts for projects which are large enough to reach constraints on inputs like labour that cause cost increases for other activities, as is the case for Waimea Dam.

Alternatively computable general equilibrium (CGE) modelling which takes account of input constraints and changing prices is widely regarded as providing a more robust analysis than multiplier methodologies.[6] By inferring from our CGE model of the Nelson-Tasman economy, we estimate the flow-on value to Nelson city of activities in the Waimea plains to range between $14.8 and $18.4 million per year.

4.1.2. Reduction in value to Nelson city

NZIER's 2014 assessment assumed the effect of the TRMP could result in 20% or 35% reductions in current irrigated production from the Waimea Plains. The effects of these reductions are summarised in Table 7 below.

Table 7 Industry impacts of non-augmentation

Impacts on value-added; Water cuts of 20% and 35%, in 2013 $NZ million per year (nominal terms)

	20% cut		35% cut	
	Tasman	Nelson	Tasman	Nelson
Apples	-10.4	0.0	-18.7	0.0
Kiwifruit	-0.4	0.0	-0.7	0.0
Grapes	-0.2	0.0	-0.4	0.0
Berries	-0.2	0.0	-0.3	0.0
Vegetables & Floriculture	-0.1	0.0	-0.1	0.0
Dairy	-0.3	0.0	-0.5	0.0
Sheep and beef (land use shift)	0.6	0.0	1.0	0.0
Total direct impacts	**-11.0**	**0.0**	**-19.7**	**0.0**
Food processing	-0.7	-0.6	-1.4	-1.3
Wholesale	-0.4	-0.9	-0.8	-2.0
Retail	-0.9	-1.2	-1.8	-2.5
Other industries	-0.2	-0.9	-1.1	-2.2
Total indirect impacts	**-2.2**	**-3.6**	**-5.1**	**-8.0**
Total value added (direct + indirect) impacts	-13.2	-3.6	-24.8	-8.1
Add: Commodity taxes	-0.3	-0.4	-0.7	-0.9
RGDP	**-13.5**	**-4.0**	**-25.5**	**-9.0**
RGDP (Tasman-Nelson region)	**-17.5**		**-34.5**	
25-Year PV (8% discount rate)	**-144.2**	**-42.6**	**-273.0**	**-95.8**

Source: NZIER

[6] On Input-Output tables: Uses and abuses http://www.pc.gov.au/research/completed/input-output-tables

The combined Nelson-Tasman economy would shrink by $17.5 million and $34.5 million respectively if 20% and 35% water allocation cuts were to occur in the Waimea Plains. Detailed results shown in Table 7 suggest that the consequent economic cost to Nelson city would be in the order of $4 million and $9 million per year.

These costs accrue from indirect 'flow-on' impacts associated with reduced activities in food processing, and from wholesale and retail trade.[7] Over 25 years, the cost (in $PV terms, discounted at 8%) to Nelson city would be $42.6 and $95.8 million as water allocation cuts increase from 20% to 35%.

Table 8 shows the economic benefits (in million $NZ per year) to the Nelson-Tasman economy as a result of water augmentation in the Waimea plains. As in our 2014 report, we assume that the full economic benefits from augmentation would only occur 8 years after the dam has been constructed. On the 8th year after the dam has been built, the Nelson-Tasman RGDP would expand by $54.5 million per year. [8]

Table 8 Industry impacts of augmentation

Industry value added; 2013 $NZ million per year (nominal terms)

Sectoral gains under Augmentation	Tasman	Nelson
Apples	25.3	0.0
Kiwifruit	2.1	0.0
Grapes	0.1	0.0
Berries	8.0	0.0
Vegetables & Floriculture	0.0	0.0
Dairy	0.5	0.0
Sheep and beef (shift)	0.5	0.0
Total direct impacts	**36.4**	**0.0**
Food processing	1.6	2.0
Wholesale	1.1	2.7
Retail	2.4	3.4
Other industries	0.7	2.6
Total indirect impacts	**5.8**	**10.3**
Total value added (direct + indirect) impacts	42.2	10.3
Add: Commodity taxes	0.9	1.1
RGDP	**43.1**	**11.4**
RGDP (Tasman-Nelson region)	**54.5**	
RGDP 25-Year PV (at 8% discount rate), benefits phased in 2 years after dam build starts, fully realised year 8	**305.4**	**81.1**

Source: NZIER

[7] We pro-rate the costs by using as weights, the data from Statistic New Zealand's business demographic survey data at the Nelson-Tasman area unit and 56 ANZSIC06 level.

[8] We have lagged full production by 8 years to allow for land use conversions and other investments to be completed.

Nelson City stands to benefit $11.4 million per year due to indirect 'flow-on' impacts associated with food processing and services trade. The benefits to food processing will come by way of expanded operations (more agricultural inputs for further processing), while the expansion in wholesale and retail trade would be driven by increased household and business activities in the region.

Over 25 years, the benefit to Nelson city (in $PV terms, discounted at 8%) would be $81.1 million.

The total economic benefits to Nelson city of water augmentation in the Waimea Plains are shown in Table 9. Depending on the severity of the water allocation cuts, the flow-on benefits to food processing and other industries in Nelson city would be between $15.4 and $20.4 million per year. In present value terms discounted at 8% over 25 years the value of the Dam would be between $123.7 and $176.9 million.

Table 9 Indirect impacts on Nelson city GDP

Present value impacts on Nelson GDP, calculated over 25 years at 8% discount rate

$m year	20% cut	35% cut
Avoided cost of non-augmentation	4.0	9.0
Value of augmentation	11.4	11.4
Total indirect benefits $m/year	15.4	20.4
PV$m	**20% cut**	**35% cut**
Avoided cost of non-augmentation	42.6	95.8
Augmentation production benefit, benefits start year 8	81.1	81.1
Total indirect benefits PV $m	**123.7**	**176.9**

Source: NZIER

4.1.3. Caveats and limitations

Our approach to estimating the potential economic costs/benefits to Nelson city of activities in the Waimea Plains is undertaken at a high level and should be viewed as a broad indication of potential economic costs/benefits rather than precise forecasts. In the absence of data on cross-boundary dependence between farming activities in the Waimea Plains and the processing industries in Nelson city, we have pro-rated our 2014 economic estimates by using as weights, Statistic New Zealand's business demographic survey data at the Nelson-Tasman area unit and 56 ANZSIC06 level.

5. A method for determining contribution to the dam

A storage dam is a large infrastructure item characterised by high front-end costs of installation and low on-going costs. Once a dam is built the efficient price for water is to charge users the marginal cost of the water they use, plus a contribution to recovering fixed costs. The challenge is to attract commitment from enough contributors to ensure it is built and covers its cost of capital. Too low a price and users will be cross-subsidised reducing the return to the dam owners (except in a co-operative company in which users are the owners). Too high a price and subscription will fail to attract enough users to allow the dam to proceed.

5.1. Principles for attributing costs

The fixed cost contribution can be applied in different ways such as:

- Averaging total cost of supply across all users, which is simple and achieves cost recovery but is inefficient in charging some users more than the value of water to them, creating disincentive to subscription
- Fully distributed cost (FDC) methods: the user charge comprises the marginal cost plus a share of fixed costs distributed according to some measure of use or benefit e.g. in proportion to volume or value obtained
- Ramsey pricing: the user charge contains the marginal cost plus a share of fixed costs distributed in inverse proportion to each user's price sensitivity (i.e. the least price sensitive bear more of the cost)
- Multi-part pricing: this has explicitly separate charges for use (covering marginal cost) and access (contribution to fixed cost) and can be the most efficient, as the access charge can be tailored to each user's willingness to pay with least distortion of choices (e.g. using Ramsey pricing, if feasible).

Multi-part and Ramsey pricing are the most efficient and least distorting of choices, but also the most difficult to apply, as they depend on the availability of good data on which to base the price differentiation. The FDC approach is more practical, but the choice of how to allocate the fixed cost component is flexible and arbitrary. For instance, the cost of environmental flows could be shared between NCC and TDC on the basis of recreation benefit measured in terms of visitor numbers or by the value attached to those visits. The resulting distribution would differ if one area has higher income, more costly access to substitutes or other characteristics that confer higher value on new recreation opportunities.

The Treasury has recommended two principles in allocating unattributable joint costs between different parties. One is the "exacerbator pays" principle which allocates costs to parties in proportion to the costs they each create for the system. The other is the "beneficiary pays" principle which allocates costs in proportion to the benefits received. The Waimea Dam has been designed with capacity to meet various current and future demands. The proposed sharing of costs in proportion to the share of capacity earmarked for different uses primarily reflects beneficiary pays.

5.2. Application to the Waimea Dam

In the case of Nelson City, the two principal benefits are access to 5% of storage capacity to provide for future regional demand growth, and some yet to be determined share of the 30% of storage provided for enhanced environmental flows in the Waimea.

Table 10 illustrates the application of the benefit principle on the basis of a set of assumptions. These include that contributing to the 5% capacity for future water would be recovered through the existing targeted rates and fees for collecting funding for water supply services. Nelson would also cover a share of the cost of the 30% of Dam capacity for environmental flows, recovered via a general rating or charge instrument as the benefit is potentially accessible to all Nelson ratepayers.

Across a range of current estimates for the cost of building the Dam, between $60 and $80 million, the table annualises the construction cost and adds yearly operating costs to give a total annual cost. A 5% share is calculated as Nelson's contribution to providing for future regional economic growth, and a similar calculation is made for assumed 20%, 35% and 50% shares of the environmental capacity cost, on the basis that Nelson residents gain recreational benefit from improved Waimea River flows.

Table 10 Illustration of Cost sharing of the Waimea Dam

Contributions to Waimea Dam						
	Lower bound		***Mid-range***		***Upper bound***	
Capital cost of Waimea Dam	$60,000,000		$70,000,000		$80,000,000	
Annualised over a term of years	25		25		25	
Using a rate of	6.5%		6.5%		6.5%	
Annualised capital cost	$4,918,889		$5,738,704		$6,558,518	
Annual operating costs	$500,000		$500,000		$500,000	
Total annual cost of Dam	$5,418,889		$6,238,704		$7,058,518	
Water Supply						
Nelson's share of capacity volume	5.0%		5.0%		5.0%	
Annual cost to Nelson City	**$270,944**	**2.1%**	**$311,935**	**2.5%**	**$352,926**	**2.8%**
PLUS TDC fee for water transport		0.0%		0.0%		0.0%
OR New link to South Nelson	$245,944	1.9%	$286,935	2.3%	$327,926	2.6%
OR Cost of New wells & pipeline	$819,815	6.5%	$1,205,128	9.5%	$1,229,722	9.7%
Current NCC Water spending/year	$12,661,000	100.0%	$12,661,000	100.0%	$12,661,000	100.0%
Consequential costs						
New links Nelson-South Nelson						
Capital Cost	$3,000,000		$3,500,000		$4,000,000	
Cost annualised as for Dam	$245,944		$286,935		$327,926	
New Waimea wells & pipeline						
Capital Cost	$10,000,000		$14,700,000		$15,000,000	
Cost annualised as for Dam	$819,815		$1,205,128		$1,229,722	
Environmental Flow Enhancement						
Environmental capacity share	30%		30%		30%	
Cost attributed to Environment	$1,625,667		$1,871,611		$2,117,556	
Nelson's share of amenity/use	20%		35%		50%	
Annual cost to Nelson	**$325,133**	**2.1%**	**$655,064**	**4.2%**	**$1,058,778**	**6.7%**
NCC Environment spending/year	$ 15,751,000	100.0%	$ 15,751,000	100.0%	$ 15,751,000	100.0%

Source: NZIER

If the Dam cost $70 million to build, Nelson City's 5% share of capacity would have annual cost equivalent to 2.5% of its combined operational and capital spending on water supply in 2014/15. At the lower and upper bound estimates that cost would range between 2.1% and 2.8% of current spending of $12.7 million a year. But accessing the Dam-enabled water and conveying it to Nelson would cost more, between 6.5% and 9.7% if NCC has to build a new well-field and dedicated pipeline from the Waimea Plain, with an estimated capital cost between $10 and $15 million.

In the longer term, it will also need to incur a capital cost of between $3 and $4 million, on connecting South Nelson to the Nelson water system, the equivalent of 1.9% and 2.6% of its current spending as shown in Table 10[9]. The connection, wells and pipeline combined could add in the range of 8.4% to 12.3% of Nelson's current water supply spending.

Much of this cost could be avoided or deferred if TDC's treatment facilities and pipelines can deliver this new water to supply South Nelson. Supply from TDC in this area is largely based on historical boundary changes and the convenience and low cost in supplying the more recent residential subdivisions. That cost is subject to agreement and is unknown at present, but should be substantially below the cost of stand-alone infrastructure for Nelson.

5.3. Application to environmental value

Table 10 presents a similar calculation of the environmental flow enhancement, which has been attributed 30% of the Dam's planned capacity, with annual cost of between $1.63 and $2.12 million. This could be allocated between Nelson and Tasman in proportion to the recreation use made of the Waimea by their respective residents. Such cross-boundary funding of recreation opportunities has precedent in the Saxton Field sports facilities on the boundary of Nelson and Tasman District, which is funded by both councils under a partnership arrangement. That is subject of a joint plan between the councils on their recreational priorities, a procedure for assessment of new funding proposals, and depends on knowing where users come from for input into a funding tool to determine allocation shares. It is not clear that enhanced environmental flows in the Waimea would fit the criteria for such an arrangement, but the discussion below is illustrative of the economic implications if it did.

The share of recreational use attributable between the districts is unknown but if Nelson were attributed with somewhere between 20% and 50% of recreational benefit it could face annual cost contributions equivalent to between 2.1% (at lower bound) and 6.7% (at upper bound) of its current annual spending on environmental protection. This is shown at the bottom of Table 10.

Would this represent good value for money for Nelson? Without having firm data on recreational use of the Waimea by Nelson residents, or the value they attach to recreation in the river, it is hard to give a firm answer. But some indication can be given by working backwards from these costs to identify the break-even point at which the benefit of increased use of the Waimea just equals the cost.

[9] Table 10's Figures of $12.661M on water supply and $15.751M on environmental are combined operating and capital expenditures on these items from Nelson City Council's 2014/15 Annual Plan.

Such analysis is illustrated in Table 11. This combines low, medium and high values per angler day from Marsh and Mkwara (2013)[10] with the lower, mid-range and upper bound estimates of Nelson's annual cost for environmental flow from Table 10, to calculate the number of recreational visits at these values required to match the costs to Nelson City. The top half of the table shows the aggregate break-even results, which range from 2,601 visits at the high value to cover the lower bound cost, to 211,756 visits at the low value to cover the upper bound cost. The bottom half of the table relates this to the number of days the average Nelson-resident angler would need to fish the Waimea under each of these aggregate results, on the assumption that there are 2,186 adult freshwater anglers in Nelson City.[11] The table shows break-even occurs with 1-4 additional days per angler per year on average at the high value of $125 per day, or 5-16 days at the medium value of $31 per day.

Table 11 Recreation days at standard values

Break-even on fishing trip value	Lower bound Dam cost	Mid-range Dam cost	Upper bound Dam cost
Low value/trip @ $5	65,027	131,013	211,756
Medium value/trip @ $31	10,488	21,131	34,154
High value/trip @ $125	2,601	5,241	8,470
Days per year at low value	30	60	97
Days per year at medium value	5	10	16
Days per year at high value	1	2	4

Source: NZIER

A daily value of $125 seems high for a regional resource that is around 20 kilometres away from Nelson, but $31 a day is in keeping with a number of other estimates of the value of a visitor day in similar settings. So 5-10 additional days would not be outside the range of plausible response to improvement in the water flows in the Waimea. But the benefit of enhanced flows is not confined to angling, as there may also be visits by Nelson residents for swimming, picnicking and kayaking. If these values applied to the full adult population of Nelson for general recreation (although Marsh and Mkwara 2013 suggest such estimated values are higher than for fishing), break-even would occur with between 2 and 6 additional visits per person per year on average at the low $5 value and between 0 and 1 additional visits at the medium value of $31.

The above analysis does not prove the enhanced environmental flows from the Dam are worth the contribution that Nelson may be called on to make, but it does show that at estimated recreation values the cost could be justified by a low uptake of additional visits by Nelson residents. The approach can be adapted to use any new information that comes to light. If new surveys are undertaken that show the level of recreational use of the Waimea River and the home locations of those who use it, there would be a stronger basis for assigning the shares of use between NCC and TDC than the assumed 20%, 35% and 50% used here.

[10] Review of freshwater non-market valuation studies, op.cit., Table 7.1: estimates are averages drawn from 5 studies

[11] Based on the 2013 Census of Nelson population aged 15 years and older, and Sport New Zealand's Active New Zealand Survey of participation in freshwater fishing

A partial cross-check on the estimates above would be to examine the costs that NCC incurs in providing other outdoor recreation opportunities to its residents, for example through a break-down of its parks budget and comparison with the annual number of park users to arrive at a cost per recreational visit. This is only a partial check because a cost of provision is not the same as the value to residents, the user numbers will be amplified by tourists and non-residents, and the quality of recreation experience in parks and the river is not the same. Such analysis is beyond the scope of this current report, but we raise it as a possible line of enquiry for considering the comparative cost of supplying recreational opportunities to Nelson's ratepayers.

An issue with allocating costs for environmental flows according to recreational benefit is that cross-border recreational use flows both ways, and that Tasman District residents may use areas on the Roding or the Maitai that are currently maintained by Nelson City, to which TDC might be expected to contribute. Whether councils do contribute to facilities in other councils' territories is a matter for individual determination and negotiation between the councils concerned, and The relative size of the populations in the respective districts and frequency of their use of facilities across the border. Councils may tolerate free use from across the border as less costly than trying to establish a mutually acceptable sharing of costs.

All the estimates above are for illustrative purposes and do not precisely predict the costs that NCC may face. NCC may have different financial options to those shown here. But the approaches described for estimating annual costs and inferring the break-even values are adaptable to input of other assumptions and figures in providing guidance on what scale of contribution is likely to be worthwhile.

5.4. Other sources of contribution to the Waimea Dam

The costs of the Waimea Dam, and in particular the portion attributed to future economic growth, might be shared by other entities with an interest in the Dam proceeding. Any firm that anticipates an increase in its business from the Dam may be willing to pay up to the present value of its expected increase in profits (after tax) to ensure the dam proceeds. But such firms may be unwilling to commit because of potential free-riding by their competitors.

Possible contenders for this are Port Nelson and Nelson Airport, who could benefit from increased throughput of freight and business-related passengers. However, both these companies are partially owned by NCC and TDC, so any contribution they make towards the Waimea Dam would result in a reduction in dividends to the councils, which will result in either a reduction in income or necessitate increase in rates revenue for both councils. While either company could contribute towards the Dam to ensure it proceeds, this is unlikely to significantly change the net benefit for their shareholding councils.

Another possible source of funding is the Crown Irrigation Fund, which has partially supported several water supply dams for irrigation across the country. The principal objective of this fund is to support irrigation, however, so it may not provide much relief to contributions for those parts of the cost which are attributable to non-irrigation functions, such as municipal water supply as the case with NCC's interest in the Waimea Dam.

6. Conclusions

The economic effects of the Waimea Dam on Nelson City can be summarised as:

- The Dam would enhance Nelson's GDP by around $15-$20 million per year, equivalent to about 1% of Nelson's current GDP: this may appear small, but it is unusual for a single project to have much larger impact on a local economy (except those that are less developed and diverse than Nelson)
- The Dam would provide an additional water source to meet growth in demand in the long term, and security against extreme water restrictions that might (but probably won't) occur in the near future:
  - But it comes at a cost, particularly if Nelson has to establish a separate well-field and pipeline, rather than use TDC's existing facilities
  - It creates large headroom in supply in face of less extreme restrictions, that would be useful if future water demand materialised
  - But there may be more cost effective alternatives for meeting smaller restrictions in water in the short term (e.g. plugging leaks and reducing unaccounted for water)
- The Dam would provide a non-market benefit from enhanced recreational opportunity in the Waimea River and estuary, about which there are no quantified data at present, although the weight of population and proximity suggest the share of Nelson's residents in the whole could be substantial.

Subscribing to the Dam for water supply enhancement would provide water at a cost per cubic metre similar to that of current water sources, but transporting water into Nelson would increase the overall cost. It would substantially increase the headroom across Nelson's current needs and improve capability to reduce abstraction pressure on other sources, but there is no current dollar value to attach to this.

Although GDP enhancement is clearly of benefit to the Nelson community and should lift property values and raise rating capacity in the long term, this process is only tenuously linked to the benefits received by ratepayers and cannot be relied on to provide sufficient additional revenue for this purpose. Contributions towards the dam would require increases in rating demands and would need to be weighed against other demands for rates increases.

The prospect of GDP gain is a benefit for NCC but the basis for supporting the Dam is more in the beneficial services it directly supplies the City. Many more activities could claim to raise regional GDP than could be subsidised by NCC, and to support them on that basis alone opens NCC to substantial risk of over optimism. The main beneficial services that the Dam would provide NCC and that justify financial support are in greater security in water supply, and benefit for recreational opportunities for Nelson residents, outside the City boundaries in the Waimea River and estuary. The general gain in regional GDP is a by-product of supporting these services rather than something that can be directly targeted.

From the perspective of water supply, the current proposed allocation of 5% of Waimea Dam capacity to Nelson City would be sufficient to more than cover the maximum potential loss of water from current Nelson water supply, should there be reduction in abstractions from the Roding, an increase in TDC's uptake of its Roding

entitlement and termination of supply from TDC into South Nelson. This is an extreme example of supply restrictions Nelson City may face. The cost of replacing water with water enabled by the Waimea Dam may be similar at source to Nelson's current sources (although difficult to estimate precisely), but Nelson City would face additional cost in transporting Waimea water for use in its network.

The value to Nelson City water supply of having this additional water depends on

- The likelihood of deep restrictions in current supply occurring
- The cost of the next best alternative way of making up such restrictions.

While the outcome of new resource consents applications to allow Nelson City to continue to abstract water from the Roding and Maitai rivers and the final allowable volumes are unknown, the likelihood of TDC exercising its full entitlement from the Roding and of ceasing to supply South Nelson is considered to be very low. In that case the value of additional capacity from the Waimea depends on there being growth in water consumption in Nelson, either from population growth or from new industry.

The cost of alternative ways of making up such restrictions is a question for water engineers to determine. While the unaccounted for extraction appears to offer scope to make up the extreme restrictions outlined above, such losses are commonly associated with leakage across extensive reticulation networks of varying age, and elimination of such leakage can be an expensive and time consuming process.

Contributing to the 5% capacity for future water would primarily serve NCC's water supply function and could be recovered through the existing targeted rates and fees used for collecting funding for water supply services. The amounts per year would be equivalent to around 2-3% of current annual expenditure on water supply in the annual plan.

It might be argued that Nelson benefits from the enhanced recreational opportunities provided by the Dam's 30% capacity provision for environmental flows. The cost of that capacity could be allocated between Nelson and Tasman in proportion to the share of recreation use made by their respective residents. This share is unknown but Nelson is attributed with between 20% and 50% of recreational benefit it could face annual cost contributions equivalent to between 2% and 7% of its current annual spending on environment. These can be recovered via a general rate or charge instrument as the benefit is a public good potentially accessible to all Nelson ratepayers. These costs seem high, but some recent estimates of the value of recreational visit days suggest they could be justified if water flow enhancement led to relatively low increases in average use of the Waimea River by Nelson residents.