RUATANIWHA WATER STORAGE SCHEME

REVIEW OF REGIONAL ECONOMIC IMPACTS AND NET PRESENT VALUE

Butcher Partners Ltd – March 2016

1. Introduction

This report was commissioned by Andrew Newman, Chief Executive of the Hawkes Bay Regional Investment Company Ltd (HBRIC Ltd) on behalf of HBRIC Ltd and the Hawkes Bay Regional Council (HBRC). It is an update of the report "Ruataniwha Irrigation Project – Regional Economic Impacts and Financial Cost Benefit Analysis of the Proposed Ruataniwha Irrigation Scheme" dated 8 September 2012[1].

Since the original economic analysis and economic impact analysis was undertaken, many factors have changed. Butcher Partners Ltd has been asked to update the economic analysis to take into account changes in construction costs, irrigable areas, land use mixes, farm profitability and rates of irrigation uptake. The major design change in terms of the scheme itself has been a decision to add a zone to the command area, to increase the network within the original zones, and to increase the length of uphill pipe and amount of pumping and have water delivered at pressure on farms. This increases the construction cost but reduces on-farm operating costs. Construction costs, including mitigation costs, have also increased for other reasons, and the construction period has shortened from four years to three.

Farm budgets have been adjusted to reflect these changes, and have also been adjusted to reflect changes in productivity, production systems and product prices. On-farm benefits arising from the project have increased substantially, with the change arising almost entirely from the increased forecast profitability of viticulture and orcharding, and a corresponding increase in the area going into these land uses[2]. While the 1,250 Ha increase in these land uses is only 5 % of the total irrigated area, these are extremely intensive land uses, and very profitable per Ha. Moreover, the revised farm budgets show increased revenues per Ha of 57 % for orcharding and 33% for viticulture. Percentage increases in farm expenses per Ha (36 % and 10 % respectively) leads to profit increases per Ha of 158 % and 96 % respectively.

There has been debate in the last two years about an appropriate project life and discount rate to use in financial analysis of the project, and this report discusses the issues and argues for use of a 5 per cent discount rate and 70 year project life. Financial results are tested for 35 and 70 year project lives, and for 5%, 6% and 7 % discount rates. There has also been debate about appropriate project residual values. Residual values are generally expected to slightly increase Net Present Value and Benefit : Cost ratios, but they have been excluded from the results reported here for reasons outlined in the text and in an Appendix.

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[1] A limited update was undertaken in March of 2014. Comparisons in this report are to the original Oct 2012 report.

[2] Assessed by AgFirst, Hastings and market tested by HBRIC Ltd.

Forecasts of irrigation water uptake were provided by HBRIC Ltd, and are based on advice from BNZ and Piperhouse Advisory. Farm budgets for both dryland and irrigated farmers were taken from the report "Ruataniwha Water Storage Scheme - Review of Farm Profitability" dated 27 January 2016[3]. Land use, both existing and after the irrigation scheme reaches full capacity, came from the same source.

[3] Prepared by MacFarlane Rural Business Ltd (Ashburton), Baker & Associates (Masterton) and AgFirst (Hastings).

2. Principle Changes to Assumptions & Effects on Net Present Value

In the original report it was argued that it was appropriate to assess Net Present Values over a 70 year project life and at a discount rate of 5 per cent (for further discussion on this see section 2.7.1 of this report). Accordingly, where changes to assumptions are accompanied by changes in Net Present Value, the NPVs changes are calculated on that basis.

2.1 Construction Costs and Timing

The costs of dam and infrastructure were originally estimated to be $239.7m (including transaction costs and mitigation during construction). In addition there was $4.9 m for electricity reticulation, and $1.6m[4] of mitigations costs over 35 years giving a total of $246m. This was spread over a 4 year construction period and had a NPV (5 %) of $203m.

The total revised capital costs are estimated to be $333m. Construction is now expected to take place over three years rather than four, and the NPV (5 % discount rate) has risen to $294m, an increase of $77m.

There is a further $16.3m of development costs, which are sunk costs to get the project to its current state and for that reason should be excluded from the project CBA from the perspective of March 2016.[5] Sunk costs were also excluded from the earlier analysis. These sunk costs are included in the BNZ financial analysis, as are capitalized interest during construction, which must be excluded from a Net Present Value calculation because the interest cost is inherent in the Net Present Value calculation. The BNZ analysis excludes the costs of the transmission lines, because the financing has been treated as an operational cost. The Net Present Value calculation includes the capital cost but excludes the interest cost.

2.2 Land Area, Land Use and Processing undertaken in region.

The total irrigated area has been increased in the farm budgets from 25,000 Ha to 26,250 Ha, and all this additional land is assumed to go into either orcharding (increased by 77 % or 870 Ha to a total of 2,000 Ha) and viticulture (increased by 22 % or 305 Ha to a total of 2,075 Ha). See Table 1 below. The Macfarlane report states that this is due to increased profitability in these two land uses. While these increases are equivalent to only 5 % of the original irrigated area, they are forecast to be very high profit land uses.

Processing can generate very significant economic impacts in the region. The original report assumed that all meat and grapes will be processed in the region, all apples will be packed in the region, half of the vegetables will be processed in the region, and none of the dairying will be processed in the region.

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[4] There was some confusion as to whether the mitigation costs in years 2-5, 5-10 and subsequent years was an annual cost of a cost spread over the period. This led to total mitigation costs being stated as $1.56m, when it is now apparent that they should have been stated as $6.98m.

[5] A CBA generally excludes sunk costs on the grounds that they cannot be recovered, and the CBA is an aid to deciding whether to continue with the project given the current environment. The March 2016 environment is that these costs cannot be recovered.

These assumptions are still considered to be reasonable, and both Delegats and Villa Maria have recently expanded their local processing facilities. The employment associated with processing is very significant, and any change in these assumptions will significantly affect the economic impact analysis. It will not affect the Cost Benefit analysis because there are assumed to be no net financial benefits arising from processing, with investments in the sector assumed to be producing a normal return on capital, whereas a CBA calculates the "above normal" return on capital.

2.3 Farm Capital Investment

Net extra farm capital investment has increased from the original expected $356m (NPV $229m) to $556m (NPV $444m).

Table 1 ***Additional Investment by Farm Type***

	Change in Area (Ha)	Original ($m)	Updated ($m)	Difference ($m)
Dairy	0	$256	$275	$20
Arable	0	-$24	-$40	-$15
Mixed	0	$89	$91	$2
Finishing	0	-$140	-$140	$0
Sheep & Beef	0	-$7	-$9	-$3
Orchards	870	$55	$208	$153
Vineyards	390	$127	$170	$43
Total		**$356**	**$556**	**$200**

Dairy farm investment rose by $20m because of increased costs for waste water treatment and for dairy sheds, while the decline in arable investment got larger simply because of a greater reduction in the area of arable land assumed to be converted to other land uses. Orchards and Vineyards have a huge increase in investment partly because of a $20,000 / Ha increase in expected investment required, but primarily because of the large increase in areas in those land uses.

Note that these figures vary from the figures in the Macfarlane report because all land has been ascribed the same value and because purchase of Fonterra shares has been included as per the original Macfarlane analysis. This is consistent with a dairy return which includes the return on shares. Fonterra shares are equivalent to 15 % of total capital investment for a dairy farm.

2.4 Water Uptake Rates

The original analysis reflected uptake rates of 56 % in the first year of operation, rising to 100% in year 8 of operations. The current analysis begins with 64% in the first year and rises to 94 % in year 8 of operations, and 100 % in year 12 of operations. This more rapid initial uptake increases NPVs by approximately $8m.

2.5 Contracted Water, Ordered Water and Price Paid

The water user agreement indicates that the Scheme will supply up to 105.55 Mm3 on a Take or Pay basis (i.e. contracted water). This includes:

- Irrigation 100 Mm3 (although farm budgets indicate a slightly higher demand of 101.7Mm3 at 100 % take-up of contracted water);
- Potable Water 1.55 Mm3 (Central Hawkes Bay District Council)
- HBRC Flows 4.0 Mm3 (taken for environmental flows over and above those required by consent conditions. This water is additional to the flushing flows as per the scheme's resource consent conditions). In the first two years of operation the volumes available to Council will be, respectively, 8 Mm3 and 6Mm3. Thereafter it will be 4 Mm3.

Water that has been contracted for supply may not be used if farmers do not require it. This will provide a saving to the farmers of $0.04/m3, being the electricity costs required to get water into the system. The contracted amount of water at full demand as per the farm budgets is 101.7Mm3, but the average ordered amount[6] in a 41 year simulation period is only 73 Mm3[7].

The assumed price of water in the farm budgets in the initial analysis was $0.20 / m3, and this has been increased to $0.27, including electricity costs of $0.04 / m3 to get water into the irrigation system. This value is slightly less than the $0.275 / m3 that current HBRIC Ltd financial modelling assumes, which suggests the farm profits are slightly optimistic. However, the farm budgets assume that farmers will pay the electricity cost of e $0.04 / m^3 on all the 101.7Mm^3 of contracted water every year, whereas as outlined above in an average year they will use only 73 Mm3 and will pay electricity costs on only that amount. Hence total farm profits are understated by $0.79[8]m per year.

The <u>value</u> of water in terms of increased farm production is independent of the price paid to the Scheme, while the price paid serves to allocate the production benefits between farmers and the water Scheme operators. All farm budgets include water at a price of $0.27/m3, and this price is used in the calculation of Scheme costs to farmers and benefits to the water company. Since the gross cost to famers equals the gross revenue (benefit) to the water company, the choice of water price does not alter the Net Benefits or Costs of the project as a whole. That is, the charge for water is a transfer between the farmers and the Scheme operators.

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6 Excluding spot water supplies

7 HBRIC Ltd– Grant Pechey, *pers. comm*

8 (101.7 Mm^3 – 73 Mm3) x $0.04 / m^3 = $1.13m / yr

2.6 Volume and Value of Sales of non-irrigation Water

2.6.1 Potable Water to Central Hawkes Bay District Council

As described above, the scheme provides 1.55Mm3 of potable water annually to Central Hawkes Bay District Council and this is assumed to have a net benefit of $0.235[9] / m3, or $0.366m / yr. NPV is $6m[10].

2.6.2 Hawkes Bay Regional Council Purchase of Water for Environmental Flows

Hawkes Bay Regional Council is in principle and subject to consultation looking to purchase an additional 4Mm3 / year for enhanced environmental flows (beyond those required by the environmental conditions imposed by consents). A council paper[11] identifies benefits as including:

- *Augmenting flows in small streams*
- *Lake Hatuma reduced residence time and flushing*
- *Increased flushing flows for the main stem rivers*
- *Temperature refugia*
- *Opening/enlarging of river mouths*
- *Potential Sales of this water to farmers if there are not sufficient environmental benefits*

The council paper makes it clear that the assessment of environmental values is initially a qualitative one, and that, should Council agree to the proposal, a more detailed quantitative assessment of environmental benefits and environmental projects would be developed. It seems reasonable to assume that since the council intends to purchase this water at an agreed price of $0.235[12] / m3 or $0.94m / year, then this is a minimum value of the additional long term environmental benefit of this water, at least in the opinion of council. This value has been used as a benefit in every year once the project begins to operate, and is independent of the amount which HBRC actually pays.
NPV is $17m.[13]

2.6.3 Spot Water Sold to Irrigators

Finally, in a typical irrigation season it is anticipated that dam starting volumes plus inflows will exceed outflows by an average of 40Mm3, and it is expected that on average 9 Mm3 of this surplus water will be sold on the spot market for a net $0.235/m3 or $2.115m in every year from year 1 of operation. This water is available on an uncertain basis, so is not part of the project's contracted supply. Contracted takes are not expected to reach full scheme capacity until year 12 of the project and in preceding years it is possible that spot sale in excess of 9Mm3 may occur. This possibility has been ignored and it has been assumed that Spot Sales will increase from 5.7Mm3 in the first year of operation to 9 Mm3 / year,

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[9] This is equivalent to the net benefit to the scheme of selling water to irrigators. It is assumed that the council will pay at least this much. A more comprehensive analysis would elicit information on the costs of an alternative supply of potable water to Central Hawkes Bay District Council. Initial indications is that the cost of an alternative supply is higher than the cost from the scheme.

[10] At 5 % over 70 years. Council can avoid the cost of building and maintain its own reservoir with a likely required capacity of 1.5 Mm3 at an estimated capital cost of $9m. Hence the benefit of scheme water is probably in excess of $6m.

[11] Agenda Item 10. Hawkes Bay Regional Council Meeting. 24 February 2016

[12] The cost of supply to Foundation Water Users, less marginal electricity cost to get the water into the irrigation system, which is not required in the case of these environmental flows

[13] At 5 % over 70 years.

or $2.115m / yr. It is possible that the spot price will be higher or lower than the assumed $0.235, and it is certain that there will be additional farm benefits over and above the spot price paid, otherwise farmers would not purchase the water. However, any on-farm benefit has been ignored both because of the uncertainty of levels of use and the kind of use made by farmers. It would be inappropriate to assume it will have a typical average value of water in farming systems based on permanent and reliable irrigation. Project NPV is $32m[14].

2.7 Discount Rate and Project Lifetime

The original analysis reported Net Present Value results based on discount rates of 5% and 8 %, and project lifetimes of 35 years, 70 years and 100 years. It was argued then that a discount rate of 5 % and a project life of 70 years was the most relevant for decision making, although this is a hotly debated topic. It is believed that from a community and farmer perspective the use of 5 % or less is justified on the grounds that this is consistent with financial decision-making by farmers and is consistent with the community's concerns about long term welfare rather than short term. While Treasury recommended a discount rate of 8 % in 2012 and reduced this to 7 % in 2014[15], in my view the use of this rate is useful primarily to enable Treasury to provide a funding priority ranking for this project against other infrastructure projects with similar lifetimes and project assumptions. Treasury has reduced the discount rate from the 10 % which it recommended during the 1980, 1990s & 2000s, and a reduction in the appropriate discount rate is consistent with steadily falling real interest rates in the last decade, and I understand that the rates of return required by Crown Irrigation are lower than the Treasury rate, although these rates are not made explicit by Crown Irrigation. National roading projects are now evaluated using a discount rate of 6 %[16].

A project lifetime of 35 years is consistent with the lifetime of consents, but is inconsistent with a very widely held view that the project is very likely to continue well past that date, and possibly indefinitely. For that reason this report is based on the view that an appropriate project life is 70 years. To provide an alternative to the either "all or nothing" approach of using 35 years or 70 years, I have also applied a probability of supply decay function which assumes that there is 100% chance of water being available at year 35 and 0 % at year 100. This is an attempt to adjust the project value downwards to reflect the possibility that water will become unavailable, and is done primarily to show how this "medium" level of conservatism affects results. The effect is to reduce the base case NPV by $67m to $665m.

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[14] At 5 % over 70 yrs.

[15] *"The Treasury recommends that the following real, pre-tax discount rates be used, unless a project-specific discount rate can be determined on objective grounds. Infrastructure ....Water and energy .....7 %." Source: http://www.treasury.govt.nz/publications/guidance/planning/costbenefitanalysis/currentdiscountrates*. Accessed 10 March 2016. These were discount rates as of Dec 2014. Treasury proposed in this document that these rates be updated annually but no update is yet available. Were it to be available, I anticipate the rate would be even lower. I am advised that Transit New Zealand currently uses a rate of 6 %, with sensitivity testing at 6 % and 8 %. See "The Discount Rate for the Economic Evaluation Manual, 2013. NZ Transport Agency EEM Technical Paper. Wayne Heerdegen.

[16] Transit New Zealand currently uses a rate of 6 %, with sensitivity testing at 6 % and 8 %. See "The Discount Rate for the Economic Evaluation Manual, 2013. NZ Transport Agency EEM Technical Paper. Wayne Heerdegen.

2.7.1 An Alternative View on Lifetime and Discount Rates, and a Response

In a public discussion about the project in Napier in August 2015, an independent economist, Mr Fraser, questioned the viability of the project, and focused on the NPV project returns over 35 years and at an 8 % discount rate, saying that the latter is consistent with a Treasury "rule"[17]. At the meeting and in subsequent communications I have pointed out to Mr Fraser that the Treasury discount rate is a recommendation rather than a "rule", that Crown Irrigation has been quite explicit that such a high rate of return is not their objective, and that there are other public policy reasons which support the use of a 5 % discount rate, with this rate being consistent with community objectives and with farmer investment behaviour. Mr Fraser justified his focus on a 35 year project life on the grounds that this was the period for which there was regulatory certainty (i.e. a consent is in place to take water for only this period), while I suggested that it would be appropriate to focus on the probability of an extension to 70 years, and suggested that this probability is likely to be about 90 % +.

2.8 Changes in Irrigated & Total Farm Area, and in Farm Profitability per Ha and Total

The report by Macfarlane Rural Business provides details of changes in farm budgets. The original farm budgets and land use area which formed the basis of the 2012 report showed that irrigation led to a total increase in farm profits[18] at full production of $46.3m / year, whereas the revised farm budgets and land uses show an increase at full production of $85.2m / year. The increase in farm profitability is $39m. This is in spite of the $8.7m increase in budgeted payments for water, which means that in total the lift in farm profits generated by irrigation has increased by $47.7m. As the table below shows, virtually all of this increase in profitability is due to the expansion of areas in viticulture and orchards, and the increased profitability per Ha for those land types. This increase in profit required an additional $200m in on-farm investment (see Table 1).

The $44m increase in the total profit on irrigated orchards arises in part from an increase in annual net profit per Ha. Revenue has been increased from $57,200 / Ha to $90,000 per Ha and costs-excluding-irrigation-scheme-charges from $44,500 / Ha to $60,000 / Ha, and this is responsible for $19.6m of the increase in profit on the area which was previously expected to be in irrigated orchard. The increase in irrigated orchard area of 870 Ha at the currently anticipated high profit levels is responsible for the remaining $24.7m of the orchard profit increase.

The $12.4m increase in annual net profits from viticulture includes $3.9m increase coming from the increased area at higher profit levels, and $8.6m coming from the increase in profitability per Ha on the originally expected irrigated area.

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[17] He later advised that the rate has been lowered to 7 %.

[18] Profit is defined as after economic depreciation, wages of management, and payments to the water scheme at $0.20/m3 in the 2012 budgets and $0.27c / m3 in the current budgets.

Table 2 Area and Profitability by Land Use

	Area of Land (Ha) affected by Irrigation		Profit $/Ha (before irrigation scheme charges)		Difference in Net profit before Water Charge
	A	B	C	D	E=(B*D)-(A*C)
	Original Report	Revised	Original Report	Revised	
	42,000	43,250	432	454	**+ $1.54m**
Sheep & Beef part irrig)	14,175	14,175	$869	$877	+$0.12m
Sheep & Beef - dry	4,671	4,671	$796	$725	-$0.33m
Finishing & Dairy Supp	1,800	1,800	$1,070	$1,163	+$0.17m
Mixed	3,688	3,688	$1,299	$1,497	+$0.73m
Arable & Vegetable	5,667	5,667	$2,667	$2,768	-$0.57m
Dairy Heavy	1,150	1,150	$4,023	$3,118	-$1.04m
Dairy light	8,025	8,025	$4,818	$3,866	-$7.64m
Orchards	1,130	2,000	$11,060	$28,359	+$44.2m
Viticulture	1,695	2,075	$5,043	$10,103	+$12.4m
Total Difference on Irrigated Land					**+$49.2m**
Increase in Profit due to Irrigation ($m/yr at full production and uptake)					**$47.7m**
Total Land Area (Ha)	42,000	43,250			
Total Irrigated Area (Ha)	25,000	26,250			

3. Updated Project NPVs and Economic Impacts

3.1 Project Net Present Values and Changes since 2012

If it is assumed that the project has only a 35 year life, than the project NPV varies from $132m to $413m depending on the discount rate (see bottom line of Table 3).

If it is assumed that the project has a 70 year project life, then the project NPV varies from $260m to $732m, depending on the discount rate (second to bottom line Table 4). The bottom line of that table assumes that sometime between year 35 and 100 the project is going to be closed with the cumulative probability rising to 100% by year 100. This assumption gives a probable project NPV of $236m to $665m.

Table 3 Net Present Value ($m) by Category, and Changes since original Analysis – 35 yr project life

Project Life 35 years	Revised Estimates				Original	Difference
Discount rate	no disc	7%	6%	5%	5%	at 5 %
	a	b	c	d	e	f=d-e
Scheme Capital Costs (incl mitigat'n)	-333	-282	-288	-294	-217	-77
Farm Capital Costs	-556	-409	-426	-444	-268	-176
Electricity Generation	0	0	0	0	+24	-24
Scheme Opex	-178	-53	-61	-71	-33	-38
Water Charges paid by farmers	+883	+254	+294	+343	+218	+126
Inc in farm profits (after irrig'n charges)	+2,394	+587	+697	+833	+501	+332
Other Water Charges*	113	+34	+39	+45	0	+45
Total	+2,212	+132	+255	**+413**	+225	+187

* Potable water to Central Hawkes Bay District Council; Extra environmental flows to HBRC; Spot sales to irrigators

Table 4 Net Present Value by Category, and Changes since original Analysis – 70 yr project life

Project Life 70 years	Revised Estimates				Original	Difference at
Discount rate	no disc	7%	6%	5%	5%	5 %
	a	b	c	d	e	f=d-e
Scheme Capital Costs (incl mitigat'n)	-348	-282	-289	-295	-217	-78
Farm Capital Costs	-556	-409	-426	-444	-268	-176
Electricity Generation	0	0	0	0	30	-30
Scheme Opex	-269	-56	-66	-79	-40	-39
Water Charges paid by farmers	+1,817	+285	+343	+421	+270	+150
Inc in farm profits (after irrig'n charges)	+5,291	+684	+848	+1,074	+632	+442
Other Water Charges*	+231	+38	+45	+55	0	+55
Total	+6,165	+260	+456	**+ 732**	+408	+324
Total with reducing probability of scheme survival after 35 years.		+236	+417	**+ 665**		

* Potable water to Central Hawkes Bay District Council; Extra environmental flows to HBRC; Spot sales to irrigators

The increase in capital costs and the more rapid completion of the project have increased the NPV capital cost[19] by $78m from NPV $217m to NPV $295m (see column f). The increase in areas in orchards and viticulture has raised the farm-related capital costs by $176m, the removal of electricity generation has reduced revenue by NPV $30m, and Scheme Opex costs have risen by $39m. However, other water sales with NPV $55m (column d), the NPV $150m higher water charges assumed to be paid by farmers, and the NPV $442m increased farm profits (in spite of the higher water charges) more than offsets this, and the project NPV increases by $324m to $732m.

3.2 Project Benefit : Cost Ratios

A Net Present Value figure tells only part of the project financial story, and this figure needs to be put into the context of total project cost. The following table shows Benefit : Cost Ratios (BCRs) under various assumptions. This can be seen as a measure of robustness of the project to changes in the benefits or costs. A project with a positive Net Present Value will, by definition have a BCR >1, and a robust project will have a BCR significantly greater than 1.0.

Table 5 Project Benefit : Costs ratios for various Life-times and Discount Rates

	5 % Discount Rate			6 % Discount Rate			7 % Discount Rate		
NPVs ($m)	Benefit	Cost	Ratio	Benefit	Cost	Ratio	Benefit	Cost	Ratio
Project Life 35 years	1,222	809	1.51	1,030	774	1.33	875	743	1.18
Project Life 70 years	1,550	818	**1.89**	1,236	780	1.58	1,007	747	1.35

As is shown in Table 5, the BCR is above 1 in all cases, and is significantly above 1 at a 5 % discount rate and particularly for a 70 year project life. As is highlighted, for a 5 % discount rate and a 70 year life the BCR is 1.89.

3.3 Project Residual Values

Items of capital equipment may have value at the end of the project, and if they do then this value should be treated as a project benefit. The principal investments off-farm and on-farm are likely to have residual value only if the project will continue beyond the chosen analysis date. If continuation is expected, then a longer project life should be used, rather than a residual value being included. The analysis includes project life variants of 35 and 70, so from this perspective only the 70 year variant should have residual value added for the dam and infrastructure. With 70 years of discounting, the residual value of the dam and water distribution network could be of the order of $14m[20]. However, this ignores such issues as siltation of the dam, major dam and infrastructure repairs, and the possibility that the resource consents will not be continued and the dam will have to be demolished and removed.

[19] 5 % discount rate. Note that project costs are shown as negative NPVs. So a higher capital cost has a higher – NPV and the difference in capital costs is a negative number.

[20] Calculated as the NPV of the expected revenues from water sales beyond year 70.

On-farm investment is likely to have no residual value as most items will be technologically obsolete. However, to the extent that continued availability of water will enable continued profits, farmers will enjoy residual value in the form of higher land values than in the absence of the scheme.

Some investments (working capital, livestock and Fonterra shares) which are expected to cost around $120m will have residual value of that amount, and hence the 35 year project NPV could be increased by $11m at a 7% % discount rate or $21m at a 5 % discount rate, and the 70 year project life NPV would increase by $4m at 5 % discount rate. These residual values have been excluded from the base case analysis on the grounds that it is quite likely to be offset by additional capital costs which are not identifiable and not included in the project analysis. For example, although the farm budgets include an allowance for economic depreciation, this is unlikely to be sufficient to fund replacement of capital items which become technologically obsolete.

3.3 Interpretation of Financial Results

The financial Net Present Values and Benefit Cost Ratios shown here are an important input into decision making about the Ruataniwha Water Storage Project, but the results need to be put into the context of other social and environmental factors. The following sections discusses the social impacts as reflected in additional regional and household income, and increased employment opportunities.

3.4 Economic Impacts

Economic Impacts are typically measured in terms of regional GDP[21], regional employment and regional earned household income. The initial impacts of the project occur during construction and continue over the entire period of farm conversion. It is estimated that this phase will generate 5,400 job-years of work in the region, spread over 12 years, but three quarters of this will take place in the first three years when an average of 1,400 jobs will be created including over 400 in the construction sector. Given that there were 4,540 construction jobs in Hawkes Bay at the time of the 2013 census, the irrigation scheme would provide work for around 10 % of those. This indicates that while the expected demand would be a major boost to the sector, it would be within its capacity.

Table 6 Economic Impacts of On-farm and Off-Farm Construction

	Output ($m)	Jobs (job-years)	Value Added ($m)	Household Income ($m)
Direct Impacts	750	n.a.	n.a.	n.a.
Total Impacts	1,490	5,400	490	320

[21] The returns to land, labor and capital. From an accounting perspective this is equivalent to EBITDA + wages and salaries

In the long term, once construction finishes and farms reach full production, approximately 1,300 jobs will be created on farm and this will be associated with value added of $131m / yr including additional earned household income[22] of $47m per year (see Row A - Table 7). As the table shows, it is the expansion of vineyards and orchards that is driving the vast majority of this growth in activity.

The additional spending by farmers on inputs, and the increased spending by households on consumption, will lead to significant off-farm impacts which once all the multiplier effects work through will increase regional employment by a further 940 jobs and regional GDP by a further $108m per year, including $62m per year of earned household income (see Row B of Table).

It is anticipated that there will be a significant increase in processing activity with half of the additional milk and all the additional vegetable and grape production being processed in the region. These industries will also have multiplier effects and the combined effect is to further increase employment in the region by 1,340 jobs and regional GDP by $140m / yr, including $79m / yr of earned household income (see Row C of table).

The total impact of all these changes will be to increase employment in the region by approximately 3,580 jobs and regional GDP by $380m / yr including $188m / yr in earned household income (Row D).

Table 7 Increases in Economic Activity Related to Expansion of Production on Farm

	Increase	Output ($m / yr)	Jobs (FTEs)	Value Added ($m / yr)	Hhold Income ($m/yr)
	Pastoral and arable farming direct	100	125	29	7
	Vineyards	47	355	34	15
	Orchards	133	820	68	25
A	**Sub-Total – Farming**	**280**	**1,300**	**131**	**47**
B	Farm support effects	220	940	108	62
	Total Farming and Farm Support	**500**	**2,240**	**239**	**109**
	PROCESSING				
	Vegetables & juiced apples	161	530	57	32
	Meat (decline)	-14	-40	-5	-3
	Grapes	212	750	75	43
	Milk	71	100	13	7
C	**Sub-Total – Processing & Support**	**430**	**1,340**	**140**	**79**
D	**Grand Total – Combined Changes**	**930**	**3,580**	**380**	**188**

These economic impacts are approximately 60 per cent larger than was estimated originally in 2012. Again, the increases are being driven largely by the increased areas in orchards and viticulture.

[22] This excludes payments of dividends to shareholders and owners.

3.5 Sensitivity of Results to Land Use Changes

As has frequently been noted in the above pages, the growth in NPV and economic impacts of the project has been substantially driven by the assumed increase in the long term profitability of orcharding and viticulture, and the significant percentage increase in the areas of these crops (although this increase is equivalent to only 5 per cent of the irrigated area, and 3 % of the total area affected by irrigation).

To see how the project looks in the absence of these increases, the analysis has been repeated with a change in land use to use the initial areas for viticulture and orchards and to re-allocate that irrigated land across all the other irrigated land use. All other farm inputs and prices are the same in both scenarios. Table 8 shows the effects on all of the measured outcomes. As expected there is a very significant decline in all economic impacts, with the increase in regional employment falling back to 2,670 jobs and the increase in regional GDP falling back to $295m.

The project NPV and BCRs also decline by around $110m and 0.2 respectively in the 70 year project life and 5 % discount rate scenario. However, the Benefit : Cost Ratio is still 1.72. Even with the 7 % discount rate and the 35 year project life the NPV is still $63m and the BCR is 1.10.

Table 8 Effects on Results of Reducing Viticulture and Orchards back to original Area

	Area of Land (Ha)		Difference
	Original	Revised	
LAND AFFECTED BY Irrigation	**43,250**	**43,250**	**0**
Sheep & Beef (part irrig)	14,175	14,175	0
Sheep & Beef – dry	4,671	4,671	0
Finishing & Dairy Support	1,800	1,912	112
Mixed	3,688	3,917	229
Arable & Vegetable	5,667	6,018	351
Dairy Heavy	1,150	1,221	71
Dairy light	8,025	8,522	497
Orchards	2,000	1,130	(870)
Viticulture	2,075	1,685	(390)
On-farm Capital Investment ($m)	$556m	$422m	(134)
Project NPV (70 yrs @ 5 % disc rate) $m	732	522	(210)
	1.89	1.72	(0.17)
Project NPV (35 yrs @ 6 % disc rate) $m	255	158	(97)
Benefit : Cost Ratio	1.33	1.23	(0.10)
Project NPV (35 yrs @ 7 % disc rate) $m	132	63	(69)
Benefit : Cost Ratio	1.18	1.10	(0.08
Economic impacts at full development			
Regional GDP ($m / yr)	$380m	$295	($85m)
Regional Employment FTEs	3,580	2,670	(910)

3.6 Effects on Port

In the original report it was estimated that the irrigation scheme would lead to an increase of 8,400 containers per year, with 1,530 of this being apples and 2,000 being wine. The revised productivity per Ha and total Ha for apples[23] suggests that there will be an additional 4.425m cartons, which at 1,175 cartons per 40 ft container is equivalent to an additional 7,500 TEUs (Twenty foot Equivalent units) per year, rather than the originally estimated 1,530 TEUs / yr.
1 tonne of grapes produces about 750 litres of wine, which is equivalent to 1,000 bottles or 83 cartons of wine. The expected production increase is 11.4 tonnes / Ha of grapes[24] x 2,075 Ha, or 23,700 tonnes of grapes which equates to 1,970,000 cartons of wine. At 700 cartons per 20' container this is equivalent to 2,800 containers or 2,800 TEUs / year, rather than the original estimate of 2,000 TEUs.

Imported Inputs were originally anticipated to increase by 1,000 TEUs per year, but the change in production has increased estimates of total farm inputs from $107m per year to $185m per year, or by 70 %. If we apply the same increase to inwards cargo then growth will be equivalent to 1,700 TEUs per year

Table 9 ***Expected increases in Container Traffic (TEUs / yr).***

Product	Original Report	Updated Farm Production
Meat	-84	-84
Apples	1,530	7,500
Dairy	590	590
Vegetables	4,400	4,400
Wine	2,000	2,800
Inwards cargo	1,000	1,700
Total	9,436	16,906

If port earnings (EBIT) at the margin are of the order of $150 per container[25], the increased traffic could increase EBIT by $2.5m / year, rather than the $1.4m / year originally estimated.

[23] Productivity rising from 2,250 ctns / Ha to 3,000 ctns / Ha. Area increasing from 700 Ha to 2,000 Ha

[24] 25 Ha @ 12 tonnes / Ha and 5 Ha @ 8.5 tonnes / Ha = average 11.4 tonnes / Ha

[25] According to the Port of Napier 2011 annual report, EBIT was $19m and traffic was 188,000 containers. Some of the earnings would come from bulk traffic, but a very rough approximation is that average EBIT is $80 / container. At the margin, one would expect significantly higher earnings per container, a point which was alluded to by the chairman who, in talking about the rapid increase in profit in the preceding year said that this “highlighted the impact of increased volumes through fixed infrastructure”.

Appendix 1. Residual Values of Capital investment.

Transfer to Council

There has been some debate about residual values, particularly given that the currently proposed financing package[26] involves transfer to council at zero cost in 70 years. There are a number of factors to consider in assessing this value, not least of which is whether we are talking about terminal value as seen from today's perspective, or from the perspective of when the project is handed over.

If the former, then in my view a first approximation is the difference between the 70 yr and 100 yr project life NPVs, which is currently assessed at about $54m at a 5 % discount rate. However, a second approximation would require one to think also about the likely costs relating to major maintenance (if any) required at handover date, the possibility that consents won't be renewed or that the dam has silted up sufficiently to have a greatly reduced capacity, and in the worst case that the dam had to be removed. This last outcome has probably a low probability of occurrence, but potentially a major cost. However, advice from HBRIC Ltd is that the concession deed/project agreement hand back requirements (yet to be concluded) are intended to be designed to mitigate this risk. So a reasonable approximation of value from today's perspective is somewhere between $54m and zero, with each value being weighted according to the respective probabilities that the Scheme will continue and that the dam will need to be removed.

If one was asking about the likely value in 70 years' time, then it depends on the likely lifetime of the Scheme and any increase in productivity with respect to water by that time. It might be reasonable to assume a scheme life time of at least 100 years[27], in which case the value as perceived in year 70 might be the same as the current NPV for 30 years (years 70 – 100), which includes zero capital cost since the infrastructure will already exist. This value is $1,760m in 2016 prices at a 5 % discount rate. On the other hand the value in year 70 might be the <u>cost</u> of having to remove the dam (-$100m or whatever).

The $1,760m is the value to the community as a whole, including farmers, and the split of benefits between farmers and dam owners (i.e. the community in 2090) will depend on the price of water at that time. The value to the owners of the dam (the ratepayers) in 70 years depends entirely on how the water contracts are set and enforced over that period and beyond. The 35 year Water User Agreement contains a CPI indexing factor which should ensure returns stay constant in real terms. It will not be overly surprising if on various occasions over the next 70 years there is a push by farmers to be charged less because farming times are difficult with the risk being that this is agreed to but without the reduction being reversed (and the underpayments recovered) when times are good. There may also be a huge push to reduce prices when the project is handed over on the grounds that the asset has been transferred to the community at zero cost. If farmers exercise their option to purchase shares in the water company, then price reductions are less likely because farmers with shares may well benefit, on balance, from an increase in water charges.

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[26] Proposed is a BOOT model, where investors Build, Own and Operate the facility for 70 years and then Transfer the ownership to the community at zero cost.

[27] Advice from HBRIC Ltd is that gravel can be extracted from the reservoir at the inlet deltas, and this is of high quality from an aggregates perspective.

It should be noted that a lower price of water will be capitalized into land prices, so if the price is reduced the beneficiaries will be the owners of the land at the time the price is reduced rather than subsequent owners, who will be getting cheap water but will have paid more for their land.

Appendix 2. Sensitivity of Results to Slower Uptake Rate

The slower uptake analysis reported here is based on advice and financial modelling undertaken by BNZ and Piperhouse Advisory. The analysis in the body of the report uses the base case uptake rates. These different uptake profiles are shown in Table 10 below.

Table 10 Different Up-take Rates

Project Year	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Base Case	62%	65%	70%	73%	75%	80%	82%	88%	90%	91%	93%	94%	95%	96%	97%	98%
Slower Uptake	64%	67%	73%	76%	79%	85%	88%	94%	95%	99%	99%	100%	100%	100%	100%	100%

The impacts of this slower uptake rate is as shown in *Table 11*. The impact on the Benefit : Cost ratios is quite small. Partly this is because the uptake rates proposed by Piperhouse – BNZ are not a lot slower than has been proposed by HBRIC Ltd. However, the other, and perhaps equally significant, reason is that delayed uptake means delayed on-farm capital investment. Given that the on farm-investment is about 60 % greater than the off-farm investment in the dam and distribution networks, the delay in project revenues is significantly offset by the delay in project costs. Note that this analysis is done from the combined perspective of both farming and the provision of water. The effect on the Benefit : Cost ratios of just the provision of water will be more significant.

Table 11 Effects on Project Benefit : Costs ratios of Slower Uptakes

	5 % Discount Rate			6 % Discount Rate			7 % Discount Rate		
NPVs ($m)	Benefit	Cost	Ratio	Benefit	Cost	Ratio	Benefit	Cost	Ratio
	Project Life 35 years								
Base Case Uptake	1,222	809	1.51	1,030	774	1.33	875	743	1.18
Slower Uptake	1,182	797	**1.48**	995	761	1.51	845	730	1.16
	Project Life 70 years								
Base Case Uptake	1,550	818	**1.89**	1,236	780	1.58	1,007	747	1.35
Slower Uptake	1,511	806	**1.87**	1,202	767	1.57	976	733	1.33