RUATANIWHA
Water Storage

WATER INITIATIVES GROUP

HAWKE'S BAY
REGIONAL COUNCIL

RUATANIWHA WATER STORAGE PROJECT

Feasibility Report to Council

September 2012
HBRC Report No. WI 12-24
HBRC Plan No. 4416

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Water Initiatives Group

Ruataniwha Water Storage Project

Feasibility Report to Council

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Reviewed By:

Approved:

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EXECUTIVE SUMMARY

Hawke's Bay's competitive agricultural advantage lies in its temporate climate, availability of productive land, and potentially abundant water supplies. The quality and quantity of our land and water resource is therefore critical.

The use of groundwater for irrigation has increased substantially over the last decade. On the Ruataniwha Plains, groundwater extraction for irrigation use has increased from approximately 3 million m^3 to around 24 million m^3 per annum. This has contributed to the over allocation of surface water in the Tukituki River Catchment, based on current allocation limits, and those limits are in any event inadequate to provide for native fish and trout habitat. Groundwater takes are exacerbating the effects of surface water over allocation. Areas of the catchment also suffer from excessive periphyton growth, which adversely affects recreational use and fishing, particularly in the lower Tukituki. If allocation limits are altered by provision of increased minimum flows to ensure appropriate ecological and cultural outcomes are achieved, and existing water users made subject to those limits, the result would be a significantly reduced security of supply for existing irrigators with a consequential material economic impact on them, and reduced regional economic output. Against that background, there is little or no prospect of additional rural land development in the catchment due to the lack of available water, thereby constraining the potential for economic growth from a substantial area of the Region.

The region's weather patterns are heavily influenced by Hawke's Bay's position eastward of the mountain ranges, which provide shelter from the predominant westerly weather pattern over New Zealand. This produces the region's characteristic dry, sunny, temperate climate. The region's geology also contributes to the frequent occurrence of droughts, particularly in association with the El Nino-Southern Oscillation phenomenon, resulting in a degree of uncertainty and variance in production for farmers and rural communities.

National predictions for climate change suggest a warming, drying trend for weather patterns in Hawke's Bay. This will impact on the region's land and water resources as extreme weather events occur more often; and could have significant implications for the primary industries in Hawke's Bay.

Hawke's Bay suffered from a series of droughts over a four year consecutive period from 2006 – 2009. According to Ministry of Agriculture and Forestry estimates at the time, the negative economic impact for the region was in the order of hundreds of millions of dollars. In 2007, 153 water take consents were renewed through a notified consent process; however due to uncertainty in regards to their sustainability, these consents were granted on a relatively short duration of 5 years; and are due for renewal through 2013-2015. Furthermore, since then no new water take consents have been granted within the Tukituki catchment.

Investigation into the feasibility of water storage is one of a suite of initiatives that Hawke's Bay Regional Council (HBRC) has been progressing since 2009, to address increasing pressures on the water resource in the Tukituki River Catchment in Central Hawke's Bay. The proposal is to store high winter flows for use in summer when pressure on the water resource is greatest.

Eighteen potential storage sites were initially identified and considered in 2009, as options for off-farm community water storage to provide irrigation water for the Ruataniwha Plains. This was narrowed down to twelve sites in 2010 due to geotechnical, environmental, and economic considerations. These short listed options included ten off-river dams (based on the concept of winter water harvesting from adjacent catchments to refill the reservoirs) and two on-river dams. Tonkin & Taylor Ltd, providing the Ruataniwha Water Storage (RWS) Project's technical expertise, found off-river dams were less economic than on-river dams due to the need for a refilling transfer system, and the fact that storage volumes were generally smaller (resulting in lower economies of scale).

The Makaroro site was identified as the preferred option in 2011, after the other on-river storage option (the Makaretu site) was ruled out following additional detailed geotechnical investigations. Further refinement of the preferred on-river water storage option has seen the proposed water storage volume revised upwards to take further advantage of economies of scale, and to meet projected irrigation demand in the catchment.

The full-feasibility phase has involved investigations into the commercial/economic and environmental/social/cultural aspects of the project. The Ruataniwha Leadership Group and Ruataniwha Stakeholder Group were established in April 2010 to provide guidance and input throughout the process. In addition, HBRC has engaged with a large number of community and interest groups, sharing project information and receiving feedback to help inform processes over time. The full-feasibility phase of investigations concluded in August 2012.

Technical Feasibility

The Makaroro dam site is located in the upper Makaroro River, approximately 1km east of Wakarara Road and 6.6km upstream of the confluence of the Makaroro and Waipawa Rivers.

The dam site sits approximately 1km from the Mohaka fault, which also crosses the proposed reservoir area. Geotechnical investigations carried out at the Makaroro dam site during the pre- and full-feasibility phases of the project have confirmed that, while challenging, the site is geotechnically feasible and that there is a suitable design available to accommodate expected seismic activity that may occur in the area during construction or operation of the dam.

Tonkin & Taylor Ltd has recommended a Concrete Faced Rockfill Dam design, providing for a dam structure approximately 83m high at the river's deepest point. This would create a 6km long reservoir with a storage volume of 90 million m^3. A reservoir outlet structure will provide for a peak irrigation release of 11.1m^3/s, with the ability to release a flushing flow of up to 21m^3/s. The spillway configuration proposed, including auxiliary spillway, will cater for all reasonably foreseeable flood events up to and including the Probable Maximum Flood, which is about 30% greater than the 1 in 10,000 year flood. A single hydro electric power station at the base of the dam is proposed to provide a generation capacity of 6.5 MegaWatts (MW). A single irrigation intake located on the Waipawa River, approximately 22km downstream of the dam, will collect flows released from the dam and distribute the water via a headrace to a secondary distribution network.

A residual flow, equal to 90% of the 7 day mean annual low flow from the toe of the dam is proposed; as well as up to four flushing flows per year, which will be released from the dam during the irrigation season. These flows have been assessed by the project engineers and ecologists as suitable in terms of maintaining in-stream values.

The storage capacity of the dam and reservoir (90million m^3) has been determined following assessment of a number of factors including: crop water demand for irrigation; environmental flows for protection of aquatic habitat; the command area and level of service; inter-annual flow variability and the level of drought security desired; hydropower generation requirements; reservoir evaporation; and system operational assumptions. An allowance of 4 million m^3 has been set aside for sediment storage in the reservoir which equates to a 22 year provision. While sedimentation effects were assessed over a 100 year period, this was considered overly conservative recognising that advances in technology and economic incentives in the future may provide opportunities to actively manage and extract trapped bedload from the reservoir.

The distribution system comprises an open canal headrace totalling approximately 21km in length and extending through Irrigation Zones A, B, and C. This is coupled with a primary system pipeline of approximately 15km length, which extends through Zones A, C, and D. The open canal alignment generally follows the 220m RL contour to balance the advantage of maintaining high elevation and gravity to reduce pumping costs, while minimising canal length and earthworks volumes. The

secondary distribution system comprises a network of pipes (approximately 121km in total), generally located within road reserve, with a layout aimed to provide water to within 2km of all farm gates within the project zones. Some of the secondary lines will require pumping.

The infrastructure capital costs for the dam and distribution infrastructure have been estimated by Bond Construction Management Ltd with input from Tonkin & Taylor Ltd. Transmission infrastructure costs have been provided by Unison Networks Ltd. The P_{50} median estimate for this work at first quarter 2012 is $232.8M excluding GST, inclusive of contingencies, fees and margins. The P_{50} is generally defined as the final cost having an equal probability of being more or less than the estimate. There are additional project costs that are not included in the estimate above, but have been included in the economic assessment.

Overall, the Core Project Team and Project Engineers consider that an appropriate level of site and geotechnical investigations have been undertaken for this phase of feasibility to support the design details, quantities and estimates developed. Those investigations have shown the proposed Scheme, as presented in the Technical Feasibility Study Report, to be technically feasible.

Tonkin & Taylor Ltd has recommended a number of further works and optimisation opportunities that need consideration as part of the next phase of works, post feasibility. These refinements may be considered as part of a discrete section of work or form part of a procurement process, which may be undertaken concurrently with the consenting process.

Environmental Feasibility

A number of environmental studies were carried out as part of the feasibility phase of investigations, providing a comprehensive analysis of the environmental, social and cultural issues associated with the RWS Project. Studies can be grouped into five distinct areas: modelling studies (land use intensification, water quality and groundwater/surface water); ecology assessments (aquatic and terrestrial); cultural effects assessments; other effects assessments (road infrastructure and traffic, noise, archaeological, social impacts, recreation, and landscape and visual effects); and integrated mitigation and offset options. If the project is deemed feasible by Council, these studies will be a critical input to the Assessment of Environmental Effects required to support the resource consent applications that will be necessary for the project to proceed, along with any notices of requirement for designations lodged.

Further work is considered necessary to confirm the conclusions reached in some areas, but based on the information in hand, the Project Team does not anticipate that this work will identify any environmental flaws that would call the entire project into question.

Areas where additional investigation is considered necessary prior to entering the resource consent process include:

- Further discussions with Te Taiwhenua O Tamatea and Te Taiwhenua O Heretaunga in relation to opportunities for realising the potential social and economic benefits for tangata whenua, potential involvement of tangata whenua in monitoring, how best to recognise any unregistered wahi tapu or wahi taonga, and Historic Places Act authority requirements, including development of Accidental Discovery Protocols;

- Further assessment of the environmental effects relating to sediment retention and the consequent interruption of downstream gravel supplies; and development of an Erosion and Sediment Control Plan;

- Confirmation of the irrigation command area;

- Planning assessment of the relevant provisions of the Hastings and Central Hawke's Bay District Plans;

- Further analysis of land use intensification effects on water quality in the catchment and evaluation of on farm measures to manage phosphorus effectively;
- Additional work to identify the margin of error the SPASMO and OVERSEER inputs have contributed to the modelled nutrient predictions for land use intensification, as well as further modelling over a larger area of the Plains to provide a more detailed analysis;
- Further scenario testing focussing on the extent to which current surface water and groundwater consent holders may move to stored water; and development of an incentives package to assist this potential movement; and,
- Refinement of the offset and mitigation package proposed, particularly as it relates to pest management in the enhancement areas identified.

Stakeholder Group meetings were held approximately every six weeks throughout the full-feasibility phase of the project. The Environmental, Social and Cultural section of this Council Feasibility Report was circulated to the Stakeholder Group and discussed at their 31 August 2012 meeting. The Group confirmed its understanding of the methodology utilised for assessing environmental effects, and acknowledged the range of studies undertaken and their review and input into the scope of studies programmed. Group representatives from Fish & Game, Forest and Bird, Te Taiao Hawke's Bay Environment Forum, and the lower Tukituki, making up approximately 20% of the Stakeholder Group, expressed the opinion that a decision on project feasibility should be deferred until the further modelling work identified is completed. This recommendation is not supported by the Core Project Team. It is noted that the results of the further modelling work proposed above, would be known before any resource consent applications are lodged.

It is recommended that the Stakeholder Group be retained as an important community based reference group throughout the consideration of the Tukituki Choices document, the development of the Plan Change and any Ruataniwha Storage Project resource consent or designation applications that are prepared through the balance of 2012 and 2013. Consideration should be given to the addition of other key parties such as representatives of Te Taiwhenua O Heretaunga, Hastings District Council, the Ministry of Primary Industries (MPI) and any other appropriate representatives, if it is decided to maintain the group through this period.

Further on-going engagement is recommended with the Land Use Intensification Working Party, which was established through the Stakeholder Group to assess the effects of land use intensification and potential mitigation options; the Pan Sector Group; with all affected landowners through the balance of 2012; and where appropriate, into the detailed design and consenting phases.

Overall, the project is considered by the Project Team to be feasible from an environmental perspective. Subject to clear regulatory limits of water allocation and nutrient input limits, the RWS Project can deliver improved summer river flows, and land use intensification can be accommodated within a limits setting regime; recognising that there are cost implications associated with achieving such environmental gains. These have been factored into the Project budget.

Economic Viability

Off-farm (supply) and on-farm (demand) investment feasibility analysis demonstrates that there is a range of water distribution prices for which the Project is financially feasible. This assumes that farmers are provided with the opportunity, but are not required to invest in the dam and associated distribution and reticulation infrastructure.

Potential returns to on-farm investment in irrigation vary across farming types. Therefore, the ultimate future agricultural make up of the Ruataniwha Plains may differ under varying water

distribution price scenarios. Macfarlane Rural Business Ltd predicts that Sheep and Beef (13%), Arable (32%), and Dairy farms (37%) will account for approximately 82% of irrigated land. BNZ Advisory's on-farm analysis demonstrates that at the feasible water distribution price range of 20-30c/m^3, a range of potential land conversions and/or intensifications are financially viable from both a returns and financing perspective; providing the public sector participates in the RWS Project during the initial ramp up period and incorporates direct Project positive externalities as well as a cash return within return requirements, to share in managing up-take risk.

Full privatisation (even with perpetual private sector ownership) is not feasible as private sector investors will not take into account the considerable (approximately $10m p.a.) environmental benefits directly flowing from the Project, or the indirect GDP multiplier benefit. If the Project was funded with 100% private sector funding from the outset, the distribution price required to derive sufficient internal Project returns would be prohibitive to farmers.

BNZ Advisory's recommended delivery structure for the Project is a Build Own Operate Transfer (BOOT) model with a 35 year concession period. This model is often used internationally to procure essential public infrastructure with private sector involvement, and has more recently been introduced into New Zealand.

Under the proposed BOOT model, the dam and associated reticulation and distribution infrastructure would be procured by a Special Purpose Vehicle that will finance, construct and operate the Project over a 35 year concession period (earning an appropriate return on their capital during this period) before handing the Project assets back to Hawke's Bay Regional Investment Company Limited (HBRIC)[1]. The BOOT structure can also accommodate a transfer of the asset to HBRC plus other inter-generational stakeholders. Where structured appropriately, this can benefit the Project.

The optimal capital structure is likely to comprise a mix of public (including HBRC and central Government funding) and private sector funding, with private sector funding comprising either bank debt and equity or a hybrid equity instrument and common equity. Once uptake has been achieved, forecast Project returns are sufficient to accommodate 100% private sector financing, with HBRC and MPI having the flexibility to exit their investments.

The water distribution price (and price escalation) can be fixed by a 35 year contract between HBRC and the Special Purpose Vehicle for the duration of the concession period to provide farmers with price transparency and certainty even if they are not in a position to invest in the RWS Project.

Strong interest has been received from the equity market sounding process conducted as part of the financial feasibility study with a number of investors interested in investing in the RWS Project at either a Greenfield or Brownfield stage. HBRC and BNZ have received letters of intent from five potential Greenfield equity participants to proceed to the next phase of the Project.

Irrigation is considered to be the key for unlocking high value agriculture in the Ruataniwha Plains, enabling land use intensification with farmers investing in farm conversions (land use change) or intensifications (introduction of irrigation to existing operations). There are a number of assumptions that drive the financial viability of investment in on-farm irrigation and farm conversions. Commodity prices and productivity assumptions are particularly crucial in determining farmers' willingness and ability to pay for distributed water. BNZ Advisory's irrigation investment analysis utilises Macfarlane Rural Business Ltd farming assumptions including a dairy payout of $6.50

[1] References to HBRIC ownership or future involvement with the Project in this report are made acknowledging that the nature of the Special Purpose Vehicle that may ultimately implement the Project is yet to be determined, and should be qualified as such. HBRIC has to date resolved to adopt the project (should HBRC as Council decide it will proceed); to then seek all necessary authorisations for it under the Resource Management Act 1991, and (at its discretion) to implement the Project either directly or indirectly through such a Vehicle.

per kg MS (including dividend), lamb and beef prices of $6.00 and $4.25 per kg respectively, and wool price of $4.00 per kg.

Macfarlane Rural Business Ltd farming budgets assume newly irrigated farms will achieve farm productivity similar to top 20th percentile performance of current farming across New Zealand. This is on the basis that newly irrigated farms will utilise newest technology, largely attract top performing and younger (highly motivated) farmers, and high water reliability will enable farmers to maximise productive outputs without mitigating for drought risk. Macfarlane Rural Business Ltd note that this assumption could be conservative looking out on the 35 year investment horizon (with technology and farming method improvements pushing future average productivity up past current top performers (for example Dairy production has increased approximately 47% over the past 21 years).

A number of other parties will benefit from the Project indirectly, for example, food processors and land operators. HBRC and BNZ Advisory are in the process of engaging these indirect Project beneficiaries to determine whether, and in what form, they could assist in increasing the Project's feasibility at the lowest water distribution price, and/or mitigating Project risk.

There are also estimated to be substantial economic benefits to the Hawke's Bay region resulting from the Project. The Project would increase Hawke's Bay's regional GDP by 4% and employment by 3.5% across all sectors that benefit directly or indirectly from growth in farming and processing. In addition to this annual GDP increase, the Project's financial cost both on and off farm of $602 million, is estimated to boost regional GDP by $320 million in total over the construction phase.

Should the project progress to the next phase, HBRC and BNZ Advisory could progress with finalising a project structure, procuring project services and financing, and documenting the Project, contemporaneously with the Environmental Protection Authority (EPA) process. This should provide the selected design and construction provider with the potential to start works in the final quarter of 2013.

Taking into account the supply side cost assessment, on farm economics, investor assessment and modelling, and demand assessment, the RWS Project overall, is considered to be feasible from a financial perspective; provided the ultimate price of water to the farm gate operates within a zone of 20-30c/m^3.

Council Decision

Advice from the project's legal counsel suggests that an Environmental Protection Authority (EPA) process, advanced jointly with the Tukituki Plan Change, would be the most efficient way (very possibly the only way) to get the project consented within the desired timeframe, should Council agree that the project is feasible. While this option requires the consent of the Minister for the Environment, it is believed that there are good prospects to secure that consent. Unless extended by the Minister for the Environment, the EPA process follows a 9-month timeline, meaning that Council would likely have a final consenting decision by November 2013, subject only to potential appeals on issues of law to the High Court.

Given the conclusion, as above, that although challenging, the project is technically, financially and economically feasible[2], in order to warrant further advancing the project to the resource consenting stage, Council should be satisfied that the project can meet the requirements of the Resource Management Act (RMA). In short, the potential environmental effects of the project would need to be identified and quantified to an appropriate level of certainty, and the ability demonstrated to achieve an acceptable level of avoidance, remediation or mitigation of the potential adverse environmental effects. It is believed that this will be possible and on that basis, it is recommended

[2] On the assumption that the Project will provide net social and environmental benefits to the region.

that Council decide to proceed to the consenting phase. Economic and commercial feasibility is fundamental to establishing a successful scheme; however this is not a test that needs to be met through the RMA consent process.

Further investigations (as outlined above) will need to be carried out over the next five months in anticipation of an EPA call-in in February 2013. The results of those investigations will be reported back to Council prior to lodgement of applications, to ensure that Council remains satisfied as to the environmental feasibility of the RWS Project. The Core Project Team does not anticipate that this further work will identify any issues that would render the project unfeasible.

1.0 INTRODUCTION

1.1 REASON FOR THIS REPORT

This report is an assessment of the feasibility of the Ruataniwha Water Storage Project (RWS Project). The objective of this report is to inform Hawke's Bay Regional Council (HBRC) of the feasibility of the RWS Project and, if feasible, the parameters within which the project might proceed. At initiation in December 2009, a completion date of June 2012 was anticipated for the feasibility phase. Project complexities meant that the feasibility study of the RWS Project was ultimately completed in August 2012. However, delivery of this project within this timeframe is arguably a New Zealand first, as on average, feasibility assessments of similar projects have taken many more years to complete.

It is important to clarify what is meant by feasibility. In our definition feasibility indicates there is a very high chance of the project successfully achieving the following:

- Deliver environmental (improved summer river flow regime) gains;
- Achieve sustainable economic growth and inwards investment;
- Improve the social wellbeing of directly affected communities;
- Operate in a manner compatible with cultural objectives, notably those of tangata whenua;
- Assessed as financially feasible within defined parameters – i.e., i) the financial case for on farm conversion from dry-land to irrigated intensive agriculture is sufficient to drive conversion over a reasonable timeframe; and ii) compelling enough to attract both public and private capital to the "off farm" infrastructure, over a minimum 35 year period, a timeframe within which the cost of the infrastructure and the cost of money both public and private is accommodated;
- Sufficiently well researched and defined so that water take and use are considered achievable;
- Consents for other related activities such as the management and mitigation of environmental effects are achievable; and
- The project is technically feasible from an engineering perspective and can be built – subject to procurement, within an acceptable timeframe;
- The potential adverse environmental effects can be avoided, remedied or mitigated to an acceptable level.

For the avoidance of doubt feasibility **does not** mean that:

- The project build is fully committed to by investors from the public and private sectors;
- Conditions of consents are fully developed and consents are granted;
- The project build is procured;
- The project build including sequencing and rollout is fully optimised; and
- The delivery of secure water and the conditions of supply to the farm-gate is contracted.

1.2 PROBLEM DEFINITION

The Ruataniwha Water Storage Project is part of the solution of a series of inter-related issues in the Tukituki Catchment. The problem is that surface water is over allocated based on current allocation limits and those limits are in any event inadequate to provide for native fish and trout habitat.

Groundwater takes are exacerbating the effects of surface water over allocation. Areas of the catchment also suffer from excessive periphyton growth, which adversely affects recreational use and fishing, particularly in the lower Tukituki. If allocation limits are altered by provision of increased minimum flows to ensure appropriate ecological and cultural outcomes are achieved, and existing water users made subject to those limits, the result would be a significantly reduced security of supply for existing irrigators, a consequential material economic impact on them, and reduced regional economic output. Against that background, there is little or no prospect of additional rural land development in the catchment due to the lack of available water, thereby constraining the potential for economic growth from a substantial area of the Region.

Hawke's Bay suffered from a series of droughts over a four year consecutive period from 2006 – 2009. According to MAF estimates at the time, the negative economic impact for the region was in the order of hundreds of millions of dollars. In 2007, 153 water take consents were renewed through a notified consent process. However, due to uncertainty regarding the sustainability of the takes, these consents were assigned on a relatively short duration of 5 years and are due for renewal through 2013-2015. Furthermore, since then, no new water take consents have been granted within the Tukituki catchment.

1.3 STRATEGIC CONTEXT

In June 2008, after an HBRC internal review of the regional water strategy, the following objectives were determined:

- When managing freshwater allocation and quality issues, a supply and demand framework would be utilised especially in catchments where allocation limits had been reached;
- When managing freshwater resources, Regional Councils' have traditionally concentrated on "supply side" allocation, in particular through the use of regulatory frameworks under the RMA; and
- An additional objective, somewhat aspirational, was to speed-up the implementation of strategy and policy. On average in New Zealand it takes 8 years to achieve plan changes. Infrastructure projects associated with rural water management, more often than not, take in excess of ten years to initiate.

Across the water strategy initiatives, a range of projects were scoped, initiated, resourced, funded and run in parallel, including:

- Delivery of a Regional Land and Water Management Strategy with the stakeholder community to set the priorities for management;
- Establishment of irrigation Water User Groups to enable more aggregated and efficient water use;
- Increasing the depth of water resource knowledge to assist with accurate allocation for consumptive water use;
- Understanding and mitigating the effects of activities on water quality on a priority catchment basis;
- Building deeper and more meaningful relationships with tangata whenua through recognition of their Kaitiaki role with regards to freshwater; through the Treaty Settlement processes (the outcome being the joint Regional Statutory Plan Committee) and by direct engagement of tangata whenua at the outset of various water related initiatives; and

- Initiating water storage prefeasibility and feasibility projects in catchments where the initial evidence pointed towards the need for infrastructure solutions for water use.

Consistent with the overall approach to running projects of the water strategy in parallel, a similar approach has been utilised in the RWS Project whereby the engineering and environmental investigations have been managed concurrently. Given the dynamic nature of this project, and in particular the iterative nature of the search for storage sites, economic analysis has been initiated at various points as a further filter for various infrastructure options. Full financial analysis has been completed towards the latter stages of feasibility, as information relating to cost structures has been improved and refined.

1.4 GOVERNANCE

Whilst the project has been governed by the Regional Council, other groups including a Project Leadership Group (considering financial and commercial aspects) and a Stakeholder Group (considering environmental, social and cultural issues) have provided advice and where appropriate input to various tasks within the RWS Project. For an overview of the RWS Project institutional setup and relationships, refer to Appendix 1.

More recently with the establishment of the Hawke's Bay Regional Investment Company (HBRIC), the HBRIC Board has monitored, reviewed and guided financial feasibility. This included the appointment of the financial advisors to the project.

Project Team

The HBRC team was established in mid-2009 to enable an explicit focus on various developmental initiatives including, but not limited to, the RWS Project. In particular, a senior executive role reporting via Andrew Newman, HBRC CEO and project sponsor, was created to focus on the technical (engineering, infrastructure costs and environmental) aspects of water storage. Initially for the RWS Project this role was filled by Bruce Corbett, however from January 2011 onwards, through the full feasibility phase, Graeme Hansen has led this work-stream. The Core Project Team directly assisting Graeme has included Larissa Coubrough and Monique Benson of HBRC; Stephen Daysh of EMS Ltd; Olivier Ausseil of Aquanet Consulting Ltd; and David Leong and Mark Taylor of Tonkin & Taylor Ltd (see Appendix 2)

Andrew Newman, Grant Pechey and Michael Bassett-Foss have maintained a focus on the initial economic and business development tasks associated with the RWS Project.

Andrew Newman, Graeme Hansen and Larissa Coubrough have managed the relationship with the Ministry of Primary Industries, relating to Central Government funding.

BNZ Advisory were appointed as the financial advisors to the RWS Project. The BNZ team includes Mick Lilley and Dave Roberts of National Australia Bank; Duncan Southwell and Renee Cassin of BNZ Advisory; and Stephen Veitch of BNZ Agribusiness, working in partnership with the HBRC team. The BNZ Advisory team have brought significant capacity, with expertise in complex infrastructure assessment and financing associated with water infrastructure projects.

Funding and Investment

HBRC has implemented the following funding strategy:

The RWS Project has been funded via a combination of HBRC investment portfolio capital and grants from the Ministry of Primary Industries. The utilisation of this money has been instrumental in framing expectations for the project. Specifically the principle is that should this project be built, there is an expectation a financial rate of return on that capital will be achieved. Conversely should

the Project prove not to be feasible, there is an acknowledgement that the investment will be written off.

Community Engagement

Ten Project leadership Group Meetings under Sam Robinson's Chairmanship have been held between April 2010 and August 2012.

Seventeen Stakeholder meetings chaired by Debbie Hewitt have been held between May 2010 and August 2012, along with nine Land Use Intensification Working Party meetings chaired by Stephen Daysh.

Between Andrew Newman, Graeme Hansen, Sam Robinson and Michael Bassett Foss, approximately 60 presentations have been given to community, environmental, business, rural, and central and local government groups, over a similar period.

1.5 PROJECT JOURNEY

Water storage has been identified through Hawke's Bay Regional Councils Strategic Plan, Long Term Plan and Land and Water Management Strategy as a potential solution to current and increasing allocation and sustainability issues in the region. Hawke's Bay's water allocation issues are an important context for consideration of water storage options.

The Ruataniwha Water Storage Project pre-feasibility level investigations into winter flow harvesting to storage dams in Central Hawke's Bay, were completed in June 2009. As a result of this initial study, six off-river storage dams (from an originally identified 18 potential sites) with a total capacity of 75 million m^3, and associated distribution to serve approximately 22,500 hectares of irrigated land were identified. Reports were also compiled on the value proposition and suggested commercial arrangements; and an environmental gap analysis was completed.

The first stage of the full feasibility study (known as the 'advanced pre-feasibility' phase) established the Leadership and Stakeholder Groups, and saw the completion of an initial water demand assessment to identify the irrigation zones to be served. An initial fatal flaw analysis to identify the costs and most economic dam sites and distribution layout was completed. Geotechnical and seismic issues saw the number of potential dam sites decrease over the course of the advanced pre-feasibility phase of investigations and a shift from considering only land-based storage options to consideration of in-tributary options also. The advanced pre-feasibility phase of work was completed in December 2010 and identified two preferred storage options; the Makaroro and Makaretu dam sites. Subsequently the Makaretu site was also disregarded due to geotechnical concerns during the feasibility phase.

The subsequent stage of the full feasibility study was initiated in January 2011. The purpose of the full feasibility study was to undertake sufficient investigation and assessment of effects to be able to establish the technical and environmental feasibility, and commercial viability, of the development of a storage dam at the favoured Makaroro site; and the associated supply distribution to the farm gate across the proposed irrigation zones making up the likely Ruataniwha Plains service area. Council will decide whether or not to proceed to the detailed design and consenting phases based on the findings of the full feasibility study.

More than 30 key environmental (including social and cultural), technical, and economic assessments have been running concurrently throughout the full feasibility phase, involving as many consultant teams. Expertise from a wide cross-section of HBRC has also been utilised.

The land use intensification study was a large and important component of the environmental study package, drawing significant resources to advance knowledge and understanding of the potential effects associated with both current and more intensive land use on the Ruataniwha Plains.

Environmental studies associated with the full feasibility phase of investigations have also assessed the effects of the project on terrestrial and aquatic ecology; groundwater and surface water flows; river geomorphology; recreation; landscape; and historic sites. Pre- and post-construction noise, traffic and social effects have been assessed and the outcomes are reported in Section 3.

Construction costs for the dam and headrace are currently estimated at $232 million, as reviewed in April 2012. The increase in project cost from the indicative cost of $170 million determined at the end of advanced pre-feasibility is accounted for by an increase in storage volume from 75 to 90 million m^3, the addition of hydro generation infrastructure, additional reticulation and geotechnical requirements. The reader should note that the revised estimate was similar to the figure determined at pre-feasibility of $212 million, particularly when taking account of the additional elements now included in the project. There have been a number of economic assessments undertaken to determine on-farm costs for individual landowners in joining the scheme; associated regional and national economic benefits; commercial investment opportunities and risks; and costs associated with transferring current consent holders to scheme water.

Engagement through Stakeholder, Leadership, Taiwhenua, Pan Sector and landowner groups has been ongoing from the outset of the full feasibility process and the results of that engagement are reported in Section 4.

There will be a period of consideration for Council, stakeholders and the community following the presentation of this report to Councillors on 26th September 2012 and the decision making meeting of 31st October 2012. There will also be a further consideration period through the remainder of the 2012 year to consider, refine and where necessary optimise aspects of the scheme prior to the more formal processes identified in 2013. This will provide the opportunity to consider all of the information obtained through the feasibility study, prior to applications for resource consent being lodged in early 2013, if the project is deemed feasible and approved by Council to move on to the next phase.

2.0 TECHNICAL FEASIBILITY

2.1 METHODOLOGY

Tonkin & Taylor Ltd were engaged by HBRC in 2009 to manage the technical feasibility component of the pre-feasibility and advanced pre-feasibility phases of investigation. The findings and recommendations of this earlier work were summarised in a report to Council in February 2011, titled "Ruataniwha Plains Water Augmentation Scheme Advanced Pre-feasibility Study" (Ref: 27195).

Subsequently, Tonkin & Taylor Ltd were also engaged, through a formal contractual process, to undertake the full technical feasibility phase of engineering and geotechnical investigations. This was carried out between June 2011 and August 2012.

Key milestones achieved through the technical feasibility phase of investigations have included:

- Completion of the Study Inception Report in August 2011, setting out the methodology proposed by Tonkin & Taylor Ltd in completing the engineering and water resource investigations;
- Completion of the Initial Project Description in November 2011. This report set out the key design and operational details of the proposed Scheme at that time, providing base information on the Project for the consultant teams engaged to commence the environmental effects investigations;
- Completion of the Final Feasibility Project Description report in August 2012; and
- Completion of the Technical Feasibility Study report in August 2012. This report provides a summary of the processes undertaken by Tonkin & Taylor Ltd throughout the feasibility phase of the study; as well as recommendations for future work and a summary of infrastructure costs.

The Ruataniwha Stakeholder Group, Leadership Group, affected landowners and other key stakeholders were regularly updated as progress was made with respect to the full-feasibility study site investigations and engineering design. Copies of the reports mentioned above have been discussed by the Stakeholder Group and are available on HBRC's website.

The remainder of this section of the Council Feasibility Report draws key excerpts and executive summaries from the Technical Reports prepared by Tonkin & Taylor Ltd and their sub-consultants throughout the full feasibility phase of the project to outline the key findings.

Content within this section has come from the following technical reports.

Table 1: Technical Reference Reports

Title	Date	Organisation	Authors	Bibliographic Reference
Ruataniwha Plains Water Augmentation Scheme: Technical feasibility Study Inception Report	August 2011	Tonkin & Taylor Ltd	M. Taylor D. Leong T Morris T. Fisher P. Carter D. Knappstein	Taylor et al, 2011a Or Ref: 27690.100

Table 1: Technical Reference Reports				
Title	**Date**	**Organisation**	**Authors**	**Bibliographic Reference**
Ruataniwha Plains Water Storage Project: Feasibility Project Description	August 2012	Tonkin & Taylor Ltd	M. Taylor D. Leong T. Morris P. Carter D. Knappstein	Taylor et al, 2012a Or Ref: 27690.100/ Issue 5
Ruataniwha Plains Water Storage Project: Technical Feasibility Study Feasibility Report	August 2012	Tonkin & Taylor Ltd	M. Taylor D. Leong T. Morris P. Carter D. Knappstein D. Bouma	Taylor et al, 2012b or Ref:27690.100/3
Ruataniwha Water Augmentation Scheme: Stage 1 - Geotechnical Factual Report A7 Makaroro	June 2011	Tonkin & Taylor Ltd	D. Leong M. Thomas	Leong and Thomas, 2011 Or Ref: 27195.200
A7 Makaroro River dam site - Phase 1B: Updated active fault and surface rupture displacement hazard and acceleration response spectra reassessment	December 2011	GNS	R. Langridge P. Villamor G. McVerry M Cabeza	Langridge et al, 2011 Or Ref: 2011/300
Ruataniwha Water Storage Project Report on Engineering Geological Investigations A7 Site, Volume 1 & 2	March 2012	Tonkin & Taylor Ltd	B. Hegan D. Bouma	Hegan and Bouma, 2012 Or Ref: 27690.200
Ruataniwha Water Storage Project Sedimentation Assessment	July 2012	Tonkin & Taylor Ltd	T. Fisher J Russell	Fisher and Russell, 2012 Or Ref: 27690.600
Ruataniwha Water Storage Project: Dam Break Analysis	July 2012	Hawke's Bay Regional Council	C. Goodier	Goodier, 2012
Ruataniwha Water Storage and Generation Value Report	February 2012	Simply Energy	M. Dyer	Dyer, 2012

Where recommendations have been made by report authors, these are highlighted in ***bold italics*** in the text below.

The HBRC Core Team comprising Graeme Hansen, Stephen Daysh, Olivier Ausseil, Monique Benson and Larissa Coubrough have considered all of the information and recommendations contained in the technical studies commissioned by the Council for this feasibility stage; and their overall findings and recommendations for further optimisation, if the project proceeds to resource consenting and detailed design, are included in Section 2.8.

2.2 DAM DESIGN AND PROPOSED OPERATING REGIME

2.2.1 Site and Geotechnical Investigations

Overview

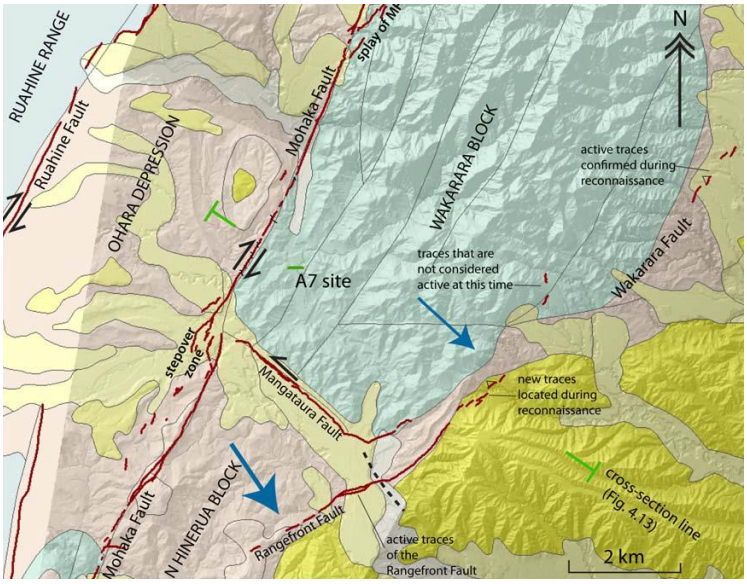
The site and geotechnical investigations were undertaken as a discrete section of work concurrently with the other engineering feasibility work. The specialist nature and significance of the seismic and geotechnical conditions in this area highlighted the need to assess and progress this phase of work sufficiently ahead of any decisions around dam design and location. The Makaroro site was selected following a process of elimination of 18 other dam sites due to environmental, economic and geotechnical considerations. The current site sits in the upper Makaroro River approximately 1km east of Wakarara Road and 6.6km upstream of the confluence of the Makaroro and Waipawa Rivers. The dam is located approximately 1km from the Mohaka fault, which also crosses the proposed dam reservoir.

The Ruataniwha basin is located within an area subject to significant earthquake shaking and where the younger geological formations are susceptible to deformation during such events. As a result, geological and geotechnical issues were identified during the project feasibility studies that complicated the feasibility level design. Alternative dam sites within the Ruataniwha basin were considered but were found to have similar or worse foundation issues than those at the Makaroro dam site. Hence, the Makaroro site is still considered to be the most appropriate site.

Following a dam type options assessment that concentrated on the dam's ability to accommodate foundation deformation as a result of seismic events, and locally available construction materials, a Concrete Faced Rockfill Dam (CFRD) was selected as the most cost effective and appropriate dam type for the site. Feasibility level design arrangements have been developed for the dam including zoning, spillways, diversion tunnel, and intake towers. These components are further described in proceeding sections.

Due to the potential for sympathetic movement in the foundation during extreme earthquake shaking, an allowance has been made for filters and drainage measures on the left abutment over a zone of rock mass weakness identified during the site investigations. GNS Science considers that the maximum single event displacement within the dam footprint to be a maximum of 0.5m. The dam has been designed to accommodate this movement, albeit it will require repair should this movement occur during the operational life of

Figure 1: Key Active Faults within 5km of the Makaroro (A7) Dam Site



the dam.

The dam allows for irrigation and flushing flows to be drawn from multiple levels within the reservoir through an intake tower into a penstock located in a tunnel beneath the dam. A hydro power station located at the toe of the dam will harness energy before releasing the water into a tailrace canal excavated to the true right of the existing river. A concrete lined spillway will take flood flows through the right abutment and discharge into a stilling basin that joins the tailrace. The discharge point to the river has been deliberately located 300m downstream from the toe of the dam in order to avoid a potentially unstable rock mass above the left bank downstream of the dam.

Tonkin & Taylor Ltd has recommended further works associated with dam design and proposed operating regime. These proposals are outlined in sections 2.6 and 2.7.

Drawings showing general dam and reservoir arrangements are shown in Appendix 3.

2.2.2 Dam Design Components

The main elements of the dam and reservoir design include:

- Construction of a Concrete Faced Rockfill Dam (CFRD) on the Makaroro River, extending to a height of approximately 83m at the rivers deepest point;
- A 6.2 km long reservoir with a storage volume of 90 million m^3. The surface area of the reservoir at the normal top water level (NTWL) of 469.5mRL has been calculated as 372 ha;
- A reservoir outlet structure consisting of a 2100 mm diameter penstock and a 600 mm diameter bypass valve providing for a peak irrigation release of 11.1 m^3/s; with the ability to release a flushing flow of up to 21 m^3/s;
- Two spillways; a concrete-lined primary spillway that operates for all floods, and an auxiliary spillway that operates for very large floods (events exceeding the 200 year annual exceedance probability);
- A single hydroelectric power station at the base of the dam with a generating capacity of 6.5 MW;
- A single irrigation intake located on the Waipawa River, approximately 22km downstream of the dam, that collects the flows released from the dam and distributes the water via a headrace to a secondary distribution network.

The operating regime proposed includes:

- A minimum residual flow at the base of the dam equal to 90% of the 7-day mean annual low flow (7-day MALF). This translates to a residual flow of 1.23m^3/s;
- Four flushing flows equal to three times the median flow (i.e. 10.5m^3/s) will be released from the dam during the irrigation season, each with a duration of nine to twelve hours. The environmental residual flow of 1.23m^3/s would be on top of this;
- Installation of an aerator, near the upstream face of the dam, to address any issues with anoxia (low levels of dissolved oxygen) in the bottom waters of the reservoir.

Assuming full scheme uptake, the modelled reservoir operation indicates that, on average, the lowest reservoir level reached each year would be around 20m below Full Supply Level, but would range between about 10m in a wet year (25th percentile value) and about 26m in a dry year (75th percentile value). This would typically occur around March/April. The reservoir would typically be full between mid-July and mid-September.

An extended flow record has been developed for the Makaroro River at the Burnt Bridge gauge for the period of the irrigation demand data 1972 to 2010, and used to represent inflows to the Makaroro dam site for subsequent reservoir storage modelling. At the dam site, the long term mean flow is confirmed at 6.36 m^3/s. The 7-day mean annual low flow, which is an important indicator for setting environmental flows, is estimated at 1.36 m^3/s. Flows are strongly seasonally biased with the highest average flows occurring in the winter months June to August (~1.5 times annual mean) and the lowest flows in the summer months (~60% of annual mean).

Flood peak estimates and design flood hydrographs for the dam site have been established using a range of site specific and regional methods. The flood flow regime is characterised by reasonably long duration and high volume events but with moderate peak flows. The 100 year return period flood peak is estimated at 340 m^3/s while the Probable Maximum Flood, computed from the assessed Probable Maximum Precipitation using a well calibrated rainfall run-off model, has a peak flow of almost 800 m^3/s.

In terms of the dam outflow regime, monthly mean flows would be broadly more uniform throughout the year, with a lesser bias towards winter. Average flows would be substantially higher during the main irrigation season (October to April), particularly over January and February (more than 100% higher), while average flows would be significantly lower in April, May and June as the reservoir retains flow to refill.

2.2.3 Water Resource Investigations

Reservoir Storage Modelling

The live storage requirement for the Makaroro dam is dependent on a number of factors, including:

- Crop water demand for irrigation (further described in Section 2.2.4 below);
- Environmental or residual flows for protection of in-stream values. Details of the residual flow considered appropriate are set out in Section 2.2.2 above and have been based on advice from Council's aquatic ecology consultants (Cawthron Institute);
- The command area and level of service (e.g. maximum volume supplied per hectare per season);
- Inter-annual flow variability and the level of drought security desired;
- Hydropower generation requirements – hydropower is considered a secondary function of the storage dam; nevertheless a nominal small buffering storage for power generation comprising a 0.20m operating range above the Full Supply Level for irrigation storage has been included;
- Reservoir evaporation;
- System operational assumptions (e.g. operation of the irrigation distribution intake on the Waipawa River downstream, in-river conveyance losses if any, and the conveyance methods and associated water losses to the service zones).

A distinct advantage of on-river storage, such as the proposed Makaroro dam, compared with off-river storage is that there is no refill infrastructure with finite capacity that limits the amount of inflow that can be captured. Further, there is more efficient use of storage space in an on-river storage resulting from refill during the irrigation season through capture of summer floods and freshes, even while the storage is being drawn down for irrigation supply.

The total storage volume (live plus dead) is 90 million m^3. This takes account of the following factors:

- 90 million m^3 of total storage corresponds to a usable live storage of 83.5 million m^3, once the provision for dead storage for sedimentation (4 million m^3 – see description below), environmental flushing flows (1.5 million m^3) and reservoir evaporation (1 million m^3) is

deducted. This equates well with the volume requirement determined for the preferred irrigated land use mix scenario from work by HBRC and Macfarlane Rural Business Ltd in May 2011.

- At 90 million m^3, the ponding footprint remains clear of the upper gorge section of the Makaroro River.
- Recognition of the "hydrological limit" of the dam catchment (i.e. a reservoir significantly greater than 90 million m^3 would be considered oversized compared with its refill capacity).

No specific allowance has been made for any leakage from the reservoir floor and seepage under and through the dam and abutments. While these losses are not anticipated to be excessive, it is anticipated that a large proportion of these flow losses would emerge at the toe of the dam or a short distance below the dam and would contribute to the environmental residual flow. It may be necessary to monitor the river flow a certain distance below the dam to realise this benefit and confirm compliance with environmental flow requirements.

Dead Storage Allowance

The dead storage allowance caters principally for long term reservoir sediment infill. Nevertheless, before dead storage allowance is used up, there will effectively be a minimum permanent pool of available water.

The Sedimentation Assessment report completed by Tonkin & Taylor Ltd (Section 2.2.5 of this report) describes the sedimentation assessments undertaken and provides an estimate of the anticipated reservoir sedimentation over a nominal 100 year design life. The estimate at this stage is for between 12 and 25 million m^3 of sediment infill over 100 years. The upper figure is considered to be overly conservative and it is likely that actual sediment infill will be somewhere between the upper and lower bounds noted.

An allowance of 4 million m^3 has been set aside for sediment storage. Based on a mid-point estimate of 180,000 m^3 of sediment infill per year, this allowance is sufficient for approximately 22 years of accumulation. Tonkin & Taylor Ltd have assessed sedimentation effects over a 100 year period; however it is considered unnecessarily conservative at this point to ring-fence the equivalent of 100 years of sediment infill within the reservoir, recognising that the term used for economic modelling and discounted cash flow analysis is much less than 100 years, and the tenure of a resource consent would be no greater than 35 years. This approach also recognises that most of the reservoir space for sediment would be available over the first few decades of operation and does not preclude advances in technology and economic incentives in the future to actively manage and extract trapped bedload in the reservoir. Trapped gravel in the reservoir is a resource that is likely to have increasing value in the future, possibly enough to warrant commercial extraction at some point.

Operation of the Waipawa River Intake

An intake is proposed on the Waipawa River below its confluence with the Makaroro River to capture water released into the Makaroro River from the dam for distribution to the irrigation command area. The proposed intake site is located approximately 1km upstream of Caldwell Road. It is noted that the river reach between the dam site and the proposed intake in the middle Waipawa River is considered a "stable" or conservative reach by HBRC Scientific Staff (i.e. neither "losing" nor "gaining" subsurface flow).

The operation of the intake may be described as:

Daily flow extracted at the Waipawa distribution intake = daily flow released from the dam, minus the environmental minimum flow.

This relationship would apply regardless of the actual flow arriving at the Waipawa intake (e.g. the contributing flows from the Waipawa River above the confluence with the Makaroro River will not be used to supplement irrigation water demand).

Figure 2: Proposed Location of the Waipawa River Intake.

2.2.4 Irrigation Demand

The rationale adopted for modelling irrigation demand and the required flow release at the dam to meet this demand, developed based on discussions with irrigation specialists, is outlined below:

- Maximum application delivery rate to the farm gate to be capped at 5mm/day per usual industry practice (i.e. 0.579l/s/ha). Note that on-farm rotation is expected to accommodate this rate even though individual irrigation events may be up to 15mm or more per day.
- The rate of 5mm/day would be an absolute maximum and need not be increased to allow for on-farm losses. This implies that if, for example, 4mm/day instead of 5mm/day gets to the root zone, then the frequency of irrigation events would need to be increased to compensate for the inefficiency.

In terms of the design of the distribution system, the following is proposed:

- For the design of the distribution system, the secondary laterals (or farm off-takes) are to be designed for the full 5mm/day.
- The main laterals are to be designed for 95% of the 5mm/day rate (i.e. 4.75mm/day or 0.55 l/s/ha).
- The main race is to be designed for 85% of the 5mm/day rate (i.e. 4.25mm/day or 0.492 l/s/ha).

In relation to the last point, if an open race is used, then an allowance for conveyance losses, including evaporative losses, in the main race would need to be made. A conservative loss rate equal to 10% of the flow has been assumed by dividing the flow rate by 0.90, giving a design flow rate for the open race of 4.72mm/day. There is no need to allow for this loss for piped sections of the distribution system.

The Tonkin & Taylor Ltd Feasibility report outlines a range of irrigation scenarios, which were modelled in order to assess a range of possible land use scenarios. Reservoir storage behaviour and live storage requirements were modelled for the selected irrigation demand scenario (Scenario 16) described in Table 2. Note that irrigation demand is based on pasture as the irrigated crop, which is the most conservative assumption.

Table 2: Irrigation Scenario 16 Adopted for the Reservoir Storage Modelling										
Scenario	Command Area Composition (net irrigable ha – pasture equivalent)					* Cap on Seasonal Volume Delivered		Environmental Residual Flow	Target Drought Reliability with Fixed Live Storage	
	Total Area	Seasonal Volume Cap	Zone B	Zone C	Zone D	Seasonal Volume Cap	m^3/ha at farm gate (areal average		Return period drought	Live Storage (million m^3)
16	17,120	4,750	5,280	4,720	2,370	85th percentile	5,315	90% 7-d MALF	20 yr	83.5
Notes: * The upper limit on the irrigation volume delivered to the farm gate is an areal average, which therefore varies according to the composition of the overall command area.										

Based on a live storage of 83.5 million m^3, an equivalent area for pasture production of 17,120 ha net may be serviced to a 20 year drought reliability, although requiring the supply per hectare to be limited to the 85th percentile seasonal demand (about 5,315 m^3/ha at the farm gate).

When an irrigated land use mix is considered, as has been assessed by Macfarlane Rural Business Ltd and HBRC, the net irrigable area would likely range from about 17,500 ha to 22,000 ha, depending on the land use composition of the irrigated area. A scenario of roughly a third dairying, a third arable and a third mixed/finishing land uses, corresponds with a command area of 21,000 ha.

2.2.5 Sedimentation

Rate and effect of sedimentation on longevity and management mechanisms

A sedimentation assessment for the Ruataniwha Water Storage Project, was produced by Tonkin & Taylor Ltd (Ref: 27690.600). The four main aspects of the scope were to:

1) Develop a sediment allowance for the dam site;
2) Assess the effects of sediment interruption on downstream sediments and the coast (based on sediment budget);
3) Review the sediment management options;
4) Develop the sediment mitigation plan.

The estimate of sedimentation in the reservoir is 12-25 million m^3 over 100 years based on the range of estimates. There remains considerable uncertainty in the bed load estimates, which is inherent with this type of estimate. Tonkin & Taylor Ltd consider the lower estimate to be non-conservative due to unaccounted for sediment losses in the sediment budget, and the upper estimate to be conservative due to the stormier period that was the basis of the Folger's Lake derived estimate for bed material. Sediment generation is greatly influenced by extreme events such as extreme floods and/or earthquakes and these have the ability to increase the rate of reservoir sedimentation. Similarly, prolonged periods of quiescent conditions will reduce sedimentation rates.

A sediment delta will form within the reservoir. The physical impacts of sedimentation are loss of storage, restrictions to access (in areas where sediment has deposited) and the potential for impacts on the dam outlets. These impacts can be mitigated by design. The delta and hydraulic backwater effects from the reservoir will eventually cause an increase in flood levels upstream of the reservoir. There are no bridges or river management infrastructure upstream of the reservoir that will be affected.

The interruption of sediment from the dam will have greatest effect on the 12 km reach of the Makaroro River between the dam and the confluence with the Waipawa River. The likely effects are degradation and coarsening of the bed sediment. There is potential for bank erosion but this is

expected to be from gravel within the active channel or adjacent recent alluvial deposits as the river width is generally limited by the gorge walls.

These effects will be mitigated to some extent by the reduction in sediment transport due to the armouring and the reduction in flood flows. However, the reduction in flood flows will reduce the ability of the flows to erode vegetation. The encroachment of vegetation will likely reduce the channel width and form. The channel will trend from multiple channels towards a single channel. Burnt Bridge (Makaroro River) and to a lesser extent the Wakarara Road Bridge (Waipawa River) have the potential to be affected by lowering of bed level. ***These should be monitored as part of the draft sediment management plan.***

The interruption of sediment from the dam will have a lesser effect on the rivers downstream of the confluence of the Makaroro and Waipawa, as there will still be a surplus of gravel for these reaches from other rivers. The interruption of sediment supply from the Makaroro River can be accommodated by less extraction (if required) based on data and professional assessment from a monitoring programme (similar to what currently occurs).

The ecological effects that result from these physical changes will need to be assessed[3].

It is recommended that sediment transport modelling be undertaken to quantify the effects of the Makaroro Dam on the lower Makaroro, Waipawa and Tukituki rivers to the coast. The modelling should consider both the interruption of sediment supply and change in flow regime due to flood attenuation in the reservoir. Sediment management options have been assessed and the preferred options are included in the draft sediment management plan.

2.2.6 Dam Break – Risk Analysis

A dam break analysis was completed by HBRC to assess the consequences of the failure of the main dam after project completion. It is emphasised that the dam break analysis is entirely hypothetical and independent of the actual probability of a dam failure occurring, nor is the analysis triggered by any particular concern with the conditions at the dam site or the proposed concept in the construction of the dam.

The dam break analysis is used to assist in determining the Potential Impact Category (PIC) of the dam, based on an assessment of the possible downstream effects in terms of potential loss of life; as well as damage to infrastructure in the event of a dam failure. The results of the analysis will indicate whether the PIC is 'Low', 'Medium', or 'High' and this will have implications for the design standard required.

Failure of the main dam after construction, and assuming the reservoir is full, would likely result in significant damage to infrastructure (bridges, roads, stopbanks, and sewage treatment plants), environmental damage to the river corridor and surrounding floodplain, and involve a population-at-risk of approximately 1000 people.

Results indicate the flood wave would be contained in the incised river sections of the Makaroro and Waipawa Rivers downstream of the dam until around SH50. Downstream of SH50 there would be significant overflows on the left and right banks of the Waipawa River.

On the left bank of the Waipawa River, downstream of SH50, the overland flow would spread out over a wide area and travel towards the Mangaonuku Stream, at which point it would be confined and flow back into the Waipawa River.

[3] For further details, see Aquatic Ecology Assessment of Effects report by Cawthron Institute in section 3.5.2.

On the right bank of the Waipawa River, downstream of SH50, the overland flow would travel to the Kahahakuri Stream and the Tukituki River, and then overtop the stopbanks on the Tukituki River around Waipukurau.

Downstream of the Waipawa/Mangaonuku confluence, the Waipawa River narrows again, forcing all the water through a confined section, then the flood wave would overtop the stopbanks at the town of Waipawa. Water depths in the area of Bibby Street near the Waipawa sewage treatment works (oxidation pond) would likely be in the order of 2 m to 4 m deep.

Another overflow would occur downstream of the town of Waipawa, just after the confluence of the Waipawa and Tukituki Rivers, down an old course of the Waipawa River to the Papanui Stream. The Pukehou and Te Aute swamp areas would become inundated in this scenario, due to their low lying nature.

Downstream of the confluence with the Papanui Stream, the flood wave would be fully contained within the Middle Tukituki River channel.

At the mouth of the Lower Tukituki River, there would likely be higher water levels in Grange Creek near Haumoana, with similar levels to those from a 50 year event in the Tukituki River.

The worst case scenario analysed for the PIC determination produced a peak discharge of around 45,000 m^3/s at the dam site. Due to the topography of the river channel, the flow would be fairly quickly attenuated. However, the results indicate a peak flow of around 10,400 m^3/s is still likely in the Waipawa River near the town of Waipawa. This is an area with stopbank protection up to the 100 year return period event, which has an estimated design discharge of 1350 m^3/s (i.e. the flood wave has a peak discharge that is roughly 8 times the 100 year discharge at this location).

The peak of the flood wave would take approximately 13 hours to travel from the dam site to the coast; a distance of about 116 km. There would likely be a minimum of 2 to 3 hours warning time between the time of start of failure, and the time when the population and infrastructure of Waipawa and Waipukurau were at risk.

Due to these potential risks, along with the size of the main dam, the PIC of the main dam is determined to be HIGH. Accordingly, the dam is designed to reflect this standard.

2.2.7 Reservoir Land Issues/Access

Private Landowners

There are five privately owned properties affected by the proposed dam structure and reservoir. With the exception of Smedley Station, which is located on the north-eastern side of the reservoir, the private farmland extends along the south-western extent of the reservoir, on the true right bank of the Makaroro River. To the north, the reservoir affects areas of Pan Pac Forest (Crown licence) and the Ruahine Forest Park (Department of Conservation).

In total, the proposed reservoir footprint would inundate approximately 268 ha of private land, inclusive of 60 ha which Council owns. In addition to the area of private land inundated by the reservoir, a further 50 ha would be affected by a proposed 20m wide buffer, which the project ecologists have recommended to be planted in native species as mitigation for the loss of vegetation within the reservoir extent (see HBRC Proposed Integrated Mitigation and Offset Approach report, August 2012). The total area of privately owned land potentially affected by the dam and reservoir equates to approximately 318 ha. Additional to this land area, a further 69 ha of Crown land (11.7ha DOC, 57 ha PanPac) will be inundated by the reservoir footprint.

Collective and individual meetings were held with affected landowners early in the process, as part of identifying possible storage sites, to seek information on local knowledge and conditions, and for gaining approvals to carry out site and geotechnical investigations.

Landowners with property within the area of the Makaroro dam structure and associated ponding area were identified as a specific group to liaise and consult with through the feasibility study; and a number of meetings have been held. Section 4 of this report provides further details of the landowner meetings carried out to-date. Some of the landowners surrounding the proposed reservoir also participate in Ruataniwha Stakeholder Group meetings. Scheme feedback received from these affected landowners to-date has largely been positive, with an open willingness to work with Council staff and to provide access to contractors involved in site investigation works.

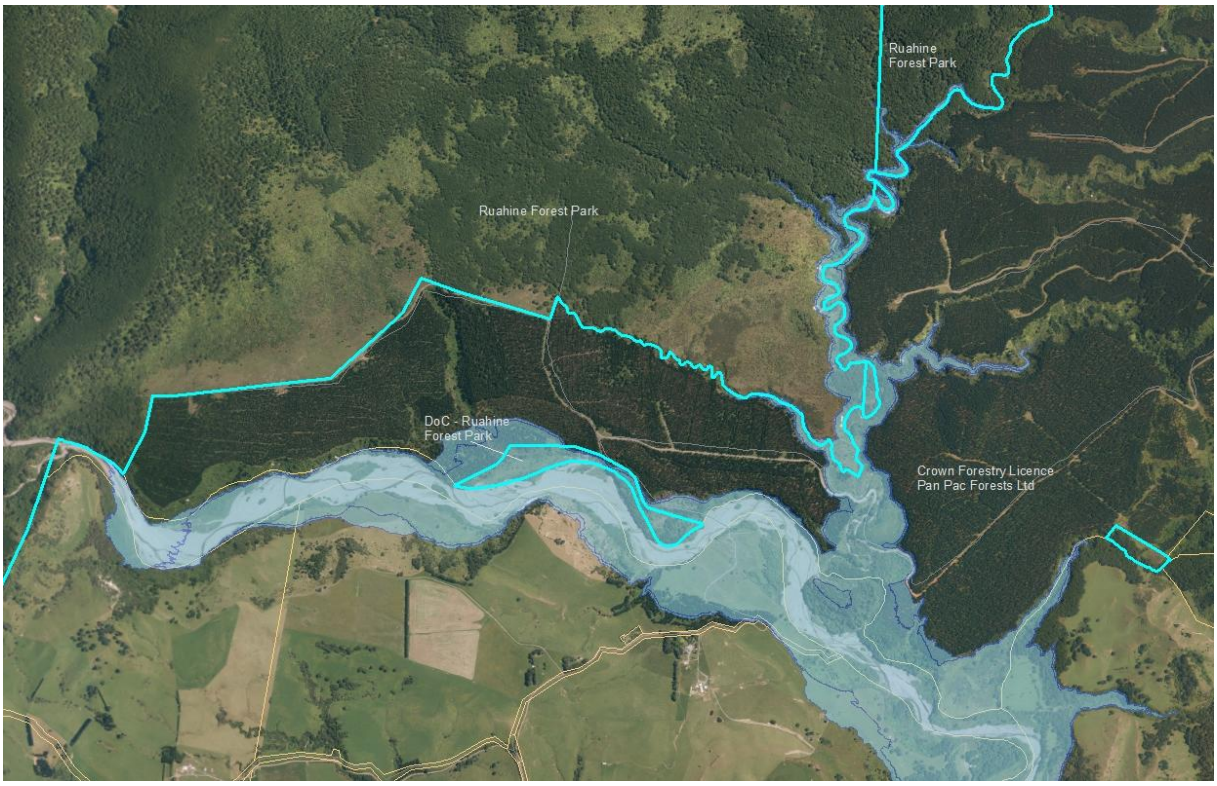
Looking forward, there is an ongoing process of landowner negotiation required to keep affected landowners well informed as to where Council is at in the design process.

Department of Conservation

The Department of Conservation (DoC) have been involved in the project to-date both as a key stakeholder (participating in the Ruataniwha Stakeholder Group meetings) and an affected landowner.

Three parcels of DoC land, forming part of the Ruahine Forest Park, would be affected by the reservoir footprint. These are identified on the following map (Figure 3).

Figure 3: DoC Land in the Reservoir Area



The Wakarara Road-end area is important to DoC as the starting point for a number of walks in the Ruahine Forest Park. The DoC area that would be inundated by the reservoir is also considered to be of significance from an ecological perspective, containing high value mature indigenous vegetation.

A design workshop was held in March 2012 to discuss the physical effects of the proposed dam structure and reservoir on the environment, and to identify opportunities for reinstating recreational

facilities that are located within the reservoir footprint. The workshop was attended by the consultant teams leading the recreation, landscape, archaeology, traffic and terrestrial ecology studies; and by representatives of DoC and Iwi. As a result of the workshop, Council prepared a mitigation and offset approach report, which details a number of initiatives targeting environmental, recreational, and cultural enhancement in the dam/reservoir area (see Section 3.8 below). DoC representatives actively participated in this design process and provided valuable feedback during development of the mitigation and offset initiatives. Feedback from DoC in the 31 August Stakeholder Group meeting indicates that there may be room for more optimisation of the proposed mitigation/offsets work programme, within the financial budget provision included in the overall scheme budget. Local DoC involvement in the project thus far has been highly constructive.

Concession Requirement and Procedure

Part of the reservoir footprint will occupy land owned by DoC for conservation purposes. As such, a concession is required under the Conservation Act 1987.

A concession may take the form of a lease, licence, permit or easement to authorise the activity. Given the nature of the activity in question, an application for an easement to store water on the conservation land is considered to be appropriate.

In granting an easement, the Minister of Conservation must be satisfied that an easement is more appropriate than a lease, licence or permit. As a lease or license conferring an interest in land can only be granted where it relates to one or more fixed structures and facilities, a licence or lease would not seem to be available for simple occupation of land by water. Nor is this a case where a lease or licence is necessary to restrict access to the area in question for the purpose of safety or security, as would justify a lease being granted under the Act (conferring exclusive possession over such an area). Such a restriction would be necessary within the dam footprint, including the boom area adjacent to the dam, but this area will be over privately owned land (not within conservation land).

The concession application will need to identify, among other project details, the type of concession sought; provide a statement as to the proposed duration of the concession and the reasons for that; and satisfy the Minister of this applicant's (assumed to be HBRIC) ability to carry out the proposed activity.

The Minister may request further information in support of an application, including the preparation of an AEE in the form set out in Schedule 4 to the RMA. The Minister may also commission reports or obtain further information regarding the application. Public notice may be given of the Minister's intent to grant an easement enabling full public rights of objection and submissions (40 working days to lodge); and entitling any person making an objection or submission to request an opportunity to appear and be heard in support of that objection or submission. The Director General sets the procedure for any hearing.

The Minister may decline the application on the basis of insufficient information, or where effects cannot be avoided, remedied or mitigated. The Minister must decline the application if it is considered the application does not comply with the provisions of the Conservation Act, or any relevant conservation management plan applying to the area.

If granted, conditions may be imposed, including the way in which the activity is carried out, the places where it may be carried out, the payment of rent, fees and royalties, compensation for any adverse effects, provision of a bond, site restoration, periodic reviews, and the like.

An easement may be granted for a term not exceeding 30 years, except where there are exceptional circumstances, in which case for a term not exceeding 60 years.

It is proposed that this process be progressed in parallel with the principal consenting procedure (likely EPA route). It is considered that the information generated under the RMA processes (see Section 3.0 of this report) would substantially address the Conservation Act requirements for obtaining a concession.

2.2.8 Hydropower Generation

Overview of Design and Capacity

Because the construction of the dam creates a large head difference on the river between the upstream and downstream faces, it is possible to harness the energy from the controlled release of water from the dam. As such, Tonkin & Taylor Ltd has recommended that a single power station at the foot of the dam be incorporated in the dam arrangements.

Preliminary optimisation of the capacity of the power plant and costs versus potential energy output has indicated that an apparent optimum is at an installed capacity of around 6.5 MW. The corresponding generation design flow is 9.73 m^3/s, consisting of 1.23 m^3/s for the residual flow turbine and 8.50 m^3/s for the main turbine; with both turbines housed in the same power station. An operational buffer of 0.20m dedicated to hydropower operation, over and above the Full Supply Level for irrigation storage is included as part of the hydropower add-on.

When the reservoir is full or nearly full, this buffering storage would allow partial capture of small floods and freshes (which would otherwise be spilled) for generation.

An average generation output of 26 GWh is predicted based on the proposed arrangement and plant sizing.

Transmission details

Unison Networks Ltd has a management contract with Centralines, the local electricity distribution company in Hawke's Bay. Unison Networks Ltd has a proprietary computer model of the transmission network of the area and has determined that the output from the proposed hydro-electric power station (6.5 MW) is too great to feed into Centralines' nearby 11kV line. Thus, it will be necessary for the power station to connect into Transpower's grid exit point (GXP) located at Ongaonga substation, about 21.5 km (as the crow flies) southeast of the proposed Makaroro dam site. An indicative and preliminary alignment for the new 33 kV line, approximately 26.5 km long, which follows the alignment of the Wakarara Rd between the power station and the Ongaonga GXP, is shown in Figure 4.

Figure 4: Indicative Alignment of the Proposed 33kV Transmission Line from the Dam Site to the Ongaonga GXP

Further work is recommended by Tonkin & Taylor Ltd with respect to refining the hydropower design. Proposed activities are detailed in section 2.6 below.

2.2.9 Distribution Network

Description of Distribution System and Site/Geotech Investigations

The distribution system comprises a single intake on the Waipawa River to collect the flows released from the proposed dam and distribute the water via a headrace and secondary distribution works to the scheme irrigation areas. The headrace is intended to provide driving pressure for the secondary distribution works where possible, although some areas will require pumping of the secondary piped network.

The headrace alignment is constrained by the geography of the area (e.g. the foothills of the Ruahine Range) and the elevation of the intake site at around 260mRL (which acts as a control for the maximum elevation of the canal). Following consideration of a number of options, a headrace alignment has been selected that balances the advantage of maintaining a high elevation to reduce pumping costs, with an alignment that minimises canal length and earthworks volumes.

Three main conveyance options have been considered for the headrace including a trapezoidal open channel, a rectangular open channel/aqueduct and a pipeline. The rectangular aqueduct was found to be too expensive. The least cost option for the headrace is preferred at this stage, which includes a combination of trapezoidal open channel where the design flows are greater than about $3m^3/s$, and buried pipes for lesser flows. There are advantages with piped systems that may justify more of the open channel sections being converted to pipes, even though this approach is expected to cost more.

The secondary distribution system is a network of pipes that have generally been located in road reserves where possible, with a layout aimed to provide water to within 2km of all farm gates within the project zones. In most cases the pipes pass close to all properties. Some of the secondary lines will require pumping. A tertiary pipe and pump system will be required for the on-farm supply. The

tertiary system design and costings have been undertaken as part of the specific on-farm economics section of work completed by McFarlane Rural Business Ltd.

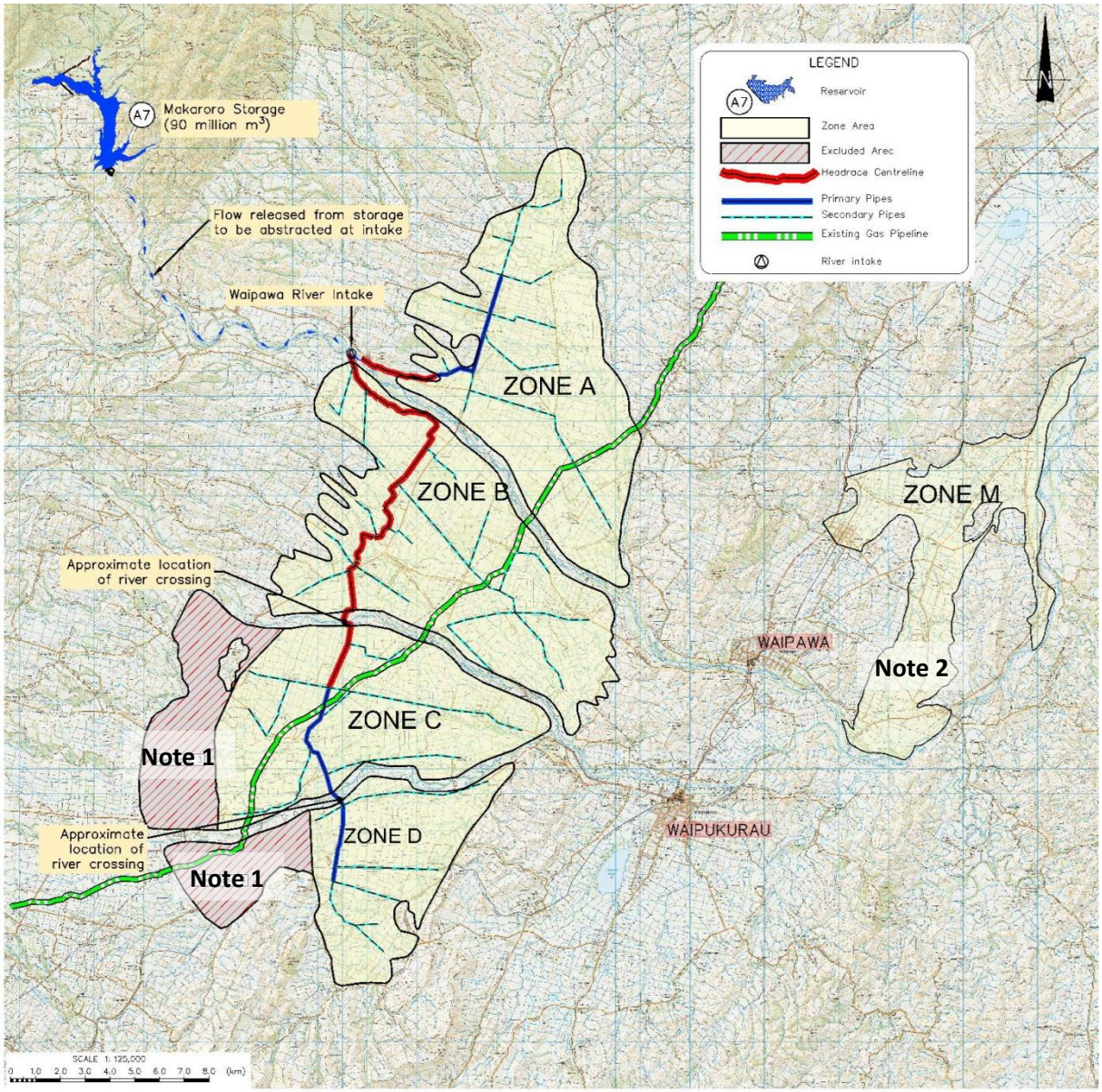
The preferred distribution system at this stage comprises:

- A single intake on the Waipawa River to collect flow released from the proposed dam and/or available on a run of river basis;
- Approximately 21km Headrace canal consisting of:
  - Approximately 3.1 km of 3.3 m^3/s capacity Primary System canal in Zone A
  - Approximately 0.3 km of 11.1 m^3/s capacity Primary System canal in Zone B (to Zone A bifurcation)
  - Approximately 14.9 km of 7.8 m^3/s capacity Primary System canal in Zone B
  - Approximately 2.9 km of 4.1 m^3/s capacity Primary System canal in Zone C;
- Approximately 14.8 km Primary System pipeline within Zones A, C and D;
- Approximately 121 km of Secondary System distribution pipe line to service a total area of approximately 22,000ha [4]; and
- Various miscellaneous works including, but not limited to, inverted siphons, control gates, road bridges, farm bridges, emergency spillways, bifurcation works/pipeline inlet structures, access roading and storm water crossings.

Example of Comparable Inverted Siphon Construction (Figure 5) and Secondary System Inlet from Primary System Canal (Figure 6)

[4] See drawing 27690-DN-001 within *Ruataniwha Plains Water Storage Project: Feasibility Project Description*, Taylor et al, 2012a; Ref: 27690.100/Issue 5

Figure 7: Scheme Overview



The scheme overview above shows the dam location, reservoir extents, currently defined water service zones, and the proposed headrace centreline and pipe distribution network. HBRC are yet to make a decision on whether an alternative fully piped scheme is adopted. A decision on the headrace type and alignment will be made following further optimisation work and landowner discussions.

Scheme Overview Notes

Note 1: Areas within the zone boundary C & D to the west (upslope) of the headrace can be serviced by pumping (not part of the Project, but can be expanded to be included during future design). Areas to the west of the Headrace in Zones A & B are serviced by pumping as part of this project.

Note 2: Zone M is a future opportunity for project expansion.

Land availability/access

As set out above, the distribution system proposed comprises an open canal headrace totalling approximately 21km in length and extending through Zones A, B, and C. The open canal generally follows a 220m RL alignment, passing through 18 properties and affecting 17 private landowners.

Two headrace alignment options (220m RL and 240m RL) and four headrace conveyance options (canal, aqueduct, fully piped and combined pipe/canal options) were assessed as part of the feasibility study. An evaluation of all options against a number of criteria that considered environmental effects, property disruption, design and operational issues and risks, and cost was undertaken by Tonkin & Taylor Ltd and HBRC Project Team members, and it was agreed that the 220m RL open canal option presented the best option at this stage (pending further post-feasibility optimisation work around optimal alignment).

Following the above mentioned evaluation process, Council arranged a series of one-on-one meetings with landowners potentially affected by the canal headrace and these were carried out through July and August 2012. Property owners were provided with maps identifying the proposed canal alignment and in some instances suggested minor realignment options, for consideration in future optimisation works, to better suit their farming operations and property infrastructure.

Landowners identified a preference for the headrace to be piped should it be a viable option. Many landowners noted their support for the Scheme concept, acknowledging the opportunities that it could provide the community.

On-going engagement with affected landowners will be required as the headrace distribution network is further refined, both in terms of alignment and design (see section 2.7 Optimisation). Council has sought advice from the project's legal counsel with respect to options for acquiring land to construct and maintain the headrace canal, with the recommended option being to designate the open canal headrace. HBRIC has also received advice from the project's legal counsel on this matter and it is expected that an application to the Minister for Environment for HBRIC to become a Requiring Authority will be made shortly. If that application is granted, the proposed canal route will be the subject of notices of requirement lodged contemporaneously with the resource consent applications necessary for the balance of the project and be considered along with those applications.

The Primary and Secondary System distribution pipe line is currently contained primarily within road reserve or public land. A designation for these components of the distribution system may not be necessary.

2.3 CONSTRUCTION MANAGEMENT

2.3.1 Preliminary Construction Programme

A detailed Construction Management Plan (CMP) and an Erosion and Sediment Control Plan (ESCP) will be developed by the Contractor prior to works commencing onsite.

A commencement date in late September of any given year is preferred to take advantage of the drier summer months for critical river bed construction. The construction date can probably be delayed for some months with only a small increase in river diversion risk. A more significant delay would substantially increase river diversion risks and may require a larger diversion tunnel. A 12 month delay to the award date would retain the preferred programming schedule. This programme simply highlights a sensible time during any given year to start construction on site to take advantage of river flows.

The programme is based on getting 240 productive days per annum, being derived from an assumed five productive days per week for 48 weeks per annum. Some activities such as the concrete face construction , once started, will continue 7 days per week, 24 hours per day.

The total construction time from contract award to project completion is currently estimated at 54 months. There are opportunities to optimise this position as part of future project investigation, final design and procurement phases. The use of the spillway excavation for dam fill is currently a programme constraint. The size, shape and depth of the cut is such that it limits efficient earthworks management. Options identified for accelerating the programme are spillway rearrangements and double shifting.

2.3.2 Borrow and Fill Disposal Areas

Gravel and 32olluviu borrow is provided primarily from programmed sub-excavation, primary and auxiliary spillway and diversion tunnel excavations. The exception is an impervious "crack filling" layer, which is to be provided from a siltstone borrow located 1.5km upstream of the dam site, and a specific grading filter material that is to be sourced from a gravel borrow near the head of the reservoir. Concrete aggregate is to be provided from a river gravel borrow upstream of the dam diversion intake. Approximately 37,500 m^3 of concrete will be required primarily for the concrete dam face and foundation works.

With the current dam arrangements the cut to fill volumes of 32olluviu material are essentially balanced. However early diversion excavations will produce more gravel and 32olluviu than can be placed in the dam foundation due to river diversion constraints so there is the expectation of some stockpiling and double handling.

Excavation activities are expected to produce excess volumes of gravel (600,00m^3), ash and 32olluviums (200,000m^3) that is not needed in embankment construction. Several potential locations for spoil disposal have been identified, as this will be a requirement of the consenting process.

2.3.3 Erosion and Sediment Control Measures

The dam construction including diversion works and spillways comprise earthworks in and out of the Makaroro River and its smaller tributaries. Large volumes of rock and alluvial materials totalling in excess of approximately 2.5 million m^3 will be required for dam construction. This volume also includes provision for unsuitable material that will require onsite disposal.

The contractor will be required to develop specific measures to manage the effects of erosion and sediment control. The control measures adopted should comply with HBRC Waterway Guidelines – Erosion and Sediment Control and the HBRC Code of Practice for River Control and Drainage Works.

2.4 DAM, DISTRIBUTION AND WATER RESOURCES DESIGN PEER REVIEWS.

Peer reviews have been undertaken for all significant components of the project, with specific emphasis on site and geotechnical issues, dam design and distribution detail. The peer reviewers for the dam design are; Engineering Geology Ltd and Damwatch Services Ltd. The peer reviewer for the distribution system was Heiler Consulting and the peer reviewer for the water resource component was David Painter Consulting (DPC) Ltd.

Full details of the extent of their reviews are included in the Technical Feasibility Report (Taylor et al, 2012b; Ref 27690.100/3).

2.5 COSTS

2.5.1 Dam, Distribution and Transmission Costs

An estimate of the capital cost for construction of the RWS Project dam and distribution has been carried out by Tonkin & Taylor Ltd, with input from Bond Construction Management (Bond CM), based on the feasibility level design presented in the Feasibility Project Description (FPD) report (T&T August 2012a; Ref: 27690.100/Issue 5). Transmission costs have been estimated by Unison Networks Ltd. All costs are presented exclusive of GST.

A summary of construction cost estimates is presented in Table 3.

Table 3: Construction Cost Estimates

Probability	Dam	Distribution	Transmission	Total
P_{50} –median estimate	$143M	$84.4M	$5.4M	$232.8M

Note: In simple terms, the final construction cost has a probability of 50% of being greater than the P_{50} estimate (the median) and an equal probability of being less.

A risk and opportunity workshop was held on 26th and 27th March 2012 with the purpose being to identify risks and opportunities and assess the potential impact these may have on the construction budget. The scope of the risks and opportunities were limited to dam design, the intake and distribution system for the selected canal alignment servicing zones A to D. While some initial refinements were realised within the capital budget above there are a significant number of risks and opportunities identified that require further specific work, some involving further site investigations and trials.

This work would normally be carried out as part of the final design phase, post-feasibility. A programme of work has been identified for the remainder of 2012, prior to the consenting processes, in an effort to consider and realise as many risks and opportunities as possible. This is however subject to Council approving the project to move to the next phase. This work may be carried out as a discrete exercise or incorporated into the procurement process which may be undertaken concurrently with the consenting process. The further work and optimisation issues are further expanded on in sections 2.6 & 2.7.

2.5.2 Land Purchase and Compensation

Land purchase issues are primarily focussed in the areas of the dam site and associated reservoir area, inclusive of buffer planting zones, and also land under the headrace corridor. There will also be a requirement for processes such as easements, disturbance, compensation and legalisation for other sections of the project, particularly those sections proposed on private property relating to the headrace pipeline and secondary piped distribution network.

A section of land of approximately 60 hectares which incorporates a section of the dam footprint and upstream reservoir area on the true right bank of the Makaroro River has been purchased by HBRC in March 2012 at a cost of $400,000. This opportunity arose from an unexpected property sale within the project area. There were other parties involved in this process and there are agreements in place for the land to be sold should the project not progress past feasibility.

Approximately 375 hectares of land around the dam and reservoir area and 75 hectares along the canal headrace corridor have been identified as part of the current project configuration. These areas will need to be dealt with using a variety of legalisation mechanisms including possible purchase or other options, as relevant. A budget provision of $5.2 million has been included in the capital budget for these requirements.

2.6 FURTHER WORK

The risk and opportunity workshop identified a list of potential risks or threats that could result in construction cost increases. Likewise, a list of opportunities to optimise the design that may result in cost savings.

The next stage of the design process for this project needs to focus on better understanding the identified risks and realising the opportunities. This will involve further site investigations and trials, and further development of the design and construction methodology.

The following further work has been recommended by Tonkin & Taylor Ltd to develop the dam design and distribution system prior to entering any consenting processes:

- ***A refined assessment of the effect of the dam on sediment transportation downstream of the dam structure to the coast at Haumoana. This additional work, which is currently underway and being advanced by HBRC Engineering in consultation with Tonkin & Taylor Ltd, will refine sediment transport rates to hourly rates rather than daily rates as previously calculated. This will provide a more accurate assessment of effects in preparation for the consent process. This work is due for completion by December 2012.***

- ***Review of the irrigation command area, particularly the extent of Zones C and D and the feasibility of supplying irrigation water to Zone M. Recent discussions between Tonkin & Taylor Ltd, the HBRC Project Team and Macfarlane Rural Business Ltd have identified potential savings in terms of the estimated water use for some land use types (indication that initial estimates may have been overly conservative). This, in conjunction with additional capacity associated with the dynamic nature of storage over an average season (initial calculations were based on a static storage) suggests that there is some capacity for optimisation of the command area.***

- ***Additional site geotechnical investigations relating to the Zone 2B filter borrow area identified upstream of the dam on the right abutment. Further works are required to quantify the volume, grading, clast strength and permeability of the gravel available beneath the terraces 40-45m above the present river level of the dam site; to confirm the current assumption that these materials will be available in suitable quantity, and are suitable for construction of the Zone 2B filter in the dam.***

- ***Assessment as to whether hydro peaking operation in the winter months should be considered further at this stage, based on the limited period typically available each year for daily peaking (mid July to mid September, in order not to interfere with irrigation operations), and the likely acceptability of the effects on in-stream values from such operation. While the units of energy generated will essentially be the same for a given planting, the average value of each unit of generation will be increased.***

- ***The potential for enhancing output from reducing the tailwater level (and thus increasing generating head) at the power house by excavating the river bed, a short distance below the dam. The net present value of the increased generation will be compared with indicative costs of tailrace deepening to assess economic viability.***

- ***Financial parameters that should be used for assessment of net present value of generation, including projected energy prices and indicative peaking premium.***

- ***Transmission line route study, including the potential for re-using existing power poles or re-conductoring sections of the transmission route where possible (to reduce cost), to confirm the optimum transmission line and associated easement requirements.***

- ***Refined construction cost estimates, for both the power station and transmission.***

- ***Should HBRC elect to incorporate hydro generation in their scheme Tonkin & Taylor Ltd recommend that the arrangements are considered to the same level of detail as the dam. This will reduce the risk of re-arrangements of either the power station or dam outlet works to accommodate one another.***
- ***On-going consultation with land owners affected by the identified Primary System canal alignment is required. Land acquisition may be constrained by limiting the alignment to areas that may have the least impact on particular land owners. Consequential realignment of the canal route may involve significant quantities of additional earthworks. For example, an issue to resolve includes the impact of the proposed Primary System canal on existing centre pivot irrigators. Once the alignment is confirmed with land owners, opportunities for energy recovery within the distribution system can be further investigated.***
- ***Consultation with potential users within the zones is necessary to identify the specific locations where users will require particular flow rates. It is noted that significant revision works may be required once this information becomes available.***
- ***Geotechnical investigation along the proposed alignment is necessary. As far as geotechnical investigations are concerned, the Primary System canal is of particular significance and investigations are required to assess foundation conditions and material properties for potential construction materials. Issues to address include:***
    - ***The ground water regime along the alignment, particularly at intake locations and consequential impacts on channel lining***
    - ***The extent to which cut and/or fill batters may be optimised (steepened beyond 2H:1V) thereby avoiding high shallow cuts where for example it may be preferable to utilise 60° slopes with intermediate benches).***
    - ***The suitability and availability of the identified red metals for use as a lining material requires investigation prior to advancing the current Primary System canal option further. Examples of issues to consider include the requirements for liner thickness, filter compatibility with underlying sub grade, under drainage (at fill locations), locations of suitable borrow areas, potential requirements for processing of material to achieve the necessary specifications, assessment of constructability issues including issues associated with moisture sensitive materials if materials have a high silt content, susceptibility to cracking from cycles of wetting and drying and ability for the liner to self armour or identification of requirements for armour protection from wave lap.***
    - ***The potential to leave some sections of the canal unlined with an assessment of potential water losses (trial canals).***
    - ***Whether there are areas where foundation conditions will not be suitable for construction of the current arrangement, and what additional works (e.g. undercutting) may be required in order to provide a suitable foundation.***
    - ***To what extent excavated material may be utilised for pipe bedding.***
    - ***Potential impact category assessment of the proposed canal.***
    - ***The location of the Vector gas pipeline is not certain. Subject to the confirmed location of the gas main the quantity of excess cut in Zone C may be minimised.***

- ***The detailed design stage of the project should include a detailed performance review of the Rangitata Water Ltd intake currently under construction on the south bank of the Rangitata River. A key component of this work will include evaluation of the potential for clogging of the infiltration system, consideration of flushing and further review of the arrangement by others with specialist expertise regarding fish behaviour.***

  Review and revision of the distribution system will then be necessary to reflect the outcome of the above. This will involve further analysis and optimisation of the canal design (for example gradient, cross section and lining details) and alignment. It will also involve the most economic and practical balance between open channel and piped sections of the Primary System.

2.7 OPTIMISATION

The feasibility report as presented defines the project with the following key assumptions;

Dam: A Concrete Face Rockfill Dam (CFRD) situated in the Makaroro River, with a number of number of site specific geotechnical issues.

Distribution: A single intake on the Waipawa River collects irrigation release water and distributes this along a 21km open channel headrace system and thereafter into a 14.8km large diameter piped section broadly adjacent to SH50. This headrace system then connects to a 121km smaller diameter High Density Polyethylene (HDPE) distribution network.

A number of optimisation opportunities are being considered as part of the next phase of work for the dam and distribution assets. The range of specific areas of optimising potential have been identified by Tonkin & Taylor Ltd, in consultation with the Core Project Team, as follows:

1. **Intake tower arrangements.** NIWA, who undertook the reservoir water quality study, have confirmed, in consultation with Cawthron Institute and Tonkin & Taylor Ltd, that only a single low level intake is required from a water quality perspective[5]. Notwithstanding this, a high level intake tower (as currently designed) offers long term flexibility in the operation and maintenance of the dam.

   Tonkin & Taylor Ltd has suggested two options for addressing this:

   a) Delete the upper level tower and design the low level intake to be the primary intake (the cost savings associated with this option may be in the order of $3m); or,

   b) Consider alternative tower / intake design arrangements.

   Analysis of the options needs to consider the implications of deleting the upper tower; including the operational issues associated with its omission, with reference to NZSOLD and international recommendations for operation of high potential impact dams. Tonkin & Taylor Ltd's experience in dam design suggests that it is unlikely that a fully submerged intake tower would be acceptable in the current regulatory environment (from an operations, maintenance and safety perspective). As such, they have advised that their recommendation may be to pursue option b. Should this be the case, alternative tower arrangements will be investigated by the project engineers, in consultation with NIWA water quality experts.

2. **Spillway and borrow area optimisation.** This activity, needs to be considered concurrently with activity 4, as they are interrelated. Elements of this activity include:

[5] See NIWA Reservoir Water Quality Assessment report summary in section 3.4.1 of this report.

a) Consideration of the merits of deleting the auxiliary spillway and increasing the primary spillway capacity;

b) Assessment of the potential benefit of re-arranging the downstream cut and batter slopes adjacent to the primary spillway for ease of construction;

c) Consideration of an alternative upstream borrow area on the right hand river terrace, in conjunction with potential modifications to the intake arrangement, and temporary works arrangements (tunnel length and diameter);

d) Consideration of moving the quarry and spillway on to the right abutment and with the spillway passing through the saddle and discharging back to the river via the right abutment creek;

e) Assessment of the potential benefits of double shifting the quarry, embankment fill and spillway operations on programme;

f) Assessment of the potential savings from utilising a borrow source from the ridge at the right abutment; and

g) Assessment of the potential programme savings from changing the dam face from concrete to geomembrane (activity 3).

Implications for the construction programme and overall costs need to also be weighed.

3. **Investigation of a PVC geomembrane** that may be suitable as the dam face protection in place of the currently proposed concrete dam face. It is understood that this product has been widely used internationally for repair of CFRD dams, but there is no confirmed precedence as a concrete substitute on new dams.

   Tonkin & Taylor Ltd has identified two options for use of the product:

   a) In the shear zone feature on the left abutment – replace the upstream filters and bulk fill with PVC. This may or may not be a cost/programme saving, but may provide a better design, enabling more robust earthquake performance and easier post earthquake repair; or

   b) Replace the entire concrete facing with PVC.

   In August 2012, Carpi (the suppliers of the PVC membrane), prepared a formal technical and financial proposal for option b. Next steps include review of the proposal by T&T Ltd and the Project's dam peer reviewers to consider and, if appropriate, fully endorse the PVC option before it is incorporated into the design. An international expert with relevant experience using the product may be required to support the consent process.

   Initial indications are that there are significant potential cost and programme savings in adopting a geomembrane facing (potentially around $7m); however these may be offset to a degree by additional costs associated with assessment of this option.

4. **Optimisation of overall construction programme**. Further consideration of the whole construction sequence and programme is required with the aim of achieving cost savings, particularly if a considerably shorter build time could be achieved. The construction programme will be refined as the above noted optimisation activities are completed.

5. **Consideration of in-headrace hydro.** There may be an opportunity to incorporate small hydro turbines in the drop structures of the canal headrace. Future optimisation works would involve developing concepts and construction cost estimates of these arrangements to concept or pre-feasibility level, in order to determine whether they are worth pursuing

further. Liaison with mini-hydro suppliers such as Hydroworks would be required; as would input from the Project's technical peer reviewers.

If the concepts appear positive then a subsequent stage would involve a mechanical and electrical engineer.

6. **Optimisation of the fully piped headrace option.** Tonkin & Taylor Ltd provided Council with a cost estimate of $36m, additional to the canal headrace, for a fully piped option in April 2012, however further intake and design parameter refinements are required.

These optimisation works will be scheduled over the balance of 2012.

In addition to the post-feasibility optimisation works described above, Tonkin & Taylor Ltd have identified three further areas of optimisation that can be advanced in parallel with the consent process. Briefly, these additional areas of investigation include:

- Consideration of the best approach to use for management and procurement of the detailed design and construction stages of the project.

- Further geotechnical investigations for detailed design. Site investigations have been completed to sufficient detail to enable feasibility level design to be prepared, however more detailed investigations will be required to enable detailed design to be completed. Some of this work could be included as part of the scope of an Alliance or Design and Construct arrangement, but there may be advantages in doing some or all of the work earlier in terms of programme time savings and risk management.

- Specimen design. There will be further opportunities to enhance or optimise the feasibility level design. Some have been identified already in the risk/opportunity workshop, and some will become evident as further site investigations are completed at the dam site and in the area of the distribution system.

2.8 HBRC CORE TEAM FINDINGS AND RECOMMENDATIONS

Overall Conclusions

The HBRC Core Project Team have reviewed the conclusions, recommendations and further works identified by Tonkin & Taylor Ltd; and the optimisation opportunities of the dam, distribution and transmission components of the project summarised above.

Completion of the site investigations and technical studies has been an iterative process, managed jointly by Tonkin & Taylor Ltd and HBRC throughout the full feasibility phase of the project. This close working relationship has seen issues and concepts discussed, agreed and accommodated, as the project has progressed.

Overall, the proposed Scheme is considered by the Core Project Team and Tonkin & Taylor Ltd to be technically feasible. The further works and optimisation activities recommended to refine elements of the scheme and reduce overall costs, where practical and possible will be advanced ahead of the consenting phase, or as part of the detailed design process, should Council agree to progress the RWS Project past feasibility.

3.0 ENVIRONMENTAL, SOCIAL AND CULTURAL STUDIES

3.1 METHODOLOGY

3.1.1 Advanced Pre-Feasibility

As part of the Advanced Pre-Feasibility Study completed in February 2011 by Tonkin & Taylor Ltd, the environmental issues associated with an assessment of 12 short-listed storage options were identified. This included an initial assessment of aquatic ecological issues undertaken by the Cawthron Institute. Other issues were highlighted as requiring further assessment.

The Advanced Pre-Feasibility Study recommended that two in-river storage options (A7 on the Makaroro River and D5 on the Makaretu River) be advanced for full feasibility assessment.

Two cultural effects reports were also prepared during the Advanced Pre-Feasibility phase by Dr Benita Wakefield, the first associated with eight of the original fourteen site options and the second focusing on the A7 and D5 sites.

Subsequently (and prior to any of the feasibility stage environmental report drafts outlined below being received) the Makaretu River D5 site was abandoned due to geotechnical issues.

3.1.2 Feasibility Scoping and Process

In March 2011 Environmental Management Services was engaged to assist Hawke's Bay Regional Council (HBRC) with the environmental, social and cultural aspects of project feasibility.

It was determined that the most efficient way of assessing the environmental feasibility of the project was to assess the environmental effects of the project in the same way that would be required for preparation of an Assessment of Environmental Effects accompanying resource consent applications under the Resource Management Act 1991. This involved the following steps:

a) Briefing the project engineers (Tonkin & Taylor Ltd) to prepare an "Initial Project Description Report" outlining the design and key operating parameters of the project. Tonkin & Taylor Ltd were also asked to undertake an assessment of sedimentation within the proposed reservoir and consequential physical changes to river morphology downstream of the dam site

b) Developing work scopes for the key modelling studies covering reservoir water quality, groundwater and surface water interaction under a range of scenarios and the nutrient flows associated with land use intensification

c) Developing work scopes for a range of environmental studies including social and cultural assessments

d) Presentation of the draft work scopes to the Ruataniwha Stakeholder Group for review and input

e) Seeking proposals and commissioning the various studies based on the finalised work scopes from experts in each field

f) The preparation of Inception reports for the terrestrial and aquatic ecology assessments to confirm the assessment methodology, based on initial site visits and meetings with HBRC and key stakeholders

g) Receiving and reviewing the first drafts of the various reports and identifying consequential changes to the Initial Project Description report

h) Development of the Final Feasibility Project Description report

i) Convening of a Land Use Intensification Working Party to provide an interactive working forum to follow the development and application of the Ruataniwha Land Use Intensification Model

j) Completion of the modelling and assessment reports to a final draft stage

k) Presentation and discussion of the modelling and assessment reports at Ruataniwha Stakeholder Group meetings

l) Development of an integrated mitigation and offset report detailing how some of the mitigation and offsetting proposals recommended by the effects assessment authors might be implemented

m) Finalising of the modelling and assessment reports. In the case of some key reports[6] this included a review by independent peer reviewers and the opportunity for report writers to respond to matters raised. In addition Mr John Cheyne coordinated "Green Group" feedback comments on the aquatic and terrestrial ecology and integrated mitigation and offset reports which were addressed by the authors of those reports as part of their finalisation.

3.1.3 Feasibility Reporting Approach

The approach taken in this report is to **reproduce** the executive summaries of the modelling and assessment reports which have been prepared by the various experts. The various assessment reports follow a structured assessment methodology which addresses the following matters.

- Potential environmental effects
- Assessments undertaken
- Results of assessments
- Suggested approach for effects identified.

It is important to note that for consistency and accuracy the key findings of each of the reports are set out in the words of the respective authors, and **have not been adapted or paraphrased** in this overall feasibility report, except where minor tense and wording changes have been needed to assist readability.

Where the report authors make recommendations these are highlighted in ***bold italics*** in the text below.

For more detail on the various assessment areas readers are directed to each of the specific reports contained on the HBRC website in the Ruataniwha Water Storage Project section.

3.1.4 HBRC Core Team Recommendations

The HBRC Core Team comprising Graeme Hansen, Stephen Daysh, Olivier Ausseil, Monique Benson and Larissa Coubrough have considered all of the information and recommendations contained in the environmental studies commissioned by the Council for this feasibility stage. Their overall findings, and recommendations for further work if the project proceeds to resource consenting are included in Section 3.10 of this report.

[6] The groundwater / surface water and effects on land use on nutrient modeling reports and the aquatic and terrestrial ecology assessment reports

3.1.5 Ruataniwha Stakeholder Group Consideration

A draft of the Environmental, Social and Cultural Studies section of this Report was considered and discussed by the Ruataniwha Stakeholder Group on 31 August 2012. The outcome of their consideration as recorded in the minutes of that meeting is included in Appendix 4 of this report.

3.2 STUDIES UNDERTAKEN

The investigations undertaken have provided a comprehensive analysis of the environmental, social and cultural issues associated with the proposed Ruataniwha Water Storage project. If the project is deemed feasible by Council, they will be a critical input to the Assessment of Environmental Effects for the purposes of the resource consent applications which will be necessary for the project to proceed.

The various reports will be updated as required to reflect any project changes and optimisation which occurs after the completion of this feasibility stage, if the Council resolves to seek resource consents for the project after considering this report. In some cases, report writers have recommended further work to confirm their findings and to feed into the final reports that would accompany resource consent applications.

Table 4: Project Technical Reference Reports

Title	Date	Organisation	Authors	Bibliographic Reference
Ruataniwha Plains Water Storage Project: Feasibility Project Description	August 2012	Tonkin & Taylor Ltd	M. Taylor D. Leong T. Morris P. Carter D. Knappstein	Taylor et al, 2012
Ruataniwha Water Storage Project: Sedimentation Assessment	July 2012	Tonkin & Taylor Ltd	T. Fisher J. Russell	Fisher and Russell, 2012

Table 5: Modelling Studies				
Title	**Date**	**Organisation**	**Authors**	**Bibliographic Reference**
Ruataniwha Plains Water Storage Project: Characterisation of Reservoir Water Quality	July 2012	NIWA	M. Gibbs C. McBride D. Ozkundakci D. Hamilton	Gibbs et al, 2012
Ruataniwha Water Storage Project: Tukituki River Catchment Assessment of Potential Effects on Groundwater and Surface Water Resources	June 2012	HBRC	R. Waldron H. Baalousha	Waldron and Baalousha, 2012
Modelling the Effects of Land Use on Nutrients Entering the Tukituki River, Hawke's Bay	August 2012	NIWA, AgResearch, Plant & Food Research, Macfarlane Rural Business Ltd	K. Rutherford A. Mackay A. Manderson S. Green B. Clothier I. Power H. Eaton A. Nicholls C. Lewis A. Macfarlane	Rutherford et al, 2012

Table 6: Terrestrial Aquatic and Ecology Assessment Reports				
Title	**Date**	**Organisation**	**Authors**	**Bibliographic Reference**
Hawke's Bay Regional Council Ruataniwha Water Storage Project: Terrestrial Ecology Study Assessment of Ecological Effects	July 2012	Kessels & Associates Ltd	G. Kessels B. Deichmann P. Stewart D. Riddell M. Hasenbank R. Clark U. Brandes	Kessels et al, 2012
Ruataniwha Water Storage Project – Aquatic Ecology Assessment of Effects	August 2012	Cawthron Institute	R. Young N. Berkett R. Holmes J. Hay	Young et al, 2012

Table 7: Cultural Effects Assessment Report				
Title	**Date**	**Organisation**	**Authors**	**Bibliographic Reference**
Tukituki River Catchment Cultural Values and Uses[1]	June 2012	Te Taiwhenua O Tamatea in Partnership with Te Taiwhenua O Heretaunga	Benita Wakefield M. Hape J. Maaka Bruce Wakefield H Maaka M Apatu D. Moffatt D. Whitiwhiti	Wakefield et al, 2012

[1] This report was prepared as an overall cultural values and uses report for HBRC in relation to the Tukituki Plan Change process. The cultural effects of the Ruataniwha Storage Project were specifically addressed in Section 5.2 of this overall report, which summarises both the earlier Te Taiwhenua O Tamatea Cultural Impact Assessment (CIA) Reports and the Lower Tukituki CIA report prepared by Te Taiwhenua O Heretaunga.

Table 8: Other Effects Assessment Reports				
Title	**Date**	**Organisation**	**Authors**	**Bibliographic Reference**
Ruataniwha Water Storage Project: Road Infrastructure and Traffic Assessment	June 2012	OPUS International Consultants Ltd	R. Landon-Lane N. Uran A. Jones	Landon-Lane et al, 2012
Ruataniwha Water Storage Project: Noise Effects Assessment	July 2012	Marshall Day Acoustics	M. Halstead	Halstead, 2012
Ruataniwha Irrigation Project: Archaeological Assessment	July 2012	Clough & Associates Ltd	S. Bickler R. Clough P. Parsons	Bickler et al, 2012
Ruataniwha Water Storage Project Social Impact Assessment	July 2012	Taylor Baines and Associates	N. Taylor	Taylor, 2012
Ruataniwha Water Storage Project Recreation Assessment	August 2012	OPUS International Consultants Ltd	S. Morgan M. Frey	Morgan and Frey, 2012
Ruataniwha Water Storage Project Landscape and Visual Effects Assessment	August 2012	Isthmus	G. Lister W. Robertson	Lister and Robertson, 2012

Table 9: Integrated Mitigation and Offset Report				
Title	**Date**	**Organisation**	**Authors**	**Bibliographic Reference**
Ruataniwha Water Storage Project: Proposed Integrated Mitigation and Offset Approach	August 2012	Hawke's Bay Regional Council	L. Coubrough G. Hansen S. Daysh G. Kessels	Coubrough et al, 2012

Table 10: Land use Intensification Working Party Report				
Title	**Date**	**Organisation**	**Authors**	**Bibliographic Reference**
Ruataniwha Plains Water Storage Project: Land Use Intensification Working Party Report	August 2012	Environmental Management Services Ltd	S. Daysh	Daysh, 2012

3.3 FEASIBILITY PROJECT DESCRIPTION

As discussed above, the Tonkin & Taylor Ltd Feasibility Project Description report was developed in two stages to provide the key base information for the modelling and assessment reports. An Initial Project Description was prepared in November 2011 to enable the key environmental assessment work to get underway while engineering investigations continued. The report provided an overview of the project including key design and operating parameters and described how construction would be managed. The report was then finalised with reference to the initial drafts of the environmental investigations.

For the purposes of environmental effects assessment, the key elements of the project are:

- Construction of a large in-river dam on the Makaroro River;
- Conversion of an upper catchment riverine environment into a lacustrine environment;
- Flooding of a substantial area of land, including an area of native bush;
- Creation of a barrier to upstream and downstream aquatic migration patterns;
- Alteration of the flow regime from the dam site downstream;
- Construction of a water intake on the banks of the Waipawa River with a water distribution network spreading laterally across the Ruataniwha Plains;
- Land use changes resulting from the use of irrigation water, causing increases in nutrient outputs both from irrigated areas and non-irrigated areas.

3.4 MODELLING REPORTS

3.4.1 Reservoir Water Quality Modelling

The scenarios modelled for this supplementary desktop study indicate that a broad range of water qualities in the reservoir and discharged from the reservoir are possible. The highest water quality

would be associated with scenario M1 which would have all water drawn from an elevation of 405mRL. This scenario is likely to provide high quality water, which would be, on average, better than the inflow water from the Makaroro River. The water in the reservoir would be well oxygenated and suitable for aquatic life except in a small (<0.25% of the total volume of the reservoir when full) dead zone below the outtake level; although short periods of low dissolved oxygen concentration (<2gm^3) would be possible without aeration under base flow conditions at the end of the stratified period. ***An aeration system should be installed in the reservoir as described in section 6.1 of the report to maintain bottom water DO levels above the minimum needed for fish and to accommodate the extreme events observed in other years, but not used in the simulations.***

An aeration-style energy dissipation device below the discharge point from the reservoir would prevent river bed scour and boost DO levels in the Makaroro River below the reservoir.

Scenarios that included base flow draw from the toe of the dam also provided water quality better than the inflow water quality but would require aeration during the base flow only discharge period during summer stratification. The initial modelling scenario and scenario M3 demonstrated the use of a dual draw from 395 plus 426mRL and 405mRL plus 443mRL, respectively, where the outflow water was nearly always well oxygenated. However, if low water levels prevented discharge from the 426 or 443mRL outtake valves, the discharge water from the low level outtake valve would become anoxic. In these scenarios (initial and M3) the upper water column would remain well oxygenated and capable of supporting aquatic life. However, the available volume of habitable water would be small until natural thermal stratification isolated a surface mixed-zone layer. If the base flow from the reservoir was drawn from the 426mRL or 443mRL outtake valve as an outflow = inflow discharge, the downstream water would also be well oxygenated although warmer than the inflow and with elevated nutrients and phytoplankton biomass due to a surface skimming effect. If phytoplankton biomass was high, the pH would also rise. For the initial and M3 scenarios to operate efficiently, aeration would be needed during the summer stratified period.

The worst water quality came from scenarios where the outtake valves were high in the water column and there was no base flow discharge from the bottom of the dam. These scenarios, with all discharge water being taken from an elevation of either 426 or 443mRL, produced semi-permanent stratification with the water below the draw depth becoming anoxic and enriched with ammonium-N and phosphate. With the potential for summer water levels to fall to near the draw depth in these scenarios, the reservoir water quality would not be suitable for aquatic life in summer without the use of aeration.

Although there are benefits to removing the vegetation in the reservoir extent before filling, the cost would be high and valuable aquatic habitat diversity would be lost.

Because the reservoir water will be sensitive to nitrogen, catchment management to reduce or maintain low levels of nitrogen will be important. Managing sediment inputs would have the dual effect of reducing phosphorus loads in the lake bed and infilling of the reservoir with silt. ***Future-proofing the reservoir by providing 25m wide planted buffer zones between production forest land the reservoir are recommended, as is the construction of the necessary infrastructure required for forest harvesting before the reservoir is filled. Because the catchment land is susceptible to erosion and particularly slipping, management strategies designed to minimise bare land exposure will also be important. Land clearance of steep land within the reservoir catchment should be a discretionary action in the regional plan requiring a resource consent, and sediment control plans should be provided and approved before harvesting production forest.+***

3.4.2 Groundwater / Surface Water Modelling

This study investigates the potential future impact of the proposed Ruataniwha Water Storage scheme on water resources in the Tukituki Catchment and Ruataniwha Basin.

The Ruataniwha Plains (approximately 40,000 hectares) are located in central Hawke's Bay overlying the Ruataniwha Basin and aquifer within the Tukituki River Catchment and have significant agricultural potential. However this is restricted by the ability to access water. Approximately 6000 hectares of the plains are currently irrigated, principally supplied by groundwater abstracted (pumped) from the Ruataniwha Aquifer. Water is also abstracted from the Tukituki River and its tributaries. Studies have identified an additional 22,550 hectares of potential irrigable land within the Ruataniwha Plains. However groundwater and surface water abstractions are considered to be fully allocated and as such, the provision of irrigation capacity from a potential community water storage scheme located on the Upper Makaroro River (a tributary of the Waipawa River which feeds into the Tukituki River) is being investigated.

The purpose of this study was to predict and compare the potential future impact of four different water resource management scenarios which incorporate different levels of water abstraction, with and without the operation of the proposed water storage scheme, on the Ruataniwha Aquifer System and river flow regimes within the Tukituki River Catchment.

Four scenarios were considered:

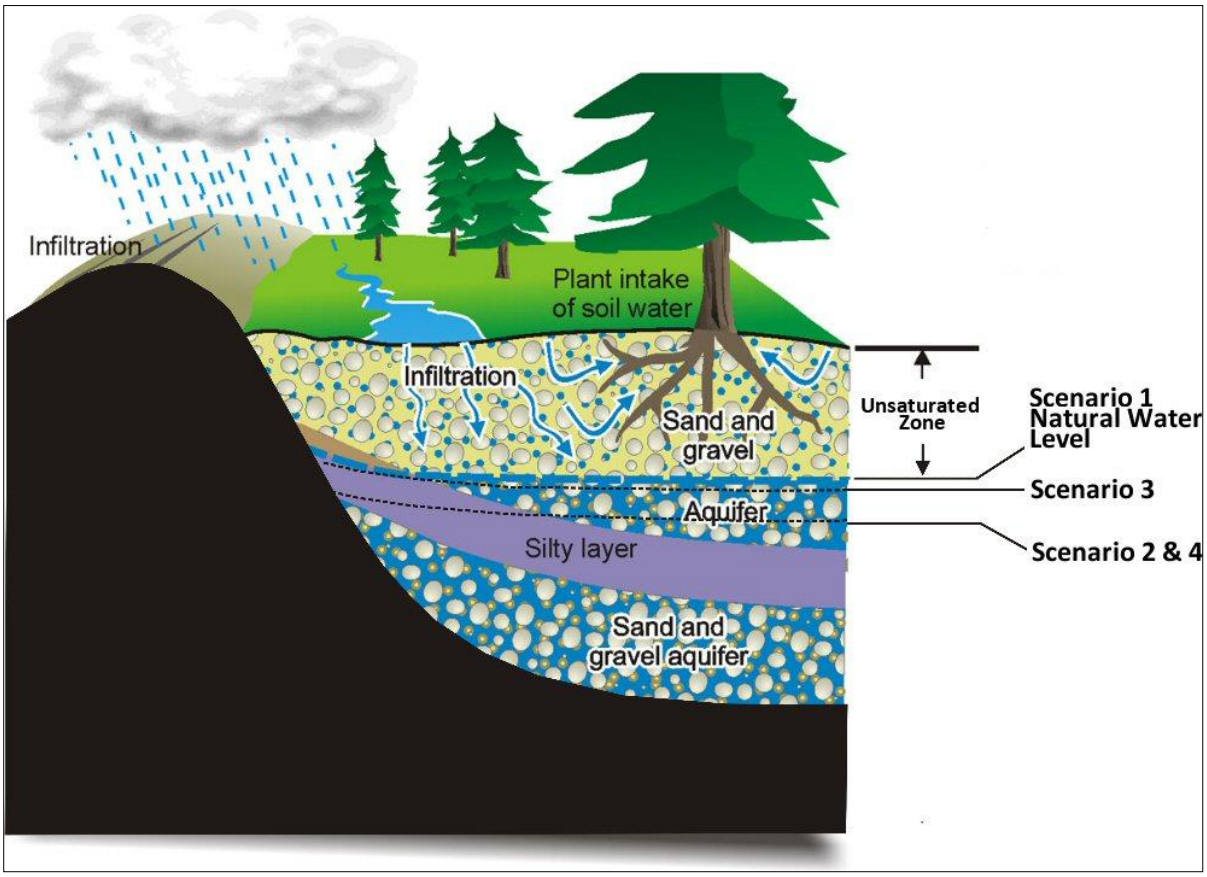
1) Natural system (no consented water abstraction or storage scheme in place)
2) Current (actual) water abstraction continues up to the end of 2016
3) Proposed water storage scheme in operation from 2017 to 2022 while consented water abstraction is discontinued from 2017
4) Proposed water storage scheme in operation from 2017 in combination with consented water abstraction continuing to 2022

A transient groundwater model developed by the Hawke's Bay Regional Council was used to simulate changes to the aquifer system in terms of aquifer storage, aquifer-spring interactions and aquifer-river interactions.

The change in aquifer contribution to river flows within the Ruataniwha Basin and change to river flow regimes were also simulated under each of the four scenarios at three river flow sites; Tukituki River at Tapairu Rd, Waipawa River at RDS and Tukituki River at Red Bridge.

Scenarios incorporating the water storage scheme (Scenarios 3 & 4) were compared to Scenario 2 which represents the effect of 'current abstraction' on the resource simulated to the end of 2016 prior to the start of the scheme in 2017. Scenario 2 was also compared to Scenario 1 which represents the 'natural state'. The relative change to aquifer storage modelled under each scenario is graphically depicted in the following figure.

Figure 8: Relative Changes to Aquifer Storage Under Each Scenario



The Scenario 3 simulation compared to Scenario 2, predicts a significant recovery in Ruataniwha Aquifer storage by 2022 (32 MCM) with spring flow returning to near natural levels as a result of ceasing all abstraction within the basin.

Scenario 4, predicts a decline in aquifer storage, spring flow and aquifer contribution to river flow similar to that predicted under Scenario 2.

The aquifer system is predicted to be close to a state of dynamic-equilibrium from 2017 to 2022 under Scenarios 2 and 4, which means that only minimal changes in aquifer storage would be expected after 2022 based on the assumed conditions. At the end of the simulation period for Scenario 4 (31-Dec-2022) the total predicted storage loss from natural conditions was 68 MCM.

The predicted decline in spring flow in Scenario 4 over the last 12 years compared to the first five years is approximately 60 l/s, which is similar to the decrease predicted in spring flow at the end of the simulation for Scenario 2.

Figure 9: Aquifer/Groundwater (GW) Contribution to Tukituki River Flow Under Scenarios 1-4

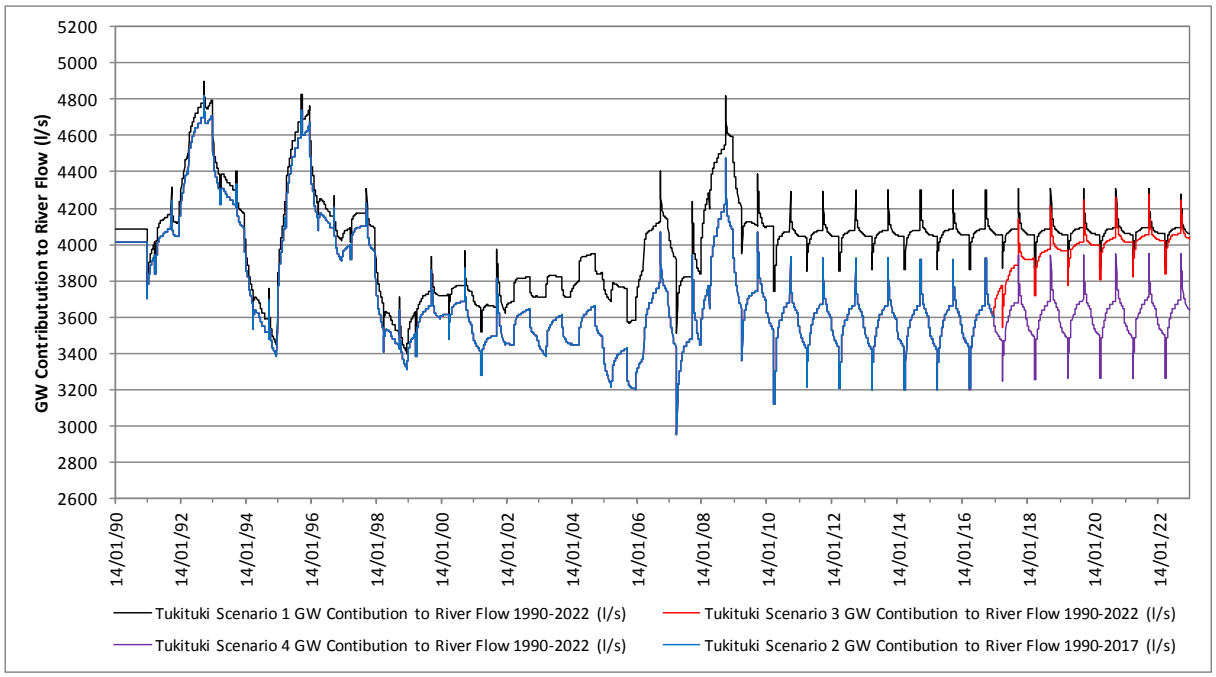
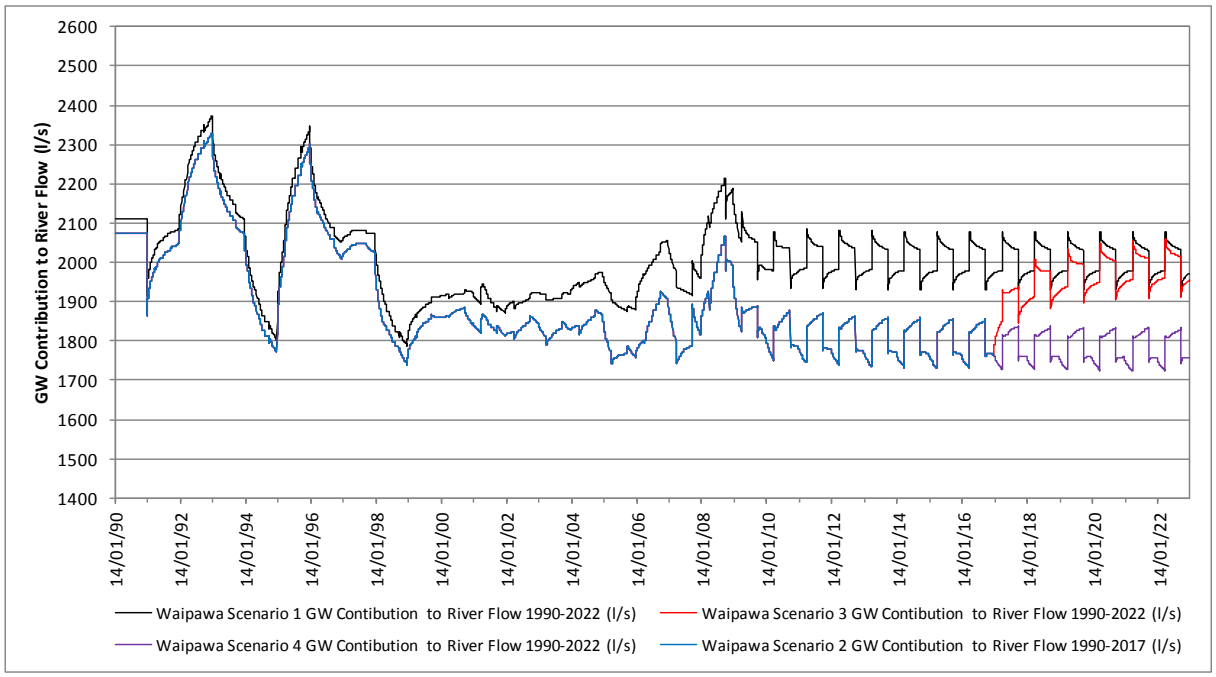


Figure 10: Aquifer/Groundwater (GW) Contribution to Waipawa River flow under Scenarios 1-4



The aquifer/groundwater contribution to river flow in the Upper Tukituki and Waipawa Rivers (shown in the previous figures) is the greatest when the system is at 'natural state' (Scenario 1).

Aquifer contribution to river flow is predicted to decline (from natural conditions) under Scenarios 2, 3 and 4 up to the end of 2016. This decline is attributed to continuing current levels of abstraction from the aquifer. Under Scenario 2, aquifer contribution to river flow is predicted to stabilise from the beginning of 2017.

Under Scenario 3, an increase in aquifer contribution to river flow is predicted from 2017 to 2022 in both the Waipawa and Tukituki Rivers. The aquifer contribution to river flow is predicted to recover

to near natural conditions at the end of the simulation period in 2022 with only minor further changes expected after that time.

Under Scenario 4, a minor further decline in the aquifer contribution to the Waipawa River and a minor recovery in the groundwater contribution to the Tukituki River are predicted from 2017.

Table 11: Summary of Modelled River Flow Statistics

River Flow Statistic		River Flow Site	Scenario 2 (2016)	Scenario 3 (2022)		Scenario 4 (2022)	
			Continuation of Current Abstraction	Change from Scenario 2		Change from Scenario 2	
Mid Flow Range	Median	Tukituki River at Tapairu Rd	8912 l/s	+6%	(9433 l/s)	+0.4%	(8949 l/s)
		Waipawa River at RDS	8452 l/s	-22%	(6587 l/s)	-25%	(6308 l/s)
		Tukituki River at Red Bridge	20657 l/s	-5%	(19526 l/s)	-9%	(18717 l/s)
	Mean	Tukituki River at Tapairu Rd	15091 l/s	+4%	(15631 l/s)	+0.3%	(15129 l/s)
		Waipawa River at RDS	14636 l/s	-14%	(12535 l/s)	-16%	(12257 l/s)
		Tukituki River at Red Bridge	43224 l/s	-3%	(41715 l/s)	-5%	(40891 l/s)
Low Flow Range	Q_{99}	Tukituki River at Tapairu Rd	1220 l/s	+44%	(1754 l/s)	+3%	(1260 l/s)
		Waipawa River at RDS	1864 l/s	+24%	(2316 l/s)	+13%	(2102 l/s)
		Tukituki River at Red Bridge	3577 l/s	+27%	(4532 l/s)	+7%	(3814 l/s)
	MALF	Tukituki River at Tapairu Rd	2161 l/s	+28%	(2772 l/s)	+2%	(2205 l/s)
		Waipawa River at RDS	2654 l/s	+5%	(2794 l/s)	-6%	(2495 l/s)
		Tukituki River at Red Bridge	5256 l/s	+15%	(6055 l/s)	-2%	(5150 l/s)
	Days ≤ Proposed Minimum Flow* (l/s)	Tukituki River at Tapairu Rd (2300 l/s)	33 days	-15 days	(18 days)	No Change	(33 days)
		Waipawa River at RDS (2500 l/s)	26 days	-11 days	(15 days)	+7 days	(33 days)
		Tukituki River at Red Bridge (5200 l/s)	26 days	-15 days	(11 days)	+3 days	(29 days)

* Days per year averaged over the modelled river flow record

The 'proposed minimum flows' referred to in the above table have been developed for the pending Tukituki Catchment Resource Management Plan Change as a result of work undertaken by the HBRC. The proposed minimum flows for the Tukituki River at Tapairu Rd and Waipawa River at RDS are based on a flow predicted to provide 90% habitat protection available at the mean annual low flow (MALF) for juvenile longfin eel. The proposed minimum flow for the Tukituki River at Red Bridge is based on a flow predicted to provide 90% habitat protection available at the MALF for adult rainbow trout. These minimum flows have yet to be formally adopted by the HBRC at the date of writing this report.

The above table summarises changes to modelled river flow statistics from which the following comparisons have been made.

The proposed water storage scheme will not involve any abstraction or retention of water from the Tukituki River upstream of the confluence with the Waipawa River. Modelling results therefore predicted that discontinuing groundwater and surface water abstractions from 2017 and migrating them to the storage scheme under Scenario 3, would have a positive impact on river flows in the Tukituki River at Tapairu Rd, predicting that river flows would return to near natural conditions (Scenario 1) by 2022.

Migrating all current groundwater and surface water abstractions to the storage scheme under Scenario 3 is predicted to result in some significant gains for rivers at low flow conditions compared to Scenario 2 (under which current abstraction continues). The greatest change to key low flow statistics is predicted in the Q_{99} statistic (flow that is equalled or exceeded for 99% of the time), which increased between 24% and 44% at all three river sites. Under Scenario 3, the MALF was predicted to increase by 28% in the Tukituki River at Tapairu Rd, by 5% in the Waipawa River at RDS

and by 15% in the Tukituki River at Red Bridge. As a point of reference, the lowest recorded flow was predicted to increase by 78% in the Tukituki River at Tapairu Rd, by 91% in the Waipawa River at RDS and by 70% in the Tukituki River at Red Bridge.

At Waipawa River at RDS the Q_{99} increased by 24% to a flow higher than that modelled under natural flows in Scenario 1. This is attributed to low flows being augmented by the residual flow discharged from the storage dam. The Q_{99} increased by 44% at Tukituki River at Tapairu Rd, a result of river flows in the Upper Tukituki Catchment returning near to natural conditions. In the Lower Tukituki River at Red Bridge, Q_{99} also increased (by 27%) to a flow higher than that modelled under natural conditions which is attributed to a cumulative effect of Upper Tukituki River flows returning to natural conditions and Waipawa River flows being augmented by the storage dam residual flow.

Modelling results predict that Scenario 3 would reduce mid to high range flow statistics in the Waipawa and Lower Tukituki Rivers (for example, reducing median flow in the Waipawa River at RDS by 22% and by 5% in the Tukituki River at Red Bridge). The reduction in mid to high range flows reflects the effect of the dam intercepting and storing Makaroro River flows, discharging a residual flow and releasing flow for subsequent abstraction downstream for irrigation. Mid to high range flows are predicted to increase in the Upper Tukituki River due to not being directly affected by the scheme.

In comparison to Scenario 2, a significant decrease in days where river flow is less than or equal to the proposed minimum flow is predicted at all sites under Scenario 3. At each site, days less than or equal to the proposed minimum flow are predicted to return to that shown in the natural flow regime under Scenario 1; a reduction of 15 days at Tukituki River at Tapairu Rd and Tukituki River at Red Bridge, and a reduction of 11 days at Waipawa River at RDS.

Continuing current groundwater and surface water abstraction in combination with operating the water storage scheme under Scenario 4, predicts an increase in the Q_{99} low flow statistic from Scenario 2 at Waipawa River at RDS of 13% and 7% at Tukituki River at Red Bridge. Again as a point of reference, the lowest recorded flow was predicted to increase by 71% in the Waipawa River at RDS and by 37% in the Tukituki River at Red Bridge. These increases are attributed to residual flows provided by the scheme during periods of low flow conditions. However this scenario is not predicted to provide significant benefits to any other flow statistics. In the Waipawa and Lower Tukituki Rivers, Scenario 4 is predicted to result in further reductions in all other flow statistics from Scenario 2. Reductions in mid to high flows ranged between 14% and 25% at Waipawa River at RDS and between 4% and 9% at Tukituki River at Red Bridge. These are slightly higher reductions than that modelled under Scenario 3 which reflects the effect of water abstractions continuing in combination with the dam intercepting and storing Makaroro River flows.

Minimal change was predicted in the flow regime at Tukituki River at Tapairu Rd under Scenario 4 from that of the river flow regime modelled under Scenario 2. Scenario 4 predicted a minor increase in low flow statistics (no more than 3%) which is attributed to the stabilisation of the Ruataniwha Aquifer System over time.

When comparing Scenarios 2 and 4, in terms of predicted days where river flow is less than or equal to the proposed minimum flow, Scenario 4 showed an increase of 7 days from Scenario 2 at Waipawa River at RDS, an increase 3 days at Tukituki River at Red Bridge, whereas no change was predicted at Tukituki River at Tapairu Rd.

Operating the water storage scheme after discontinuing all current abstraction under Scenario 3 predicted:

a) A lower overall impact on river flows in the Waipawa and Lower Tukituki Rivers than if current abstractions continued in conjunction with the water storage scheme in operation under Scenario 4.

b) An increase in low flow statistics towards natural conditions in all rivers.

c) A higher impact on mid to high range flows in the Waipawa and Lower Tukituki Rivers than if only current abstraction continued under Scenario 2.

d) Upper Tukituki River flows would return to near natural conditions throughout the full range of the flow regime.

For each site, scenario-modelled daily mean flow records have been produced. These are available from the Hawke's Bay Regional Council on request.

The scenarios modelled in this report were designed to predict relative changes to a complex dynamic system when changes are made to various input parameters. Some future predictive input parameters were averaged from historical records. An additional margin of uncertainty was introduced by strong reliance on literature values for input parameters where measured data was not readily available.

In addition, modelling current levels of surface water abstraction on river flow records used estimates of actual water use throughout a typical year. These estimates were based on available metered actual water use data. The available metered data for the Tukituki Catchment was limited to 2007-2008. In the absence of additional metered data, it was assumed that 2007-2008 represented a typical year of surface water abstraction in the Tukituki Catchment. Groundwater abstraction estimates used in the transient groundwater model were based on crop water demand studies and available metered well data.

In view of the previous statements, modelling results in this study should principally be used for making comparisons between scenarios rather than identifying absolute changes or making comparisons with actual values.

3.4.3 Land Use Intensification Modelling

The Hawkes Bay Regional Council (HBRC) requires an assessment to be made of the likely impacts of the proposed Ruataniwha irrigation scheme on nutrient inputs to the Tukituki River, and the resultant impacts on aquatic plants. A multi Crown Research Institute (CRI) approach has been used to model the current and expected nutrient loss into the Tukituki River, as a result of land use intensification. The agencies and experts involved in this process include:

- **Dr Steve Green and Dr Brent Clothier;** Plant and Food Research (PFR)
- **Dr Alec Mackay and Dr Andrew Manderson;** AgResearch
- **Dr Kit Rutherford**; NIWA

Input assumptions to the model were developed through the On-Farm Economic Study (2011) by MacFarlane Rural Business Ltd. This included the predicted future land use and farm management practices.

The purpose of the nutrient modelling has been to determine:

- Current nutrient loss from farms, through the SPASMO model
- Potential nutrient loss from a likely change in land use through the SPASMO model
- The extent of current and potential nutrients reaching surface water as a result of farm land nutrient losses and the resulting effects on water quality, through the NIWA land use model, and on nutrient transformations and biomass growth, through the NIWA stream model.
- Mitigation options to avoid or minimise effect of land use on surface water through the OVERSEER model.

This report details the development and calibration by NIWA of a model of nutrient loss (the 'land use model') from the Ruataniwha Basin to the Waipawa and Tukituki rivers. The land use model predicts soluble nitrogen (N) and total phosphorus (P) losses, but does not predict particulate nitrogen losses. A conceptual model for nutrient, rather than a process-based model, is considered suitable for this project given its aims and the information available.

The land use model considers the spatial distribution of land use across an area of 80,500 ha, which includes 31,870 ha of land (Zones A, B, C and D – the irrigation command area) assessed as potentially suitable for irrigation[7] and an additional 45,800 ha (Zone X – the upstream area within the model area) which overlies the Ruataniwha aquifer and may undergo land use change to support farming enterprises in the irrigation area. The land use model predicts annual average N and P loads and yields in the Tukituki and Waipawa rivers near Waipukurau and Waipawa, taking account of groundwater travel times and nutrient attenuation.

Three scenarios of land use are modelled in detail: Scenarios A, B and C.

Scenario A represents current land uses and models the movement and attenuation of N and P estimated (from the SPASMO modelling process described in Appendix 1) to be lost from land via surface runoff and sub-surface groundwater pathways into surface water bodies. Scenario A is intended to provide a baseline scenario capturing current nutrient loadings to the catchment and the resulting aquatic plant growth, against which the impact of land intensification utilising water stored as part of the Ruataniwha Storage Scheme might be assessed.

The land use model was 'calibrated' for current land use by adjusting three key model coefficients – drainage, attenuation and groundwater travel time – to match observed stream nutrient loads in the Tukituki River at Waipukurau and the Waipawa River at Waipawa from 2004-2009. Model calibration and sensitivity analysis indicate that a similar goodness of fit can be obtained using several combinations of the key model coefficients. The choice of coefficients used for prediction is guided not just by goodness of fit, but also by other information from the Ruataniwha and similar studies elsewhere.

After calibration to measured N and P loads in the Tukituki River at Waipukurau, predicted annual yields in the Waipawa River at Waipawa match important features of observed 1994-2009 yields including average yield and year-to-year variations driven by climate. The land use model is considered to be sufficiently accurate to predict the likely impact of the proposed irrigation scheme on annual nutrient exports at the basin outlet.

The outputs of the land use model (expressed as nutrient yields downstream from the irrigation area) are used as inputs to the 'stream model' which predicts nutrient concentrations and aquatic plant biomass in the Tukituki River below the townships of Waipukurau and Waipawa.

For Scenario A, Macfarlane Rural Business Ltd provided farm production and management information to PFR for input into the SPASMO modelling. Macfarlane Rural Business Ltd assumed 'average' performance with farming practices and associated nutrient losses typical of current farms. If farms currently lose more nutrient than is calculated by SPASMO assuming 'average' performance, then the calibrated attenuation coefficients will be under-estimated. This means that for Scenarios B and C, predicted stream loads will be over-estimated, the actual nutrient concentrations and consequent effects on ecosystem 'health' are likely to be less significant than the predictions, and hence there is a 'margin of safety' in the modelling. If farms currently lose less nutrient than is predicted by SPASMO assuming 'average' performance, then the converse applies but this is not considered to be likely.

[7] The revised Macfarlane Rural Business Ltd report (currently in press) assumes an irrigable area of 22,500 ha. HBRC is considering some modifications to the area of land modelled. It is recommended that the land use model be re-run once the final irrigation area and area of influence have been resolved.

The second scenario (Scenario B) models modified land uses resulting from the availability of irrigation water from the Storage Scheme across the irrigation area. The nature and extent of modified land uses reflects advice from Macfarlane Rural Business Ltd as to what land use changes might realistically be expected on irrigated farmland (refer to Appendix 1). N and P losses from those modified land uses have been calculated by PFR using the SPASMO model. The purpose of Scenario B is to quantify the likely increase in nutrient losses to the Tukituki catchment resulting from land intensification associated with the Storage Scheme and the consequent effect on aquatic plant growth. For Scenario B Macfarlane Rural Business Ltd provided production and management information to PFR assuming that the 'top 20%' of farmers would be operating after the Storage Scheme is implemented (compared with 'average' performance assumed for Scenario A). Scenario B assumes that land use does not change in Zone X. In the irrigation area it assumes: fenced and destocked waterways, no fertiliser spread in waterways, nitrogen applied at a rate that can be taken up by pastures and crops, fertiliser applications made according to a nutrient budget, careful cultivation to minimise soil loss by erosion and to reduce the breakdown of organic matter, careful grazing management to minimise pugging and runoff, and irrigation management to maintain growth but minimise leaching.

Because the level of nutrients and aquatic plant growth in the Tukituki catchment below Waipukurau and Waipawa is affected by discharges from the municipal wastewater facilities servicing those communities, which are the subject of plans to reduce contaminant levels, the stream model for Scenario B has two sub-scenarios, one assuming continuation of those wastewater discharges and one assuming they reduce.

Using data supplied by PFR and AgResearch, the land use model indicates that, comparing Scenario B (irrigation and 'top 20%' performance) with Scenario A (current land use and 'average' performance):

- N losses from the model area increase from 2,440 to 3,060 t y^{-1} (25%).
- P losses from the model area increase from 67 to 80 t P y^{-1} (20%).

The model area encompasses Zones A-D and X but land use change is assumed to change only in Zones A-D. N and P loads leaving the Ruataniwha Basin increase by lower percentages than losses from the irrigation area because of dilution from upstream and attenuation.

- N loads leaving the Ruataniwha Basin increase from 1,320 t y^{-1} to 1,615 t y^{-1} (22%).
- P loads leaving the Ruataniwha Basin increase from 57 t y^{-1} to 63 y t^{-1} (10%).

In a separate analysis the implications of extending dairy and intensive arable by a further 5,450 ha and reducing sheep and beef extensive, orchard and vineyard by the corresponding area translated to an increase in total N losses of 101 t y^{-1} compared with Scenario B.

The third scenario (Scenario C) tests the potential benefits of reducing N losses from a selection of land uses under the irrigated Scenario B by adopting specific mitigation actions to reduce N losses. Intensive arable and process vegetable cultivation and dairying were chosen to be the subject of this scenario because they represent a significant proportion of the assumed land uses in the irrigation area under Scenario B, and because they produce relatively high levels of N losses. Macfarlane Rural Business Ltd has advised what on-farm mitigation options might realistically be employed (described in Appendix 3) which include the actions listed for Scenario B plus: application of nitrification inhibitors, reduction in nitrogen fertiliser use, reduction or removal of high nitrogen loss crops such as potatoes and squash, reduction in grazing time on pasture in order to reduce the number of urine patches, substitution of pasture with other feeds such as grain or silage, holding stock off pasture on feed pads to collect dung and urine for more even distribution, and reduced lactation periods to allow destocking by grazing off on support farms. AgResearch calculated, using the OVERSEER model, the effect of adopting a suite of mitigation practices on the level of nitrogen losses from the

intensive arable and dairy systems. A reduction of 16 kg ha-1 (for intensive arable/process vegetable cultivation) and 21 kg ha-1 (for dairying on light soils) was required to reduce the N leaching losses for both land uses to 30kgN/ha/yr. The methodology employed is described in more detail in Appendix 4. The purpose of Scenario C is to provide an initial indication of the sensitivity of the predicted effects of land intensification on water quality to an on-farm N leaching limit. Mitigation of N losses may, or may not, be required depending on the N guidelines adopted to protect downstream water quality and ecosystem 'health'. Comparing Scenario C (irrigation with N mitigation to an on-farm limit for two land uses) with Scenario B (irrigation and 'top 20%' performance), N mitigation measures reduce N losses by 9%.

Comparing Scenario C with Scenario A (current land use):

- N losses from the model area increase from 2,440 to 2,780 t y-1 (14%).
- N loads leaving the Ruataniwha Basin increase from 1,320 t y-1 to 1,480 t y-1 (12%).

Again, the model area encompasses Zones A-D and X but land use change only occurs in Zones A-D.

If we assume 10, 20 or 50% (extreme) of the extensive sheep and beef operations (22,018ha) in Zone X (45,802ha) shift enterprises to include wintering dairy cows and contract heifer grazing, the increase in total N losses in Zone X would amount to 1.04, 2.1 and 5.2 t y^{-1}, respectively, This is a small increase in N loss from the zone and an insignificant amount compared with the N loads leaving the Ruataniwha Basin. The corresponding increases in total P losses in Zone X, again assuming 10, 20 or 50% (extreme) of the extensive sheep and beef operations in Zone X shift enterprises to include wintering dairy cows and contract heifer grazing, would amount to 23, 46 and 116 kg P y^{-1}, respectively. These increases are again very small.

Work is on-going to refine the assessments reported here, and further scenarios will be modelled to assess the effects on nutrient losses and consequential downstream effects of: mitigating both N and P losses, a wider range of modified land uses and changing the mix of land uses modelled.

An existing mechanistic model of stream nutrient dynamics and aquatic plant growth (the 'stream model') is applied in the lower Tukituki River between Waipukurau and the sea. The model is used to assess the effect of the Storage Scheme and Waste Water Treatment Plant (WWTP) discharges in the lower Tukituki River downstream from the townships of Waipukurau and Waipawa. It is also used to estimate the effects of the Storage Scheme on nitrate concentrations to enable an assessment of the risks to stream ecosystem 'health' posed by nitrate toxicity once revised nitrate toxicity guidelines become available. The majority of reported problems with high periphyton biomass occur in the lower Tukituki River downstream from the townships of Waipukurau and Waipawa, although there may be some 'hot spots' in streams within the Ruataniwha Basin, where high nitrate concentrations and/or high plant biomass occur.

Daily nutrient concentrations are estimated from annual yields using the available monitoring data, to provide input data for the stream model. The estimated daily concentrations match the observed variations of concentration with flow and time, and furnish estimates of annual nutrient yield that compare favourably with published estimates.

Predicted nutrient concentrations account for the reduced dilution of nutrient losses arising from likely flow changes. Scenarios B and C make the 'worst case' assumption that surface and groundwater abstractions continue at current levels after irrigation starts. Data supplied by HBRC indicate that the irrigation scheme will decrease average river flows, notably in the Waipawa River, although it will increase summer low flows.

A possible guideline, derived from a review of (mostly overseas) published nitrate toxicity studies is 1.7 g NO3N m^{-3} quoted as providing protection for 95% of species. The percentage of days when this guideline is exceeded in the Tukituki River at Waipukurau increases from 18% (Scenario A) to 36%

(Scenario B) and 29% (Scenario C). Work has recently been completed by NIWA to measure the susceptibility to nitrate of two keystone New Zealand freshwater organisms (one fish species (Galaxias maculatus (inanga)) and one mayfly Deleatidium sp.). That work, and other recent nitrate toxicity data, have not yet been incorporated into existing guidelines. There are indications, however, that the 1.7 g NO3N m^{-3} guideline may be conservative for the organisms tested and that a higher guideline may be acceptable, but this awaits confirmation.

The wastewater treatment plants (WWTP) at Waipukurau and Waipawa townships discharge large amounts of P compared to losses from the Ruataniwha Plain. In this report both land disposal and phosphorus stripping are modelled, as well as irrigation. The stream model predicts that there are likely to be significant beneficial effects, in terms of reduced DRP concentrations, reduced periphyton biomass and associated improvements in ecosystem 'health', from reducing P inputs from the WWTP discharges at Waipukurau and Waipawa.

Irrigation (Scenarios B and C) leads to higher peak biomasses than for current land use (Scenario A) in the vicinity of Waipukurau. If P inputs from the WWTPs are reduced as planned, then the highest biomass is predicted to occur at the top of the modelled reach (viz., in the vicinity of Waipukurau). Whereas the 10%ile biomass (viz., the biomass that is only exceeded 10% of the time) at SH2 currently averages 49 gC m^{-2}, this is predicted to increase to 57 gC m^{-2} with irrigation because of increased P inputs. These simulations do not consider possible P loss mitigation measures which are currently being investigated.

There is uncertainty in model predictions of periphyton biomass arising from high variability in observed biomass used for calibration. In addition, spatial variability in bed stability, water depth and water velocity affect predicted periphyton biomass. There is also uncertainty arising from the omission of particulate N losses from the irrigation area. Consequently, the longitudinal profiles of predicted biomass presented here may not be quantitatively accurate. Nevertheless, they provide strong qualitative indications of the likely magnitude of change.

Further work is currently being undertaken to extend the model upstream from Waipukurau and Waipawa in order to assess the impact of irrigation and land use intensification within the Ruataniwha Plain, notably where groundwater upwelling occurs and 'hot spots' of N and P occur. This work will include modelling the effects of land use change outside the irrigation area, including land in the lower Tukituki River.

3.5 ECOLOGICAL EFFECTS ASSESSMENTS

3.5.1 Terrestrial Ecology

The Terrestrial Ecology Study is part of the wider Technical Feasibility and other scientific assessment studies that will provide the information for the resource consenting process for the proposed Ruataniwha Water Storage Project in Central Hawke's Bay if the project is deemed feasible. Kessels & Associates have been engaged by Hawke's Bay Regional Council to conduct an ecological impact assessment and make recommendations regarding measures to avoid, mitigate or offset potential adverse effects on indigenous terrestrial fauna and flora species and their habitats.

Potential Ecological Effects

The potential ecological effects of the construction and operation of the Ruataniwha Water Storage Project on terrestrial indigenous fauna and flora are:

- A permanent loss of a variety of indigenous vegetation communities and braided river within the inundation, dam and spillway footprint area;
- A permanent loss of a variety of feeding, roosting and breeding habitats (both exotic and indigenous) for birds, lizards, bats and invertebrates;

- Alteration of habitats for indigenous flora and fauna within and adjacent to braided river ecosystems downstream of the dam and intake structure associated with changes in sediment deposition rates, river flow patterns and changes in landuse; and
- A change of habitat types on the margins of the reservoir due to changes in hydrology and effects of seasonal and irrigation drawdown causing inundation and ebbing of the 'lake' edge; and
- Disturbance of remaining indigenous flora and fauna adjacent to the reservoir due to potential increases in the recreational use of the reservoir and its margins.

Assessments Undertaken

Field assessments have been undertaken over the period of September 2011 to February 2012 within, and over areas potentially affected by, the proposed Ruataniwha Water Storage Project. In addition, literature searches, data analysis, GIS mapping analysis and ecological significance determination have also been undertaken during this period. Specifically, the investigations have focussed on:

- Field Investigations to ground truth and refine vegetation maps and to assess whether any at risk or threatened plants are in the affected areas;
- Avifauna surveys to determine relative abundance of common indigenous and native birds and to assess whether any at risk and/or threatened birds utilise the affected areas;
- Field investigations to confirm the level of importance of affected habitat for long-tailed bats;
- Field investigations to confirm the importance of affected habitat for lizards, in particular to identify the presence or absence of at risk and threatened species;
- Field investigations to confirm the importance of affected habitat for invertebrates, in particular to identify the presence or absence of at risk or threatened species;
- An examination of the impact of habitat loss on functional landscape ecology values;
- Potential effects of river morphology changes on terrestrial linked ecosystem values; and
- Recommendations for appropriate measures to avoid, remedy, mitigate, or offset for any potential adverse effects identified.

Results of the Assessment

- The total area affected by flooding, the dam structure and spoil disposal is approximately 450.21 ha. A third of this area (i.e. 38.7% or 174.24 ha) is covered in pasture or rank grasses, with the area classified as indigenous vegetation or habitats covering 242.4 ha[8] (53.8%). The total area of terrestrial indigenous vegetation cover (which excludes wetlands, seepzones and gravel riverbed) is 163.23 ha (36%), in comparison to 204.90 ha (45%) of exotic vegetation cover (i.e. pasture and exotic forest and scrub). One At Risk plant species was found – red mistletoe.
- A total of 37 bird species (11 endemic) were identified at the proposed reservoir locality during field surveys. Of these birds 55% were native and 45% introduced. Threatened or At Risk species comprise 2.3% of all observations, including one pair of the Nationally Vulnerable New Zealand bush falcon, which was most likely nesting in the site during spring. Nationally 'At Risk' species detected were pied stilt, New Zealand pipit, black shag and North Island fernbird.

[8] NB: Includes all indigenous woody vegetation, wetland and seeps, as well as braided river and open stream channel

- Long-tailed bats were found throughout the proposed reservoir during an ultrasonic survey completed between November 2011 and February 2012. Simultaneous surveys of the inundation area and wider landscape showed that it is likely that bats are resident and roosting within the inundation area, and then move out into the wider landscape throughout the night. Activity levels are higher within the inundation zone when compared to the wider landscape demonstrating the importance of this habitat for the bats.
- Eleven lizard species are known from the southern Hawke's Bay region or neighbouring areas of the southern North Island. However, only one lizard was found during the field survey. This was a southern North Island forest gecko. It is not classified as being a nationally At Risk or Threatened species.
- Targeted rapid surveys for terrestrial invertebrates were undertaken within the proposed reservoir site in December 2011 and again in January 2012. In addition, passive detection devices have been deployed and checked throughout the site from November 2011 until February 2012. Results showed a rich diversity of insects and land snails. However, to date, no terrestrial invertebrates listed as rare, or threatened have been discovered.
- A total of 182.52 ha of ecologically significant indigenous vegetation and habitats would be flooded by the proposed reservoir. This comprises of: 80.72 ha of mature and secondary indigenous forest; 22.71 ha of secondary indigenous scrub; 73.97 ha of gravel river bed; and 5.11 ha of wetland or seepzones.

Suggested Approach for the Effects Identified

A number of measures are required to avoid or remedy potential adverse effects on terrestrial ecology. These include:

- ***A two year pre-construction bat survey to determine the size of the resident bat population; its roosting sites and movement patterns across the landscape;***
- ***A bat management plan pending the results of the two year survey;***
- ***A pre-construction lizard survey and translocation plan;***
- ***A weed hygiene and surveillance plan; and***
- ***Post-construction monitoring of key wader bird species within affected braided river habitat and contingency habitat enhancement if adverse effects are shown to occur.***

In addition to measures to avoid, remedy or directly mitigate for potentially affected flora and fauna, three broad biodiversity restoration and enhancement packages are recommended. These are:

A: <u>Ruataniwha Reservoir Restoration Buffer and Catchment Enhancement Zone</u>

The objectives of this package are to:

- ***Recreate 46 ha of riparian margin with indigenous vegetation, which will provide habitats and ecological linkages for a wide range of fauna and flora.***
- ***Restore and enhance at least 100 ha of marginal farmland and existing forest, scrub, treeland, shrubland and wetland remnants within the sub-catchment above the dam to quickly improve existing habitat for flora and fauna, reinforce ecological linkages within the landscape and provide refuge for species during and after the flooding process.***

B: <u>Ruataniwha Riparian Enhancement Zone</u>

The objectives for this package are to:

- ***Control of willows/lupins and other braided river weeds to maintain and enhance habitat for wading birds, particularly banded dotterel, within the Waipawa and Makaroro Rivers. This may also include fencing and restoring margins of the main stems of the two rivers where required, in consultation with adjoining landowners. The primary target area for these works would be high quality wading bird habitat.***
- ***Carry out ongoing animal pest control over the 616 ha of existing bush, scrub and wetland habitats within the zone, targeting possums and rats.***
- ***Assist landowners with fencing, replanting (as required) and legally protecting existing areas of wetlands, bush and scrub within or contiguous with the 1 km enhancement zone.***

C: <u>Ruataniwha Threatened Species Habitat Enhancement</u>:

Its objectives are to:

- ***Instigate measures to enhance habitat for key threatened species, such as falcon and blue duck.***
- ***Implement a targeted assistance programme to foster research, advocacy and habitat protection/enhancement of bats and their habitats throughout the Hawke's Bay Region.***

The mitigation recommendations contained within the report have been integrated into a separate report entitled "Ruataniwha Water Storage Project – Proposed Integrated Mitigation and Offset Approach", which should be read in conjunction with the report.

3.5.2 Aquatic Ecology

This assessment of aquatic ecological effects of the proposed Ruataniwha Water Storage Project (RWSP) informs a wider assessment of environmental effects that will be lodged as part of a resource consent application process, if the Hawke's Bay Regional Council (HBRC) decides to proceed with the project. HBRC engaged the Cawthron Institute to review the Tukituki catchment's aquatic values, summarise the state of the existing environment, provide an assessment of effects on aquatic ecology as a result of the RWSP, and identify mitigation and monitoring options.

Current Values

Values that apply to the whole of the Tukituki Catchment include: life supporting capacity, mauri, contact recreation, water use (quality and economic), and fish passage.

Values that may vary across the catchment include: natural state, wetlands, riverine bird habitat, inanga spawning, native fish habitat, trout spawning and habitat and contact recreation (amenity).

Potential Project Effects

The key potential effects of the construction and operation of the RWSP on aquatic ecology and associated values are:

- Disturbance of the riverbed during construction and associated mobilisation of sediment that could influence water clarity and have effects on periphyton, invertebrates and fish (both native and introduced species)
- Effects of changes in bed geomorphology downstream of the dam on periphyton, invertebrates and fish
- Effects on water quality associated with water storage within the proposed reservoir
- Blockage/interruption of upstream and downstream fish passage by the dam
- Permanent loss of riverine habitat resulting from inundation by the proposed reservoir
- Reductions in the quantity and quality of spawning habitat for rainbow trout
- Changes to angling opportunities
- Changes in water quality associated with changes in the flow regime downstream of the dam
- Changes in periphyton abundance and distribution as a result of changes in the flow regime
- Effects of changes in the flow regime downstream of the dam (including short-term fluctuating flows associated with changes in irrigation demand and hydro-peaking) on habitat availability for invertebrates and fish
- Effects of flow changes on fish stranding
- Diversion of fish into the water distribution network at the irrigation intake
- Instream and riparian habitat disturbance associated with changes in land use on the Ruataniwha Plain associated with the RWSP
- Changes in water quality and effects on periphyton, invertebrates and fish associated with changes in land use.

Assessments Undertaken

A combination of existing data, models, interviews, field studies and literature reviews were used to identify the key values associated with the Tukituki catchment and the state of the existing environment. Similarly, Cawthron's assessment of effects of the RWSP was conducted using the

information gathered on the state of the existing environment, modelling of how water quality and instream habitat are affected by changes to the flow regime, and guidelines/knowledge associated with sediment effects, periphyton, invertebrate and fish habitat requirements. Concurrent work on water quality in the reservoir (*Gibbs et al. 2012*), predicted changes to the flow regime (*Tonkin & Taylor 2012; Waldron & Baalousha 2012*), predicted changes to sediment transport and geomorphology (*Tonkin & Taylor 2011*), surveys of trout spawning and juvenile trout density (*Maclean 2011; 2012*), predicted effects of land use on water quality and periphyton (*Rutherford 2012*) and new information on nitrate toxicity thresholds (Chris Hickey, NIWA, report in preparation) have been incorporated into Cawthron's assessments.

Results of Assessments

- Effects of construction on water quality are predicted to reduce rapidly once the working site is adequately stabilised. However, deposition of mobilised sediment downstream of the proposed dam site may have longer term effects that take 6-months to one year for full recovery. The effects will be most marked close to the proposed dam site and have less influence downstream of the Waipawa and Tukituki confluences.
- The reduction in bed aggradation, due to sediment retention in the proposed dam, is likely to result in a reduction of gravel removal from the channel, and associated reduction in habitat disturbance. This is likely to have a net benefit to the aquatic ecosystem. The coarsening of the bed substrate is also likely to have a net benefit for many species of native fish which prefer coarse substrates. However, bed coarsening and armouring will potentially increase the suitability of habitat for nuisance periphyton growth and reduce the availability of suitable spawning gravels for rainbow trout downstream of the dam.
- Modelling (*Gibbs et al. 2012*) predicts that changes in water quality associated with storage of water within the reservoir are expected to be relatively minor. ***Water quality will be continuously monitored and an aerator is recommended to be installed near the upstream face of the dam to manage any unforeseen changes in water quality.*** Problems with levels of dissolved oxygen, nutrients and sediment released downstream from the reservoir are not expected.
- Movement of fish, both upstream and downstream, past the dam will be affected by the presence of the dam. The seven migratory native fish species currently present in the vicinity of the dam are unlikely to sustain self-supporting populations above the dam. Consequently, these species would be lost from the fish community above the dam over time, unless fish passage is provided. While the loss of the seven migratory species within the Makaroro River upstream of the proposed dam would restrict the geographic range of these species within the wider Tukituki catchment, the loss of the upper Makaroro River populations of these species is not expected to result in a significant increase to the threat of extinction of these species from elsewhere in the catchment. Nevertheless habitat loss for any indigenous or valued species is not desirable, so we recommend that fish passage be provided.
- The creation of a 372 ha reservoir will result in a loss of approximately 7 km of flowing water habitats. Some of the native fish species currently found in the river habitat are also commonly found in still water habitats and will be able to use the newly formed lake-like habitat of the reservoir. However, other species (e.g. torrentfish, bluegill bully, redfin bully, Cran's bully, and dwarf galaxias) are unlikely to use the still-water habitat in the reservoir, and for these species the inundation of streams in this area will represent a loss of habitat. Many of the invertebrate species found in the Makaroro River are also unlikely to use the still water habitat in the reservoir, although invertebrates that prefer still waters will replace them to some extent and provide food for fish living in the reservoir.
- A trout population of between 1000-2000 adult fish is likely to develop in the reservoir and support a full season fishery for small rainbow trout, rather than the current early and late

season fishery for post- or pre-spawning rainbow trout of average size. Juvenile trout production from these adult trout may be enhanced compared with the status quo as a result of the reservoir. It is very likely that some of these juvenile trout will successfully pass downstream through the turbines or over the spillway and make a substantial contribution to the fishery in the Waipawa and Tukituki rivers. The benefits to be derived from the juvenile trout that will pass downstream are difficult to quantify precisely and hence so are the overall effects on the trout fishery of the inundation and loss of spawning habitat associated with the reservoir and the blockage of the spawning migration from downstream caused by the dam.

- The proposed project will result in substantial changes to the flow regime downstream of the dam. In the reach between the dam and the irrigation intake there will be higher flows in the summer irrigation period and lower flows in late autumn and winter. Flood frequency will be reduced particularly during late autumn and winter when floods will be captured within the refilling reservoir. Downstream of the irrigation intake, there will be a general reduction in median flows throughout the year as a result of the project, but an increase in the lowest flows. The changes in flow are most significant in the Makaroro and Waipawa rivers. Downstream in the Tukituki River, the changes in the flow regime are smaller because flow inputs from the upper Tukituki River and other tributaries are largely unaffected by the project.
- Increases to low flows are predicted to occur when the scheme is in operation, particularly if current surface and ground water abstractions are 'migrated' to the Scheme water (*Waldron and Baalousha, 2012*).
- At times, the water temperatures within the Tukituki catchment currently approach levels that will begin to stress sensitive aquatic life. The RWSP will result in higher summer flows and cooler summer water temperatures between the dam and the irrigation intake because of the flow releases of cool water sourced from the dam. Therefore, this is expected to be a net benefit to the river ecosystem in these reaches. Downstream of the irrigation intake, there will be a decrease in median flows, but higher minimum flows than occurs under the status quo. Any effects of changes to the flow regime itself on water temperature will be at most, minor (predictions of no change to mean temperature and <0.5°C increase in maximum temperature).
- The change in the flow regime in the Makaroro River will provide better hydraulic conditions for the growth of undesirable long and short filamentous algae on the river bed, but reduce habitat suitability for desirable diatoms. This is considered to be a net negative effect on the river ecosystem, but periphyton growth is not expected to be problematic in this reach because nutrient concentrations are relatively low. Further downstream and below the irrigation intake, the changes in flow regime on habitat suitability for different components of the periphyton community are mixed, with increases in suitability in some months and decreases or no change in other months.
- The frequency of flows large enough to flush periphyton from the river bed is more important in controlling periphyton biomass than general hydraulic suitability for periphyton. The frequency of flows capable of flushing periphyton will be reduced, particularly during the irrigation season and during late autumn/winter when the reservoir will be refilling. However, the project design has incorporated the capacity for four flushing flows to be released from the dam per year to remove nuisance accumulations of periphyton. These flushing flows will be most effective in the Makaroro and Waipawa rivers downstream of the dam, but could also be effective in the Tukituki River if the flow releases are timed to coincide with natural freshes from the upper Waipawa and Upper Tukituki rivers. Therefore, nuisance periphyton accumulations will be able to be managed to a large extent using these flushing flows.

- The broad-scale changes to the flow regime will result in both gains and losses in habitat suitability for invertebrate species. While there will be changes to the composition of invertebrate communities in the Makaroro as a result of changes to the flow regime, the predicted habitat losses will not affect the viability of populations below the dam down into the Tukituki system. The largest effect of the proposed flow regime on the invertebrate community relates to the regular short-term fluctuations in flow that result from changes in irrigation demand during the summer and from hydro-peaking during winter. These flow fluctuations will have negative effects on habitat suitability for species with limited mobility. Margins of the channel that are suitable at the high end of the flow fluctuation cycle will dry out or become too shallow during the low flow part of the fluctuating cycle, while areas in mid-channel that are suitable at the low end of the fluctuating cycle may become too fast at the high end of the cycle. These flow fluctuations are predicted to result in a 50% reduction in habitat availability for invertebrates (and up to a 100% reduction i.e. complete removal in habitat availability for rainbow trout spawning) in the Makaroro and Waipawa rivers downstream of the proposed dam. The effects in the Tukituki River will be much lower due to flow contributions from other parts of the catchment making the relative change in flow smaller, and downstream attenuation of the flow fluctuations themselves. It should be noted however, that these predictions do not take into account the effects of natural flow fluctuations and therefore are probably an overestimate.
- The degree to which fish abundance and/or growth rate may be affected by this reduction in invertebrate habitat is uncertain, because it depends on whether fish are currently food limited. But given that the predicted reduction in invertebrate habitat is potentially large (around 50% for Deleatidium which represents a riverine trout's main food source), this may have some adverse effect on food intake by fish - with a consequent adverse effect on growth rates and/or survival.
- Fluctuations in flow that result from changes in irrigation demand during the summer and from hydro-peaking during winter may result in relatively fast declines in flow within the Makaroro River at times, potentially resulting in fish strandings. However, the shape of the Makaroro River channel means that there will be limited areas where isolated pools are likely to be formed by rapid dewatering. Therefore, the effects of flow reductions on fish stranding in this reach are expected to be minor.
- The main potential effect of the irrigation intake structure is the potential entrainment of fish into the canal system. A rockfill infiltration bund is currently proposed to act as a fish screen at the proposed intake. The efficacy of this bund as a screen will be dependent on the size of the packing fill used to construct the bund because the fill needs to emulate 3 mm mesh openings in a metal screen. Tonkin & Taylor Ltd have confirmed that the packing fill will meet this intent and therefore the effects on fish entrainment should be largely avoided.
- Possible future land use changes may mean that there will be more heavy animals (i.e. cattle rather than sheep) and higher stocking rates on the Ruataniwha Plains. These changes to stock type and stocking rate have the potential to increase the amount of physical damage to instream habitat and the riparian margins of streams flowing through the irrigated areas if stock are not excluded from waterways. ***It is recommended that riparian protection works be an integral part of the overall project design.***
- Modelling of a future land use scenario for the Ruataniwha Plains with good practice farm management predicts that annual average nitrogen concentrations will increase by 24% and annual average phosphorus concentrations will increase by 7% in both the Waipawa at SH2 and Tukituki at SH2. The increase in phosphorus concentration is predicted to result in faster periphyton growth and higher peak biomasses of periphyton in the lower Waipawa and Tukituki rivers. Periphyton biomass currently exceeds guidelines for the protection of

biodiversity and trout fisheries on a relatively regular basis, so the adverse effects of periphyton proliferation on invertebrates and fish are already occurring.

- Prior to construction of the RWSP, the discharges of sewage from Waipukurau and Waipawa will be significantly reduced as part of their consent conditions. This diversion of phosphorus load to the river will reduce periphyton growth rates and peak biomasses. For example, periphyton biomass in the Tukituki River at Walker Road is currently predicted to exceed relevant guidelines for 32% of the time. The reduction in phosphorus inputs from the sewage discharges is predicted to result in guidelines being exceeded for only 10% of the time assuming current land use, and for only 20% of the time assuming the future land use scenario. Therefore, even with land use change associated with the RWSP, periphyton blooms are predicted to be less common than they are now as a result of the reduction in contaminants from the sewage discharges.
- The frequency of flushing flows is also a primary factor controlling the proportion of time when periphyton biomass exceeds the relevant guidelines. This again demonstrates the need for the flushing flows that are planned to be released from the dam each year to reduce nuisance accumulations of periphyton to below guideline levels.
- High concentrations of nitrate nitrogen can be toxic to aquatic life affecting growth rates, development and, at extremely high concentrations, mortality. Due to the substantial contribution of nitrate-rich groundwater to river flows at the outlet of the Ruataniwha Basin, concentrations of nitrate in the Tukituki River are at their highest at this point. Under the future land use scenario, mean annual nitrate nitrogen concentrations are predicted to increase from 1.24 to 1.54 mg/L at the Tukituki at SH2 and from 0.65 to 0.81 mg/L at the Waipawa at SH2. These concentrations all meet the 95% species protection guideline (1.7 mg/L) that is likely to be proposed for the Tukituki Plan Change, indicating that nitrate toxicity is unlikely to adversely affect aquatic organisms downstream of these points.
- Winter peaks and summer lows in nitrate nitrogen concentration are observed in the Tukituki catchment. Therefore, the risk of seasonal peaks in nitrate concentration also needs to be assessed. Statistical distributions of nitrate concentration at the outlet of the Ruataniwha Plain shows that seasonal peak concentrations (95th percentiles) are around 2.4 mg/L and are predicted to increase to 3.0 mg/L under the future land use scenario. Again these seasonal high concentrations are below the 95% protection threshold effect concentration guideline (3.2 mg/L) that is likely to be proposed in the Tukituki Plan Change for managing nitrate toxicity risk of seasonal concentration peaks, providing further assurance that nitrate toxicity is unlikely to adversely affect aquatic organisms.
- The only residual issue regarding nitrate toxicity is in spring-fed systems at the base of the Ruataniwha Plains where nitrate-rich ground water may comprise all of the base flow. There is currently little information on nitrate concentrations in these systems and the model predicting the effects of land use change does not cover these areas of the catchment. Further monitoring and modelling of nitrate concentrations in a range of rain-fed and groundwater-fed streams surrounding the Ruataniwha Plain is planned for winter 2012 to determine the scope of this issue.

Suggested Approach for Effects Identified

A number of initiatives are recommended to mitigate potential adverse effects of the RWSP on aquatic ecology. These include:

- ***A trap and transfer programme that will enable migratory native fish to access habitat upstream of the proposed dam***
- ***Pre and post-construction monitoring of the age-structure of the eel population upstream of the dam to ensure that the trap and transfer programme is enabling successful***

recruitment.

- ***Post construction monitoring of the efficacy of the rockfill infiltration bund as a fish screen.***

We recommend that these initiatives could be implemented alongside three broad restoration and enhancement packages. These include:

- ***<u>Ruataniwha Reservoir Restoration Buffer and Catchment Enhancement Zone:</u>***

  This is as proposed in the terrestrial ecology effects assessment. In terms of aquatic ecology the key objectives of this initiative would be to protect and enhance the aquatic habitat within the upper Makaroro River above the dam and other reservoir tributaries such as Dutch Creek. This would also help to limit inputs of nutrients and sediment to the proposed reservoir and maintain reservoir water quality, although this effect would be minor.

- ***<u>Ruataniwha Riparian Enhancement Zone:</u>***

  Again, this is as proposed in the terrestrial ecology effects assessment. The focus of this initiative should be on protection of riparian habitats alongside the Makaroro and Waipawa rivers that are affected by flow fluctuations resulting from the project.

- ***<u>Ruataniwha Plains Spring-fed stream Enhancement and Phosphorus Mitigation:</u>***

  The changes in land use associated with the RWSP will have to be managed carefully. The objectives for this initiative are to protect and enhance the spring-fed streams and other waterways that drain the lower Ruataniwha Plains (e.g. tributaries of the lower Mangaonuku, Kahahakuri, Waipawamate, Black Stream, Maharakeke, Tukipo and presumably many unnamed ones). These streams provide good habitat for eels and some other native fish species and also appear to be important locations for spawning and juvenile trout rearing. The package would involve support for landowners with fencing, replanting and ongoing riparian maintenance and legal protection and fencing of any existing wetlands. A focus will be on ensuring that stock are permanently excluded from waterways and sediment/phosphorus inputs are restricted.

Provided that all these mitigation initiatives are in place, the RWSP will have relatively minor effects on the aquatic ecosystem and the Tukituki will continue to support the current wide range of values.

3.6 CULTURAL EFFECTS ASSESSMENT[9]

3.6.1 Tamatea CIA Reports

Over the last few years, the HBRC has undertaken a pre-feasibility and feasibility study to investigate potential dam sites within the Ruataniwha region. The initial CIA report was commissioned in 2010 to investigate eight potential dam sites (*Wakefield et al, 2010*). The supplementary report was commissioned in 2011, which narrowed the focus to two potential dam sites on the Makaretu and Mākāroro Rivers (*Wakefield et al, 2011*). The CIA reports identified registered and unregistered wāhi tapu and other cultural values likely to be adversely affected by the location of the proposed sites. Another focus of the reports was to assess any cumulative effects on the health state of the Tukituki River catchment in terms of tangata whenua relationship to cultural values, mauri, water quality, indigenous biodiversity, and other concerns within the Tukituki catchment. These two CIA reports focused primarily on the views of mana whenua within the central Hawke's Bay region associated with Te Taiwhenua O Tamatea. The HBRC Māori standing committee representatives strongly advocated for the involvement of marae and hapū from the lower Tukituki River catchment. This resulted in a CIA report commissioned by the HBRC to be undertaken by Te Taiwhenua O Heretaunga and was completed in 2012 (*Te Apatu & Moffat, 2012*). There was a single focus on the proposed dam site on the Mākāroro River.

The first CIA report identified several cultural values of importance to mana whenua and has formed the foundation for the cultural values framework constructed for this report on the Tukituki River catchment cultural values and uses change plan. These cultural values were applied to the supplementary and third CIA report completed. There was a broad description of tangata whenua cultural values and their relationship to the Tukituki catchment and included: Te Ao Māori world views; Papatūānuku earth mother; Kaitiakitanga responsibilities; the elements of nature; ki uta ki tai - Ruahine ranges: headwaters, Ruataniwha plains and the lowlands of the Tukituki river mouth; Taonga Tuku Iho of ngā wai and the biodiversity values and mahinga kai resources within the Ruataniwha plains of importance to tangata whenua.

Tangata whenua were asked their views on potential effects of cultural values, potential benefits and costs and finally, their socio-economic aspirations for marae and hapū and the findings are briefly outlined below:

First CIA Report

The relationship of cultural values to water flow regime and water quality focussed on the headwaters as the source of mauri, waipuna/ springs/ aquifer and the effects of land use intensification activities, Riparian areas, mahinga kai/ biodiversity and indigenous species, river mouth environment and the role of Kaitiakitanga.

There are no known wāhi tapu sites registered or unregistered specifically located within any of the eight proposed water storage site. However, sites A1, A2 and D3 are included in the Waitangi Tribunal claims under He Toa Takitini claimant group and the HBRC needed to continue consulting with the Group.

Potential issues associated with the proposed Tukituki water storage dams outlined particular concerns with water flow management and water allocation, water quality, land use activities and effects on water quality and water bed and river margins.

The findings from the first CIA study indicated that marae and hapū were cautious and uncertain on what the potential benefits might be for Māori. There was a significant issue with the lack of

[9] From Section 5.2 of *Wakefield et al, 2012* which includes and summarises three separate Cultural Impact Assessment (CIA) reports prepared by Te Taiwhenua O Tamatea and Te Taiwhenua O Heretaunga.

consultation that did not occur with marae/hapū during the pre-feasibility study. Most of the recommendations made from Tangata whenua were focused around the HBRC consulting directly to follow-up on this CIA study and to discuss how the council would address the issues and concerns highlighted in the report.

Supplementary CIA Report

The findings from the supplementary CIA report revealed there was some support in principle for the proposed dam sites on the Makaretu and the Mākāroro. Mataweka and Tapairu marae reinforced their position stated in the first CIA report concerning sites A1 on the Mākāroro in that they are were not very supportive of this site located in an area that is pristine, was where taonga species like tuna spawn, and still had remnants of precious native bush.

The change from smaller dams to one large dam proposed on the Mākāroro raised concerns on any potential break in the dam which was likely to directly flood out the Waipawa district in particular. Their preference is for smaller dams and would like to discuss this more directly with the HBRC. There are concerns for the cumulative health effects from pollution, water quality, flows and over allocation of water which needed to be mitigated.

There were unregistered wāhi tapu/ wāhi taonga which would require more discussion with tangata whenua directly to ensure these sites were protected in the assessment process of the feasibility study. There was also a need for more discussion on potential social and economic benefits for tangata whenua. With Waitangi Treaty claim negotiations still to be settled, this was likely to highlight wider issues concerning co-management of the waterways within the Ruataniwha region.

3.6.2 Lower Tukituki (Heretaunga) CIA Report

Within the CIA report, there is a comprehensive overview of the historical and contemporary issues raised for Heretaunga marae/hapū. Although these issues are related to the proposed dam on the Mākāroro, they are also relevant to how mana whenua cultural values relate to the whole of the Tukituki River catchment. The executive summary of the CIA is reproduced below and provides a deeper insight and understanding of their cultural values as they apply to the Tukituki River.

> *Ko Heretaunga Haukunui, Ararau, Haaro te Kaahu, Takoto Noa*
>
> *Heretaunga - of the life-giving dew, of the hundred pathways, the vision of the far-sighted hawk, left to us, the humble servants.*

"Ko Heretaunga Haukunui, Ararau, Haaro te Kaahu, Takoto Noa" is a centuries old tribal whakataukī (proverb), that is as relevant today as it was when it was first uttered. It has many layers from which to identify and describe the tangata whenua (people of the land), acknowledging Maori and their spiritual connection and birthplace of Heretaunga, the environment, and their relationship to each other, and as such is the framework upon which this report is based.

It is a statement of mana whenua (authority, possession and spiritual connection to certain land), and that in turn is the foundation that says ngā hapū o Heretaunga (clans of the Heretaunga region), are entitled to be equal partners at all levels of engagement, to be decision-makers for the future, and to have guardianship of the whenua (land) and awa (waters), which cannot be broken.

While appreciating the differences between the lower and upper Tukituki catchments, the hapū residing in the lower Tukituki area do not separate the awa, and have cultural links right from the headwaters to the river mouth.

Environmentally, tangata whenua see an awa as a whole entity whose parts are interdependent and the health or well-being of any tributary, flora, fauna, birds, fish, or insect will be affected by the health of the awa, and vice versa; and so too the well-being of the people.

Marae/ hapū (common village, clan or social order) feel very much a part of the river and see it as their right, as tāngata whenua, to be involved in its life. It is their duty as kaitiaki (guardians) to be involved in protecting its mauri (life force, essence), and "Hurumanu" (with a bird's-eye view) reminds us that there must be an active role and participation in doing so. The questions arise, "*Will this be possible*?" "*How*?"

Many of the issues raised in this report are related to protecting the mauri of the river and its environs, habitats and ecosystems. There have already been losses from a hugely modified river, and it is of concern that further modification will render mahinga kai (traditional food gathering sources or places), livelihoods, traditional practices, and recreation very much reduced, or even non-existent - not only for marae/ hapū, but for other local communities, interest groups, and the majority of whānau and families of the region.

Hapū wish to be involved at all levels of the process to ensure that the Māori world view is represented, that they can fulfil their obligation as kaitiaki and that they are not marginalised or excluded from prosperity. It is vital that they do not continue to suffer disconnection from their awa as has happened in the past.

Whakapapa (Genealogy)

In December 1992, Ngāti Kahungunu produced the document, "Kaitiakitanga mo ngā Taonga Tuku Iho" as an introduction to Ngāti Kahungunu ethics for sustainable resource management. It was mooted as the forerunner to further development by hapū and was adopted by Councils as a basis for discussion prior to preparation of policies and plans. In explaining the Ngāti Kahungunu perspective, the document states, "That our Māori forebears were willing to 'share' the natural and physical resource is a fact – they never intended to give away or cede tino rangatiratanga (self-determination) or kaitiakitanga (intergenerational guardianship – inherited responsibilities) in the process. An invitation to share a meal is not a license to take the whole harvest."

Ownership issues and loss, early and on-going modification, pollution, and loss of access to traditional Mahinga kai, as well as marginalisation of Māori in the development of the structure and economy of the Hawke's Bay Region, has been the basis of protest and grievance over time, but the close identification of Māori with their ancestral waterways has never waned.

Wai-Awa (Wai – Water, Awa - River)

The importance of water today is reaching epic proportions globally, and this is no less so in Hawke's Bay. It is a precious resource, a taonga (treasures, highly prized) that underpins Māori well-being and economy. Water is the basis of life without which nothing would exist.

From a Māori perspective, waterways are the life-blood of the whenua and therefore, themselves. This is irrefutable.

Mauri (Life Force, Essence)

The authors of this report can say with surety that the issues, impacts and recommendations herein are all based on a timeless Māori world view that has the protection and enhancement of mauri as a foundation principle.

Wāhi Tapu (Sacred Places)

There are site-specific wāhi tapu in regards to the Makaroro Water Storage Project and the Tukituki River catchment, and these have been expanded on in the body of this report.

Perhaps the most significant wāhi tapu in the vicinity of the Makaroro dam site are the Te Whiti o Tu Pā site and the location/s of the hostile encounter (also referred to as Te Whiti o Tu), that took place along the corridor/passage in the Makaroro sub-catchment that links with the Waipawa River.

Te Reo Māori

Te reo Māori is a taonga for tangata whenua.

An essential component of mātauranga (knowledge) Māori, and Ngāti Kahungunu cultural knowledge, is Te reo Māori. In the Ngāti Kahungunu Iwi summary of WAI 262 Flora and Fauna Waitangi Treaty hearing, it is clear that unless there is on-going support and encouragement of Te reo Māori the loss of Ngāti Kahungunu cultural knowledge will worsen.

Treaty Claims

It is in an evolving political environment and how the Heretaunga-Tamatea claim affects contemporary issues in the Tukituki catchment is an on-going discussion. However, as Crown lands abut the Makaroro dam site, it is fair to say that this area will be in contention for Heretaunga-Tamatea claims discussion with the Crown.

For the purposes of the Ruataniwha Water Storage Project, those hapū with mana whenua in the Tukituki River catchment have been asked to comment requiring some prescience as to settlement outcomes. The results are undoubtedly influenced by historic and contemporary grievances as yet unresolved. Extracted from the CIA Report (2012: pg 4-5).

Within the CIA reports there is a description of the contemporary environmental issues for Heretaunga and are reproduced below:

Contemporary Environmental Issues

The research commissioned by the Crown Forest Rental Trust (CFRT) to provide background for the Heretaunga-Tamatea Treaty Settlement Claim covers the timeframe from the early 19th century to the end of the 20th century and records issues being raised about the Tukituki River during that time that are still relevant today, and may be subject to the claims. Instances are highlighted below in excerpt from the commissioned Heretaunga-Tamatea Environmental Overview Report (2009: 287-294):

> *… dependent on seasonal factors and also rainfall. In 1851 Robert Park reported that the Tukituki was 'navigable for canoes in the winter time as far as the Western boundary' of the Waipukurau block…The Tukituki, as we have seen, was the main transport route through Heretaunga for much of the nineteenth century but by 1900 it was no longer navigable, as a consequence of [land clearance3 for pasture and resultant erosion and] river run-off.*
>
> *…the notion that the HBCB [Hawke's Bay Catchment Board] 'cooperated' with nature is debatable. Both rivers [Ngaruroro & Tukituki] were hugely modified from the 1860s onwards – including private stop banks and works of early river boards as detailed in the section above…*
>
> *Both the Ngaruroro and Tukituki rivers were important sites for Maori for kai moana. The various river works and pollution from farming [related activities] and from other sites damaged the [indigenous] fishery resources of these rivers. However, the environmental damage that was occurring was not recognised until the 1950s and fishery surveys were not undertaken until the 1970s. Control of the fisheries was also operated on a license system.*

Because of riparian rights to use water for landowners whose property abuts rivers, and the dominance of pastoral and agricultural use [industries] in the Hawke's Bay plains, pollution of the rivers does not figure in archival records until the late 1950s.

By the early 1970s the pollution of Hawke's Bay Rivers was impacting upon seafood throughout the region's inland waterways. In March 1971 Mr Tomoana, the Māori Welfare Officer at Hastings, informed the Marine Department that shell-fish were being polluted by sewerage discharge along an extensive stretch of the coastline, including the Awatoto sea frontage (where there was a sewerage outfall), the Ngaruroro and Tutaekuri River outlets, and east Clive and the foreshore to the mouth of the Tukituki River. The mussel reef running from Haumoana to Cape Kidnappers (Matau-a-Maui) remained unpolluted as it was subject to tide and currents, but perhaps for not much longer unless something was done. This area needed protection not only from pollution, but also 'commercialisation'. It was claimed by Mr Tomoana that hundreds of people took 'tons' of shell-fish every weekend. Strict laws were needed so that 'future generations can enjoy the heavy yield, that there is an abundance…It was also likely, according to the writer, that pollution would occur at Te Awanga and Clifton. Unless the disposal of sewerage was regulated by the use of septic tanks or some other means, Tomoana added, the position would become much worse.

(Extracted from the CIA Report (2012: pg 25-27).

The CIA report highlights several contemporary environmental concerns impacting on cultural values and are summarised in the next section. The comments and feedback from marae/ hapū are given below:

Comments and Feedback from Marae/ Hapū

Loss of the Continuation of Traditional Practices

The transportation option is long gone; whanau recreation is fast becoming a memory and remaining options for kai gathering are at high risk.

…pollution, loss of mauri of the river, severely limited access from private land ownership or other access restriction…it's not our river anymore.

How will the dam affect our practices? Will there be fish passage?

Everyone could swim, even the babies. Don't remember being taught. Didn't know of anyone that drowned…now I'm paying $40 for my moko to learn to swim at the baths.

Mahinga Kai

Hapū used whānau land and traditional 'possies' to have seasonal camps on the river. These nohoanga were as much a tradition as mutton-birding is down South. This practice is severely restricted now.

Keep our kai basket clean.

…water was clean. It's gone now…won't go near fish [because of] pollution.

My Grandfather would take us when he would get inanga. Our job was to hang them up to dry. He would split the flax and we would thread it through their eyes to hang them up. Yes, they were that big.

Traditional Hapu Asset Management

Resources were managed by knowledgeable people. We all knew who they were. Rāhui were placed on stretches of the river if stocks were depleted or things weren't 'right'.

Water needs to be running…the Maori way, way I've been taught.

…clean and running or don't gather kai there, or rongoa…

Effect on Native Species/ Eel passage to and from Pacific Moana (Hikurangi, Tonga trenches)

Experts knew the life cycle of everything, of the tuna, it was their word ….the cycles must not be compromised.

How will the tuna get home?

We would get īnanga there. Whitebait further down and smelts at Haumoana.

Inland Habitats and Ecosystems

These things are connected and interdependent. If one is gone the whole chain can disappear.

We should not limit ourselves to fish stock only but look at shingle in the river, whenua on the side of the river, flora and fauna on the side of the river…

Now when you go down there, there is no water on the side. You have to walk across the whole dry river bed to the water - hoha.

Estuarine Habitats

The life on the beach and at the river mouth is so fragile and complex, you can't risk that…it is our most abundant provider.

…in the river it was okay. At the mouth, the beach…if you turned a rock over you had to turn it back…I was taught you leave everything as you found it.

Whole of Takiwa Consideration

Ki uta ki tai….always.

The minimum flow could end up being the maximum flow.

…acknowledge the wars that have taken place along the awa."

The dam is not being built for the health of the river. It is for milk.

Is the dam going to be used for fracking? Will the aquifer be used for fracking?

What will drilling companies do with the waste water?

Biodiversity/ Loss of Indigenous Species, Bush, Flora and Fauna

Every part of the waterways used to provide a rongoa, from kai to medicine, from fun to cleansing…whether it's the trees and plants or the life in the river. I don't know anything to do with willows

My Nanny taught me [about the river}…ate from the river, the sea, from the land.

That was in 1938, 39 when I was about 8 years old. There's none there now.

Indigenous Biosecurity/ Risk Management Practices (e.g. Tapu, Rāhui)

…it is not just about taking the paru out but not putting the teko in the awa.

Mauri of the Awa

Mauri is life itself. It is paramount. One thing dies, it affects us all.

…regard for the awa is quite different …water means more.

river was deep in the middle, not bad on the side.

Dredges and gravels….interfering with the flow.

Water Quality

It's not just the drinking water. We lived around the river. It is so sad that our young ones won't learn in that manner. Tuakana, teina…just learning from the older ones around you. Even pakehas with not much money used to spend their time at the river. Where do they go now? Mac Donalds, wander the street? Sad alright.

…water was clean. It's gone now…won't go near fish [because of] pollution.

My mokos won't swim in the river…they go Eww, Nan!

We used to take our kids to the river back when they were little. It wasn't always that nice but it was what we knew …can't do that anymore and they don't take their kids either.

Access to/ Loss of Traditional Resources

We used to own our land and we used to let everyone go where they needed to, we could wander over it without harm. But now our land is gone or leased out & we have to ask permission to go on our own land, and if they say no…well, what can you do?

… someone would do this, someone would do that. Your mana…nice table for tangi, for anything…how water provides.

Nowadays…buy everything for the tangi…

Kaitiakitanga / Traditional & Contemporary Planning and Monitoring

Tohunga, or knowledgeable river people, decreed when it was time to fish, time to stop fishing, how to look after things, what to do with respect to keeping things safe, when not to go near things…they knew, it was their area of expertise.

Council don't get taken to task. Nobody takes the Council to task for the things they do.

…looked after one another…and you knew whose 'possies' were whose too.

If you didn't get a catch you were given some….if you caught some you would drop some off to Aunty or Uncle.

You don't take heaps and heaps, get enough for your needs, for kai.

Summary of Issues Identified by Focus Groups and Runanganui

- Cultural auditing
- Economic impact on Māori / region
- Land / farming intensification effects

- Gravel extraction
- Erosion of hills / accretion / denuding of hills (native trees)
- Lack of understanding of what will ACTUALLY happen in practice
- Lack of trust in authorities
- Oil & mineral drilling/ mining - Fracking and potential contamination
- Treaty claims settlement
- Waste management
- Air quality
- Ownership, co-governance, co-management of resources

Technical Issues Raised

- What are the protocols around solid rock forms (elements of Rakahore) in terms of a water storage structure? Is there a connection or synergy there that needs addressing?
- From a structural perspective, where will the materials (rocks, stones, shingle and concrete mix) be sourced from? Will rocks be sourced from elsewhere?
- Te Whāriki o Rakahore (infrastructure lining and walls of the resulting dam and lake) ; what protection will there be from threats from Whakaruaumoko (earthquake, tremors) Tū Matau-enga and Mamaru (causes of severe storms)?
- Will awa flow be enhanced through augmentation on a daily basis or as a result of a more sophisticated flow regime?
- Depending on conditions (seasonal changes & extremes) will there be enough water at the required level throughout the awa? Successive droughts will create issues
- Mauhi's role denotes the importance of 'eel passage' from the mountains to the sea and to the Tonga trench – Will there be a fish passage? With participation and guarantee will this be carried out to meet expectations? Extracted from the CIA Report (2012: p 27-37).

The CIA report makes numerous recommendations throughout the report which are reproduced below:

Summary of Recommendations

RECOMMENDATIONS – WHAKAPAPA (MITIGATION OF IDENTIFIED EFFECTS)

This report recommends that:

a) Heretaunga marae/ hapū be provided an on-going role in governance, management and monitoring of the Tukituki River, the Ruataniwha Water Storage Project, and other developments in the Tukituki catchment, in order to uphold the mana of Heretaunga.

b) Replication and/or restoration of natural elements and laws are given priority in the development and construction of the Makaroro site and dam.

c) The mauri of the Tukituki River and its environs is safe-guarded and enhanced through concurrent replanting, reforestation, and other environmental measures targeting mauri enhancement.

d) There be acknowledgement and commemoration of the mana whenua history of the Makaroro catchment, and opportunity provided to record that which may be lost/submerged. (Extracted from the CIA Report (2012: p 17).

RECOMMENDATIONS – WAI-AWA (MITIGATION OF IDENTIFIED EFFECTS)

This report recommends:

a) Future planning and strategies keep the river as natural as possible (pre-empt, not react).

b) Enhancement of flow and depth of water in the Tukituki River.

c) No increase in the number of water takes on the Tukituki River, in particular in the lower catchment, and robust monitoring of groundwater takes.

d) The hierarchy of need for water/cost benefit includes the mauri model and is based on people being a priority before cows.

e) Replanting & reforestation of hills.

f) Riparian plantings.

g) Monitoring/compliance of dairy farming.

h) A system be implemented and monitored that pre-empts water shortage in the Tukituki due to full or over-stretching of allocation of stored water. Extracted from CIA report (2012: p 24).

RECOMMENDATIONS – MAURI (MITIGATION OF IDENTIFIED EFFECTS)

This report recommends that:

a) The Water Storage Project be governed and managed so as not to compromise the mauri of the Waipawa and Tukituki Rivers, or their tributaries, by ensuring water flow and levels, water quality, and species protection, are the main priorities.

b) Mana whenua cultural values and matauranga Māori be recognised and incorporated into the Central Hawke's Bay waste management plan as a priority.

c) Marae/ hapū of the Tukituki awa have a role in governance, management and monitoring of the Tukituki awa.

d) Future modifications and planning for the Tukituki awa adopt whole-of-takiwā and mauri models as guidelines.

e) A Heretaunga hapū 'Red Bridge to Waipureku' mauri-based river strategy be initiated and implemented in partnership with Hawke's Bay Regional Council. This to be inclusive of a whole-of-takiwā gravel extraction plan, species monitoring, mahinga kai protection, and so on. Extracted from CIA report (2012: p 28-29).

RECOMMENDATIONS - WĀHI TAPU (MITIGATION OF IDENTIFIED EFFECTS)

This report recommends that:

a) As the immediate impact upon many outlying sites is indeterminate, a precautionary or monitoring approach is employed over time to gauge effects on outlying systems, and consequently on wāhi tapu sites situated further away from the Makaroro dam site and the Tukituki River itself.

b) A cultural audit of the Makaroro Valley and river take place. This will require the services of a suitable tohunga and matakite (seer) in order to determine any sites of concern, and to discuss how the tapu may be remedied or avoided.

c) The process of engagement for Council on wāhi tapu matters includes seeking mana whenua guidance and direction.

d) There be a strengthening of the clause to "recognise and provide for the relationships of tāngata whenua with their ancestral lands, water, sites, wāhi tapu and other taonga",

within statutory plans (and plan changes), to ensure mana whenua have a role in governing and managing activities that impact on wāhi tapu.

e) Access is made available for tangata whenua to traditional wāhi tapu sites or areas to allow for cultural practices and traditions to be maintained.

f) Inclusion of Accidental Discovery Protocols to allow appropriate actions and procedures to be taken in relation to the unearthing of cultural material including kōiwi, wāhi tapu, ancient pā sites etc.

g) Cultural artefacts or materials found are returned to Ngāti Kahungunu Iwi Incorporated (a registered holder of antiquities).

h) Cultural monitoring of earthworks is carried out within areas of particular cultural relevance.

i) There is recognition of Māori oral histories alongside other recorded evidence, as oral evidence forms a major part of Ngāti Kahungunu's history and traditions and must be given sufficient weight when considering historical matters and cultural heritage values.

j) Archaeologists and historians are kept informed of Ngāti Kahungunu iwi and hapū histories in relation to specific sites, as per the Historic Places Act 1993.

k) Contractors undertaking work in the Makaroro and Tukituki catchments where there is a high probability of cultural material or wāhi tapu being unearthed, provide opportunities for cultural kaitiaki to access and inspect soil and sites.

l) Any site that fulfils the criteria of the Historic Places Act 1993, whether recorded or not (it just has to be suspected), is protected under the Act.

m) Mātauranga of Ngāti Kahungunu are recognised and provided for in all cultural and historic heritage resource management matters.

n) Tikanga Māori is observed on all wāhi tapu sites affected by the Ruataniwha Water Storage Project, to protect such sites from inappropriate activities during development which may disturb the tapu status. Extracted from CIA report (2012: p 31-32).

RECOMMENDATIONS – TE REO MAORI (MITIGATION OF IDENTIFIED EFFECTS)

This report recommends that:

a) Before it is changed, the essence of the Makaroro catchment is captured in order for the mātauranga and te reo of the area to survive. This is a contemporary claimant issue that will involve tangata whenua and Ngāti Kahungunu Iwi. Extracted from the CIA report (p 35).

RECOMMENDATIONS – TREATY CLAIMS (MITIGATION OF IDENTIFIED EFFECTS)

This report recommends that:

a) Mana whenua are involved in all levels of decision-making in regard to issues that affect them directly.

NB In terms of water and its values, causes of actions by various authorities and their ordinances are stated in the Heretaunga–Tamatea comprehensive Treaty claim. Redress to these claims is currently being worked through with He Toa Takitini. Extracted from CIA report (2012: p 37).

3.7 OTHER EFFECTS ASSESSMENTS

3.7.1 Road Infrastructure and Traffic

This report provides an assessment of the impact that the Ruataniwha Water Storage Project will have on existing road infrastructure and provides recommendations on improvements where required, along with appropriate monitoring, inspection and response measures over the course of the project (construction phase in particular). The report was commissioned by the Hawkes Bay Regional Council, and it outlines the findings of Opus International Consultants.

Potential Project Effects

Potential project effects considered as part of this study are:

- Suitability of the roading network affected by the project, in terms of adequate pavement strength and appropriate geometric alignment
- Structural capacity of existing bridges affected by the project

Assessment Undertaken

The following assessments were undertaken:

- Magnitude of construction traffic
- Roads affected by construction traffic
- Bridge infrastructure affected by construction traffic
- Traffic loading requirements of the construction traffic
- Road pavements and surfacing affected by construction traffic
- Suitability of existing road alignments

Results of Assessments

Bridge Infrastructure

All the bridges affected by the construction traffic are currently assumed to withstand a Class I type loading, as none have any restriction on their live load carrying capacity. However, local CHB bridges will see a large increase in their current traffic volume which may affect their load carrying capacity, and so 'before, during and after' inspections for the construction period are recommended along with appropriate remedial response (refer below). It is considered that the effect of the construction traffic on the SH bridges will be minimal.

Road Pavement and Surfacing

Delivery of initial project plant to site and dam construction traffic are likely to follow similar routes. Any overweight loads are likely to impact on the road surfacings in vulnerable areas, such as curves and intersections. In particular, sections of SH50 and Wakarara Road have curvilinear alignment which may be impacted by construction traffic. The surfacings on Wakarara Road are also all single coat seals which will be more susceptible to shear related distress or binder pickup on the vehicle tyres, particularly at surface temperatures above 40°C.

A further factor to consider with overweight and overdimension vehicles, is any pavement and surfacing construction works being undertaken during the period of transportation. If this takes place during the period from October to March, there will be pavement rehabilitation construction and resurfacing completed on isolated areas along the construction traffic routes which will be impacted by construction traffic.

For State Highways, based on the preliminary analysis there is unlikely to be any significant impact on the existing pavement from the additional construction traffic on this route.

Local Authority roads, in particular sections of Wakarara Road may be impacted due to the proportional increase in heavy vehicle loadings (double existing traffic on some lengths). The increased loading requires an increase in design pavement depth. However, for the majority of the existing road, pavement depth and age data could not be obtained to verify actual improvement requirements.

Road Alignment

A desktop assessment has identified three possible sites on Wakarara Road which may warrant further investigation to check their suitability for an increased number of heavy vehicles during the construction period. These are detailed below:

- Curve immediately west of Hardy Road
- Curves at Pendle Hill Road

New Access Roads

The main dam access road is likely to require a granular pavement to a depth of up to 300mm and a minimum width of 5.0m.

An existing forestry access road and a farm access track will become inundated with water from the reservoir once the dam is completed. Preliminary alignments of alternate accesses have been identified.

Suggested Approach for Effects Identified

Bridge Infrastructure

Due to the increase in the volume of traffic the Central Hawke's Bay bridges will experience during the construction stage of this project, it is recommended the affected structures are evaluated in accordance with the NZTA Bridge Manual Section 6 and their load carrying capacity confirmed. The evaluation shall take into account the current condition of the structures as some defects (i.e. deck cracking) may decrease their load carrying capacity.

In order to assess any changes during the construction period in the condition of the both local Central Hawke's Bay and State Highway bridges, it is recommended a regime of inspections is established.

It has been assumed most of the construction traffic will be Class I loading and it is recommended the traffic is limited to this in particular over the CHB Bridge infrastructure. Nevertheless, if an overweight load (indivisible) needs to be taken into the construction site an Overweight Application Process could be completed as detailed in Section 5.4.2.

Alternatively, the construction route could also be assessed as a HPMV route if it is considered there will be more frequent or regular demand to carry heavier than Class I type loading. Both of these processes will entail carrying out bridge evaluations specific to the desired traffic configuration and weight of vehicles. As a consequence, bridge strengthening/replacements may be required to achieve the higher load carrying requirements.

Road Pavement and Surfacing

In order to minimise the likelihood of damage to surfacing from overweight vehicles the following conditions are recommended:

- ***The maximum surface temperature that any section of the pavement on the construction traffic route should be trafficked is 40℃. This maximum could be raised to 45℃ if experience shows that no damage occurs at temperatures close to 40℃.***
- ***No overweight loads should be transported over any seal that is less than one week (7days) old.***

Further, it is recommended that no transportation of overweight/overdimension loads should take place during construction and for a week long period following any pavement rehabilitation construction. This condition will allow pavements to be constructed without interruption and will allow the cement stabilised pavements to "set up" prior to heavy loading.

It is recommended that vulnerable areas of the routes to be used by construction traffic be regularly (e.g. 3-monthly) monitored throughout the construction period. This should be completed by experienced surfacing practitioners (e.g. network consultants). Where any failures of the surfacing, including reduced skid resistance, are observed the areas should be resurfaced.

Monitoring of older sections of pavement on both State Highways and Local Authority roads should be carried out throughout the construction period and maintenance completed as required to ensure the road continues to meet the Levels of Service set by road controlling authorities. The monitoring could be carried out by network maintenance contractors during their normal monthly inspections and any maintenance issues that appear to be outside normal expected maintenance requirements reported to the dam construction project management team.

It is recommended that where the existing pavement depth and age is unknown this is verified through on site testing to establish its current capacity. This would include using more detailed project level FWD testing and/or destructive test pitting and subgrade scala penetrometer testing. From this information on the current subgrade strength, pavement depth, materials and an indication of pavement age can be determined. If areas of the pavement prove to be inadequate, pavement rehabilitation works should be undertaken, such as an overlay of granular basecourse or stabilisation of the existing pavement.

At the end of construction period all pavement lengths should be assessed by experienced practitioners using appropriate visual inspection and condition data to determine any significant deterioration beyond normal expected deterioration based on modelling and forward works programmes. Those areas deemed to have deteriorated to an unacceptable level would need to be rehabilitated.

<u>Road Alignment</u>

On site topographical survey of identified potential problem areas should be completed and actual construction traffic configurations sourced, particularly for over-dimension vehicles. From this information a more detailed swept path analysis can then be undertaken to determine actual realignment requirements.

<u>New Access Roads</u>

In order to reduce dust along the main dam access route, it is recommended that it be chipsealed as this route will carry the majority of construction traffic.

The existing subgrade along new access routes should be tested using scala penetrometer testing to verify actual granular pavement depths required.

Replacement forestry and farm access roads will need to be constructed similar to existing access roads, in consultation with the landowners requirements.

3.7.2 Noise

The Ruataniwha Water Storage Project comprises very significant earthworks in and around the Makaroro River. Significant amounts of noise will be produced over approximately a 4-1/2 year construction timeframe. The report considers the noise sources, reviews the standards and assessment methods for evaluating noise effects, presents predicted noise levels from the activity, and recommends mitigations to avoid, remedy or mitigate noise effects.

Potential Project Effects

The noise effects which are expected to arise from the proposed water storage project are almost entirely related to construction activities. These include construction of access roads, excavation and transport of aggregate, placement of aggregate and spoil, blasting, concrete batching and placement, and site reinstatement. This will occur in the vicinity of the proposed dam site and to a much lesser extent near the water intake site and along the reticulation network. These sites are generally at large distances from dwellings.

The noise effects from the operation of the water storage project will be very limited, and will generally consist of a modification of natural noises rather than introduction of man-made noise.

Assessments Undertaken

This assessment of noise effects has been made by comparing predicted noise levels from construction activities to the applicable noise standards, including district plan noise limits and the Construction Noise standard (NZS6803:1999).

Noise predictions have been made on the basis of typical construction machinery sound power levels, with geometry and duration as described in the Tonkin & Taylor Ltd Project Description document. Noise is predicted using the ISO9613-2 Industrial Noise Model, implemented in SoundPLAN software.

Results of Assessments

Construction noise levels are predicted to comply with daytime construction noise limits in NZS6803:1999 at all dwellings, and night-time construction limits at most dwellings.

The noise effects at all dwellings are considered to be reasonable provided that adequate consideration of night-time noise mitigation at near dwellings Rec 6, 7 and 9 is taken into account during certain specific periods of construction. This may require limiting activities at night-time, or providing some other means of mitigation to the residents of those dwellings.

The noise levels in the working rural environment are considered to be reasonable, and will not have adverse effects.

The noise level and character of the ongoing operation of the water storage project are consistent with the expectations of rural land near a water course, and no adverse noise effects are predicted.

Suggested Approach for Effects Identified

It is recommended that a Construction Noise Management Plan (CNMP) be prepared to ensure that construction activities are carried out in a manner which avoids unreasonable noise emissions, and which ensures that adverse noise effects are appropriately mitigated at the three dwellings identified, and any noise sensitive locations which are found to be affected near the headrace construction. The CNMP should also provide a means for good communication with the community and a pathway for feedback to the project team regarding noise concerns.

With this CNMP, adverse noise effects will be avoided or appropriately mitigated.

3.7.3 Archaeology

Potential Project Effects

The Ruataniwha irrigation project proposed by Hawke's Bay Regional Council (HBRC) has some potential to destroy, damage or modify archaeological sites. This potentially applies to:

- Previously unrecorded but visible archaeological sites
- As yet unknown archaeological sites that might be exposed by earthworks.

Assessments Undertaken

HBRC commissioned Clough & Associates to carry out an archaeological survey and assessment of the areas affected by the proposed irrigation project (the reservoir, dam, headrace corridor and reticulation network).

The assessment involved:

- A search of the NZ Archaeological Association's site record database (ArchSite) and the Central Hawke's Bay District Plan schedules for information on any recorded or scheduled archaeological or other historic heritage sites.
- A search of early Survey Office (SO) Plans and Deposited Plans (DP) held by Land Information New Zealand (LINZ) for information on former land use.
- A brief review of literature and archaeological reports relevant to the area.
- Meetings with Dr Benita Wakefield and staff of Te Taiwhenua O Tamatea, and Pat Parsons regarding the cultural and historic heritage aspects of the project. Historical background information provided by Pat Parsons has been included in this report.
- An initial visual inspection of the dam area on 7 September 2011.
- A more detailed archaeological survey covering the larger footprint of the dam and reservoir in January 2012. Where possible, this involved close examination of the ground surface for evidence of former occupation or use.
- A desktop assessment covering the route of the proposed headrace and associated irrigation infrastructure.

Clough & Associates did not include an assessment of effects on Maori cultural values. Such assessments should only be made by the tangata whenua, and Maori cultural concerns may encompass a wider range of values than those associated with archaeological sites. These assessments have been undertaken separately.

Results of Assessments

No archaeological sites had been recorded in the immediate vicinity of the proposed dam and reservoir prior to the assessment, although sites including two Maori pa are recorded approximately 7-10km away. The density of archaeological sites previously recorded in the wider area around the proposed dam site is low.

No Maori or other pre-1900 archaeological sites were identified during the field survey. The area of the reservoir and dam does not appear to have been a favoured location for pre-European settlement for topographic reasons, and the tangata whenua have not identified any archaeological sites of significance to them in the immediate vicinity. However, the possibility that pre-1900 subsurface archaeological remains may be encountered during earthworks cannot be completely excluded.

One archaeological site of early 20th century date was identified within the project area – the site of Gardner and Yeoman's Sawmill, located on the southern bank of the Makaroro River near Dutch Creek. Various remains of the mill operation were noted, dating from the period 1920s-1950s.

The mill site is of local historic heritage significance based on its archaeological values, its historical values and its educational potential. However, its heritage values are considered to be moderate rather than high in view of its relatively late date and limited integrity. It is not scheduled for protection on the Central Hawke's Bay District Plan, or registered as a historic place by the NZ Historic Places Trust.

The site of the mill would be permanently flooded by the Ruataniwha irrigation project.

No recorded archaeological sites in the vicinity of the proposed headrace and associated irrigation infrastructure will be affected.

Suggested Approach for Effects Identified

As it would not be possible to protect the Gardner and Yeoman mill site in situ, the following measures are proposed by way of mitigation:

- ***Archaeological investigation and further recording of the site should be carried out prior to flooding.***
- ***A report on the history of the mill (based on oral and archival sources) and the results of the archaeological investigation should be prepared and deposited in the local museum and library and the NZHPT library.***
- ***An interpretation plan should be prepared and interpretive signage detailing the location and history of the mill should be installed in a suitable location (or locations) near the dam and reservoir that is accessible to the public. This could be associated with the existing Yeoman's Track.***
- ***The boiler and any other significant industrial remains should be removed from the site prior to flooding and deposited in a local museum or installed on higher ground nearby in a location accessible to the public as part of the interpretation of the site.***

Although the potential for archaeological remains to be exposed during construction is low, it is also recommended that comprehensive Accidental Discovery Protocols should be developed in consultation with the NZHPT and tangata whenua. These would ensure that if koiwi tangata (human remains), taonga or sub-surface archaeological evidence is uncovered during construction, work would cease in the immediate vicinity of the remains so that appropriate action could be taken. A field survey of the headrace should also be carried out by an archaeologist prior to earthworks as a precaution in case any unrecorded sites are present.

If modification of an archaeological site does become necessary, the effects could be appropriately mitigated under the provisions of the Historic Places Act 1993. An Authority to modify an archaeological site would be required before any work could be carried out that would affect an archaeological site. It would be possible to apply for a general Authority from the NZHPT prior to earthworks as a precaution to minimise delays should archaeological remains be accidentally discovered.

A Workshop on a potential integrated Mitigation and Offset programme associated with the physical effects of the project on the environment was held on 6 March 2012. This was attended by DOC and Iwi representatives as well as the authors of the Recreation, Landscape, Archaeology and Terrestrial Ecology Reports. The recommendations contained in this report were discussed at the workshop and HBRC have prepared a separate report entitled "Ruataniwha Water Storage

project – Proposed Integrated Mitigation and Offset Approach", which should be read in conjunction with this report.

3.7.4 Social Impacts

Potential Project Effects

The Social Impact Assessment reports on the social and socio-economic effects associated with the proposed Ruataniwha Plains Water Storage Scheme.

Key land use changes anticipated with irrigation are:

- Dairying & its associated dairy support – more than double existing areas
- Intensified horticultural operations
- Irrigated arable farming
- Some irrigated sheep and beef farming.

The assessment found that, as in comparative areas of New Zealand, this level of land-use change will lead to a series of social changes driven by changes in land use, new farmers moving into the area with new or different approaches to debt and farming practices, and higher levels of employment with more intensive farming practices. While these changes will lead in turn to strengthening of local populations and communities through the employment created on and off farm and additional business activity, including in the towns of Waipukurau and Waipawa, potential social issues could arise with land use change around the integration of newcomers, loss of sense of place and possible values conflicts. With appropriate strategies in place to manage change, however, the proposed scheme should result in a significant net beneficial social effect for the people and communities of the district.

Assessment Undertaken

The scope of this assessment was directed at the potential social effects of the scheme associated with:

- Changes in farming practices
- Changes in land ownership
- Demographic changes (numbers and composition of the population)
- Strengthening rural communities (education, health, commerce, clubs etc)
- Value conflicts associated with new / intensified land uses versus traditional dryland farming practices
- Wider regional socio-economic effects including construction effects.

A multi-method approach was used with the main phases being scoping of effects and profile of the assessment area, assessment of effects, feedback and validation of findings, and reporting. The main sources of information were:

- Analysis of data about the affected communities and social trends from census and other secondary data sources
- Use of a scenario of potential land use change and projection of likely changes in farm ownership, employment and populations
- Analysis of social infrastructure and likely changes in communities resulting from changes in numbers and characteristics of farmers, farm workers and their families

- Information from meetings with stakeholders and key-informant interviews to assist with understanding of social issues and trends and likely changes with irrigation.

Results of Assessments

There are 429 farms greater than 10 hectares in the key zones A-D of the Ruataniwha Plains. Increased areas of irrigation and associated changes in land use on these farms will lead to the following effects:

- A reduced average age of farmers and new families coming into the area
- Some of the new farm workers are likely to live in the villages and main townships and some seasonal workers in on-farm accommodation camps
- A turn around from negligible growth in population evident in the district over recent years
- A flow on effect of growth in numbers employed and population for any new processing plant associated with new or increased farm outputs
- A change in the composition of the population, especially of the rural areas, with younger families and children and consequent rises in school rolls
- Increased turnover of population and more overseas workers, with more ethnic diversity and a need to provide social support to new comers
- Increased participation in sport and recreation and community activities and greater demand for social services, including health services, although with the exception of health there are facilities and capacity to meet new demand.

Other potential effects identified included:

- New and increased health and safety risks around new waterways, increased traffic on rural roads and on farm with intensified activities. There may be a perception of risk around dam failure
- Consequences of residual bio-physical effects on local people and communities from construction activities, alleviated by suitable mitigation measures and management plans
- Changes in recreational and cultural values as identified in the recreation and cultural assessments with potential for community tensions and conflict in an inherently adversarial planning approach.

Suggested Approach for Effects Identified

Experience with irrigation projects demonstrates the importance of a proactive approach to managing social and economic change to achieve desired social-economic outcomes. The net social-economic benefit of the scheme will depend on active management of change by the councils and key stakeholders, along with communication and consultation with the affected communities.

Active involvement of the two councils along with the stakeholder group provides an opportunity to develop a change management strategy around the following initiatives:

- ***Develop a social impact management plan for the construction phase as part of the front-end engineering design of the headworks in order to maximise local employment benefits from construction and avoid adverse effects of an incoming workforce***
- ***Develop a coordinated employment strategy with agencies and training providers for future land uses and off-farm opportunities including training and skills development, with an emphasis on local placement, including working closely with Maori***

- ***Prepare a business development strategy working with regional and district business development agencies and sector groups***
- ***Build on community, youth and sports and recreation development in the district to enhance community benefits from incoming population***
- ***Establish a programme to assist the integration of newcomers into the community, including migrants from outside the district and overseas workers***
- ***Establish a programme of technology transfer for the uptake of the latest land, water and nutrient management practices to enhance social, economic and environmental outcomes***
- ***Develop a strategy to encourage to identify and retain important landscape values in the face of land-use change***
- ***Undertake a comprehensive communications strategy for the scheme through the consenting and construction phases, with regular communications through multiple media, to support participation of interested and affected parties through the planning process.***

3.7.5 Recreation

Potential Environmental Effects

Potential recreation effects of the proposed Ruataniwha Water Storage Dam project include the following:

Recreation Zone 1 - (upstream of the dam head)

- Effects on access to the Ruahine Forest Park for a range of recreation activities including tramping/ hiking, hunting, mountain biking, kayaking and fishing.
- Effects on the activity of fishing, four wheel driving and kayaking in the dam footprint. The opportunity to undertake these activities in 'Recreation Zone 1' will be affected.
- Effects on day visits and the activities associated with scouts/ Wakarara Camp at the Wakarara Road end and associated heritage and natural amenity areas. The Wakarara Road end will be affected.
- The activity of camping will be affected. The private camping ground at Wakarara Road end is located within the dam footprint.

Recreation Zone 2 - (between the dam head and the outlet)

- There will be no effects on existing access to the Makaroro River and Waipawa River by the current dam proposal.
- Although the mean annual flow in the Makaroro River in Recreation Zone 2 will not change, monthly median flows will change. This means that although the activities of fishing, swimming and kayaking will not be lost, the nature of the activity will change.

Effects During Construction

- There will be effects on access to all current recreation activities during construction.
- There will be effects on the activities of kayaking, fishing, four-wheel driving, day picnicking and swimming during construction.

Assessments Undertaken

Hawke's Bay Regional Council commissioned Opus to prepare a Recreation Assessment (April 2012) which addresses the following:

- Identify and characterise the range of recreational activities undertaken in the project area. Determine the context of these opportunities on the basis of the range and availability of existing outdoor recreational opportunities within Hawke's Bay and surrounding regions as well as their proximity to people living in Hawke's Bay.
- Assess the effects of the project on the identified recreational activities being undertaken in the project area.
- Identify and characterise any new recreational opportunities that may be created by the project, and their potential benefits (in the context of the availability of existing outdoor recreational opportunities available to Hawke's Bay residents).
- Identify and report on any available and appropriate means to avoid, remedy or mitigate adverse effects on current recreational use of the project area.

The Recreation Assessment was undertaken between the months of December 2011 and February 2012. It entailed observation from two site visits; consultation with key stakeholders and recreational groups; and research of relevant literature to develop a sound understanding of the area and associated recreation activities currently undertaken. Findings from other dam developments were also reviewed particularly where recreation has been considered. This assisted in developing an overall impression of the activities affected, possible mitigation for the effects identified and possible opportunities for a project of this nature.

Suggested Approach for Effects Identified

The preliminary suggested approach for effects identified for each recreation activity is discussed in Section 4 of this Assessment. Overall the main effect on recreation will be loss of access to recreation activities in the wider area. It is recommended that alternative access to these activities be provided for in the long term. This has been acknowledged by HBRC and alternative access is being considered around the top end of the dam.

The other key conclusion of this report is in relation to the opportunity the completed dam will have for recreation activities. Flat water is sought after in Hawke's Bay for rowing and motor boat activities, and it is acknowledged that there is potential for these and a range of other recreational activities such as fishing, swimming and lakeside activities to be provided for at the future dam. If provision for these activities is a desired outcome it is recommended that work be undertaken with user groups to better understand their needs and the ability of the dam to accommodate these.

Issues such as water plumage (as discussed further in section 1.2 of this assessment); devegetation (or lack of) and how this is managed (discussed further in section 1.2); and treatment of the 'dead zone' around the dam periphery will potentially place constraints on the dam for recreational use. The requirement for a recreation management plan as a condition of consent is therefore recommended.

In addition, a Workshop on a potential integrated mitigation and offset programme associated with the physical effects of the project on the environment was held on 6 March 2012. This was attended by representatives from the Department of Conservation (DoC) and Iwi along with the authors of the Recreation, Landscape, Archaeology and Terrestrial Ecology Reports. The recommendations contained in this report were discussed at the workshop and the Hawke's Bay Regional Council (HBRC or the Council) have prepared a separate report entitled "Ruataniwha Water Storage project – Proposed Integrated Mitigation and Offset Approach" which should be read in conjunction with this report.

3.7.6 Landscape and Visual Effects

Potential Project Effects

Potential landscape effects of the Ruataniwha Water Storage Project include the following:

a) Potential effects on the **natural character** of the following rivers and their margins:

- The Makaroro River and its tributaries (Dutch Creek and Donovan's Gully) as a result of construction of the dam and inundation of the existing river;
- The Makaroro, Waipawa and Tukituki Rivers downstream of the dam as a result of changes to flow regimes;
- The Waipawa River at the location of the water out-take structure in the vicinity of Caldwell Road as a result of changes to the river bank; and
- Smaller streams and watercourses in the Ruataniwha Plains where traversed by the headrace, as a result of construction of culverts or inverted siphons.

b) Potential effects on the **outstanding natural landscapes** of the Ruahine Ranges as a result of the nearby reservoir lake.

c) Potential effects on **landscape amenity** including:

- Visual effects of the dam and reservoir lake;
- Visual effects of the head-race (from both private and public views);
- Visual effects of the power station and transmission line; and
- Effects on the character of the Ruataniwha Plains as a result of increased irrigation (including pasture 'greening' and additional use of pivot irrigators);

d) Effects on the biophysical landscape including effects of earthworks on landforms, watercourses, or vegetation; and

e) Temporary construction effects.

Assessments Undertaken

Hawke's Bay Regional Council initially commissioned Isthmus to undertake a 'Baseline Landscape Assessment' (23 January 2012) and to provide input to the refinement of the project design. The 'Baseline Landscape Assessment' assessed the existing landscape values, scoped potential landscape effects, appraised alternative headrace types and alignments, and proposed a series of principles or guidelines for the detailed design of the headraces.

The subsequent Landscape and Visual Assessment addressed the following matters:

a) A description and appraisal of the existing landscape including;

- Its physical, perceptual and associative factors,
- The nature and degree of natural character of the rivers and their margins; and
- Identification of outstanding natural features and landscapes.

b) An analysis of the effects on natural character of the rivers, including effects on both biophysical and perceptual aspects of natural character, taking into account the inundation of the existing river by the dam, modification of downstream flows, and the construction of the primary distribution system including the intake structure and crossing of smaller streams by the headrace;

c) An analysis of the effects of the dam and reservoir on the values of the nearby Ruahine Ranges (being the only Outstanding Natural Landscape potentially affected);

d) An analysis of the effects of landscape amenity and biophysical effects. Given the dispersed nature of the project this was dealt with by dividing the project into its components as follows:

- Dam and Reservoir
- Hydro-electric (add-on) Station
- Transmission Line
- Secondary Distribution System and Changes to Land Use Patterns
- Primary Distribution System including the Head-race Canal and Buried Pipelines

e) An assessment of potential temporary construction effects.

Results of Assessments

Natural Character

The main adverse landscape effect will be on natural character of the Makaroro River in the vicinity of the dam and reservoir, and on the downstream flows below the dam. Such effects are common to any in-river dam. However, the effects will be minimised for a project of this type because of the following factors:

a) The adjacent land has a modified 'working rural character';

b) The dam will have low visibility (hence low effects on visual aspects of natural character);

c) The reservoir lake will have a naturalistic appearance; and

d) There will be positive effects on the lower Tukituki River as a result of increased summer flows.

Outstanding Natural Features and Landscapes

The only outstanding natural feature or landscape in the area is the Ruahine Ranges. The project will have negligible effects on the landscape values of the Ranges because the dam and reservoir will be in a working landscape that is clearly separate from the Ruahine Ranges, the dam itself will not be visible from the ONL (except in very long distance views from the mountains) or from roads providing access to the Ranges, and the upstream end of the reservoir will not be visible from where the Makaroro River emerges from the Ranges.

Landscape Amenity and Biophysical Effects

Adverse landscape amenity effects will be low for a project of this type for the following reasons:

a) The dam, which is the feature with the greatest potential adverse amenity effects, will have very low visibility. To most intents and purposes it will have no public visibility except for future users of the reservoir;

b) The distribution system intake on the Waipawa River is tucked against a bank in an unobtrusive location;

c) The headrace, which forms part of the primary distribution system, will not be out-of-place in a working rural landscape and will continue a tradition of community water races in the area;

d) The headrace alignment follows the contours, avoids most houses, and minimises the extent of earthworks required; and

e) While there will be changes in land-use, field patterns and associated structures (such as pivot irrigators), such land uses will not be dissimilar to existing activities and they will continue a pattern of change and evolution that has characterised the landscape over the last 150 years.

There will be some positive landscape amenity effects:

a) The reservoir will have high amenity as a lake taking into account its serpentine form, tributary reaches, and bold hill backdrop; and

b) The head race canal may also be perceived as a positive and interesting feature.

The main potential biophysical landscape effects are subsumed under the topic of 'natural character' above. Any adverse biophysical effects in addition to those addressed under that topic will be low for the following reasons:

a) The project will be within a modified working rural landscape;

b) Most of the distribution network will be by means of buried pipelines; and

c) The headrace canal has been aligned to follow flat to rolling topography which will minimise the scale of the earthworks, and it traverses open farmed country.

Temporary Construction Effects

The dam and its ancillary structures present the main potential for construction effects. However such effects will be confined to a relatively small area with visibility essentially restricted to private farmland.

There will be some adverse construction effects associated with the contouring and armouring of the reservoir margins, headrace construction, laying of distribution system pipelines, installing the transmission line, and constructing such elements as the intake structure and inverted siphons. Such effects will, however, be temporary in nature, short term in duration (construction and earthworks will be rehabilitated as the project progresses), limited in scale, and will not be out-of-place in a cultivated rural landscape.

Summary of Effects Assessment

In summary the project will not be out-of-place in the landscape, the main elements have been appropriately designed and located, and the degree of residual adverse landscape or visual effects will be relatively modest for a project of this type.

Suggested Approach for Effects Identified

Measures that are already incorporated within the project design will avoid or minimise potential adverse landscape effects. Such measures include the selected dam site and footprint of the reservoir, the location and design of the primary distribution system including the intake structure, headrace type and alignment, and proportion of the system that will be buried.

Suggested further measures to mitigate residual adverse effects (and enhance amenity) include planting around parts of the lake margin, measures (such as armouring and contouring) to ameliorate the fluctuating water level bare zone, public amenity facilities adjacent to the lake, and implementing the landscape principles and guidelines for the detail design of the headrace. Landscape measures should be incorporated into an integrated design, along with measures relating to other disciplines, as described in the parallel document 'Ruataniwha Water Storage Project – Proposed Integrated Mitigation and Offset Approach'.

3.8 INTEGRATED MITIGATION AND OFFSET REPORT

A range of studies were completed during the feasibility phase of the Ruataniwha Water Storage Project in order to quantify the potential effects of the project on the environment and communities in Central Hawke's Bay. Outcomes of these studies were presented as a series of Assessment of Environmental Effects (AEE) reports by the consultant/HBRC teams commissioned to undertake them, and will guide development of any future resource consent applications for the project.

Through their assessments, study authors have taken account of avoidance, remediation, and mitigation proposals built into the scheme design, and where necessary, have made recommendations for additional actions avoiding, remedying or mitigating potential effects.

This report sets out the proposed integrated mitigation and offset approach designed to address the residual biophysical effects (e.g. effects on terrestrial and aquatic ecology) around the dam/reservoir area and downstream of the intake site, that are not practicably able to otherwise be avoided, remedied, or mitigated directly. Flooding of the Makaroro River bed upstream of the dam will also have a permanent effect on recreation facilities and the historic Yeoman Mill site at the end of Wakarara Road. As such, the effects on recreation, landscape, heritage and cultural values have been considered also. Effects addressed in this report include:

- Loss of an area of ecologically significant indigenous vegetation covered by the dam and reservoir footprint; calculated to be 104.32 ha.
- Edge effects across an area of approximately 10 ha.
- Loss of braided river habitat (gravel river bed) that would be inundated by the reservoir, equating to 73.76 ha.
- Loss of 4.95 ha of ecologically significant wetland and seep zone habitat.
- Loss of 183.03 ha of habitat utilised by Threatened and At Risk Species.
- Loss of fish passage beyond the proposed dam to the upper bounds of the Makaroro River and Dutch Creek.
- Loss of habitat for some indigenous aquatic species that are unlikely to find the reservoir habitat suitable for them.
- Loss of trout spawning habitat in the areas occupied by the dam and reservoir.
- Changes to the flow regime of the Makaroro and Waipawa River's; in particular, upstream of Caldwell Road, with a consequent adverse effect on the invertebrate population and trout spawning in those reaches.
- Potential increase in DRP inputs to the rivers as a result of land use intensification and an associated increase in periphyton growth.
- Loss of the established walking track from the end of Wakarara Road, across the Makaroro River, to the DoC tracks extending throughout the Ruahine Forest Park.
- Loss of the informal camping area located on Mr Stephen Wilson's property.
- Inundation of any remaining infrastructure associated with the historic Yeoman Mill site located at the end of Wakarara Road.

The mitigation/offset projects proposed were developed via the following steps:

a) Individual AEE reports were completed by consultant/HBRC teams. This included assessing the proposed project against relevant planning provisions, quantifying potential effects, recommending actions to avoid, remedy or mitigate those effects, and where residual adverse effects were identified, highlighting these in the study reports for follow up by the

HBRC project team. With respect to the terrestrial ecology study, this also included an assessment against the BBOP Principles and proposed National Policy Statement on Indigenous Biodiversity

b) The issues, constraints and opportunities identified through the AEE reports were explored during a Design Workshop held on 6 March 2012 and attended by key consultant teams and representatives of Department of Conservation and Iwi

c) A meeting with landowners was held on 30 March 2012 to share information about the project and flag the issues, constraints and opportunities for follow-up with landowners on a one-on-one basis

d) Individual study findings and recommendations were presented to the Ruataniwha Stakeholder Group, including the measures proposed to mitigate or offset potential effects where concepts were adequately advanced

e) Consideration was given to the combined Tamatea and Heretaunga Tukituki Cultural Values and Uses report (June 2012), which makes recommendations regarding the maintenance and restoration of Mauri to provide appropriate responses through a mitigation and offset programme that ensures the Ruataniwha Water Storage project recognises appropriate cultural values (including native fish and water quality benefits)

f) The draft "Proposed Integrated Mitigation and Offset Approach" report was presented to the Ruataniwha Stakeholder Group during their 27 July 2012 meeting, and feedback sought

g) The report was refined in August 2012, taking into consideration the feedback received from Forest and Bird, Department of Conservation, and a Hawke's Bay conservation group including representatives from Sustaining Hawke's Bay Trust, Forest and Bird, Bay Watch Environmental Group, Fish & Game, and Te Taiao Hawke's Bay Environment Forum.

Four projects are proposed in response to the potential effects outlined above. Projects A-C set out biodiversity restoration and enhancement strategies proposed to address residual effects on both terrestrial and aquatic biodiversity. These projects also address effects on recreation, cultural and heritage values associated with the Wakarara Road-end area. Project D provides an additional offset for adverse effects of the project on phosphorous inputs to streams and the availability and quality of in-stream habitat for trout spawning, native fish and invertebrates.

The estimated total cost provision for offset mitigation requirements over a 30 year period equates to just over $7 million, with the most significant costs incurred in the first ten years of the project. Acknowledging that the success of the projects proposed depends on the long-term, sustained agreement and effort of a number of key stakeholders, it is proposed that a Ruataniwha Biodiversity Trust be established prior to construction of the dam. The Trust's primary role would be to administer and manage project funds, to lead consultation with affected landowners and stakeholders, to prioritise activities, and to ensure delivery of the proposed projects within the agreed timeframes.

3.9 LAND USE INTENSIFICATION WORKING PARTY REPORT

The Working Party Terms of Reference specifies the following outcome as part of the Operational Protocols:

> *A Working Party Report will be compiled by the Facilitator at the completion of the process. This Working Party Report shall record the matters traversed by the Working Party and any recommendations that are agreed for HBRC to consider in its assessment of the projects feasibility. This Working Party Report will be made public by HBRC as part of its deliberations and reporting on the feasibility of the project.*

3.9.1 Working Party Findings and Recommendations

Table 12 below records the recommendations of the Working Party.

Table 12: Findings and Recommendations – Discussed and Agreed at 17 August 2012 Meeting
Nutrient Allocation Framework and Policy Development
1. That the SWOT Analysis and Principles outlined in Appendix 2 of this Report generally reflect the views of the Working Party. A version of the Natural Capital Based (Land Use Capability) approach is generally favoured over the Equal Allocation (Averaging) and Grandparenting approaches.
2. That the Working Party acknowledges the water quality information regarding periphyton control, provided to them to date by HBRC, and understands that the Councils advice is to focus periphyton control around phosphorus management. However it is noted that some Working Party members have different views regarding the phosphorus and nitrogen management and reserve their position pending further information and discussion among experts.
3. That the Working Party acknowledges that further nitrate toxicity analysis has been undertaken for HBRC by Dr Chris Hickey of NIWA and these numbers are being used in the Tukituki Choices document.
4. It is recommended that HBRC convene a caucus of water quality experts (including water quality experts nominated by Ruataniwha Stakeholder members) to discuss the matters in point 2 and 3 above, with the objective of seeking agreement between the scientists on the approach undertaken and the recommendations.
5. Managing the environmental impacts of land use intensification successfully will require universal adoption of effective and appropriate land management (good agricultural practices) by farmers utilising irrigation water in particular, as well as by other farmers in the catchment.
6. That the "Trigger Level" approach for nitrogen management outlined in the paper entitled *Nutrient Management Framework* presented to the Working Party by Helen Codlin on 9 August 2012 is generally supported, however it is noted that Working Party members wish to reserve their position on the approach, pending the publication of the Tukituki Choices document, the supporting report entitled *Nutrient Management Approaches for the Tukituki Catchment, August 2012*, and the Draft Tukituki Plan Change including more detail regarding operational, monitoring and enforcement mechanisms (such as nutrient management plans and stock exclusion rules).
7. It is recommended that the HBRC policy team reconvene the Working Party to discuss and provide input to the Draft Tukituki Plan Change document once it has been prepared by HBRC following completion of the Tukituki Choices consultation period.

Continued: Findings and Recommendations – Discussed and Agreed at 17 August 2012 Meeting
Ruataniwha Storage Scheme Land Use Intensification
8. The Working Party records that it has followed the development of the NIWA report entitled Modelling the effects of Land use on nutrients entering the Tukituki River, Hawke's Bay and notes the further modelling actions that are outlined in the Executive Summary of that Report. It is recommended that HBRC convene a caucus of water quality experts (including water quality experts nominated by Ruataniwha Stakeholder members) to discuss this work with the objective of seeking agreement between the scientists on the approach undertaken and the scope of the further modelling proposed for the upper catchment area.
9. It is recommended that if HBRC determines that the Ruataniwha Water Storage project is feasible and resolves to seek resource consents for the project that the Council reconvene the Working Party to discuss and provide input to proposed resource consent conditions (including the development and assessment of tools for managing and monitoring intensified farms) for nutrient management within the irrigated area.
10. The Working Party acknowledges that it has not developed and assessed a complete mitigation tool box and this needs to be a continual improvement process supported by extension, education and regulation where required.

All parties participating in the Land Use Intensification Working Party process have agreed with these recommendations and signed off the final report with the exception of Fish & Game, who make the following statement:

> *"Hawke's Bay Fish & Game has not signed the final report from the land use intensification working party. Fish & Game has concerns regarding some of the content including records of minutes, and the current proposed approach of the regional council to set instream nitrogen levels at toxicity standards. The report is a mix of process, administrative, and outcome statements which should stand on its own merit. Fish & Game has fully participated in the process from the outset, appreciates the efforts made by the Regional Council to engage, and will be confirming its position on the project at the appropriate time once it is fully informed on the issues."*

3.10 HBRC CORE TEAM FINDINGS AND RECOMMENDATIONS

Overall Conclusions

The HBRC Core Project Team have reviewed the conclusions and recommendations of the various modelling and environmental, social and cultural assessment reports summarised above. Collectively the reports are considered to be thorough and of high quality given the stage of the project leading up to the feasibility decision. We are confident that the Council has sufficient information on the environmental, social and cultural issues and effects associated with the scheme to make an informed decision as to its feasibility in relation to these aspects. In particular we have identified no material gaps in the assessment work done to date that would suggest a need to defer a decision to proceed to the next stage (preparation of resource consent applications and the associated Assessment of Environmental Effects documentation).

To the extent that the study authors have identified the need for further work we support their recommendations. We believe that there is further work required to confirm the conclusions they have reached in some areas, but based on the information in hand we do not anticipate that this

further work will identify any fatal environmental flaws that would call the entire project into question.

Cultural Values

In relation to the recommendations contained in the Cutural Impact Assessment Report we consider the following matters are relevant considerations:

a) The recommendations regarding governance and management associated with the Tukituki Catchment seem to be largely addressed by the co-governance function of the recently established HBRC Regional Planning Committee whose function is to oversee the development of policy and plan instruments for the catchment

b) The recommendations associated with "mauri" have been recognised and addressed through the development of the integrated mitigation and offset report, with iwi representation proposed on the administering Trust

c) Council is assessing the implementation of higher minimum flow limits to address the historic low flow issues in the catchment, as part of the upcoming Plan Change.

We consider that further discussions should be held with Te Taiwhenua O Tamatea and Te Taiwhenua O Heretaunga in relation to the other key recommendations such as:

a) How to realise potential social and economic benefits for tangata whenua

b) Potential involvement of tangata whenua in monitoring

c) How best to define and recognise any unregistered wahi tapu / wahi taonga; and

d) Historic Places Act authority requirements including the development of appropriate Accidental Discovery Protocols.

Downstream Effects of Sediment Retention

As recommended in the Tonkin & Taylor Ltd sedimentation assessment report (*Fisher & Russell, 2012)* HBRC has recently commissioned some further assessment work associated with effects of sediment retention and the consequent interruption of downstream gravel supplies. We understand this work is to be completed during the balance of 2012 and note that the outcomes of the work will need to be included with the Assessment of Environmental Effects if the project is put forward for resource consenting.

Erosion and Sediment Control

Another area where we definitely consider further work is required is in the area of erosion and sediment control, where Tonkin & Taylor Ltd has recommended that an Erosion and Sediment Control Plan (ESCP) be prepared by the contractor once that body is appointed. Given the extensive areas of earthworks involved and the critical importance of controlling sediment run off to waterways we recommend that a detailed ESCP be prepared as part of the suite of documents to support resource consent applications if these are lodged.

Irrigation Command Area

We also note that there are some inconsistencies through the various reports regarding the amount of land area that might be ultimately serviced by the scheme. This has resulted from progressive refinement of the project occuring in parallel with modelling and effects assessments. There is also the factor that depending on the ultimate mix of land use that might develop, a greater or lesser area would able be able to be serviced with the irrigation water, as different land uses have different water demands. We do not believe that the differences are material to the conclusions the authors have reached, but this is a matter that needs to be better reconciled and explained in further reporting on the scheme if it is progressed past feasibility.

Contentious Issues

Community engagement to date would suggest that the contentious issues in any consenting process are likely to surround the effects on water quality resulting from land use intensification and the ability to guarantee an improved summer flow regime in the lower catchment where amenity and contact recreation values are important for the community living in this area.

Integrated Tukituki Catchment Management

HBRC has invested significantly in assessing these issues and we note there is an overlap with the development of changes to the Regional Policy Statement and the Regional Plan occurring alongside the feasibility study for the Ruataniwha Water Storage Project. We are aware that the policy statement and plan change process also has to reflect changing scientific understanding around water quantity and quality limits. The National Policy Statement for Freshwater Management means that the status quo management of the Tukituki catchment is not an option for Council. During the middle of 2012 the Council decided that it was appropriate to integrate the consideration of the Ruataniwha Water Storage project and the relevant regional policy and planning instruments.

The key linking document between the two processes is "Tukituki Choices" which summarises the catchment issues and the potential management options available to Council. Normally in an assessment of environmental project feasibility of this nature, one would analyse the key planning instruments in some detail. In this case, with the regional planning position also at a key decision making point, this would not be a useful exercise. Therefore, our analysis on environmental feasibility has proceeded on the assumption that the outcome of the Tukituki Choices process is one of general support for water storage in the Tukituki catchment and that the regional planning framework will reflect that. The counterpoint is that in our view a Council decision on project feasibility should necessarily be provisional pending the outcome of the Tukituki Choices process where Council is seeking community input and discussion on the priorities for catchment management.

Planning Status

We have, however, undertaken a preliminary assessment of consenting status of the project within the District Council planning jurisdictions. While the vast bulk of the project footprint resides in Central Hawke's Bay District, a small portion of the proposed reservoir lies in Hastings District. Our conclusion is that any land use applications will be considered as discretionary activities under both District Plans. The effects assessments prepared to date in relation to District Council matters (e.g. noise, landscape, traffic, archaeology) do not identify any issues that cannot be managed through appropriate mitigation and suitable resource consent conditions. It will be necessary to undertake a full planning assessment if the project is to proceed to a resource consenting phase.

Land Use Intensification

Returning to the contentious environmental issues associated with the project, the analysis of land use intensification effects on water quality suggests to us that effective management of nitrate to avoid toxicity effects in some spring fed tributaries on the Ruataniwha Plains is likely to be a key issue and NIWA have recommended further work to give greater confidence that an acceptable environmental outcome can be achieved.

We also believe that with the current NIWA modelling showing increased phosphorus inputs to the catchment resulting from land use intensification, providing confidence that farm nutrient management plans and mitigation actions will minimise phosphorus reaching surface water bodies will be a key consenting issue. While the NIWA modelling predicts an improved in-river outcome in terms of periphyton levels in the middle to lower catchment from the current position, this is the product of reduced phosphorus from the Waipukurau and Waipawa waste water plants and the modelling demonstrates that without effective management, future land use intensification will

erode some of the benefit from reductions from these point sources. From the information we have, we believe it is possible to control phosphorus outputs from irrigated farms to an acceptable level, but the Council will need to commit the resources and planning framework to provide the necessary confidence that this will actually occur. Again this is an area where development of the project assessments and consent conditions, and the upcoming plan change, need to be integrated.

The peer reviewer of the land-use intensification modelling work has commented that more work is required in respect of the SPASMO and OVERSEER inputs to that work, to identify what margin of error those components contribute to the modelled predictions. If the project proceeds further, it is proposed to focus on this aspect of the modelling work, desirably with the assistance of a specialist peer reviewer, expert in the construction and use of such models.

Specifically, if it is decided by Council that the project should progress to the consenting phase, it will be necessary to expand the extent of the modelling that has already been completed and the Core Team recommends that:

a) The land use/nutrient/periphyton model be expanded to the whole of the Tukituki catchment to provide more detailed outputs, particularly within the Ruataniwha Plains area;

b) The above expanded model be applied to the current and future land use scenarios developed as part of the feasibility study;

c) If a decision is made to extend the irrigation area to Zone M, the land use/ nutrient/ periphyton model will need to be extended to that zone, to assess the potential effects of irrigated land uses;

d) A comprehensive assessment of the following be undertaken:

- the options to mitigate phosphorus losses from land, including livestock exclusion, and
- the likely water quality and periphyton outcomes resulting from the implementation of the above mitigation options within the irrigation command areas.

Summer Low Flows

The other issue highlighted by the HBRC groundwater / surface water modelling assessment and emphasised by stakeholder feedback to date is that realisation of the full potential benefits of the Ruataniwha Water Storage project in terms of increasing summer low flows is tied to the extent to which existing surface and groundwater consent holders on the Ruataniwha Plains migrate to use of stored water. The development scenarios tested in the HBRC modelling report assumed either 100% migration of consent holders or nil migration. Obviously with reduction in irrigation security for at least some of those existing irrigators if the signalled increased minimum flow limits are put in place in the Tukituki Plan Change, it is likely that some greater or lesser percentage of existing irrigators will migrate. However, any estimate of what the percentage might be can only be speculation at this point so the HBRC report prepared for feasibility purposes correctly models only the extremes.

In terms of Waipawa River flows at RDS and Tukituki River flows at Red Bridge (sites directly affected by the operation of the scheme), modelled predictions of the extreme case with no existing irrigators migrating to the scheme (Scenario 4) show minor increases in flow statistics representing extreme low flow conditions (e.g the Q_{99} statistic where flows are exceeded 99% of the time), but minor decreases in other flow statistics such as the Q_{95} and MALF when compared to relation to current conditions (represented by Scenario 2). In contrast, the Q_{99}, Q_{95} and MALF all show a material increase in the scenario that assumes all existing irrigators migrate to the scheme (Scenario 3).

Council cannot require existing irrigators to relinquish their consents and move to the Ruataniwha Water Storage scheme. However the Core Team believes that an environment which encourages existing Ruataniwha Plains irrigators to migrate to the scheme will improve environmental

conditions in the lower catchment and assist achievement of community aspirations for that area of the catchment. We note there are a range of potential incentives which may encourage existing irrigators to consider a transition to utilising stored water from the Rauataniwha Water Storage Scheme including:

a) If the Council implements the proposed increased minimum flow regime in the upcoming Tukituki Plan Change, the reliability of irrigation water for many current irrigators will decrease from what it is at present. Water security under a stored water scenario at 95% reliability would be materially better than surface water and linked groundwater take reliability;

b) Increasing electricity charges over time will mean the predominantly gravity-fed Ruataniwha Water Storage Scheme will have energy cost advantages over pumped groundwater irrigation water;

c) If the project proceeds to the consent application stage, a consent term of 35 years will be sought which, if granted, would provide long-term regulatory security for irrigators.

In addition to the potential incentives listed above, we recommend Council consider favourably an economic incentive package which enables existing irrigators to transfer to the storage scheme (if it is built) on a cost effective basis for their businesses. The reality is that the uncertainty as to how many irrigators will migrate to the scheme will remain but the more likely it is that irrigators will make the change, the greater the level of confidence RMA decision-makers will have that the benefits of the scheme will be optimised.

In conjunction with development of such incentives, we recommend further work be undertaken on the construction of the “no migration” water flow scenario. Recent analysis of the areas able to be serviced by scheme water in Zones A to D suggests that it may well not be possible to utilise all the stored water unless a substantial number of existing irrigators join the scheme and/or the command area is extended into substantial areas of Zones M and/or N. Accordingly the modelled “no migration” scenario (Scenario 4) requires some re-definition in our view. We also note that any extension of the command area would require further consideration of a range of technical, environmental and presumably economic issues before any resource consent applications are made.

Another potential benefit that might be assessed relates to the availability of “unutilised water” during the initial uptake period when the water from the storage scheme is not being fully used for irrigation. During this period, there is potential for stored water to be released as an additional “environmental flow contribution” (over and above the constant residual flow) to augment low summer flows downstream. However, from an effects assesment persepective, we would caution that this potential benefit would only be temporary, as the economics of the project will require full uptake of the available water for irigation as soon as it can be contracted.

We consider that longer term Tukituki River benefits might acrue from some further analysis being undertaken associated with the most effective utilisation of the “environmental flows” assumed in the Tonkin & Taylor Ltd Feasibility Project Description. The constant residual flow from the dam of 90% of MALF combined with the proposed flushing flow volume provision of 1.5 million m^3 per annum is a significant amount of water and we recommend that Cawthron and Tonkin & Taylor Ltd be jointly tasked with assessing the most effective utilisation of this water volume in terms of overall river ecology.

Integrated Mitigation and Offsetting

As discussed in section 3.11 below, feedback from the Department of Conservation in the Stakeholder Group meeting discussing the draft Environmental, Social and Cultural sections of this report, suggested that the expenditure proposed in the Integrated Mitigation and Offsetting Report might be able to be redistributed in order to achieve greater overall environmental benefits. The

Core Team recommends that this potential be explored in direct discussions with the Department, if it is decided by Council that the project should progress to the consenting phase.

3.11 RUATANIWHA STAKEHOLDER GROUP CONSIDERATION

Section 4.3 below discusses the membership and role of the Ruataniwha Stakeholder Group. A draft of the Environmental, Social and Cultural section of this Report was circulated to the Stakeholder Group and was discussed at its 31 August 2012 meeting. The format of the discussion was that Stakeholder Group members considered each section of the Environmental, Social and Cultural component of this Report in turn.

In relation to the methodology adopted (section 3.1 above) the Stakeholder Group confirmed its understanding of the methodology utilised for assessing reporting on the Environmental, Social and Cultural elements of the Project feasibility.

The Stakeholder Group acknowledged the range of studies undertaken (outlined in section 3.2 above) and confirmed their review of and input into the scope of the studies.

Prior to discussion of the findings and recommendations of the various studies, the Fish & Game representative indicated that they had insufficient time to fully review and comprehend the studies and would therefore abstain from expressing any views at that point in time. Fish & Game advised that they would provide their position subsequently in writing. The following statement has been provided by Fish & Game:

> *"The critical information that is required for a professional response has only just been provided to Fish and Game and other parties in the past few weeks and months. It requires detailed technical analysis and to do this work requires input from a variety of sources which comes at considerable unbudgeted cost.*
>
> *It is not accurate to identify Fish and Game as having 'no position', and I trust that the Hawke's Bay Regional Council team will respect the fact that a number of issues are unresolved for Fish and Game largely as a consequence of information still to come to hand, and expert technical conferencing on the existing and intended technical reports. In particular fish and game has significant concerns with current proposals to set instream nitrogen limits at toxicity standards instead of for periphyton growth and life supporting capacity. As we have identified, this project is costed by your own projections at many hundreds of millions of dollars, and it would be ridiculous to continue to work to arbitrary dates when further technical information and informed discussion is required on a number of matters related to the project.*
>
> *Fish and Game has concerns regarding some of the content including records of minutes, and the current proposed approach of the regional council to set instream nitrogen levels at toxicity standards. Fish and Game has fully participated in the process from the outset, appreciates the efforts made by the regional council to engage, and will be confirming its position on the project at the appropriate time once it is fully informed on the issues."*

The balance of the Stakeholder Group confirmed their understanding and support for the Reservoir Water Quality Modelling Report discussed in section 3.4.1 above.

In relation to the discussion of the Land Use Intensification Modelling discussed at section 3.4.3 above, Messrs Belford, Christie and Cooper (representing Forest & Bird), and Cheyne (representing Te Taiao Environmental Group) expressed the view that the additional modelling recommended in this report should be undertaken prior to a determination of project feasibility.

Members of the Stakeholder Group (excluding Fish & Game) indicated their understanding and support for the recommendations in the Terrestrial Ecology Assessment (discussed in section 3.5.1 above).

In relation to the Aquatic Ecology Assessment, Messrs Belford and Christie reserved their support and Mr Carlton of Department of Conservation did not support the trap and transfer system proposed by Cawthron. All other Stakeholder Group Members (excluding Fish & Game) indicated their understanding and support for Cawthron's recommendations.

All members of the Stakeholder Group aside from Fish & Game indicated their understanding and support for the balance of effects assessments discussed in sections 3.6 - 3.7.6 inclusive.

In relation to the Integrated Mitigation and Offset Report the Department of Conservation representative expressed the opinion that there were additional opportunities that could be realised within the current budget provision for the offset mitigation work recommended. Forest and Bird requested that mitigation work should be mandated in the resource consent application as opposed to being left as "best efforts".

Mr Belford reserved his position on the Core Team recommendations set out in section 3.10 above. The balance of the Stakeholder Group, excluding Fish & Game, agreed that the recommendations set out in section 3.10 be implemented if Project feasibility is confirmed by Council and the Project proceeds to a resource consenting phase.

The Stakeholder Group unanimously agreed that the more detailed matrix, attached in Appendix 4, should be included in the Feasibility Report to Council.

Having considered the input from the Stakeholder Group, the Core Team believes it is appropriate to draw the Council's attention to the expression of opinion on behalf of the environmental groups represented on the Stakeholder Group that a decision on project feasibility should be deferred until completion of further monitoring work as above. This recommendation is not supported for the reasons set out in section 3.10 above. In addition, if the Core Team recommendations are accepted, the results of the further modelling will be known before any resource consent applications are lodged.

The suggestion from Department of Conservation that a redistribution of proposed mitigation/offset expenditure might achieve greater environmental benefits is also worthy of note. An additional recommendation has been added to section 3.10, that discussion be held with the Department to explore this issue further.

4.0 COMMUNITY ENGAGEMENT

4.1 INTRODUCTION

Community engagement with the project was established early on in the process, and included development of two formal groups, the Leadership Group and Ruataniwha Stakeholder Group, to assist and advise the Project Team throughout the pre- and full-feasibility phases of the project. The structure and role of these groups is further outlined in the sections below.

Public meetings, media releases, field days and speaking engagements have also allowed the public to remain informed of the project over time. Groups such as Rotary, Fish & Game and Forest & Bird have had personal presentations; and Territorial Authorities and elected officials have been provided with regular updates on the project and invited to attend field trips as they are arranged. Table 15 provides a summary.

4.2 LEADERSHIP GROUP

The Leadership Group was established in April 2010 to champion, govern and guide the feasibility project; and to ensure that the correct market, economic, commercial, risk and benefit/cost questions were asked and systematically addressed so that the feasibility (including scale, extent and timing) of the project could be determined.

Sam Robinson, a Central Hawke's Bay farmer and Chair of AgResearch, was appointed to Chair the group. Other members include representatives of the business and farming communities, Iwi and Regional Council elected officials. Debbie Hewitt, the Chairman of the Ruataniwha Stakeholder Group is an active participant in the group discussions but remains independent of group decisions.

Throughout the feasibility phase of the project, the Leadership Group has generally met on a bi-monthly basis, or as required in order to advise on process at key points. Table 13 lists the dates and location of Leadership Group meetings held during the feasibility phase of the project.

Table 13: Leadership Group Meeting Summary

Date	Location
13 April 2010	Council Chamber, HBRC
2 June 2010	Council Chamber, HBRC
2 August 2010	Council Chamber, HBRC
12 October 2010	Council Chamber, HBRC
10 March 2011	Council Chamber, HBRC
18 August 2011	Council Chamber, HBRC
31 October 2011	Council Chamber, HBRC
29 March 2012	Council Chamber, HBRC
25 June 2012	Council Chamber, HBRC
14 August 2012	Council Chamber, HBRC
19 September 2012	Council Chamber, HBRC

4.3 RUATANIWHA STAKEHOLDER GROUP

The Ruataniwha Stakeholder Group was established in April 2010 to share information and identify and explore community expectations on water management for the various uses in the Upper Tukituki catchment, specifically on the Ruataniwha Plains. The group's role also includes assisting with identification of the value of water to the whole community and in coordinating more effective stakeholder input into water management decision-making processes for the Plains. This includes providing guidance to the development of the storage project in a collaborative way, with specific emphasis on environmental, social and cultural elements of the project.

Debbie Hewitt, a Director for Horticulture NZ and a Central Hawke's Bay farmer, Chairs the group, which includes representatives from Fish & Game, Forest and Bird, Department of Conservation, Central Hawke's Bay District Council, Tukituki Liaison Group; as well as Iwi, landowner, recreation club, and water user group representatives.

During the advanced pre-feasibility phase of the project, Stakeholder Group meetings were held bi-monthly. This was increased to 6-weekly intervals during the full feasibility phase (June 2011 – August 2012). Table 14 summarises the Stakeholder Group meeting schedule and key topics discussed during each meeting.

Table 15 sets out other Community Engagement.

Table 14: Summary of Stakeholder Group Meetings and Key Topics Discussed

Date	Summary of Meeting
6 May 2010	- Presentations on Regional Water Management Strategy, Tukituki Liaison Group, North Otago Farm – Audit Report, HBRC – Regional Strategic Water Demand and Availability Study, Science Programme - Terms of Reference discussed
22 June 2010	- Project Update - sites removed from project due to geotech work/seismic activity, - F&G indicated Trout spawning site in Dutch Creek - HBRC presentation on RC Science work, - Update on 31 May Landowner Meeting, - Group reminded this is a two year process.
10 August 2010	- Project Update – Ruataniwha GW model completed by HBRC Science, trend showed decreasing availability of water for irrigation and other uses. - Hapu site visit took place 7 Aug. - Latest dam sites map displayed. - Project Timeline circulated. - Opuha Irrigation System & Dam (Rural Delivery TV) shown to group. - Presentation from DOC on Canterbury Experience.
26 October 2010	- Project Update – National Land & Water Forum Report discussed. - Regional Councils' position paper on National Water Strategy discussed. - Debbie Hewitt to present at HB Regional Water Symposium. - Presentation on Ruataniwha soil types. - Presentations by Dan Bloomer & Chris Perley – Land Use Options & A Strategic View.

Date	Summary of Meeting
1 February 2011	- Update on D5 & A7 sites, significant fault lines outlined in Ruataniwha Basin. Science Presentation on Tukituki hydrology and gw/sw interaction. - Stakeholders asked for their Key issues ... Costs, gravel, recreation , land use balance, keep the information flowing, environmental impact, how will best practice be enforced, see working in partnership – a Kaitiaki role. ... - We don't have all the answers today, feasibility process will go for next 18 months.
3 Jun 2011	- Projects relationship with the media questioned. - Sam Robinson, Chairman of RWS Leadership Group briefed the group. - Cultural Impact Assessment study presented by Dr Benita Wakefield. - Engineering Work programme – tender issued. - Environmental Work programme – Eight Environmental work scopes presented.
6 July 2011	- Update on Council approved funding & MAF funding for next financial year. - Technical Feasibility Update – Makaretu site drilling uncovered previously unknown aquifer. Expansion of drilling programme at Makaroro site. - Environmental Work Programme – Tenders for Aquatic & Terrestrial work scopes closed today. - Glen McLean appointed to undertake Spawning Survey. - Non-Physical Science Study Scopes outlined.
19 August 2011	- Dam Engineering Update – D5 site no longer being investigated due to complex geotechnical discoveries. New footprint for A7 site shown. - Updates provided on Ecology Studies, Spawning Survey, Social Impact Assessment, Iwi Communications, Communications Strategy
6 October 2011	- Project Update – Drillers on site, 2 more potential irrigation zones M & N being considered, Land Use Intensification Study commencing. - Update on Expectations for Current Consent Holders. - Iwi Values Setting Study – for wider plan change work commencing - Social Impact Assessment presentation by Nick Taylor - Update on Tukituki Regional Plan Change and Community Engagement - Communications Strategy outlined
22 November 2011	- Project Update – Tonkin & Taylor Ltd Initial Project Description draft report received - exec summary to be provided to Stakeholder Grp. - MAF representatives to meet with Council on funding - HBRC to have stand at CHB A & P Show - 2nd HB Land & Water Symposium announced for 30 November. - The "Risks" reiterated – Technical/Geological, Land Use Intensification, Change process for Consent Holders, Uptake Risk. - Nominations asked for LUI steering group.
10 February 2012	- Project Update – HBRC attending workshop on reticulation and refining costs.

Date	Summary of Meeting
	- Hydro Power evaluation being undertaken - MAF funding secured through to end of feasibility stage. - LUI update received. - Update on Study scopes received - Presentation by Nick Taylor – Social Impact Assessment - conclusion Irrigation brings as important range of potential social-economic benefits that can enhance social and economic wellbeing. - Finance and Business modelling update by Andrew Newman
22 March 2012	- Project Update – Timelines discussed may mean push from June to August. - Helen Codlin on Tukituki Plans Change – critical timelines to be in line with Water Storage Project, Stakeholder Group to be kept informed of key issues. Stakeholder members received feedback from community on recent "Consent Holder Newsletter". - Iain Maxwell gave update Water Quality programme – specifically nitrates and phosphorus. - Presentations received from Gavin Lister, Isthmus Group on the Landscape Study, Simon Bickler, Clough & Associates – Archaeology, Michele Frey, Opus – Recreation Study. - Update from LUI working party
27 April 2012	- Combined Leadership / Stakeholder Group meeting to be arranged. - A clear summary of studies to be provided. - Updated Gantt chart circulated - project timelines pushed out to August. - Estimated cost for a piped distribution noted $30 mil. This on top of the est. $230 build cost. - Presentation on Noise Assessment study and Traffic/Roading Study. - Presentation on NIWA report on Reservoir Water Quality. - Gerry Kessels presented his Terrestrial Ecology Report. - Update from LUI working party
14 June 2012	- Feedback received on Terrestrial Ecology Report. - Project Update – Zones M & N engineers currently reviewing. Construction of distribution network would be driven by uptake. - Tukituki Cultural Values & Uses Assessment presented by Marei Apatu and Dale Moffatt of Te Taiwhenua O Heretaunga. - Update from LUI working party. - HBRC Draft Ground Water/Surface Water Resource Report presented by Iain Maxwell and Rob Waldron.
25 June 2012	- Presentation on HBRC Water Strategy, integration of Tukituki Plan Change and Water Storage Project. - Group discussed EPA, making submissions, timelines - Presentation on Tukituki Choices, consultation process. - Group discussed cost, ownership, employment, investment, consenting process

Date	Summary of Meeting
27 July 2012	- Overview given of next phase - Discussion on Feasibility Summary Report - Small Scale on Farm Water Storage - Presentation on Tonkin & Taylor Ltd Sedimentation Report - Presentation on Dam Break Analysis by Craig Goodier - Update from LUI working party. - Presentation of Cawthron Aquatic Ecology Report by Roger Young from Cawthron. - Presentation of Mitigation Offset Report by Larissa Coubrough - Overview of Tukituki River Catchment Cultural Values & Uses Report by Benita Wakefield - Update on Communication Activity
31 August 2012	- Project Update – science caucusing proposal, final aquatic ecology and mitigation/offset reports. - LUI final update and presentation of final Working Party report for members signatures. - Draft Feasibility Environmental Summary Report to Council and completion of decision matrix. - Discussion on position of cadmium as part of nutrient management discussion. - Economic overview from Macfarlane Rural Business Ltd – Review of Farm Profitability Report. - Presentation on Tukituki Choices document and process. - Discussion on Stakeholder Group future.

Table 15: A Summary Outline of Community Engagements Held Since 2009.

Meeting Type/Organisation	Date	Location(s)
Central Hawke's Bay District Council & Hastings District Council meetings	Jun 2009 – Aug 2012	CHBDC; Hastings District Council; Dam Site
Various public meetings (approx. 10)	Jul 2009 – Sept 2012	Various Hawke's Bay Locations
Potentially Affected Landowner meetings (group and one-on-one meetings – approx. 20)	Sept 2009 – Aug 2012	Various locations, Central Hawke's Bay
Various Forest and Bird meetings (e.g. CHB, Hastings and Havelock North Branches)	Oct 2010 – Apr 2012	Waipukurau Hastings & Havelock North
Regional Water Symposiums	31 Nov - 1 Dec 1010 & 30 Nov 2011	Napier War Memorial Conference Centre
Grasshoppers	Jan 2012	Wakarara Road & Wallingford Station
Nga Kaitiaki o te Awa a Ngaruroro @ Love Our River Day	18 Feb 12	Kuripapango
Greenmeadows Rotary	21 Mar 12	Taradale Town Hall
HB Chamber of Commerce	21 Jun 12	Hettinga Estate
Napier Freemasons	22 Aug 2011	Napier
CHB Anglers	4 Jul 12	CHB
Fish & Game Board HB	17 Jul 12	Fish & Game HB
Professional bodies (e.g. IPENZ HB, Contractors Federation)	Jul 12 – Sept 12	HBRC
Sector Group Market/Science meetings including financial institutions (>100)	2010 - 2012	Various locations, New Zealand
Pan Sector Group meetings (4)	Mar 12 – Aug 12	Various locations, Napier
Meetings with Iwi/Hapu (>20)	2009 - 2011	Various locations, Hawke's Bay

4.4 LAND USE INTENSIFICATION WORKING PARTY

To assist HBRC and its consultancy team in the tasks associated with Land Use Intensification in particular, the Land Use Intensification Working Party, comprising nominated members of the Ruataniwha Stakeholder Group, HBRC Staff and consultants was established in November 2011. Ruataniwha Stakeholder Group members nominated onto the Working Party included: Hugh Ritchie, Campbell Chard, Peter McIntosh, Benita Wakefield, and Tom Belford. The nominated Working Party members represented a range of interest groups including two farmer representatives (cropping and dairy), Fish & Game, Tamatea Taiwhenua, and a Lower Tukituki representative.

The primary objective of the group was to provide an interactive working forum to follow the development and application of the Ruataniwha Land Use Intensification Model; providing input into the development and testing of potential on-farm and off-farm means of managing and mitigating the effects of existing land use and intensification.

The group met on a monthly basis between January and August 2012, with two meetings held in August.

The group's final meeting for this phase of work was held on 17 August 2012. The Working Party prepared a report (*Daysh, 2012*) summarising their key findings and recommendations for future work around intensification, and this was presented to the Stakeholder Group at their 31 August 2012 meeting. Refer to Section 3.9.1 for findings, signatories and exclusions.

4.5 LANDOWNERS

Landowner meetings have been scheduled as required throughout the course of the pre-feasibility and full feasibility phases of the project in order to keep potentially affected landowners informed of progress and key decision points. The importance of keeping all landowners in the region as up-to-date as possible on the project is acknowledged; however the changing dynamics of the Scheme since its inception has meant information has been quickly superseded.

At the end of the pre-feasibility phase of investigations one on one meetings were held with those that owned land in locations of the proposed storage sites to inform them of the project. During the advanced pre-feasibility phase Council kept in telephone contact with landowners potentially affected by the project and advised individuals as sites were discounted. The first HBRC-run landowner meeting was held at Ongaonga Golf Club on 31 May 2010, and was attended by approximately 50 landowners. During this key meeting, two landowner representatives (Andrew Watts and Duncan Holden) were voted onto the Stakeholder Group to represent the interests of affected landowners from that point forward. Successive landowner meetings were held in January and July 2011 and March 2012 to update landowners affected by the dam/reservoir area on project progress and to enable any concerns to be raised and addressed.

Tonkin & Taylor Ltd's Feasibility Project Description (June 2012) provided the certainty required, in terms of the proposed headrace canal route, to enable Council to approach landowners potentially affected by the scheme distribution system; and one-on-one meetings with affected landowners on the proposed headrace route were carried out in July and August 2012. It is anticipated that the same level of landowner liaison will continue through the optimisation phase and any future consenting processes associated with the project.

The overall position of the landowners affected by the potential project infastrucure (reservoir, dam and headrace canal) is that if the project is advanced after feasibility is completed they will want to discuss with HBRC details on specific effects on their properties and how they might be able to be managed and mitigated, to form a basis to begin negotiations in relation to property access and compensation.

4.6 IWI

Having local Iwi representatives on the Stakeholder Group, and Dr Roger Maaka as a member of the Leadership Group, has allowed for good communication with Iwi throughout the feasibility project. HBRC's Maori Committee, and the recently expanded Regional Planning Committee, provides two further forums for sharing of information.

A number of Maori organisations have been engaged in the project over time:

- **Mataweka and Tapairu marae (Waipawa)** – have a direct interest in the dam proposed at Makaroro.
- **Te Taiwhenua O Tamatea** – represent all Central Hawke's Bay marae and has been represented on the Stakeholder Group.
- **TeTaiwhenua O Heretaunga** – represent all marae in the Lower Tukituki catchment.
- **He Toa Takitini** – are the claimant group for the Hastings and Central Hawke's Bay marae. This group will eventually be replaced by a post-settlement governance entity, which will provide the vehicle by which any settlement sponsored investment would be channelled. It is estimated that settlement will take place around 2013-14.
- **Ngati Kahungunu Iwi Incorporated (NKII)** – manages fisheries assets on behalf of Iwi and has a holding company that deals with NKII investments. The group is interested in water management in general but has no direct input into the storage project at present. The group may have a future interest in investing
- **Aorangi Maori Trust Board – formed in 1958**. The Board manages assets on behalf of the Takapau hapu that came from compensation for the Aorangi land block (land around Oruawharo). The Board has no current interest in the storage project but as a statutory body that represents local hapu, may potentially be an investor in future.

Two Cultural Impact Assessments (CIAs) were initially completed during the advanced pre-feasibility phase of the project, providing technical information from a tikanga Tangata whenua perspective and identifying areas of cultural significance within the footprint of the proposed storage area.

In June 2012 a *"Cultural Values and Uses of the Tukituki Catchment"* report was completed. The report, which was jointly commissioned as part of the Tukituki Plan Change and the Ruataniwha Water Storage project feasibility processes, was completed by Te Taiwhenua O Tamatea in partnership with Te Taiwhenua O Heretaunga. The assessment report describes the cultural values and uses of the wider Tukituki River and Catchment, pulling together the key points and recommendations from the two previously completed CIAs also. As part of this process Te Taiwhenua O Heretaunga produced their own report entitled *"Ko Wai Ka Hua – Cultural Values and Uses, Cultural Impact Assessment Report of the Lower Tukituki Catchment"* (Te Apatu & Moffat, 2012). The key findings of this report were presented to the Stakeholder Group at their meeting of 14 June 2012 by Marei Apatu and Dale Moffatt from Te Taiwhenua O Heretaunga.

The presentation highlighted the relationship of all hapu residing in the Tukituki catchment, emphasising that the importance of the Awa cannot be differentiated between the upper and lower catchments of the river. The importance to Maori in being able to express their relationship and values within the Tukituki River Catchment through concepts such as mauri, mana whenua and kaitiakitanga was also acknowledged.

4.7 PAN SECTOR GROUP

A Pan Sector group was established in early-2012 to facilitate input into the Ruataniwha Water Storage and Tukituki Plan Change processes, by industry and academic organisations. At a high level, the group's role is to assist and coordinate the maximum sustainable benefit from the Ruataniwha

Plains, recognising that a collaborative approach is required to realise the potential environmental, economic and social gains possible for the region.

The group includes representatives from: Fonterra, Silver Fern Farms, McCain Foods, Foundation for Arable Research, AgResearch, Massey, Ministry of Primary Industries, Zespri, HortNZ, Federated Farmers, DairyNZ, Beef and Lamb, Heinz Watties, Fert Research, Plant & Food, Irrigation NZ, PipFruit NZ, Rural Futures, NZ Wine Growers, and HB Fruit Growers; as well as Hawke's Bay farmers.

Since its establishment, the group has been actively involved in the land use intensification work completed through the project, and in developing the nutrient management framework proposed through the Tukituki Plan Change process. The Pan Sector group has met on three occasions to-date, and it is planned that this group will be a key forum for HBRC to discuss the Tukituki Choices / Plan Change process and the development of potential resource consent conditions for the Storage project associated with nutrient control and management, if Council determines to proceed to seek resource consents on the project.

4.8 RECOMMENDATIONS FOR FURTHER COMMUNITY ENGAGEMENT

- That the Ruataniwha Stakeholder Group be maintained as an important community based reference group through-out the consideration of the Tukituki Choices document, the development of the Tukituki Plan Change and any Ruataniwha Storage Project resource consent applications that are prepared through the balance of 2012 and 2013. Consideration should be given to the addition of other key parties such as representatives of Te Taiwhenua O Heretaunga, Hastings District Council and the Ministry of Primary Industries, if it is decided to maintain the group through this period.
- That the Land Use Intensification Working Party be reconvened to provide input into the resource consent condition drafting process associated with land use intensification management and monitoring conditions if the project proceeds through to the consenting phase later this year.
- That Council engage further with the Pan Sector Group if the project develops past feasibility into a consenting phase, in particular to seek input and assistance with the development of appropriate land use intensification management and monitoring conditions.
- That detailed one-on-one meetings are held with all landowners affected by the dam/reservoir and distribution headrace canal so that issues can be discussed and addressed in the design of the scheme prior to any application for resource consent being lodged.

5.0 ECONOMIC VIABILITY

5.1 INTRODUCTION

The Ruataniwha Plains Water Storage Project ("Project") would provide a reliable supply of water for approximately 25,000 ha of farmland. The availability of water would allow intensification of existing dryland farms and conversion to new farm types, with subsequent economic benefit and improved resilience for the greater Hawke's Bay region. So far, the report has outlined the Project's technical feasibility and how the Project will assist Hawke's Bay Regional Council (HBRC) in achieving its environmental goals. This Section outlines the financial feasibility for the Project, providing analysis which explores financial implications for farmers and investors in the dam and distribution infrastructure, and the wider regional economic benefits to justify HBRC's involvement.

An assessment of the financially feasible water distribution price is critical from both a water supply and water demand perspective. On the supply side, the water distribution price needs to be at a level such that returns from the dam and distribution infrastructure are sufficient to attract investment to fund the initial construction cost and ongoing operational costs of off-farm infrastructure. On the demand side, the water distribution price needs to be assessed such that farmers can afford to purchase the water to intensify and convert farmland in the Ruataniwha Plains, unlocking regional economic benefits.

The wider economic benefits of the Project to the Hawke's Bay region are important to understand to foster well informed support for the project. While social, recreational and environmental benefits are all important considerations, the direct on farm and farm-related financial, economic resilience, and employment benefits to the region are considered in this Section, being a key component of social benefits.

This section is structured by firstly looking at the financial feasibility of the Project and of on-farm irrigation investment (Section 5.2). Section 5.3 then summarises why the Project is the most economic water storage option, providing farmers with reliable access to water for irrigation at the lowest possible cost given various water storage alternatives (both on- and off-farm storage). Section 5.4 details the regional economic benefits of the Project and Section 5.5 summarises the HBRC Core Team findings.

5.2 FINANCIAL FEASIBILITY

BNZ Advisory has been engaged to evaluate the financial feasibility of the Project in order to inform HBRC and assist with its decision on whether to proceed to the next stage. BNZ Advisory has analysed the Project's financial feasibility from both a supply and demand perspective:

Supply: does there exist an investor pool that will be prepared to fund and manage the Project's construction and operation in exchange for a return provided (predominantly) from payments for water distributed to irrigating farmers?

Demand: is there a sufficient pool of farmers that will be prepared to undertake on farm investment in irrigation infrastructure and land conversions, and pay the Project operator for irrigating water (based on marginal returns from investment)?

BNZ Advisory's financial feasibility analysis focuses on whether there exists water distribution price (or price range) at which the Project will provide sufficient returns to attract the necessary off-farm investment capital; and still provide farmers with sufficient incremental returns (after payments for distributed water) to incentivise on-farm investment in irrigation systems.

BNZ Advisory has also made recommendations on the Project's potential procurement strategy, ownership structure, and the allocation of Project risks.

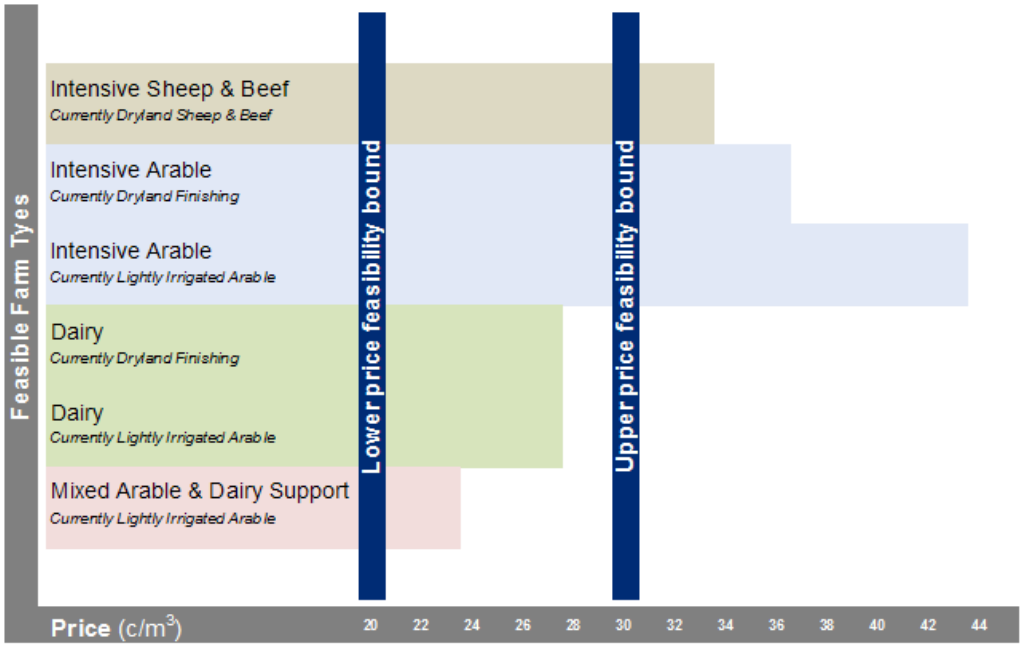
5.2.1 Summary of Findings

Off-farm (supply) and on-farm (demand) investment feasibility analysis demonstrates that there is a range of water distribution prices for which the Project is financially feasible. A water distribution price of 20c/m^3 to 30c/m^3 should be sufficient to incentivise investment in both off farm and on farm infrastructure; provided the public sector participates in the Project during the initial ramp up period with return requirements that incorporate direct Project positive externalities as well as a cash return, to share in managing up-take risk.

Potential returns to on farm investment in irrigation vary across farming types. Therefore, the ultimate future agricultural make up of the Ruataniwha Plains may differ under varying water distribution price scenarios. Macfarlane Rural Business Ltd predicts that Sheep and Beef, Arable, and Dairy farms will account for approximately 80%[10] of irrigated land. BNZ Advisory's evaluation of the on farm analysis, conducted by Macfarlane Rural Business Ltd, demonstrates that at the feasible water distribution price range of 20-30c/m^3, a range of potential land conversions and/or intensifications are financially viable from both a returns and financing perspective. While water in this range should attract on-farm investment, the incentive to invest will decrease as water becomes more expensive.

The following chart demonstrates the land intensification and conversion scenarios that are financially feasible (for a farmer with a 10% marginal return requirement, 20% current gearing, requiring 100% debt finance for the on farm investment), against the water distribution price range that BNZ Advisory's analysis demonstrates as being financially feasible from a off-farm capital perspective.

Figure 11: Feasible water prices for off-farm water storage and on-farm investment



At a water distribution price of approximately 20c/m^3 to 30c/m^3, returns are sufficient to compel investment in both on-farm conversions/intensifications across a range of farming types and investment in off-farm dam and distribution infrastructure.

In the upper bound of this price range, future land use is likely to be concentrated between Sheep & Beef and Arable farming. However, in the lower bound of this range, Dairy and Mixed Arable & Dairy

[10] Ruataniwha Water Storage Project: Review of Farm Profitability, 24 August 2012, Macfarlane Rural Business Ltd

Support farming also become financially feasible, resulting in greater diversity and resilience of the catchment.

Other farming types are also viable in this price range, but will require investment by farmers with either lower return requirements, lower current gearing levels, or more favourable commodity price expectations.

Full privatisation (even with perpetual private sector ownership) is not feasible as private sector investors will not take into account the considerable (approximately $10m p.a.[11]) environmental benefits directly flowing from the Project, or the 4% increase in regional GDP. If the Project was funded with 100% private sector funding from the outset, the distribution price required to derive sufficient internal Project returns would be prohibitive to farmers.

5.2.2 Supply Analysis – Off Farm Infrastructure Financing Feasibility

BNZ Advisory has undertaken extensive analysis of Project financials, examining a range of potential investment and funding structures to determine whether or not, and under what assumptions the Project is financially feasible. This analysis focuses on off-farm investment only, assuming farmers are provided with the opportunity, but are not required to invest in the dam and associated distribution and reticulation infrastructure.

Financing Structure

BNZ Advisory's recommended delivery structure for the Project is a 35 year Build Own Operate Transfer ("**BOOT**") model with a 35 year concession period. This model is often used internationally to procure essential public infrastructure with private sector involvement, and has more recently been introduced into New Zealand.

Under the proposed BOOT model, the dam and associated reticulation and distribution infrastructure would be procured by a Special Purpose Vehicle ("**SPV**") that will finance, construct and operate the Project over a 35 year concession period (earning an appropriate return on their capital during this period) before handing the Project assets back to the Hawke's Bay Regional Investment Company[12]. The BOOT structure can also accommodate a transfer of the asset to HBRIC plus other stakeholders. Where structured appropriately, this can benefit the Project.

BNZ Advisory's supply side analysis demonstrates that some Public sector funding which incorporates direct Project externalities in return requirements is required during the initial ramp up period to make the Project financially feasible. However, after 10-15 years once the Project de-risks, public sector financiers will be able to sell their investments to the private sector to recycle public capital (in the knowledge that the asset will be returned to public ownership at nil cost at the end of the 35 year concession period).

The optimal capital structure is likely to comprise a mix of public (including HBRC and central Government funding) and private sector funding, with private sector funding comprising either bank debt and equity or a hybrid equity instrument and common equity. Once uptake has been achieved, forecast Project returns are sufficient to accommodate 100% private sector financing, with HBRC and MPI having the flexibility to exit their investments.

[11] 14 million m^3annual flows for environmental flushing and maintenance of minimum flows multiplied by the mid-range price of 25c/m^3

[12]References to HBRIC ownership or future involvement with the Project in this report are made acknowledging that the nature of the Special Purpose Vehicle that may ultimately implement the Project is yet to be determined, and should be qualified as such. HBRIC has to date resolved to adopt the project (should HBRC as Council decide it will proceed); to then seek all necessary authorisations for it under the Resource Management Act 1991, and (at its discretion) to implement the Project either directly or indirectly through such a Vehicle.

The water distribution price (and price escalation) can be fixed by a 35 year contract between HBRC and the SPV for the duration of the concession period to provide farmers with price transparency and certainty even if they are not in a position to invest in the Project.

Potential Equity Financing

Private Sector Equity

Strong interest has been received from the equity market sounding process conducted as part of the financial feasibility study with a number of investors interested in investing in the Project at either a Greenfield or Brownfield stage. HBRC has received letters of intent from five potential Greenfield equity participants to proceed to the next phase of the Project. Potential private sector equity providers include farmers wanting to invest in off-farm infrastructure, infrastructure investors, superannuation funds, and Maori interests. Such structures will be explored further during the next phase of the Project.

Market soundings have also identified some stakeholder groups have a true intergenerational focus and would value ownership past the end of the concession period. BNZ Advisory has identified a range of structures whereby perpetual ownership in the Project can be accommodated, and if structured appropriately, can provide benefit to the Project.

Public Sector Equity

BNZ Advisory's financial feasibility analysis demonstrates that public sector investment is required to achieve a water distribution price that is affordable from a farmer's perspective. The public sector investment will bridge the viability gap that exists for the Project when it is in its initial Greenfield, demand ramp-up stage. Public Sector equity is appropriate for the Project due to direct and indirect environmental, economic and community benefits of the Project, including:

- The environmental benefits from maintenance of minimum flows and periphyton flushes, which make up approximately 30% of total flows at 95% reliability;
- The fact that the asset will be handed back to HBRC's ownership after 35 years at nil cost;
- An increase in regional GDP of 4% per annum; and
- Estimated rate increases of $2.4 million per annum.

BNZ Advisory's analysis assumes some equity is available for the initial 10-15 years from HBRC (as per its Long Term Plan[13]) and from central Government (via MPI and the proposed Crown Water Investments scheme). Although there is no official decision regarding the Crown's proposed investment in New Zealand irrigation schemes, HBRC and BNZ Advisory have been in continual engagement with MPI and have assumed a structure that is consistent with MPI's investment preferences.

Potential Debt Financing

BNZ Advisory has indicated that since the Global Financial Crisis, commercial banks have generally been unwilling to take demand risk in Greenfield projects. Therefore, Project gearing is likely to be limited unless a material portion of demand can be contracted (long term) or underwritten prior to the start of construction. The equity market sounding process confirmed that equity investors would also prefer to match any debt funded repayments with that of contracted revenues.

Supply Side Financial Feasibility Analysis

BNZ Advisory has undertaken extensive supply side financial modelling to determine the Project's financial feasibility at a water distribution price range of 20-30c/m^3 including examination of:

[13] Hawke's Bay Regional Council Long Term Plan 2012 – 2022, June 2012, HBRC

- Structures with varying proportions of public versus private sector funding;
- Structures with varying levels of bank debt financing;
- Structures that incorporate various hybrid-equity fixed return instruments;
- The impact of varying the investment metrics for public sector capital;
- The impact of varying the concession period length;
- Variations of the ownership structure at the end of the concession period (including full HBRC ownership and partial HBRC, partial stakeholder ownership);
- Sensitivity to base financial assumptions including:
  - Construction cost;
  - Construction timeframe;
  - Demand ramp up profile;
  - Ultimate long run demand / capacity utilisation;
  - Operating and maintenance costs;
  - Electricity prices; and
  - Electricity generation.

The Project's feasibility is robust to base financial assumptions in the 20-30c/m^3 range up to movements of approximately 25% in individual assumptions.

5.2.3 Demand Analysis – On Farm Infrastructure Financing Feasibility

Irrigation is considered to be the key enabler for unlocking high value agriculture in the Ruataniwha Plains, enabling land use intensification with farmers investing in farm conversions (land use change) or intensifications (introduction of irrigation to existing operations). Macfarlane Rural Business Ltd estimates that the Project could irrigate up to 25,000 ha of farm land (current irrigation is approximately 6,000 ha), and increase the productivity of 42,000 ha of farm land once the wider 'area of influence' is taken into account[14].

Large capital commitments are required from farmers to undertake on-farm investment in irrigation and land conversions. Therefore, only some farmers will be in a position to undertake investments and only some land uses will achieve sufficient increases in returns to financially justify the investment. The demand side analysis undertaken focuses on on-farm investment only. That is, the water distribution price that could be supported through investments taking into account capital costs, and operating revenues and costs for on-farm irrigation and land conversions.

Changes in Land Use

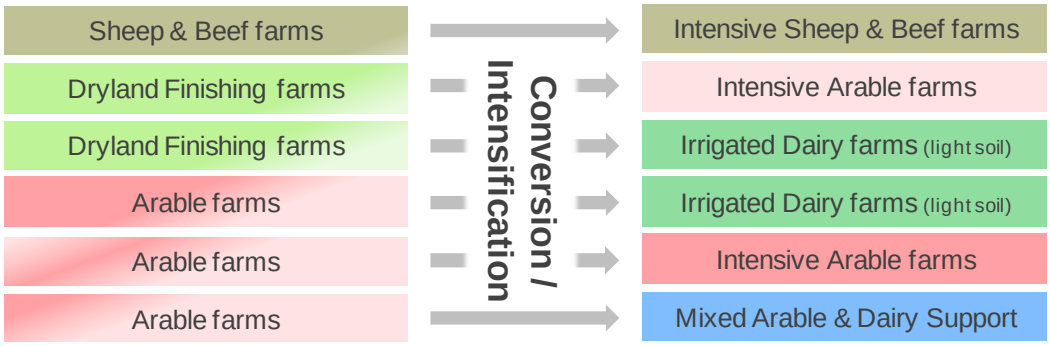
Returns from farm conversions differ depending on current and converted land use. Macfarlane Rural Business Ltd approximates that there are seven predominant current land use types, and nine feasible future land uses if reliable water is available for irrigation via the Project. Overall, Macfarlane Rural Business Ltd predicts that 82% of irrigated land will be converted to Dairy (37%), Arable (32%), or Sheep & Beef (13%) farms. Furthermore, mixed land uses are a trend that Macfarlane Rural Business Ltd see further developing in the future based on the opportunity to maximise income per hectare and manage nitrogen.

The on-farm investment feasibility analysis (which is based on Macfarlane Rural Business Ltd's farming budgets) identifies six primary land use change or intensification scenarios that provide a

[14] Ruataniwha Water Storage Project: Review of Farm Profitability, 24 August 2012, Macfarlane Rural Business Ltd

reasonable (10% plus) marginal return on capital to farmers, and can be 100% bank debt financed (for farmers with average or lower current gearing) at a water distribution price of 20-30c/m^3:

Figure 12: On-farm conversion/intensification scenarios which support water price of 25c/m^3



Additionally, the flat section of Sheep & Beef farms could be converted to Irrigated Dairy at similar returns to Dryland Finishing to Irrigated Dairy conversions.

On-Farm Assumptions

There are a number of assumptions that drive the financial viability of investment in on-farm irrigation and farm conversions. Commodity prices and productivity assumptions are particularly crucial in determining farmers' willingness and ability to pay for distributed water. The investment analysis utilises Macfarlane Rural Business Ltd farming assumptions including a dairy payout of $6.50 per kg MS (including dividend), lamb and beef prices of $6.00 and $4.25 per kg respectively, and wool price of $4.00 per kg.

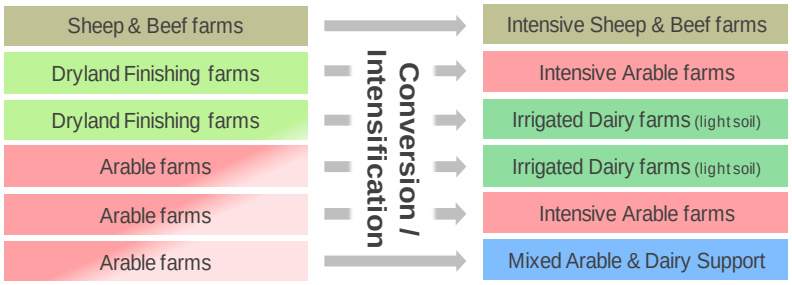
Macfarlane Rural Business Ltd's farming budgets assume newly irrigated farms will achieve farm productivity similar to top 20th percentile performance of current farming across New Zealand. This is on the basis that newly irrigated farms will utilise newest technology, largely attract top performing and younger (highly motivated) farmers, and high water reliability will enable farmers to maximise productive outputs without mitigating for drought risk. Macfarlane Rural Business Ltd note that this assumption could be conservative looking out on the 35 year investment horizon (with technology and farming method improvements pushing future average productivity up past current top performers (for example Dairy production has increased approximately 47% over the past 21 years [15]).

Financial Feasibility for Land Conversion or Intensification

The following chart summarises the Marginal Return on Capital (at a mid-range water distribution price of 25c/m^3), and the water distribution price at which farmers' Marginal Return on Capital will be at least 10% per annum and on-farm investment can be 100% bank debt financed (for farmers with average to below average current gearing), based on Macfarlane Rural Business Ltd's farm budgets.

[15] Andrew Macfarlane, 8th August 2012, Macfarlane Rural Business Ltd

Figure 13: Financial Feasibility of Farm Conversions and Intensifications



Marginal ROC** at 25c/m³	Max price for 10% ROC & 100% debt finance*
16%	33c/m³
17%	36c/m³
12%	27c/m³
14%	31c/m³
27%	43c/m³
6%	23c/m³

** For farmer with 20% (approx. average) current gearing*
*** Marginal ROC = Marginal return on marginal capital*

Therefore, a range of possible irrigated farm types are financially feasible at a water distribution price of 20c/m^3 to 30c/m^3.

The on-farm demand analysis has focused on the marginal returns and financing component of a farmer's investment decision. Perceptions (for example commodity price outlook) and qualitative factors (such as farmer age) are likely to have an even greater influence on farmer's investment decisions. Also, other farmers may purchase dry farms and convert them (as was the experience for Canterbury irrigation schemes). Potential farm acquirers could be neighbouring farmers or farmers from outside the Hawke's Bay. Castalia Strategic Advisors ("**Castalia**") were engaged to conduct a Demand Study to evaluate the wider investment decision for farmers, including consideration of qualitative factors and timing and propensity for farmers to invest on-farm or sell or lease their farm. Castalia's findings have been incorporated as base assumptions in BNZ Advisory's financial feasibility analysis. Potential contracting strategies will be developed further during the next phase of the Project.

5.2.4 Procurement and Risk Allocation

The financial feasibility analysis assumes the Project (dam and associated reticulation and distribution infrastructure) is procured under a BOOT model via an SPV, with hand back of ownership to HBRC (and potentially other stakeholders) after 35 years, at which point it will be worth approximately $600m[16]. A BOOT model is considered the best strategy for this Project for a number of reasons, including competing priorities for public sector funding and farmer preference for long run ownership being either with the public sector or a co-operative.

Potential Risk Allocation

Under this model Project risks will be transferred to Project SPV, reducing HBRC's Project risk to its proportionate shareholding. However, it may be more efficient for HBRC or MPI to retain some Project risks. The risks that may be best retained by the public sector are obtaining approvals and resource consents, legislative risks, and potentially force majeure risk, as summarised in Table 16.

[16] Based on remaining life of a 65 year remaining useful life, 1% Irrigation Revenue growth, 3% cost and generation revenue growth, and a (post tax) discount rate of 10% pa

Table 16: Potential Risk Allocation				
	Potential Risk Allocation			
	Contractor	SPV	HBRC/Govt	Other
Planning and other approvals			✓	
Legislative risks			✓	
Force majeure risk		✓	✓	
Demand / Up Take risk		✓		✓
Financing risks		✓		
Maintenance and refurbishment		✓		
Operational performance and risk	✓	✓		
Transition and implementation risk	✓	✓		
Design, Construction, development risk	✓	✓		

Private Sector Returns

Whilst the water distribution price able to be charged by the Project SPV will be regulated via a 35 year contract with HBRC, private sector investors will still be able to make upside returns from faster than expected ramp up, or higher than expected 'spot' market sales due to favourable water patterns, for example. However, given the requirement for public sector funding in the Project initially, BNZ Advisory has identified a range of mechanisms under which private sector returns can be capped, preventing the ability to make supernormal profits on this essential infrastructure Project.

Regional Promoters

A number of other parties will benefit from the Project indirectly, for example, food processors and land operators. HBRC and BNZ Advisory are in the process of engaging these indirect Project beneficiaries to determine whether, and in what form, they could assist in increasing the Project's feasibility at the lowest water distribution price, and/or mitigating Project risk.

Procurement Timeline

Should the Project progress to the next phase, HBRC and BNZ Advisory could progress with finalising a Project structure, procuring Project services and financing, and documenting the Project, contemporaneously with the 9 month EPA process. This should provide the selected design and construction provider with the potential to start works in the final quarter of 2013.

5.3 ECONOMICS OF ALTERNATIVE STORAGE OPTIONS

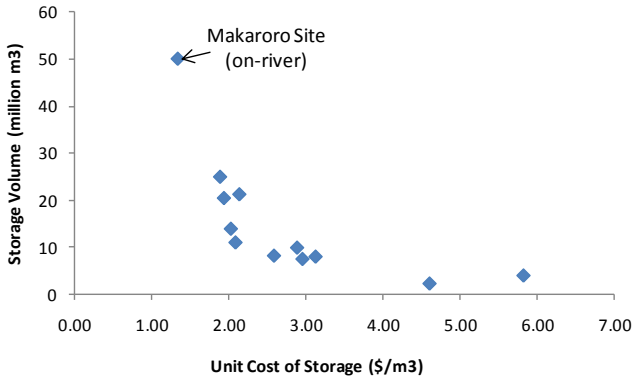
The proposed Project is the preferred solution from a technical and economic perspective, following a rigorous process to assess various water storage options in the region. Alternative bulk off-farm water storage and small scale on-farm storage options were assessed, with the present Project deemed to be the preferred solution. The Project's storage design and final location was ultimately selected due to the favourable geotechnical, environmental, and economic characteristics when compared with the other bulk and small scale storage options.

5.3.1 Off-Farm Bulk Water Storage Alternatives

Tonkin & Taylor Ltd was commissioned by HBRC in 2009 to determine technically feasible off-farm water storage options for the Ruataniwha Plains[17]. Eighteen sites were initially identified as potential options, which were narrowed down to 12 based on geotechnical and environmental considerations.

These short listed options included 10 off-river dams (based on a concept of winter water harvesting from adjacent catchments to refill the reservoirs) and 2 on-river dams. Tonkin & Taylor Ltd found off-river dams were less economic than on-river dams due to the need for a refilling transfer system, and the fact that storage volumes were generally smaller (resulting in lower economies of scale), as illustrated in Figure 14.

Figure 14: Unit cost for short listed storage options



The Makaroro site was the preferred option after the alternative on-river water storage option was ruled out following further geotechnical investigations. Further refinement of the preferred on-river water storage option has seen the proposed water storage volume revised upwards to further take advantage of economies of scale, and to meet irrigation demand in the catchment.

5.3.2 Small Scale On-Farm Water Storage Alternatives

On-farm water storage generally consists of an excavated pond ("turkey nest dam") located on a flat area of a farm, or a pond created in a natural gully ("gully dam"), where geography allows. Turkey nest dams are refilled primarily through existing water consents or older-style irrigation schemes; while gully dams are usually located on a creek or drainage line that is used to refill the dam, taking advantage of natural watersheds.

In both instances, the storage dams are a secondary source of water for irrigation, supplementing a primary water source such as consented river takes or groundwater abstraction. Therefore, on-farm storage is distinctly different from this Project, which is a primary source of water with high reliability. Given water consents for summer takes in the Ruataniwha Plains are already over-allocated with no new water consents available for additional irrigation, on-farm water storage is not, and should not be considered to be an alternative to this Project.

However, for completeness, an examination of on-farm storage costs demonstrated that the per-unit capital cost of on-farm water storage is more expensive than the proposed Project. On-farm water storage costs vary substantially, depending on the dam type, liner and volume, but are estimated to average approximately \$3.00/m^3 and range up to \$5.80/m^3 plus opportunity and actual costs for land flooded, and maintenance and pumping costs. This compares with the Project's storage unit cost of \$2.91/m^3, with water delivered to the farm gate. Additionally, on-farm storage does not achieve the desired environmental outcomes that the Project will deliver, including

[17] Ruataniwha Plains Water Augmentation Scheme: Advanced Pre-Feasibility Study – Summary Report, February 2011, Tonkin & Taylor Ltd

improved summer flows for the Tukituki River and the ability to 'flush' the river channel to control periphyton levels.

5.4 ECONOMIC BENEFITS

The investment feasibility analysis in Section 5.2 concentrated on the financial viability of the proposed Project from both off-farm and on-farm private investment perspectives. That is, the direct private benefits and costs.

HBRC commissioned Butcher Partners Limited ("Butcher") to undertake a preliminary assessment of the wider regional economic impacts of the Project. Butcher's economic analysis focuses on regional GDP and district employment impacts only. Therefore, there may be additional environmental and social benefits (or costs) not considered in the analysis.

Butcher estimates that the Project would increase Hawke's Bay's regional GDP by 4% and employment by 3.5% across all sectors that benefit directly or indirectly from growth in farming and processing. The more specific regional effects and impacts of the Project are outlined in sections 5.4.1 – 5.4.6 below.

5.4.1 Farm Effects

Farm output will rise by $160 million/year, and farm value added will rise by $70 million/year including additional household income of $24 million / year. On-farm employment will rise by 632 Full Time Equivalent jobs.

5.4.2 Farm Flow-on and Total Effects

The additional farm activity will lead to multiplier effects in the region as farmers buy additional inputs and spend the higher household income. This together with the increases in on-farm income mean that total regional income will rise by $127 million/year, including an increase of $52 million/year in household income. Regional employment will increase by 1,160 jobs

5.4.3 Processing Effects

There is also the possibility of significant processing in the region. Estimates of the economic impacts of this have high error margins because of the uncertainty as to what proportion of the output will be processed in the region and because the multipliers applied are averages for a much broader processing sector. Butcher estimates that the processing sector, plus multiplier effects which flow from it, could generate as many as 1090 jobs and generate an additional $108 million per year in regional income, including $60 million per year of household income.

5.4.4 Total Regional Effects

The combination of farm direct and flow-on effects and processing effects will lead to an increase of 2,250 Full Time Equivalent (FTE) jobs and $230 million per year of regional income, including $110 million per year in household income.

5.4.5 Construction Impacts

The costs of constructing the dam and distribution network combined with on-farm investment are expected to total approximately $600 million. These will generate significant multiplier effects. The total regional economic impacts, which will be spread over a number of years, are an additional 4,500 job-years of work and an additional $320 million of value added, including $210 million of household income.

5.4.6 Increased Activity at Port of Napier

The increase in farming production and processed product is expected to go almost entirely to export. This will increase shipping through the port and will significantly increase port revenue, and hence profits and Council dividends. An additional 8,000 containers of export cargo and possibly 1,000 containers of inward cargo are expected.

5.5 HBRC CORE TEAM FINDINGS

Overall Conclusion

In summary, off-farm and on-farm investment feasibility analysis demonstrates that there is a range of water distribution prices for which the Project is financially feasible. A water distribution price between 20c/m^3 to 30c/m^3 should, in principle, be sufficient to incentivise investment in both off-farm and on-farm infrastructure. This is provided the public sector participates in the off-farm water storage infrastructure during the initial ramp up period with return requirements that incorporate direct Project positive externalities as well as a cash return, to share in managing up-take risk. Furthermore, within this water distribution price range, a range of potential land conversions and/or intensifications are financially viable from both a returns and financing perspective.

There are estimated to be substantial economic benefits to the Hawke's Bay region resulting from the Project. The Project would increase Hawke's Bay's regional GDP by 4% and employment by 3.5% across all sectors that benefit directly or indirectly from growth in farming and processing. In addition to this annual GDP increase, the Project's financial cost both on and off farm of $602 million, is estimated to boost regional GDP by $350 million in total over the construction phase.

Based on the financial and economic analysis, the project team considers that the Project is financially and economically viable[18] at an optimal point within the 20c/m^3 to 30c/m^3 price range.

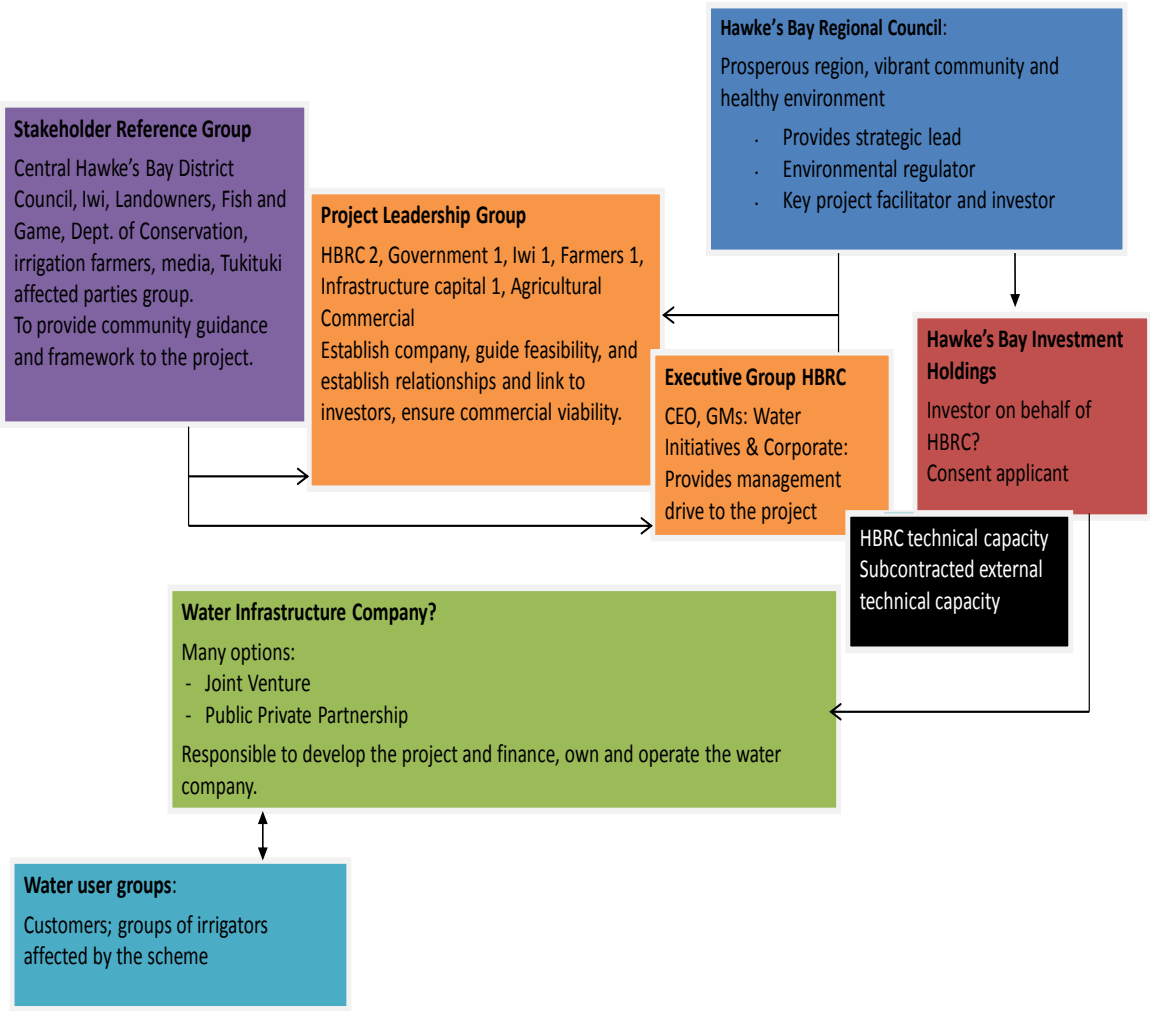
[18] On the assumption that the project provides net environmental and social benefits to the region.

5.6 GLOSSARY

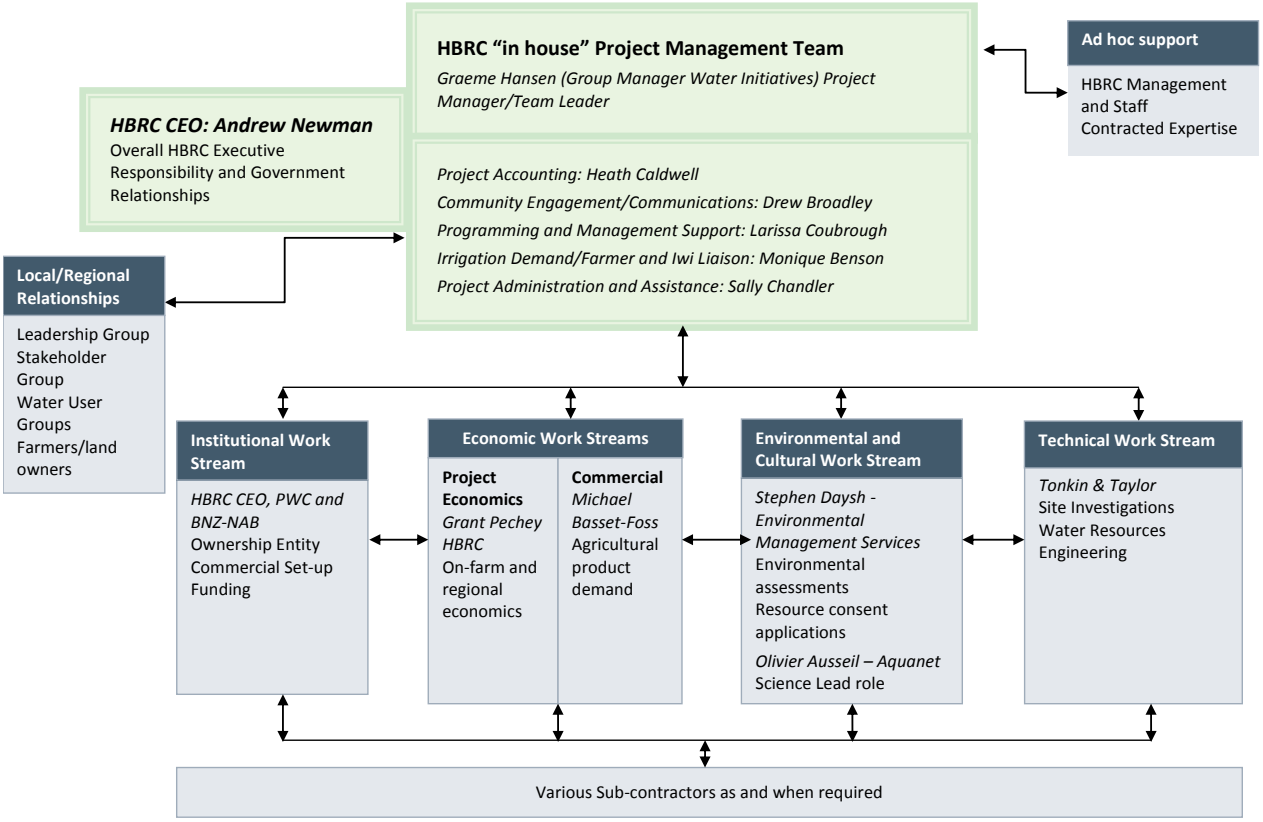
BOOT:	Build Own Operate Transfer
BNZ Advisory:	An independent division of Bank of New Zealand, a subsidiary of National Australia Bank
Butcher:	Regional Economic Impacts Study of the proposed Ruataniwha Irrigation Scheme Report prepared by Butcher Partners Limited
Castalia:	Castalia Limited (a subsidiary of Castalia Advisory Group)
Demand Study:	Demand forecasting analysis being undertaken (but not yet completed) by Castalia at the time this report was written
EPA:	Environmental Protection Authority
HBRC:	Hawke's Bay Regional Council
GFC:	Global Financial Crisis
Gully Dam:	A type of on-farm water storage that is created by damming up a gully (often on a stream or drainage line), capturing runoff from the surrounding watershed.
Macfarlane Rural Business Ltd:	Farm Profitability Report, with contributions from Baker & Associates and AgFirst
MPI:	Ministry for Primary Industries
Phase One:	Current Full Feasibility Phase of the Project
Phase Two:	Procurement Phase assuming the Project proceeds past feasibility
Project:	Ruataniwha Water Storage Project
Regional Promoters:	Large entities that will benefit indirectly from the Project and therefore may be willing to provide some level of financial or otherwise support to assist in the Project's feasibility.
ROC:	Return on Capital
SPV:	Special Purpose Vehicle
Turkey Nest Dam:	An earth dam type that is generally located on flat farmland using borrowed earth to create a bund. They are filled from external sources, and unable to capture runoff.

APPENDICES

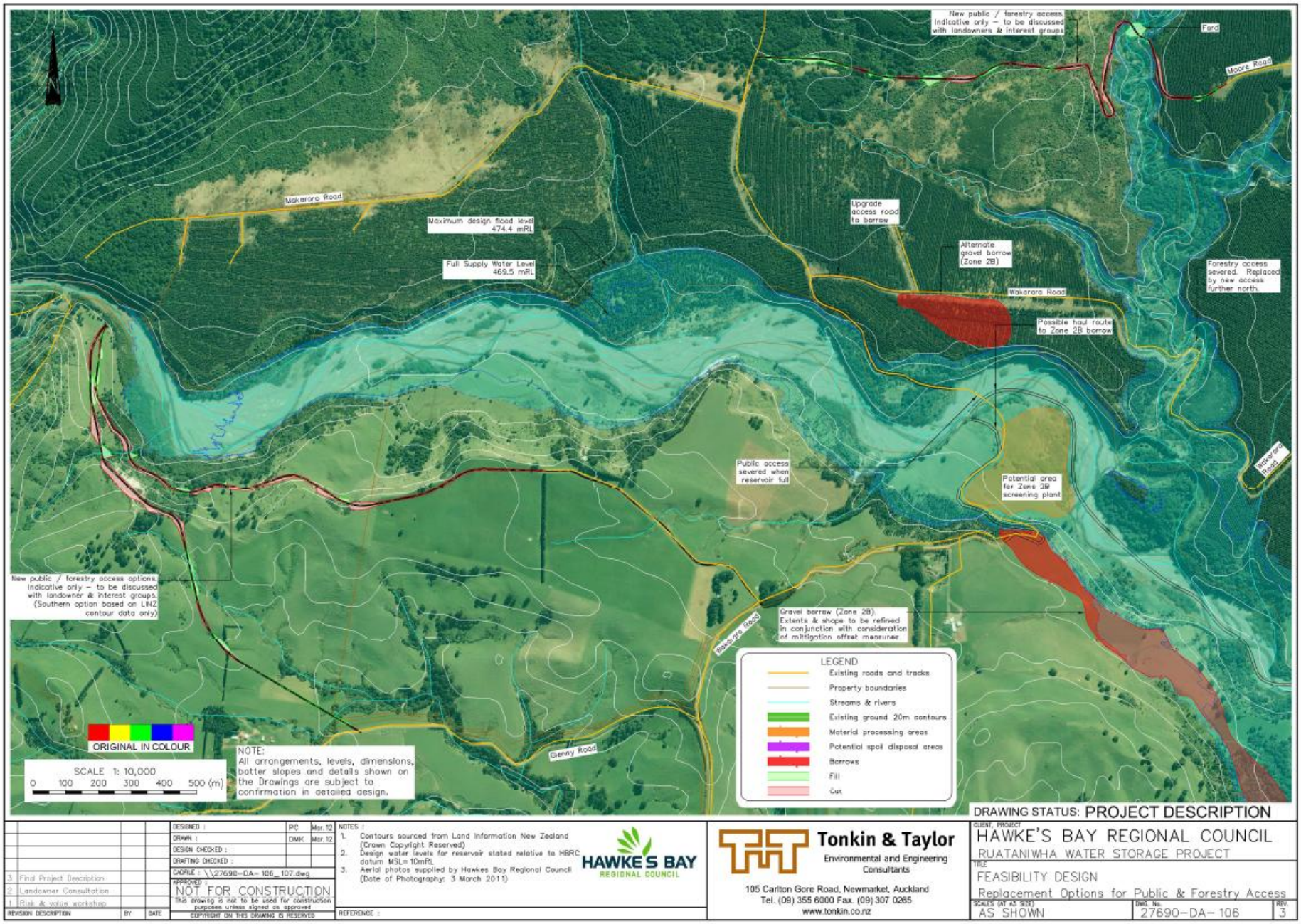
Appendix 1: Ruataniwha Water Storage Project Institutional Setup and Relationships



Appendix 2: Project Team Structure



Appendix 3: Tonkin & Taylor Ltd Dam and Reservoir Arrangement Drawings


New public / forestry access. Indicative only – to be discussed with landowners & interest groups
Ford
Moore Road
Makaroro Road
Maximum design flood level 474.4 mRL
Full Supply Water Level 469.5 mRL
Upgrade access road to borrow
Alternate gravel borrow (Zone 2B)
Forestry access severed. Replaced by new access further north.
Makaroro Road
Possible haul route to Zone 2B borrow
Public access severed when reservoir full
Potential area for Zone 2B screening plant
Makaroro Road
New public / forestry access options. Indicative only – to be discussed with landowner & interest groups. (Southern option based on LINZ contour data only)
Gravel borrow (Zone 2B). Extents & shape to be refined in conjunction with consideration of mitigation offset measures
Makaroro Road
LEGEND
Existing roads and tracks
Property boundaries
Streams & rivers
Existing ground 20m contours
Material processing areas
Potential spoil disposal areas
Borrows
Fill
Cut
ORIGINAL IN COLOUR
SCALE 1: 10,000
0 100 200 300 400 500 (m)
NOTE:
All arrangements, levels, dimensions, batter slopes and details shown on the Drawings are subject to confirmation in detailed design.
Gienny Road
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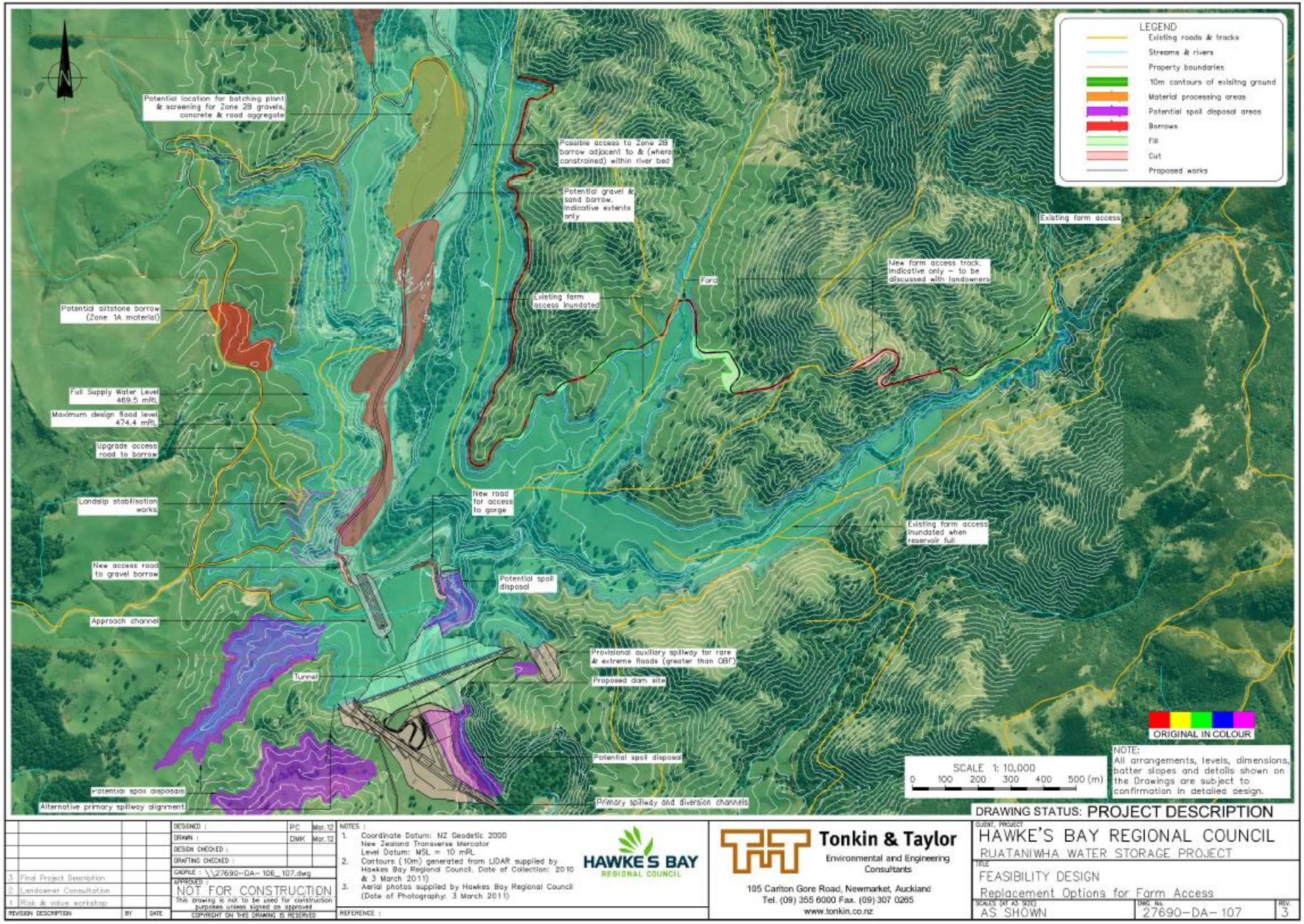
DESIGNED : PC Mar. 12
DRAWN : DMK Mar. 12
DESIGN CHECKED :
DRAFTING CHECKED :
CADFILE : \\27690-DA- 106_107.dwg
APPROVED :
NOT FOR CONSTRUCTION
This drawing is not to be used for construction purposes unless signed as approved
COPYRIGHT ON THIS DRAWING IS RESERVED
3 Final Project Description
2 Landowner Consultation
1 Risk & value workshop
REVISION DESCRIPTION BY DATE
NOTES :
1. Contours sourced from Land Information New Zealand (Crown Copyright Reserved)
2. Design water levels for reservoir stated relative to HBRC datum MSL= 10mRL
3. Aerial photos supplied by Hawkes Bay Regional Council (Date of Photography: 3 March 2011)
REFERENCE :
HAWKE'S BAY REGIONAL COUNCIL
Tonkin & Taylor
Environmental and Engineering Consultants
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkin.co.nz
CLIENT, PROJECT
HAWKE'S BAY REGIONAL COUNCIL
RUATANIWHA WATER STORAGE PROJECT
TITLE
FEASIBILITY DESIGN
Replacement Options for Public & Forestry Access
SCALES (AT A3 SIZE)
AS SHOWN
DWG. NO.
27690-DA- 106
REV.
3


LEGEND
Existing roads & tracks
Streams & rivers
Property boundaries
10m contours of exisitng ground
Material processing areas
Potential spoil disposal areas
Borrows
Fill
Cut
Proposed works
Potential location for batching plant & screening for Zone 2B gravels, concrete & road aggregate
Possible access to Zone 2B borrow adjacent to & (where constrained) within river bed
Potential gravel & sand borrow. Indicative extents only
Existing farm access
New farm access track. Indicative only – to be discussed with landowners
Ford
Existing farm access inundated
Potential siltstone borrow (Zone 1A material)
Full Supply Water Level 469.5 mRL
Maximum design flood level 474.4 mRL
Upgrade access road to borrow
Landslip stabilisation works
New road for access to gorge
Existing farm access inundated when reservoir full
New access road to gravel borrow
Potential spoil disposal
Approach channel
Provisional auxiliary spillway for rare & extreme floods (greater than OBF)
Tunnel
Proposed dam site
Potential spoil disposal
Potential spoil disposals
Alternative primary spillway alignment
Primary spillway and diversion channels
ORIGINAL IN COLOUR
SCALE 1: 10,000
0 100 200 300 400 500 (m)
NOTE:
All arrangements, levels, dimensions, batter slopes and details shown on the Drawings are subject to confirmation in detailed design.
DRAWING STATUS: PROJECT DESCRIPTION
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DRAWN : DMK Mar. 12
DESIGN CHECKED :
DRAFTING CHECKED :
CADFILE : \\27690-DA- 106_107.dwg
APPROVED :
NOT FOR CONSTRUCTION
This drawing is not to be used for construction purposes unless signed as approved
COPYRIGHT ON THIS DRAWING IS RESERVED
3 Final Project Description
2 Landowner Consultation
1 Risk & value workshop
REVISION DESCRIPTION BY DATE
NOTES :
1. Coordinate Datum: NZ Geodetic 2000 New Zealand Transverse Mercator Level Datum: MSL = 10 mRL
2. Contours (10m) generated from LIDAR supplied by Hawkes Bay Regional Council. Date of Collection: 2010 & 3 March 2011)
3. Aerial photos supplied by Hawkes Bay Regional Council (Date of Photography: 3 March 2011)
REFERENCE :
HAWKE'S BAY REGIONAL COUNCIL
Tonkin & Taylor
Environmental and Engineering Consultants
105 Carlton Gore Road, Newmarket, Auckland
Tel. (09) 355 6000 Fax. (09) 307 0265
www.tonkin.co.nz
CLIENT, PROJECT
HAWKE'S BAY REGIONAL COUNCIL
RUATANIWHA WATER STORAGE PROJECT
TITLE
FEASIBILITY DESIGN
Replacement Options for Farm Access
SCALES (AT A3 SIZE)
AS SHOWN
DWG. No.
27690-DA- 107
REV.
3

Appendix 4: Draft Ruataniwha Stakeholder Group Meeting Minutes Including Matrix – 31 August 2012

MINUTES OF A MEETING OF THE RUATANIWHA PLAINS WATER STORAGE STAKEHOLDER GROUP

DRAFT

Date:	Friday 31 August 2012
Time:	9.00 am
Venue:	Council Chamber Central Hawke's Bay District Council
Present:	Debbie Hewitt (Chairman) Dave Carlton - DOC Grenville Christie – F&B Vaughan Cooper – F&B Pete McIntosh – Fish & Game Phil King – Water User Group Andrew Watts – Land Owner Campbell Chard – Water User Group Christine Scott – HBRC Councillor Benita Wakefield – Te Taiwhenua O Tamatea Hugh Ritchie – Land Owner Tom Belford – Land Owner Peter Butler – CHB DC John Freeman – CHB DC Craig Preston – Land Owner John Cheyne – Te Taiao Environment Group George Williams – Recreational User Group (from 9.45 am)
In Attendance from HBRC:	Andrew Newman Fenton Wilson Graeme Hansen Stephen Daysh, EMS Ltd Grant Pechey Helen Codlin Larissa Coubrough Drew Broadley Barry Lynch Monique Benson Sally Chandler Olivier Ausseil, Aquanet
Observers	Marge Hape & Hirani Maaka, Tamatea Taiwhenua Corina Jordan Fish & Game

1. WELCOME AND APOLOGIES

The Chairman, Debbie Hewitt welcomed everyone to the meeting.

Apologies were accepted from: Mike Mohi, Liz Graham, Chris Lester and Duncan Holden.

Andrew Watts/Benita Wakefield
CARRIED

2. CONFIRMATION OF MINUTES OF MEETING HELD ON 27 JULY 2012

The Minutes of the meeting held on 27 July 2012 a copy having been circulated prior to the meeting were accepted.

Vaughan Cooper/Hugh Ritchie
CARRIED

3. REVIEW OF MATTERS ARISING/ACTION ITEMS

There were no outstanding matters arising or action items.

Mr Newman however reiterated his comments from the last minutes ... *a plan change alone cannot cancel all current water take consents, but under the minimum flow scenarios being considered there will be less security for current irrigators, which in itself may be an incentive for irrigators to migrate to the storage scheme' s water.*

He further noted that he has been consistently suggesting that a combination of regulation and storage infrastructure may offer the best route to healthier summer river flows.

Further discussion on plan change and consents took place and the following points were noted:

- Stored water provides greater security, potentially providing for 35 year consents
- Transition period an option
- CHB waste water discharge consent must meet standard
- GW/SW migration of consents would be a negotiated process
- Incentives for early uptake

4. PROJECT UPDATE

- **Science Caucus** – Mr Hansen advised that Iain Maxwell, HBRC Resource Management Group Manager was coordinating this process. Stakeholder group representatives including Benita Wakefield, Pete McIntosh, Tom Belford, Hugh Ritchie, CHBDC and Chris Lester replied to the offer of a caucusing option.
- First meeting sometime mid September.
- Will look at Water Quality, Ecology issues.
- Identify any work still to be done.
- Provide a position statement whether Agree or Disagree with the findings. It is still a useful exercise to undertake.
- **Aquatic Ecology -** Mr Daysh advised the comments provided by John Cheyne and his group to the Cawthron report had been responded to and included in the final Cawthron report.

- **Off-set Mitigation** – Mr Daysh advised a response had been provided to Mr Cheyne following his comments on the Offset Mitigation report.
- Following a question on when the 100 point survey was taking place in the catchment Mr Ausseil advised staff were just waiting on river conditions and weather to improve.

5. LUI UPDATE

Mr Daysh advised a final copy of the LUI Working Party report was available for members to sign or the option not to sign if you weren't at the last meeting.

Hugh Ritchie recommended the group reconvene at some stage to work on appropriate land management plans for farmers.

8. DRAFT FEASIBILITY SUMMARY REPORT TO COUNCIL

Stephen Daysh provided the group with an overview of the report that was emailed earlier in the week giving clarification on what outcome was expected for the group.

A draft document, with suggested stakeholder comments, was circulated at the meeting that gave an outline of the items that needed to be discussed, debated and agreed upon if possible.

The document was shown on the screen allowing for comments and amendments to be directly inserted. This was carried out by Larissa Coubrough.

An updated version is attached to these minutes.

Mr Daysh proceeded to read through the items:

Items 1.1 & 1.2 - Agreed – All

Items 1.3.1 & 1.3.2 – following a point of order, Fish & Game advised they would abstain from participating in the remainder of this agenda item until they had time to fully comprehend it. They advised they would provide their position in writing.

Craig Preston questioned whether Fish & Game had surveyed their CHB members for their feedback on the project and they responded that they hadn't spoken directly to their members.

Item 1.3.3 – Agreed – All

Item 1.4.1 – Agreed – All

Item 1.4.2 – Agreed - All

Item 1.4.3 – The following did not agree with the statement – Tom Belford, Grenville Christie, John Cheyne, Vaughan Cooper; they considered that additional modelling work should be undertaken prior to deciding on project feasibility.

Clarification was provided on the project timeline –

- 26 September Council meeting - full Feasibility Report presented to Council
- 31 October Council meeting – Council decision due on project feasibility

Meeting broke for morning tea at 10.40 am and resumed at 11.00 am

Item 1.5.1 – Agreed - All.

Item 1.5.2 – Tom Belford and Grenville Christie reserved their support. Dave Carlton from DOC did not support the trap & transfer programme recommended.

It was advised that mitigation costs had been modelled into the financial feasibility for the project.

A correction to last paragraph of the Aquatic Ecology recommendation was noted.

Item 1.6 – Agreed – All.

Benita Wakefield indicated that whilst she shared some of Fish & Game & Tom Belford's concerns about potential effects on the river. While advising the importance of improving and enhancing the Mauri of the river there were also wider considerations including economic and social and on balance, supported the development going forward.

Items 1.7.1, 2, 3, 4, 5, 6 – Agreed All

Item 1.8 – Agreed All. It was noted DOC believed there were more opportunities that could be realised within the current budget provision for the offset mitigation work recommended.

It was requested by Vaughan Cooper (Forest & Bird) that Mitigation work should be mandated in the resource consent application and not left as "best effort". This also applied to 1.5.1 and 1.5.2.

Item 1.9 – Agreed All.

Item 1.10 – Tom Belford reserved his position.

Item 2.1 to 2.7 – Agreed All.

Item 2.8 – Note: a) recommendation - invite HDC and Te Taiao Environment Forum to join the stakeholder group. Note: b) Consideration be given to expanding the LUI working group with suitably qualified members i.e. farming technical / industry expertise.

Note: to amend Clause C to D and add clause C from environmental report.

Recommendation

That the Stakeholder Group agree the position paper **Record of 31 August 2012 Discussion** be included as their recommendation and included in the Environmental, Social and Cultural Studies and Community Engagement section of the Feasibility Report to Council dated September 2012.

Benita Wakefield/Andrew Watts
CARRIED
UNAMIOUSLY

Dr Barry Lynch – was introduced to the group. Dr Lynch provided an update from Council on the position of Cadmium in the soil. The following was noted:

- Cadmium accumulation in soils is primarily associated with the application of phosphate based fertilizers as cadmium is a trace contaminant found in phosphate rock, the raw material for phosphate fertilizers
- The best way to reduce the rate of cadmium accumulation in soils is by reducing the cadmium content of the phosphate fertilizers.

This issue is well acknowledged by the farming industry and government agencies. The Ministry for Primary Industry (MPI) is currently working on a plan in conjunction with fertilizer companies, farmers, regional councils and research establishments to deal with this issue.

- ensure that risk based guidelines for management of cadmium are in place by 2017.
- Council already has more than 30 soil quality monitoring sites that are sampled every year for multiple parameters including cadmium. This current network of sites is being added to annually until a regional coverage is attained (approximately 92 sites).

7. UPDATE ON ECONOMICS

Mr Newman introduced Mr Grant Pechey. An overview of the project economics was provided.

Mr Pechey showed a selection of slides from Macfarlane Rural Business - Review of Farm Profitability.

The meeting broke for lunch at 12.45 pm and returned at 1.30 pm

The following participants did not return to the meeting from the lunch break –

Andrew Newman, Fenton Wilson, Campbell Chard, Benita Wakefield, Marge Hape & Hirani Maaka.

6. TUKITUKI CHOICES SCENARIOS – HELEN CODLIN

Helen Codlin provided an update on the Tukituki Choices document and process.

ACTION: Provide the Stakeholder Group with a list of all the public meetings scheduled.

The group discussed different aspects of the presentation and the following was noted:

- In response to a question from Mr Belford on why the stakeholder group was not asked to provide input into this document, after being told at an earlier meeting that it would, Mrs Codlin advised she was not aware of this.
- Stephen Daysh also commented that he did not recall this commitment being made at the last meeting and he did not think it had been recorded as an Action in the 27 July Stakeholder Meeting minutes.
- Mrs Scott advised a wide number of groups had informed the development of the document -including those participating in the Water and Land Strategy Group.
- Mr Belford believed the LUI working group had access to the most critical issues and they could have provided valuable input to the scenarios. He suggested HBRC staff had identified the preferred option and put that into Tukituki Choices.
- Stephen Daysh disagreed with the position Mr Belford put. He believed the LUI working party did have input into the scenarios. The LUI Working Party Minutes of 9 August (Special Meeting regarding Policy Issues) and 17 August (Final Working Party Meeting) which are appended to the Final LUI Working Party Report record the discussions between Helen Codlin and the members of the Working Party regarding the future scenarios and the position of the parties.

- Mr Belford advised that at last LUI working party meeting there was disagreement around “these numbers” and asked that “you note the reservations we have”. He believed this was not answered or reflected in the framework presented.

- Helen Codlin confirmed that drafts of the Scenario Construction Report had been circulated to and discussed with the LUI Working Party and that Choice B had been adapted after the 9 August LUI Working Party Meeting to reflect the suggestion from Fish & Game at the 9 August meeting that N limits be based on managing periphyton growth (and not nitrate toxicity).

- Mr Ritchie asked how farmers would know if their bore is a stream depleter or not and indicated they would need to know that in order to evaluate the scenarios. He also noted that the document should be clear that Land/farm Management Plans will be a requirement of any Storage Scheme.

- Mr Cheyne questioned the zones and trout spawning locations indicated within the scenarios, he said that most of the spawning occurs between SH50 and SH2 in the main rivers and tributaries. It was advised the location of the zones related to Water Management Zones within the catchment, and did not necessarily reflect the location of spawning habitats.

- Mr Cheyne suggested that by increasing the nitrate toxicity guideline, HBRC staff had created more headroom so that it made the storage project feasible in his view this equated to a permit to pollute, which was unacceptable.

- Helen Codlin responded that the scenarios were based on the Nitrate Risk Framework developed by Dr Chris Hickey for the Tukituki catchment and based on the ANZECC methodology, and it represents the latest scientific findings. She acknowledged that the report was only recently completed and that the Group had not had an opportunity to review this report and that copies were now available.

- Olivier Ausseil commented that Dr Hickey is a leading scientist in this field, and is an independent professional who was asked to undertake independent work, and this was the basis under which all external experts for the project were engaged. Dr Ausseil stated that the numbers came out higher than the 2009 ECan review, but could equally have come out lower. The final numbers were a reflexion of the data, not of HBRC staff trying to influence the outcomes of Dr Hickey’s work. Suggesting otherwise was calling Dr Hickey’s integrity into question.

- Helen Codlin suggested a sentence could be included in the Tukituki Choices document if the group agreed along the lines of “environmental groups challenge some of the data”. Draft wording was suggested on white board, but when asked, no one in the group indicated they wanted it included.

- It was suggested that this group make a submission to the Tukituki document and that a special meeting of the Group be organised to provide feedback on the Tukituki Choices discussion document.

Other Items

- Mr Broadley advised that the Ruataniwha Water Storage Project was now framed by the Tukituki Choices Project.

- Mr Belford advised of a public forum taking place at EIT on 18 September, speakers confirmed at this stage were Andrew Newman and Dr Roger Maaka.

- New works for the project including optimisation to be identified, budget and MPI support being worked through.
- Full Feasibility document will be presented to Council on 26 September. Tukituki Choices consultation running alongside this.
- This group to review Tukituki Choices document and discuss and provide feedback to Council. **ACTION – date to be confirmed.**
- Concern was raised on the 'self audited management' approach proposed for farmers and that this approach would be too soft with few results achieved. It was clarified that this approach is easily confused but is in fact an audited self management approach which would require on farm audits from an external body. The details of this are yet to be defined but would require some sort of on farm planning (including nutrient) and assurance that the plan is being implemented.
- In summing up Mrs Hewitt noted that the LUI Working Party report had been signed by all except Fish & Game.
- She also recommended the group review the Social Impact Assessment report that had been provided and pass on the recommendations to the community.

The meeting closed at 2.45 pm.

Ruataniwha Plains Water Storage Project Stakeholder Group

Record of Discussion on the Draft Council Feasibility Report Environmental, Social and Cultural Studies and Community Engagement Sections

31 August 2012

Forest and Bird's preference would have been for an out-of-stream dam, but acknowledge that economic and geotech issues meant that this was not feasible.

Record of 31 August 2012 Discussion		
Draft Report Section	**Topic**	**Stakeholder Group Comments / Position**
1.1	Methodology	The Stakeholder Group understands the methodology utilised for assessing and reporting on the environmental, social and cultural elements of the project feasibility.
1.2	Studies Undertaken	The Stakeholder Group acknowledges the range of studies undertaken and confirms their review of, and input into, the scope of these studies.
Note: *From this point forward (1.3.1) Fish and Game have abstained and will advise their position at a later date, in writing.*		
1.3.1 & 1.3.2	Feasibility Project Description	The Stakeholder Group understands the scope of the Feasibility Project Description document developed by Tonkin & Taylor to includes the design and operational proposals for the project and that this document has been used as the basis for the various environmental, social and cultural expert assessments reported to Council.
1.3.3	Sedimentation Assessment	The recommendations of Tonkin & Taylor in their sediment assessment report are understood and supported.
1.4.1	Reservoir Water Quality Modelling	The recommendations of NIWA in their reservoir water quality modeling report are understood and supported.
1.4.2	Groundwater / Surface Water Modelling	The Stakeholder Group acknowledges that this is a modelling report which does not include any recommendations for further work, but that the HBRC

Record of 31 August 2012 Discussion		
Draft Report Section	**Topic**	**Stakeholder Group Comments / Position**
		Core Team is suggesting further flow analysis be undertaken (refer to comments under 1.10 below).
1.4.3	Land Use Intensification Modelling	The Stakeholder Group acknowledges that further work is being undertaken by NIWA and the wider modeling team as set out in Section 1.4.3 and understands that this will be reported prior to any resource consents being lodged for the project. *Tom Belford, Grenville Christie, Vaughan Cooper and John Cheyne consider the additional modeling work should be undertaken prior to deciding on project feasibility.*
1.5.1	Terrestrial Ecology Assessment	The recommendations of Kessels and Associates in their terrestrial ecology assessment reports are understood and supported.
1.5.2	Aquatic Ecology Assessment	The recommendations of the Cawthron Institute in their aquatic ecology assessment report are understood and supported. *Tom Belford and Grenville Christie reserve their support.* *Dave Carlton does not support the trap and transfer system proposed.*
1.6	Cultural Effects Assessment	The recommendations of Te Taiwhenua O Tamatea and Te Taiwhenua O Heretaunga in their cultural effects assessment are understood and supported.
1.7.1	Road Infrastructure and Traffic Assessment	The recommendations of Opus International Consultants in their road infrastructure and traffic assessment report are understood and supported.
1.7.2	Noise Assessment	The recommendations of Marshall Day Acoustics in their

Record of 31 August 2012 Discussion		
Draft Report Section	**Topic**	**Stakeholder Group Comments / Position**
		noise assessment report are understood and supported.
1.7.3	Archaeology Assessment	The recommendations of Clough & Associates in their archaeology assessment report are understood and supported.
1.7.4	Social Impact Assessment	The recommendations of Taylor Baines in their social impact assessment report are understood and supported.
1.7.5	Recreation Assessment	The recommendations of Opus International Consultants in their recreation assessment report are understood and supported.
1.7.6	Landscape and Visual Assessment	The recommendations of the Isthmus Group in their landscape and visual assessment report are understood and supported.
1.8	Integrated Mitigation and Offset Report	The Stakeholder Group acknowledges that HBRC has developed and costed an Integrated Mitigation and Offset proposal involving four identified projects in this report and the Group understands that there are further opportunities for interested parties to be involved in the focus and implementation of these projects if the Ruataniwha Water Storage project proceeds.
1.9	Land use Intensification Working Party Report	The Stakeholder Group thanks the Landuse Intensification Working Party for the work it has undertaken between January and August 2012 and supports the recommendations of the Working Party as recorded in their report.
1.10	HBRC Core Team Findings and Recommendations	The Stakeholder Group acknowledges the findings of the HBRC Core Team and agrees that their recommendations as outlined below be implemented if project feasibility is confirmed by Council and the project proceeds to a resource consenting phase:

Record of 31 August 2012 Discussion		
Draft Report Section	**Topic**	**Stakeholder Group Comments / Position**
		That further discussions should be held with Te Taiwhenua O Tamatea and Te Taiwhenua O Heretaunga in relation to: e) How to realise potential social and economic benefits for tangata whenua f) Engagement of tangata whenua in monitoring, improving and enhancing Mauri g) How best to define and recognise any unregistered wahi tapu / wahi taonga; and h) Historic Places Act authority requirements including the development of appropriate Accidental Discovery Protocols. Given the extensive areas of earthworks involved and the critical importance of controlling sediment run off to waterways we recommend that a detailed ESCP be prepared as part of the suite of documents to support resource consent applications if these are lodged. It will be necessary to undertake a full planning assessment if the project is to proceed to a resource consenting phase. The Core Team recommends that: e) The land use/nutrient/periphyton model be expanded to the whole of the Tukituki catchment to provide more detailed outputs, particularly within the Ruataniwha Plains area f) The above expanded model be applied to the current and future land use scenarios developed as part of the feasibility study g) If a decision is made to extend the irrigation area to Zone M, the land use/ nutrient/ periphyton model will need to be extended to that zone, to assess the potential effects of irrigated land uses. h) A comprehensive assessment of the following be undertaken: • the options to mitigate phosphorus losses from land, including livestock exclusion, and • the likely water quality and periphyton outcomes

Record of 31 August 2012 Discussion		
Draft Report Section	**Topic**	**Stakeholder Group Comments / Position**
		resulting from the implementation of the above mitigation options within the irrigation command areas. Council consider favourably an economic incentive package which enables existing irrigators to transfer to the storage scheme (if it is built) on a cost effective basis for their businesses. In conjunction with development of such incentives, we recommend further work be undertaken on the construction of the "no migration" water flow scenario. The constant residual flow from the dam of 90% of MALF combined with the proposed flushing flow volume provision of 1.5 million m^3 per annum is a significant amount of water and we recommend that Cawthron and Tonkin & Taylor be jointly tasked with assessing the most effective utilisation of this water volume in terms of overall river ecology. *Tom Belford reserves his position.*
2.1 to 2.7	Sections Recording Community Engagement	The Stakeholder Group acknowledges and confirms the record of community engagement processes undertaken by HBRC as set out in these sections.
2.8	Recommendations for Further Community Engagement	The Stakeholder Group ratifies the following recommendations: • That the Ruataniwha Stakeholder Group be maintained as an important community based reference group through-out the consideration of the Tukituki Choices document, the development of the Tukituki Plan Change and any Ruataniwha Storage Project resource consent applications that are prepared through the balance of 2012 and 2013. Consideration should be given to the addition of other key parties such as representatives of Te

Record of 31 August 2012 Discussion		
Draft Report Section	**Topic**	**Stakeholder Group Comments / Position**
		Taiwhenua O Heretaunga, Hastings District Council, Te Taiao Hawke's Bay Environment Forum, and the Ministry of Primary Industries, if it is decided to maintain the group through this period • That the Land Use Intensification Working Party be reconvened to provide input into the resource consent condition drafting process associated with land use intensification management and monitoring conditions if the project proceeds through to the consenting phase later this year. Consideration should be given to expanding this group, recognising that additional expertise may be required. • That Council engage further with the Pan Sector Group if the project develops past feasibility into a consenting phase, in particular to seek input and assistance with the development of appropriate land use intensification management and monitoring conditions. • That detailed one-on-one meetings are held with all landowners affected by the dam/reservoir and distribution headrace canal so that issues can be discussed and addressed in the design of the scheme prior to any application for resource consent being lodged.