14 EFFECTS ASSESSMENT METHODOLOGY

14.1 Assessment Methodology

This AEE is based on a comprehensive suite of studies that HBRIC Ltd has commissioned in relation to the Scheme (referenced in Table 1.8.1 to 1.8.3 in Section 1.8 of this AEE, and presented on the attached CD-Rom).

The effects which have been assessed and which are covered in the following sections of the AEE are:

14.1.1 Water Quality Assessments

Section 15 Reservoir water quality effects on Receiving Environment

14.1.2 Ecology Assessments

Section 16 Aquatic Ecology

Section 17 Terrestrial Ecology

14.1.3 Cultural Social and Recreational Assessment Reports

Section 18 Cultural Impacts

Section 19 Social Impacts

Section 20 Recreation Assessment

14.1.4 Construction, Landscape and Operations Assessment Reports

Section 21 Road Infrastructure and Traffic

Section 22 Noise Effects

Section 24 Historical Heritage / Archaeological Assessment

Section 25 Landscape and Visual Effects

Section 26 Sedimentation Effects

Section 27 Dam Break Study

14.1.5 Economic Assessment Reports

Section 23 Regional Economics

The effects 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.

The results outlined in each of the assessment sections that follow are the executive summaries of the Assessment Reports prepared for this AEE.

It is important to note that for consistency and accuracy the key findings of each of the Assessment Reports are set out in the words of the respective authors, and have not been adapted or paraphrased in the AEE, except where minor tense, referencing and wording changes have been needed to assist readability, or where recommendations from the study authors have been converted to firm commitments by the applicant.

The Assessment Reports form part of this AEE.

For more detail on the various assessment areas readers are directed to each of the specific reports contained on the CD-Rom.

15 EFFECTS OF RESERVOIR WATER QUALITY ON RECEIVING WATERS

An assessment of water quality effects was undertaken, and is discussed in a report prepared by NIWA (*Reservoir Water Quality – NIWA, May 2013b).*

15.1 Potential Environmental Effects

The major effect of constructing a dam on the Makaroro River will be a change in flow regime in the river below the dam from a natural high-low response to rainfall events to a more regulated flow without extreme flood events. The use of the Makaroro reservoir, which forms behind the dam, as a water supply for the proposed RWSS will cause changes in the water level in the reservoir and different flow patterns in the downstream river, as defined in the Project Description[33].

The water in the Makaroro reservoir will have a theoretical mean residence time of about 164 days, based on the full volume of 90 million cubic metres and a proposed mean annual discharge of 6.342 cubic metres per second (Tonkin & Taylor data provided for the Feasibility Study[34]). This residence time will delay the movement of sediment down the river channel by causing the heavier rocks, gravel and sand to deposit at the inflow end of the reservoir and allowing sufficient time for the finer particles to settle to the lake bed as the water moves the 6 km downstream to the dam wall and outtake structures. This will substantially reduce the sediment load and produce higher clarity water downstream of the dam.

The residence time will also allow the surface waters in the lake to become warmer than the inflow river in winter and consequently the downstream river will be slightly warmer than it would naturally be without the reservoir. Conversely, in summer the water temperature in the reservoir will be cooler than the midday temperatures in the inflow river but warmer than the night time river temperatures. This "thermal damping" will result in less variability in temperature than would otherwise occur in the river downstream of the dam.

15.2 Assessments Undertaken

The assessment undertaken required characterisation of the predicted water quality in the proposed Makaroro reservoir including:

- Expected physio-chemical characteristics of the water within, and discharged from the reservoir

[33] See *Tonkin & Taylor (May 2013a)*
[34] Ruataniwha Water Storage Project - Feasibility Report to Council - Report No. WI 12-24 September 2012

- Suitability of reservoir water quality for aquatic life, recreation and other uses
- Effects of removing versus retaining vegetation within reservoir extent
- Other considerations/recommendations regarding future dam site management before, during and after dam establishment
- Further investigations/information that may be required to characterise reservoir water quality.

To achieve this, the proposed reservoir was modelled using the coupled hydrodynamic-ecological model DYRESM-CAEDYM to simulate hydrological, hydrodynamic and water quality for several operating regimes. Expected bathymetry of the completed reservoir and flow data in the Makaroro River were provided by Tonkin & Taylor Limited. Meteorological and climate data were obtained from five of NIWA's Virtual Climate Network Stations (VCNS) over the reservoir site and catchment, as well as national Meteorological climate stations at Dannevirke and the Takapau Plains. Water quality data for the Makaroro River were obtained from the NIWA National Rivers Water Quality Network (NRWQN) monitoring site at Burnt Bridge. Additional parameters used in the model were obtained from literature values and other studies producing similar simulations. These data were applied to the DYRESM-CAEDYM model which was run with a daily step interval for the 5-year period 2000 to 2005.

Because the Makaroro reservoir does not exist, the model was unable to be calibrated against empirical observations using statistical measures of model performance. Rather, the calibration for sensitive parameters during the setup of the model was based on a combination of expert knowledge, coefficients from other model applications, and values from literature. Consequently, predictions and assessments use best scientific practice based on the available data provided.

Assumptions made in the modelling include no changes to land use in the catchment that would increase nutrient loads to the Makaroro River and reservoir and that land clearance for production forestry and other activities would be managed to keep sediment erosion to a minimum.

Initial model scenarios used operating regimes where a mean flow of around 6 cubic metres per second was drawn from outtake valves set at either 455.5 m relative level (RL) (upper) or 426 m RL (lower) with additional compensation water of about 1.23 cumecs being drawn from the toe of the dam at 395 m RL. These modelling results indicated that the upper and lower outtake levels resulted in selective draw-induced stratification at the draw depth. Water quality above the draw depth was generally good but below the draw depth the water quality was poor, and would become anoxic for

extended periods. It was concluded that selective draw from as deep in the lake as possible would greatly improve the water quality in the reservoir.

This was tested with three new model scenarios:

- **M1**: main draw depth set at 405 m RL (allows 10 m deep sediment accumulation below the draw depth)
- **M2**: main draw depth set at 443 m RL (has 48 m water depth below the draw depth)
- **M3**: minimum base flow of 1.228 cumecs drawn from 405 m RL and the remainder, about 5.1 cumecs being drawn from the 443 m RL outtake.

15.3 Results of Assessment

The presence of organic matter remaining within the reservoir extent at the time of construction was found to cause oxygen depletion due to natural decomposition processes for several years after the reservoir is first filled. As the organic matter was consumed over time, the extent of the oxygen depletion reduced. While there was a small reduction in the time required to reduce the oxygen depletion by removing the vegetation within the reservoir extent before filling, the costs of removing the vegetation would be great and there would be areas of the reservoir extent where it would be impractical.

Additional considerations were the management of the reservoir catchment to eliminate unnecessary soil erosion due to land slippage following land clearance and future logging operations for production forest.

In general, modelling showed that the water quality in the Makaroro reservoir was likely to be similar to water quality of the inflow water although biogeochemical processes that occur naturally in lakes may change the relative concentrations of some parameters. Seasonal changes followed the natural cycles found in other deep lakes with the water column being fully mixed and well oxygenated in winter but thermally stratified during summer. The depth of stratification was strongly affected by the draw depth with oxygen depletion in the bottom waters, unless an aeration system was used.

Scenario **M1** produced the best water quality with less than 0.25% of the volume of the reservoir (when full) becoming anoxic. Aeration may be required in some years with this scenario.

Scenario **M2** produced the worst water quality with an estimated 21% of the total lake volume becoming anoxic during summer stratification. Because of the large volume of stagnant water below the draw-induced stratification depth, the modelling indicated that under this scenario the reservoir

may not mix in some years. This would compound the issues of nutrient release from the sediments in the bottom waters and could stimulate substantial algal blooms in the year when the reservoir water column did mix. Aeration would be required with this scenario.

Scenario **M3** produced an intermediate water quality with anoxia below the 405 m RL outtake (as in scenario M1) and progressive oxygen depletion below the 443 m RL outtake eventually becoming anoxic by mid-summer in some years. Aeration would be required with this scenario.

The **M1** scenario model showed that nutrient concentrations were likely to be low in the upper water column during summer but were likely to increase following winter mixing, and were likely to support a low level of phytoplankton (free floating algae) in the upper water column in spring. With low phytoplankton levels and low suspended solids concentrations from sediment, the water clarity was likely to be high. Overall, the expectation was for the Makaroro reservoir to have a trophic level classification of oligotrophic to mesotrophic.

15.4 Suggested Approach for Effects Identified

The Feasibility Study modelling found that scenario M1 produced the best water quality in the lake with the least oxygen depletion in the bottom of the reservoir. Consequently, Scenario M1 is the recommended option for the Makaroro reservoir operation regime.

It is also recognised that there are likely to be a few years after first filling when the bottom waters will develop anoxia, before the reservoir stabilises. The proposed conditions provide for that an aeration system to be installed in the bottom of the reservoir near the dam wall to provide water column mixing and reduce the effect of or prevent anoxia.

The water quality in the reservoir is dependent on the quality of water entering the reservoir. Sediment is a major pollutant of freshwater as is nutrient runoff from farming. It is recommended that management strategies are developed for the reservoir catchment to reduce the incidence of erosion that could exacerbate sediment accumulation in the reservoir, and to control land use changes, including farming intensification, that could enhance nutrient runoff into the Makaroro River and the reservoir.

The proposed conditions provide that a routine monitoring programme will be implemented on the Makaroro reservoir to facilitate adaptive management strategies for the reservoir. Of critical importance is the monitoring of temperature and dissolved oxygen (DO) at all depths in the reservoir water column in order to manage the aeration system and thereby keep the DO concentration above the minimum required for fish, i.e., 5 mg/L. A recommended aeration activation threshold and

monitoring regime for the aeration system is provided in this report and this has been adopted in the proposed conditions.

It is also important to have a monitoring programme that will provide basic water quality information on the water in the reservoir in order to assess trophic condition and change over time. Without this type of information it is not possible to detect changes in the reservoir water quality that will allow management strategies to be developed and implemented in a timely manner.

While the Feasibility Study[35] found that scenario M1 produced the best water quality and was therefore the recommended option, subsequent hydrological modelling produced a new operating regime (Scenario 3-28M) defined in the Project Description Report (*Tonkin & Taylor, May 2013a)*. Scenario 3-28M will allow water levels in the proposed Makaroro reservoir to be lower more often than in Scenario M1 in most years. However, the lower levels indicated from the Scenario 3-28M modelling are well within the range of water levels modelled for Scenario M1.

Consequently, provided the main draw depth for water is kept as deep as possible in the reservoir, nominally at 405 m RL, the change in operating regime is unlikely to have more than a minor effect on the lake water quality and thus the quality of the water discharged to the downstream river. Further hydrological modelling was undertaken following the release of the Final Draft (March 2013) suite of documents, which superseded scenario 3-28M described above. The outcomes of this modelling with regards to lake level behaviour are presented in Figure 3.8 of the Project Description (*Tonkin & Taylor, May 2013a).* Visual examination of this plot indicates very minor differences with the 3-28M scenario described below and the conclusions drawn above in relation to the 3-28M scenario are also valid for this latest scenario in the May 2013 Project Description Report.

[35] *ibid*

16 AQUATIC ECOLOGY

HBRIC Ltd engaged the Cawthron Institute (Cawthron) 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 Scheme, and identify mitigation and monitoring options.

The report - Aquatic Ecology Assessment (*Cawthron, May 2013)* is an updated and revised version of the initial assessment of effects on aquatic ecology report that was prepared as part of the feasibility stage of the Scheme (*Young et al. 2012*) and assesses the effects of the Scheme as described in the Project Description (*Tonkin & Taylor, May 2013a*).

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).

16.1 Potential Environmental Effects

The key potential effects of the construction and operation of the Scheme 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 Scheme
- Changes in water quality and effects on periphyton, invertebrates and fish associated with changes in land use.

16.2 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, our assessment of effects of the Scheme 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 (*NIWA, May 2013c*), predicted changes to the flow regime (*Tonkin & Taylor 2011; HBRC Science May 2013a; Aquanet, May 2013*), predicted changes to sediment transport and geomorphology (*Tonkin & Taylor, May 2013b*), surveys of trout spawning and juvenile trout density (Maclean 2011; 2012), predicted effects of land use on water quality and periphyton (*NIWA, May 2013a, b*) and new information on nitrate toxicity thresholds (Hickey 2013a, b) have been incorporated into our assessments.

16.3 Results of Assessments

Outlined below are the results of the Cawthron Assessment:

- 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 extraction 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 (*NIWA, May 2013c*) 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 proposed 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 the report recommends that an upstream and downstream trap and transfer programme and habitat enhancement initiatives be used to mitigate the effects.
- 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 water 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 Scheme 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 Scheme, 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 Scheme.
- 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 (*HBRC Science, May 2013a*).
- At times, the water temperatures within the Tukituki catchment currently approach levels that will begin to stress sensitive aquatic life. The Scheme 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 general reduction in median flows downstream of the irrigation intake will reduce the capacity of the river to dilute contaminants at moderate flows. However, in contrast the general increase in minimum flows will result in an increase in dilution of contaminants at low flows.

- 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 Scheme design has incorporated the capacity for four flushing flows of up to 30 m^3/s to be released from the dam per year to aid the management of periphyton growth in reaches downstream of the dam, including the lower Tukituki River. These flushing flows will be very effective in the Makaroro and Waipawa rivers downstream of the dam. However, evidence suggests that they are also likely to provide significant benefits in the Tukituki River below the Waipawa confluence, particularly if the flow releases are timed to coincide with small 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. This is a clear environmental benefit of the Scheme over the status quo and will help to meet the periphyton objectives of the proposed Change 6.
- 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 stranding. 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 upper 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 upper 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 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 stock exclusion be an integral part of the overall Scheme design, and in any event it is noted that stock exclusion is a key rule in HBRC's Change 6.

- Modelling of a future land use scenario with no on-farm mitigation predicted that nitrogen and phosphorus inputs for the whole catchment would increase by 32% and 6%, respectively as a result of the land use intensification associated with the Scheme. Nitrogen and phosphorus losses within the irrigation command area are predicted to increase by an average of 81% and 41% respectively (*NIWA, May 2013b).* The resulting increase in phosphorus concentration was predicted to result in faster periphyton growth and higher peak biomasses of periphyton in the lower Waipawa and Tukituki rivers. However, the Scheme is now being progressed on a phosphorus neutral basis, compared with a 2013 baseline. At a whole catchment scale, modelling indicates that fencing to exclude stock from streams and the optimal use of phosphorus fertiliser are predicted to offset the 6% increase in phosphorus losses and make the RWSS close to phosphorus-neutral overall (predicted 1% increase). However, within the irrigation command area, land use change with mitigation is still predicted to increase phosphorus losses by 7% relative to pre-irrigation levels – significantly lower than the predicted 41% predicted without any mitigation, but still not 'phosphorus-neutral'. The modelling does not capture all of the benefits of stock exclusion, but even so, additional mitigation measures may be required in some irrigated sub-catchments for them to be 'phosphorus-neutral' (*NIWA, May 2013b*).
- Prior to construction of the Scheme, 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 in the lower Tukituki and Waipawa rivers.
- The combination of phosphorus neutral status and reduced inputs of phosphorus from the Waipukurau/Waipawa waste water treatement plants is predicted to result in significant reductions in annual average periphyton biomass, and less frequent periods of high biomass. Nevertheless, during periods of prolonged low flow, periphyton biomass will continue to reach high levels (*NIWA, May 2013b*). The proposed flushing flows associated with the Scheme are expected to provide additional reduction in the incidence of high periphyton biomass by interrupting the periods of biomass accumulation during prolonged summer low flows.
- High concentrations of nitrate nitrogen can be toxic to aquatic life. Land use changes associated with the Scheme are predicted to increase nitrate concentrations significantly in tributaries draining the irrigation command areas. It is predicted that without mitigation nitrate concentrations will exceed the limits set in the proposed Tukituki Plan Change in five of the tributaries – three affected by point source waste discharges and intensive farming,

and the remainder affected by intensive farming only (NIWA, May 2013b). To address this issue additional monitoring will be required and particular attention will need to be given to sites that are predicted to be close to, or beyond, the proposed limits. Management actions aimed at reducing nitrogen leaching will be required in any areas that are over the limit to avoid the risk of nitrate toxicity problems. If cost-effective nitrogen mitigation measures are unable to ensure that toxicity limits are not exceeded then it may be necessary to restrict the types of agriculture that will be permitted in some, sensitive, sub-catchments.

16.4 Suggested Approach for Effects Identified

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

- An upstream and downstream trap and transfer programme that will enable migratory native fish to access habitat upstream of the proposed dam, and enable mature longfin eels to move downstream and complete their life cycle.
- 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 rock-fill infiltration bund at the upper irrigation intake as a fish screen.

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

Ruataniwha Reservoir Restoration Buffer and Catchment Enhancement Zone:

This is as proposed in the Integrated Offset and Mitigation Approach report (*HBRIC, May 2013f)*. 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.

Ruataniwha Riparian Enhancement Zone (River Halo Project):

Again, this is as proposed in the Integrated Offset and Mitigation Approach report (HBRIC, May 2013f). 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 Scheme.

Ruataniwha Threatened Species Habitat Enhancement

This initiative focusses on fostering habitat protection/enhancement for bats throughout Hawke's Bay, terrestrial predator trapping to enhance biodiversity values within the upper Makaroro Catchment and downstream to the upper intake structure, and the upstream and downstream trap and transfer programme for native fish.

Ruataniwha Plains Spring-fed stream Enhancement and Priority Sub-Catchment Phosphorus Mitigation

The changes in land use associated with the proposed Scheme 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. This project is presented in more detail in the Integrated Offset and Mitigation Approach report (*HBRIC, May 2013f)*

Modelling indicates that with appropriate mitigation the Scheme can be developed on a phosphorus-neutral basis and therefore if all the mitigation and rehabilitation efforts and measures are in place, the Scheme will have relatively minor effects on the aquatic ecosystem and the Tukituki Catchment will continue to support the current wide range of values.

Restoration of Old Waipawa River Bed / Papanui Stream

The objective of this package is to rehabilitate and enhance water quality and stream habitat in the bed of the old Waipawa River / Papanui Stream subsequent to any works required to meet Zone M irrigation requirements. This will involve funding to contribute to fencing, planting and wetland creation along the riparian margins of the stream.

At a whole-catchment scale, modelling indicates that with stock exclusion and optimal use of phosphorus fertiliser the Scheme can be developed on a near 'phosphorus-neutral' basis. Provided the 'phosphorus-neutral' status can be achieved in all sub-catchments, the provision of augmented flushing flows, as now proposed, should contribute to reducing periphyton growth in the lower Waipawa and Tukituki rivers. However, within the irrigation command area it appears likely that

careful monitoring, additional mitigation measures, and perhaps restrictions on the types of agriculture permitted in some sensitive subcatchments will be required to avoid increases in phosphorus concentrations and exceedances of proposed nitrate toxicity limits in some streams draining the Ruataniwha Plains. If this can be achieved and if all the other mitigation and rehabilitation efforts are in place, the Scheme will have relatively minor effects on the aquatic ecosystem and the Tukituki will continue to support the current wide range of values.

17 TERRESTRIAL ECOLOGY

Kessels & Associates conducted an ecological impact assessment of the Scheme and made recommendations regarding measures to avoid, mitigate or offset potential adverse effects on indigenous terrestrial fauna and flora species and their habitats. The focus of the assessment and report (*Kessels and Associates, May 2013*) is on the reservoir and dam components of the Scheme, although the assessment extends to the braided river ecosystems downstream of the dam and reservoir.

17.1 Potential Environmental Effects

The potential ecological effects of the construction and operation of the Scheme on terrestrial indigenous fauna and flora as assessed in the report are:

- A permanent loss of a variety of indigenous vegetation communities and braided river within the reservoir,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 upstream water intake structure associated with changes in sediment deposition rates, river flow patterns and changes in land use
- 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
- 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.

17.2 Assessments Undertaken

Field assessments have been undertaken over the period of September 2011 to February 2013 within, and over areas potentially affected by, the proposed dam and reservoir components of the Scheme. 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
- Recommendations for appropriate measures to avoid, remedy, mitigate, or offset for any potential adverse effects identified.

17.3 Results of Assessment

The total area affected by flooding, the dam structure and spoil disposal is approximately 450.18 ha. A total of 185.18 ha of ecologically significant indigenous vegetation and habitats would be flooded by the proposed reservoir, or covered over by associated infrastructure including the dam structure, new access tracks and soil disposal sites. This comprises of:

- 80.71 ha of mature and secondary indigenous forest (including a number of trees which would be in excess of 300 years old)
- 2.69 ha of treeland
- 22.70 ha of secondary indigenous scrub
- 73.97 ha of gravel river bed
- 5.11 ha of wetland or seep zones.

One At-Risk plant species was found – red mistletoe.

A total of 38 bird species (11 endemic) were identified at the proposed reservoir locality during formal field surveys. Of all individual birds formally observed 55% were native and 45% introduced. Threatened or At Risk species comprise 2.5% of all observations, including one pair of nesting and Nationally Vulnerable New Zealand bush falcon, and one adult banded dotterel with a chick. Nationally 'At Risk' species detected were pied stilt, New Zealand pipit, black shag and North Island fernbird.

Long-tailed bats were found throughout the proposed reservoir during an ultrasonic survey completed between November 2011 and February 2012 and again between January and February 2013.

Simultaneous surveys of the reservoir area and wider landscape showed that it is likely that bats are resident and roosting within the reservoir area, and then move out into the wider landscape throughout the night. Activity levels are higher within the reservoir zone when compared to the wider landscape demonstrating the importance of this habitat for the bats, albeit evidence of a discrete population within the wider landscape was obtained through the surveys.

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 2013. Results showed a rich diversity of insects and land snails. Two individuals of the 'At Risk' Hawke's Bay tree weta, *Hemideina trewicki*, have been discovered within the study area.

17.4 Suggested Approach for Effects Identified.

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

- A bat management plan
- A pre-construction lizard survey and translocation plan
- Weed hygiene and surveillance
- 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 key Mitigation and Offset packages are recommended. These are:

Ruataniwha Reservoir Restoration Buffer and Catchment Enhancement Zone:

The objectives of this package are to:

- Re-create 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.

Ruataniwha Riparian Enhancement Zone (River Halo Project)

The objectives for this package are to:

- Control 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
- Assist landowners with fencing, replanting (as required) and legally protecting existing areas of wetlands, bush and scrub within or contiguous with the 1 km buffer (width) enhancement zone.

Ruataniwha Threatened Species Habitat Enhancement

The objectives for this package are:

- Targeted assistance programme to foster research, advocacy and habitat protection/enhancement for bats and their habitats throughout Hawke's Bay
- Predator trapping programme to enhance the biodiversity values of indigenous forest areas within the upper Makaroro River catchment and downstream of the dam structure to Caldwell Road (principally focusing on blue duck and wader bird habitats, subject to results of pre-construction blue duck survey and wader bird population survey)
- Trap and transfer programme focusing on native fish.

The above programmes would result in a number of significant benefits, including: Intensive, targeted animal pest control over 1,100 ha of habitats within the Makaroro River catchment, 146 ha of habitat recreation and enhancement around the new reservoir and within its sub-catchment; assisting landowners to protect and manage over some 622 ha of bush, scrub, and wetland, and approximately 314 ha of braided river habitat for wading birds within a corridor of the mid reaches of the Waipawa and Makaroro Rivers; and contributing towards projects that will enhance the knowledge of Threatened and At Risk species, as well as their habitats within the Hawke's Bay Region. In addition, Project E will re-create and restore wetlands in and along the Old Waipawa River / Papanui Stream, providing additional compensation for the wetland ecosystem losses associated with the Scheme.

The mitigation recommendations contained within this report have been integrated into a separate report entitled "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (*HBRIC, May 2013f*).

18 CULTURAL IMPACT ASSESSMENT

18.1 Introduction

Cultural Impacts are assessed in two reports (Taiwhenua ō Tamatea & Taiwhenua ō Heretaunga - June 2012) and (Taiwhenua ō Tamatea - April 2013). The first report was jointly commissioned for the RWSS and Change 6 processes and deals with cultural values and uses in the whole catchment. Section 5.2 of that report specifically addresses the RWSS and the text outlined in Section 18.2 to 18.5 below is taken from that section.

As discussed further in 28.6 a Mana Whenua Working Party was established to implement the key recommendations regarding the RWSS contained in Taiwhenua ō Tamatea & Taiwhenua ō Heretaunga - June 2012.

As part of the Mana Whenua Working Party process an additional Cultural Impact Assessment Report was commissioned (Taiwhenua ō Tamatea, April 2013) which assessed the cultural effects of Zone M which was brought into the Scheme after feasibility assessments were completed in 2012. Section 18.6 below sets out the executive summary of the Addendum Report.

18.2 Involvement of Mana Whenua

Over the last few years, the HBRC and HBRIC Ltd have 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 Makaroro Rivers (Wakefield et al, 2011). The CIA reports identified registered and unregistered wahi 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 ō Tamatea. The HBRC Maori standing committee representatives strongly advocated for the involvement of Marae and Hapu from the lower Tukituki River catchment. This resulted in a CIA report commissioned by the HBRC to be undertaken by Te Taiwhenua ō Heretaunga and was completed in 2012 (Te Apatu & Moffat, 2012). There was a single focus on the proposed dam site on the Makaroro 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 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 Maori world views; Papatuanuku 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 nga 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 hapu and the findings are briefly outlined in the sections below.

18.3 First CIA Report – Overarching Issues

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 were no known wahi tapu sites registered or unregistered specifically located within any of the eight originally proposed water storage sites. 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 hapu were cautious and uncertain on what the potential benefits might be for Maori. There was a significant issue with the lack of consultation that did not occur with marae/hapu during the pre-feasibility study. Most of the recommendations made from Tangata whenua were focused around the HBRC (and then HBRIC Ltd) 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.

18.4 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 Makaroro.

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

There were unregistered wahi tapu/ wahi taonga which would require more discussion with tangata whenua directly to ensure these sites were protected during subsequent stages of the Scheme study development. There was also a need expressed 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.

18.5 Lower Tukituki (Heretaunga) Specific Issues

Within the CIA report, there was a comprehensive overview of the historical and contemporary issues raised for Heretaunga marae/hapu. Although these issues were related to the proposed dam on the Makaroro, 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 nga hapu 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 hapu 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/ hapu (common village, clan or social order) feel very much a part of the river and see it as their right, as tangata 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*?" and "*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/ hapu, but for other local communities, interest groups, and the majority of whanau and families of the region.

Hapu wish to be involved at all levels of the process to ensure that the Maori 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.

18.6 Zone M Addendum Report

The addendum report provides a cultural impact assessment of the proposed Zone M located within the region starting from Waipawa, Otane, Pukehou and Te Whatuiāpiti areas of Central Hawke's Bay. The Hawke's Bay Investment Company Limited (HBRIC Ltd) is proposing to deliver irrigation water to Zone M of the RWSS by using the Old Waipawa Riverbed and the Papanui Stream as the primary distribution mechanism/ headrace.

The tangata whenua from this area involve four marae: Mataweka, Tapairu, Pukehou and Te Whatuiāpiti. The overwhelming response from tangata whenua is primarily concerned with the protection of cultural values and to improving the mauri of their waterways. This includes the three lakes known as 'Ngā Puna a Tara' within Pukehou, which have been in private ownership for many

years. The Papanui Stream source flowed from the springs and as an outlet of Lake Roto-a-Tara. Over the years the stream has been modified, re-diverted, narrowed and deepened, and most alarmingly, shrunk in size and water velocity and polluted to the point of being 'mauri-mate.' The HBRC and HBRIC Ltd acknowledge the Papanui Stream now has a 'poor quality' grading.

The Zone M concept is proposing to release the water from the Makaroro Dam to be re-diverted along the Old Waipawa River Bed that was blocked off many years ago. Tangata whenua are supportive of the opportunity to enhance the life supporting capacity of the river. The springs located along the Waipawa River stretch close towards the township. It is a major concern for tangata whenua who are hoping the increase in surface water from Walker road along the old Waipawa River Bed will allow the ground water aquifer to replenish itself.

The council are seeking to develop riparian strips alongside the Papanui Stream. This is being supported by the tangata whenua and viewed as an opportunity to enhance the fishery, habitats, fauna and flora in the waterways.

Tangata whenua have raised some concerns over the lack of specific detail concerning the construction of the piping systems, canals and to utilising the existing natural characteristics of the Old Waipawa River Bed and the Papanui Stream. There is some perceived risk to wāhi tapu sites located in close proximity to the Papanui Stream that will require further dialogue with the marae on mitigation measures to protect these sites.

Tangata whenua have expressed scepticism on how the proposed Zone M concept will benefit the four marae located within the region. The loss of water drained away for agricultural farming over the years has also impacted on the ability of marae to access water from the waterways that used to flow past their papakāinga (i.e., the springs, streams and lakes) which are now virtually non-existent or are in poor health.

The CIA report has made a number of recommendations for HBRIC Ltd to consider and the four marae in particular, are keen to dialogue directly with HBRIC Ltd to discuss their concerns further.

19 SOCIAL IMPACT ASSESSMENT

19.1 Potential Environmental Effects

A Social Impact Assessment report was prepared by Taylor Baines (*Taylor Baines, May 2013)* on the social and socio-economic effects associated with the proposed Scheme.

Key land use changes anticipated with irrigation are:

- Dairying and its associated dairy support
- Intensified horticultural operations
- Irrigated arable farming
- Some irrigated sheep and beef farming.

The assessment found that, based on analysis of the Scheme area and 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.

19.2 Assessments Undertaken

The scope of the 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.

19.3 Results of Assessment

There are approximately 470 farms greater than 10 hectares in irrigation zones A to D and M. The report concluded that 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 turnaround from negligible growth in population evident in the district over recent years – in both rural areas and the main towns
- 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 the shift to an inherently adversarial planning process.

19.4 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.

Taylor Baines concluded that 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 community strategy to identify and encourage retention of features that reinforce sense of place as land uses 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 rest of the planning and design process.

HBRIC Ltd accepts the general tenor of these recommendations but does not consider that they are suitable to incorporate as consent conditions within *Part D- Proposed Conditions* of this application. Because they rely upon the enthusiasm and participation of a number of stakeholders including (but not necessarily limited to) Business Hawke's Bay, CHBDC, HDC and mana whenua, HBRIC Ltd considers that a more appropriate approach is to develop a Memorandum of Understanding with these stakeholders and discuss and evolve a suitable terms of reference in consultation with them. It proposes to implement that approach to Taylor Baines' recommendations.

20 RECREATION ASSESSMENT

20.1 Potential Environmental Effects

A report prepared by OPUS (*OPUS, May 2013a*) assesses the recreational values and effects of the Scheme. OPUS considers that potential recreation effects of the proposed Scheme 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 upstream water intake)

- There will be no effects on existing access to the Makaroro River and Waipawa River
- Monthly mean flows would be generally more consistent during the year. There would be greater flow (compared with current flows) in the summer and lower flows (compared with current flows) in the winter. Average flows during the irrigation season (October to April) would be considerably higher. Although the activities of fishing, swimming and kayaking will not be lost, the nature of the activity in recreation zone 2 will change.

Zone M – (forms part of the wider distribution network)

- The recreation activities that occur at Walker Road end are unlikely to be affected by the intake structure proposed in this area
- Currently the Papanui Stream has low amenity values characterised by low flows and weed growth. As part of the proposal to utilise the stream for the conveyance of irrigation water through Zone M, it is proposed to improve the in-stream ecology, general amenity through a Papanui Stream Rehabilitation Plan as set out in the Proposed Resource Consent Conditions. This rehabilitation may '*provide recreation opportunities,*

such as developing a walking/cycling path, linking the settlements of Otane and Waipawa at the edge of the new riparian margins along a portion of the Papanui Stream, subject to engagement and approval by with landowners', thus creating a positive environmental effect. Our conclusion is that Zone M (Papanui Stream Section) has the potential to have a positive recreational effect through the provision of cycling opportunities suitable for recreational cyclists of all ages as well as additional walking opportunities.

Effects during Construction

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

20.2 Assessments Undertaken

HBRIC Ltd commissioned Opus to prepare a Recreation Assessment (April 2012) which addresses the following:

- Identify and characterise the range of recreational activities undertaken in the Scheme 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 Scheme on the identified recreational activities being undertaken in the Scheme area
- Identify and characterise any new recreational opportunities that may be created by the Scheme, 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 Scheme area.

The Recreation Assessment was undertaken between the months of December 2011 and February 2012 as part of the feasibility stage of the Scheme. 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 Scheme area and proposal (as it then was) 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 scheme of this nature. A further site visit was undertaken in March 2013 to assess the changes from the Feasibility Design to the Application Design, which for the purposes of this report focus primarily on the inclusion of Zone M to the Scheme.

20.3 Results of 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 adopted in the Project Description *(Tonkin & Taylor, May 2013a)* by HBRIC Ltd including a commitment to alternative access around the top end of the reservoir.

The other key conclusion of this report is in relation to the opportunity the completed dam and reservoir 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 reservoir. Proposed mitigation acknowledges the provision of these activities is a desired outcome and the report recommends 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; de-vegetation (or lack of) and how this is managed; and treatment of the 'dead zone' around the dam periphery will potentially place constraints on the dam for recreational use.

20.4 Suggested Approach for Effects Identified

A workshop on a potential integrated mitigation and offset programme associated with the physical effects of the Scheme 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 the recreation report were discussed at the workshop.

Following further engagement with landowners and other stakeholders over the period since that meeting to discuss implementation of these recommendations, HBRIC Ltd has completed a separate report entitled "Ruataniwha Water Storage Scheme – Proposed Integrated Mitigation and Offset Approach" (*HBRIC, May 2013f*). This explains the commitments being made to address or offset any adverse effects of the Scheme including on current recreation activities, particularly in the reservoir area, and to support or promote new recreational opportunities created by the Scheme.

The suggested approach for effects identified for each recreation activity assessed in this report applies these commitments as recorded in *HBRIC (May 2013f)*. Proposed conditions of consent incorporate these commitments including the requirement to implement the Integrated Mitigation and Offset Approach and through the **Reservoir Filling and Edge Rehabilitation Plan** to be progressively implemented upon commencement of construction of the Scheme.

21 ROAD INFRASTRUCTURE AND TRAFFIC

A Road Infrastructure and Traffic Assessment report prepared by OPUS (OPUS, *May 2013b)* assesses the impact that the Scheme 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).

21.1 Potential Environmental Effects

Potential Scheme effects considered as part of this report are:

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

21.2 Assessments 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.

21.3 Results of Assessment

21.3.1 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 proposed along with appropriate remedial response (refer below)[36]. It is considered that the effect of the construction traffic on the SH bridges will be minimal.

[36] The proposed conditions in *Part D* expand the scope of the proposed inspections to include culverts as well as bridges.

21.3.2 Road Pavement and Surfacing

Delivery of initial plant to site and dam construction traffic are likely to follow similar routes. Any overweight loads are likely to impact on the road surfacing 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 surfacing 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 over dimension 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.

21.3.3 Road Alignment

A desktop assessment has identified two 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 the curve immediately west of Hardy Road and curves at Pendle Hill Road.

21.3.4 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. Potential alignments of alternate accesses have been identified.

21.3.5 Beach Nourishment Operation

Once the dam is operational annual beach nourishment of 3,400 m3 is required to mitigate the downstream effects of the dam. The location of this is shown in Figure 3 of the report . This would result in approximately 280 return trips by truck and trailer vehicle (assuming $12m^3$ capacity). This annual operation will be carried out around October / November after the winter storms. This would represent an additional 22-28% increase in daily HCVs for a 10 day operation.

21.4 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 the Scheme, 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 will need to 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 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 the OPUS report.

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 likely hood of damage to surfacing from overweight vehicles associated with initial plant delivery, the following conditions are recommended for inclusion within the proposed Construction Traffic Management Plan (CTMP):

- The maximum surface temperature that any section of the pavement on the construction traffic route should be trafficked is 40°C. This maximum could be raised to 45°C if experience shows that no damage occurs at temperatures close to 40°C.
- 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/over dimension loads should take place during 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 (as identified in the OPUS report) 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.

Road Alignment

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.

New Access Roads

In order to reduce dust along the main dam access route, the report recommends 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 in consultation with the landowners' requirements.

Beach Nourishment Operation

The beach nourishment operation will likely represent a 28-28% increase in HCV volumes for a 10 day operation. It is recommended the local residents be informed beforehand when this annual operation takes place.

The above recommendations are implemented through the proposed conditions of consent.

22 NOISE EFFECTS

The RWSS comprises very significant earthworks and construction activity in and around the Makaroro River. Significant amounts of noise will be produced over approximately a four and half year construction timeframe. A report prepared by Marshall Day (*Marshall Day, May 2013*) 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.

22.1 Potential Environmental Effects

The noise effects which are expected to arise from the proposed water storage scheme 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 water distribution network. These sites are generally at large distances from dwellings.

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

The Beach Nourishment Scheme has potential noise effects associated with the transport and deposition of sediment.

22.2 Assessment 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 Project Description document *(Tonkin & Taylor 2013a)*. Noise is predicted using the ISO9613-2 Industrial Noise Model, implemented in SoundPLAN software.

22.3 Results of Assessment

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[37] 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 are not predicted to have adverse effects.

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

Noise effects from the beach nourishment scheme are predicted to be minor or less than minor except along the residential portion of Haumoana Road where noise effects from truck traffic may be significant for a one week period each year. We would consider this noise effect reasonable given its short duration, and relative to noise levels provided for in NZS6803:1999.

22.4 Suggested Approach for Effects Identified

The report recommendation to address construction noise issues in a construction noise management plan has been implemented by the applicant in the Construction Environmental Management Plan (CEMP). The report concludes that the CEMP will 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 as well as at any noise sensitive locations which are found to be affected near the headrace construction. The CEMP will also provide a means for good communication with the community and a pathway for feedback to the project team regarding noise concerns.

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

[37] As described more fully in *Marshall Day (May 2013)*

23 REGIONAL ECONOMICS

23.1 Potential Effects

The assessment of Regional Economic Effects and net national benefits is presented in a report prepared by Butcher Partners Limited (*Butcher, May 2013*). The report is based on the Project Description prepared by Tonkin & Taylor[38]. It also applies information supplied by Macfarlane Rural Business Ltd (MRBL)[39] as to 'before and after' Scheme land irrigation use scenarios, along with on farm conversion costs and returns.

Applying the post Scheme land use irrigation scenario adopted by MRBL, the proposed Scheme will irrigate 19,000 Ha of dry land[40] with potential to provide increased reliability of irrigation on a further 6,000 Ha of currently irrigated land. The Scheme is estimated by Tonkin & Taylor to cost $246[41] million for an in-river dam, a headrace which is a mix of piped and open channel, and then piped distribution beyond the headrace, although farms will generally not get water at sufficient pressure for irrigating.

On-farm investment will depend on the land uses on the newly irrigated land, but base case estimates[42] by MRBL are that the farmer investment will cost $356 million, including $247 million for physical investment on-farm, $16 million for livestock, and $93 million for dairy company shares and working capital.

23.2 Assessments Undertaken

The scope of this assessment was the net national benefit from a commercial perspective only, and the net regional economic impacts in terms of regional GDP, employment and household income. These arose from:

- Change in land use on irrigated land and changes in farming practices
- Industry support effects arising from the expansion of output in those industries which directly or indirectly provide supporting goods and services to agriculture
- Changes in output of processing industries including for meat, milk, grapes and vegetables

[38] *Tonkin & Taylor (May 2103a)*
[39] Macfarlane Rural Business -*Macfarlane September 2012*
[40] This is a conservative assumption to ensure the economic benefits are not overstated, and assumes 6,000 Ha of Scheme irrigation capacity is used to irrigate land already irrigated by less reliable surface water and ground water takes, rather than being applied to irrigate additional land.
[41] Includes $7 million of mitigation costs over the Scheme lifetime.
[42] Adjusted to remove increases in raw land value, and allowing for some existing plant being redundant or unsuited to new farming practices.

- Effects on Napier Port.

The benefits and impacts are based on an analysis of likely irrigated areas, irrigated land use mix, and farm financial performance as estimated by MRBL.

There is considerable uncertainty as to the exact mix of land uses on future irrigated land, the level of processing of production from the irrigated farms, and the proportion of processing which will take place in the region. The figures given here are realistic assessments of what is likely to occur, but actual outcome could be higher or lower than this.

The cost benefit analysis in the report ignores any environmental effects which arise from the land use changes. The cost benefit analysis also ignores any benefits arising purely from increased employment opportunities, or from increased value added in industries other than farming. This is a conservative position, but reflects the possibility that in an efficient economy the capital and labour would otherwise be used elsewhere in the economy and the expansion of irrigation does not actually provide any additional employment.

The analysis also ignores any benefits arising from additional irrigation water that will on occasion be available[43]. Nor has any assessment been made of the potential for using some water to supplement water available to other downstream users. While this water may have greater value in use downstream, its use will reduce either irrigable area or reliability in the existing production land area, the additional value has been neither estimated nor proved.

The economic impact analysis shows the potential scale of impacts, provided there are spare resources of labour and capital available. The *Butcher (May 2013)* study did not include a regional general equilibrium analysis.

23.3 Results of Assessment

23.3.1 Economic Benefits

The Net Present Value of the Scheme is estimated to be $7 million at an 8% discount rate. In broad terms this benefit is equivalent to the Scheme participants[44]receiving a 35 year stream of benefits of $0.6 million / year (after all the costs of additional on-farm and off-farm capital have been met).

[43] See *Tonkin & Taylor (May 2013)* Section 3.2.2.6 which refers to secondary irrigation water of up to 28 million m3 per year. Given the uncertainty surrounding the availability and reliability of this water, and its potential use for purposes other than agriculture, no assessment has been made of the benefits or regional impacts of this water.

[44] Farmers and the irrigation supplier.

Reducing the discount rate to 5 %[45] increases the NPV to $225 million, equivalent to $14 million per year in net benefits to farmers and the irrigation supplier.

The base line 35 year Scheme life corresponds to the proposed water right term and 8 % is the recommended Treasury discount rate. Using different assumptions of a 70 year Scheme life and a 5% discount rate, which arguably is more consistent with farmers' investment decisions elsewhere and with a societal concern about long term impacts and the likely minimum life of the irrigation infrastructure, the benefit has a NPV of $408 million, which is equivalent to $21 million per year. It is our view that from a community and farmer perspective these latter figures are more relevant. This benefit can be thought of as a "super profit"; a return above what the resources used in this Scheme would normally earn elsewhere and accrues to farmers and the irrigation supplier.

The above assessments of benefit follow a standard CBA assumption that apart from this "super profit", there is no net benefit from the Scheme. The extra production both on and off-farm requires the use of resources (land, labour and capital) which could otherwise have been used elsewhere in the economy to achieve the same community economic and social impacts and benefits as they will in these projects. Hence there is no particular additional benefit from investing in the Scheme.

This assumption is not accepted by many in the community who are of the view that this Scheme will provide more jobs and income than would occur in the absence of the Scheme, and that accordingly the community is better off and there is a net benefit. The magnitude of the benefit will likely be debated with opinions ranging upwards from zero.

Against these benefits need to be weighed up any wider community social, recreational and environmental outcomes associated with the change in water use and river state.

Table 23.3.1a - Net Present Value of Ruataniwha Scheme

Values at full development	Financial Value	NPV 8 % over 35 years ($m)	NPV 5 % over 35 years
Water Storage Capex	- $246 m	- 203	-217
Farm Investment Capex	- $356 m	- 229	-268
Electricity Generation	$1.9 m / yr	21	30
Scheme Operating Costs	- $2.5m / yr	-29	-40
Revenue from Water Charges*	$19 m / yr	136	218
Increased Farm Profit**	$65 m / yr	308	501
Net Benefit		**+ 7**	**+225**

* Assumes charges of $0.20 / m3

[45] There are strong arguments in favour of a lower discount rate, of the order of 3 – 5%, This reflects a "Social Rate of Time Preference", and is also consistent with observable farmer decisions regarding land purchase prices and other on-farm investments. See NZIER *Insight* no. 32/2011 for a discussion of the issues.

** After adding back water charges, which are assumed to be sufficient to cover capital and operating costs.

The results assume all water will be taken up within 8 years of the Scheme becoming operative, and also rely on the farm budgets presented by MRBL. The results also assume that the Scheme will provide water for only the 35 years covered by the water consent, and hence implicitly assume that infrastructure at this point has no residual value. Changing this restrictive assumption to a 70 year or 100 year lifetime of the Scheme increases the Scheme NPV as is shown in Table 23.3.1b below. The net financial benefit of the Scheme at a 5 % discount rate and a 70 year life is $408 million, which is equivalent to $21 million per year.

Table 23.3.1b Net Present Value of Scheme ($m) under varying assumptions

Scheme Life		8 % discount rate	5 % discount rate	
	NPV ($m)	Equivalent Annual Value ($m/yr)	NPV ($m)	Equivalent Annual Value ($m/yr)
35 years	7	0.6	225	14
70 years	54	4.5	408	21
100 years	57	4.6	439	22

The commercial benefits arising from expanding the area in orchards and vineyards, as measured by the NPV, are negative at a discount rate of 8 %. This is consistent with the MRBL report showing marginal accounting rates of return of 9.5 % for orchards and 7.5 % for vineyards[46]. While these rates roughly straddle the discount rate, implying a close to zero NPV for these activities, the accounting rate of return does not reflect the time lag between investment and full production, which is four years for vineyards and six years for orchard. Hence the IRR for orchards and vineyards is less than the discount rate and the NPV is negative.

There is a clear net commercial benefit to farmers and the irrigation supplier from irrigation over and above the opportunity cost of capital and labour employed in increased production, and this benefit is what the Scheme NPV measures. The Net Present Value calculation ignores any net recreational, environmental and community costs and benefits of irrigation. The recreational and environmental values will be discussed by others with expertise in these areas, but the impacts on regional employment and income are outlined in this report.

The report notes an expectation that people in other sectors who experience an increase in economic activity will also perceive themselves to be receiving a benefit. The formal cost benefit

[46] MRBL 2012, p44. Assuming conversion from finishing farms

analysis framework does not recognise this latter benefit because of the framework's restrictive assumptions regarding price equalling opportunity cost in these other sectors[47]. It is for this reason that we show in the following sections the increase in employment, regional GDP and regional household income. Decision makers can take these impacts into consideration when deciding whether the Scheme has larger benefits than costs when viewed from the widest societal perspective.

23.3.2 Economic Impacts

The economic impacts arising from the Scheme have two components. The first is the impact of construction on and off-farm. This is a one-off impact, and for this reason impacts are expressed as $million (rather than $million per year) and job-years (as opposed to on-going jobs). The second component of economic impact is the on-going effect of increased farm production. This generates impacts including:

- on-farm
- in all the industries that support farming production and farm household spending (e.g. agricultural contractors, stock and station agents, rural transport, shops and service providers)
- In processing industries such as meat, dairy and vegetable processing, and in all the industries that support the processing industries and the household spending that flows from them.

Economic impacts are generally reported in terms of changes to output (sales), value added[48] (sometimes referred to as regional income or regional GDP), household income (which is a component of value added) and employment. The impacts are split up into the direct effects, which in this case are the direct changes in output, employment and income on-farm, and the multiplier effects, sometimes referred to as the indirect and induced effects, or the industry-support effects.

One-Off Construction Impacts

The investment of $602 million leads to economic impacts during construction including an increase in regional value added of $350 million, including household income of $230 million, and an additional 4,000 job-years of work. This economic impact will be focussed on the first four years, when all the dam construction and the first 56 per cent of pastoral on-farm investment are assumed

[47] In simple terms, formal cost benefit analysis assumes that unless there is reason to assume otherwise, price equals opportunity cost, which is the benefit foregone in the next best possible use.
[48] In accounting terms this is equivalent to EBITDA.

to take place. The balance will be spread over the remaining eight years of the investment programme until land development is completed.

Table 23.3.2a Regional Economic Impacts of Ruataniwha Scheme – Construction-related only (One-off effects spread over 12 years)

	Output ($m)	Jobs (job-years)	Value Added ($m)	H/hold Income ($m)
Direct Impacts	602	na	na	na
Total Impacts	1,100	4,000	350	230

On-Going Impacts Arising from Increased Farm Production

The Scheme will increase farm-gate output by $160 million per year. This increase will be accompanied by an increase in direct value added[49] on farm of $70 million per year, including $25 million per year of earned[50] household income. There will be an increase of 630 jobs on farm, with 500 of those occurring in vineyards and orchards (see upper section of Table 23.3.2b).

Multiplier effects arise as a result of the expansion of economic activity in supporting industries. The combination of direct impacts on farm and multiplier[51] effects in the farm-support industries gives a total increase in regional value added of $127 million per year, of which earned household income will be $52 million per year. The additional 530 jobs created off-farm give a total increase of 1,160 jobs in the region (see lower section of Table 23.3.2b).

Table 23.3.2b Regional Economic Impacts of Ruataniwha Scheme – Farm and Farm-Support Only at Full Development

Increase	Output ($m / yr)	Jobs (FTEs)	Value Added ($m / yr)	Household Income ($m/yr)
Pastoral and arable farming direct	107	130	40	8
Orchards and Vineyards (or similar)	53	500	30	17
Sub-Total – Farming	**160**	**630**	**70**	**25**
Farm support effects (multiplier effects)	120	530	56	27
Total Farming and Farm Support	**280**	**1,160**	**127**	**52**

About 55 % of these farm and farm-support regional employment and value added impacts occur on farm. There are also significant effects on agricultural contracting, wholesale and retail trade, transport and communications, and services (including local authorities who get an estimated $2.4 million per year extra in rates income).

[49] Value added is the return to labour and capital. It is the equivalent concept to Gross Domestic Product. In accounting terms it can be seen as EBITDA + wages & salaries, or as gross output less purchases of inputs (other than capital and labour).
[50] Wages and salaries, plus self-employed income. Excludes any dividends from increased profits
[51] Sometimes called indirect and induced effects.

About 80% of direct on-farm employment, 40% of direct value added and 70% of direct household income arises from conversion to either viticulture or orchards. If there is no expansion of either of these activities[52], total value added in the region would increase by only $77 million per year (rather than $127 million) and total employment would increase by only 510 jobs (rather than 1,160 jobs). As described earlier, investment in these activities is by no means certain, with a commercial return (IRR basis) being less than 8 %.

On-going Impacts Arising from Increased Processing

Additional processing of vegetables and grapes, slightly offset by a decline in processing of meat, could significantly increase the regional economic impacts. We estimate that if all the extra processing of these items was done within the region, then there could be additional economic impacts of 980 jobs and $93 million/ year of value added, including $53 million per year of household income. There is no significant dairy factory in the region, but if one was developed and half the additional dairy production was processed within the region, then a further 110 jobs could be created along with value added of $14 million per year, including $7 million per year of household income (see Summary Table 2, lower section). *Butcher* (*May 2013)* cautions that there is enormous uncertainty associated with these numbers because of the uncertainty as to the mix of irrigated land uses, and hence the mix of product available for processing, and the location of any resultant change in processing activities (see lower section of Table 23.3.2c).

As is shown in Table 23.3.2c, the Scheme and the associated increase in farm production following full implementation, with all processing and related supporting industry activity factored in, could increase total regional GDP by $235 million per year or 4 %[53], including an additional $110 million per year in regional household income. The Scheme could increase total regional employment by 2,250 on-going jobs, or 3.5 % of current Hawke's Bay employment.

[52] Assuming that the land instead converted to mixed arable farming
[53] Latest available data for 2006-07

Table 23.3.2c On-going Regional Economic Impacts of Additional Agricultural Production Arising from the Ruataniwha Scheme (at full development)

	Output ($m / yr)	Jobs (FTEs)	Value Added ($m / yr)	Household Income ($m/yr)
Farming and farm support	280	1,160	127	52
Processing and processing support (high uncertainty)	340	1,090	108	58
Potential Total Impacts per year	**620**	**2,250**	**235**	**110**
Potential NPV of impacts (8 % over 35 years)	**2,500**	**17,800**	**1,800**	**910**
(5 % over 70 years)	**4,700**	**34,300**	**3,500**	**1,700**

The impacts reported here should be seen as likely upper limits to the net impacts on the community[54][55]. The estimates are based on an implicit assumption that there will be labour available to take up these jobs, and that the people taking them up will be either unemployed or out of the labour force in the absence of the irrigation, or will be migrants into the region from elsewhere. To the extent that the jobs are filled by people leaving existing jobs in the region and those jobs are not filled, the impacts will be lower than is estimated here.

Effects on the Port[56]

The additional product could lead to up to 9,000 additional full containers per year being shipped through Port Napier, which could increase port earnings by perhaps $1.3 million per year. The number of additional containers is significantly affected by the level of processing taking place in the region, and by shippers' decisions as to the best port to use given the schedules of the shipping lines at the time.

Farmer Affordability

MRBL believes that farmers look at accounting rates of return rather than more formal NPVs or IRRs. The available data suggests that conversion will be affordable from the farmers' perspective. The MRBL estimate of the accounting rates of return on marginal farm investment are 10 - 15 % for

[54] For the assumed land uses. Different land use mixes will give different results.

[55] It has been assumed that owners of 6,000 Ha irrigated from current ground-water permits will surrender their water rights and take water from the Scheme. Hence the economic impacts are based on an additional 19,000 Ha irrigated. If these users do not transfer, then there will be a net increase of 25,000 Ha irrigated, and the benefits and economic impacts will be correspondingly greater. It is understood that the analysis of environment effects associated with such things as nitrate leaching is based on the assumption that there is a net increase of 25,000 Ha irrigated. Hence the assumptions differ, and either the economic impacts will be greater than is assessed here, or the negative environmental effects will be less than has been assessed.

[56] Economic impacts associated with increased port activity are included in the processing effects.

dairying, 6 % for finishing, 4 % for mixed arable, 30 % for intensive arable with crops for processing, and 65 % for mixed livestock and dairy support.

The benefit on farms will be derived from a number of sources.

On the irrigated area:

- An increase in production associated with irrigation of existing systems
- A change in systems to higher intensity land uses such as dairying and cropping which are possible with more reliable irrigation
- Reduced farming risk, which increases returns by enabling famers to move towards more risk-neutral behaviour, which generally has a higher average return than does a risk-averse management style.

On associated dry land:

- Ability to manage associated dryland areas better, given the increased flexibility which irrigation usually generates.

24 ARCHAEOLOGICAL ASSESSMENT

24.1 Potential Environmental Effects

A report prepared by Clough and Associates (*Clough and Associates, May 2013)* considers the historical heritage and archaeological impact of the Scheme. The report notes that the Scheme 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.

24.2 Assessment Undertaken

An archaeological survey and assessment of the areas affected by the RWSS (the reservoir, dam, headrace corridor and reticulation network) was undertaken by Clough & Associates. 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 ō Tamatea, and Pat Parsons regarding the cultural and historic heritage aspects of the RWSS. 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.

24.3 Result of Assessment

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 RWSS 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 RWSS.

No recorded archaeological sites in the vicinity of the proposed water distribution network will be affected.

Desktop assessment did however identify a number of archaeological sites near the water distribution channel in Zone M, east of Waipawa.

24.4 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 water distribution network (including the Zone M channel) 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 RWSS 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 HBRIC Ltd have prepared a separate report entitled 'Ruataniwha Water Storage Scheme – Integration and Mitigation and Offset Approach' (*HBRIC, May 2013f*) which should be read in conjunction with this report.

Proposed conditions of consent give effect to these recommendations by requiring their progressive implementation upon commencement of construction of the Scheme, and the adherence to a specific Cultural/Accidental Discovery Protocol.

25 LANDSCAPE AND VISUAL EFFECTS

A study of the Scheme's landscape and visual effects has been completed by Isthmus (*Isthmus, May 2013).*

25.1 Potential Environmental Effects

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

- 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 natural flow regimes
  - The Waipawa River at the location of the upstream and downstream water intake structures as a result of changes to the river bank
  - Smaller streams and watercourses in the Ruataniwha Plains where traversed by the primary distribution system headrace, as a result of construction of culverts or inverted siphons
  - Papanui Stream as a result of changes to the flow regime, modifications to the stream channel, and proposed fencing and revegetation of the stream banks
- Potential effects on the outstanding natural landscapes of the Ruahine Ranges as a result of the nearby reservoir lake
- Potential effects on landscape amenity including
  - Visual effects of the dam and reservoir lake
  - Visual effects of the primary distribution system head-race (from both private and public views)
  - Visual effects of the power station and transmission line
  - Effects on the character of the Ruataniwha Plains and Zone M as a result of increased irrigation (including pasture 'greening' and additional use of pivot irrigators)
  - Effects on the biophysical landscape including effects of earthworks on landforms, watercourses, or vegetation
- Temporary construction effects.

25.2 Assessments Undertaken

HBRC initially commissioned Isthmus in November 2011 to undertake a 'Baseline Landscape Assessment' and to provide input to the refinement of the Scheme design. The 'Baseline Landscape Assessment' report (Final 23 January 2012) 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. Isthmus participated in site visits and workshops that addressed appraisal of alternative headrace options (types of headrace and alternative alignments) and remediation / mitigation measures with regard the dam and reservoir.

The subsequent Landscape and Visual Assessment addressed the following matters:

- 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.
- 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 and outfall structures and crossing of smaller streams by the headrace canal
- 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)
- An analysis of the effects of landscape amenity and biophysical effects. Given the dispersed nature of the Scheme this was dealt with by dividing the Scheme into its components as follows:
  - Dam and Reservoir
  - Primary Distribution System including the Water Intake Structures, Headrace Canal and Buried Pipelines
  - Secondary Distribution System and Changes to Land Use Patterns
  - Downstream Intake Structure and changes to the Papanui Stream
  - Hydro-electric (add-on) Station
  - Transmission Line
- An assessment of potential temporary construction effects.

25.3 Results of Assessment

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. Natural character will clearly not be preserved in the vicinity of the dam and within the reservoir footprint, and it will be diminished to some extent on the Makaroro River (and to a lesser extent the Waipawa River) downstream of the dam as a result of changes in flow regime and sediment load. Such effects are common to any in-river dam.

Factors to take into account when considering the appropriateness in relation to such effects include the following:

- The modified 'working rural character' of the adjacent land
- The low visibility of the dam (and hence low effects on the appearance (visual aspects) of natural character)
- The naturalistic appearance of the reservoir
- Proposed measures as described in the 'Proposed Integrated Mitigation and Offset Approach' report which will enhance the biophysical and visual aspects of natural character of the reservoir including establishing a fenced and planted margin around the reservoir, and measures to enhance habitat and control predators in the reservoir catchment
- Proposed management of the downstream flow regime to provide minimum low flows in the Makaroro River, regular flushing during summer months, and biodiversity enhancement measures in the downstream sections of the Makaroro and Waipawa Rivers
- Beach replenishment at the mouth of the Tukituki River to replace the reduction in sediment load – to be carried out in allocation and manner that will not create any new adverse landscape effects apart from the temporary effects of the replenishment activity.
- The low impacts of the intake and outfall structures on natural character because of their low profiles, low visibility locations, and modified rural settings
- Positive effects on the lower Tukituki River as a result of increased summer flows and flushing 'freshes'
- Positive effects on the natural character of the Papanui Stream because of increased flows which will partly restore historic flows, and the associated fencing and margin restoration; (partly restoring the historic diversion of water from the previous course of the Waipawa River).

Outstanding Natural Features and Landscapes

The only outstanding natural feature or landscape in the area is the Ruahine Ranges. The Scheme 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 Scheme of this type for the following reasons:

- 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
- Similarly the 6.5MW hydro power station will be a minor adjunct to the dam, and will essentially have no public visibility. The associated 33kV transmission line will be an unremarkable element carried on power poles along the road reserve
- While there will be some potential adverse amenity effects resulting from the seasonal bare zone around the reservoir margins, a range of measures is proposed to mitigate such effects
- The upstream water intake structure on the Waipawa River will be tucked against a bank in an unobtrusive location with low visibility, and similarly the downstream intake structure will have a low profile, and will be in a low visibility location at the toe of a stopbank
- The primary distribution system headrace canal, which forms part of the primary distribution system, will not be out-of-place in a working rural landscape (it will continue a tradition of community water races in the area). The selected route follows the contours and traverses relatively subdued topography so that earthworks will have low profile. The selected route also avoids houses
- 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:

- The reservoir will have high amenity as a 'lake' taking into account its serpentine form, tributary reaches, bold hill backdrop, and the re-vegetation proposed around its margins

- The primary distribution system head race canal may also be perceived as a positive and interesting feature
- The use of the Papanui Stream to convey irrigation water will partly restore the watercourse, and the fencing and replanting of its banks will enhance its natural character.

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:

- The Scheme will be within a modified working rural landscape
- Most of the water distribution network will be by means of buried pipelines
- The primary distribution system 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, primary distribution system 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 Scheme progresses), limited in scale, and will not be out-of-place in a cultivated rural landscape.

Summary of Effects Assessment

In summary the Scheme 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 Scheme of this type.

25.4 Suggested Approach for Effects Identified

Measures that are already incorporated within the Scheme 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 structures, headrace type and alignment, and proportion of the water distribution network 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 Scheme – Proposed Integrated Mitigation and Offset Approach' (*HBRIC, 2013f*).

26 SEDIMENTATION EFFECTS

A report prepared by Tonkin & Taylor (Sedimentation Assessment -*Tonkin &Taylor, May 2013b*) considers sedimentation effects of the Scheme.

26.1 Potential Environmental Effects

Although not specifically listed in the Executive Summary of the report, potential environmental effects discussed include:

- The trapping and filling of the reservoir with sediment resulting in declining efficiency in storage capacity for water, restrictions to access, upstream flooding and potential impacts on Dam outlets
- Dust effects at times when the reservoir has low storage
- Downstream degradation and coarsening of bed sediments
- Coastal depletion of sediment load.

26.2 Assessments Undertaken

The four main aspects of the assessment scope are:

- Develop a sediment allowance for the Reservoir
- Assess the effects of the dam on downstream sediments and the coast
- Review the sediment management options
- Develop the sediment mitigation plan.

The methodology utilises the good sources of measured data that exist for the Tukituki/ Waipawa River system. The measured data consists primarily of river cross-sections that are used to develop a sediment budget, and the measured accumulation at Folger's Lake. Suspended sediment yields were estimated using the WRENZ[57] model calibrated to the Waipukurau gauge (Tukituki River) and the trapping efficiency in the reservoir based on the Brune[58] method.

The changes to the sediment budget due to the Dam are quantified for each reach and the effects qualitatively assessed. A number of reports/papers provide useful information on sedimentation for the Tukituki/Waipawa River system, which were used where relevant.

[57] Water Resources Explorer NZ
[58] The Brune method applies a trap efficiency to the sediment transport of the river to calculate an annual sedimentation in the reservoir. It is an internationally accepted methodology for large reservoirs.

Assessments of changes to gravel transport capacity and assessments of degradation depths and armouring effects are made.

26.3 Results of Assessment

The estimate of sedimentation in the Reservoir is 15-26 million m^3 over 100 years based on a range of estimates. These sedimentation estimates result in reservoir half full times ranging from 175 to 287 years and ultimate fill times ranging from 355 to 603 years.

There remains considerable uncertainty in the bed load estimates, which is inherent with this type of exercise. The report's authors consider that the lower estimate is non-conservative due to unaccounted sediment losses in the sediment budget, and the upper estimate is conservative due to the stormier period that was the basis of the Folger's Lake derived estimate for bed material.

The suspended sediment estimates are from the WRENZ model based on the unscaled estimate and the Waipukurau measured suspended sediment upscaled for the upper Makaroro catchment characteristics, which give similar estimates.

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 existing bridges or river management infrastructure upstream of the reservoir that will be affected.

When the reservoir is drawn down there is the potential for dust generation. The Dam site is remote with few surrounding dwellings. Therefore, the potential for affecting the general public appears to be low.

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.

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 river will trend towards fewer channels.

There is no river management infrastructure on this reach. Therefore, changes to the channel form and levels will have no effect on river management infrastructure. 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 will result in less aggradation (currently occurs) and can be accommodated by less extraction (if required). A reduction in sediment transport capacity is predicted at the upstream water intake, which may result in local aggradation.

An additional effect is the reduction in gravel transport capacity to the coast of 1,700 cubic metres /year. Mitigation by coastal nourishment is proposed so that existing coastal erosion that is occurring in the vicinity of the mouth of the Tukituki River is not worsened.

There will be a net long term reduction in the gravel resource for extraction and construction industry purposes from the Waipawa and Tukituki. Although gravel will become available at the Reservoir, this is further away from markets (i.e. the Dam and reservoir location is more remote than the current extraction locations).

The ecological effects that result from the change in river morphology are described in ecology assessments that form part of the suite of reports accompanying this Application.

26.4 Suggested Approach for Effects Identified

Sediment management options have been assessed and the preferred suggested options are included in the draft Sediment Management Plan in the Sedimentation Assessment report *(Tonkin & Taylor, May 2013b)*. A summary is provided below.

Location/ issue	Monitoring	Management
Reservoir	Cross-section/bathymetry survey to monitor sedimentation and delta development. Frequency 3 years. Flow gauging of releases from the Dam.	***Design*** Include sedimentation allowances in the volume requirement of the Dam. Design of outlet structures for sedimentation. The location of recreation areas and access points to the reservoir to consider sedimentation. Land management measures including sediment management practices for forestry areas and fire protection programmes for the Ruahine Forest Park and the commercial forestry. ***Medium to long-term*** (not included in the Application Design) Extraction of gravel for construction industry e.g. roading aggregate Hydraulic flushing of fine sediments via low outlets (would need to be provided for at the detailed design stage). Sediment focussing by in-reservoir works to manage sediment storage within the reservoir. These can consist of training banks and similar structures to enhance flushing of sediment from live storage to dead storage, and for access up-river. ***Closure*** (not included in the Application Design) Dam removal is an option to consider at the end of the operating life if required. Restrictions to access (in areas where sediment has deposited) and the potential for impacts on the Dam outlets.
Reservoir dust	Dust generation should be monitored with inhabitants provided a contact number of the Dam operator if they wish to make complaints. The operator should keep a register of complaints consistent or similar with Appendix 2 of Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions (MfE 2001). Copies of the register should be forwarded to HBRC for their consideration of whether further preventative action is appropriate.	Should a dust issue arise then consideration to planting shelter belts. An additional contingency measure may be to raise the minimum operating water level to cover the bottomset sediments. This would require careful consideration of secondary effects of this action including irrigation supply and residual flows.

Makaroro River downstream of the Dam	Cross-section survey at 3 year frequency to match existing HBRC monitoring programme. Maximum spacing to match existing HBRC monitoring programme of 500 m and to include Burnt Bridge. Measure particle size distribution of bed surface particle-size distribution at three year frequency at representative and accessible locations to monitor armour development.	Respond to degradation of channel at Burnt Bridge (if required). Options include grade control (rock weir) or underpinning of piers.
Waipawa River between Makaroro confluence and SH50	Cross-section survey at 3 year frequency which is a continuation of existing HBRC river monitoring. Additional cross-sections to be included for Waipawa upstream of the Waipawa/Makaroro confluence including Wakarara Road Bridge and Pendle Hill Bridge (1 km upstream) with maximum spacing of 500 m. Additional cross-section for the Upstream Water Intake.	Respond to degradation of channel at Wakarara Road Bridge (if required). Options include grade control (rock weir) or underpinning of piers. The long term reduction in extraction (if required) based on monitoring in accordance with current HBRC flood and sediment management practices. Extraction of excess gravel at the irrigation intake and elsewhere in accordance with HBRC river management practices. Optional spraying and raking of gravel beds to increase the supply of gravel (if required). Significant accumulation of gravel has occurred in this reach.
Waipawa/ Tukituki Rivers downstream of SH50	Cross-section survey at existing cross-section locations at 3 year frequency, which is a continuation of existing HBRC river monitoring.	Normal river management practises undertaken by HBRC. The long term reduction in extraction (if required) based on monitoring in accordance with current HBRC flood and sediment management practices, refer to Section 3.5 for details.
Coast	Cross-section surveys at existing cross-section locations, which is a continuation of existing location and frequency of HBRC coastline monitoring.	**Beach nourishment** of 3,400 cubic metres /year comprising of 1700 cubic metres /year of river sediment placed within the Coastal Marine Area directly along the barrier beach between Richmond Road and School Road extension and an additional 1,700 cubic metres /year to the south along the spit. Review the beach nourishment requirements based on updated assessments of reduction in capacity (and renourishment needs) due to the Scheme using the consented reservoir operating regime. Review to be based on monitoring and modelling at year 3 and at subsequently at nine year intervals. Changes in beach nourishment to be approved by HBRC manager.
Tukituki River basin	Cross-section monitoring (as above), selected PSD sampling, sediment and flow gauging.	**Morphological model** be developed for the Tukituki River basin including Waipawa and Makaroro Rivers.

The proposed conditions in *Part D* require preparation and implementation of a Sediment Management Plan referenced to the report recommendations.

27 DAM BREAK STUDY

The Scheme consists of a large water storage reservoir created by a proposed dam on the Makaroro River, as well as associated works used to distribute the water to downstream locations. A Dam Break analysis for the Scheme has been completed by HBRC Asset Management Group (*HBRC Engineering, May 2013*).

The report provides analysis and results showing the consequences of the failure of the Dam during its operational phase. The dam break analysis is entirely hypothetical and divorced from the actual probability of a dam failure occurring, and is not instigated 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 potential 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 this analysis indicate the proposed dam will be a HIGH PIC dam.

27.1 Potential Environmental Effects

Failure of the main dam after completion of 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.

27.2 Assessments Undertaken

The assessment of the potential downstream effects of a dam break consists of three parts:

1. Determination of the dam breach discharge hydrograph,
2. Determination of the extent and timing of the flood wave,
3. Assessment of potential impact category (PIC).

The HBRC Engineering (*May 2013*) report outlines the method used in the analysis, and then presents the results with maps showing the timing and extent of the flood wave as it travels down the river system.

27.3 Results of Assessment

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 spreads out over a wide area and travels towards the Mangaonuku Stream, at which point it is confined and flows back into the Waipawa River.

On the right bank of the Waipawa River, downstream of SH50, the overland flow travels to the Kahahakuri Stream and the Tukituki River, and then overtops 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 overtops 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 3 m to 5 m deep.

Another overflow occurs 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 become inundated in this scenario, due to their low lying nature.

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

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

The scenario analysed for the PIC determination produced a peak discharge of around 45,000 cumecs at the dam site. Due to the topography of the river channel, the flow is fairly quickly attenuated. However, the results indicate a peak flow of around 10,400 cumecs 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 m3/s, i.e. the flood wave has a peak discharge that is roughly eight times the 100 year discharge at this location.

The peak of the flood wave takes 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 two to three hours warning time between the initiation of failure and the time when the population and infrastructure of Waipawa and Waipukurau were at risk.

27.4 Suggested Approach for Effects Identified

Due to these potential risks, along with the size of the main dam, the PIC of the main dam is determined to be high. The primary mitigation of the potential effects from an unlikely dam break event is the adoption of the highest standards for design, construction and operation to ensure that the probability of failure is extremely small related to the degree to which the potential impact is high. In addition to minimum standards for design, a High PIC dam will require an appropriate Dam Safety Assurance Programme (DSAP) under New Zealand's Dam Safety Regulations. Part of the DSAP will be an **Emergency Action Plan** (EAP) that will detail the actions that the owner, operations personnel and relevant Government and Local Authorities should take if an incident or emergency develops that threatens the safety of the dam. Both the DSAP and EAP will be required prior to commissioning of the dam.

The requirement for an EAP forms part of the conditions contained in *Part D – Proposed Consent Conditions.*

Assessment of proposed land exchange between Ruahine Forest Park revocation land and proposed Smedley Exchange Block in relation to Ruataniwha Water Storage Scheme

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Contents

Executive Summary

This report was produced following a request to undertake a comprehensive gathering and evaluation of relevant conservation values including biological data and other technical information applicable to Ruahine Forest Park revocation land and the Smedley Exchange Block, and to provide the Convenor with a report detailing the conservation values of each, as well as a comparative analysis of the two sets of values (refer to Appendix 1).

The Ruahine Forest Park revocation land comprises two distinct parcels, the 8 ha Makaroro River parcel and the 14 ha Dutch Creek parcel that are separated by approximately 600 m of pine forest. The Makaroro River parcel is located on an alluvial plain next to the Makaroro River. Such alluvial plains are rare in the landscape. Three point three (3.3) ha of an Acutely Threatened land environment occurs on this site. Approximately 92 ha of this habitat occurs on public conservation land elsewhere in the district. The vegetation comprises about 1.6 ha of black beech forest, 1.9 ha of broadleaf forest, and 3 ha of secondary shrub/treeland. The area has been heavily logged and used for firewood when a mill was operating on the opposite bank, and a Forest Service house used to be on the site. Woody weeds, including shade-tolerant Darwin's barberry, will impact on the succession of this block. No emergent podocarps remain, but there are some podocarps present. This parcel is therefore in a poor condition.

The Dutch Creek parcel comprises about 9 ha of black beech forest and 5 ha of broadleaf small-leaved monocot scrub/treeland. This secondary successional scrub was probably clearfelled and burnt during logging operations. The black beech forest has had the emergent podocarps logged, and they are no longer part of the canopy. However, the black beech forest has an intact understorey. There is also a small oxbow wetland which could be considered significant. This parcel is similar to the surrounding Ruahine Forest Park, other than that further up Dutch Creek it hasn't been logged.

The 146 ha Smedley Exchange Block that has been offered in exchange comprises 122 ha of indigenous vegetation interspersed with 24 ha of pasture. There is 33 ha of black beech forest, including one patch of 4.4 ha that is in similar condition to that of the Dutch Creek parcel, other than that it has some emergent podocarps present. Although the Smedley Exchange Block has been logged, it has retained scattered emergent podocarps throughout the black beech forest. The rest of the vegetation comprises broadleaf and small-leaved scrub and treeland, and includes naturally occurring dry west-facing slopes dominated by small-leaved broadleaf scrub. There are also two significant wetlands present.

The underlying geology of Smedley Exchange Block is different from the rest of the Ruahine ranges, it covers an altitudinal range of over 300 m, and complements the Gwavas Conservation Area, which does not include black beech forest with emergent podocarps down to the altitudes represented by the Smedley Exchange Block.

We have considered the relevant information that's available as part of the Ruataniwha Water Storage System RMA application process and as part of the land exchange hearings process. We have

also assessed other pertinent literature, and undertaken two site assessments of the Ruahine Forest Park revocation land and the Smedley Exchange Block.

Based on this information and our own site assessments we conclude that, from an ecological and biological point of view, exchanging the 146 ha Smedley Exchange Block for the 22 ha Ruahine Forest Park Revocation Land would enhance the conservation values of land managed by the Department. The main reasons for reaching this conclusion were:

- The Ruahine Forest Park revocation land and its immediate surroundings have been heavily logged in the past, with virtually no emergent podocarps left. Although Smedley Exchange Block has been logged it has some emergent podocarps.
- The Makaroro River parcel of Ruahine Forest Park revocation land has been heavily logged, is infested with woody weeds, including shade-tolerant species, has an old house site, and is in a generally degraded state. It requires a higher level of management input than the other two sites.
- Smedley Exchange Block is larger than Ruahine Forest Park revocation land (146 ha compared to 22 ha), and covers an altitudinal range of almost 300 m. However, some of the 146ha has been cleared for grazing and the understorey of some forested areas is currently degraded due to grazing. With grazing removed the block will regenerate over time.
- Smedley Exchange Block forms part of the Wakarara Range, which has a different underlying geology when compared to the rest of the Ruahine Range, including the Ruahine Forest Park revocation land.
- This different geology and greater altitudinal range also support ecosystems that are not present in Ruahine Forest Park revocation land, such as the naturally occurring dry west-facing slopes dominated by small-leaved broadleaf scrub.
- The Smedley Exchange Block extends the altitudinal range of Gwavas Conservation Area, and contains habitats and vegetation that are not present on the adjoining Gwavas Conservation area. The two sites complement each other.
- The Makaroro River parcel of Ruahine Forest Park revocation land includes 3.3 ha of an Acutely Threatened land environment. Approximately 92.3 ha of this land environment is on public conservation land elsewhere in the district. The designers of this threatened environment classification system (Walker et al 2007) pointed out that their system is not a replacement for field work, did not see it as a replacement for the biogeographic planning framework of ecological regions and districts, did not see it as a fine-scale tool, and did not see it as a reserve planning tool. Based on our assessment the site is in a degraded condition, and does not rate highly when assessed against ecological significance criteria.
- While the possible loss of the seven migratory fish species, including four of the five At Risk-Declining species, within the Makaroro River catchment 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 catchment populations of these species is not expected to result in a significant increase to their threat of extinction from elsewhere in the catchment.
- Dutch Creek has more suitable habitat for the seven migratory fish than Smedley Exchange Block, and so may have more of the migratory or threatened fish species present. Trap and transfer has been recognised by the fish experts as the best mitigation method for moving

migratory fish above and below the dam. They have also identified that a management plan is needed for each species. This initiative is supported.

We found additional wetland habitats on Smedley Exchange Block that were not included in the applicant's and submitters' reports and submissions. The wetlands on Smedley Exchange Block and the oxbow wetland on Ruahine Forest Park revocation land were all considered significant in terms of the second National Priority for Protecting Rare and Threatened Biodiversity on Private Land (MfE & DOC 2007). The oxbow was also considered significant for its distinctiveness, whereas the wetlands on Smedley Exchange Block were not considered distinctive.

The two land parcels were deemed similar for providing suitable habitat for wildlife species known to be present in the area, except for fernbird, two birds being recorded from the oxbow wetland. Should the Ruataniwha Water Storage Scheme proceed and the fernbirds be displaced, the secondary successional scrub immediately above Dutch Creek is considered suitable habitat for them. Fernbirds were also recorded at the nearby PanPac wetland which suggests that fernbirds are present within the surrounding area where suitable habitat is available.

The loss of kowhai as a food source for birds is not considered a potential problem, because there is a large amount of kowhai in the district that will not be inundated should the Ruataniwha Water Storage Scheme go ahead.

Smedley Exchange Block had promising habitat for skinks and geckos.

There were similar levels of bat activity recorded at the two sites during times of recording. There was no evidence of maternity roosts in either parcel of the Ruahine Forest Park revocation land. Both Dutch Creek and Smedley Exchange Block appeared to provide suitable roost trees, including emergent podocarps in the case of Smedley Exchange Block, and either site might well have roosts at times outside of the survey period.

Other than one red mistletoe found in the Dutch Creek parcel no threatened plant species were recorded from Ruahine forest Park revocation land or Smedley Exchange Block. Red mistletoe are widespread in the district, as well as in Ruahine Forest Park, and it is feasible to translocate mistletoe through careful placement of seed on host trees, therefore the presence of this one red mistletoe is not considered significant.

Therefore from an ecological and biological point of view we believe that the proposed exchange offers an enhancement to conservation values. Given that Smedley Exchange Block is underpinned by a different geology from that in Ruahine Forest Park, and thereby supports different ecosystems not currently present in the Park, we believe it complements the current values of, and would be a worthy addition to, Ruahine Forest Park.

We believe that this enhancement would be further improved by redesigning the boundaries of Smedley Exchange Block to include some areas of pasture and Donovan Gully. A more coherent design would reduce the length of the boundary and associated edge effects and fencing costs, and consolidate some of the wetland systems that would be split under the current design. Nonetheless, there is still an enhancement of conservation values under the current design.

Purpose

The purpose of this study was to undertake a more comprehensive gathering and evaluation of all relevant conservation values including biological data and other technical information applicable to Ruahine Forest Park revocation land and the Smedley Exchange Block, and to provide the Convenor (Director-General's delegate) with a report detailing the conservation values of each, as well as a comparative analysis of the two sets of values to assist the Convenor with his task under s 49(2) of the Conservation Act.

The report sought was an assessment of ecological and biological values at both sites, including, but not limited to:

- Ecosystems and habitat values
- Freshwater and hydrological values (including the oxbow)
- Flora and fauna values
- Status of endangered and threatened species and ecosystems
- An assessment of the sites' contributions to conservation over the longer term
- An assessment placing the Ruahine Forest Park revocation land and Smedley Exchange Block in context with their surroundings

The full task assignment is included as Appendix 1.

A map of the sites is included (Figure 1). We've followed the format of Townsend et al. (2008) for referring to the threat status of species.

Ecological issues raised by submitters Forest & Bird and Te Taiao Environment Forum

As the chief purpose of this report is to assess the conservation values associated with the Ruahine Forest Park revocation land and the Smedley Exchange Block from an ecological and biological perspective, we've restricted our consideration of issues raised by submitters to those of an ecological and biological nature.

These issues fell into several themes:

- Freshwater fish
- Threatened land environments
- Wetlands
- Threatened species
- Smedley Exchange Land not identified as an RAP (Recommended Area for Protection)

Detailed transcripts of these issues are contained in Appendix 2.

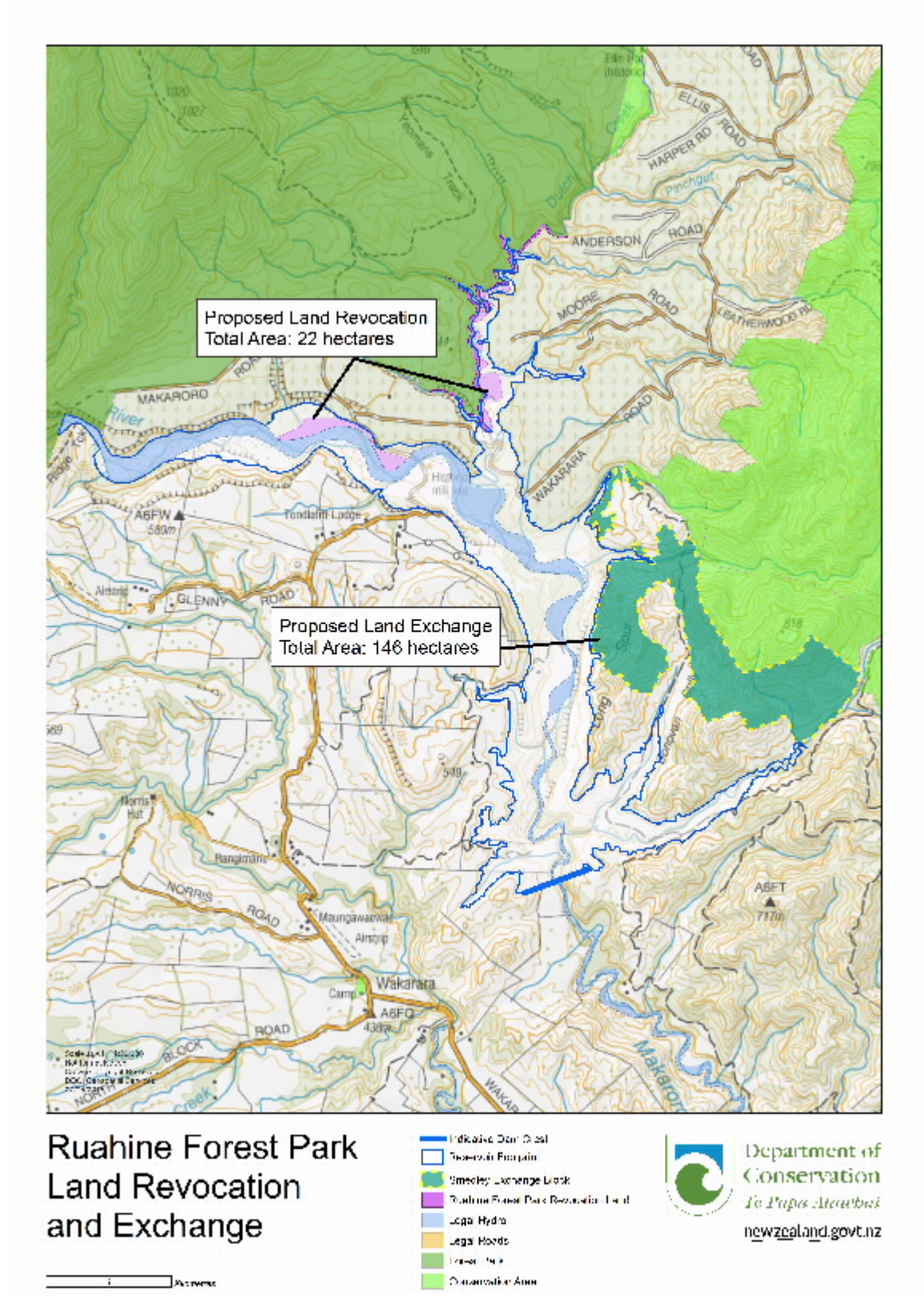

Figure 1: Map showing the Ruahine Forest Park Revocation Land and Smedley Exchange Block, as well as roads and rivers referred to in the text and the level of the proposed dam.

Site assessments

Two site assessments were undertaken to gain an ecological perspective of the Ruahine Forest Park revocation land and the Smedley Exchange Block in the context of their surroundings and adjacent land, taking into consideration the information contained and issues raised in the ecological reports prepared for HBRIC and the objections and submissions on the Ruataniwha Water Storage Scheme and the proposed land exchange between Ruahine Forest Park revocation land and the Smedley Exchange Block. The issues raised in the objections are set out in appendix 2.

Site assessment 1: G La Cock, C West, A Lee - 8 April 2015:

On 8 April the team assessed the two sites as well as their surroundings from the air, and visited the Ruahine Forest Park Makaroro River site block on foot. Specific objectives of this flight and ground visit were to:

gain an overview of the Ruahine Forest Park revocation land and Smedley Exchange Block;

place the specific habitats, including the oxbow wetland, in context with their surroundings;

improve our knowledge of the state of vegetation in the Ruahine Forest Park Makaroro block, and identify any threatened species that may have been missed in site visits during the original surveys or a subsequent visit by Kelvin Lloyd;

Assess whether there are areas of kowhai in the vicinity of Ruahine Forest Park revocation land to replace the kowhai food source that could be lost in Ruahine Forest Park revocation land should the Ruataniwha Water Storage Scheme proceed, in order to gauge how significant that loss might be;

Assess whether there are similar areas to those that occur in the Dutch Creek stream and in the Makaroro River gravels.

During this visit a wetland was spotted amongst the pines in the PanPac forest located between Ruahine Forest Park and Gwavas Conservation Area. An assessment of this site was included in the brief for the second trip, because of its potential to provide some insight into the wetlands in the vicinity. However, it was not taken into consideration in our recommendations.

Site Assessment 2: G La Cock, G Rogers, P Gerbeaux, J Scrimgeour, A Lee -13 to 15 April 2015

Specific objectives of this trip were to:

Assess each parcel of land against the information provided during the Ruataniwha Water Storage Scheme processes;

Classify and compare the values of the wetlands on Ruahine Forest Park revocation land, PanPac and Smedley Exchange Block;

Identify threatened species of plants that may have been missed during site visits by consultants acting for the applicant and by submitters and their consultants, and attempt to improve the knowledge on distribution and population size of threatened birds and plants;

Assess habitat in the vicinity of Ruahine Forest Park revocation land for its potential to accommodate threatened species that may be displaced from Ruahine Forest Park revocation land should the Ruataniwha Water Storage Scheme proceed, in order to gauge how significant the loss of the habitat currently occupied by the threatened species might be;

Assess whether the seepage areas adjacent to Dutch Creek contain threatened plants.

On 13 April G La Cock, G Rogers and J Scrimgeour attempted to access the Makaroro Block by approaching from the south and crossing the Makaroro River. Heavy rain in the Ruahines meant that the Makaroro River was swollen and too dangerous to cross. This trip, however, allowed us to gain an overview of the district to the south of Ruahine Forest Park revocation land and Smedley Exchange Block.

On 14 April the full team visited the PanPac wetland and the two parcels on Ruahine Forest Park revocation land (Makaroro River and Dutch Creek). For the Makaroro River parcel we viewed the entire site from the top of the ridge above the central part of the site, and visited theeastern end near the old house site. For the Dutch Creek parcel we viewed the site from above the oxbow wetland, and walked up Dutch Creek. Three of us assessed the wetland, and two of us (G Rogers and J Scrimgeour) continued to the main block of black beech forest. Steep seepage areas next to the stream were searched for anything unusual botanically. We then entered the forest on the opposite bank from Moore's Rd, and gained an overview of some of the steep sided gullies that will be inundated should the proposed Ruataniwha Water Storage Scheme go ahead.

On 15 April the full team visited Smedley Exchange Block. We did not have time to visit the whole block, so we visited the wetland near the forest in the NW, and did a walk through survey ofthe property up to Donovan Gully. Two of us (A Lee and G Rogers) went down Long Spur to view the southern end of the block, and one of us (J Scrimgeour) visited the broadleaf small-leaved shrubland to the east of Donovan Gully to assess a scree slope and rock outcrops as potential habitat for lizards. P Gerbeaux and G La Cock assessed the Donovan Gully wetlands.

We had copies of the plant lists from Kessels & Associates (2013a, c) and Lloyd (2013a, b) for comparative purposes as we assessed the sites.

Advice on freshwater issues was also sought from Ben Woodward, who processed the Resource Consent application for the disruption of fish passage on behalf of the Department.

Overall assessment of the terrestrial ecology reports by the applicant and submitters

Te Taiao Environment Forum, Forest and Bird (Central Hawke's Bay, Napier, Hastings) and DOC district office staff had rated a draft of Kessels & Associates (2013a) as "Overall a very good report which identifies the ecological impact of the dam and reservoir" (Cheyne 2012). Although we found many of the aspects of the reports to be well done, from our perspective we found the following to be issues that could have been considered in the main reports, submissions and joint expert witness statement on terrestrial ecology (Kessels & Associates 2013a, b, c; Kessels et al. 2013; Lloyd 2013a, b), and would have improved them:

- the major impact that previous logging and human influences have had and are currently having on Ruahine Forest Park revocation land and Smedley Exchange Block;
- the underlying geology of the sites;
- the context of vegetation and habitats on Ruahine Forest Park revocation land and Smedley Exchange Block in relation to surrounding vegetation and habitats.

In addition, neither the terrestrial ecology reports nor the freshwater reports and submissions (e.g. Young et al. 2013, Death 2013; Joy 2013, Ausseil et al. 2013) placed the wetlands in a national or regional context, other than to point out the value of the oxbow (Forest & Bird Inc et al. 2015, Lloyd 2013a, McQueen 2015).

Kessels & Associates (2013c) included kanuka in their plant list, but not manuka. We only found manuka. We also found red beech, which wasn't listed. However, both red beech and manuka were referred to in the vegetation descriptions, as was kanuka.

We didn't find kanuka at either site, and it isn't known from the region (A Lee pers comm.). Lloyd (2013a) also didn't list kanuka in his plant list. The dominant vegetation at Gwavas Conservation Area is described as "scrub and low forest dominated by manuka and kanuka" (Department of Conservation, 1994). Even though Lloyd (2013a) and we didn't find kanuka in the areas we visited, it may be elsewhere on the properties.

Improved knowledge gained from site assessments

Dutch Creek habitat

The aerial assessment of the Dutch Creek parcel revealed that similar habitat to that which will be inundated should the proposed Ruataniwha Water Storage Scheme go ahead was present for approximately another 5km to the north. This stretch will not be inundated should the Ruataniwha Water Storage Scheme go ahead.

The long lasting impact of logging of the podocarps in the region (e.g. Bickler & Clough 2013, Elder 1965, Fromont 1991, Masters et al. 1957, New Zealand Forest Service 1977) was evident from the differences in structure and appearance between black beech forest with and without podocarps and clear-felled forest (that might have also been burnt) that has now succeeded to scrub or low forest. The loss of emergent podocarps from the Dutch Creek black beech forest contrasts with the unmodified black beech-podocarp forest further up the Makaroro River catchment.

Makaroro River braided river habitat

Braided river stretched for several kilometres above the proposed dam site and the Ruahine Forest Park revocation land Makaroro River parcel, and for several kilometres into Ruahine Forest Park. This stretch of river will not be inundated should the proposed Ruataniwha Water Storage Scheme proceed.

Concerns have been raised about the loss of kowhai as a food source for birds, should the Ruataniwha Water Storage Scheme proceed. Our aerial assessment revealed kowhai to be present on the banks of the Makaroro River well into Ruahine Forest Park, with a kowhai dominated face on the bank opposite the western end of the Makaroro River parcel of Ruahine Forest Park revocation land. This face will be above the footprint of the dam, should the Ruataniwha Water Storage Scheme proceed.

The high level of woody weed infestation, including shade-tolerant species such as Darwin's barberry, raised concerns about the future functioning and recovery ofthis site in the absence of intensive management.

Photo 1: Secondary successional scrub immediately above Dutch Creek, apparent here as the steep-sided treed creek to the right of the photo. (Photo: Carol West)

Threatened species

During the field work no additional threatened plant species were discovered, despite specific searches in some habitats, especially wetlands, cliffs and seepage areas, as suggested by Lloyd (2013a, b). In addition, we didn't record any new threatened birds or herpetofauna, although we acknowledge that this was unlikely given the short visit. However, two fernbirds were heard at the PanPac wetland, and we heard two fernbirds at the oxbow site. This was an improvement on the previous recordings of one fernbird at the oxbow on two separate occasions.

Scrimgeour (Appendix 4) has provided a report on the fauna values at all sites, and the potential habitat of each site to sustain these species. More detail on her findings is included under the "Review of relevant information" section below.

Photo 2: Oblique aerial view, looking west towards the Ruahine Range in the distance. Dutch Creek is located between the main pine plantation in the foreground and the triangular patch of secondary successional scrub (centre left of photo) and beech forest in Ruahine Forest Park. The Dutch Creek parcel of Ruahine Forest Park revocation land is located below the secondary successional scrub. Makaroro River is on the left. (Photo: Carol West)

Wetlands

Philippe Gerbeaux (Appendix 3) has provided a report on the wetlands we visited, including future management scenarios.

The wetland on Smedley Exchange Block was in better condition than photos in the Smedley Exchange Block report (Kessels & Associates 2013c) suggest, and we found significant areas of wetlands in Donovan Gully. Some of these areas were within the proposed Smedley Exchange Block boundary, and some were excluded. These Donovan Gully wetlands were not identified in the Smedley Exchange Block ecological report (Kessels & Associates 2013c).

The oxbow wetland on the Dutch Creek Ruahine Forest Park revocation land may have been created artificially, because it is about two metres above the level of Dutch Creek, and has a ridge running between the two arms of the wetland. There is a steep cut face on the opposite bank. The existing confluence between Dutch Creek and Makaroro River was created artificially by bulldozing a new route for Dutch Creek to simplify the dragging of logs down the river. Based on the tightness of the bends on the oxbow lake it would have been very difficult to drag logs around it. The area of black

beech to the north had the podocarps logged, so there is a possibility that the river was straightened out at this site as well, to facilitate removal of logs. However, decades since logging ended the wetlands are functioning as wetlands, and we have opted to treat them as an oxbow wetland for the purposes of this exercise.

Review of relevant information

The following responses are based on our observations during the field trips, the relevant reports that formed part of the Ruataniwha Water Storage Scheme RMA process (see "list of evidence and background information consulted"), and other relevant literature and information on the area.

Freshwater fish

There is a vast amount of information and evidence related to the Ruataniwha Water Storage Scheme on potential effects on freshwater fish (e.g. Death 2013, Joy 2013, Young 2013, Young et al. 2013). The fish experts in the expert conferencing (Ausseil et al. 2013) representing the applicant and submitters all agreed that the effects of the dam are as reported in Young et al. (2013).

Up to five At Risk-Declining native fish species, including long fin eel, torrent fish, redfin bullies and dwarf Galaxias, possibly occur at the Dutch Creek parcel of Ruahine Forest Park and on Smedley Exchange Block. Species lists are included in Young et al. (2013), and maps of predicted distribution appear as appendices (Young et al. 2013). Four of these five At-Risk-Declining species are migratory (cf Kessels & Associates 2013a, c). There is a greater chance of more species being in Dutch Creek than the first order streams on Smedley Exchange Block, because of its greater size and length.

Four of these five At Risk-Declining species are amongst the seven migratory fish that may occur at both sites.

The seven migratory native fish species, including four of the five At Risk-Declining species (Kessels & Associates 2013c) are unlikely to maintain self-supporting populations above the dam unless fish passage is provided (Ausseil et al 2013, Young 2013, Young et al. 2013). Nonetheless, landlocked populations of fish have established in other areas, so this is a possibility, albeit it uncommon (B Woodward pers comm.).

Should the Ruataniwha Water Storage Scheme proceed it will impede movement of fish between Dutch Creek and Makaroro River below the dam. There is at least another 5 km of Dutch Creek habitat above the upper limits of the reservoir, so fish habitat will remain. Similarly the upper Makaroro River will remain as a natural fast-flowing stream for several kilometres above the upper extent of the dam, should the Ruataniwha Water Storage Scheme go ahead. Should the scheme proceed the impoundment would not inundate streams on Smedley Exchange Block. However, it would still block streams below Smedley Exchange Block, thereby impeding fish access to Makaroro River below the dam.

Should the Ruataniwha Water Storage Scheme proceed migratory fish on Smedley Exchange Block will have short steep reaches to live in, compared to the 5 km or more in Dutch Creek that won't be

inundated, thereby resulting in increasing pressures on these Smedley Exchange Block populations. However, there is the possibility that a greater number of species may be affected in Dutch Creek.

The fish experts (Ausseil et al. 2013) agreed that, while the possible loss of the seven migratory fish species, including four of the five At-Risk-Declining 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 would not be expected to result in a significant increase to their threat of extinction from elsewhere in the catchment (Young 2013, Young et al. 2013).

The fish experts (Ausseil et al. 2013) agreed that trap and transfer was the best available mitigation option, but that trap and transfer would not fully mitigate the effects of the dam on fish passage, and that there was considerable uncertainty about the efficacy of the trap and transfer approach. However, it was the best approach. The fish experts (Ausseil et al. 2013) further agreed on additional mitigation, being a management plan focused on each species of fish and including, but not limited to, enhancing fish habitat and enabling fish access to areas they currently cannot access. They noted that it was important that these fish management plans were not restricted solely to the dam site. This dedicated approach is supported, and should extend to streams on Smedley Exchange Block.

Threatened land environments.
There are 3.65 ha of Acutely Threatened land environment on the Ruahine Forest Park revocation land, but none on Smedley Exchange Block.

Kessels & Associates (2013a, b, c) used LENZ Level IV environments (Leathwick et al. 2002). The Acutely Threatened land environment on the Ruahine Forest Park revocation land is LENZ Environment B2.1d (Leathwick et al. 2002). It includes 3.30 ha on the Makaroro River and 0.35 ha up Dutch Creek. This land environment occupies 95.6 ha of public conservation land in the vicinity, including parcels elsewhere on Dutch Creek and Makaroro River, as well as nearby on Waipawa River and Tukituki River. It occupies 2286 ha overall in Hawke's Bay.

The following details on LENZ B2.1d are from Leathwick et al. (2002) pg 60.

Environment B2

This environment occurs on inland areas of the southern Hawke's Bay plains on gently sloping alluvial surfaces. The climate is mild, with high solar radiation and low annual water deficits. Soils are imperfectly drained and have low natural fertility mainly due to the parent material consisting of rhyolitic tephra, loess and mixed alluvium.

Level III & IV Descriptions
Level III
Area: 70,188 ha
Elevation: 310 m
Location: Southern Hawke's Bay
Climate: Mild temperatures, high solar radiation, low annual water deficits and very low monthly water balance ratios
Landform: Gently undulating plains

Soils: Imperfectly drained soils of low fertility from a mixture of rhyolitic tephra, loess and mixed alluvium

Level IV
B2.1 – No Subdivision at Level III
d. lower annual water deficits, well-drained soils of loess and very high fertility

Several authors (e.g. Norton & Roper-Lindsay 2004, Walker et al. 2007, Davis in press) have outlined the issues with the way the threatened land environment classification is being applied by practitioners. Norton & Roper-Lindsay (2004) described the LENZ system as being a classification based on computer modelling of a range of climatic, substrate and landform attributes to generate a series of land units. They saw these land units as an approximation of potential ecosystem character. Walker et al. (2007) reiterated that their threatened environment classification, based on LENZ and Land Cover Database 2 (LCDB2), is not a substitute for field survey, did not see their system as a replacement for the biogeographic planning framework of ecological regions and districts, did not see it as a fine-scale tool, and did not see it as a reserve planning tool. Davis (in press) pointed out that LENZ is not a classification of ecosystems and vegetation, but should rather be seen as part of a wider toolkit that complements field survey and other information.

We could not pick obvious differences that would have distinguished LENZ B2.1d from a neighbouring LENZ on Ruahine Forest Park revocation land, and have relied on the field assessments undertaken by Kessels & Associates (2013a, b, c), Lloyd (2013a, b) and ourselves in our assessment of the Ruahine Forest Park revocation land and Smedley Exchange Block.

The consultant reports pay particular attention to unusual vegetation types in relation to the dominant forest cover. Scrub communities are a case in point. Ecologically, the Dutch Creek small-leaved communities are driven by factors such as high water tables, frosts and disturbance. The Smedley Exchange Block communities are driven by different stress factors such as steep-slope rock outcrops with thin, drought-prone soils. They are also much larger than the small-leaved communities on Ruahine Forest Park revocation land, and provide habitat for a different suite of animals, such as skinks and geckos. These ecosystems are not present on the Ruahine Forest Park revocation land, and represent a different and complementary component from a conservation perspective.

Wetlands
Gerbeaux (Appendix 3) assessed the oxbow wetland in Dutch Creek and the two wetlands on Smedley Exchange Block according to a process that had been applied on the West Coast (Maseyk & Gerbeaux 2015). He also commented on the PanPac wetland, but that is not pertinent to this section.

In summary, he found the oxbow wetland to be significant for representativeness, rarity, distinctiveness and ecological context. He assessed two wetlands on Smedley Exchange Block, although Kessels & Associates (2013c), Forest & Bird and Te Taiao Environment Forum only referred to one. They did not refer to or appear to know about the Donovan Gully site, possibly because it was not in the original report (Kessels & Associates 2013c). These two wetlands were assessed as being significant for representativeness, distinctiveness and ecological context. Once grazing has been

removed these wetlands and their surrounding vegetation will start to recover within ten to twenty years.

Gerbeaux (Appendix 3) considered that the oxbow as well as the two wetlands on Smedley Exchange Block would trigger the second National Priority for Protecting Rare and Threatened Biodiversity on Private Land (MfE & DOC 2007). Forest & Bird only considered that the oxbow lake met these criteria. Based on the description of the wetland on Smedley Exchange Block (Kessels & Associates 2013c) this is understandable. We relied on our own site assessments to identify the extent of wetlands on Smedley Exchange Block, and their significance.

Threatened species

Neither Lloyd (2013a) nor we found additional threatened plant species during our surveys, despite searching habitats suggested by Lloyd.

Scrimgeour (Appendix 4) addresses issues around fauna, including threatened fauna. Long-tailed bats have been recorded throughout the landscape (Kessels & Associates 2013a). Based on recorded passes/night at Dutch Creek and on the margins of Smedley Exchange Block it was apparent that both sites were suitable for activity/foraging, but were not being used for roosting at the time of recording. However, both sites appeared suitable for bat roosts with large beech trees and in the case of Smedley Exchange Block, some emergent podocarps. Kessels & Associates (2013a) identified the confluence of the Makaroro River and Dutch Creek as the possible location of roost sites in the area, based on intensive sampling on 22-30 November 2011, 2-9 February 2012, 11-22 January 2013 and 2-10 February 2013 (Kessels & Associates 2013c). These surveys found no evidence to support the presence of long-tailed bat maternity roosts on Ruahine Forest Park revocation land, as claimed by Forest & Bird and Te Taiao Environment Forum in their submissions (Appendix 2).

Cheyne (2012), on behalf of Te Taiao Environment Forum, Forest & Bird and DOC, accepted that New Zealand falcon are scattered along the eastern Ruahine Forest Park boundary and therefore not uncommon. We concur with this observation.

We didn't record North Island fernbirds on Smedley Exchange Block. The regenerating secondary successional scrub immediately west of Dutch Creek is considered to be good habitat for fernbird that may be displaced if the oxbow wetland is inundated should the proposed Ruataniwha Water Storage Scheme go ahead. They were present at the PanPac wetland between the two sites, which suggests that fernbirds are present throughout the area where suitable habitat is available. This is supported by the fact that only small numbers of birds were recorded at each site (i.e. not enough to be self-sustaining at that site), which means they have to be part of a larger population that can disperse betweens sites.

Scrimgeour (Appendix 4) also noted potential habitat on Smedley Exchange Block for skinks and geckos. Overall Smedley Exchange Block has the potential to provide enhancement of conservation values, which would be further enhanced when grazing is excluded (as it would be) and greater enhancement of conservation values if the current shape of the proposed exchange was altered to a more coherent design that would also minimise edge effects (Scrimgeour Appendix 4).

Although one red mistletoe was found on Ruahine Forest Park revocation land in Dutch Creek, none have been observed on Smedley Exchange Block. However, they are widespread within the Ruahines, with around 300 records (BioWeb). There's a population of at least 25 on Sunrise Track about 10 km south of Dutch Creek. They can be translocated to black beech on Smedley Exchange Block by placing seed on small branches, so their apparent absence from Smedley Exchange Block should not be of concern.

Smedley Exchange land not identified as an RAP (Recommended Area for Protection)
Smedley Exchange Block falls in the Ruahine Ecological District. Fromont (1991) produced a Protected Natural Areas Survey report for the Ruahine Lowlands. In this she did not identify specific sites as is common practice. Instead she identified botanical features listed by Elder (1965) as future sites worthy of study to advance their protection. This list included lowland black beech forest, although not specifically Smedley Exchange Block.

Assessment of the significance of the ecological values for Ruahine Forest Park Revocation Land and Smedley Exchange Block, and a comparison of these values

The two parcels of Ruahine Forest Park Revocation Land are separated by at least 600 m of pine forest, and therefore will be assessed separately for the purposes of this comparison. Treating the Ruahine Forest Park revocation land parcels as one entity would lead to lower assessment ratings for criteria such as naturalness/intactness and size shape and buffering, and no assessment criteria would have an improved rating , hence the decision to assess the two parcels separately. For the purposes of this exercise we've accepted that Dutch Creek is part of Ruahine Forest Park revocation land where it borders Ruahine Forest Park revocation land.

Smedley Exchange Block comprises more or less uniform valley or hillslope physiography. The proposed reserve design encompasses areas set aside for pasture or forestry, resulting in one 4.4 ha patch of black beech forest being isolated from the rest of the Smedley Exchange Block by about 150 m. Should the Ruataniwha Water Storage Scheme proceed proposed riparian planting will connect these two blocks (Figure 1). We chose to treat Smedley Exchange block as one parcel because of its uniform physiography, with the understanding that this separation of the two main blocks will be taken into account in the assessment, particularly for the long term viability and size, shape and buffering criteria.

For comparative purposes with Ruataniwha Water Storage Scheme documents we've applied the habitat types used by Kessels & Associates (2013b; c). However, the habitat criteria used by Kessels & Associates (2013a, b, c) are equivalent to vegetation communities and by definition do not engage with the full ecosystem context of the Ruahine Forest Park revocation land and Smedley Exchange Block, that is the land's underlying physiography (climate landforms and soils) that select for the habitat, or vegetation communities, thereon. By this measure the Ruahine Forest Park revocation land alluvial riparian terraces with their predominantly soft mudstone and overlying outwash gravel

landforms strongly contrast with the drier colluvial greywacke hill country of the Wakarara Range and hence Smedley Exchange Block (Kingma 1958). We note these differences, but for consistency and convenience we've adopted the habitat criteria of Kessels & Associates (2013b, c).

Maseyk & Gerbeaux (2015) argue for the use of four (sometimes distilled to three) criteria for the assessment of significance as recently endorsed by the Environment Court and upheld by the High Court (in the case of the West Coast Regional Council's Land and Water Plan). These criteria were representativeness, rarity, distinctiveness, and ecological context. Others have debated the application of significance criteria in New Zealand (e.g. Norton & Roper-Lindsay 2004, 2008, Walker et al. 2008). However, as a rule these authors have focussed on identifying significant sites at a district or regional scale, rather than the application of the assessment criteria to comparing two sites which may or may not meet significance thresholds. Our preference therefore is to adopt the seven criteria of Davis (2010, in press) predominantly because of their comprehensiveness, their convincing use applied to a proposed land exchange in Canterbury (Davis 2010), and their further promulgation by the Department (Davis in press). This approach also differs from the assessment of significance by Kessels & Associates (2013b; c), whereby they evaluated the significance of their habitat classes in the context of the Hawke's Bay Regional Policy Statement (Appendix XII in Kessels & Associates 2013a) or the Central Hawke's Bay District Plan (Appendix XIII in Kessels & Associates 2013a). Both Ruahine Forest Park revocation land and Smedley Exchange Block would be considered significant under these processes, but they don't allow for a robust comparison of ecological values. Keesing (Appendix XV in Kessels & Associates 2013a) also noted the simplicity of the significance criteria under the Hawke's Bay Regional Policy Statement and the Central Hawke's Bay District Plan.

The assessment criteria we have used follow those used by Davis (2010, in press). This assessment method includes five criteria on ecology and two management criteria on long term viability and fragility, threat and management. From an ecological perspective this requires us to consider the impact of flooding on adjacent areas, e.g. impact of flooding Dutch Creek on fish, and the impacts of management and mitigation, e.g. impacts of removing grazing from Smedley Exchange Block and impact of the reservoir on fish in Smedley Exchange Block streams. This is also in keeping with the objections by Forest & Bird and Te Taiao Environment Forum which raised issues with the way sites were assessed.

Davis (2010, in press) used the following five ecological criteria (brief description from Davis in press):

Representativeness : The extent to which indigenous biodiversity is typical of the natural diversity of the relevant Ecological District.

Diversity and pattern: The extent to which the expected range of diversity and pattern is present for the relevant Ecological District.

Rarity and special features: Rarity is the natural or induced scarcity of biological, physical and ecological features within an area; special features identify unusual or distinctive features of an area.

Naturalness: The relative absence of human disturbance or modification within an Ecological District.

Size and shape, buffering/surrounding landscape and boundaries: The extent to which the size and configuration of an area, and its degree of buffering from a surrounding landscape affects its ability to maintain its indigenous biodiversity.

There are also two management related criteria (Davis in press). These are not used to assess ecological significance:

Long-term ecological viability: The ability of an area of indigenous biodiversity to retain its ecological health and values over time with minimal management input.

Fragility and threat and management input: A site's inherent vulnerability to environmental change by virtue of the nature of its ecological components and its position in the landscape.

Ruahine Forest Park revocation land Makaroro River parcel

Representativeness

This 7.896 ha area comprises an alluvial plain next to the Makaroro River. Such plains are rare in the landscape. The habitats were described as black beech forest, broadleaf forest, podocarp/broadleaf, broadleaf and black beech treeland, exotic forest, and braided riverbed (0.424 ha). The site has been logged, and no large podocarps were recorded. It was used for firewood to fire furnaces and run a sawmill, includes an old house site, and is heavily infested by woody weeds. However, some elements of indigenous vegetation are present, particularly some black beech. There is a small stretch of braided river typical of the Makororo River above the site.

Diversity and pattern

The site is a fairly uniform alluvial plain, with little variation in habitat, except for some braided river bed. Variations in vegetation patterns are largely as a result of previous human influences. It has low plant species diversity, and few podocarps and broadleaf trees.

Rarity and special features

Long-tailed bats (Threatened-Nationally Vulnerable) have been recorded at the site, and New Zealand bush falcon (Threatened – Nationally Vulnerable) would in all likelihood overfly the area as part of their home range, as pairs of falcon are accepted as being scattered along the eastern Ruahine Forest Park boundary and therefore not uncommon (Cheyne 2012). No Threatened or At Risk plants have been recorded by any of the parties visiting the site. The braided river is not recognised as a significant area for indigenous fauna, and is not recognised as being regionally, nationally or internationally important for its assemblage of indigenous river birds (Kessels et al. 2013).

However, this site includes 3.30 ha of Acutely Threatened LENZ B2.1.d (see pg 14 for description). This land environment occupies 95.6 ha of public conservation land in the vicinity (25 km radius), and

2286 ha overall in New Zealand. This stretch of river appeared to be typical of the Makaroro River for several kilometres above the proposed reservoir, and into Ruahine Forest Park.

Naturalness/intactness

The vegetation has been heavily modified by man. It's been logged, used for firewood, and was the site of a Forest Service hut. Weeds, including woody weeds such as Darwin's barberry, are widespread. This weediness would inhibit successional rebuilding of the vegetation.

Size, shape and buffering

The site is small, long and narrow, ranging in width from 50 to 150m. It is separated from the rest of Ruahine Forest Park by a pine plantation over 500 m wide.

Long term viability

The site is ephemeral and, given its current degraded state, is unlikely to recover to a viable indigenous forest without significant levels of management. It is not included in one of the Department's Ecological Management Units.

Fragility, threat and management

The site is fragile, degraded, and under threat from woody weeds that would inhibit future successional rebuilding of the vegetation. Human activities continue to impact on the site, and it is prone to flooding. It requires high levels of management input if it is to be restored. Given other DOC priorities in the district and country this is unlikely to occur.

Ruahine Forest Park revocation land Dutch Creek parcel

Representativeness

This 14.335 ha parcel of land is mainly comprised of 8.883 ha black beech forest (Photo 3) and 5.154 ha of broadleaf-small leaved monocot scrub/treeland (Photo 4). The black beech forest has had all the large podocarps logged, and the broadleaf-small leaved monocot scrub/treeland is part of a much larger patch of secondary successional scrub that is very evident from the air. The black beech forest has a good understorey. There is a 0.293 ha wetland which is significant as a wetland, and Dutch Creek which is a second order stream.

Diversity and pattern

This site has a stream, wetland, and intact black beech forest that has had podocarps logged, and includes some seepage areas and cliff habitat, leading to the area of secondary successional scrub on the escarpment above (see Photo 1). These diverse habitats contribute to a moderate plant species diversity.

Rarity and special features

Long-tailed bats (Threatened-Nationally Vulnerable) and North Island fernbird (At Risk-Declining) have been recorded at the site, and New Zealand bush falcon (Threatened – Nationally Vulnerable) would in all likelihood overfly the area as part of their home range, as pairs of falcon are accepted as being scattered along the eastern Ruahine Forest Park boundary and therefore not uncommon

(Cheyne 2012). One plant of red mistletoe (At Risk-declining) was observed. Up to 5 At Risk-Declining fish species may use this stretch of Dutch Creek.

This site includes 0.39 ha of Acutely Threatened LENZ B2.1.d (see pg 14 for description). This land environment occupies 95.6 ha of public conservation land in the vicinity (25 km radius), and 2286 ha overall. Dutch Creek stretches for several kilometres above the land parcel. This stretch will not be inundated should the Ruataniwha Water Storage Scheme should it proceed.

Photo 3. Black beech forest in Dutch Creek, taken from opposite bank. (Photo: Geoff Rogers)

Photo 4. Broadleaf-small leaved monocot scrub/treeland in Dutch Creek.(Photo: Geoff Rogers)

Naturalness/intactness

The vegetation has been modified by man, with podocarps missing from the black beech forest. Another area on the escarpment is secondary successional scrub that appears to have been clearfelled and burnt in the past. However, the black beech forest is intact in its current state, albeit without emergent podocarps, and it is not heavily infested by woody weeds.

Size, shape and buffering

The site is small, long and narrow, and adjoins the main body of Ruahine Forest Park.

Long term viability

In the long term the broadleaf-small leaved monocot scrub/treeland will regenerate, and podocarps will return to the black beech forest, but it will be over a hundred years before they are emergent above the canopy.

Fragility, threat and management

The site is well buffered, and will not require much active management to recover from past human impacts, other than browser and predator control. Woody weeds did not appear to be present in densities that would suppress successional rebuilding of the vegetation, but some wilding pine control may be required in future.

Smedley Exchange Block

Representativeness

The 146 ha Smedley Exchange Block contains 122 ha of indigenous vegetation. It is currently grazed, except for the separate block of 4.4 ha of black beech that has been fenced off (Photo 5). Some areas of black beech still have emergent podocarps. There's a mosaic of vegetation types, some induced through logging and agriculture, but there is a naturally occurring dry west facing slope dominated by small-leaved broadleaf scrub (Photo 6).

Smedley Exchange Block is in the Wakarara Range, a greywacke piercement body, which is separated from the main greywacke block of the Ruahines by a long narrow graben, the Ohara Depression (Kingma, 1958). The Wakarara Range is dominated by the Gwavas Conservation Area. The vegetation of Gwavas CA is described as "Some remnant pockets of forest in gullies containing red and black beech, rimu, matai and kahikatea. Most vegetation is scrub and low forest dominated by manuka and kanuka" (Department of Conservation, 1994).

Smedley Exchange Block therefore represents an area of beech forest with emergent podocarps that extends the altitudinal range of Gwavas Conservation Area, and includes some dry west facing slopes that are not represented elsewhere in Gwavas Conservation Area.

Photo 5. Patch of black beech forest on Smedley Exchange Block that has had grazing removed. Note emergent podocarps. (Photo: Geoff Rogers)

Photo 6. Mosaic of treeland and scrub vegetation types with patches of pasture on Smedley Exchange Block, and dry west facing slope dominated by small-leaved broadleaf scrub. (Photo: Geoff Rogers)

Diversity and pattern

Smedley Exchange Block is relatively large (146 ha) and has an altitudinal range of approximately 300 m (480 to 780 m asl.). It has a range of vegetation classes, some natural and some resulting from human interference, four streams and two types of wetland.

Rarity and special features

Long-tailed bats (Threatened-Nationally Vulnerable) have been recorded from the margins of the Smedley Block, but have not been searched for on the actual Exchange Block. However, bats have been recorded throughout the landscape and are therefore likely to be present throughout the Smedley Exchange Block. New Zealand bush falcon (Threatened – Nationally Vulnerable) would likely overfly the area as part of their home range, as pairs of falcon are accepted as being scattered along the eastern Ruahine Forest Park boundary and therefore not uncommon (Cheyne 2012).

Up to 5 At Risk-Declining fish species may use the streams on Smedley Exchange Block. Although the proposed reservoir will not influence the streams on Smedley Exchange Block itself, the proximity of the reservoir will have an impact on the fish in the streams currently draining Smedley Exchange Block land and their passage to Makaroro River, and needs to be considered as an impact of the Ruataniwha Water Storage Scheme on the site.

No threatened or at risk plants were found by any of the parties that have visited this site.

The beech forest with emergent podocarps and the dry west facing slopes with broadleaf small-leaved scrub are poorly represented on the Wakarara Range. The Wakarara Range is also not protected down to the altitude as proposed in Smedley Exchange Block.

Naturalness/intactness

There are some areas of pasture (24 ha of 146 ha overall), but we believe that these areas will recover once grazing is removed as proposed.

Large podocarps have been logged from the beech forest, but several were not logged and remain as emergent podocarps throughout the black beech forest. By comparison no emergent podocarps remain in the black beech forest on the Ruahine Forest Park revocation land parcels. Other habitats described in Kessels & Associates (2013c) are impacted by current grazing. The area of black beech that has been withdrawn from grazing has developed an understorey, and appeared intact.

Size, shape and buffering

The site is large, and complements the adjoining Gwavas Conservation Area. Its proposed shape would be awkward to manage, with an area in the north that is set aside for forestry or pasture resulting in one separate 4.4 ha area about 150 m from the rest of the Smedley Exchange Block.

There is also a section around Donovan Gully which has been excluded. From a management perspective the inclusion of this area would simplify management and reduce edge effects. It also contains the lower reaches of the significant wetland that we recorded in Donovan Gully. Its inclusion has merit from a catchment management perspective.

Long term viability

The site does not have a major weed problem, so in the long term the vegetation and wetlands will recover, and areas currently in pasture will regenerate. Although extensive replanting is proposed, we do not believe that this will make a significant difference to the speed and direction of regeneration that would be achieved without planting.

The proposed increase in predator and browser control will also improve the long-term viability of the site.

Fragility, threat and management

The site is well buffered, and will not require much active management to recover, other than browser and predator control and exclusion of grazing. Some wilding pine control will be needed in future. A trap and transfer system is proposed to assist native fish (primarily eel) to move above or below the dam.

Discussion

Smedley Exchange Block has scored the same or higher than the two parcels of Ruahine Forest Park revocation land for every ecological significance assessment criterion (Table 1). This is attributed to the diversity of habitats offered by its size and altitudinal range, habitats in this altitude rangebeing poorly represented on the Wakarara Range, which has a different geology from the neighbouring

Ruahine Forest Park, and the way that the Smedley Exchange Block complements the Gwavas Conservation Area. In contrast, the Ruahine Forest Park revocation lands make a disproportionately much smaller contribution to the present values of Ruahine Conservation Park. Both sites contain significant wetlands, and, other than long-tailed bats, do not support viable populations of threatened birds or plants.

The fragility, threats and management needs of Smedley Exchange Block are similar to those of the Dutch Creek parcel of Ruahine Forest Park revocation land, as is long-term viability. The Makaroro River parcel of Ruahine Forest Park revocation land had a lower long term viability and higher fragility, threat and management needs than Smedley Exchange Block and the Dutch Creek parcelof the Ruahine Forest Park revocation land.

Table 1: Comparison of significance criteria for Ruahine Forest Park revocation land and Smedley Exchange Block.

Assessment criteria	Ruahine Forest Park Makaroro River	Ruahine Forest Park Dutch Creek	Smedley Exchange Block
Representativeness	L/M	M	M/H
Diversity and pattern	M	M	H
Rarity and special features	M	M	M/H
Naturalness/intactness	L	L/M	L/M
Size, shape and buffering	L	L/M	M
Connectivity	L	H	H
Long-term viability	L	M	M
Fragility, threat and management	H, H, H	L, L, M	L, L, M

Conclusions

We have considered the relevant information that's available as part of the Ruataniwha Water Storage System RMA application process and as part of the land exchange hearings process. We have also assessed other pertinent literature, and undertaken two site assessments of the Ruahine Forest Park revocation land and the Smedley Exchange Block.

Based on this information and our own site assessments we conclude that, from an ecological and biological point of view, exchanging the 146 ha Smedley Exchange Block for the 22 ha Ruahine Forest Park Revocation Land would enhance the conservation values of land managed by the Department. The main reasons for reaching this conclusion were:

The Ruahine Forest Park revocation land and its immediate surroundings have been heavily logged in the past, with virtually no emergent podocarps left. Although Smedley Exchange Block has been logged it has some emergent podocarps.

The Makaroro River parcel of Ruahine Forest Park revocation land has been heavily logged, is infested with woody weeds, including shade-tolerant species, has an old house site, and is in

a generally degraded state. It requires a higher level of management input than the other two sites.

Smedley Exchange Block is larger than Ruahine Forest Park revocation land (146 ha compared to 22 ha), and covers an altitudinal range of almost 300 m. However, some of the 146ha has been cleared for grazing and the understorey of some forested areas is currently degraded due to grazing. With grazing removed the block will regenerate over time.

Smedley Exchange Block forms part of the Wakarara Range, which has a different underlying geology when compared to the rest of the Ruahine Range, including the Ruahine Forest Park revocation land.

This different geology and greater altitudinal range also support ecosystems that are not present in Ruahine Forest Park revocation land, such as the naturally occurring dry west-facing slopes dominated by small-leaved broadleaf scrub.

The Smedley Exchange Block extends the altitudinal range of Gwavas Conservation Area, and contains habitats and vegetation that are not present on the adjoining Gwavas Conservation area. The two sites complement each other.

The Makaroro River parcel of Ruahine Forest Park revocation land includes 3.3 ha of an Acutely Threatened land environment. Approximately 92.3 ha of this land environment is on public conservation land elsewhere in the district. The designers of this threatened environment classification system (Walker et al 2007) pointed out that their system is not a replacement for field work, did not see it as a replacement for the biogeographic planning framework of ecological regions and districts, did not see it as a fine-scale tool, and did not see it as a reserve planning tool. Based on our assessment the site is in a degraded condition, and does not rate highly when assessed against ecological significance criteria.

While the possible loss of the seven migratory fish species, including four of the five At Risk-Declining species, within the Makaroro River catchment 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 catchment populations of these species is not expected to result in a significant increase to their threat of extinction from elsewhere in the catchment.

Dutch Creek has more suitable habitat for the seven migratory fish than Smedley Exchange Block, and so may have more of the migratory or threatened fish species present. Trap and transfer has been recognised by the fish experts as the best mitigation method for moving migratory fish above and below the dam. They have also identified that a management plan is needed for each species. This initiative is supported.

We found additional wetland habitats on Smedley Exchange Block that were not included in the applicant's and submitters' reports and submissions. The wetlands on Smedley Exchange Block and the oxbow wetland on Ruahine Forest Park revocation land were all considered significant in terms of the second National Priority for Protecting Rare and Threatened Biodiversity on Private Land (MfE & DOC 2007). The oxbow was also considered significant for its distinctiveness, whereas the wetlands on Smedley Exchange Block were not considered distinctive.

The two land parcels were deemed similar for providing suitable habitat for wildlife species known to be present in the area, except for fernbird, two birds being recorded from the

oxbow wetland. Should the Ruataniwha Water Storage Scheme proceed and the fernbirds be displaced, the secondary successional scrub immediately above Dutch Creek is considered suitable habitat for them. Fernbirds were also recorded at the nearby PanPac wetland which suggests that fernbirds are present within the surrounding area where suitable habitat is available.

The loss of kowhai as a food source for birds is not considered a potential problem, because there is a large amount of kowhai in the district that will not be inundated should the Ruataniwha Water Storage Scheme go ahead.

Smedley Exchange Block had promising habitat for skinks and geckos.

There were similar levels of bat activity recorded at the two sites during times of recording. There was no evidence of maternity roosts in either parcel of the Ruahine Forest Park revocation land. Both Dutch Creek and Smedley Exchange Block appeared to provide suitable roost trees, including emergent podocarps in the case of Smedley Exchange Block, and either site might well have roosts at times outside of the survey period.

Other than one red mistletoe found in the Dutch Creek parcel no threatened plant species were recorded from Ruahine forest Park revocation land or Smedley Exchange Block. Red mistletoe are widespread in the district, as well as in Ruahine Forest Park, and it is feasible to translocate mistletoe through careful placement of seed on host trees, therefore the presence of this one red mistletoe is not considered significant.

Therefore from an ecological and biological point of view we believe that the proposed exchange offers an enhancement to conservation values. Given that Smedley Exchange Block is underpinned by a different geology from that in Ruahine Forest Park, and thereby supports different ecosystems not currently present in the Park, we believe it complements the current values of, and would be a worthy addition to, Ruahine Forest Park.

We believe that this enhancement would be further improved by redesigning the boundaries of Smedley Exchange Block to include some areas of pasture and Donovan Gully. A more coherent design would reduce the length of the boundary and associated edge effects and fencing costs, and consolidate some of the wetland systems that would be split under the current design. Nonetheless, there is still an enhancement of conservation values under the current design.

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Appendix 1

Task Assignment – Consolidating conservation values of Ruahine land exchange

To: Carol West
From: Reg Kemper (Hearing Panel Convenor)
CC: David Bishop, Guy Kerrison, Graeme La Cock
Date: 27 March 2015

Context

HBRIC (the Hawke's Bay Regional Investment Company Limited) is an applicant for a Land Exchange involving part of Ruahine Conservation Park. It is not possible to exchange specially protected public conservation land for other land. To achieve that outcome the specially protected status must be revoked.

The Minister formed an intent to revoke the special protection over the land on the basis that the land offered by way of exchange appeared to enhance the conservation values of land managed by the Department and promote the purposes of the Conservation Act.

That notice of intent to revoke has been publicly notified and a hearing has been held. As a result of this revocation hearing the Convenor has asked that a more detailed assessment of the sites involved be carried out by DOC staff.

Purpose

Undertake a more comprehensive gathering and evaluation of all relevant conservation values including biological data and other technical information applicable to these two sites (revocation and the exchange) and provide the Convenor with a report detailing the conservation values of each and undertaking a comparative analysis of the 2 sets of values to assist the decision maker in exercising his statutory powers under s 16A (2) and s 18 (7) of the Conservation Act.

The two sites being an exchange of the parcel of land known as the Smedley Exchange Block (SEB) for the parcel known as the Ruahine Conservation Park revocation land (RL).

Quality

Complete a report to the Convenor which provides a considered assessment of biological values of both sites including, but not limited to:

Ecosystems and Habitat values

Freshwater and hydrological values (including the Oxbow)

Flora and Fauna values

Status of endangered and threatened species and ecosystems.

An assessment of the sites' contributions to conservation over the longer term.

An assessment placing the RL and SEB in context with their surroundings.
The assessment must include an analysis (including a ranking on threatened species/habitat basis) of all the biological and natural resource information provided by the applicant and submitters to the Land Exchange and the Revocation Land [and should include any of the relevant technical information submitted for the RMA processes- e.g. the Terrestrial Ecological Report].
This assessment must include a comparative conservation value analysis of each of the sites; so that the decision maker can form a view as to whether SEB enhances the conservation values of land managed by the Department and promotes the purposes of the Conservation Act, and if so whether the conservation park status of the RL should be revoked.
The assessment should state what DOC's technical/science view is on this information.
Undertake a separate Departmental assessment of both sites, according to the bullet points in the item above. This assessment is to be developed having consideration for the application's proximity to Ruahine Conservation Park, and is to be based on field work by Departmental staff/contractors.

Quantity
A report to the Convenor in line with the quality requirements by 15 May 2015.

Actions
David Bishop is to confirm with HBRIC the financial deadline required by the company and to inform DOC internal of this, prior to any other action being taken;
Carol West to arrange for a separate WBS to be established to record costs against;
Carol West and Graeme La Cock (with urgency) to visit both sites prior to determining a response to this task assignment. Following the site visit, discussion with Convenor & PRSG managers (Guy Kerrison & Marie Long) should occur should the Task Assignment require changing;
Carol West to develop a cost estimate and timeline for the S&C assessments and report writing and submit those to David Bishop as soon as can practically be undertaken and before Good Friday (3 April 2015).

Critical Issues
Timing deadline, need to be completed by 15 May 2015 or earlier.
There is a BOI draft decision due at the end of April 2015, which is then open for comment for 10 working days. A final BOI decision will be issued as soon as possible after comments relating to the draft report have been considered;
The people engaged on the task assignment must have the appropriate knowledge and expertise and be recognised as technical experts in their field.
The DG, as decision maker must be able to make informed decisions on the revocation & exchange based on all the relevant information before him, including this report.

Appendix 2

Ecological issues raised by submitters Forest & Bird and Te Taiao Environment Forum

These are direct quotes from the submissions, except for text in italics which is paraphrased from the submissions.

Freshwater fish.

Forest & Bird pt 31: It is not clear why the Department has not assessed the freshwater ecological values of the two sites. Evidence before the Board of Enquiry indicates that threatened fish species have habitat within the conservation Land proposed for exchange.

Te Taiao Environment Forum*: Indigenous fish species were included in the list of threatened species, but they didn't elaborate on the issue of fish.*

Threatened land environments

Forest & Bird pt 34. The four National Priorities for Protecting Rare and Threatened Biodiversity on Private Land (MfE and DOC, 2007) are widely used as national assessment criteria for ecological values. The first National Priority is protection of Threatened Land Environments of New Zealand. Acutely threatened land environments are those land environments of which nationally less than 10% remains in indigenous cover. Chronically threatened land environments are those where nationally less than 20% remains in indigenous cover. An assessment of the land exchange in terms of the Threatened Land Environments and National Priorities does not support the exchange:

a. 99.1% of the 22 ha conservation Land comprises acutely threatened (16.6%) and chronically threatened (82.5%) land environments.
b. In contrast, of the remaining indigenous vegetation on the Smedley land, 29.95ha falls within the chronically threatened land environments, and none is within the acutely threatened land environments category. Most of the Smedley land that is in indigenous vegetation (about 161 ha) is on "less reduced and better protected" land environments. Protection of those land environments is not a National Priority.

The Conservation Land includes a small area of braided river, which triggers the third National Priority for Protection (Naturally Rare Ecosystems).

Te Taiao Environment Forum: The Doc exchange block comprises of Acutely Threatened (16.6%) and Chronically Threatened (82.5%) land environments. The 22ha within the Doc exchange block forms a continuous block of threatened land environments which is a national priority for the protection of indigenous biodiversity. The Smedley exchange block has no Acutely Threatened land environments and 29.95ha of Chronically Threatened land environments. The 29.95ha of Chronically Threatened Environment is patchy and dispersed through 234.25 ha of less reduced/better protected
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environment. Furthermore not all of the 29.95ha of the Chronically Threatened land environments would be protected (i.e. exchanged) within the 146ha DOC has proposed for the land swap. The exchange of Acutely Threatened for Chronically Threatened land environments is a fundamental problem with the proposed exchange, as it results in net loss of important lowland indigenous biodiversity that is exchanged for a larger area of less important hill country indigenous biodiversity.

The conservation gain of small-leaved shrubland is not valid. The small–leaved shrubland recognized within the Smedley block refers broadly to 'kanuka/manuka/coprosma species and varying amounts of pasture'. Small-leaved shrubland based on major vegetation types (e.g. kanuka/manuka/coprosma species) also exist within the Doc exchange land and are referred to as 'Broadleaf-small leaved-tussock scrubland', 'Broadleaf-small leaved -monocot scrub/treeland', 'kanuka/manuka treeland' types within TER and DOC Submission documents. Therefore there is a greater diversity of small-leaved shrubland types on the conservation land, and the suggested additional gain of a small-leaved shrubland type (indigenous shrublands) will not occur as the same shrubland type is found within the Doc exchange area. Furthermore the diversity of small-leaved shrubs described within the Doc exchange site indicates that this vegetation type is in significantly better condition than that within the Smedley exchange block. Therefore the exchange would result in a significant loss of an important shrubland habitat type if the revocation and exchange were to occur.

Wetlands

Forest & Bird pt 35. The second national priority is wetlands. The presence of an oxbow wetland on the true right of Dutch Creek triggers Prioirty 2 for the conservation land.The oxbow wetland type does not appear to be represented elsewhere in Ruahine Forest Park. The oxbow wetland contains diverse indigenous species, is hydrologically intact and is well-connected to surrounding indigenous vegetation, habitats, and the riparian margins of Dutch Creek. In contrast, the wetland within the Smedley block is has been classed as a seepage (A treeland with podocarps (e.g. kahikatea and rimu), lacebark, manuka, cabbage tree linked to a seep zone with remnant sedges, fern species, blackberry, pasture grasses and herbs) and is highly degraded.

Te Taiao Environment Forum: Wetlands on the conservation land and in the Smedley Block are not equivalent. The wetland areas covered in the land swap differ significantly in nutrient status and hydrology and vegetation types. Seepages on the Smedley block have a high level of degradation and eutrophic conditions as indicated by cattle pugging and exotic grasses evident in photo provided in Kessels et al. SEB survey, Figure 7, pg 10. The oxbow wetland on conservation land contains indigenous wetland plants, is hydrologically intact and is well-connected to surrounding indigenous vegetation, habitats, and the riparian margins of Dutch Creek (photo provided, Kessels et al. TER, pg 35). The oxbow wetland within the Doc exchange area has a greater diversity of habitats and indigenous plants. The wetland within the Smedley block is has been classed as a seepage (A treeland with podocarps (e.g. kahikatea and rimu), lacebark, manuka, cabbage tree linked to a seep zone with remnant sedges, fern species, blackberry, pasture grasses and herbs). The wetland within the Doc exchange has been classed as an oxbow wetland (including diverse indigenous vegetation; slender spike sedge, Carex and Juncus species, kiokio and swamp kiokio, toetoe, astelia, mountain flax, Hydrocotyle, Sphagnum moss, Coprosma species, cabbage tree, manuka and koromiko, wheki-ponga kahikatea, wineberry, broadleaf, kowhai, lancewood, lacebark, black matipo, snowberry, mingimingi, matai and horopito)

The area of wetland within the Doc exchange is larger than the 0.29 ha stated due to the fact that the desktop mapping technique used by Kessels Ecology does not identify small wetlands. Refer to comments of Dr Kelvin Lloyd (EPA, Statement of Evidence, point 97) below:

'The reservoir site includes swamp wetlands, seepages on cliffs and riverbanks, and what Mr Kessels defines as 'seepzones', which are probably also seepages, in toeslope habitats. The TER mapping defined 5.11 ha of wetland vegetation on terraces and in 'seepzones', but the mapping units do not cover seepages on cliffs, which are a prominent feature of the part of the project area that I visited, for example in the lower part of Dutch Creek. I appreciate that these seepages would be difficult to

map, due to their presence on steep topography, but they are a distinctive indigenous wetland type in the proposed reservoir site and would qualify under National Priority 2. I note that the TER maps only a single swamp wetland. I observed indigenous swamp vegetation on a terrace on conservation land on the north bank of the Makaroro River [Doc exchange land] within the proposed reservoir, but this vegetation has not been mapped, possibly because it is difficult to distinguish from surrounding vegetation in aerial imagery. None-the-less, it is apparent that there will be more than 5.11 ha of indigenous wetlands affected by the proposed reservoir.'

Threatened species

Forest & Bird. The fourth National Priority is protection of habitats of threatened and declining species. The Conservation Land supports North Island long tail bat (including maternity roosts), North Island fernbird, NZ falcon and red mistletoe (not all of these are identified in the Technical Advisor's File Note). The Smedley land is not known to support any threatened or at risk species. The potential for the Smedley land to support threatened species in future is highly uncertain.

The importance of the Conservation Land as long tail bat roosting and foraging habitat is a highly relevant aspect of its value that ought to be considered. The Smedley Block is not known to be bat habitat. The Conservation Land has been undervalued due to its value as bat habitat having been disregarded.

Te Taiao Environment Forum: The TER survey indicates that threatened species (e.g. NZ falcon, long tailed bat, North Island fernbird, red mistletoe, indigenous fish species [refer to Young et al. for fishes]) have habitats within the conservation land proposed for exchange. In contrast, There are no recorded red mistletoe plants within the Smedley Exchange block and no recent, specific recordings of NZ falcon or North Island fernbird, even though calls for fernbirds were elicited during Smedley Block bird surveys, and all bird sightings were recorded (SEB survey).

The exchange of a maternal long-tailed bat roost close to the river on the conservation land, for uncertain bat mitigation proposals on the Smedley Block, is not equivalent as it exchanges certain loss of an important habitat for indigenous fauna for very uncertain gain.

Exclusion of recordings - Fernbirds (more than 1 bird) and pair of NZ falcons and frequent long-tailed bat activity were recorded within the Dutch Creek tributary (refer to TER) and will be frequenting the Doc Exchange land. Therefore Doc land exchange should be recognized as important habitat of these Acutely and Chronically Threatened species.

Smedley Exchange Land not identified as an RAP

Forest & Bird: ..if the Smedley land were considered to be a desirable addition to the conservation estate, it would have been identified as a Recommended Area for Protection. PNAP surveys have identified RAPs in the area (Smedley Bluffs, Mangaoho 1 &2) but did not identify theSmedley land as a RAP.

Department of Conservation
Te Papa Atawhai

Appendix 3

Comparison of aquatic freshwater conservation values between existing conservation land and private land proposed for exchange

(Report to assist with the assessment of proposed land exchange between Ruahine Forest Park revocation land and proposed Smedley Exchange Block in relation to Ruataniwha Water Storage Scheme)

P. Gerbeaux

Technical Advisor

May 2015

1. Background

The Hawke's Bay Regional Investment Company Limited, a regional council owned entity,requires approximately 22 hectares of Ruahine Forest Park for the proposed Ruataniwha Water Storage Scheme [RWSS] (located in Central Hawke's Bay near Wakarara), and proposes to exchange this land (Land Revocation Site – LRS) for 146.87 hectares of land containing 122.2 ha of indigenous vegetation, known as the Smedley Exchange Block (SEB).

Figure 1 shows the area to be inundated and Figure 2 shows the blocks of land under scrutiny for the exchange.

I was provided with five documents: two reports describing ecological values of 1) DOC managed land, and 2) Smedley Exchange Block (Kessels Ecology 2013a and 2013b); an internal report "Assyst R56997: Proposed land swap at Ruataniwha Dam: Comments on proposal (La Cock, November 2014); the submission to the Minister of Conservation "Revocation of specially protected status to enable a land exchange decision, and associated actions" (Bishop, December 2014). I also had access to a Cawthron report on the aquatic ecology assessment of effects of the Ruataniwha Water Storage Scheme (Younget al. 2013); this report is not specifically targeted at the land managed by DOC or the SEB.

A site visit was organised over 13-15 April 2015. Allan Lee, Graeme La Cock, Jessica Scrimgeour and Geoff Rogers (DOC) took part in the visit. It should be noted here that my main brief was related to the value of wetlands present on both blocks. I will however comment on stream values where appropriate.

Figure 1: Area to be inundated by the proposed Ruataniwha Water Storage Scheme

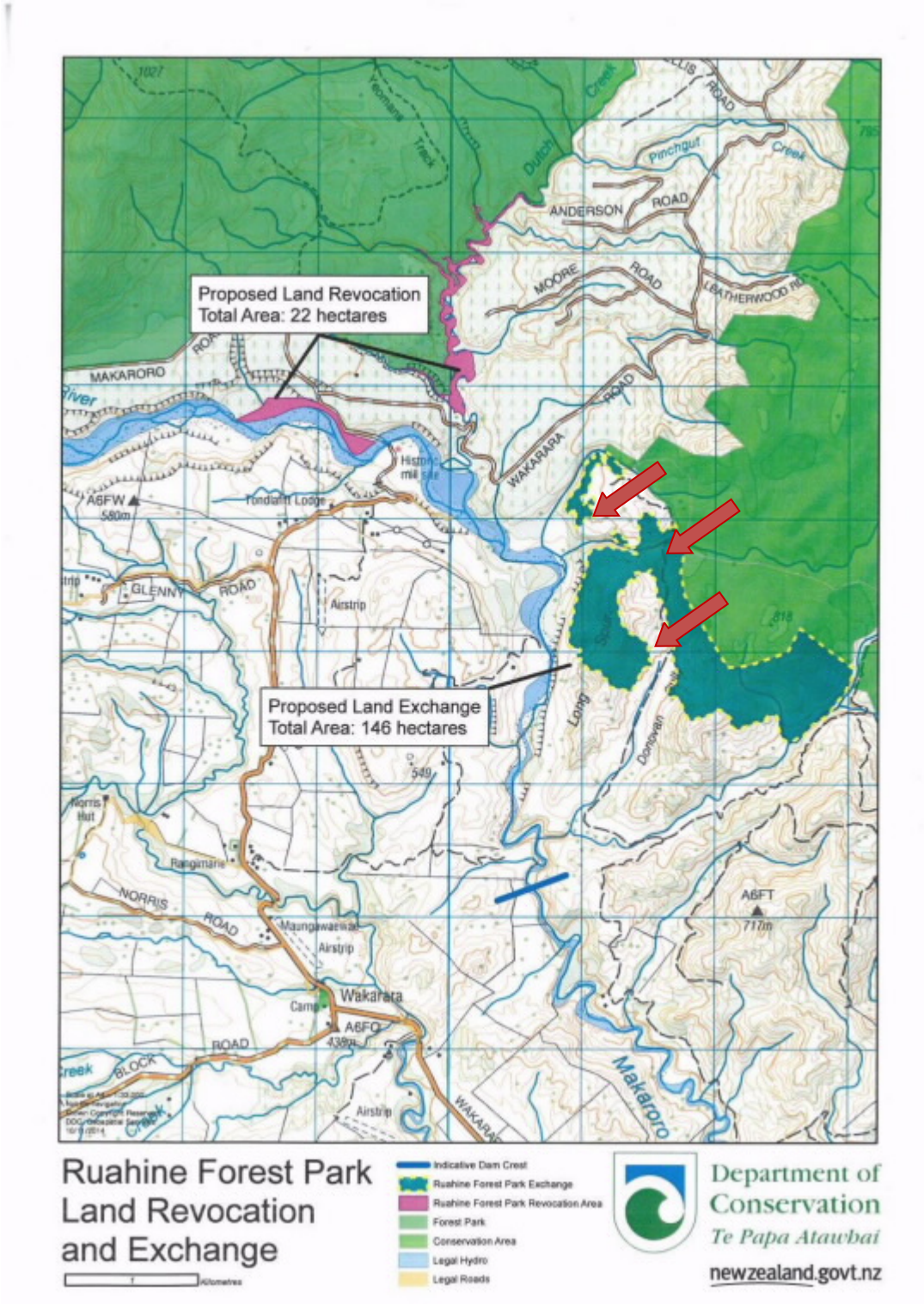

Figure 2: Areas proposed for revocation and exchange (red arrows indicate where seepage wetlands were observed – referred to as top, middle and bottom arrows in the text below. The bottom arrow points to wetlands in Donovan Gully that occur outside the Smedley Exchange Block)

2. **Overview of Freshwater and wetland sites at the two sites**

Three per cent of wetland (0.29ha – indigenous dominated floodplain swamp vegetation) and braided riverbed habitat (0.42ha) are reported to be present in the total area of land managed by the Department- Dutch Creek and Makaroro River - that would be affected by the proposed Ruataniwha water storage scheme (Kessels Ecology 2013a; Bishop 2014).

Figure 3: Oxbow wetland attached to Dutch Creek

Figure 4: Aerial views of oxbow wetland

Four first order streams run through the SEB, although none as large as Dutch Creek – a second order stream (or Makaroro River) – no braided river habitat is present in the block. The lower reaches of these streams would become inundated by the filling of the reservoir (Kessels Ecology 2013b). The block however contains a 0.49ha wetland (top arrow on figure 2) of which a portion contains indigenous dominated vegetation (podocarp-broadleaf-small-leaved shrubland/seep zone). Most of the exotic vegetation (blackberry, pasture grasses and herbs) are around the margins of the areas.

Figure 5: Unnamed creek in the SEB (near middle arrow on figure 2)

Figure 6: Seepage wetland in the SEB

3. Overall Assessment of wetlands in Hawke's Bay using FENZ/WONI

Any wetland assessment of significance needs to be done in the context of the regional and the relevant ecological scale.

It is worth noting that Hawkes Bay (as a freshwater biogeographic unit(BU)– see Ausseil et al. 2008) has lost most its original wetland cover (see Table 1 below).

Table 1: Proportion of wetlands (total) and wetland classes remaining in the Hawkes Bay BU (historical extent (ha) in brackets)

	Total	Pakihi	Bog	Swamp	Marsh	Fen	Seepage	Inland saline
Hawkes Bay	3% (33902)			2% (27457)	4% (3714)	15% (2715)	100% (15)	

A comparison with the other biogeographic units around New Zealand shows us (Figure 7 and Table 2) that the extent of most types is severely reduced in Hawkes Bay. Many wetlands in New Zealand, including in Hawkes Bay, have often disappeared through an insidious nibbling away process, giving way cumulatively to large losses of extent.

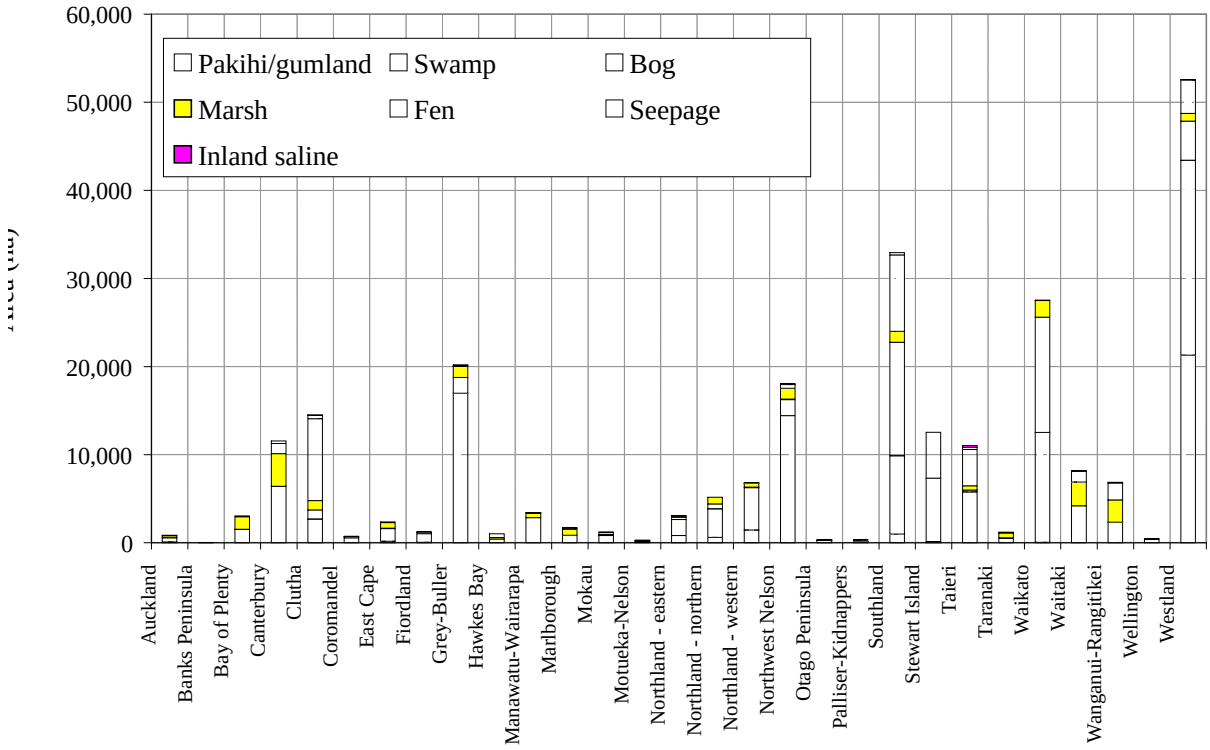

Figure 7: Distribution of wetland classes in each Freshwater Biogeographic Unit

(N.B. the seepages are poorly mapped in FENZ due to their small size and pasture-looking characteristics; the numbers associated to the extent of seepages cannot therefore be relied upon for that class of wetland)

Table 2: Proportion of wetland classes remaining in all biogeographic units (the historical extent is in brackets)

	Total	Pakihi/ gumland	bog	swamp	marsh	fen	seepage	Inland saline
Auckland	3% (30381)	2% (4393)	4% (1141)	2% (20815)	13% (1541)	0.2% (2478)	100% (12)	
Banks Peninsula	10% (356)			3% (297)	51% (47)		12% (12)	
Bay of Plenty	10% (29136)	0% (513)	3% (888)	7% (21569)	47% (2981)	1% (3184)		
Canterbury	7% (164869)			4% (150249)	31% (12068)	49% (2366)	100% (186)	
Clutha	25% (58803)		47% (2191)	12% (23202)	16% (6635)	38% (24612)	34% (1136)	7% (1027)
Coromandel	3% (25984)		0% (108)	2% (24507)	52% (236)	3% (1128)	42% (5)	
East Cape	2% (97033)	41% (388)	22% (233)	2% (62879)	2% (32036)	0.4% (1443)	97% (54)	
Fiordland	4% (28704)	0% (24587)	0% (40)	100% (653)		5% (3405)	100% (19)	
Grey–Buller	20% (102379)	21% (82521)	1% (437)	18% (10076)	13% (9321)	100% (0)	100% (24)	
Hawkes Bay	3% (33902)			2% (27457)	4% (3714)	15% (2715)	100% (15)	
Manawatu–Wairarapa	1% (254257)		0.3% (1266)	1% (230068)	2% (21631)	1% (1290)	100% (2)	
Marlborough	12% (14756)			8% (11028)	38% (1755)	5% (1863)	91% (109)	
Mokau	5% (23638)		13% (715)	5% (17411)	5% (5126)	2% (371)	100% (15)	
Motueka-Nelson	5% (5802)			2% (5379)	26% (382)		52% (41)	
Northland – eastern	4% (79457)	3% (25812)	3% (6432)	5% (34596)	2% (10296)	1% (2320)		
Northland - northern	18% (27973)	5% (12529)	8% (7705)	47% (6809)	100% (451)	1% (479)		
Northland – western	4% (179120)	5% (31175)	2% (3080)	4% (121376)	2% (18341)	0.3% (5141)	100% (7)	
Northwest Nelson	27% (66461)	35% (41349)	4% (1960)	15% (11702)	11% (11336)	100% (54)	100% (61)	
Otago Peninsula	35% (930)			31% (925)			74% (5)	
Palliser-Kidnappers	0.4% (74009)			0.3% (59544)	1% (14156)	0% (306)	100% (4)	
Southland	8% (415785)	17% (5927)	36% (36209)	4% (250924)	3% (36058)	10% (86264)	67% (404)	
Stewart Island	100% (12552)		100% (7173)	100% (140)		100% (5239)		
Taieri	30% (36828)		21% (1020)	24% (23818)	10% (4701)	67% (6181)	44% (548)	39% (559)
Taranaki	5% (23117)		100% (82)	2% (20166)	29% (1868)	8% (997)	100% (4)	
Waikato	9% (312011)	3% (1321)	19% (69799)	7% (179957)	5% (37811)	0.2% (23123)		
Waitaki	35%			27%	50%	51%	22%	

	(23416)			(15275)	(5441)	(2406)	(293)
Wanganui-Rangitikei	5% (127233)		0% (442)	2% (94548)	9% (27930)	45% (4283)	100% (30)
Wellington	8% (5834)			16% (2437)	86% (58)	0.3% (3340)	
Westland	24% (215164)	20% (108767)	37% (12162)	31% (72398)	6% (14784)	54% (7051)	100% (2)

4. Assessment of significance in the context of the above FENZ/WONI information, the recommended criteria for assessing significance under section 6c of the Resource management Act, and various other policy recommendations.

Due to the low extent of wetland remaining in the Hawkes Bay Biogeographic Unit, all wetlandscan and should be considered significant under section 6c of the Resource Management Act. I have attached in Appendix A the list of criteria for assessing wetland significance that was agreed on for the West Coast region through RMA caselaw (see Maseyk and Gerbeaux 2015). The table highlights that any type with less than 30% of the original extent remaining will indeed trigger the 'rarity' criterion (20% is more commonly adopted as a threshold for the rest of New Zealand).

The oxbow is immediately adjacent to Dutch Creek and includes two wetlands of riverine origin: one is totally filled in with vegetation, while the other one still retains open water areas – see figures 3 and 4; they are separated in the middle of the oxbow by a 2-3m high mound. Besides the 'rarity' aspect that would apply to any wetland in Hawkes Bay as mentioned above, those wetlands (on the revocation block) would also trigger significance for 'representativeness' (dominated by a typical indigenous dominated floodplain swamp vegetation - native sedges), 'ecological context' (well connected to surrounding vegetation and habitats including the creek and its riparian margins), 'rarity' related to species (two fernbirds were recorded from the area on the day of the visit) and possibly 'distinctiveness' – as a likely oxbow wetland type (this was confirmed from the site inspection by the presence of a mound in the centre of the oxbow – the aerial photos on Figure 4 tend to confirm this as well).

The realignment of the creek may be the result of historic logging operations around the area or possibly a consequence of severe earthquakes).

Of the four National Priorities for Protecting Rare and Threatened Biodiversity on Private Land (MfE and DOC, 2007) – which are widely used as national assessment criteria for ecological values, the second national priority is wetlands. The presence of wetlands on the SEB would therefore trigger Priority 2.

Only one wetland appears to have to be subjected to an assessment in the reports I have read. That wetland within the SEBis has been classed as a seepage (a treeland with podocarps (e.g. kahikatea and rimu), lacebark, manuka, cabbage tree linked to a seep zone with remnant sedges, fern species, blackberry, pasture grasses and herbs) and would trigger in my view the 'representativeness' (dominance of indigenous vegetation) and the 'rarity' criteria (acknowledging that FENZ does not identify seepages remaining as less than 20% than the former area – due to the mapping difficulties reported on above).

Figure 8: The ridge on the top right of this photo may have been connected to the mound in the middle of the oxbow and subsequently naturally or artificially opened, thus redirecting the creek

I have not walked the entire block, but I note that, at least in the area visited, other wetlands (seepages) are present within or nearby the land offered for exchange (see middle and bottom arrows on figure 2) – especially on toeslopes and in gullys. While those seepages may not always be dominated by indigenous vegetation, most are effectively headwaters/springs that in my view are significant (especially under 'ecological context' and –where dominated by indigenous vegetation- under 'representativeness').

Those seepages seem to have been overlooked in the Kessels Ecology (2013b) report (they are not recorded on the maps in figures 1 and 14). Those areas should in my view be identified, added to maps, and included as suitable under the proposed land exchange. Approximately half of the wetlands in Donovan gully occur outside the proposed exchange land.

A number of those are found in and along both sides of the upper parts of Donovan Gully (in the middle part of the land proposed for exchange – within a large white polygon on Figure 15 of Kessels Ecology (2013b); the area does include broadleaf-small leaved shrubland of high significant value).

I am unclear why the pastoral land (including the upper part of Donovan Gully) within the largest southern area proposed for exchange is currently excluded from the land on offer. If no grazing is envisaged for that area it would make sense from an ecological perspective to 'fill that gap' and include it in the proposed exchange.

I note that those headwaters located in Donovan Gully will run directly into the proposed reservoir and protecting those wetlands from stock/sheep grazing (via covenanting and fencing) would be desirable from a water quality management perspective and this could be further explored.

A few photos of a seepage wetland (middle arrow on Figure 2 – this area may be included in the proposed area for exchange but does not seem to be identified as seepage) and of Donovan Gully are included on Figure 9 and 10 respectively.

Figure 9: Unnamed gully (middle arrow on Figure 2) dominated by native sedges

5. Comparison of values between the two blocks and conclusions

Stream and braided habitats

This was not part of my brief and I will therefore only comment briefly. I am not aware of any braided habitat in the SEB (0.42ha of braided riverbed are present in the Ruahine Forest Park revocation land). Streams present within the SEB are first order streams of lesser value than those currently running through the DOC land offered for exchange. Due to the presence of grazing, the riparian margins of those streams are also of lesser integrity and significance, contributing in some places to degradation of habitat quality (sedimentation was observed along a number of reaches). I understand that freshwater species values are being assessed separately, but based on my experience and due to the smaller habitat size; they are likely to be also of lesser importance.

Wetlands

0.29ha of wetland has been recorded from the Land Revocation Sites - (Dutch Creek and Makaroro River). The wetland area present in the LRS is clearly dominated by indigenous species and is of a riverine type. The area triggers all primary criteria relevant to significance assessment methodology (representativeness, rarity, distinctiveness and ecological context). A few *Carex* sedgelands belonging to the Dutch Creek floodplain were observed on the way up to the wetland. Although restricted in extent they would possbly qualify as wetlands.

0.49ha of wetland (Figure 6) has been assessed and proposed for inclusion in the SEB. The size of that seepage is larger than the size of the wetland on the LRS. It is of a different type (palustrine – instead of riverine). It nevertheless retains a high degree of indigenous character, even if of lesser intactness. It triggers two of the significance criteria used in significance assessment methodology (representativeness and ecological context).

However, other seepages and similar headwater wetlands of significance have been observed during the site visit. They would all trigger in my view the 'ecological context' criterion and would certainly be significant under the second National Priority for Protecting Rare and Threatened Biodiversity on Private Land (MfE and DOC, 2007). Some, or some sections of them, would also trigger the 'representativeness' criterion due to the dominance of native species, some (e.g. *Schoenus fluitans*, *Isolepis crassiuscula*) specific to the Ruahine District adding possible 'distinctiveness'. A number of wetland species were common to both the LRS and the SEB (e.g. *Carex secta*, *Carex virgata*, *Eleocharis acuta* and a number of *Coprosma* species). A number of bryophytes have also been recorded from both areas, adding to their biodiversity values.

Finally, although outside the SEB, we also visited another wetland (see photos in Appendix B) within the forestry plantation owned by Pan Pac Ltd. Independently from the land exchange. This wetland was relatively large (a few hectares) and included several palustrine types of wetland including seepage (apparent spring areas), and fens. The vegetation was dominated by indigenous plants (*Baumea/Machaerina* spp. sedgeland for the fen part; *Carex* sedgeland for the seepage areas). It is recommended that the owners are approached to highlight the significance of that wetland, with a view to discuss future options for the area, including covenanting. This wetland was not captured in the FENZ national layer.

6. References

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Figure 10 : Gully and toeslope seepage wetlands in Donovan Gully

Appendix A: Criteria for assessing wetland significance as upheld by the Environment Court for the West Coast Land and Water Plan

	1. Representative Wetlands	2. Rarity	3. Distinctiveness	4. Ecological Context
West Coast Land and Water Plan (Schedule 3: Ecological Criteria for Significant Wetlands A wetland is ecologically significant if it meets one or more of the following criteria:	A wetland that contains indigenous wetland vegetation types or indigenous fauna assemblages that were typical for, and has the attributes of, the relevant class of wetland as it would have existed circa 1840.	(A) Nationally threatened species are present; or (B) Nationally at risk species or uncommon communities or habitats are present and either: The population at this site provides an important contribution to the national population and its distribution; There are a number of at risk species present; or The wetland provides an important contribution to the national distribution and extent of uncommon communities or habitats; or (C) Regionally uncommon species are present; or (D) The wetland is a member of a wetland class that is now less than 30% of its original extent as assessed at the ecological district and the freshwater bio-geographic unit scales; or (e) Excluding pakihi, it contains lake margins, cushion bogs, ephemeral wetlands, damp sand plains, dune slacks, string mires, tarns, seepages and flushes or snow banks which are wetland classes or forms identified as historically rare by Williams et al (2007).	The wetland has special ecological features of importance at the international, national, freshwater bio-geographic unit or ecological district scale including: (A) Intact ecological sequences such as estuarine wetland systems adjoining tall forest; or (B) An unusual characteristic (for example an unusual combination of species, wetland classes, wetland structural forms, or wetland landforms); or (C) It contains species dependent on the presence of that wetland and at their distribution limit or beyond known limits.	The wetland has one or more of the following functions or attributes: (A) It plays an important role in protecting adjacent ecological values, including adjacent and downstream ecological and hydrological processes, indigenous vegetation, habitats or species populations; or (B) Is an important habitat for critical life history stages of indigenous fauna including breeding/spawning, roosting, nesting, resting, feeding, moulting, refugia, or migration staging points (as used seasonally, temporarily or permanently); or (C) It makes an important contribution to ecological networks (such as connectivity and corridors for movement of indigenous fauna); or (D) It makes an important contribution to the ecological functions and processes within the wetland.

(See Maseyk and Gerbeaux 2015)

APPENDIX B; Wetland within the Pan Pac Forestry Plantation included in the visit

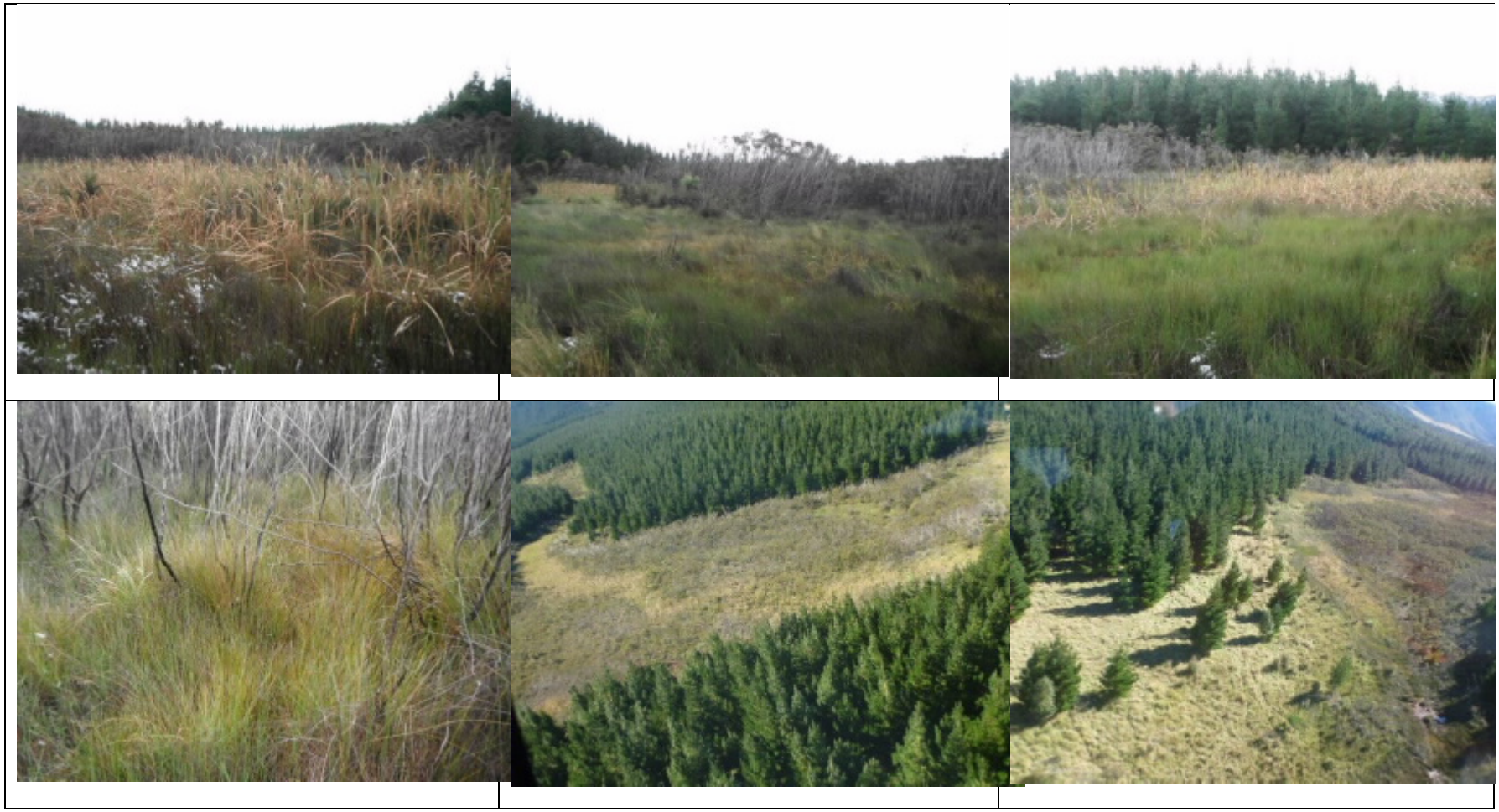

Figure 11: Raupo reedland seepage and *Baumea/Machaerina* sedgeland/Manuka shrubland fen

Appendix 4

Assessment of fauna values in a proposed land exchange in Hawkes Bay

Jessica Scrimgeour
Technical Advisor Ecology
Department of Conservation
Taupo

Introduction

The Hawke's Bay Regional Investment Company has applied to exchange 146 ha of private land (Smedleys), for 22 ha of the Ruahine Forest Park, which it needs for the proposed Ruataniwha Water Storage Scheme. Ecological assessments of both sites were made by Kessels & Associates in 2013.

The purpose of this document is to describe the site visit undertaken by Department of Conservation (DOC) staff including myself in April 2015, and specifically report on the potential bird, bat and lizard values of a proposed land exchange in Hawkes Bay. Please note that this report does not assess the impact of the proposed Ruataniwha dam on the wider landscape.

Methods

Four DOC staff and a DOC honorary research associate visited the sites on the 14th and 15th of April 2015. The first day was spent looking at the 22 hectares of conservation park which involves a fringe area (14 ha) of the Ruahine Forest Park where it lies alongside Dutch Creek and a separate block (8 ha) located between the Makaroro River and pine plantations.

The following day was spent at the proposed Smedley Exchange Block, and although we were not able to walk through the entire block, we got an overview of the site from high points where possible.

From a terrestrial fauna perspective, this was not considered a site assessment. A similar effort to that undertaken by Kessels & Associates would be required to have confidence in what values both sites provided for different species. This has in part been obtained by the reports provided by Kessels Ecology, although the level of effort for the Smedley Block was less. Therefore during this visit a 'snapshot' was obtained of what fauna were identified on site and the habitat suitability of each site for threatened, rare or other species was noted. Considerations of what values the sites presented included thinking about size of the area, connectivity, available habitat, future potential and impact of loss of that habitat on resident fauna.

Observations

Birds

Both sites had similar composition of native birds heard, which included predominantly common forest birds. They were kereru (*Hemiphaga novaeseelandiae*), bellbirds (*Anthornis melanura*), grey warbler (*Gerygone igata*), silvereye (*Zosterops lateralis*), tomtits (*Petroica macrocephala*) and harriers (*Circus approximans*). Fernbirds (*Bowdleria punctata vealeae)* were recorded in the small wetland in Dutch Creek, but were not heard at Smedleys.

Based on Kessels and Associates Ltd reports, birds that are known to be present at both sites but not recorded in this visit are tui (*Prosthemadera novaeseelandiae*), kingfisher (*Halcyon sancta*) and whitehead (*Mohoua albicilla*).

Of note is the pair of NZ bush falcon (*Falco novaeseelandiae*; Threatened - Nationally Vulnerable*)* recorded nearby along the Makaroro River. These are birds that have large home ranges and would find suitable habitat at both sites.

NZ pipit (*Anthus novaeseelandiae;* At Risk - Declining) was also noted in the braided river of the Makaroro River, but not recorded in this visit. They may be present along the river at the 8ha Conservation Park Block (similar habitat to where they were noted), and as their habitat preferences extend to open pasture/woodland they may also be present at Smedleys.

Bats

Long-tailed bats (*Chalinolobus tuberculatus*) were found throughout the landscape by Kessels and Associates. There were two recorders placed along Dutch Creek in November 2011, that recorded 2.6 and 3.7 passes/night along Dutch Creek. When compared to a site further along the Makaroro River that recorded closer to 65 calls/night, it did suggest that for that recording period bats were probably not utilising Dutch Creek for roosting. However, the habitat appeared suitable for bat roosts (i.e. large mature beech trees) and bats may well use that habitat at other times.

Two recorders were placed on the margin of the Smedley Exchange Block, and recorded within the same timeframe as Dutch Creek 2.7 and 12.8 passes/night. Similarly to the Conservation Park, there were large mature beech and some podocarp trees available for roosting opportunities. Therefore both sites appeared suitable for long-tailed bat activity/foraging, but neither site had been shown to conclusively be used as roosting sites during the timeframe of monitoring. More work would be required to more clearly understand bat use of both blocks, although to me both blocks had the potential to support bat colonies.

Lizards

Of the 11 lizard species that have been recorded in Hawkes Bay, only northern grass (common) skink (*Oligosoma polychroma),* common gecko *(Woodworthia maculatus*), Wellington green gecko (*Naultinus elegans punctatus*) and forest gecko (*Mokopirirakau granulatus*) would be expected to be found in this area. Kessels Ecology undertook diurnal searches of the public conservation land, and found no lizards. This does not mean that they are not present, but it does indicate that they are not present in large numbers. Note that effective monitoring techniques for green gecko are still in development.

Similarly, no lizards were found in the Smedley Exchange Block, although the search effort was confined to a 2-day visit which did not include active searching for lizards. I personally noted potential habitat for both skinks and geckos (scree slopes, rock outcrops, cracks etc. – see Figure 1), although none were seen at midday (which is not unexpected considering the heat of the day) and no lizard droppings were noted on the rock outcrops.

Again, without a significant search effort devoted to both sites it is difficult to tell whether they are present, but Smedley Exchange Block provided more obvious potential for lizard habitat (in terms of those that inhabit scree slopes and/or rock outcrops).

Discussion

Habitat opportunities

In terms of opportunities for providing suitable habitat for fauna species, both the public conservation land blocks and the Smedley Exchange Block appeared similar in the composition of fauna species that were present, or had the potential to be present.

The only notable exception was fernbirds, although neither I nor Kessels spent a lot of time searching for them at Smedleys. From the small portion of the Smedley block that I saw, there wasn't obvious suitable habitat, although Kessels noted otherwise. The potential for fernbirds to be present in potential wetland margins that could be created around the new dam was noted. This however remains an unknown and very dependent on the nature of the margins created by the proposed dam. I do note however that we detected fernbirds in a nearby wetland in the PanPac forest relatively close to the oxbow wetland in Dutch Creek. This suggested to me that fernbirds may be present throughout the area where suitable habitat is available. This is supported by the fact that only small numbers of birds were recorded at each site (i.e. not enough to be self-sustaining at that site), which means they have to be part of a larger population within the landscape where juveniles can disperse between sites.

The quality of habitat varied, both within the public conservation land blocks and compared to Smedley Exchange Block. With the two public conservation land blocks, the 8ha block along the Makaroro River was relatively degraded, with tracks, habitat clearance and weeds noted. However, the 14ha of conservation land along Dutch Creek appeared intact (excepting the logging that had occurred) and in good condition with no weeds noted. This site looked like it would support a range of species in a productive system.

The Smedley Block varied in habitat quality. Much of the land was cleared for pasture. Large beech and some podocarp trees were commonly present in clusters, but where grazing has been allowed to occur the understorey was degraded or in some cases non-existent. This may reduce the food availability for some species like kereru, tui and bellbirds, although they were noted as present. It was in the areas where grazing had been excluded that the potential for the site could be seen, and regeneration resulted in a dense understorey providing ample food, nesting and roosting opportunities. Currently the Smedley Block is more degraded in parts than the public conservation land, and similar in other areas where grazing is excluded. Therefore the potential for increased habitat for threatened species once grazing is excluded should be acknowledged.

For lizards specifically there appeared to be some promising habitat opportunities worth further investigation.

Size, shape, connectivity and impact of loss

For most fauna species the available habitat at a site needs to be taken in context of the landscape. The size of habitat is important as it will allow for self-sustaining populations to be supported in one place. If a site is not large enough, dispersal of juveniles becomes important to help sustain small numbers, which can become problematic since dispersal can be at risk from barriers such as isolation, land use change, geographic features etc. Therefore a large self-sustaining population in one place is more resilient than a number of small populations that relies on dispersal. Similarly most species benefit from a habitat shape that is more circular and has reduced edge effects compared to a long narrow shape.

The 8 ha of public conservation land next to the Makaroro River is unlikely to support a self-sustaining population of most species, and relies on the connection with the forestry land behind it and pockets of vegetation within the farmland to provide stepping stones with other populations. Therefore the loss of this bit of land is unlikely to impact significantly on those species present which are adapted to the modified landscape.

The remaining 14 ha of conservation land along Dutch Creek was in better condition, and probably provides a more productive system which could support more birds than along the river. In isolation this bit of land might have been significant within the landscape, but it is connected to 94,000 ha of the Ruahine Forest Park, and therefore the loss of this 14 ha is unlikely to significantly impact any terrestrial fauna populations.

The Smedley Block has a network of vegetation clusters that would act as stepping stones for smaller birds and probably bats. It neighbours the Gwavas Conservation Area and its addition to that area will connect the two sites, increasing the area under protection and therefore the size of the fauna populations inhabiting the area. This increases the resilience of populations when faced with a modified landscape which may inhibit dispersal for some species.

As an aside, the shape of the Smedley Exhange Block introduces edge effects due to an increased boundary exposed to sun, wind and other elements. It is recommended that the shape be revised to include the central area around Donovan's Gully.

Summary

Currently there appears to be no significant difference in habitat opportunities for fauna between public conservation land and the Smedley Block. Both sites had generalist species present, except for fernbirds which were not found on the Smedley Block. It has been noted that the Smedley Block will be on the edge of the proposed dam, which may provide further habitat opportunities for fernbirds. Whether this will naturally happen remains an unknown.

The 14 ha of public conservation land along Dutch Creek is in better condition than the small portion of the Smedley Block that we explored, other than the fenced 4.4 ha of black beech forest, and in its current state has the potential to support more productive populations. It is however connected to a further 94 000 ha of the Ruahine Forest Park, and the loss of 14 ha is unlikely to impact native fauna significantly. The Smedley Block is in a degraded state at present, with vegetation (including large beech and podocarp trees) present in clusters, but it is much larger than Dutch Creek, and has habitat suitable for lizards that is not present in Dutch Creek. Exclusion of grazing is likely to allow for regeneration to occur which will be able to support more birds, bats and lizards. It also links in with the Gwavas Conservation Area, adding to the size and therefore the available habitat of that protected bit of forest.

Therefore the proposed exchange of the 146 ha Smedley Block for the 22 ha of Ruahine Forest Park would enhance the value of land managed by DOC. These benefits will be further enhanced should the current shape of the proposed exchange land be altered to minimize edge effects and once grazing is removed.

References

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