August 2015

SUMMARY REPORT

Manuherikia Catchment Feasibility Study

Executive Summary Only

Submitted to:
Manuherikia Catchment Water Strategy Group
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Report Number: 1378110270-2000-R-Rev0-224 Executive Summary

Distribution:

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REPORT

Golder Associates

This Executive Summary should be read in conjunction with the full summary report (Golder report titled, "Manuherikia Catchment Feasibility Study Summary Report" and dated August 2015) which provides context and details of the Manuherikia Catchment Feasibility Study.

The limitations outlined in Appendix A of the fully summary report are applicable to this Executive Summary.

Executive Summary

Background

The Manuherikia Catchment Water Strategy Group (MCWSG) commissioned a Feasibility Study, (summarised in this report), to assess the technical, environmental, economic and financial feasibility of five water development options which are aimed at developing and implementing cost effective, efficient and sustainable options for water users within the Manuherikia River catchment. Three options involve raising the impoundment of Falls Dam by 5.4 m, 15.2 m, or 27 m, through either building a new dam or raising the existing dam. The fourth option considered improving the efficiency of irrigation within the Manuherikia Valley by developing efficient water distribution systems. The fifth option is the construction of a new dam (the Mount Ida Dam) on the upper Ida Burn. In addition to the five main options a preliminary assessment has been completed on the proposed Hopes Creek Dam which would supply water to the Ida Valley. Key locations and water management infrastructure within the study are shown in the figure on page ii.

The Feasibility Study was separated into five interconnected components based on discipline (Hydrology, Geotechnical and Engineering, Water Allocation and RMA Planning, Environmental and Economic and Commercial). The relationship between the components and various key documents that make up the overall feasibility study are shown in the figure on page iii.

Hydrological assessment

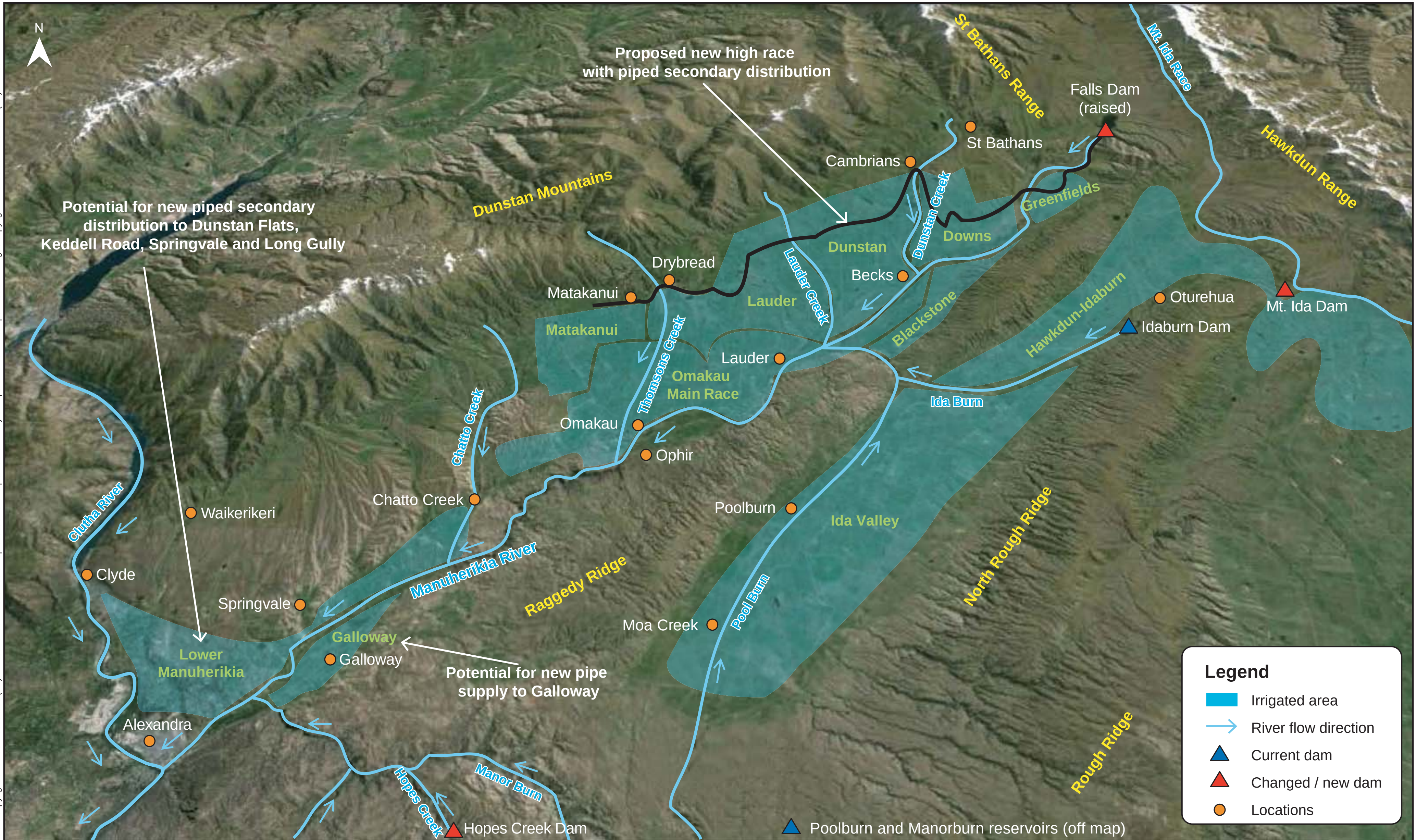
Hydrological models were used to assess various development scenarios, including the existing reservoir impounded by Falls Dam, but under increased minimum flow regimes, the various larger reservoirs impounded by larger dams at the site of Falls Dam and a proposed new reservoir on the Upper Ida Burn. The modelling indicates that annually it is not a lack of water within the Manuherikia Catchment, but rather the seasonality of flows and the lack of storage, that are the critical issues. The models were used to support a collaborative stakeholder process to assess potential flow regimes under the 27 m raise option for Falls Dam. The model predicts that the large reservoir associated with a 27 m raise of Falls Dam would reliably fill and together with run of river takes would allow reliable spray irrigation of 20,500 ha above Ophir (excluding the Ida Valley) and a further 4,500 ha below Ophir while also allowing for an increased minimum flow regime.

The models were also used to evaluate the efficiency of some preliminary scenarios incorporating an alternative, intermediate impoundment volume at Falls Dam that may be closer to optimal than the three original Falls Dam options. These preliminary scenarios suggest that if reduced supply reliability is acceptable, then substantially less water storage (in the order of 70 - 80 Mm^3 of live storage achieved by a 20 - 22 m impoundment raise) is required at Falls Dam. This would reduce total storage costs.

Storage options

<u>Falls Dam:</u>
Feasibility level designs and costs estimates were prepared for the three options for enlarging the impoundment at Falls Dam. Engineering assessment of both dam stability and construction methodology were focused on the large (27 m) raise option for Falls Dam and construction of a new Roller Compacted Concrete (RCC) dam located downstream of the current dam. The findings from the large (27 m) raise option were then applied to the mid (15.2 m) and low (5.4 m) raise options for Falls Dam which meant that the mid and low raise options were progressed as new RCC dams downstream of the existing dam. The cost estimates for the three RCC dam options (outlined in the table on page iv) are substantially more than proposed in the prefeasibility study.

An optimisation process was completed to review the dam designs with the goal of identifying potential cost savings and a potential optimised dam design and location. The optimised RCC dam is expected to have the following characteristics:



1. AERIAL IMAGE: Google Earth Pro.
2. NOTE: Oblique Basemap – Not to scale.
3. Schematic only, not to be interpreted as an engineering design or construction drawing
4. DRAWN BY: SG REVIEWED BY: RW

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TITLE MANUHERIKIA OVERVIEW MAP

AUGUST 2015

PROJECT 1378110270

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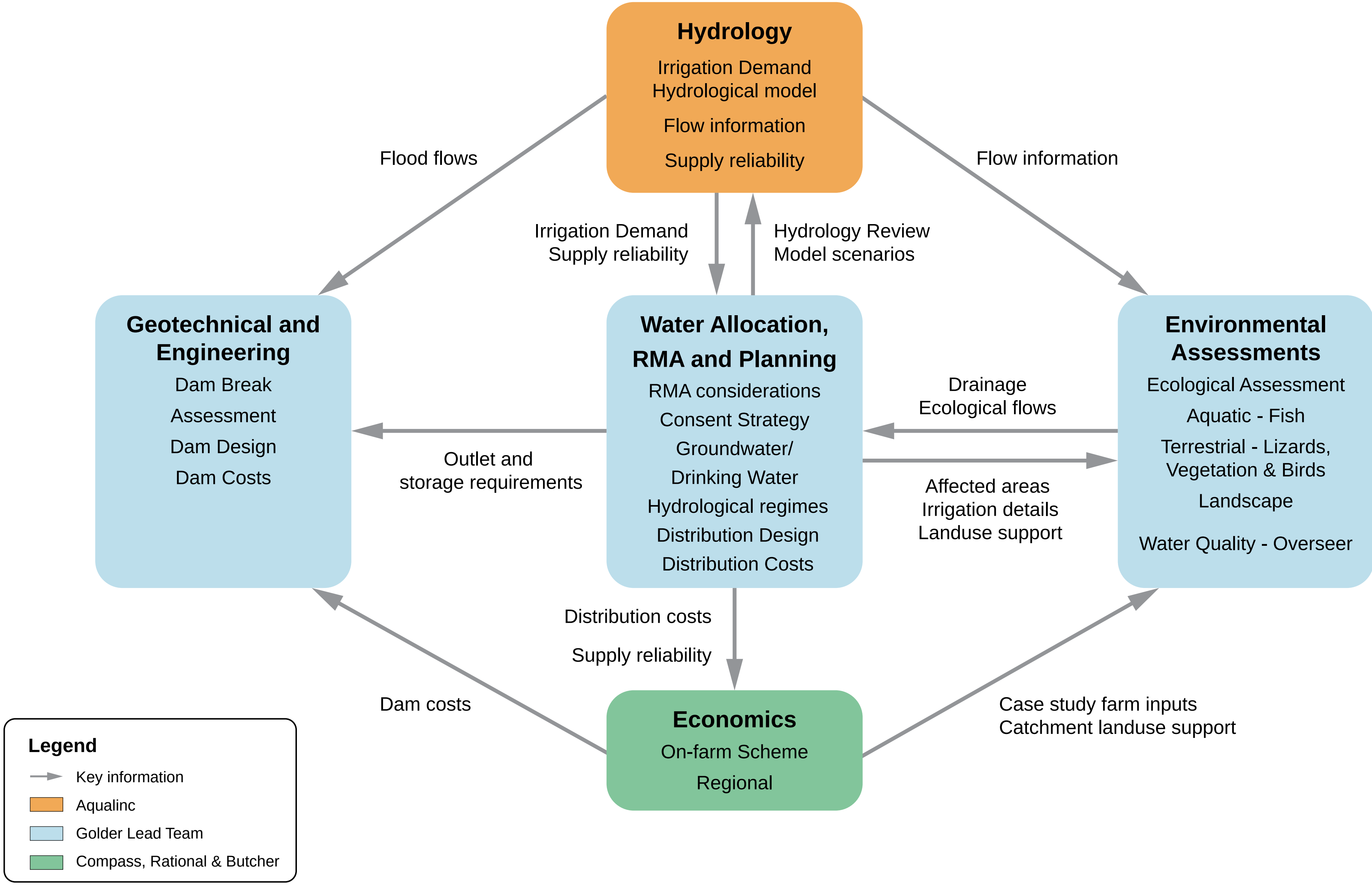

1. Schematic only, not to be interpreted as an engineering design or construction drawing
2. DRAWN BY: SG REVIEWED BY: XX

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TITLE FEASIBILITY STUDY STRUCTURE

AUGUST 2015
PROJECT 1378110270

Water development options details and costs.

Parameter		Falls Dam			Mt Ida Dam	Hopes Creek Dam
	Current	5.4 m raise	15.2 m raise	27 m raise		
Dam type	CRFD	RCC	RCC	RCC	Earth Embankment	CRFD or RCC
Location		Downstream of existing powerhouse	Downstream of existing powerhouse	Downstream of existing powerhouse	Seagull Hill Upgrade of Mount Ida Race required	Gorge below Stone Hut Flat
Usable Storage (Total storage) (Mm^3)	10.0 (10.3)	19.0 (20.6)	50 (51.6)	114.1 (119.0)	14.6 (15.6)	15 (19)
Storage costs ($M(1)): Base Construction Cost (BCS)		62.5	84.9	116.3	10.6	25.0 (33.6)
Construction Management (7 % of BCS), Engineering and Design (10 % of BCS) Bonds and Insurance (5 % of BCS) Consenting (2 % of BCS)		14.6	20.4	27.9	3.9	6.5 (8.7)
Direct Construction Cost (DCS)		77.1	105.3	144.2	14.5	31.5 (42.3)
Uncosted Items (35 % of DCS(2))		27.0	36.8	50.5	5.1	11.0 (14.8)
Total Estimated Preliminary Project Costs		104.1	142.1	194.7	19.6	42.5 (57.2)
Cost per m^3 usable storage ($/m^3)		5.5	2.8	1.7	1.3	2.8 (3.8)
Area Irrigated(3) (ha)	~11,500	~11,500	~16,000	~25,000	Additional ~2,000 in Hawkdun/Idaburn	Additional ~3,000 in Ida Valley
Storage Cost per hectare(4) ($/ha)		9,100	8,900	7,800	9,800	14,200 (19,100)
Reliability Comment	Poor	High	High	High	High	Significant improvement on current
Distribution comment	Existing network needs upgrading and maintenance	Uses existing network which needs upgrading and maintenance	New High Race to Lauder Creek plus upgrade of existing. Potential for some pressurised supply	New High Race to Matakanui Station plus upgrade of existing. Potential for significant pressurised supply	Distribution system required not included in assessment.	A pumped rising main and a new race to feed into upper Bonanza race required.

Notes: 1) Costs are rounded up to the nearest $100,000 and exclude GST.
2) The 35 % contingency for uncosted items is based on experience from similar large water projects at feasibility stage design.
3) Unless stated irrigated area is within the Manuherikia Valley only (i.e. excludes Ida Valley). The irrigated area is based on spray irrigation and is based on hydrological model results.
4) Assumes storage costs spread evenly over area irrigated. Estimated storage costs per hectare are rounded up to the nearest $100 and exclude GST.

- A full supply level of between 585.0 m (19.8 m raise with usable storage of ~70.5 Mm^3) and 587.4 m (22.2 m raise with usable storage of ~83.6 Mm^3).
- Be located between the toe of the current dam and the existing power station.
- A downstream slope for the RCC embankment of between 0.8H:1V and 1H:1V.
- Have an overtopping spillway down the centre left of the dam, thereby allowing for an offtake structure on the right abutment.

Mount Ida Dam:
The feasibility investigations have identified a number of issues with the proposed Mount Ida Dam including increased seismic risk, weak clay material below the terrace on the true left (eastern) bank of the dam site and estimated high construction costs.

Hopes Creek Dam:
Preliminarily assessments indicated that either a Concrete Faced Rockfill Dam (CFRD) or a RCC dam are potentially suitable options for the Hopes Creek Dam. Conceptual designs for both a 41 m high CFRD and a similar height RCC dam have been prepared. Design and overall feasibility of the proposed Hopes Creek Dam is strongly linked to the stage storage curve, the available inflows, and irrigation demand. Further work is required to confirm the hydrology of the proposed dam site and the potential supply reliability benefits to the Ida Valley Irrigation Scheme.

Distribution Options

A distribution assessment identified various potential distribution scenarios for each of the five irrigation development options on a scheme by scheme basis. In assessing the various irrigation development options, current and potential irrigators need to consider the development as a whole, including: storage, distribution, on-farm development, water management and scheme operation. The various distribution options identified provide differing levels of service, particularly in regard to the provision of pressurised versus non-pressurised water, which need to be considered when comparing options. The table on page vi summarises the distribution development options.

Environmental considerations

Storage reservoirs:
The upper Manuherikia River valley supports a significant array of indigenous plants, birds, lizards and fish. The braided river habitat in the upper Manuherikia River valley provides the only habitat for the Manuherikia alpine galaxias and habitat for a number of threatened braided river birds. Additionally, the Manuherikia River gorge immediately downstream of Falls Dam and gullies to the east of Falls Dam provide good habitat for threatened plants and lizard species. All options to raise Falls Dam will increase inundation of the braided river system. This habitat loss will have impacts on the Manuherikia alpine galaxias and the nesting area of the nationally critically threatened black-billed gull. A proportion of the nesting habitat of the nationally endangered black fronted tern will also be lost as will some threatened plants and a portion of high value lizard habitat around the reservoir edge.

The Mt Ida dam and reservoir site has been assessed as having relatively low environmental values and mitigation is considered limited or not necessary.

The preliminary assessment of the Hopes Creek Dam did not considered environmental issues.

Irrigated area:
The principal environmental concerns regarding the irrigated area are:

- Ensuring that remaining areas of indigenous vegetation and high biodiversity are suitably protected.
- Flow regimes are developed for the areas waterways which suitably consider instream values.
- That land use intensification is managed to ensure existing water quality is maintained or enhanced.

The highly modified valley floors of the Manuherikia and Ida valleys provide little indigenous species habitat. However, any remaining areas of indigenous vegetation and particularly saline wetlands are of high value.

Catchment summary of distribution scenarios.

Irrigation Scheme[(1)]	Distribution scenarios	Irrigated area (ha)	Capital Cost ($)	Annual Operational Cost[(2)] ($)	Reliant on increased storage	Relevant Irrigation development option	Comments[(3)]
Galloway (GIS)	Pumped Open Race (Status Quo unpressurised supply)	520	410,000 (800/ha)	210,000[(4)] (390/ha)	No	Status Quo	Current supply reliability is sufficient to support on-farm spray irrigation and distribution development. Given the existing power arrangement, a move to pumped piped supply from the Manuherikia River is supported. If Keddell Road pipe goes ahead as part of MIS developments then investigate the potential of gravity supply from MIS main race. If Hopes Creek Dam goes ahead investigate shifting supply to the Lower Manorburn Dam. Costs exclude consideration of the Lower Manorburn Dam.
	Pumped piped pressurised supply from Manuherikia	550 (potentially more)	1,930,000 (3,500/ha)	160,000[(4)] (290/ha)	No	4 (Efficient Distribution)	
Manuherikia (MIS)	Open Race (Status Quo excludes areas below)	3,600	3,620,000 (1,000/ha)	230,000 (70/ha)	No	Status Quo excludes Dunstan Flats etc.	Current supply reliability sufficient to support on-farm spray irrigation and distribution development. Development of a gravity piped supply to Dunstan Flats, Keddell Road, Springvale and Long Gully areas is supported. Investigate the potential to tie the Keddell Road pipeline in with a gravity supply to the GIS. Reduced use of the Borough Race and transfer of the take to the main intake from the Manuherikia River should be investigated as it will simplify scheme operation, reduce maintenance and maximise the area that can be supplied with gravity pressurised water.
	Gravity pipe Dunstan Flats	500	3,150,000 (6,300/ha)	70,000 (140/ha)	No	4 (Efficient Distribution)	
	Gravity pipe Keddell Road, Springvale etc.	600	1,420,000 (2,400/ha)	70,000 (120/ha)	No	4 (Efficient Distribution)	
Blackstone (BIS)	Open Race (Status Quo unpressurised supply)	660	410,000 (600/ha)	70,000 (110ha)	No	Status Quo & 2 (Falls Dam low raise)	Current supply reliability is relatively poor which will limit development of spray irrigation to the area with secure peak of season water supply. Falls Dam High, Mid and Low raises increase supply reliability allowing increased spray irrigation. A gravity piped supply is possible but expensive. Focus development on-farm initially then on improving supply reliability.
	Gravity pressurised pipe supply from new High Race	1,200 (potentially more)	6,480,000 (5,400/ha)	50,000 (40/ha)	Yes	1 and 3 (Falls Dam mid and high raise)	
Omakau (OIS)	Main Race status quo (unpressurised supply)	3,759	3,830,000 (1,000/ha)	160,000 (40/ha)	No	Status Quo & 2 (Falls Dam low raise)	Current supply reliability is relatively poor (particularly for the Lauder, Matakanui and County parts of the OIS) which will limit development of spray irrigation to the area with secure peak of season water supply. Development of spray irrigation on-farm only for areas with secure peak of season water supply. Falls Dam High, Mid and Low raises increase supply reliability allowing increased spray irrigation. A gravity piped supply to the Becks Flat area from the Blackstone Race is possible and should be investigated further. Focus development on-farm initially then on improving supply reliability. Investigate potential to supply Matakanui extension area from expanded OIS main race.
	Dunstan, Lauder, Matakanui and County status quo (unpressurised supply)	2,083	2,320,000 (1,100/ha)	280,000 (130/ha)	No	Status Quo	
	Main Race expanded capacity (unpressurised supply)	6,000[(5)]	10,670,000 (1,800/ha)	160,000 (30/ha)	Yes	1 and 3 (Falls Dam mid and high raise)	
	Gravity pipe to Becks Flats	600	2,790,000 (4,700/ha)	10,000 (20/ha)	No	Status Quo	
High Race	High Race to Matakanui Station Boundary piped secondary distribution.	14,100[(5)] (~ 8,000[(5)] pressurised supply)	63,880,000 (4,500/ha)	230,000 (20/ha)	Yes	1 (Falls Dam high raise)	High race associated with Falls Dam Mid and High raises, would increase supply reliability allowing increased spray irrigation. Falls Dam High raise allows High Race to replace all irrigation from Dunstan, Lauder, Thomsons Creeks and associated tributaries. Falls Dam Mid raise allows High Race to replace all irrigation from Dunstan Creek and suppliants current takes from Lauder Creek. There is a large potential for gravity pressurised supply and development should focus on these areas. Focusing development closer to Falls Dam will reduce distribution costs.
	High Race to Lauder Creek piped secondary distribution.	6,500[(5)] (~ 4,000[(5)] pressurised supply)	32,680,000 (5,000/ha)	230,000 (40/ha)	Yes	3 (Falls Dam mid raise)	
Hawkdun Idaburn (HIIC)	Upgrade Mt Ida Race, gravity unpressurised supply	3,585	1,260,000 (400/ha)	90,000 (30/ha)	No	Status Quo	Current supply reliability very poor. Development of spray irrigation on-farm only for areas with secure peak of season water supply. There is potential to increase water harvesting by the Mt Ida Race through reducing leakage, upgrading intakes and potentially harvesting from additional sub-catchments, all of which should be investigated further. The proposed Mt Ida Dam improves supply reliability allowing increased spray irrigation. With Falls Dam High Raise the potential to pump over Home Hills Saddle to suppliant R race should be investigated.
	Expand Mt Ida Race	2,000	2,2900,000 (1,200/ha)	Included in above	Yes	5 (Mt Ida Dam)	
Private irrigators	Development focused on-farm	Total area unknown	n/a	n/a	No	Status Quo	For irrigators who take from the Manuherikia River, current supply reliability is sufficient to support conversion to spray irrigation. For many of the irrigators who take from the tributaries current supply reliability is relatively poor and on-farm development of spray irrigation will be limited to those areas with secure water supply during the peak of the irrigation season.

Notes:
(1) The Ida Valley Irrigation Scheme (IVIS) was not assessed as it is not influenced by any of the 5 development options covered by the Feasibility Study.
(2) Unless stated annual operational costs exclude any scheme or on farm pumping.
(3) Supply reliability comments are based on hydrological model results (Aqualinc 2012f, 2013a and 2014).
(4) Operational costs for the Galloway scenarios include scheme pumping.
(5) Area is indicative only and based on assessment of current areas irrigated and potential increases suggested by the hydrological model results (Aqualinc 2012f, 2013a and 2014).
Shaded scenarios represent either full (dark grey) or partial (light grey) provision of pressurised (>30 m pressure) water to the farm gate. Unshaded scenarios require on-farm pumping for spray irrigation.

For each farm that becomes part of an irrigation scheme it is recommended that the Farm Management Plans (FMP) include a biodiversity assessment, especially for any areas where new irrigation development is occurring.

The water resources of the Manuherikia Catchment are very highly allocated and potentially over-allocated during summer. Increased water harvesting and storage of water is required to overcome the current allocation issues and potentially allow for environmental flows and increased irrigation. The larger the storage volume the more opportunity there is to address over-allocation issues and provide for improved environmental releases and minimum flows.

The current state of the Manuherikia River and its tributaries is varied. In general, the upper catchment has excellent water quality. However, in the lower reaches of the Manuherikia River the water quality has declined to 'good'. In the tributaries, water quality declines downstream as each stream flows across the Manuherikia or Ida valley floor. Current irrigation in the catchment is dominated by flood irrigation practices. Large application depths are applied which cause saturation of the soil profile, runoff and significant drainage of water through the soil profile. Increased runoff leads to sediment and phosphorus being washed into the watercourses while increased drainage results in leaching of nitrogen. There is potential for algal blooms, although this is currently limited by low levels of nitrogen in the streams. Nutrient budget analysis undertaken using Overseer indicates that the Manuherikia catchment has a number of characteristics (e.g., a dry climate, deep soils with limited susceptibility to phosphorus loss and the ability to significantly reduce drainage and nitrogen loss from existing flood irrigated areas by converting to spray irrigation) that significantly reduce the risk of increased nutrient concentrations. At a catchment level the proposed irrigation development scenarios are expected to result in reduced nitrogen loss from the bottom of the root zone. A reduction in catchment scale nitrogen loss is expected to result in reduced nitrogen concentrations in the area's waterways and potentially improved groundwater and surface water quality.

At a catchment level the proposed irrigation development scenarios are expected to result in increased phosphorus loss from the catchment's farms. Phosphorus loss is principally associated with runoff, overland flow and active soil erosion. Measures such as appropriate cultivation techniques, vegetation management to limit erosion, riparian strips, controlling stream bank erosion and preventing stock access to waterways will be required to control phosphorus concentrations in the waterways that drain the irrigated areas.

Farm Management Plans which identify and address potential erosion "hotspots" and which require detailed on-farm nutrient budgeting will be an important mitigation measure to reduce the risk that future land use intensification poses to water quality.

<u>Overall:</u>
The environmental assessments of the five proposed water development options have identified a number of issues (particularly those associated with endangered species) which will require very careful management. However, it is anticipated that suitable management and mitigation options could be developed that would allow the proposed water development options to potentially progress.

Economic Assessment

The off-farm water supply cost estimates developed during the feasibility study were considerably higher than the earlier prefeasibility estimates and result in decreased on-farm economic viability. Due to the high off-farm water supply costs the economic assessment of the overall scheme was put on hold while an optimisation process was undertaken to assess options for reducing off-farm costs. This optimisation process is ongoing.

Future resource consent applications

It is anticipated that the completed Feasibility Study will form the technical 'backbone' for subsequent resource consent applications. As part of the Feasibility Study a consenting strategy was developed to guide any future consent applications. The strategy was developed via a collaborative working party process involving representation from MCWSG, Golder, ORC and CODC. The common goal of the process was to

"seek mutually acceptable outcomes in relation to water allocation and/or management and future resource consenting within the Manuherikia Catchment and project area".

Conclusions and recommendations

Given the estimated high costs of the five irrigation development options there is need to look critically at water demand, hydrology, storage options, engineering design, costings and to a lesser extent distribution and environmental issues to determine an optimised solution which could progress to more detailed investigations. Of the environmental issues, the area of new inundation above Falls Dam is considered the issue most likely to affect selection of the optimum solution. Based on the investigations to date the optimum solution is expected to involve a smaller dam, lower supply reliability and possibly review of expected water demand to include consideration of land uses which are less water intensive.

To progress the project and to assist in the identification of the optimum water management and irrigation development solution for the Manuherikia Catchment the following investigations are recommended.

- The hydrological models prepared for the Manuherikia Catchment provide a means for quickly assessing potential development scenarios. Some refinement of the models is recommended to:
  - Better assess tributary contributions.
  - To include the production implications of water supply restrictions.
  - To provide more flexibility in terms of future water demand, so that different crops and climate change scenarios can be assessed.
  - To allow whole catchment water management options to be quickly assessed.
- That predicted future irrigation demand requirements be reviewed to assess if future water demand and hence storage requirements can be reduced.
- Optimisation of Falls Dam to identify the preferred dam design and location and then confirm estimated costs. Following selection of the preferred water storage option, potential flow regimes and water supply reliability needs to be confirmed through an open stakeholder process. Following confirmation of the flow regime and supply reliability further design work is required to optimise the distribution networks and confirm estimated distribution costs.
- Irrigator support for each of the development options should be assessed, in light of the results of this feasibility study.

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