LOWER MANUHERIKIA VALLEY WATER RESOURCES STUDY

Lower Manuherikia Valley Water Resources Study

SUMMARY DOCUMENT FOR DISCUSSION BRIEF

Manuherikia Irrigation Co-operative Society Ltd

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1 Purpose

This report presents a summary of the main feasibility study reports for public circulation to stakeholders.

2 Foreword

Central Otago has a unique and rich history built on the labours of gold field pioneers and long-standing family names that have worked and shaped this harsh landscape through some of the most extreme environmental conditions experienced in New Zealand.

The legacy of this effort has been to turn arid terraces and steep dry hillsides of the Manuherikia Valley into diverse farming units and spectacular lifestyle blocks with a mixture of intensive agriculture through to vineyards and orchards. Some of the land remains under low intensity dry land farming or hobby blocks, some without high expectations of farm gate revenue but with a high intangible value gained from living in this historic landscape.

However, one of the most important features of the Lower Manuherikia Valley, and in fact the wider Central Otago district, is the heavy reliance on irrigation mostly from water available through mining privileges dating back to origins in the 1860's.

Mining privileges were licences issued for water races, dams and similar features under the Mining Act 1926, subsequent amendments, and previous Acts. Among these licences, only water race licences confer any right to take water. A water race licence stated the location of the taking of water, the amount of water allowed to be taken, the dimensions of the race, and the purpose for which water is taken. As miners and landowners developed other land uses, the use of the water changed from mining to irrigation, other rural uses, or industry.

First priority, and in most cases second priority licences were more likely than other licences to provide a reliable supply of water depending on the nature and flows of the water source. People using the system have become accustomed to this system of water allocation and have developed their water and land use patterns in line with this.

With the introduction of the Resource Management Act (RMA) 1991, all current mining privileges and rights granted under the Water and Soil Conservation Act 1967 in substitution of mining privileges that were current immediately prior to the commencement of the Resource Management Act 1991, continued to be authorised until the thirtieth anniversary of the Resource Management Act 1991 on 1 October 2021.

It is this critical deadline upon which the rights to take and use water will come under scrutiny that has underpinned this study of the options for water allocation for the Lower Manuherikia Valley. To ensure long term security of investment, stability of communities and maintenance of environmental values associated with irrigated land holders, the mechanism for determination of consented takes needs in-depth investigation and thorough preparation for an RMA consents process.

The Otago Regional Council (ORC) will, with the water users, investigate and develop methods and strategies for the orderly transition of deemed permits to resource consents, given that the deemed permits will expire on 1 October 2021. The commentary from ORC procedures to this method includes:

"The exercise of deemed permits can constrain opportunities to implement minimum flows established by the Plan to maintain the life-supporting capacity for aquatic ecosystems and natural character of rivers. The Regional Council will assist deemed permit holders with the development of an appropriate management regime to replace deemed permits when they expire. The Council, in partnership with the affected community, will assist with appropriate investigations and monitoring of the effects of deemed permits."

There is no doubt that the irrigated valleys of the Central Otago region face considerable challenges between now and 2021 to ensure that a long-term view is taken, and adequate time and attention is given to gather data to support applications for water resource allocation, taking into account environmental water quality and minimum environmental flows.

A key advantage in the Otago Region is having an operational water plan that clearly sets out the parameters under which the RMA consenting process will be conducted. These parameters include:

- local water first used for local use
- no area stranded dry
- efficient use of water resources

The need to address potential conflicting demands for water use in a district has focussed the irrigation schemes in the Lower Manuherikia Valley on how to best use their local water for the best community outcome. This includes agricultural use, domestic drinking water for both urban and rural communities, and consideration of environmental flows. This report has provided the basis upon which a community-based decision process can be commenced, and the various features and factors that need to be taken into account investigated in some detail.

This report could equally be used as the basis for further investigation of the Upper Manuherikia Valley water resource dilemma. This point is raised because the solution to the Lower Valley issues can probably not be concluded without close cooperation with the agricultural and other water users of the Upper Manuherikia Valley catchment. One location's solution to the water allocation problem will likely have a direct impact on the other as the water resource volume is directly linked by the Manuherikia River. It could be asserted therefore that the attention given to addressing the Lower Valley issues now needs a similar effort by the Upper Valley to ensure adequate time remains to build a consenting case before 2021.

Key assumptions have been made about the way in which water will be applied to the land in the future and challenging assumptions have been made about many of the current practices. This is closely aligned to parallel water allocation models being developed in other New Zealand agricultural regions that assume adoption of modern irrigation codes of practice for design and operational practices. The critical factor here will be working closely with the Otago Regional Council in determining what the criticality is of providing a minimum environmental flow in the Manuherikia River to meet its core allocation framework criteria. If the river flow is set at a level that is acceptable to the Regional Council through a consultative process with the community water users, it is likely that this will require a significant modification of the existing border dyke and wild flood irrigation systems commonly used in the area. It is anticipated that a much higher proportion of efficient and effective spray application methods will have to be adopted to meet the local water allocation model.

Although a view has been taken in this report on the likely future mix of agricultural practices, in reality, the type of farming that uses water does not significantly affect the water balance model. It is likely, however, that once a reliable water supply is established for the current and potentially greater irrigated area, land use changes will occur over time, in some cases linked to ownership changes.

Whilst the water extraction point at Dairy Creek provides some elevation advantage being above part of the irrigable land, there is a large proportion of the land that will require the water to be pumped. This obviously has a significant long-term operational cost per hectare for the life of any proposed system. The equitable spread of this cost across the ownership of the scheme will create a value of water that has not previously had high consideration during water management decision making. This scheme will effectively make the efficient and effective management of water a critical factor in the overall agricultural and land ownership decision-making process because of its increased value.

Although this report has considered a number of scenarios for the mechanics of water distribution in the valley to establish some form of capital and operational costing, this report is not a detailed engineering design, and hence any costing are of a rough order. Further decisions will need to be taken by the community through some form of governance mechanism to establish the affordability of whichever option is taken forward.

In common with many irrigated areas of New Zealand, the driver for improved environmental performance and economic stability has indicated a number of improvements or expansion of irrigation systems. The long-term benefits of this infrastructure work will really fall with future generations of water users, both commercial and environmental. The improvement issues being addressed in many cases arise from either deferred maintenance and/or failure to address the underlying drivers over previous generations of land tenure. If the cost of any infrastructure work falls only with the current generation, it is unlikely that these improvements will be realised and hence a higher level view will be necessary. It is acknowledged that parallel to this report, some representation has been made to central Government regarding the need for some form of funding support mechanism.

There are, however, several possible cost offsets, such as the possible provision of secure drinking water supply to Clyde and Alexandra, which if undertaken, would spread the asset costs. Furthermore, there is the potential for cost recovery through mini hydropower generation which could reduce the cost burden to the land owners.

The scope of this report was not intended to be a detailed engineering design or whole of life costing of an irrigation scheme. The intent has been to provide a basis for further investigation of the various options considered and a test of some of the assumptions made around future land use and water demands. The process has included the broad-brush determination of where water will be needed in the Lower Valley and at what depth of application (and thus, annual volumes). Arising from the general conclusions about the feasibility and cost of a scheme to meet the requirements of the combined irrigation schemes, a process of close consultation and surveying of current landholder practices and future intent will need to be conducted to further build on the data available on which development decisions can be made. However, as with many other regions where improved water supply reliability and improved application practices have been achieved, the ownership of land and farming type often changes too. The underlying driver is that ‘reliable water supply provides increased options’ that are not available for land use and environmental outcome-focused decision-making processes where water is restricted.

Stephen McNally
Manager – Environmental Engineering and Resource Management

3 Summary

This feasibility study provides the basis upon which a community-based consultation and decision process surrounding the water resources for Lower Manuherikia Valley can commence, and the various factors that need to be taken into account investigated in some detail.

This study investigates the water resource options available to the Lower Manuherikia Valley in Central Otago, in light of their current water supply sources being under review in the near future. Our summary report covered the following main points:

- We found that mini hydropower generation at Chinky Gully to offset annual operational costs appears to be technically feasible and has the potential to be economically viable depending on the refinement of some assumed inputs, thus it warrants further investigation.

- We present how we have broadly determined where in the valley and at what application depth irrigation water is required, and therefore estimated the water demands. We then consider several options for the mechanics of water distribution in the valley.

- We found that water sourced from Lake Dunstan is suitable for drinking water after suitable treatment, and we have estimated the related costs.

- We highlight the Regional Plan – Water for Otago and the proposed Plan Change 1C among other legislation that will likely influence future decisions by the community surrounding water resource management for the valley.

The scope of our study did not include detailed engineering design, thus these options have been developed to a point that capital and operational costing is only of a rough order. Preliminary capital costs for the various options commence from $78.6M for an irrigated area of 8,320 hectares ($9,400 per hectare), whereas preliminary annual operational and maintenance costs commence from $2.9M for the same irrigated area ($347 per hectare). These costs have wide ranges, which would be narrowed down through community consultation to determine preferences for the available variables, followed by further engineering design.

This summary report is supplemented by the following reports which cover the results of this feasibility study in more detail:

- High Level Overview;
- Hydrology Study;
- Mini Hydropower Pre-feasibility Study;
- Drinking Water Security Review; and
- Detailed Concept Study.

The equitable distribution of the costs across the ownership of the scheme will increase the value of water, hence requiring efficient and effective management of water. Furthermore, the long-term commercial and environmental benefits of this scheme will really fall mostly with future generations. If the costs fall only with the current generation, it is unlikely that these improvements will be materialized, and thus, a higher level view by the community will be necessary, with possibly some form of government funding support.

We recommend that the community uses the outcomes of this study to proceed with a process of close consultation that includes surveying of current landholder practices and future intent, establishing landowner buy-in to better refine the actual areas to be irrigated, and working out acceptable risk levels.

4 Background

The Lower Manuherikia Valley currently relies heavily on irrigation for much of the land area from water available through mining privileges dating as far back as the 1860s. With the introduction of the Resource Management Act (RMA) 1991, all current mining privileges continued to be authorised until the thirtieth anniversary of the RMA 1991, i.e. 1st October 2021.

It is this critical deadline when the rights to take and use water will come under scrutiny that has underpinned this water resource study for the Lower Manuherikia Valley. To ensure long-term security of investment, stability of communities, and maintenance of environmental values associated with owners of irrigated land, the mechanism for determination of consented takes needs in-depth investigation and thorough preparation for an RMA consents process.

This water resources study was commissioned to examine extending the consented Lake Dunstan water supply for the proposed privately-supported Dairy Creek Irrigation Scheme to incorporate the water resource management needs of the entire Lower Manuherikia Valley. We explored the feasibility of combining the various irrigation and water supply schemes in the command area into a single entity, and with a single source being Lake Dunstan.

Key Reasons to Support a Lower Manuherikia Valley Scheme:

- Water sources currently supporting the Lower Manuherikia Valley are under review in the near future as water permits expire. Currently, the Manuherikia Irrigation Scheme and part of the Galloway Irrigation Scheme are supplied from historic race systems from the Manuherikia River under the mining privileges which expire in 2021. As such, there is pressure to identify alternative water sources as a contingency against unsuccessful consenting under the RMA for continuing the supply.

- To keep in step with legislation changes which promote efficient water allocation, management and use. The combined Lower Manuherikia Valley scheme would, among other things, reduce water losses through evaporation and infiltration by using a piped system, as well as encourage and facilitate good water management through water metering.

- Local water first used for local use. The proposed Dairy Creek Irrigation Scheme alone would not have fully used the consented allocation. Using the consented allocation to supply more of the Lower Manuherikia Valley would reduce demand on the Manuherikia River, which also supplies irrigated farming operations in the Upper Manuherikia Valley, nominally identified as north-east of Tiger Hill.

- No area stranded dry. There is land that is currently not being irrigated for various reasons, e.g. because of their location above the gravity-fed water races, but that would benefit from access to irrigation water. This scheme presents the opportunity to irrigate these new areas.

- Economies of scale. There are likely to be savings achieved from a combined scheme that shares water infrastructure.

- Economic benefit. More reliable water supply leads to higher and more diverse, and thus more resilient revenue and profit for the landowners. The wider community and region also benefits from flow-on economic effects.

- More reliable water supply. The current supply from the Manuherikia River is not sufficiently reliable. Rationing is often required in the dry summer months. Having water available on demand empowers the landowner by allowing flexibility in on-farm water resource management, i.e. landowners can irrigate only as and when it is actually required.

- Private water rights are likely to become less reliable. Irrigation methods are changing from flood irrigation to more efficient irrigation methods such as spray and drip irrigation. It is likely that the less efficient irrigation methods have been recharging the groundwater, which many private rights in the area depend on.

What area did the study cover?

The study covered the Lower Manuherikia Valley, which nominally stretches from Lake Dunstan in the west to Tiger Hill in the east. While we start off with this command area covering approximately 15,300ha, we eventually focused on a smaller area[1] which includes the Manuherikia and Galloway irrigation schemes, as well as the proposed Dairy Creek Irrigation Scheme.

For the eventual solution to successfully meet the needs of the Lower Manuherikia Valley, future detailed design must take into account input from members of the wider community, including Upper Valley areas.

[1] The reasons for focusing on this smaller area are described in Section 6.

5 Consenting Framework

There is an existing consent to take water from Lake Dunstan which allows the abstraction of up to a maximum of 4.53 m^3/s and 326,160 m^3/day, from 1st August through to 30th May annually. Various conditions apply to this consent and it expires on 1st April 2038. However, the consent provides for the abstraction of water, but not for the use of the water. Obtaining a consent to use the water is not a given and would depend on demonstrating sustainable and efficient use of water and power resources. Furthermore, we highlight that Condition 5 of the consent states that the consent will lapse on 19th May 2013 unless:

- the consent is exercised (water is taken under the water permit); or
- an extension of the lapse period is applied for and successfully granted by the Otago Regional Council (ORC) on the basis of effort made towards the exercising of the consent (e.g. this feasibility study).

There are several pieces of legislation that are relevant to the potential development of a combined irrigation scheme. In particular, the Regional Plan – Water for Otago contains the rules and standards that govern development and dictate whether a proposed activity in the Otago region is permitted as a right or will require a resource consent. At the time of this report, Proposed Plan Change 1C (Water Allocation and Use) is currently in the final phase of development, and will become operative once appeals have been resolved.

Under both the operative Regional Plan and Proposed Plan Change 1C, the use of water, in terms of the existing consent to take water, is not a permitted activity as it breaches the thresholds for permitted water use. The use of the water would either be a restricted discretionary or discretionary activity. Therefore, a resource consent would be required to allow use of the water.

In considering an application for the use of the water, the Regional Council would take into consideration a number of factors, including whether the use of the water would meet the objectives and policies of the Regional Plan and the Proposed Plan Changes. Central to the objectives and policies are ideas including:

- the development of shared water infrastructure;
- the establishment of water allocation committees or water management groups;
- to grant consent for only as much water as actually used/needed;
- to prioritise the use of water from within the area it was taken over its use elsewhere;
- to promote shared use and management of water resources; and
- to ensure the efficient use of water resources.

We believe that a Lower Manuherikia Valley Irrigation Scheme in principle meets these criteria, and recommend that all further development and decision-making with respect to the scheme take them into account.

The Regional Plan also promotes the storage of water at periods of high water availability such as the use of reservoirs for holding water that has been taken from any lake or river. Both the Regional Plan and Plan Change 1C state that the means of encouraging efficient water use will not be the enforcement of rules, but rather a two-way sharing of information between the council and the landowners.

The other relevant legislation covers buildings and structures, underground utilities, earthworks and vegetation clearance, separation distances, archaeological sites, construction of dams, and esplanade reserves. Some activities may require resource consents, depending on whether certain conditions are met.

6 Preliminary Design Process

The preliminary design process is diagrammatically represented in the information flow chart at the end of Section 6, and is described in more detail in the following paragraphs.

6.1 Consented Water Supply from Lake Dunstan

There is an existing consent to abstract water from Lake Dunstan for irrigation and frost-fighting with an extraction point identified at Dairy Creek, approximately 1 km north of the Clyde Dam. Various conditions apply to this consent and it expires on 1st April 2038. The consent allows the abstraction from 1st August to 30th May annually of an instantaneous maximum of 4.53m^3/s and a daily maximum of 326,160m^3/day.

To avoid peak power charge times per day and to provide downtime for the farm irrigation systems during relocation/maintenance, pumping was assumed to be for only 20 hours per day. Based on this assumption, we calculated the available annual water supply volume and instantaneous flow rates.

6.2 Area to be Irrigated

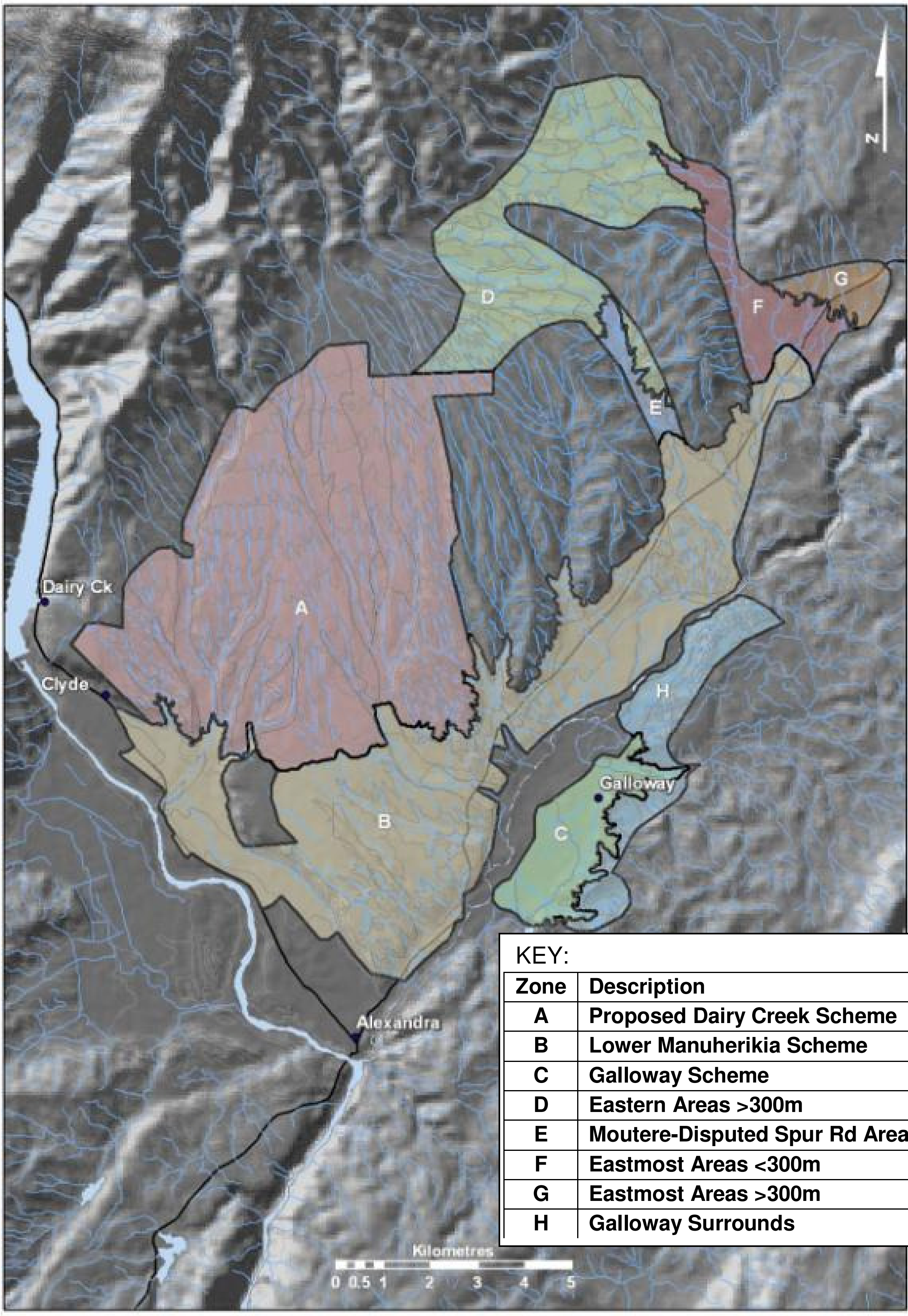
The command area identified in our brief is for the potential irrigation of the Lower Manuherikia Valley, stretching from Lake Dunstan in the west to Tiger Hill in the east. This general description captures a land area of approximately 15,300 hectares, covering the existing Manuherikia and Galloway irrigation schemes, the proposed Dairy Creek irrigation scheme, and other surrounding areas. Our study made an attempt to identify and eliminate features not necessarily of interest for irrigation, such as urban areas, road reserves, the airport reserve, and existing water bodies.

We looked at the maximum operating slope (mechanical limit) for the most common irrigation systems, and chose to eliminate areas with slopes greater than 20 degrees (roughly a 36% incline).

Incorporating local knowledge applied to the soil databases available, we also looked at soil types and depth to see what, if any, area should be eliminated as simply unsuitable for irrigated farming practices. This process did not significantly reduce the irrigable area.

The resultant irrigable area was approximately 10,900 hectares. Figure 6-1 presents a plan layout of the command area. Obtaining more local knowledge from the client into the current and likely future desired irrigation coverage, we reduced the area to be irrigated. In particular, we have excluded some of the irrigable areas to the north-east of the Lower Manuherikia Valley (Zones D, E, F and G) which, in our opinion, might be better supplied with water from the Upper Manuherikia Valley.

Only Zones A, B, C, and H remained after the reduction in area. We investigated two sets of design options with different total land areas to be irrigated, set at 8,320 hectares and 6,511 hectares. The options which use a land area of 6,511 hectares are based on local knowledge received that it was possible that not all of the 8,320 hectares that we had determined to be irrigable was likely to actually be irrigated. Therefore, some parts of Zones A, B, C, and H were trimmed out with guidance from the client to better reflect the likely future increase in irrigated area.



KEY:

Zone	Description
A	Proposed Dairy Creek Scheme
B	Lower Manuherikia Scheme
C	Galloway Scheme
D	Eastern Areas >300m
E	Moutere-Disputed Spur Rd Area <300m
F	Eastmost Areas <300m
G	Eastmost Areas >300m
H	Galloway Surrounds

Figure 6-1: Location of zones within the Lower Manuherikia Valley

6.3 Gross Irrigation Application Depth Profile

A. Soil Moisture Deficit Profile

To estimate the irrigation water demand of the valley, we started not with current practice, but with an evaluation of the actual requirements based on local climate and soil data. We completed desktop soil and climate studies which formed the basis for our soil moisture balance. Our soil moisture balance assessed the availability of water in the soil for plants over different months of the year, and hence the irrigation water application depths required. The soil moisture balance accounts for water added through rainfall, stored in the limited capacity within soil pores, and removed from the system through evapotranspiration.

Historical rainfall data was used to determine the one in five year minimum growing season rainfall, which was considered in our model as the “dependable rainfall”. What this means is that at this stage, we designed the scheme to have sufficient water supply to sustain crops for a drought that has 20% probability of occurring each year. This involves an issue of risk management that requires an informed decision by the stakeholders, but at this stage, we have assumed that this is an acceptable risk level.

Potential evapotranspiration is the maximum amount of water lost from the system assuming an unlimited soil moisture supply, and is affected by solar radiation, vapour pressure deficit and wind speed. In the water balance, precipitation is initially used to meet the potential evapotranspiration. Any excess water will recharge the soil moisture storage, or when that reaches capacity, become surplus runoff. The moisture stored in the soil is released to the plants and atmosphere when water supply from precipitation is short. However, soil moisture may be insufficient to meet potential evapotranspiration, resulting in a water deficit which places plants under stress. During these times, the soil must be irrigated to prevent lost production or ultimately, death of the plant. Historical local rainfall and potential evapotranspiration data was used together with local soil moisture storage capacity data to estimate the soil moisture deficit profile.

B. Irrigation Season Length

Based on the soil moisture balance alone, the irrigation season should begin in September and end in April. However, when the soil is too cold (based on common practice, we set a minimum soil temperature of 10℃ at 10 cm depth), plant growth is inhibited by the low temperature, rather than lack of soil moisture. Starting irrigation too early might delay the increase of soil temperatures, whereas starting irrigation too late would delay growth. We looked at the historical 10 cm depth soil temperature data from a nearby electronic weather station as a reference, suggesting that the soil in the command area would only be warm enough between mid-October and mid-April.

We estimate that on average, irrigation should be started no earlier than the second week of October, not for growth, but just enough to recharge the soil moisture to field capacity in anticipation of the growing season starting in mid-October. Once the soil moisture is recharged to field capacity, the monthly application depths from the soil moisture balance would be sufficient during the irrigation season to keep the plants from moisture stress so that growth is not inhibited. We have allowed for irrigation to continue to mid-April to maximise growth before it gets too cold. Using the soil moisture deficit profile and refined irrigation season length, we estimated the net required application depth profile over the year.

C. Irrigation Efficiency

We made assumptions about the way in which water will be applied to the land in the future and challenging assumptions have been made about many of the current practices. This is closely aligned to similar water allocation models being developed in other New Zealand agricultural regions that assume adoption of modern irrigation codes of practice. We assumed an average efficiency of 80%, taking into account both distribution efficiency (percentage of water reaching the farm gate compared to water leaving the source) and application efficiency (percentage of water retained in the root zone compared to water reaching the farm gate). Applying this efficiency, we developed a gross application depth profile.

6.4 Likely Future Mix of Agricultural Practices

It is likely that once a reliable water supply is established, changes in agricultural practices will occur over time, in some cases linked to ownership changes. The gross application depth profile described in the previous section would suit areas with high-intensity land use (such as pasture farming and nutraceuticals). However, areas with low-intensity land use (such as viticulture and lifestyle blocks) require lower application rates.

Therefore, to give a better representation of the required irrigation flow rates, we assumed that the future land use intensity split for the entire Lower Manuherikia Valley would be similar to the proposed Dairy Creek Irrigation Scheme, which has 60% of the irrigable area for high-intensity land use and 40% for low-intensity land use. We adjusted the application depths and hence the flow rates accordingly.

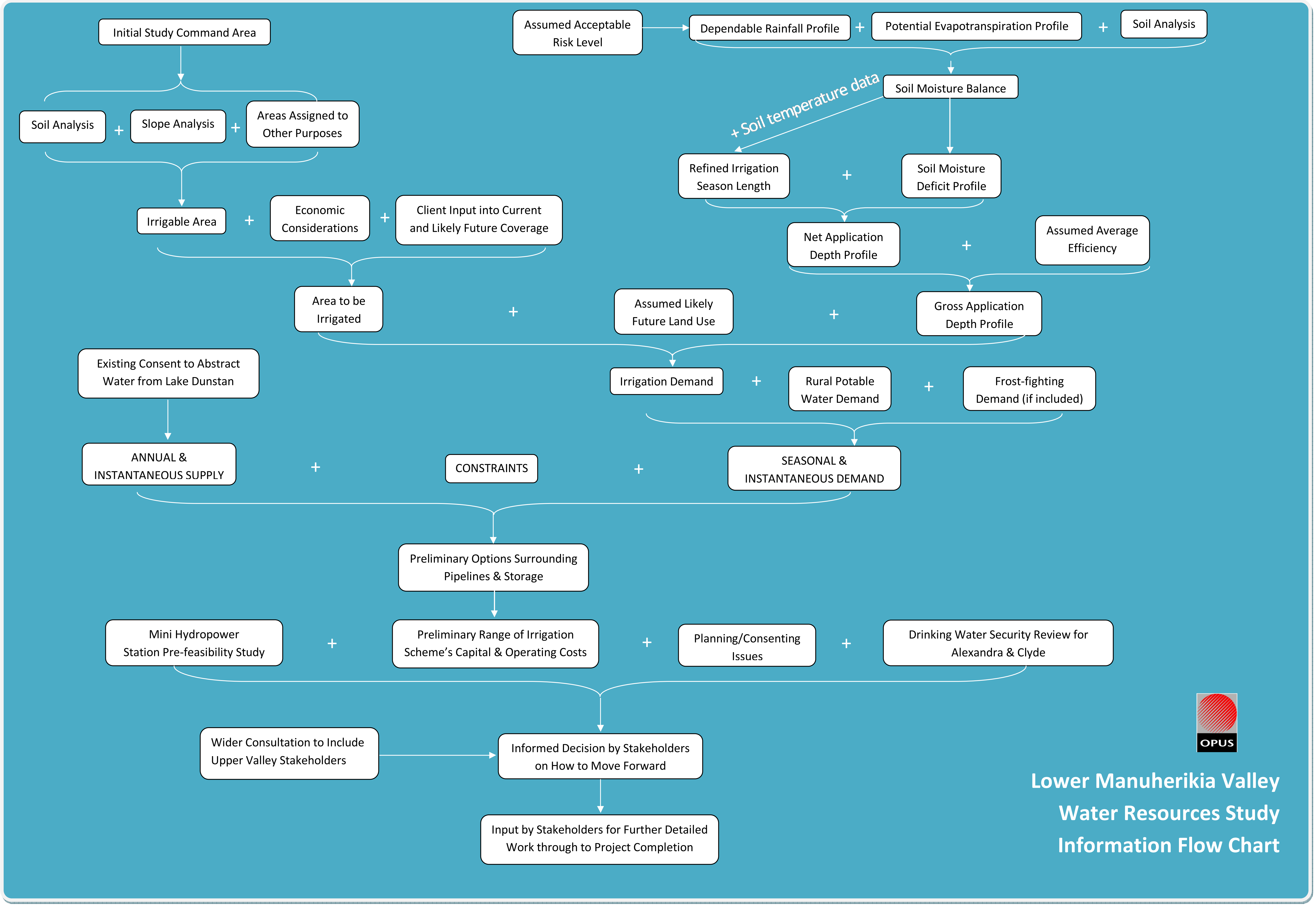
6.5 Water Demand

With the area to be irrigated, assumed likely future land use intensity, and gross application depth profile, we calculated the seasonal and monthly volumes required for irrigation. Assuming 20 hours per day pumping, we estimated the instantaneous flow rates required for irrigation. We then added the rural residential potable water demand, based on assumptions of 1,000 L per rural dwelling per day (based on ORC's advice, excluding curtilage irrigation) and 2,450 rural residential properties in the Lower Manuherikia Valley in the future (based on client input).

We considered several different scenarios, some of which did not include water for frost-fighting[2] (it was assumed that alternative methods might be considered). For scenarios that included water for frost-fighting, we assumed frost-fighting for five clusters of four nights per cluster, 9 hours per night, and 5 mm per hour. We excluded potable water for Alexandra and Clyde from our calculations because Central Otago District Council's decision on their raw water source was still uncertain.

Putting these various demands together, we generated a seasonal and instantaneous demand profile.

[2] In scenarios where we have not allowed for water for frost-fighting, there is actually sufficient pipe capacity and water allocation to supply water for frost-fighting for only part of the viticulture area.


Initial Study Command Area
Assumed Acceptable Risk Level
Dependable Rainfall Profile
+
Potential Evapotranspiration Profile
+
Soil Analysis
Soil Moisture Balance
+ Soil temperature data
Soil Analysis
+
Slope Analysis
+
Areas Assigned to Other Purposes
Refined Irrigation Season Length
+
Soil Moisture Deficit Profile
Irrigable Area
+
Economic Considerations
+
Client Input into Current and Likely Future Coverage
Net Application Depth Profile
+
Assumed Average Efficiency
Area to be Irrigated
+
Assumed Likely Future Land Use
+
Gross Application Depth Profile
Existing Consent to Abstract Water from Lake Dunstan
Irrigation Demand
+
Rural Potable Water Demand
+
Frost-fighting Demand (if included)
ANNUAL & INSTANTANEOUS SUPPLY
+
CONSTRAINTS
+
SEASONAL & INSTANTANEOUS DEMAND
Preliminary Options Surrounding Pipelines & Storage
Mini Hydropower Station Pre-feasibility Study
+
Preliminary Range of Irrigation Scheme's Capital & Operating Costs
+
Planning/Consenting Issues
+
Drinking Water Security Review for Alexandra & Clyde
OPUS
Wider Consultation to Include Upper Valley Stakeholders
Informed Decision by Stakeholders on How to Move Forward
Input by Stakeholders for Further Detailed Work through to Project Completion
Lower Manuherikia Valley
Water Resources Study
Information Flow Chart

7 Preliminary Design Options

We matched the available supply flow rates against the required demand flow rates, and put together several preliminary design options based on constraints at hand (which include available land for storage and financial viability). These preliminary designs were done for the primary purpose of establishing the feasibility of the scheme.

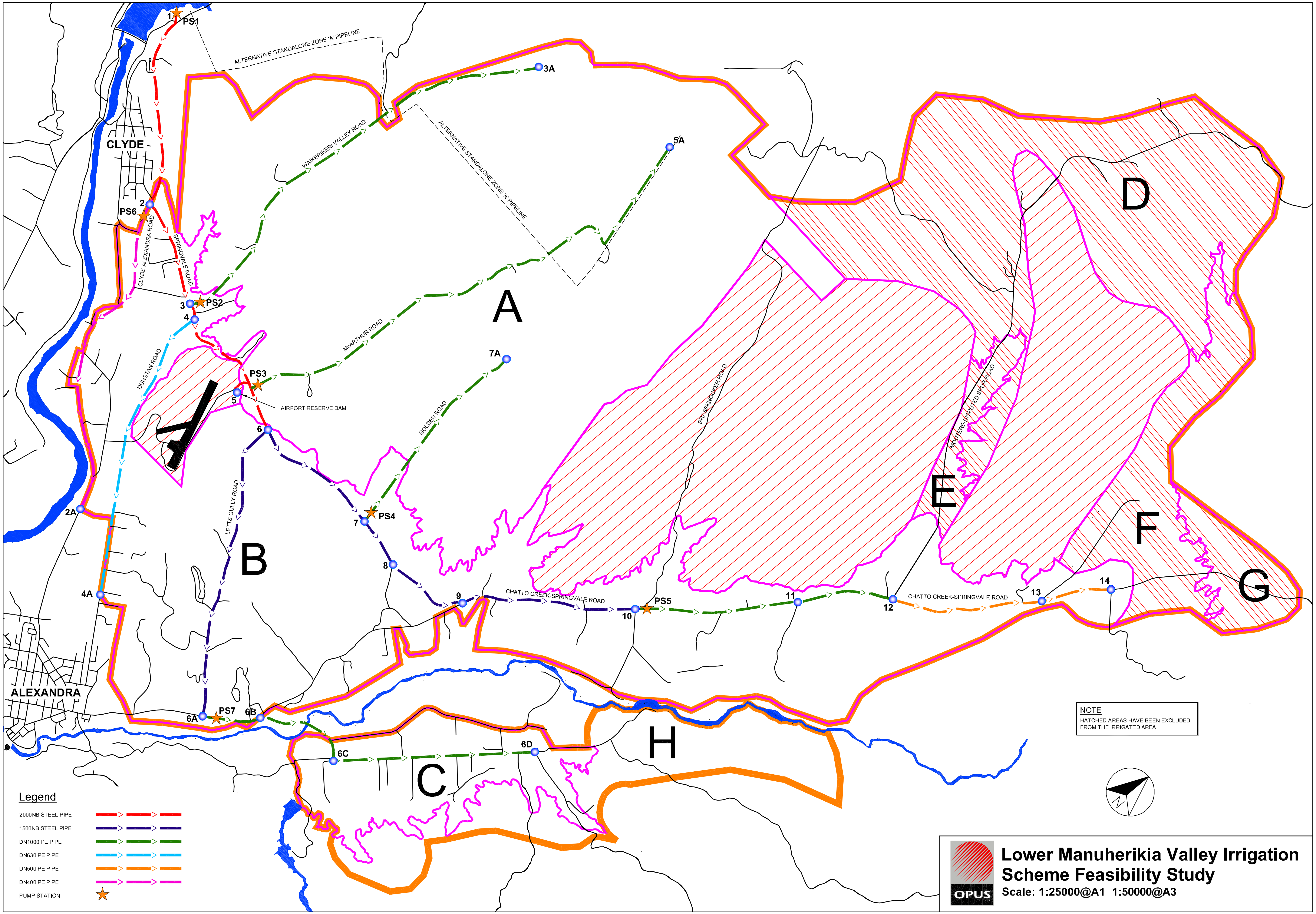
At this preliminary stage, we designed the system to provide a delivery pressure of 40m water to various points in the area to be irrigated. The figure at the end of Section 4 presents the locations of the pump stations and arterial pipeline routes. While we worked on various options through multiple iterations, we present a summary of our final five preliminary design options in Table 7-1.

Options P and R1 are the primary options from which the others are derived. Option Q is a variation of Option P with the proposed Dairy Creek Irrigation Scheme being a separate, standalone pipeline network with a separate intake structure and separate pumps. Similarly, Option S is a variation of Option R1 with the proposed Dairy Creek Irrigation Scheme being a separate, standalone pipeline network. Option R2 is a variation of Option R1 with higher pipeline velocities.

Table 7-1: Comparison of Final Five Options

Variables	Option P	Option Q	Option R1	Option R2	Option S
Basis of Design	Adjust flow rates to accommodate limited storage	Adjust flow rates to accommodate limited storage	Minimise flow rates	Minimise flow rates and pipe sizes	Minimise flow rates
Area To Be Irrigated (ha)[3]	8320	8320	6511	6511	6511
Standalone Dairy Creek	No	Yes	No	No	Yes
Required Storage	Airport Reserve Dam	Airport Reserve Dam	On-farm Shared Storage	On-farm Shared Storage	On-farm Shared Storage
Weighted Average of Peak Gross Application Rate (mm/day)	4.0	4.0	4.9	4.9	4.9
Calculation for High Intensity Land Use Net Application Rate	Crop factor of 1.0	Crop factor of 1.0	Adjusted peak to 5mm/day	Adjusted peak to 5mm/day	Adjusted peak to 5mm/day
Calculation for Low Intensity Land Use Net Application Rate	Crop factor of 0.8	Crop factor of 0.8	Adjusted peak to 2.2mm/day	Adjusted peak to 2.2mm/day	Adjusted peak to 2.2mm/day
Includes Water for Frost-fighting	No	No	Yes	Yes	Yes
Includes Urban Potable Water Needs	No	No	No	No	No
Includes Rural Potable Water Needs	Yes	Yes	Yes	Yes	Yes
Total Seasonal Demand (Mm^3/year)	48	48	57	57	57
Velocity Range in Main Pipelines (m/s)	1-2	1-2	1-2	2-3	1-2

[3] Refer to Section 6.2 for description of the included areas.


1
PS1
ALTERNATIVE STANDALONE ZONE 'A' PIPELINE
3A
CLYDE
WAIKERIKERI VALLEY ROAD
ALTERNATIVE STANDALONE ZONE 'A' PIPELINE
5A
D
2
PS6
CLYDE ALEXANDRA ROAD
SPRINGVALE ROAD
3
PS2
4
A
McARTHUR ROAD
7A
DUNSTAN ROAD
PS3
5
AIRPORT RESERVE DAM
GOLDEN ROAD
6
BRASSKNOCKER ROAD
MOUTERE-DISPUTED SPUR ROAD
E
PS4
7
LETTS GULLY ROAD
2A
F
B
8
G
9
CHATTO CREEK-SPRINGVALE ROAD
PS5
10
11
12
CHATTO CREEK-SPRINGVALE ROAD
13
14
4A
ALEXANDRA
6A
PS7
6B
H
6C
6D
C
NOTE
HATCHED AREAS HAVE BEEN EXCLUDED FROM THE IRRIGATED AREA
Legend
2000NB STEEL PIPE
1500NB STEEL PIPE
DN1000 PE PIPE
DN630 PE PIPE
DN500 PE PIPE
DN400 PE PIPE
PUMP STATION
OPUS
Lower Manuherikia Valley Irrigation Scheme Feasibility Study
Scale: 1:25000@A1 1:50000@A3

8 Preliminary Range of Cost Estimates

While our study did not include detailed engineering design, we modeled the design options to a point that a preliminary range of capital costs could be developed. Between our five options, Option Q had both the lowest capital and annual cost estimates. We present the preliminary range of capital costs for Option Q in Table 8-1. We have also estimated annual operating and maintenance (O & M) costs for Option Q, as presented in Table 8-2.

Table 8-1: Summary of capital costs for lowest cost option (Option Q)

Category	Description	Preliminary Range of Capital Costs ($mil)
1	Pump stations	8.6 to 9.1
2	Pipe work	48.3 to 50.4
3	Scheme Storage	2.4 to 3.0
4	Professional Fees[4]	4.8 to 6.1
5	Original Dairy Creek Irrigation Scheme Costs[5]	14.5 to 17.3
	Approximate Total Capital Cost ($mil)	**78.6 to 85.9**
	Irrigated Area[6] (ha)	8320
	Approximate Capital Cost per hectare ($'000)	**9.4 to 10.3**

Table 8-2: Estimated annual operating and maintenance costs for the lowest cost option (Option Q)

Category	Description	Estimated Annual Cost ($'000/year)
1	Power Consumption	656
2	Distribution and Transmission Line Charges	270
3	Administration	150
4	Maintenance[7]	664
5	Original Dairy Creek Scheme Annual Costs	1,359
	Approximate Total Operating Costs ($'000)	2,888
	Irrigated area (ha)	8,320
	Approximate Annual O&M Costs per ha ($/ha)	347

[4] The professional fees category includes professional engineering and planning services which is estimated at 4% of capital cost, as well as construction supervision, estimated at 4% of capital cost.

[5] The original Dairy Creek Irrigation Scheme costs have been extracted without adjustment from the joint Delta-Opus Dairy Creek Irrigation Scheme Design and Build Proposal prepared in 2007.

[6] The irrigated area includes the Dairy Creek area because the original Dairy Creek Irrigation Scheme costs have been included.

[7] Annual allocation into a maintenance fund based on assumptions of 1% of pipeline capital cost and 5% of mechanical equipment capital cost.

There are large differences in capital and operating costs between the various options, pointing to the importance of further refinement through community consultation to determine preferences for the available variables, followed by further engineering design. However, the preliminary cost estimates suggest the following:

- Having the Dairy Creek Irrigation Scheme as a separate pipeline network from the rest of the irrigated area appears to produce a lower total capital cost, but we note that the original Dairy Creek Irrigation Scheme costs in 2007 have not been adjusted to 2010 rates for materials and construction costs. As for the annual costs for options with the Dairy Creek Irrigation Scheme separate, our estimates are inconclusive, i.e. annual costs for such options might be higher or lower.
- Reducing pipe sizes by increasing pipe velocities would increase capital costs for pump stations, but reduce capital costs for pipe work, and likely leads to a decrease in the overall capital costs. However, reducing pipe sizes would significantly increase pumping requirements and hence operating costs, leading to increased overall annual costs. Over the life of the project, the higher annual costs outweigh the capital cost savings.

9 Mini Hydropower Station Pre-feasibility Study

Supplying irrigation water to the Lower Manuherikia Valley from Lake Dunstan frees up the Manuherikia Scheme water allocation currently abstracted at the Manuherikia Scheme intake from the Manuherikia River. This water could be used possibly in conjunction with the existing Manuherikia head-works infrastructure for hydropower generation. The purpose of such a system would be to feed the generated power into the local grid and either use:

- An embedded generation system, where the generated power is fed into the local grid and the revenue received from electricity companies is used to offset the operational costs of the irrigation scheme; or
- A self-supply system (where the irrigation scheme's pump stations use the generated power, rather than from the grid) and use the local grid just for transmission.

Our desktop pre-feasibility study investigated suitable turbine technology based on available flow and head, as well as historical hydrological data (amount and timing of available flow) and likely minimum environmental flows. We found that a proposed mini hydropower station at the site appears to be technically feasible, but recommend that a more detailed assessment be done to confirm this.

Our preliminary economic assessment based on the potential annual power output and common investment costs indicates that the proposed mini hydropower station might only be viable under certain conditions. New Zealand currently has low specific compensations (also called feed-in tariffs, which are what electricity companies pay to generators) relative to electricity prices. Therefore, self-supply significantly improves viability and the possibility of part or all of the generated electricity being used for self-supply should be investigated. Our sensitivity analysis suggested that its economic viability also depends highly on the financial conditions (discount rates and project financing) and specific compensation. It also showed that a short amortization period is unrealistic, especially with embedded generation schemes. We recommend that further investigation involves making initial contacts with relevant electricity companies and grid operators to refine cost and revenue estimates.

We also recommend further investigation into the planning framework surrounding the proposed mini hydropower station, such as resource consent requirements, consent conditions and the possibility of increasing winter abstraction volumes.

10 Drinking Water Security Review for Alexandra and Clyde

We understand that Central Otago District Council is considering Lake Dunstan among several other alternatives as a possible drinking water source for Alexandra and Clyde. Therefore, part of our brief was to investigate the possibility of providing domestic water for Alexandra and Clyde (as well as lifestyle blocks in between the two townships) with water supplied under the consented abstraction from Lake Dunstan.

On the basis of available water quality data, the water from Lake Dunstan is suitable for drinking water after treatment. There is no evidence that the water contains chemical contaminants which would be of public health concern. However, from time to time, the water has increased turbidity, and there are discharges from the community wastewater systems upstream of the abstraction point. For use as a drinking water supply, treatment would be required to remove particulate material, including protozoa and to disinfect the water for microbiological contaminants.

A preliminary assessment of the catchment indicates that to meet the requirements of the Drinking Water Standards for New Zealand (DWSNZ), treatment would need to provide protozoa removal of between 3 and 5-log. This cannot be confirmed until a detailed catchment assessment or protozoa monitoring is undertaken. Conventional treatment and membrane filtration have been identified as the options that would provide the level of treatment required. It is considered that membrane filtration followed by UV disinfection with chlorination would be the most suitable option to provide 5-log protozoa removal. Membrane filtration with chlorination would be suitable if only 3-log or 4-log protozoa removal is required.

Three scenarios were developed:

- Scenario A would require the construction of a 26 million litres per day (MLD) treatment plant at Clyde and provision of treated water to Clyde and to Alexandra via a 10 kilometre pipeline at a total cost of approximately $19M.
- Scenario B would require the construction of a 26 MLD treatment plant adjacent to a proposed irrigation storage reservoir at Muttontown and supply of treated water to both Clyde and Alexandra via pipelines at a total cost of approximately $16.5M.
- Scenario C would require the construction of treatment plants at Clyde at a cost of approximately $5M and Alexandra at a cost of approximately $9M.

The favoured option is Scenario B because it has the lesser cost of thesingle treatment plant options (Scenario A and B). Compared to Scenario C which requires the operation of two treatment plants, the single treatment plant options have a considerable advantage of having significantly reduced operational costs and greater flexibility to provide water to lifestyle properties between Clyde and Alexandra.

Scenario B would utilise water stored for irrigation and would require a mutually beneficial agreement with the Lower Manuherikia Valley Irrigation Scheme.

11 Conclusions and Recommendations

This study has provided the basis upon which a community-based decision process can commence with regards to the water resource management of the Lower Manuherikia Valley, and the various features and factors that need to be taken into account investigated in some detail.

We have presented a summary of the consenting framework which is likely to shape the decisions made surrounding water resource management in the valley. Our pre-feasibility study for mini hydropower generation using the existing Manuherikia River consented take and associated existing head-works showed that it had potential and should be investigated in more detail. Our drinking-water security review concluded that water sourced from Lake Dunstan is suitable for drinking water after treatment, and presented preliminary costs for suitable treatment options.

We have also presented our design process that allowed broad-brush determination of where water will be needed in the valley and at what application depth (and thus quantify the water demands). We then presented several options and prepared a preliminary range of capital costs and annual costs for these options to assist the community in making informed decisions to move forward.

Water abstraction from Lake Dunstan provides some elevation advantage being above part of the area to be irrigated. Nevertheless, there is a large proportion of the land that will require the water to be pumped. This obviously has a significant long-term operational cost per hectare implication for the life of any proposed system. Furthermore, the initial capital cost will be spread over many years depending on how the scheme is financed. The equitable distribution of these costs across the ownership of the scheme will create a value of water that has not previously had high consideration during water management decision making. Because of the increased value of water, this scheme will effectively make the efficient and effective management of water a critical factor in the overall agricultural and land ownership decision-making process.

The long-term benefits of this infrastructure work, both commercial and environmental, will really fall with future generations of water users. If the associated costs fall only with the current generation, it is unlikely that these improvements will be materialized, and hence, a higher level view will be necessary, with possibly some form of government funding support.

Although this report has considered a number of options for the mechanics of water distribution in the valley to establish some form of capital and operational costing, this report is not a detailed engineering design, and hence any costing are of a rough order. The intent of this study has been to provide a basis for further investigation of the various options considered and future detailed engineering design of a suitable solution.

Arising from the general conclusions about the feasibility and cost of a scheme to meet the water resource needs of the valley, we recommend that the community proceeds with a process of close consultation that includes surveying of current landholder practices and future intent, establishing landowner buy-in to better refine the actual areas to be irrigated, and working out acceptable risk levels. The community as a whole needs to stay engaged with this process to ensure a suitable outcome is achieved to meet the deadline of 2021.

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