REPORT

Greater Wellington Regional Council

Wairarapa Water Use Project:
Options Refinement Phase
Summary Report

Report prepared for:

Greater Wellington Regional Council

Report prepared by:

Tonkin & Taylor Ltd

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Glossary

Abbreviations

DOC	Department of Conservation
GWRC	Greater Wellington Regional Council
MCA	Multi-Criteria Analysis (a basis for ranking and comparing schemes)
MCM	Million Cubic Metres
QEII	QEII National Trust open space covenants
SAG	Stakeholder Advisory Group (WWUP)
T&T	Tonkin & Taylor Limited
WWUP	Wairarapa Water Use Project

Terminology

Command area	Equivalent to "indicative irrigable area" as defined below, and used interchangeably within the current report
Dead storage	Portion of reservoir volume *un*available for consumptive use
Distribution system/network	Conveyance structures, comprising existing rivers, canals, races and pipework (located downstream of the reservoir) that transfer flow from the reservoirs to the indicative irrigable areas
Gross storage	Sum of dead and live storage
Harvesting	Transferring water to a storage from a nearby stream/river located in a different catchment. Note definition is different from the Proposed Regional Policy Statement, which uses harvesting to refer to on-river storage also.
Headworks	Storage reservoir, dam structures required to impound the reservoir, and any intakes, conveyances and pumpstations (if required) to "harvest" water to fill the reservoir
Indicative irrigable area	The gross area that could be irrigated, defined for the purposes of the current study using land slope
Live storage	Portion of reservoir volume available for consumptive use (excludes dead storage)
Net irrigated area	The portion of indicative irrigable area expected to actually be irrigated, after accounting for buildings, tracks, hedges etc
Own catchment infill	Flow available from the local catchment of a stream on which a dam is situated
Refill reliability	Refers to the reliability or frequency with which a reservoir is completely filled. Refill reliability can be expressed as an

	Average Recurrence Interval or Annual Exceedance Probability of a failure to fill to full supply level. Refill reliability may or may not impact on supply reliability.
Reservoir	A natural or artificial pond or lake used for the storage and regulation of water, used interchangeably with “storage” within the current report in some contexts
Direct / run-of-river take	Abstraction occurring directly from a river or stream and that has no significant storage component
Scheme	Headworks and associated distribution network to transfer water from storages to an indicative irrigable area
Supply reliability	Refers to the ability of a scheme to supply water to the desired demand. A shortfall could be expressed either in terms of units of discharge or in terms of volume to be supplied over a given period of time, or more complex criteria. Supply reliability can be expressed as an Average Recurrence Interval or Annual Exceedance Probability of a shortfall event.
Uptake	The commitment of water users to use (buy) water from the scheme

1 Introduction

1.1 Introduction

Tonkin & Taylor (T&T) has been engaged to undertake an Options Refinement Phase for the Wairarapa Water Use Project (WWUP), which was introduced as a follow-up to the Options Identification and Analysis Phase prior to the next stage of investigations, for reasons described more fully below. The approach, findings and recommendations from the Options Refinement Phase are summarised in this report, and described in more detail in the full Options Refinement Report (T&T August 2013).

The Options Refinement Phase builds on earlier work documented in the Scheme Options Identification and Analysis Summary Report (T&T, April 2013a) and Scheme Options Identification and Analysis (Full) Report (T&T, April 2013b). The methodology used in this Options Refinement Phase is generally consistent with the approach described in these previous reports, and the detail is not repeated in this report except in specific instances where the methodology has been refined. These earlier reports also provide more information on the background to the WWUP.

Ten possible storage sites were developed and assessed as single-storage schemes, six of which were also assessed as part of a multi-storage scheme concept. One of these possible storage sites represents a smaller version or 'subset' of another site.

The need for water across the valley has been considered, and the multi-storage scheme concept represents a first-cut arrangement to meet those needs that have been identified as higher priority within the valley as part of a long-term development plan. This integrated, whole of catchment approach to development has been considered to help highlight where smaller-scale development, driven by the needs in a localised area, could have potential implications for development in other areas in the valley. The single-storage schemes have been developed as independent options for the purposes of comparison and prioritisation of individual storage sites. The findings from developing the single-storage and multi-storage scheme concepts have both been considered in determining recommendations for future phases of work.

1.2 Options Refinement Phase

The decision to undertake an Options Refinement Phase emerged from the recommendations set out in the Scheme Options Identification and Analysis Report and feedback on that report from GWRC's peer reviewers, Stakeholder Advisory Group (SAG), Leadership Group (LG) and Working Group (WG), and the key findings presented at meetings with the SAG and LG during March 2013.

A list of potential tasks was identified by T&T based on findings from the Options Identification and Analysis Phase, and following feedback from the groups identified above, the scope below was agreed upon:

- Review any design criteria or assumptions with the potential to influence scheme selection for future phases of work;
- Reconsider storage options in the Tauweru Valley catchment and, on confirmation, bring investigation of any promising schemes up to the same level as the other sites;
- Update analysis of water demand and water availability;
- Optimisation and refinement of single-storage scheme sizes;
- Development of a multi-storage scheme concept;

- Consideration of a 70% weighting scenario on environmental, social and cultural themes as part of the sensitivity assessment undertaken for the Multi-Criteria Analysis.

All the tasks undertaken during Options Refinement are aimed at assisting WWUP in making a well-informed decision on which storages, intakes and distribution networks should be considered in more detail in the next phases of work. This decision requires a clear understanding of where the greatest demand for water is, where additional water can add the most value in terms of potentially increased production, where and how the most cost-effective schemes can be developed to service these areas, and how these schemes may fit into a long-term development plan to provide water to where it is needed across the Wairarapa Valley.

The information and recommendations presented in this report form one part of the information that the WWUP Project Team, the SAG and the LG will consider in determining whether to proceed with further investigations.

It is emphasised that even if the decision is taken for the WWUP to proceed to the next phase of investigations, the current level of assessment represents an early stage in any project development and does not imply any commitment to seek resource consents or proceed through to construction.

At this preliminary phase of the project, the potential effects of land use intensification have not been investigated, but it is recognised that this will be a key aspect during further investigation phases.

1.3 Assumptions and Limitations

The work undertaken in the Options Refinement Phase is based on a large number of assumptions and criteria regarding water demand estimates, water availability, scheme service parameters (reliability, water pressure etc.), and engineering design criteria, which it is acknowledged have the potential to change during later phases of work and more detailed investigations. In addition, GWRC is currently reviewing policies around water allocation and minimum flows as part of its Regional Plan review process. The work undertaken on the WWUP to date has made assumptions on water allocation scenarios that may change.

Furthermore, the work undertaken on the relative cost of potential schemes is extremely preliminary due to the number of uncertainties at this early stage of investigation. The relative cost estimates to date have been developed purely for the purpose of comparing schemes. The scheme arrangements have been developed to a concept level suitable for comparison of options only, and significant modifications to arrangements can be expected during later investigation, consultation and design stages.

2 Scheme Arrangements

2.1 Introduction

Fifteen possible storage sites have been considered during the Options Refinement Phase, as shown in Figure 2-1. The 15 sites considered are as follows:

- Five sites in the upper tributaries of the Tauweru River Catchment: Site 1 Ngaumu, Site 10 Tividale, Site 27 Kaumingi, Site 36 Rorokoko, and Site 240 Mangarei[1].
- Nine sites selected during the Options Identification and Analysis Phase: Site 53 Te Ore Ore, Site 74 Mauriceville West, Site 79 Dorsets Road, Site 135 White Rock Road, Site 175 Martinborough South, Site 197 Te Mara, Site 200 Kiriwhakapapa, Site 210 Black Creek, and Site 215 Mangatarere.
- A smaller version of Site 210 Black Creek, referred to as Site 206 Wakamoekau. While Site 206 Wakamoekau is located within the reservoir footprint of Site 210 Black Creek, it differs fundamentally in that Site 210 Black Creek extends across a saddle to cover both the Black Creek and Wakamoekau Creek valleys whereas Site 206 Wakamoekau is located entirely within the Wakamoekau Creek valley. Both sites have been progressed as options in the assessment.

[1] The numbering used to identify possible storage sites is consistent with previous phases of work when a larger number of options was under consideration.

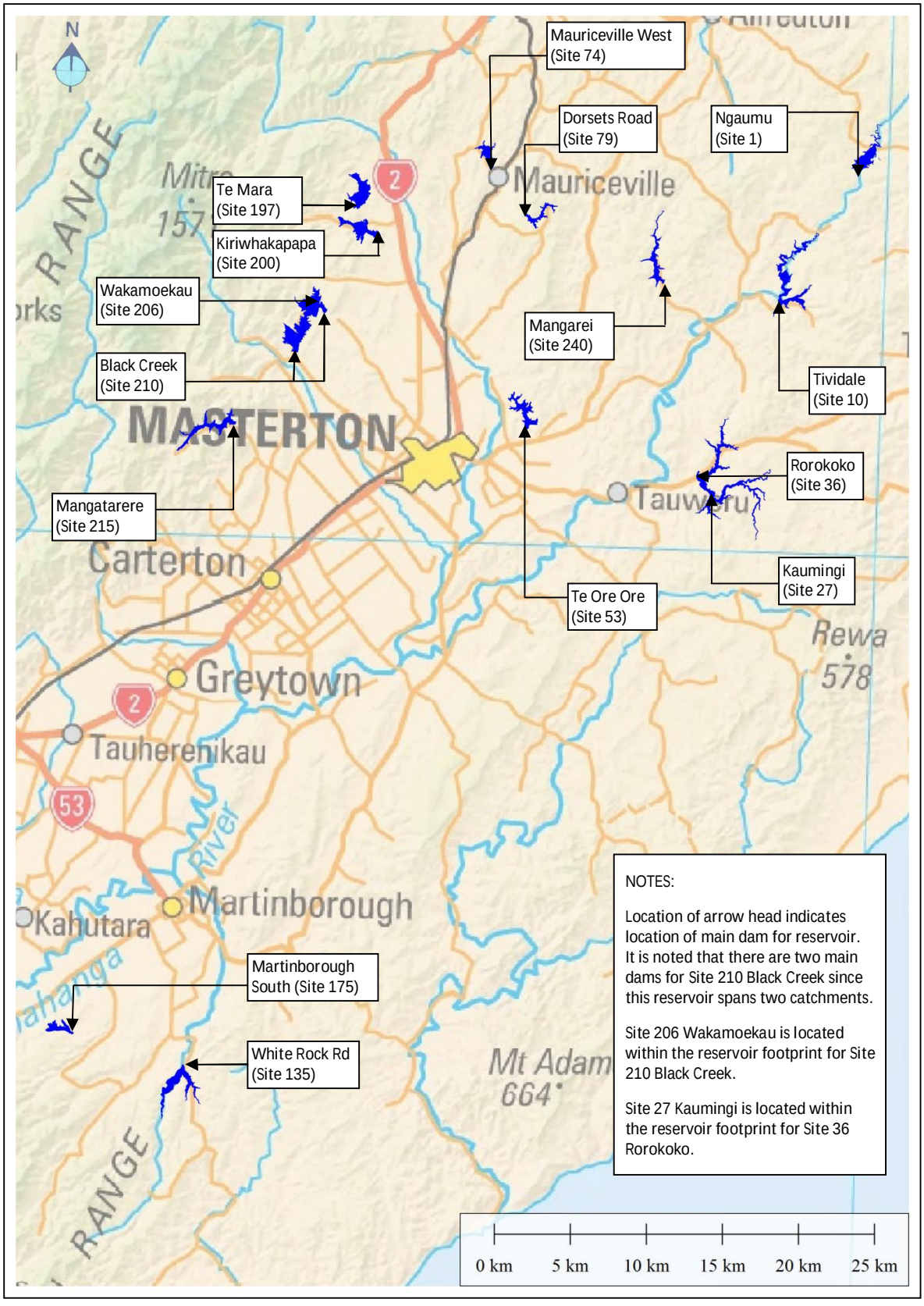

Figure 2-1 Location of storage site options considered in the Options Refinement Phase

Work undertaken during the Options Refinement Phase has resulted in the 15 sites being reduced to a refined list of 10 possible sites. The following sites are not recommended as being in the top 10 sites:

- Site 74 Mauriceville West and Site 79 Dorsets Road. These sites have been assessed as being unrealistically expensive compared with the other sites under consideration, and would provide only small volumes of storage, close to the minimum under consideration for the WWUP. Site 79 Dorsets Road is anticipated to become even less financially favourable at larger sizes. Site 74 Mauriceville West is expected to be more financially favourable at a larger size, but has been constrained to provide a buffer around the cemetery.
- Site 1 Ngaumu, Site 27 Kaumingi and Site 36 Rorokoko. Because of constraints in relation to distribution, all the Tauweru Catchment storage options would be expected to supply similar irrigable areas in the Wairarapa Valley. Accordingly it is not necessary to take all options forward. These three sites have been removed from further assessment because they are considered to be significantly less favourable than the other two options in the Tauweru River Catchment (Sites 10 Tividale and 240 Mangarei) based on a preliminary assessment of environmental, social, cultural, geotechnical risk, and financial themes.

The remaining 10 possible storage sites have been developed and assessed as single-storage schemes during the Options Refinement Phase. Six of the sites have also been assessed as part of a multi-storage scheme. The reasons for developing both single-storage schemes and a multi-storage scheme are described in the following sections on scheme arrangements.

The single-storage scheme assessment was completed in advance of developing the multi-storage scheme concept, and is not influenced by whole of catchment considerations. Conversely however, some aspects of the single-storage scheme assessment have influenced development of the multi-storage scheme arrangement; specifically, the optimisation of headworks on a capital cost basis has influenced selection of storages to be included in the multi-storage scheme, tempered by consideration of spatial requirements to minimise distribution costs. The findings from the single-storage scheme assessment and the multi-storage scheme concept have both been considered in determining recommendations for future phases of work.

2.2 Single-storage Scheme Arrangements

The single-storage schemes each comprise a single storage supplying an indicative irrigable area. These schemes have been developed as independent options for the purposes of comparison and prioritisation of individual storage sites. The indicative irrigable areas identified for the single-storage schemes have been selected on the basis of the area that can be irrigated most cost-effectively from the relevant storage. As the locations of the selected storage reservoirs for the 10 schemes are not evenly distributed around the valley, the associated distribution areas tend to overlap, and significant areas of the Wairarapa Valley are not covered. Table 2-1 presents the storage sizes, sources of water, indicative irrigable area and volume of water supplied in a drought year for each of the single-storage schemes. Figure 2-2 presents the location of the single-storage schemes.

Although the 10 single-storage schemes are all shown on the one figure (Figure 2-2), it is not expected that all 10 options could be developed in combination as they currently stand. Rather, the degree of overlap of the indicative irrigable area for each scheme shown in Figure 2-2 is intended to provide an indication of where there are a large number of storage options relatively close to a potential area for irrigation. For instance, Figure 2-2 illustrates that the northern part of the Wairarapa Valley is expected to represent the most cost-effective indicative irrigable area for multiple storage options. The areas with no coverage or little overlap, such as around Greytown, illustrate where there are limited storage options under consideration nearby, and supplying these areas is likely to involve a relatively longer, more expensive distribution network from a more distant storage site. The degree of overlap provides guidance in selecting storage sites to include in the multi-storage scheme, which is described following. Assessment of the single-storage scheme concepts also allows comparison to inform favourability of smaller scale development options if the multi-storage scheme concept does not progress.

Table 2-1 Top ten single-storage schemes assessed in the Options Refinement Phase

Storage	Location of storage	Live storage size	Water supply source	Indicative irrigable area (net)	Volume of water supplied for irrigation in a drought year
Site 10 Tividale	Tauweru River, downstream of the confluence with Mangapurupuru Stream	25.9 MCM	Own catchment infill	6,900 ha	27.7 MCM
Site 53 Te Ore Ore	Unnamed tributary of Whangaehu River	16.4 MCM	Own catchment infill & harvesting from Ruamahanga River at up to 1,200 l/s	4,200 ha	20.1 MCM
Site 135 White Rock Road	Confluence of Makara River & Mangapari Stream	26.0 MCM	Own catchment infill	6,200 ha	29.1 MCM
Site 175 Martinborough South	Unnamed tributary to Dry River	4.9 MCM	Own catchment infill & harvesting from Ruamahanga River at up to 300 l/s	1,300 ha	6.2 MCM
Site 197 Te Mara	Te Mara Stream	23.1 MCM	Own catchment infill & harvesting from Ruamahanga River at up to 1,100 l/s	6,200 ha	28.8 MCM
Site 200 Kiriwhakapapa	Kiriwhakapapa Stream	16.1 MCM	Own catchment infill	4,100 ha	18.4 MCM
Site 206 Wakamoekau	Wakamoekau Creek	20.7 MCM	Own catchment infill & harvesting from Waingawa River at up to 1,300 l/s	5,900 ha	26.4 MCM
Site 210 Black Creek	Black Creek and Wakamoekau Creek	47.5 MCM	Own catchment infill & harvesting from Waingawa River at up to 4,200 l/s	13,100 ha	59.3 MCM
Site 215 Mangatarere	Mangatarere Stream	29.6 MCM	Own catchment infill	7,000 ha	33.7 MCM
Site 240 Mangarei	Mangareia Stream	9.1 MCM	Own catchment infill	2,200 ha	10.0 MCM
Total		219 MCM		57,100 ha (if rearranged so no overlap)	260 MCM

Note 1: MCM = million m^3

Note 2: Volume supplied on-farm in a drought year, represents the maximum annual volume supplied on-farm during the 30 years simulated in the supply-demand modelling (adjusted for 5% distribution losses)

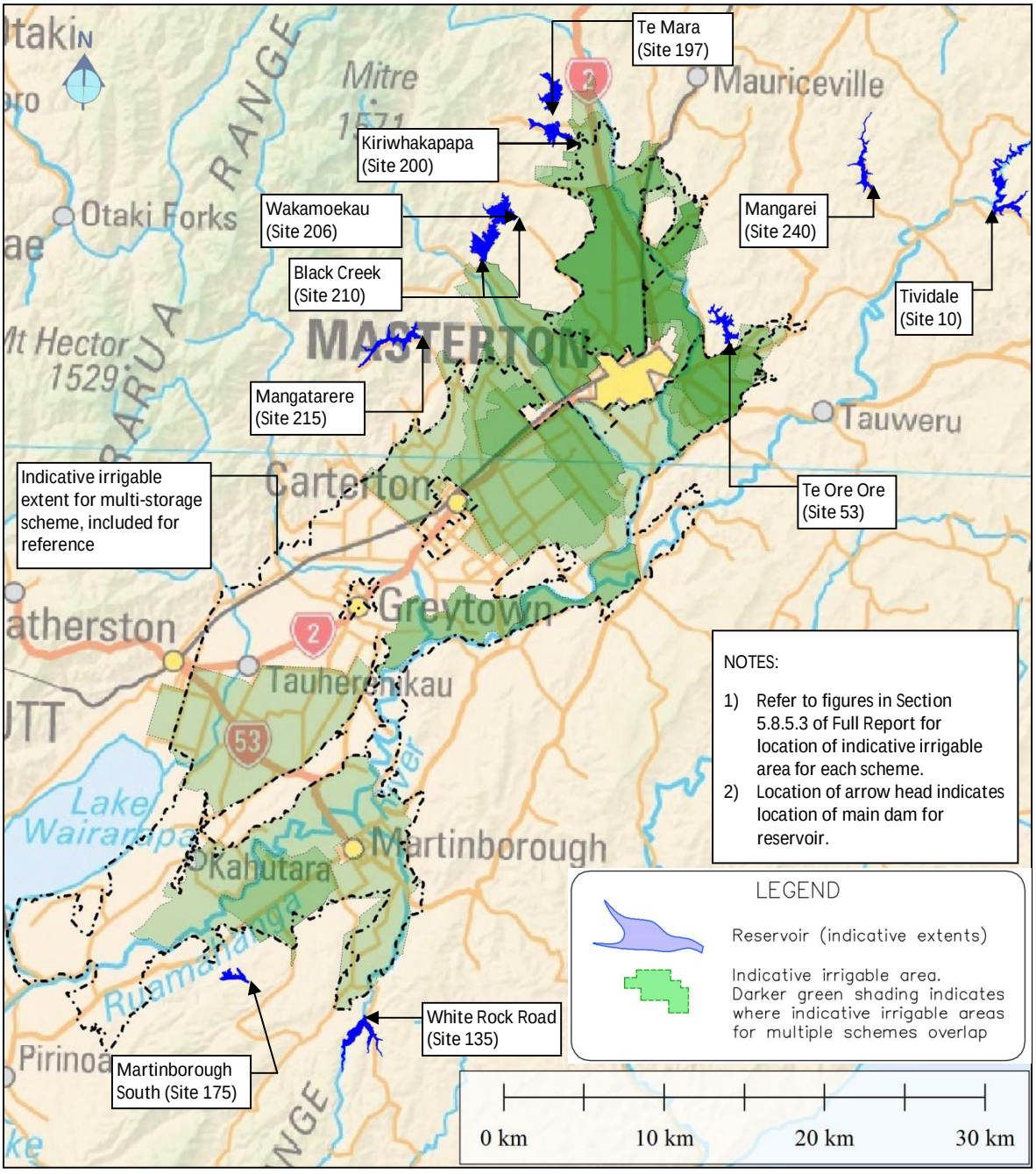

Figure 2-2 Location of top ten single-storage schemes assessed during the Options Refinement Phase

2.3 Multi-storage Scheme Arrangement

In the Options Refinement Phase, T&T was tasked with developing a concept for a multi-storage scheme that comprises multiple storages supplying a distribution network covering the high and medium priority areas for irrigation identified within the Wairarapa Valley study area. The multi-storage scheme that has been developed includes six of the 10 storages analysed as single-storage schemes, and a distribution system covering most of the valley. It is expected that the extent of the scheme that has been developed in this phase of work is an upper-bound and would be refined during future phases of work as water demand is investigated further and relatively expensive "pockets" of irrigable area (where the benefit does not justify the cost) are removed, such as where a substantial river crossing would be required to supply a small area of land.

As noted above, the selection of storages for inclusion in the multi-storage scheme has been informed by some aspects of the single-storage scheme assessment, specifically the optimisation of headworks, which examined cost-effectiveness across a range of storage sizes. The selection has also been tempered by spatial requirements across the study area to minimise distribution costs. It is noted that the storages are matched to a different irrigable area for the multi-storage scheme than for the single-storage schemes, and correspondingly, differ in size.

A number of variants have been considered for the multi-storage scheme that incorporate, to varying degrees, direct river takes[2] to supplement supply of water from the reservoirs. These variants are:

- Variant 1 incorporates 11 direct takes from the Kopuaranga River, Waingawa River, Waiohine River, Tauherenikau River, Whangaehu River, Tauweru River, and the Ruamahanga River at five locations across the study area.
- Variant 2 incorporates two direct takes from the Waingawa River and Waiohine River.
- Variant 3 does not rely on any direct takes, but assumes all water is supplied from storage.

The multi-storage scheme developed for this Options Refinement Phase is a first-cut arrangement. It is intended to demonstrate a proof of concept, and to provide a preliminary indication of how much more expensive it might be to develop a multi-storage scheme compared with the more cost-effective single-storage schemes. The multi-storage scheme concept also provides insights into how development of irrigation over the valley could be staged. Table 2-2 presents the storages, direct takes, storage sizes, sources of water, indicative irrigable extent and volume of water supplied in a drought year for the multi-storage scheme. Figure 2-3 presents the multi-storage scheme arrangement assessed (Variant 2 shown).

The indicative irrigable areas identified for the 10 single-storage schemes sum to 57,100 ha (net) if rearranged to avoid overlaps. This can be compared with the net potential irrigable extent targeted for the multi-storage scheme, which is 44,500 ha, to provide an indication of the degree of redundancy and surplus storage options that have been assessed.

[2] A direct or run-of-river take represents an intake on a river into a distribution network, from which flow is abstracted directly to a potential irrigable area without being stored. Abstraction only occurs when water demand and water availability occur at the same time.

Table 2-2 Multi-storage scheme (Variant 2)

Water source	Location of storage	Live storage size	Water supply source	Indicative irrigable extent (net)	Volume of water supplied for irrigation in a drought year
Storage site 10 Tividale	Tauweru River, downstream of the confluence with Mangapurupuru Stream	43.9 MCM	Own catchment infill	44,500 ha	208.2 MCM
Storage site 135 White Rock Road	Confluence of Makara River & Mangapari Stream	35.3 MCM	Own catchment infill		
Storage site 197 Te Mara	Te Mara Stream	22.3 MCM	Own catchment infill & harvesting from Ruamahanga River at up to 1,100 l/s		
Storage site 206 Wakamoekau	Wakamoekau Creek	24.1 MCM	Own catchment infill & harvesting from Waingawa River at up to 1,800 l/s		
Storage site 215 Mangatarere	Mangatarere Stream	35.9 MCM	Own catchment infill		
Storage site 240 Mangarei	Mangareia Stream	18.8 MCM	Own catchment infill		
Total storage volume:		180.3 MCM			
Direct take from Waingawa River at up to 4,000 l/s					
Direct take from Waiohine River at up to 8,100 l/s					

Note 1: MCM = million m^3

Note 2: Volume supplied on-farm in a drought year, represents the maximum annual volume supplied on-farm during the 30 years simulated in the supply-demand modelling (adjusted for 5% distribution losses)

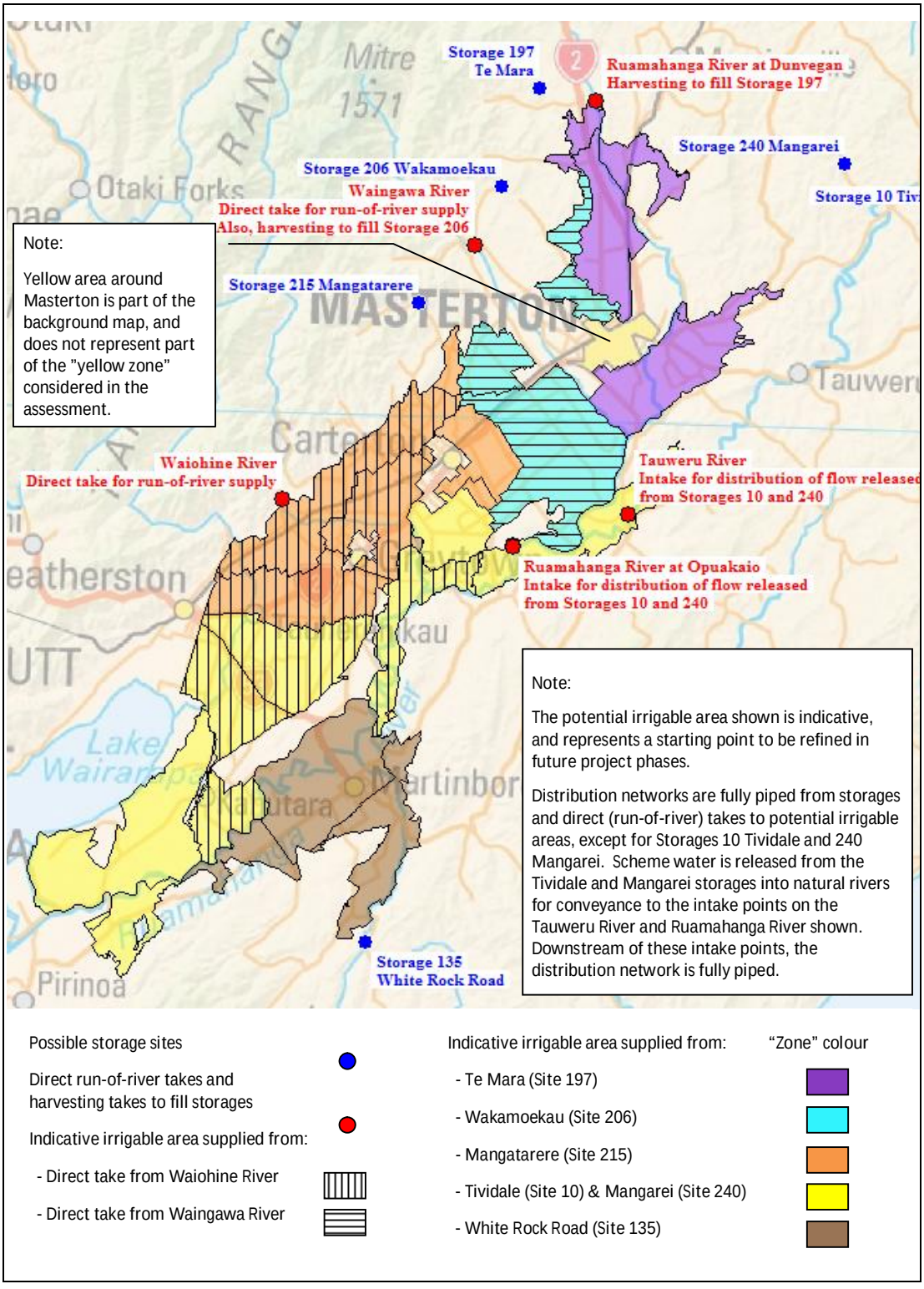

Figure 2-3 Multi-storage scheme arrangement (Variant 2)

3 Tasks Completed and Conclusions

3.1 Single-storage Scheme Conclusions

The key tasks that have been undertaken in the single-storage scheme assessment are as follows:

- An optimisation exercise has been completed examining how the relative cost-effectiveness of headworks for each of the top 10 storage options is likely to vary across a range of storage sizes and corresponding command areas. The findings from this exercise were used to select the storage sizes listed in Table 2-1.
- Supply-demand modelling over a 30 year period has been undertaken to match the storage sizes selected to an extent of indicative irrigable area that can be serviced at a particular target level of supply reliability. The sum total live storage assessed for the top 10 schemes in combination is 219 MCM, sufficient to irrigate a total area of 57,100 ha (net), if the indicative irrigable areas identified for each scheme were rearranged to avoid overlaps.
- Comparative construction cost estimates and preliminary assessments of environmental, social and cultural impacts have been undertaken for the top 10 single-storage schemes at the optimised sizes adopted as above. These findings were used in the multi-criteria analysis described below.
- A multi-criteria analysis (MCA) has been completed that compares the schemes based on environmental, social, cultural and financial themes. Opportunities and risks have also been considered separately.

The MCA "scores" are summarised in a table in Appendix A. The key conclusions from the MCA are:

- There is relatively little difference between the financial favourability of the top 10 schemes based on construction cost, especially if only the top nine schemes are considered (excluding Site 53 Te Ore Ore). The scheme that ranked 9th on a relative cost basis (Site 240 Mangarei) is only 16% more expensive than the top-ranked scheme (Site 10 Tividale) (in terms[3] of comparative \$/m^3 of water supplied in a drought year).
- The MCA incorporated a sensitivity analysis, considering a number of alternative weighting scenarios for the environmental, social, cultural and financial themes. The assessment indicated that there is relatively little difference between the top 10 schemes, especially if only the top nine schemes are considered (excluding Site 53 Te Ore Ore), in terms of the overall MCA scores (based on the environmental, social, cultural and financial themes combined) for any one weighting scenario, and also relatively little difference across the weighting scenarios considered.

Because there is relatively little difference between the top 9 single-storage schemes on balance after considering environmental, social, cultural and financial themes, the spatial distribution of the storages and how they best service the multi-storage scheme has been considered and has effectively had a greater influence on the selection of recommended storages for further investigation. This is addressed in Section 3.2.

[3] The comparative cost estimates completed during the Options Refinement Phase have been assessed in terms of \$/m^3 supplied on farm in a drought year in order to provide a common basis for comparing the cost-effectiveness of schemes of different sizes.

3.2 Multi-storage Scheme Conclusions

The key tasks that have been undertaken in developing the multi-storage scheme are as follows:

- Development of a first-cut concept arrangement, as supported by supply-demand modelling described below.
- Supply-demand modelling over a 30 year period. The results from the assessment have been used in multiple ways:
  - The modelling has provided guidance on how the storage requirements vary across the study area to meet a target level of supply reliability. This has supported decisions on which storages are incorporated for the first-cut concept and identifying linkages to irrigable areas, although noting that selection of storages was also informed by the comparison of cost-effectiveness of the 10 storage sites undertaken as part of the single-storage scheme assessment. It is noted that the storages are matched to a different irrigable area for the multi-storage scheme than for the single-storage schemes, and correspondingly, differ in size. The total live storage of the six sites included in the scheme for Variant 2 is 180 MCM.
  - The modelling has estimated the potential contribution from run-of-river intakes. The two direct run-of-river takes supply approximately 6% of the irrigation water delivered on-farm for Variant 2.
  - The modelling provides guidance on the likely level of refill reliability. Based on the modelling completed, it is anticipated that the storages would be completely refilled each year in general, but at least every two to three years during severe dry periods.
  - Aside from guiding selection and sizing of storages and direct takes, the supply-demand modelling also provided information that informed the comparative construction cost estimates, such as spillway requirements and design flows for distribution and harvesting infrastructure.
- Comparative construction cost estimates have been developed for the multi-storage scheme for Variant 2, incorporating two of the largest and most reliable direct take options, and Variant 3, based on supply from storage only with no direct takes. The estimates also considered the variation in cost-effectiveness across the study area.

An inference from the supply-demand modelling is that if the indicative irrigable extent and level of refill reliability currently adopted for the multi-storage scheme is retained, based on the current demand model, there is limited scope to reduce the water supply sources currently adopted. The water supply sources are represented by the storages under consideration, which each capture water from their local catchment, the harvesting take points to fill storages from nearby catchments, and to a lesser degree (because of limited water availability when it is needed), the direct run-of-river takes. It is inferred that there is limited scope to reduce the number[4] of storages under consideration without substituting additional water supply sources. However, it is noted that the indicative irrigable extent and the demand model adopted for the multi-storage scheme are considered to be upper-bound. Reductions in the demand assumptions or irrigable area would reduce the storage requirement.

[4] Catchment size and other factors influencing water availability are also relevant.

The preliminary, comparative, construction cost estimates developed for the multi-storage scheme for Variant 2, incorporating two of the largest and most reliable direct take options, and Variant 3, based on supply from storage only with no direct takes, indicate the following:

- The multi-storage scheme is more cost-effective without the direct takes i.e. Variant 3 of the multi-storage scheme is more cost-effective than Variant 2. Although 6% of the demand is supplied by the two direct run-of-river takes for Variant 2, the savings this provides by allowing a reduction in storage size relative to Variant 3 (which assumes no direct takes) are outweighed by increases in distribution costs. Based on this first-cut assessment, the direct takes do not appear worth investigating further except in specific cases where the takes can utilise the distribution network already required for supply from storages.
- The multi-storage scheme is less cost-effective than the typical single-storage scheme. The current estimate indicates that the multi-storage scheme (Variant 3) is approximately 22% more expensive in terms of average comparative $\$/m^3$ of water supplied on-farm in a drought year than the typical single-storage scheme.
- Variability in the cost to irrigate specific areas of the study area compared with other areas across the valley; i.e. an indication of spatial variation in relative $\$/m^3$ across the valley. The brown zone is the most financially favourable, followed by the purple zone, and then the blue zone. The orange and yellow zones are the least financially favourable due to their elongated shape and long distance from the supply sources under consideration. (Refer to Figure 2-3 for locations of zones.) One approach to staging development of the multi-storage scheme would be to start with the most favourable areas in terms of construction cost, such as the brown and purple zones.
- There are opportunities to refine the design concept and reduce the cost for the multi-storage scheme, potentially reducing the indicated difference between the multi-storage scheme and single-storage schemes in terms of cost-effectiveness.

It is noted that if single-storage schemes are adopted without consideration of a long term whole of catchment approach, it would likely lead to the lowest cost (in terms of $\$/m^3$ of water supplied on-farm in a drought year) for the irrigated area, but this approach may not be able to serve all the medium and high priority areas identified across the Wairarapa Valley. Moreover, depending on the particular option progressed, the single-storage schemes as presented in this report may not fit with the most cost-effective strategy for long-term development across the entire study area.

4 Recommendations and Next Steps

The findings from the single-storage scheme assessment and from development of a multi-storage scheme concept have both been considered in determining recommendations for further study during the next phase of work. However, because a key finding from the single-storage scheme analysis was that there is relatively little difference between the 10 single-storage schemes (the top 9 in particular) on balance after considering environmental, social, cultural and financial themes, the findings from developing the multi-storage scheme have effectively had a greater impact on recommendations. In particular, the spatial distribution of storage required across the Wairarapa Valley has influenced the selection of storages to recommend for further study. In order to ensure a spread across the medium and high irrigation priority areas identified in the Wairarapa Valley, the study area has been divided into zones, represented as coloured areas in Figure 2-3. A priority storage site and reserve storage site has been identified for each zone.

The storage sites shaded green in Table 4-1 are identified as the best options to prioritise for further investigation at the next phases of investigation. The sites shaded orange in Table 4-1 are considered reasonable back-ups to the top priority sites, although in some cases will not be large enough to meet the theoretical demand for the defined zone.

Table 4-1 Priority Storage Sites Recommended for Further Investigation

Service area zone[Note 1]	Priority Storage site	Reserve Storage site
Purple Zone – North, South and East of Masterton	Site 197 Te Mara	Site 200 Kiriwhakapapa
Blue Zone – between Masterton and Carterton	Site 210 Black Creek (including Site 206 Wakamoekau as a subset)	Site 200 Kiriwhakapapa
Orange Zone – west side of valley between Carterton and Featherston	Site 215 Mangatarere	Site 210 Black Creek
Yellow Zone – east side and southern end of valley	Site 10 Tividale	Site 240 Mangarei and Site 53 Te Ore Ore
Brown Zone – around Martinborough	Site 135 White Rock Road	Site 175 Martinborough South

Note 1: Zones correspond to the coloured areas shown in Figure 2-3

Note 2: The storage sites are listed from north to south in terms of the relevant service area, rather than in order of priority.

The multi-storage scheme is anticipated to represent a conceptual, long-term strategy for development, all of which may or may not proceed to development. It is expected that the current scheme extents are an upper-bound and would be refined during future phases of work as water demand is investigated further and relatively expensive "pockets" of irrigable area, where the benefit does not justify the cost, are removed.

As part of a long-term strategy, the multi-storage-scheme could be "staged"; i.e. some areas of the scheme could be developed in advance of other areas in order to match capital expenditure to gradual uptake. One approach to staging would be to start with the most financially favourable areas. The development of a first-cut concept for the multi-storage scheme has provided a preliminary indication that the brown and purple zones are likely to be the most cost-effective in terms of comparative construction cost (based on $\$/m^3$

supplied on-farm in a drought year), and a programme for staging could consider starting with these zones. (Refer to Figure 2-3 for locations of zones.) The next most cost-effective in terms of construction cost is the blue zone, and the orange and yellow zones are the least cost-effective due to their elongated shape and long distance from economic water supply sources.

The arrangement developed for the multi-storage scheme represents one option, intended to test proof of concept. There is substantial room for considering alternative arrangements, optimisation and value-engineering. Therefore, it is recommended that the next phases of work should further develop the arrangement for the multi-storage scheme focussing on:

- Supplying water to the high and medium water demand areas of the valley;
- Minimising the life-cycle cost of the multi-storage scheme;
- Allowing staged development starting with those parts of the scheme supplying high demand areas at the lower end of the cost range;
- Future-proofing the network to allow ongoing expansion across the valley.

The development of the distribution aspects of the multi-storage scheme is expected to be critical in determining optimum sizes for the selected storage sites and therefore should be investigated along with further work on specific storage sites.

5 Acknowledgements

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7 Applicability

This report has been prepared for the benefit of GWRC with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose without our prior review and agreement.

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Appendix A: Summary Table for Multi-criteria Analysis of Ten Single Storage Schemes

Combined MCA scores for various weighting scenarios for each scheme (schemes listed generally in order of decreasing favourability)

Scheme		10 "Tividale"	135 "White Rock Road"	215 "Mangatarere"	200 "Kiriwhakapapa"	206 "Wakamoekau"	210 "Black Creek"	197 "Te Mara"	175 "Martinborough South"	240 "Mangarei"	53"Te Ore Ore"
Opportunities Score		1.8	2.5	3.7	3.0	3.2	3.5	3.1	3.1	1.9	2.1
Risk Score		3.3	1.3	3.8	3.4	3.0	1.6	3.1	4.6	3.3	3.4
Combined Score for Environmental, Social, Cultural & Financial themes	0% Weighting on Environmental, Social & Cultural and 100% on Financial	5.0	4.1	3.5	3.4	3.0	2.9	2.8	2.7	2.4	1.0
	10% Weighting on Environmental, Social & Cultural and 90% on Financial	4.7	4.0	3.4	3.4	3.0	2.8	2.8	2.8	2.6	1.2
	20% Weighting on Environmental, Social & Cultural and 80% on Financial	4.5	3.8	3.2	3.4	3.1	2.7	2.8	2.9	2.7	1.4
	30% Weighting on Environmental, Social & Cultural and 70% on Financial	4.2	3.7	3.1	3.4	3.1	2.6	2.8	3.0	2.9	1.6
	40% Weighting on Environmental, Social & Cultural and 60% on Financial	4.0	3.5	3.0	3.3	3.1	2.6	2.8	3.1	3.0	1.8
	50% Weighting on Environmental, Social & Cultural and 50% on Financial	3.7	3.4	2.9	3.3	3.2	2.5	2.8	3.3	3.1	2.0
	70% Weighting on Environmental, Social & Cultural and 30% on Financial	3.2	3.1	2.6	3.3	3.2	2.3	2.8	3.5	3.4	2.4

Note: Green = most favourable, Red = least favourable