



Report of the Waitohi Selection Panel

7 December 2011

Submitted to:

ECan, Hurunui-Waiiau Zone Water Management Committee, Hurunui District Council and the CWMS Regional Water Management Committee
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1.0 EXECUTIVE SUMMARY

This is the report by the Waitohi Selection Panel (“**the Panel**”) in relation to three potential irrigation / hydro schemes proposed for the Waitohi River catchment. The Panel was brought together in August 2011 under the auspices of Environment Canterbury and at the request of the Hurunui Zone Water Management Committee as set up under the CWMS. The Panel comprised both technical and commercial skills in recognition of the nature of the recommendations that would be required.

The Zone Committee had opted for irrigation development on the Waitohi rather than on the Hurunui River and found itself in a situation of contemplating potentially conflicting schemes and sought a facilitated process to resolve a direction.

The three proponents varied significantly in scale and resources and their proposed schemes involved very different approaches, though similar in outcome. The Panel sought to identify differentiating factors. In so doing it had to “equalise” as best as possible for the diversity of technical information provided. In the event, the Panel found that the differences between the fundamentals of the schemes were not that great from a technical point of view and that judgements around commercial considerations were important to the final recommendations.

The Panel concluded that a scheme in the Waitohi, though involving a higher cost of supply of water, was likely to be affordable, but the impact of higher water costs on farming practice and uptake would be significant. The Panel decided to support the scheme brought forward by Hurunui Water Project, but identified some notable features of the other schemes that it believed should be considered through the process of development.

1.1 INTRODUCTION

The Panel was made up of the following three professionals: Greg Anderson (Northington Partners) –financial and commercial, Andrew Fenemor (Landcare Research) – hydrology and policy alignment, Walter Lewthwaite (URS) – engineering and technical. It was facilitated by Geoff Henley, a professional facilitator.

The three irrigation/hydro schemes proposed for the Waitohi are as follows:

- Hurunui Water Project (“**HWP**”)
- Direct Project Management Limited – (“**DPML**”)
- Fraser Geologics Limited (“**FGL**”)

The sponsors of the process are Environment Canterbury, Hurunui District Council, the Hurunui-Waiiau Zone Committee and the Regional Water Management Committee. The Panel reports to these parties.

After a period of discussion and due diligence by the proponents, all three finally made the decision to participate in the selection process in early September and the Panel has been working together for the past 12 weeks. The scheme proponents all had input into the scope of the assessment.

1.2 SCOPE OF THE PANEL’S ASSESSMENT

The purpose of the Panel was to expedite the development of irrigation storage in the Hurunui in the face of three substantive scheme proposals, by providing advice and recommendations on the merits of the schemes. The scope of the selection process was agreed prior to commencement of the assessment by the Panel. The key task of the Selection Panel was to select a preferred scheme from amongst the three schemes proposed. In so doing the Panel would ideally rank the three schemes in order of preference. However, the scope also required that the Panel consider the following:

- It was recognised that more than one scheme could be preferred or elements of two schemes (or even all three) could be favoured. In the interests of ensuring that the best solution is considered by all proponents, the Panel was not necessarily restricted to recommending just one of the proposed schemes in its entirety.

- It was not considered part of the brief of the Panel to select a preferred entity to implement the preferred scheme. If necessary, it is assumed that the proponents will consider implementation issues as part of a follow-up commercial negotiation process once the scheme selection has been completed.
- It was considered conceivable but unlikely that none of the schemes was preferred because the selection Panel considered none viable. If that outcome did occur, the Panel was still expected to select and rank the proposed schemes whilst explaining their concerns.

By necessity, the selection process needed to be based on the level of information currently available for each scheme: the process should not of itself be interpreted in any way as a feasibility or pre-feasibility study. Any original work undertaken by the Panel was focussed on identifying differentiating factors among the three proposals and, if appropriate, making recommendations as to how potentially beneficial features of the proposed schemes may be incorporated into the preferred scheme.

It was recognised that the Panel would face difficulties in relation to the level and consistency of information from the three proponents. Not only was it likely that each would choose different approaches and assumptions in its information provision, it was also clear that HWP is in a position to provide more detailed information and analysis than that provided by DPML and FGL. The Panel was, nevertheless, expected to make the best possible comparisons of the schemes and focus on the question of what it believed would be best for the Hurunui region. Because of the significant differences in the level of detailed data available from the proponents, the Panel recognised early in the exercise that a significant level of judgment would be required in its recommendations.

1.3 THE PANEL PROCESS

The Panel undertook the following steps:

1. Overview and consultation with sponsors and proponents

Prior to commencing the assessment itself, the basis for selection was developed through individual interviews and workshops with the proponents. An outline document which became the terms of reference was completed and agreed by each of the proponents as part of their agreement to participate in the process.

2. Presentation by proponents

Each of the proponents made a presentation to the Panel outlining their proposal. HWP's presentation included considerable input from engineering and economic advisers.

3. Analysis of key criteria

The Panel members undertook a comparative analysis of the information presented by each of the proponents. Further information was sought from the proponents which was discussed and subsequently incorporated into the Panel's assessment.

4. Site visit

The Panel undertook a site visit to the Waitohi Valley and the key Hurunui locations (Maori Gully and the Mandamus/Hurunui confluence).

5. Two draft reports and recommendations

Based on the initial information provided, two draft reports (including draft recommendations) were prepared and presented to the proponents on a confidential basis. Each proponent then met with the Panel to provide feedback. Additional professional advisors contributed at this stage on behalf of two of the proponents.

6. Face-to-face discussion

Immediately prior to the preparation of the final report the Panel met with all three proponents together to review outstanding issues and to identify areas of common ground.

7. Final report

This final report was then prepared and released to the sponsor organisations for their consideration.

1.4 SELECTION CRITERIA

A set of selection criteria was developed as part of the early consultation with the proponents. The Panel was concerned to use criteria that differentiated the schemes and found that many of the important features of the schemes identified in the early stages of the consultation process were common to all three proposals, or could be applied to all three, and were therefore not useful in the ranking process. As a result, the Panel refined the initial criteria and subsequently settled on the revised framework outlined in Appendix 1. From that refined set of criteria, the following particular matters were deemed to be the most important:

- Capital cost per hectare and NPV of the scheme infrastructure
- Environmental acceptability and consequent consentability
- Potential contribution of hydroelectricity generation to offsetting irrigation costs to farmers
- A scheme proposal that could proceed at the earliest possible opportunity

1.5 RECOMMENDATIONS

Throughout the process the Panel has been very much aware of the need to provide a clear direction forward. All stakeholders including the sponsor organisations, the farmer stakeholders and the environmental and recreational interests are seeking clear direction. Although substantial feasibility work will clearly be needed irrespective of the final recommendation, the Panel was concerned to point a clear direction for the feasibility effort. The Panel recognized that in making its recommendations it needed to consider the technical information provided, but also make judgements around the pragmatic and commercial realities that would be faced in implementation.

Scheme Ranking

The Panel has chosen to not rank the schemes one to three. Instead, it has ranked the Hurunui Water Project as the preferred scheme, but has highlighted features of the two other schemes that it believes are worthy of note. It has done this mindful of the fact that there is still much feasibility work to be done on the preferred scheme and that new information that may come to light during feasibility may require one or more of the other schemes to be brought back into consideration.

Valuable Features of the Other Schemes

The two schemes not selected had notable beneficial features:

- DPML proposed a method of energy modelling which impressed the Panel and would have potential application to all three schemes and could provide significant refinement of those schemes, including the preferred HWP Scheme;
- FGL, with its emphasis on gravity-fed water supply and hydro generation on a main dam, offers an attractive level of resilience because of the lack of dependence on pumped water to influence the long term economics of the proposal. It could be included as a “Stage 3” at a later date, but would have to stand up to scrutiny at that time, whenever that might be;
- FGL’s proposal for a run-of-river generation capacity on the south side of the Hurunui River below Mandamus also has much to recommend it and is worthy of consideration as a staging option and an addition to a whole Hurunui-Waiau solution.

The Panel would strongly encourage collaborative action around these additional features and respect for the intellectual property components of these ideas. Additional expertise and support such as that available from a reputable civil construction firm and independent hydro expertise could be coopted into the process.



Hurunui River looking across at the proposed tunnel intake for the FGL Scheme.



The Panel surveying the Hurricane Gully area that would be inundated if the HWP proposal were to go ahead. The intake from the Hurunui River would come up through the hill in the middle distance.

2.0 SUMMARY OF THE PROPOSED SCHEMES AND PROPONENTS

2.1 SUMMARY DESCRIPTION OF EACH PROPOSAL

Hurunui Water Project	Fraser Geologics Ltd	Direct Project Mgmt Ltd
<p>Stage 1 works</p> <ul style="list-style-type: none"> • Two small dams in Waitohi Valley using Waitohi water • Intake on Hurunui at Mandamus leading to headrace at top of plains • Irrigate 7-10,000 ha <p>Stage 2 works</p> <ul style="list-style-type: none"> • Main intake from Hurunui near Surveyors Stream (below Maori Gully) leading to pumped and tunnelled supply • Main dam at Hurricane Gully in upper Waitohi Valley and possible fourth dam in Lower Waitohi Gorge • Power stations included at all four dams • Irrigate up to 58,500 ha from Mouse Point to Hurunui mouth to Amberley <p>Electricity</p> <ul style="list-style-type: none"> • Break-even for amount of power consumed and generated in off-farm works 	<p>Stage 1 works</p> <ul style="list-style-type: none"> • Intake on Hurunui at Mandamus leading to headrace at top of plains • Power station on side of Hurunui • Irrigate 15,000 ha <p>Stage 2 works</p> <ul style="list-style-type: none"> • Gravity supply to dam via tunnel from above Maori Gully • Large dam in lower Waitohi Gorge • Power station in Lower Waitohi Gorge • Irrigate up to about 48,000 ha in original HWP area <p>Electricity</p> <ul style="list-style-type: none"> • Significant net electricity generated from off-farm works 	<p>Stage 1 works</p> <ul style="list-style-type: none"> • Intake on Hurunui at Mandamus leading to headrace at top of plains • Small dam in Lower Waitohi Gorge • Pumped supply to dam from Hurunui headrace • Irrigate 21,000 ha <p>Stage 2 works</p> <ul style="list-style-type: none"> • Raise dam in Lower Waitohi Gorge • Irrigate up to 58,680 ha from Mouse Point to Hurunui mouth to Amberley <p>Electricity</p> <ul style="list-style-type: none"> • Approximate break-even for amount of power consumed and generated in off-farm works

Hurunui Water Project	Fraser Geologics Ltd	Direct Project Mgmt Ltd

2.2 THE PROPONENTS

In undertaking an evaluation of the three proposed schemes, the Panel was very aware that the entities proposing each of the schemes are very different. HWP is a long-established irrigation company with strong local shareholding and support. It has also received significant financial backing from its farmer and corporate shareholders. The other two proponents are each owned and operated by a single principal (Maurice Fraser for FGL and John Rice for DPML) and have funded the development work to date using substantially their own limited resources. Although both principals are engineers with relevant experience in energy generation and irrigation developments, the FGL and DPML proposals were not supported with anything like the level of detailed information provided by HWP. FGL has particular strengths in civil engineering and DPML in hydroelectricity infrastructure and the electricity market.

Throughout the process (both before and after the provision of the Panel’s first draft report), HWP was able to supply substantial and detailed information from a range of independent consultants to a pre-feasibility level normally expected for this stage of the planning process. The FGL proposal, while well thought out, was more conceptual and scoped canal routing and power station sizing. The DPML proposal was supported by considerable detail in modelling aggregate water flows and the consequent energy balance for the scheme.

Notwithstanding the significant differences in detailed information provided by the proponents, the Panel was conscious of ensuring, as best it could, that the lack of resources was not a barrier to identifying the preferred proposal. Considerable effort was therefore made to access sufficient information to allow a reasonable basis of comparison between the proposed schemes, and to ensure that:

- i. potentially beneficial elements of the FGL and DPML proposals were not overlooked simply due to lack of resources and detailed information; and
- ii. the HWP proposal was not favoured solely because it was supported by considerably more detail and analysis.

The Panel believes it is in a position to reasonably allow for these significant differences in the level of information provision when considering the proposals although uncertainties remain in all three proposals.

3.0 KEY FACTORS CONSIDERED IN THE PANEL'S ASSESSMENT

3.1 DIFFERENTIATING FACTORS

As a first step, the Panel undertook comparisons on what could be termed the potentially differentiating factors of each proposal – dam size, water volume, construction cost, hectares irrigated, commercial considerations, etc. Preliminary checks were made regarding design assumptions and the accuracy of cost estimates, both with the proponents and using available external sources. Higher quality information was not always available. A summary schedule of this assessment is presented below, and an expanded summary appears in Appendix 2 – Vital Statistics.

The Panel believes that the HWP proposal is either equal to or outperforms the other two proposals when taking an integrated view of these key factors. The particular characteristics of the HWP proposal that the Panel focused on in forming this conclusion were as follows:

- The Hurricane Gully dam proposed by HWP involves smaller scale of earthworks for roughly the same storage volume as the FGL and DPML dam proposals (which have essentially the same size and location). This meant that, provided there is no significant difference in availability of materials or problems with the dam site foundation, the HWP dam is likely to be more cost effective per cubic metre of water stored, or at least no less.
- The water supply source for HWP (from the Hurunui River near Surveyor's Stream) is located below Maori Gully, and therefore avoids the environmental and recreational issues related to the FGL proposal. The section of the river from Surveyors Stream to the Mandamus was seen as having less important recreational values than Maori Gully. Although the proposed DPML intake below the confluence of the Hurunui and Mandamus rivers is even further downstream and therefore arguably provides the best solution from this point of view, the Panel did not assess this advantage as being sufficiently significant to be an important differentiator compared to the HWP intake proposal.
- The HWP proposal results in a roughly balanced energy demand and supply, with a lift of 118 metres from the main intake to the reservoir and a fall of 180 metres back to the main distribution channel, via 3 further storages (each with its own efficiency losses). DPML, by both pumping and generating through 130m, cannot have the same energy efficiency. However, the Panel accepts DPML's contention that with optimized management of the pumping and generation balance, the net cost of energy could conceivably be neutral or better for schemes designed for an area of less than about 50,000 hectares. HWP is at the very least, likely to not be inferior on this criterion.
- Other secondary factors that favour the HWP proposal over the competing schemes include the need for minimal changes to the Lake Sumner road, minimal inundation of farmland and buildings, and the reduced visual impact of the large operating drawdown for the dam because of the location of the HWP dam in the upper valley.

- Staging was seen by the Panel as an important consideration in the commercialization of the project. The HWP Stage 1 proposal enables the quick provision of water to about 10,000 hectares which would get the project underway, with few consenting barriers likely and build confidence amongst farmers looking to commit to Stage 2. The staging proposals put forward by DPML and FGL were more ambitious, would take longer to build and would involve greater barriers to achievement.

3.2 SUMMARY OF SCHEME COSTS

The Panel has developed the following summary of scheme costs from the information provided by the scheme proponents, including adjustments required to provide a roughly equal basis for comparison. These costs are for scheme areas between 42,000 ha and 48,000 ha rather than the maximum area sought by HWP as the Panel considers the full area might not be developed from the Hurunui (it is noted that the Zone Implementation Plan expresses a preference for bringing Waiau water south, rather than shift Hurunui water north). See Appendix 3 for a more detailed summary of costs, and comments on the estimates.

Item description	HWP	DPML	FGL
Capital cost	\$205 million	\$185 million	\$413 million
Assumed area	46,400 ha	46,680 ha	48,000 ha
Capital cost/ha	\$4,400	\$4,000	\$8,600
Net hydro generation income (Capitalised)	minimal	minimal	\$145 million to \$195 million
Net Present Value	\$200 million	\$184 million	\$228 million to \$278 million
Net Present Value/ha	\$4,300	\$3,900*	\$4,800 to \$5,800

*Note: These figures at first glance create the impression that DPML is cheaper than HWP. These DPML figures were received late in the process and have not been subject to significant independent analysis. Because of the uncertainties in cost estimates at this stage of cost development the Panel considers the differences between HWP and DPML are not significant and has treated the costs per hectare as being roughly the same.

3.3 SUMMARY OF POLICY ALIGNMENT

As detailed further in Appendix 4, the Panel extracted relevant principles, targets and policies from the Canterbury Water Management Strategy (CWMS), the Hurunui Waiau Zone Implementation Plan (ZIP) and the proposed Hurunui Waiau River Regional Plan (PHWRRP) notified for submissions on 1 October 2011. Each scheme has been assessed by the Panel and scored qualitatively for its alignment with those principles, targets and policies.

The following is a summary of the findings in Appendix 4. The table identifies the key issues, comments on whether or not each of the issues is a differentiator between the schemes, and includes some key observations.

Issue	Differentiator?	Observations
Regional approach including augmentation of Waipara flows	No	All proposals achieve this
Kaitiakitanga & mauri	DPML&HWP>FGL	Relates to volume of water taken. Inter-catchment water transfers require discussion with tangata whenua with regard to all proposals.
Natural Character especially of Hurunui as a braided river	DPML&HWP>FGL	All proposals avoid damming the Hurunui River. FGL takes more water and has intake structure in Maori Gully which is highly valued and publicly accessible
Ecosystem health including biodiversity protection, aquatic ecosystems, wetlands, freshwater fisheries and avoiding toxic algae	DPML>HWP>FGL	DPML takes water further downstream than HWP, which is in turn downstream of the FGL water take at Maori Gully. HWP floods more wetland than others but not highly significant and can be offset by new wetland. Similar effects of all proposals on ecosystem health and potential for algal growth in waterways
Public access	HWP>DPML&FGL	Improved access likely for all proposals. DPML and FGL lower gorge dam requires relocation of Lake Sumner road
Provide for community drinking water and stock water	No	Water required to be made available, though likely to require treatment for potability
Recreational amenity	DPML&HWP>FGL	Limited recreation benefits in Waipara & Waitohi offset by potential effects on existing recreational uses of the Hurunui River.

Community and commercial benefits	No	All schemes provide potable and irrigation water, plus hydroelectricity for commercial use. Overall community benefits of all options
Use water efficiently	No	Assumed similar reliability of supply, minimisation of water losses as required in Proposed Hurunui-Waiiau Regional Plan (PHWRRP)
Energy Security & Efficiency	FGL>HWP>DPML	Proportional to electricity generation capability. All could also incorporate run-of-river power generation.
Regional & National Economics	FGL>HWP&DPML	Differentiator is electricity contribution (but excludes consideration of economic viability, covered below)
Allocation limits, minimum flows for Hurunui and Waitohi, water sharing	DPML&HWP>FGL	Largely prescribed by PHWRRP however FGL larger take will likely require more mitigation, and obtaining C block water (33 cumecs) likely to be more difficult than B block (10 cumecs)
Multiple use, integrated approach	No	All can make equal major contribution towards ZIP/ CWMS target of 100,000 ha irrigated, and all can meet ZIP requirements
Preference for a Waitohi option	HWP>DPML&FGL	All proposed dams are in the Waitohi
Social Effect	HWP>DPML&FGL	DPML & FGL lower gorge dam affects more farmland and buildings
Economic Viability	No	Viable for higher valued irrigated land uses. Depends on costing assumptions
Water Quality Outcomes for Zone	No	Same PHWRRP requirements for all schemes (reduce N&P losses by 2017 to 2005-10 levels) and some risk of non-achievement
No dams on Hurunui River, water storage within Zone B and no inter-catchment water transfer from outside Zone B, Map3, PHWRRP	DPML>HWP>FGL	No proposal dams the Hurunui River, but it is unclear whether present PHWRRP policy 6.6 would affect consenting for HWP intake near Surveyors Stream (Zone A) or FGL intake at Maori Gully (Zone A further upstream)

The Panel concludes from this assessment that all three proposals can be designed and operated to achieve good alignment with the CWMS, Hurunui Waiiau ZIP and the proposed regional plan (subject to clarification of the effect of Policy 6.6 of this Plan).

A qualitative comparison of the three proposals is possible based on their degree of policy alignment with the selected criteria. Without applying any weighting to any criterion, the totals of the scores attributed to each proposal in Appendix 4 are +3 HWP, +2 DPML and -3 for FGL. However the Panel did not give any emphasis to these aggregated scores because of their level of subjectivity, and the fact that other factors may arise when consents are sought, including effects (positive and negative) relating to specific locations and activities within the scheme proposal.

The principal reason for the lower FGL score is the impacts of water take in the Hurunui above Maori Gully. While the FGL proposal has the benefit of being gravity fed, and notwithstanding the fact that taking water in Maori Gully is not precluded by the proposed Plan, obtaining consent for that water take while retaining an economic scheme is likely to be difficult. The FGL tunnel intake proposal does have the advantage of being treated as a later stage of the DPML proposal and could be more attractive if electricity price differentials increase.

4.0 SUMMARY DISCUSSION AND ANALYSIS

The Panel's decision making process was predicated on the requirement to operate within the framework of the Canterbury Water Management Strategy (CWMS). The CWMS is premised on the key strategic imperative of "parallel development" whereby a programme catering simultaneously for irrigation, environmental, recreational and amenity interests is required. In the Hurunui, the key development objectives are reflected in the Zone Implementation Programme (ZIP).

The CWMS also emphasises the need to move expeditiously on water management programmes to build experience and capability. Water now falls into the category of a natural resource under heavy and increasing demand requiring management from both a short and long term perspective. All new developments will require the prudent management of different and often competing interests and are therefore subject to complex and challenging issues. The resilience of water management schemes well into the future is a vital part of present planning.

The capability that is now required of any scheme proponent includes many dimensions: governance, finance, efficiency and distribution, water quality management and equity considerations. Any development pathway must also take account of the need to build new knowledge and capability. These requirements do not exist in isolation but are a cluster that together can produce a successful outcome.

With respect to the Hurunui area, the Panel was conscious that this is the first zone to complete its ZIP and that development based on the ZIP will involve an element of breaking new ground. The Hurunui area will be used as a reference site for further development based on the CWMS. The Panel recognises that there is a need for a combination of quick action and prudent caution to ensure that the principles and approach of the CWMS are maintained and that a virtuous cycle of action, learning and adaptation is set in motion. In this respect the Panel is particularly attracted to staged approaches to development that allow early progress without foreclosing later possibilities.

Financial Viability

The Panel has concluded that an irrigation/hydro scheme in the Waitohi that draws water from the Hurunui has the potential to be financially viable. The Zone Committee has clearly judged that such a location for storage is desirable from a "parallel" development point of view because of the environmental and recreational values it preserves whilst still enabling irrigation development.

The Panel was asked to address the affordability of the schemes, regardless of their ranking. When the likely costs of distribution (as supplied to the Panel) are added to the headworks costs estimated by the scheme proponents, the cost at the farm gate is estimated to be in the order of \$7,000 per hectare. The Panel is aware of schemes built elsewhere in New Zealand that are more expensive than this and which are considered affordable in the current

economic environment (in some cases following a change in land use). In the end, affordability will be decided by potential scheme members immediately prior to the start of the construction period, taking into account the prevailing on-farm economics and the perceived financial viability of the investment. Because it will be a number of years before this decision point is reached for any of the proposed schemes in the Hurunui zone, there is considerable scope for perceptions of affordability to change before the scheme is actually built.

Financial viability is a relative concept. The Panel recognises as a general principle, the more expensive the water the narrower the range of viable land use opportunities, particularly in the short term. The Panel does not see the current indicative scheme costs as a barrier to proceeding but urges appropriate scaling of the development (and associated capital costs) to reflect the likely increase in demand through time. The Panel is likewise conscious of the advice of many in the industry who say that farm practice can adapt quickly and what may have seemed like a prohibitive cost of water at one time is subsequently perceived to be manageable in a relatively short space of time. Already in Canterbury and Otago there are a number of schemes contemplating or providing water that is more expensive than the likely cost for the proposed Waitohi scheme.

Affordability has been a difficult criterion for the Panel to assess because the assumptions and estimates provided by all three proponents vary significantly, and the frameworks on which they are based are also quite varied. Affordability can only really be properly tested through full feasibility undertaken by a commercial entity that accepts the commercial responsibility of taking the scheme forward.

Policy Alignment

A great deal of innovative thinking about policy alignment by all three schemes means that there is moderate to high alignment evident in all three. The mere fact that the Waitohi catchment has been chosen over Hurunui alternatives is a major alignment factor. The areas where policy alignment requires the most attention is in relation to water quality, but this is not a differentiator between the proposed schemes.

Adaptability & Staging

During the Panel evaluation process all three proponents were asked to supply a staged scenario relative to their base case proposal. These varied considerably. HWP appeared to give this matter the most in-depth consideration and developed a credible staging proposition. The main concern the Panel has with their proposition is that it is only a fit with the rest of its proposal – the development of Hurricane Gully – as it would largely foreclose on other developments. For example, if Hurricane Gully proved not to be feasible after HWP's Stage 1 programme had advanced and a dam was required in the lower Waitohi gorge, then the Stage 1 development would need to be inundated. This is not a fatal flaw, but a change such as this would result in some lost investment.

A further criticism of their proposal could be that the cascade of dams that they propose may be less than ideal compared with the infrastructure concentrated in one location as proposed by DPML and FGL.

However, the Panel is very supportive of the concept of staging; staged development encourages a virtuous cycle of learning and innovation that ensures that subsequent development fully incorporates new information related to changing financial and environmental objectives. Staging will also ensure that at least part of the existing demand can be satisfied as quickly as possible.

Potential criticism of staging is that it is likely to come at a higher construction cost per hectare. On the other hand, uptake for a staged scheme is likely to be quicker and that will reduce the carrying costs associated with slow uptake. A more modest target for the initial scheme size takes the pressure off “selling” the full scheme and allows progress on key criteria such as transitioning more farmers to irrigation (given the projected cost of water) and managing water quality. Ultimately, an appropriately staged development will significantly improve the likelihood of achieving the level of support needed to make the scheme successful.

On balance the Panel favoured the HWP staging scenario because at 10,000h it is sufficiently large to be meaningful and enable water to be supplied at the earliest date with the fewest consenting challenges. It is truly a stage in itself but will have to be followed by Stage 2 to ensure it achieves its full potential. The fact that it may only provide 93% reliability does not concern the Panel and is common in these types of early stage developments.

The other Stage 1 proposal was larger and therefore would take more time, present more complexity and would have the danger of prejudicing or delaying completion of Stage 2 if Stage 1 had not worked out well. The HWP’s Stage 1 a gradual pathway to “full” reliability irrigation.

Environmental, Amenity & Social Impact

As already discussed, consentability factors such as recreation and environment largely apply to the preservation of natural features of the Hurunui River which are highly valued, especially by kayakers and fishers.

While there may be some recreational and amenity benefits to the lakes proposed by all three schemes, these would be relatively minor because of the large operating ranges required. The real environmental and recreational benefits remain in the Hurunui River which would not be dammed and from which takes would be reasonably controlled.

The lower gorge dam proposed by DPML and FGL would inundate several properties, a disadvantage which would be avoided by the use of the Hurricane Gully site selected by HWP. However, when compared to the scale of the proposed scheme and the benefit to farmers across the region, the inundation of these properties might be considered an acceptable cost.

From a Hurunui perspective the DPML proposal, which takes water only at the Mandamus, is probably the most consentable of the three proposals.

Hydro Contribution

The Panel considered the impact of possible hydro development for each scheme primarily on the basis of the potential for the development to reduce the overall costs of irrigation (although the Panel noted that the ZIP identified other potential benefits of hydro including contribution to regional economy and community benefits). Despite its shortcomings on some aspects of policy alignment, the FGL scheme is differentiated from the other two schemes on the basis of the significant hydro opportunity that is integral to the scheme design. The FGL proposal is predicated on a water extraction site that allows for the reservoir in the lower valley to be gravity fed. Without the need for pumping and its associated energy usage, the FGL scheme would be a significant net electricity generator. The key focus of the Panel was in determining whether the potential value of the hydro opportunity is sufficiently large to cover the substantial capital costs of establishing the hydro infrastructure and part of the irrigation infrastructure to reduce the cost of irrigated water to the farmer.

Following submissions from HWP and based on its own independent analysis, the Panel accepted the broad costs outlined by FGL for the gravity-fed hydro opportunity. However, the Panel has concluded that the FGL hydro proposal does not provide sufficient upside potential to warrant any changes to the HWP scheme as proposed except as a potential “Stage 3”. Key issues considered in forming this view are as follows:

- The scale of the capital costs for the hydro infrastructure;
- The amount of water that would realistically be available for the hydro component of the overall scheme considering the environmental and recreational issues that would be need to be mitigated given a water take above Maori Gully;
- A wide range of long-term electricity price paths typically adopted by the industry when evaluating the economic feasibility of new hydro schemes; and
- The sensitivity of the economic value of the hydro scheme to small changes to all of these key assumptions.

Dam Break

Dam break analysis has not been used to differentiate the proposals.

Other Considerations

Despite concluding that the HWP scheme is the preferred of the three proposals, aspects of both the FGL and DPML schemes should be considered further by HWP. These benefits have already been identified and could be summarized as:

- The modeling undertaken by DPML in relation to optimizing the net energy output and revenue from the system. The modelling framework and approach is likely to be directly transferable to the HWP scheme and would no doubt assist with further optimization in relation to the design of the HWP hydro component.
- The Panel also recognizes the potential value of the hydro generation component suggested by FGL below the Mandamus (the PS3 proposal) which could be incorporated into Stage 1 of the HWP design. This potential development involves the redirection of some water into a canal on the south side of the river which is passed through a generation plant before being put back into the river downstream of Bishell's Road. The potential effect of this power station on opportunities for generation on the north bank of the Hurunui would need to be considered.
- In the event that problems arise with the Hurricane Gully proposal and given that there is a small cost differential between it and the DPML/FGL proposal, this latter proposal should be kept alive until the Hurricane Gully option is proven.
- FGL has also offered the possibility of bringing financial parties to a development consortium. The Panel is unaware of the details but would encourage the investigation of such options.

There are risks which are covered later in the report which may impact during feasibility and may change the equation on which the Panel has made its recommendations. It is the task of the developer to consider these matters as they arise. They could include: less than expected uptake, consent issues around operating range of lakes and water quality issues and rates of land use change.



The Hurunui River immediately below the Mandamus confluence looking at the possible site of the canal which is part of the FGL and DPML proposals.



The Selection Panel from right to left is Walter Lewthwaite, Greg Anderson, Andrew Fennemor and Panel Facilitator Geoff Henley on site in the Waitohi.

Appendices

Appendix 1: Evaluation Criteria

The following criteria were chosen by the Panel as being the most relevant for differentiating the schemes. It should be noted that these criteria were used in the discussion and analysis part of the report.

1. Policy Alignment

Definition: This refers to alignment with key documents which were the Hurunui Waiau ZIP, the CWMS targets, and the proposed Hurunui Waiau Rivers Regional Plan

Description: Each of the three schemes will be assessed and scored in terms of their alignment. The Panel's aim is to determine whether there is any non-compliance which may prove problematic for proceeding with any scheme. Without any consideration of weighting of criteria, the scores may be combined into an overall score to give an overall impression of the alignment of each scheme with current policy directions.

2. Adaptability & staging

Definition: Opportunity to demonstrate and prove the concept

Description: The idea of staging is supported by the Panel, who sought specific details on staging at step 3 of this evaluation process. The Panel is looking for staging options that can be used to prove the concept but also encapsulate the overall vision of the scheme. Staging enhances the ability to learn and adapt.

Dimensions:

- Meet first mover demand
- Create momentum
- Minimise foreclosure on future options and variations
- Staging within a future vision or plan

- Workability – dealing with endemic issues such as water quality
- Cost efficiencies

3. Affordability

Definition: Maximising Uptake

Description: Assess whether for a range of likely uses of the water the scheme is affordable for users. The higher the cost per hectare the less diverse the range of irrigated land uses able to afford to invest in the scheme

Dimensions:

- Long-run returns
- Capital costs and operating costs
- Uncertainty
- Risk
- Offsetting of irrigation cost by hydro
- Water demand assumptions

4. Consentability

Definition: Assessment of costs and benefits in terms of environmental, social, amenity and other effects considered in the RMA process for gaining resource consents

Description: Time delays, costs and risks caused by difficulties gaining viable consents are a relevant consideration.

Dimensions:

- Environmental effects including of construction, water take and of irrigated water use
- Inundation impacts
- Other landowner impacts such as canals across farmland
- Landscape impacts
- Cultural and recreational impacts

- Current and likely community support

5. Critical Risks

Definition: The risks included in this list are potential game-breakers

Description: These are risks that could either be fatal for a project or impose significant costs to a project making it non-viable

Dimensions:

- Consents
- Cultural considerations
- Seismic considerations
- Business continuity impediments
- Construction costs
- Barriers to uptake
- Dam break implications

Appendix 2: “Vital Statistics” - scheme outlines for comparative purposes

Issue	Hurunui Water Project	Fraser Geologies	Direct Project Mgmt
Key features	<p>Stage 1</p> <ul style="list-style-type: none"> • Two small dams at Seven Hills and Inches Road in Waitohi Valley providing 11 MCM storage • Second intake at Mandamus leading to level headrace at 305 m • Together feeding top of Waitohi plain below 305 m • Might build lower intake at 280 m instead of 305 • No HEP in Stage 1 <p>Stage 2</p> <ul style="list-style-type: none"> • Main intake below Surveyors Stream at 383.5 m (downstream from Maori Gully) • Dam at Hurricane Gully in upper Waitohi Valley (210 MCM, twl 500 m, up to 50 m operating range) • Pumped and tunnel supply to dam lifting 17 m³/s, 117 m lift • Possibly fourth dam in Lower Waitohi Gorge • Supply to 340-305 m land would largely bypass Lower Waitohi dam (supply might be at 320/ 325 m) • HEP included at all four dams in Stage 2 	<p>Stage 1</p> <ul style="list-style-type: none"> • Intake at Mandamus, 20-25 m³/s, RL~315 (our info is that level will be lower than this) • Flow re-reg pond below dam, 10-15 MCM • Power Station 3 on side of Hurunui R, 50 m head, 9 MW, 50 GWh <p>Stage 2</p> <ul style="list-style-type: none"> • Gravity supply to dam from above Maori Gully (RL 448) • Tunnel (4.5 m dia, 6900 m long) to Waitohi valley diverting up to 50 m³/s • Dam in lower Waitohi Gorge (base level 330 m, TWL 438 m, 230 Mm³, 25 m operating range) • Includes Waiiau (Isolated Hill) project and Horsley Downs HEP – which are separable • HEP • 8.7 km road realignment 	<p>Stage 1 (possible)</p> <ul style="list-style-type: none"> • Single intake at Mandamus, RL 315 or 318 m [the Panel’s information is that the level will be lower than this] • Dam in lower Waitohi Gorge (43 MCM, twl 400 m, 25 m operating range) • Pumped supply to dam from level headrace, possibly cut-and-cover feed to base of dam • Partially pumped storage scheme wrt HEP <p>Stage 2</p> <ul style="list-style-type: none"> • Raise dam (209 MCM, twl 435 m, 30 m operating range) • 8.7 km road realignment
Irrigated area	<ul style="list-style-type: none"> • Stage 1: ~7-10,000 ha on Waitohi plain 	<ul style="list-style-type: none"> • Stage 1: ~21,180 ha (as for DPML) 	<ul style="list-style-type: none"> • Stage 1 21,180 ha south of Hurunui

Issue	Hurunui Water Project	Fraser Geologics	Direct Project Mgmt
	<ul style="list-style-type: none"> Stage 2: 58,500 ha with 215 MCM storage from Hurricane Gully + lower dams (inc 6,000 ha above 305 m, supplied at 'no net cost'), supplying 14,000 ha north to Mouse Point, 44,000 south inc coastal areas from Hurunui mouth in north to Kowhai in south Reliability will fit accepted standards 	<ul style="list-style-type: none"> Stage 2: Early supply to ~10,000 ha from Waitohi River while top part of dam is under construction 48,000 ha at efficiency of 90% 	<ul style="list-style-type: none"> only, fully using B block water Stage 2 42,180 ha with 122 MCM storage, inc 36,970 ha new Reliability >99% for 42,180 ha and 122 Mm³ dam Or 58,680 ha with 209 MCM storage
Hydro generation aspects	<ul style="list-style-type: none"> Re-regulation dams maximise power generation 35 m³/s, 28 MW capacity station 118 m max pump head, 180 m max generating head 177 GWh/year output 	<ul style="list-style-type: none"> 32 m³/s, 35 MW capacity station, ~200 GWh/year output Re-regulation pond supplies 2nd power station on Hurunui River 	<ul style="list-style-type: none"> Pumped storage scheme 120 m max pumping and generating head 16 m³/s for both pumping and generating Operational model targets half hourly spot prices for pumping; average prices for generation
Landowner impacts (e.g. inundation)	<ul style="list-style-type: none"> One house flooded Canal effects not known 	<ul style="list-style-type: none"> Three houses flooded Canal effects not known 	<ul style="list-style-type: none"> Three houses flooded Canal effects not known

Notes:

- The larger areas adopted for analysis, i.e. ~58,000 ha, assume a substantial amount of water in addition to present supplies will be needed north of the Hurunui River, and the proposals allow a feed from Waitohi storage to those areas. It is likely that will not be fully required if the Waiau generally supplies land to the south and if limited storage is built within Balmoral Forest in the near future to use A-block water more fully.
- All options:
 - include intake at Mandamus
 - can feed into same distribution downstream
 - can enhance reliability north of Hurunui if required – but see note above
 - can supplement low flows in Waitohi and Waipara
 - could build power stations further down Hurunui although HWP and DPML would have reduced capacity

Appendix 3: Waitohi Dam Options: Equalised headworks costs for ~42,000 ha

	Parameters	Cost	Comments	Cost	Comments	Cost	Comments
		HWP		FGL		DPML	
Intake No 1		\$1,975,000	at Surveyors Stream	\$5,405,000	upstream site	\$8,675,000	intake from HWP plus tailrace from DPML
Intake No 2		\$5,000,000	at Mandamus	\$5,000,000	adopted from HWP		
Pump station		\$7,875,000	pumps only				
Rising main		\$5,764,744					
Tunnel to reservoir		\$8,200,000		\$100,748,200			
Canal: Hurunui to Waitohi		\$4,975,900	adopted from FGL	\$4,975,900	Mandamus to Waitohi	\$4,975,900	adopted from FGL
Dam No 1		\$46,134,000	141 MCM, 50 m operating range	\$110,877,800	includes new road	\$67,723,632	137.4 MCM, 50m operating range
M&E		\$22,940,000	includes power house, extra transmission costs	\$35,199,600		\$27,917,043	weir spillway assumed
Dam No 2		\$7,075,000			PS3 and Isolated Hill omitted from this estimate		
M&E		\$3,500,000					
Dam No 3		\$5,947,000					
M&E		\$2,800,000					
Dam No 4		\$1,700,000					
M&E		\$2,000,000					
Works in Waitohi River				\$594,200			
Re-regulation pond				\$2,441,900			
Other		\$1,045,000		\$2,430,000	ex HWP, excludes new road	\$5,930,000	ex HWP, includes new road
Subtotal capital cost		\$126,931,644		\$267,672,600		\$115,221,575	
Contingencies		\$38,079,493	adopted 30% across the board	\$80,301,780	adopted 30% across the board	\$34,566,473	adopted 30% across the board
P&G		\$12,693,164		\$26,767,260		\$11,522,158	
Professional fees		\$12,693,164		\$20,075,445		\$11,522,158	
Land purchase		\$11,373,000		\$12,631,000	ex HWP	\$9,418,000	ex HWP
Owner costs		\$2,766,093	adopted 2% as in FGL	\$5,353,452		\$2,304,432	adopted 2% as in FGL
Total capital cost		\$204,536,559		\$412,801,537	\$412,801,537	\$184,554,794	
Total capital cost/ha		\$4,408		\$8,600	\$8,600	\$3,954	
Annual power consumption		\$3,266,834				\$1,779,210	
Annual power generation		-\$5,125,264	combines figures from September and November			-\$2,944,044	
Other Opex		\$1,275,000		\$1,170,000	\$1,170,000	\$1,098,000	ex HWP
Total net annual Opex		-\$583,430				-\$66,834	
Opex capitalised	8%	-\$4,870,024		\$9,766,258	\$9,766,258	-\$557,879	
Value of Hydro Opportunity				Low	Mid-Point	High	
				\$145,000,000	\$160,000,000	\$195,000,000	
Total project NPV		\$199,666,535		\$277,567,795	\$262,567,795	\$227,567,795	\$183,996,915
Total project NPV/ha		\$4,303		\$5,783	\$5,470	\$4,741	\$3,942
Agro area irrigated		46,400		\$48,000	\$48,000	\$48,000	46,680

Notes:

- 1. Costs supplied by the different parties did not allow an item-to-item comparison. The costs presented here show an attempt to adjust estimates to enable comparison of the schemes on an equal basis.**
- 2. With the exception of Note 5 below the Panel made no attempt to verify the cost estimates. The Panel understands that key unit costs/m³ of materials are reasonably similar for all schemes.**
- 3. Notes indicate where there is uncertainty over a cost item or where costs were adjusted from those supplied by the scheme proponent.**
- 4. The Panel used for comparison a scheme option of smaller area than the maximum sought by HWP, using figures supplied by HWP and DPML. The smaller scheme made little difference to the cost/ha for HWP but reduced the cost/ha for DPML. FGL provided estimates for only a 48,000 ha scheme.**
- 5. HWP provided a substantially higher estimate for FGL tunnelling costs. Based on further advice the Panel decided to adopt the FGL costs as supplied.**
- 6. For FGL, because of its significant net electricity generation, the Panel estimated the effects of a range in electricity prices.**
- 7. Costs of off-farm distribution have been omitted and are assumed to be similar for all schemes below the headworks. Typical capital costs in Canterbury are ~\$1000/ha for open channel distribution and ~\$3,000/ha for piped networks, but these costs cannot be adopted for the Hurunui without investigation.**
- 8. It is acknowledged that there is considerable uncertainty with all the cost estimates. This uncertainty will be reduced when detailed engineering studies have been advanced and it is possible the figures above could change substantially.**
- 9. DPML's figures show a net income from electricity by targeting spot rates. The same benefit could be gained by the other two schemes, enabling them to show a better NPV, therefore this approach is not a differentiator.**
- 10. HWP and FGL exclude electricity reticulation excludes costs outside Waitohi Valley. DPML has included \$3.5 million for this.**
- 11. The different schemes are at different stages of optimization of proposed works and cost estimates, and this will have caused some further distortions.**

Appendix 4: Policy Alignment Comparisons

This appendix contains the detailed scoring and commentary on each scheme’s conformity with the Canterbury Water Management Strategy (CWMS), Hurunui Zone Implementation Plan (ZIP) and Proposed Hurunui-Waiiau River Regional Plan (PHWRRP) which is summarised in the main document.

Similar criteria have been grouped below and scored only once as a group to avoid duplication

Assessment Scale: compared either to status quo, or to the absolute target (whichever is relevant).
Data quality scores are included for information purposes only.

Assessment categories	Assessment Scale				
	-2	-1	0	1	2
	Significantly negative	Slightly negative	Neutral	Slight improvement or positive	Substantial improvement or very positive

Data Quality Scale:

Scale	5	4	3	2	1
Meaning	Excellent information	Very good information	Good information	Limited information	Very limited information

Criterion	HWP		DPML		FGL		Notes
	Score	Data Quality	Score	Data Quality	Score	Data Quality	
CWMS P1: Sustainable Management							This is an overall judgement so has not been separately scored
CWMS P2: Regional							“First order priorities - environment, customary use, community supplies and stock water;

<p>Approach</p> <p>CWMS T7: Irrigated Land Area & Reliability</p> <p>¹ZIP 8.1.1: Increasing Waipara river flows</p> <p>^{2,3}PHWRRP Policies 6.10, 6.11: Consider augmenting Waipara River flows, but ensure sufficient water left for landowners in the source catchment</p>	<p>1 3</p>	<p>1 2</p>	<p>1 1</p>	<p>Second order priorities - irrigation, renewable electricity generation, recreation and amenity.”</p> <p>FGL could score lower because of emphasis on electricity generation, a 2nd order priority, compared with environment, however considered insufficient to differentiate this criterion</p> <p>“The Committee supports an increase in Waipara River flows....support a Waipara River Care Group ...that will identify options for increasing river flows (including ...flow augmentation from outside of catchment)...”</p> <p>“Any proposal for water storage greater than 20,000,000m3 within the Hurunui Catchment shall consider making water available to either:</p> <p>(a) increase the flow in the Waipara River to offset the ecological effects of current abstraction on that River; or,</p> <p>(b) provide an alternative source of water to existing abstractors, taking from the Waipara catchment to allow for the minimum flow in the Waipara River to be increased while maintaining a reliable supply to those abstractors.”</p> <p>“Despite Policy 6.10 above, any consent to transfer water between the Hurunui and Waiau Catchments or from the Hurunui and Waiau Catchments to another catchment should not be granted if it results in there being insufficient water remaining instream to meet the reasonable out of stream needs of land owners within the catchment from which the water is taken.”</p> <p>All three proposals assumed to achieve this.</p>
<p>CWMS P3: Kaitiakitanga</p> <p>CWMS T3: Kaitiakitanga</p>				

¹ Where a ZIP recommendation requires the Hurunui Regional Plan to take the action, that action is summarised as part of the Plan summary, not the ZIP summary

² Plan Objectives are not listed as they generally support the policies referenced here, but they will also affect scheme requirements

³ Policy descriptions are shorthand summaries; the most relevant text is quoted in smaller font in the Notes section at right

<p>PHWRRP Policy 2.6: Protect mauri (applies to Hurunui and Waitohi)</p>	<p>-1 3</p>	<p>-1 2</p>	<p>-2 1</p>	<p>“To ensure that any new take, dam, diversion or discharge of water does not adversely affect the mauri of the Hurunui and Waiau rivers and their tributaries.”</p> <p>Hurunui water take likely to diminish mauri. Main differentiator likely to be the volume of water taken. Larger take by FGL may have a higher impact. Mauri is possibly an issue for all proposals regarding inter-catchment transfers, Waiau-Hurunui and Hurunui-Waipara.</p>
<p>CWMS P4: Natural Character CWMS T2: Natural character, processes and ecological health of braided rivers</p>	<p>-1 3</p>	<p>-1 2</p>	<p>-2 1</p>	<p>Refers to Hurunui impacts. FGL will have higher impacts because more water taken from Hurunui and intake structures within the gorge at Maori Gully. However, all have major achievement of no dam on Hurunui main stem or South Branch</p>
<p>CWMS P5: Indigenous Biodiversity CWMS T1: Ecosystem health/ biodiversity</p>				<p>“Indigenous flora and fauna and their habitats in rivers, streams, lakes, groundwater and wetlands are protected and valued.”</p> <p>Insufficient information to differentiate, however Waitohi contains no highly significant indigenous habitats</p>
<p>ZIP 3.1.2: River flows to protect aquatic ecosystems and braided-river processes</p>				<p>“...braided rivers require a ‘natural’ flow regime characterised by environmental flows incorporating flood flows (for sediment and bed movement), flow variability (including small to medium freshes, which flush periphyton, revitalise invertebrate food supplies, limit mammalian predator movement) and defined flow minima (fish habitat including for passage, food production and protection of nesting birds from mammalian predators). Linked to these elements of natural character is the cleansing role of riparian vegetation...”</p> <p>FGL take affects more river ecosystems than HWP at Surveyor’s Stream than DPML Mandamus take further downstream. Maximising FGL water take during winter and limiting summer take would mitigate these impacts.</p>

ZIP 3.1.1: Biodiversity funding for Lower Waitohi wetlands				<p>“Lower Waitohi River alongside State Highway 7 to its confluence with the Hurunui River – remnant wetlands in highly modified environment...opportunity to address water flows, water quality, more water and land use intensification issues associated with development elsewhere in the catchment.”</p> <p>Insufficient information to differentiate</p>
ZIP 3.1.3(a): Wetland protection & land use development				<p>“...identify and protect, maintain and enhance these wetlands. Where wetlands are impacted by land-use development, ensure appropriate offsets are developed to ensure no ‘net loss’ of wetlands.”</p> <p>“...Hurunui Water Project (HWP) has surveyed all farmers in the command area of their proposed irrigation scheme requesting information on existing wetlands. The Zone Committee is very supportive of this initiative by HWP and their desire to protect wetlands as part of irrigation development. The initiative should be extended to protection of other significant native ecosystems and wetlands throughout the Zone...”</p> <p>“...The enhancement of the wetland area at the confluence of Waitohi and Hurunui Rivers (see above) is an example of where wetland enhancement would provide biodiversity and water quality gains...”</p> <p>HWP encourages farmer protection of wetlands but Hurricane dam also likely to flood more wetland than the other options. All can be equally required to address wetlands below the Waitohi Gorge.</p>
ZIP 3.1.4: Ecosystem protection & irrigation development				<p>“...Developers will ensure, as part of irrigation development, that the most significant ecosystems adjacent to the proposed development (including dam, reservoir, canals and irrigation command area) are protected and have a restoration plan as a first order priority or where affected, ensure appropriate offsets are developed.”</p> <p>Little information provided including any offsets</p>
ZIP 3.1.8(a): Freshwater fisheries: eel				<p>North Canterbury Eel Management Plan key policies are to be included in the 2012 ZIP... Assume gravity supplies may enhance eel habitats including in-reservoir, but pumped may not because pumps create a barrier to eel entry</p>
ZIP 3.1.8 (b) & (c): Inanga & other native fisheries				<p>ZIP recommendations to come in 2012, therefore we have taken these fisheries into account</p> <p>“...seek to ensure that flows in Hurunui, Waiau, Conway and Waipara Rivers maintain native fish populations. The Committee’s recommendation in Section 12 that augmentation of Waipara River flows be a component of major water infrastructure in Hurunui catchment should improve native fish populations in Waipara River...”</p> <p>Effect on inanga at hapua similar because irrigation areas similar and hydroelectric water is returned upstream</p>

				Effects on upstream native fisheries depend on amount of water taken but offset with some augmented habitat in canals & reservoirs
ZIP 13.1.4: Toxic Algae	-1 4	0 2	-2 1	<p>“The Zone Committee with support from Environment Canterbury will work with developers and interested parties to ensure that toxic algae blooms do not occur in the Waipara and Waitohi Rivers.”</p> <p>Higher residual flows and potential for flushing flow releases should mitigate this risk. Ability to build in larger flushing capacity will be limited by costs of doing so</p>
CWMS P6: Public Access	1 3	0 3	0 2	Improved access at all dam sites likely; DPML and FGL dams will disrupt existing Lake Sumner road which requires relocation; HWP upper dam could provide new public access to upper Waitohi and to Virginia Road.
CWMS P7: Quality Drinking Water				Water will be made available but water quality may require treatment so one balances the other
CWMS T4: Drinking Water				
ZIP 4.1.3: Drinking water provided from major water storage				“Provision of secure community drinking water (and stockwater) of a quality capable of being treated to New Zealand Drinking Water Standard should be part of an integrated “more water” project.”
PHWRRP Policy 1.2: 200l/s for new stock and/or community water supplies	0 2	0 1	0 1	<p>“To enable up to 200 l/s of additional water to be abstracted from the mainstem of the Hurunui River, for new community and/or stock drinking water supplies, where the water is sourced either by way of a surface water take or a hydrologically connected groundwater take.”</p> <p>“Note: The additional water provided for in policies 1.2 ... is not shown in Environmental Flow and Allocation Regime in Table 1 as these takes will not have to comply with the minimum flow and allocation regime in Table 1 where a Water Supply Asset Management Strategy is in place (see Rule 2.2).”</p> <p>Required in HWPRP so assumed provided for by all proposals. Water from storage is likely to require treatment for potability whereas groundwater may require less treatment</p>

CWMS P8: Recreational & Amenity Opportunities				
CWMS T5: Recreational & Amenity Opportunities				Waitohi recreation opportunities (limited because of summer draw-down) offset Hurunui river recreation impacts for HWP & DPML
ZIP 13.1.2: River flows for recreation				(c) The Zone Committee will work with developers to increase flows in the Waipara and provide flows in the Waitohi in a manner that will benefit recreation (swimming/fishing). “...If the Waitohi storage option is developed and the upper reaches of the Hurunui are protected then the current kayaking amenity in the Hurunui can be protected. It is noted that to fully offer this protection for kayaking values it would be preferable to have any large takes on the Hurunui River to occur below Maori Gully.” Recreation benefits in Waipara & Waitohi offset by potential effects in Hurunui. Impacts on nationally significant kayaking, and on jetboating, rafting and angling amenity potentially significant for FGL water take above Maori Gully
PHWRRP Policy 2.7: Provide for recreational flows (30-50 cumecs on Hurunui mainstem)	0 3	0 2	-1 1	“To ensure that any new take, dam or diversion of water provides for a range of flows, between 30 and 50 m3/s in the mainstem of the Hurunui River, to provide for recreational activities.” Some impact of all proposals in this flow range depending on which part of the Hurunui mainstem is considered. FGL will require more mitigation because of greater volumes taken
CWMS P9: Community & Commercial Use				Potable and irrigation water, plus hydroelectricity for commercial use
ECAN T11: Local Communities				“Vibrant and viable local communities & Direct social impact of development” Damming impacts offset by irrigation benefits (electricity benefits likely more significant nationally than locally)
PHWRRP Policy 1.4: Provide for tributary				“To provide for the sustainable development of communities in the Hurunui, Waiau and Jed river catchments, by providing for the taking and use of water for community water and/or stock drinking supplies, where water is to be taken from the Jed River or a

abstractions for stock and/or community water supply, subject to effects				tributary of the Hurunui River or Waiau River provided: (a) abstraction will not induce the river to go dry; (b) the frequency of flow events between 1.5 and 3 times the median flow will not be reduced; and, (c) native and salmonid fish passage will not be compromised.”
PHWRRP Policy 6.7: Reserve water for community and stock supply to all properties	1 2	1 2	1 2	“To require all water storage proposals, storing more than 20,000,000m3 of water to provide a source for community and stock drinking water supplies, sufficient to supply potable water to all properties impacted by the water storage scheme.” Overall community benefits of all options
CWMS T6: Water Use Efficiency				
PHWRRP Policy 8.1: Minimise leakage, maximise irrigation efficiency (and Obj 8 requires water to be left Instream “to the greatest extent practicable”)	0 3	0 2	0 1	“To maximise efficiency in the taking and use of water in the Waiau, Hurunui and Jed river catchments, by ensuring that: (a) any leakage in the design and operation of infrastructure used to take or convey water is minimised; (b) the surrender or transfer of unused water takes is encouraged; (c) a minimum of 80% application efficiency for irrigation uses as per WQN16 of the Natural Resources Regional Plan with an annual volume to provide reasonable use of water, for the intended land use, for 9 out of 10 years;...” Insufficient information to differentiate. HWP adopts a more conservative estimate of 20% water supply losses (Central Plains used 10% canal leakage) than the others
CWMS T8: Energy Security & Efficiency	1 4	0 4	2 2	Assessment primarily based on amount of electricity generated. All could add FGL’s PS3 run-of-river hydro generation below Mandamus.
CWMS T9: Indicators of Regional & National Economics	1 4	1 3	2 2	Assumes similar areas irrigated hence differentiator is electricity contribution. All make a major contribution to regional economics and a significant contribution to national economics.

CWMS T10: Implementation of Environmental Limits				Take into account likely outcomes of implementing environmental limits – water quality and effects of water take primarily
PHWRRP Policy 2.1: Must comply with minimum flows of Table 1 (includes minimum flows for Hurunui River and Waitohi Stream)				“No resource consent to take, dam or use water should be granted if the proposed activity will cause the minimum flows specified in the Environmental Flow and Allocation Regime in Table 1 to be breached; unless the take is for a community or stock drinking water supply and there is a Water Supply Asset Management Strategy in place.” Compliance required
PHWRRP Policies 2.3.and 2.4: Sharing of restrictions with other water users				“To require all takes and diversions of water on the mainstem of the Hurunui and Waiau rivers, to reduce the amount of water taken on a pro-rata basis...” Compliance required
PHWRRP Policy 2.5: Maintain flows between 1.5 and 3x the median (on Hurunui mainstem)				“To ensure that any new take, dam or diversion of water does not adversely affect the effectiveness of flows, between 1.5 and 3 times the median flow, that flush periphyton, mobilise gravel, and reset algae and macro-invertebrate populations in the mainstem of the Hurunui and Waiau rivers. Some water takes within these flow ranges proposed by all proposals
PHWRRP Policy 2.8: Adjusted minimum monthly flows at Mandamus and SH1 after a >20M m3 storage scheme is commissioned				“To ensure that the minimum flow at Mandamus and State Highway 1 in the Hurunui River is increased to 15 m3/s during February, March and April, and decreased to 12 cumecs in August and for non consumptive takes the minimum flow is decreased to 10 m3/s in June, July and August following the commissioning of any water storage facility which takes and stores more than 20,000,000m3 of water (whether water is stored in-stream or out of stream) within the Hurunui River Catchment to ensure that the factors in Objective 2 are protected while at the same time creating an incentive for storage.” Compliance required
PHWRRP Policies 3.1, 3.4, 3.5: New A block allocation (11m3/s)	0 2	0 1	-1 1	“...C block allocations... provided the following is maintained: (a) water quality; (b) flow variability and in particular flows between 1.5, and 3 times the median flow that flush periphyton and turn over larger gravel boulders and reset the bed of the mainstem

<p>and B block (10 m³/s) allocation limits, with stricter criteria for allocations from C block (33 m³/s)</p>				<p>of the Hurunui and Waiau rivers;</p> <p>(c) water temperature suitable for salmonid species;</p> <p>(d) the natural braided character of the Hurunui and Waiau Rivers, including the river mouth and coastal dynamics;</p> <p>(e) a flow regime in the mainstem or tributaries of the Waiau and Hurunui Rivers that maintains invertebrate food production;</p> <p>(f) the reliability of supply for existing abstractors;</p> <p>(g) the ability of large salmonid and eel species to traverse the river from the marine environment to upstream habitats;</p> <p>(h) the ability to navigate the river by Jet Boat; and</p> <p>(i) daily patterns of flow that allow existing recreational opportunities and experiences in the mainstem of the rivers, their mouths or tributaries to be maintained.”</p> <p>Minor impacts from all proposals but likely higher for FGL which will require extra mitigations. Obtaining C block water likely to be more difficult to consent for all proposals than B block because of matters listed above.</p>
<p>ECAN T12: Multiple Use</p>				<p>Credit where multiple uses align with the first order priorities in the CWMS (environment, community water supplies and customary use)</p>
<p>ZIP 12.1.1: Integrated approach</p>				<p>“The Zone Committee supports an integrated approach that includes a major water storage reservoir in Waitohi River catchment. The integrated approach may also include major infrastructure for transfer of Waiau water to Hurunui Basin, storage of Waiau water, transfer of Hurunui water to Waipara area, and hydro-electric generation.”</p> <p>“The Committee is uncertain whether major storage in Waitohi River catchment is affordable. Environment Canterbury will facilitate an independent review of the four Waitohi options proposed to identify one option that would seek Irrigation Acceleration Fund for further feasibility studies.”</p> <p>“The Zone Committee will work with developers to bring forward an integrated “more water” proposal or proposals for the Zone that:</p> <ul style="list-style-type: none"> •uses water from Waiau and Hurunui Rivers in an integrated manner; •utilizes off-mainstem storage reservoir(s); •provides more water for Waipara River and environmental flows for Waitohi River; •includes hydro-power generation as part of an integrated approach with irrigation

				<p>development;</p> <ul style="list-style-type: none"> •protects and develops wetlands and significant native ecosystems within the irrigation command area; •will be capable of irrigating (with existing irrigation) most of the approximately 100,000ha (net) of irrigable land in the Zone; •will adopt good nutrient management practices to meet their share of nutrient load limits for Hurunui River (and other areas as limits developed for all of the Zone); •meets significant in-stream, cultural, environmental and recreational needs •uses highly efficient distribution and irrigation systems; •takes a community irrigation scheme approach; •provides recreation opportunities, where possible.” <p>HWP has explained and planned their integrated approach more than the other two</p>
ZIP 13.1.3: Quality of bathing sites				<p>(b)” The Zone Committee with support from Environment Canterbury will work with developers and interested parties to deliver enhancement opportunities for the bathing sites identified in the Waipara and Waitohi Rivers.”</p> <p>Bathing suitability in Waipara & Waitohi will depend on flow releases (including ramping of flows), flow volumes and quality of released water. Insufficient information to differentiate this factor.</p>
PHWRRP Policy 3.6: Limits for non-consumptive discharges (would include hydroelectric ones)	1 3	1 2	1 2	<p>“To enable water to be discharged from nonconsumptive activities to the Waiau and Hurunui rivers and their tributaries provided the following is maintained downstream of the point of take:</p> <p>(a) macro-invertebrate populations both upstream and downstream of the discharge point;</p> <p>(b) habitat and unimpeded passage for existing populations of native fish species, salmon and trout;</p> <p>(c) health and safety of people and communities using the river;</p> <p>(d) bare gravel islands and bars are free of woody vegetation for bird nesting; and,</p> <p>(e) the water is returned to the river in the same or better state and quality.”</p> <p>Hydroelectric flow releases allow some flexibility to meet these requirements</p>
ZIP 12.1.3:	1 3	0 2	0 1	<p>“The Committee supports an integrated option utilizing a major water storage in</p>

Waitohi/Waiau option				<p>Waitohi River combined with or in conjunction with transfer of Waiau River water and storage of Waiau River water. The Committee regards this is an environmentally & recreationally attractive option but acknowledges that it is uncertain at this stage if Waitohi River storage is affordable.”</p> <p>“The Committee supports a major water storage in Waitohi River as a key component of an integrated more water solution for the Zone because:</p> <ul style="list-style-type: none"> •The adverse impacts on environmental, conservation and recreation values are considered by conservation and recreation groups to be substantially less than other options for major storage in Hurunui catchment; •The storage is well located to provide water for irrigation development on south side of Hurunui River and in Waipara, Omihi and Glasnevin; •The dam is located relatively close to major electricity transmission lines, increasing the attractiveness of hydro generation at the site; •The storage is well located to be able to provide secure drinking water to some Hurunui District Council community drinking (and stockwater) schemes; •The reservoir may provide a major recreation resource that was easily accessible for the local community and visitors from Christchurch and elsewhere; •The reservoir would allow release of water to provide environmental flows, including increased summer flows, for Waitohi River and water to augment flows in Waipara River. <p>The Committee acknowledges the significant adverse impact of a dam in Waitohi River in the vicinity of Waitohi Gorge bridge on the people and their properties that would be flooded by the lake. Two of the Waitohi options have less impact on the Waitohi settlement.”</p> <p>HWP storages have less impact on farms and their infrastructure at Waitohi Gorge Bridge than the other two.</p>
ECAN T13: Economic Viability	1 4	1 3	1 2	Viable for only higher value land uses; offset by electricity returns (see financial section of this report)
ZIP 11.1.1: Water Quality Outcomes for				<p>“Water quality outcomes for mainstem of Hurunui and Waiau Rivers:</p> <ul style="list-style-type: none"> •Achieve in most years periphyton limits as identified in NRRP (that is, four years in

Zone				<p>every five);</p> <ul style="list-style-type: none"> •Safe for contact recreation; •Maintain or enhance the mauri of the river; •Toxin producing cyanobacteria shall not render the river unsuitable for recreation or animal drinking water; •Nutrients (particularly nitrate and phosphorous) will decrease over time at sufficient rate and to a level such that additional irrigation development can occur without compromising water quality outcomes for the river (i.e. reduce current loads to create “headroom” for new irrigation development). <p>Water quality outcomes for tributaries of major rivers:</p> <ul style="list-style-type: none"> •As above for mainstems, and; •Achieve ecosystem health outcomes agreed for the particular tributary through a collaborative community-based process.” <p>Water quality outcomes are uncertain, and reducing N&P by 2017 to 2005-10 levels has significant risk, but this is assumed similar for all proposals.</p>
ZIP 11.1.3: Nutrient Implementation Plan				<p>“Urgently develop a plan for implementing improved nutrient management in Hurunui Basin...including HWP...”</p> <p>Assumed neutral as all proposals will have to do this</p>
PHWRRP Policy 5.2: Best nutrient management practices by 2017 for all land uses (would apply to supply area)				<p>“To ensure all existing and new land use activities in the Nutrient Management Area shown on Map 4, have best nutrient management practices in place by 2017.”</p> <p>Similar requirements of farmers and scheme operator likely for all proposals (scoring does not judge likelihood of successful implementation)</p>
PHWRRP Policy 5.3: DIN (nitrogen) and DRP (phosphorus) at 2005-2010 levels or better except a 20% increase up to 2017 is allowed	-1 3	-1 2	-1 1	<p>“To protect existing values, uses and the mauri of the Hurunui River and its tributaries while also providing for future development in the catchment by ensuring the annual nutrient loads (as set out in Schedule 1) at the:</p> <p>(a) Mandamus flow recorder, for both Dissolved Inorganic Nitrogen and Dissolved Reactive Phosphorous, are maintained at 2005 – 2010 levels.</p> <p>(b) State Highway 1 flow recorder:</p> <p>(i) dissolved Reactive Phosphorous, is maintained at 2005 – 2010 levels;</p> <p>(ii) dissolved Inorganic Nitrogen prior to 2017, does not increase more than 20% above 2005 – 2010 levels; and</p>

				<p>(iii) dissolved Inorganic Nitrogen post 2017, is improved to 2005 – 2010 levels or better.”</p> <p>Assuming same areas and crop mixes irrigated, this factor is not a differentiator but scoring reflects risk. Any scheme with lower capital cost per hectare will allow a wider range of land uses than mainly intensive dairy.</p>
PHWRRP Policy 6.1: No Hurunui River mainstem dams				<p>“To prohibit the damming or impoundment of water... on the mainstem of the Hurunui and Waiau Rivers.”</p> <p>All Waitohi options achieve this factor. Need to ensure any intake isn’t regarded as a dam under RMA consent requirements.</p>
PHWRRP Policy 6.2: Requirements for storage infrastructure (Zone B includes Waitohi catchment, and Policies 6.4 and 6.5 provide for Waitohi as preferred option up to October 2013)				<p>“To enable the development of storage facilities for A, B or C Block water in the parts of the Hurunui and Waiau River Catchment shown as Zone B ‘Infrastructure Development Areas’, on Map 3, provided:</p> <p>(a) the Environmental Flow and Allocation Regime for the mainstem of the Hurunui and Waiau Rivers in Table 1 is complied with;</p> <p>(b) the minimum flow for any tributary identified in the Environmental Flow and Allocation Regime in Table 1 is maintained;</p> <p>(c) water is reserved for community and stock drinking water supplies;</p> <p>(d) woody vegetation is managed to provide for bird habitat, natural channel and bed forming processes and sediment supply from the headwaters to the sea is maintained by flow events;</p> <p>(e) nuisance periphyton growths are removed by flow events;</p> <p>(f) health and safety of communities is provided for;</p> <p>(g) loss of wetlands is mitigated;</p> <p>(h) the reliability of supply of existing abstractors is not reduced; and,</p> <p>(i) existing recreational activities which occurred prior to storage are provided for.”</p> <p>Potential for effects listed, but difficult to differentiate</p>
PHWRRP Policy 6.6: Inter-catchment transfer requirements (and must be within Zone B boundaries)	-1 3	0 3	-2 2	<p>“To provide for the transfer of water from the Hurunui to the Waiau catchment or the Waiau to the Hurunui catchment, provided:</p> <p>(a) it occurs in a culturally sensitive manner which aligns with the values of Ngāi Tahu and local Rununga;</p> <p>(b) the point of take, discharge and the entire length of the transfer infrastructure is in</p>

				<p>the parts of Hurunui and Waiau River Catchment shown as Zone B – Infrastructure Development Areas, on Map 3; and,</p> <p>(c) Water is provided in accordance with the A or B Allocation Blocks identified in Environmental Flow and Allocation Regime in Table 1.”</p> <p>Both HWP and FGL propose water takes within Zone A (Map3 of proposed Plan) and may include transfer to Waiau catchment thereby contravening (b). This policy is not followed through in Rule 3.2 or any other rule, so may need amending.</p>
PHWRRP Rules				<p>Rules are not reviewed or scored here because they can generally be accommodated through scheme design and issues addressed in the AEE supporting scheme consent applications</p>
From Preamble on Hurunui Flows				<p>“The Committee prefers Waitohi River catchment for the location of major water storage in Hurunui River (see Section 12) and wants the flow and allocation regime for Hurunui River to enable such an option.... The Committee expects major abstraction associated with major multi-use Waitohi storage to be done in a manner that maintains whitewater recreation opportunity and amenity in the reach of Hurunui River downstream of South Branch confluence and upstream of Surveyors Stream...”</p> <p>“Should a ‘more water’ proposal proceed, the Committee would expect the following in-river outcomes to be achieved:</p> <ul style="list-style-type: none"> •Maintain or enhance river mouth and coastal processes; •Maintain the extent of active floodplains; •Maintain or enhance the mauri of the Hurunui River; •No net loss of braided river bird habitat; •No net loss of natural high quality and large wetlands; •No net loss of important indigenous plant communities; •Maintain native fisheries and valued introduced fish species; •Maintain or enhance mahinga kai access and resource; •Maintain the diversity and quality of water-based recreation and amenity.” <p>“The Committee recommends water use proposals should avoid the following:</p> <ul style="list-style-type: none"> •Altering the flow regime of the main stems or significant tributaries of the Hurunui in

			<p>such a way that it would significantly reduce invertebrate food production;</p> <ul style="list-style-type: none"> •Changing daily patterns of flow in such a way so as to jeopardise the safety of recreational and others users of the above water bodies or their river mouths; •Changing daily patterns of flow in such a way as to significantly reduce the recreational opportunities and experiences in the main stems, their river mouths or significant tributaries of the Hurunui; •Changing daily flow patterns in such a way that lead to native fish stranding.” <p>Not scored, as covered in ZIP recommendations or PHWRRP content</p>
From Rationale in section 10			<p>“...the Committee believes the use of water for irrigation should have higher priority than the use of water for hydropower generation (without associated irrigation development)...”</p> <p>Not scored, as covered in ZIP recommendations or PHWRRP content</p>

Appendix 5: Risk Register

This section assesses risks associated with the three proposals that need to be considered in making a final assessment of them. It is particularly intended to identify any fatal flaws for any of the proposals, which would immediately disqualify them from further consideration.

	Risk	Explanation	Differentiator?	Mitigation
1	Consenting: The project might not gain consents with suitable conditions	Consents might not be granted or might be granted with conditions that seriously reduce attractiveness of scheme	<ul style="list-style-type: none"> • FGL has higher risk as it would take water above Maori Gully • HWP proposal would inundate wetland in upper Waitohi Valley 	<ul style="list-style-type: none"> • FGL could restrict water take and include flow releases at key times • HWP plans to provide offset wetlands • Other potential difficulties need to be properly identified and addressed
2	Electricity prices: Electricity prices might rise and render projects uneconomic or might be considered too uncertain at outset or rise in future	Viability of pumped schemes depends on whether each is a net generator or has the ability to operate in the spot market, i.e. efficiency and reliability of that component	FGL would be less risky for this parameter, with gravity inflows and substantial generation capacity. Electricity price rises work in favour of FGL.	<ul style="list-style-type: none"> • Forward electricity contracts • Investment by an electricity generation company (HWP has Mainpower as a shareholder) helps spread the risk
3	Farmer sign-up: Farmers might be unwilling to sign up if price expectations rise too high or are too uncertain, or if market predictions are too unsure, or for other reasons	Viability of water distribution infrastructure depends on farmer buy-in within each distribution area	<ul style="list-style-type: none"> • Little difference on economic argument • Farmers might view DPML or FGL proposals less favourably because there is no existing relationship 	<ul style="list-style-type: none"> • Need firm charges set before asking farmers to sign up • Have good information and communication programme • Have form of water take contract that minimises risk of shareholders pulling out

				<ul style="list-style-type: none"> • Seek support from equity partners such as government and electricity investors
4	Landowner negotiations: Land owners whose properties would be disrupted might not reach agreement with project promoters	This could apply particularly to landowners in Waitohi Valley or in key positions on an intake or headrace canal	Lower gorge dam site has greater landowner impacts HWP currently better placed due to wide farmer buy-in	<ul style="list-style-type: none"> • Good communication program • Adequate funds for compensation
5	Construction market: Too many construction projects in South Island might make it difficult to obtain a satisfactory contract	Combination of Christchurch rebuild and Canterbury water developments is beyond present capacity of engineering industry	Affects all proposals	<ul style="list-style-type: none"> • Get in early, or • Become part of steady and assured build-up programme supported by government and other key players, to give confidence to engineering industry to expand in advance of major projects
6	Construction costs: Costs of construction could blow out	<p>The following costs could rise significantly:</p> <ul style="list-style-type: none"> • Land acquisition • Prices for imported equipment and materials • Dam foundations and abutments • Instability of reservoir slopes • Availability of materials 	<ul style="list-style-type: none"> • FGL risk of tunnelling costs increasing. Tunnelling itself not seen as major risk • HWP upper dam site and other dams in the valley would have higher costs for electricity infrastructure 	<ul style="list-style-type: none"> • Do investigations to good standard before seeking commitment from shareholders (HWP has already done this for its proposal) • Use form of contract that reduces risk for shareholders

		<p>for dam construction</p> <ul style="list-style-type: none"> • Tunnelling costs • Electricity infrastructure i.e. supply and distribution costs 		
7	Contractor: The selected construction contract or contractor might fail	Costs and time of pulling out of a contract or engaging a new contractor can be high	Affects all proposals	<ul style="list-style-type: none"> • Follow good processes in assessing and engaging reliable contractor (HWP has addressed this in its own Risk Register) • Monitor progress for early warnings of poor financial performance
8	Environmental flows: Residual flows in Hurunui or enhancement flows into Waitohi and Waipara might be too high	The requirements resulting from consent approvals may affect viability and reliability of the scheme	Affects FGL more in relation to Hurunui water take	Address these issues before committing to final project design including e.g. storage capacity
9	Nitrates: There might be excessive loss of nitrates, phosphorous and other pollutants into groundwater, streams and thence into rivers	<ul style="list-style-type: none"> • Achieving the 2017 cap on total nitrogen and total phosphorus losses in the Hurunui set in the ECan plan may prove problematic, given uncertainties about lag times and effectiveness of good land management practices 	Affects all proposals, but the larger the irrigated area, the higher the risk of not meeting the cumulative targets set at the Hurunui State Highway bridge	<ul style="list-style-type: none"> • Require good water and nutrient management practices both on newly irrigated areas and existing properties • Monitor TN, TP and other pollutants such as E.Coli, as well as levels of implementation of Good Management Practices within subcatchments

		<ul style="list-style-type: none"> • Could lead to reduction in area irrigated, or reduction in intensity of farming, affecting economics of individual farming operations and of schemes 		<ul style="list-style-type: none"> • Staged development allows responses based on these monitoring results • Research improved collective and individual management of nutrient losses
10	Seismicity: There might be damaging earthquakes on known or unknown faultlines	Two known faultlines pass through or near proposed works, and the community is now wary of the potential for additional undiscovered faultlines	<ul style="list-style-type: none"> • A risk for all options • Greatest danger to FGL along tunnel line • Arguably less danger to HWP as upstream site not near known fault lines, but there is more risk with multiple dams 	<ul style="list-style-type: none"> • Assess and manage dambreak risk (HWP has completed an assessment for its scheme) • Adopt designs with good defences against earthquakes
11	Future electricity prices : Future movements in electricity prices might make some options non-viable		HWP & DPML are more vulnerable as they would have a net demand for electricity when on-farm electricity demand is included	Run sensitivity analyses
12	Product prices: Farming product prices might fall making farmers unable to service debts	<ul style="list-style-type: none"> • There could be a fall in export markets • There could be further unfavourable 	Affects all proposals, though long run price prospects for some products are good making the Waitohi scheme proposal appear viable	<ul style="list-style-type: none"> • Build this risk into long-run estimates of agricultural returns • Conservative economic assessments (HWP has done this to support consent)

		movements in exchange rates		applications)
13	Climate change: Climate change might lead to increased demands for water and/or drop in available water	<ul style="list-style-type: none"> • Projections indicate there may be increased incidence of drought therefore greater demand for irrigation • There may be a reduction in flow in the Hurunui in some seasons • Flow in Hurunui may be more flashy and more difficult to capture • Flow may reduce in Waitohi requiring extra filling of reservoir from the Hurunui 	Affects all proposals	Built into long term design and water demand projections

No risk has been identified which could be regarded as a fatal flaw. The risk register highlights many of the same issues that have been identified in the earlier analyses. The greatest consenting risk rests with FGL because of the scale and location of its draw on the Hurunui River but its gravity tunnel could be deferred to a Stage 3 development. In addition both FGL and DPML would inundate some properties in the lower Waitohi. Proposals that are most dependent on electricity pricing margins – primarily DPML and HWP – pose potential longer term risks of higher cost water in the longer term. Construction risks such as tunneling are not considered very significant with modern tunneling techniques. Similarly, recent events excepted, seismic risks are not considered a significant differentiator. Risks associated with nitrates, phosphorous and other pollutants relate much more to the size of the area irrigated and to on-farm mitigation. While significant and important, they affect all proposals roughly equally.

Appendix 6: Comparison Against Evaluation Criteria

This section uses the information in the three sections (technical, financial and compliance) above and compares it with the key evaluation criteria – see Appendix 2 – seeking differentiators to help in the Panel’s decision-making.

Criterion	HWP	DPML	FGL
Affordability (1): general	<ol style="list-style-type: none"> 1. Affordability is likely to be the key issue in determining whether any of the schemes will proceed. 2. Affordability depends on eventual construction costs, financing arrangements, future markets, operational costs and income (especially HEP), and farmer-specific financial situations. 3. All options are costly compared with past irrigation investments, but all are within the costs that are currently being considered (and built) across Canterbury and Otago and in the range of affordability assessed by Geoff Butcher. 		
Affordability (2): specific	Likely to be similar cost to DPML and therefore as likely to be affordable	Likely to be similar cost to HWP in cost (per hectare) in short term and therefore almost as likely to be affordable as HWP	<ul style="list-style-type: none"> • Highest capital cost with long lead time to returns; will require favourable financing arrangements • NPV very sensitive to assumptions regarding accounting for hydro power: power costs, assumed discount rates, tax arrangements
Relative economics: medium to long term			Potential to have most favourable economics in longer term depending on power costs and discount rates
Fit with planning documents (1): general	<p>All have reasonable fit with planning documents in that</p> <ul style="list-style-type: none"> • all could be designed and operated to fit with the water allocation plans, and hence to generally safeguard in-river interests • none have a dam on main stem or South Branch of the Hurunui, • all will make a major contribution towards the irrigation and economic goals of 100,000 ha irrigated in the Hurunui-Waiau zone, with good reliability of supply, and high efficiency • all would have similar risks in terms of water quality consequences of irrigated land uses • all fit with zone goals regarding integrating water use across Waiau, Hurunui and Waipara Rivers 		
Fit with planning documents (2):			FGL has higher contestability and potentially financial risks because of the proposed water

project specific			take in Maori Gully, but could be deferred to Stage 3
Flexibility/ robustness	<ul style="list-style-type: none"> All will be equally able to adapt to climate change within the ranges of current expectations, and continue to provide a reliable supply of water All have possible staging options that do not commit the whole project in one initial decision and risk financial failure 		
Staging	Has the most obvious staging options as currently proposed, but staging options foreclose on other proposals	Suggested initial staging option is larger than HWP's but there is risk that supply could exceed uptake in the short term	Stage 1 similar to DPML. Has also suggested an initial option of a re-regulation pond below the Waitohi dam site as Stage 1, and the tunnel as Stage 3.
Consentability	Given the above, HWP is probably consentable, unless the wetland higher in the catchment becomes a fatal flaw, which is unlikely	Given the above, DPML is probably consentable	Given the above, FGL may be consentable unless the Maori Gully issue becomes a fatal flaw or it requires such mitigations that the FGL option becomes uneconomic