Before Hearings Commissioners appointed by the Otago Regional Council

Under	the Resource Management Act 1991
And	
In the matter of	Otago Regional Council's Proposed Otago Regional Policy Statement 2021.

STATEMENT OF EVIDENCE OF IAN DANIEL LLOYD
ON BEHALF OF OTAGO WATER RESOURCE USER GROUP INC
22 NOVEMBER 2022

INTRODUCTION

Qualifications and Expertise

1. My name is Ian Lloyd. I am a Principal Water Engineer in the Christchurch office of Davis Ogilvie and Partners Limited, a privately owned Engineering, Surveying and Planning Consultancy.

2. I hold the qualifications of Master in Science (Environmental Science), Bachelor of Engineering (Civil) and Bachelor of Science (Geology), all obtained from Canterbury University (Christchurch). I am a Member of Engineering New Zealand (MEngNZ) and a member of the New Zealand Hydrological Society.

3. I have 30 years professional experience as an environmental scientist and water engineer including projects in Africa and New Zealand. I specialise in catchment water studies, groundwater and surface water assessments, and have a particular interest in issues associated with efficient irrigation.

4. Over the last approximately 20 years I have undertaken numerous projects in the Manuherekia Catchment, and I am very familiar with the catchment and its hydrology. I am part of the Manuherekia Hydrology Group which was assembled by the Otago Regional Council (ORC), and I am currently co-ordinating the preparation of a joint expert statement on the hydrology of the Manuherekia Catchment.

Code of Conduct

5. While this is not an Environment Court hearing, I have read and agree to comply with the Code of Conduct for Expert Witnesses in the Environment Court Practice Note 2014. This evidence is within my area of expertise, except where I state that I am relying on material produced by another party. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in my evidence.

SCOPE OF EVIDENCE

6. My evidence is presented on behalf of Otago Water Resource User Group Inc (OWRUG). It provides a brief history of the various water related processes that have occurred within the Manuherekia Catchment, and uses the catchment to highlight some of the challenges facing water management and water planning.

7. In preparing this evidence, I have reviewed:
   - The Land and Freshwater section of the Proposed Otago Regional Policy Statement 2021.
   - The submissions and further submissions made by OWRUG in relation to the above document.

- The Section 42A Hearing Report Chapter 9 LF - Land and Freshwater prepared by Felicity Boyd for the Otago Regional Council.
- ORC' document entitled *Manuherekia Scenarios - A discussion of freshwater management in the Manuherekia catchment* dated May 2021.

Specifically, my evidence includes:

- A brief history of water development in the Manuherekia Catchment;
- Current water management in the Manuherekia Catchment;
- The challenges facing water management;
- ORC's Manuherekia Scenarios;
- Implementation and Timeframes; and
- Conclusion.

WATER DEVELOPMENT IN THE MANUHEREKIA CATCHMENT

8. The catchment has a long history of active water management which stretches back to the early gold mining days in the 1800s, when numerous races were established to supply water to the various gold fields.

9. In the early 1900s, many of these races were converted to supply water for irrigation and in predominantly the 1930s, five main dams were constructed to store winter runoff and snow melt for summer irrigation use. The Upper Manorburn Dam was completed 1916, the Poolburn and Idaburn dams were completed in 1931, the Lower Manorburn Dam was completed in 1934 and Falls Dam was completed in 1935. Collectively these five dams have a total storage in the order of 90 Mm^3 which represents approximately 15% of the mean annual flow from the entire Manuherekia Catchment(1).

10. In addition, there is a significant amount of other water infrastructure throughout the catchment including:
    - Extensive water races which cover much of the catchment including over 600 km of scheme races which include various tunnels, syphons, viaducts etc.
    - A large number of intake structures and a lesser number of discharge structures.
    - Numerous smaller schemes and on-farm dams and water storages.

11. Water is imported to the Manuherekia Catchment from Totara Creek, a tributary of the upper Taieri River. Water is exported from the Manuherekia Catchment to both the Clutha Catchment via irrigation on, and discharges to, the Dunstan Flats; and to the Taieri Catchment via the Mount Ida Race.

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(1) Values based on storage volumes and mean annual flow values presented in Aqualinc 2012, Manuherikia Catchment Study: Stage 2 (Hydrology). Report numbered C12040/2 prepared for the MCWSG, dated 22 September 2012.

12. In addition to the above, there are numerous water transfers between sub-catchments and numerous watercourse reaches (including most of the main stem of the Manuherekia River below Falls Dam) are used to transport irrigation water including water discharged from upstream storages.

13. Approximately 25,000 ha is currently irrigated within the Manuherekia Catchment, of which approximately 15,000 ha is considered fully irrigated with the remainder only partially irrigated[(2)]. Six main irrigation companies operate within the catchment as well as numerous private irrigators. Prior to 1988 – 1990, the Government via the Ministry of Works and Development operated and managed the irrigation schemes and associated storages. After which, ownership, operation and management transferred to the irrigators.

14. More recently there has been a move to more efficient irrigation both on farm (increased spray irrigation, improved irrigation scheduling, and construction of on-farm buffer storage etc.) and at a scheme level (increased automation, improved distribution infrastructure, increased monitoring, and enhanced management etc.).

15. Over the last 20 years there has been numerous investigations undertaken on the catchment's water resources. Many of these were initiated by the water users and the Manuherekia Catchment Water Strategy Group in preparation for the expiry of 'deemed permits', on 1 October 2021. The investigations were split between improving understand of the catchments water resources and investigating potential water development options – namely new water storages and improved water distribution. The investigations have essentially culminated in the work currently being undertaken by the Manuherekia Hydrology Group.

CURRENT WATER MANAGEMENT IN THE MANUHEREKIA CATCHMENT

16. Hydrologically, the Manuherekia Catchment is complex due to the catchment's physical characteristics, the large amount of water infrastructure and the extensive active water management. This complexity makes managing water in the catchment difficult.

17. There is currently no formal flow regime for the Manuherekia River system, and ORC are in the process of developing one. ORC's current Regional Plan: Water for Otago indicates a minimum flow in the Manuherekia River at Ophir of 820 L/s and a primary allocation limit of 3,200 L/s for the Manuherekia River catchment upstream of Ophir. Flow records from Ophir indicate that between 1 June 1973 and 31 May 2020 average daily (midnight to midnight) flow in the Manuherekia River at Ophir dropped below 820 L/s on 53 occasions, which were

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[(2)] Aqualinc 2012, Manuherikia Catchment Study: Stage 1 (Land). Report numbered C12040/1 prepared for the MCWSG, dated 6 November 2012.

spread over 4 years, (1974, 1976, 1982 and 1999) and represents approximately 0.7 % of the time. Through the irrigation season, flow in the Manuherekia River at Ophir is enhanced by water released from Falls Dam for irrigation below Ophir. Current allocation and water use above Ophir far exceeds 3,200 L/s particularly during the irrigation season.

18. Currently the flow regime of the Manuherekia River and its main tributaries is predominantly managed by the existing water users (namely the 6 main irrigation schemes, the Falls Dam Company and to a lesser extent Pioneer Energy Ltd[(3)]). Their management practices have been developed over many years and are based on carefully balancing storage, river flow, water demand and imposing voluntary water restrictions. Two main management practices are imposed:

   a. For the main stem of the Manuherekia River, Falls Dam Company impose voluntary water restrictions on irrigators in the Manuherekia Valley in order to retain storage in the Falls Dam reservoir and then use that storage to, when necessary, augment flow in the Manuherekia River to achieve a voluntary minimum flow of 900 L/s at Campground. The voluntary water restrictions imposed by the Falls Dam Company are generally accepted by the vast majority of water users in the Manuherekia Valley even those who do not directly benefit from water released from Falls Dam. The voluntarily imposed water restrictions achieve two things:

      (i) They restrict water takes throughout the Manuherekia Valley thereby reducing run of river demand and allowing more water to be retained in the tributaries and main stem, thereby improving downstream flows. This has a particularly strong influence in the tributaries.

      (ii) By restricting water takes from the main stem of the Manuherekia River the voluntarily imposed water restrictions reduce demand on storage in Falls Dam. Storage is retained for longer, prolonging the ability of Falls Dam to provide both water to main stem users and for augmentation of downstream flows. Retaining storage and prolonging water supplies, benefits the majority of the main stem as it is used to convey irrigation water, particularly Falls Dam to the Manuherekia Irrigation Scheme intake and to a lesser extent down to the Galloway Irrigation scheme intake. It also prolongs return irrigation water - while most of the water supplied to irrigators is used, a proportion is returned to the system through irrigation not being 100% efficient in terms of water use.

   b. The Ida Valley Irrigation Scheme manages storage in their Poolburn and Manorburn / Greenland reservoirs on a multiyear basis, with the annual irrigation quota set at the start of each irrigation season depending on the available storage and projected long range forecasts i.e. El Niño-Southern Oscillation.

[(3)] Pioneer Energy Ltd manage storage within and releases from Falls Dam over the non-irrigation season for hydroelectricity generation on the basis that they ensure the reservoir is full on 1 September each year in preparation for the irrigation season. Over the irrigation season the Falls Dam Company manages storage within and releases from Falls Dam with Pioneer Energy Ltd generating hydroelectricity from the releases.

19. Both management practices help to prevent the main storages (Falls Dam, Poolburn Dam, and the Manorburn / Greenland Reservoir) from being drained. They have a significant effect not only on flow downstream of the reservoirs but also (via the numerous water races and sub-catchment water transfers) irrigation season flows in the lower reaches of most of the Manuherekia River tributaries.

20. The majority of water use in the Manuherekia Catchment was previously authorised under 'mining privileges' or 'deemed permits', which expired on 1 October 2021. The 'deemed permits' included a priority system which typically was based on the age of the permit. While the priorities were not often enforced their existence encouraged water users to work together and are a key reason why the voluntary water restrictions imposed are generally widely accepted. The 'deemed permits' are being replaced by resource consent under Plan Change 7 (Water Permits) to the Regional Plan: Water for Otago, with continuation of the priority system.

THE CHALLENGES FACING FUTURE WATER MANAGEMENT

21. The large amount of existing water infrastructure and the high demand of water in the Manuherekia Catchment poses significant challenges to future water management. The hydrology and water resources of the Manuherekia Catchment have been significantly modified and there is little evidence of what natural flow conditions in the lower catchment were. Water use within the catchment is high and there are numerous competing demands and challenges. The complexity of the system often means that solutions to one challenge cause additional challenges and can have unintended consequences. For example, increased minimum flows will lead to reduced supply reliability for water users, which would encourage irrigators to move to crops with a shorter growing season and to irrigate fully for a short period up until the storages are depleted and then move to maintenance watering. Such a regime would lead to the storages being drained earlier in the season which removes the ability to release water from storage to augment downstream flow and shortens the period when flows are enhanced due to the transport of irrigation water. Recent investigations and modelling have indicated that when storage in the catchment's main storage reservoirs is depleted, downstream flows often fall to low levels.

22. Much of the water infrastructure is old and due in part to a lack of clarity on future long-term regulations (i.e., dam regulations, water allocation, water quantity / quality requirements and consents) development and maintenance of some of the larger scheme infrastructure has stalled over the last 20 years. With consents unlikely to be clarified until after 1 October 2027 (i.e., allowing for the replacement of 'deemed permits' with resource consents with a 6-year duration under Plan Change 7 (Water Permits) to the Regional Plan: Water for Otago) this lack of clarity is expected to continue. Significant investigations and work was completed in the leadup to the expiry of the 'deemed permits'. Unfortunately, it is expected that much of

this work will now need to be repeated before the short, 6 years duration, resource consents expire.

23. The catchment is left in a situation where flow in the lower parts of the catchment is heavily dependent on upstream water management practices and particularly how the upstream water infrastructure is operated and managed. Much of that water infrastructure now requires considerable catch-up maintenance and does not have the operational features typical of modern structures. For example, there is limited ability to release flushing flows from the storages, few of the intakes are automated and very few would be able to accurately achieve flow sharing. The cost associated with both the catch-up maintenance and / or any operational improvements would be significant. The current and potentially ongoing uncertainty regarding the long-term regulations and particularly resource consents, increases the difficulty in securing the large investments needed.

ORC'S MANUHEREKIA SCENARIOS

24. In their *Manuherekia Scenarios - A discussion of freshwater management in the Manuherekia catchment* document dated May 2021, ORC presented the Status Quo and the five scenarios for the future management of freshwater in the Manuherekia Catchment. The five future scenarios were developed by the ORC and were based on the minimum flows outlined in the Table below and that the Falls Dam Company would continue to impose irrigation restrictions and would continue use storage in Falls Dam to augment minimum flows in the Manuherekia River at Campground.

	Minimum flow L/s				
Minimum flow site	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**
Manuherekia River at Campground	1,200	1,500	2,000	2,500	3,000
Dunstan Creek at Confluence	410	510	680	850	1,020
Lauder Creek at Confluence	130	160	210	260	320
Thomsons Creek at Confluence	70	80	110	140	170
Chatto Creek at Confluence	70	90	120	150	180

25. The implications of the above scenarios on river flow, storage and water supply reliability for irrigation were assessed using a hydrological model (Manuherekia Catchment Hydrology Model) developed by the Manuherekia Hydrology Group. That model was developed as a decision support tool to assist in the development of potential flow regimes. The model has considerable functionality and flexibility and can quickly assess the implications of a wide variety of future water management scenarios. To date, the model has only been used to assess the implications of future water management scenarios that were developed

independently from the model. The model's ability to inform and assist the development of future water management scenarios has not as yet been utilised.

26. The five future water management scenarios are projected to have a significant impact on the water supply reliability of the existing users. The table below highlights the projected water supply reliability for the existing users on the Omakau Irrigation Scheme's Main Race, currently and under the five future water management scenarios.

	Volumetric Water Supply Reliability %					
Parameter	**Status Quo**	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**
Supply reliability for the Omakau Irrigation Scheme's Main Race which is reliant on water that passes through Falls Dam	96.0	92.2	89.9	85.8	81.1	76.2

Notes:

- Volumetric water supply reliability = volume supplied / volume demanded
- Represents projections from the Manuherekia Catchment Hydrology Model - for the period 1 June 1973 to 31 May 2020 i.e. average volumetric water supply reliability.
- An Options Validation and Refinement Report prepared for the Manuherikia Catchment Water Strategy Group (MCWSG) in January 2016 adopted a target volumetric reliability criteria of at least 96% on average and at least 90% during a 1 in 10 year drought.

27. In terms of Falls Dam, the Manuherekia Catchment Hydrology Model projected that the five future water management scenarios essentially shift the reservoir from currently releasing water predominantly for irrigation to a situation where more than half of the water released is for environmental reasons – refer table below.

	% of water released from Falls Dam					
Parameter	**Status Quo**	**Scenario 1**	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**
Irrigation Releases	65	61	59	55	50	45
Environmental Releases	35	39	41	45	50	55

Notes:

- Above values are based on modelled output from the Manuherekia Hydrology Model for the period 1 June 2014 to 31 May 2015 a dry hydrological year.
- Environmental water released includes water released from Falls Dam to meet residual flows immediately below the dam (note some of this water is available to be taken for downstream irrigation) and augmentation to meet shortfalls in the lower catchment below Ophir. In the model shortfalls below Ophir are defined as shortfalls in the minimum flow at Campground plus shortfalls in irrigation supply to the Manuherekia Irrigation Scheme's Main Race intake on the Manuherekia River.

28. The current Falls Dam management practices of imposing voluntary irrigation restrictions on irrigators in the Manuherekia Valley in order to retain storage in Falls Dam, and using storage in Falls Dam to augment minimum flows at Campground is known to have a

significant effect on low flows at Campground. Model projections for the five future water management scenarios indicate that as the minimum flow increases the effect of the currently voluntarily management practices become more significant, and results in the reallocation of water from irrigation to the environment. Without the management practices, flow in the main stem quickly reduces and particularly for the higher minimum flow scenarios, results in the desired minimum flows not being maintained and flow quickly receding to levels similar to the current Status Quo situation. For the higher minimum flow scenarios, the effect on low flows at Campground, of the current Falls Dam management practices is expected to be greater than the effect of the desired minimums.

29. It is unclear if the development of five future water management scenarios considered the existing water infrastructure and whether that infrastructure could achieve the desired management outcomes. In such a heavily modified catchment, to ensure successful and workable future flow regimes are developed, I consider it critical, that the functionality of the existing infrastructure is considered, and that the experience of the existing managers who understand that infrastructure is fully utilised.

IMPLEMENTATION AND TIMEFRAMES

30. Water management requires clear direction and long-term certainty. The development / alteration of large water infrastructure requires considerable investment and generally takes many years to design, fund, and implement. The age and nature of much of the water infrastructure in the Manuherekia Catchment further complicates things and will delay implementation and extend timeframes.

31. For example, extensive investigations and discussions regarding refurbishment and enhancement of Falls Dam (including potentially increasing storage) began in approximately 2010 and reached a feasibility level assessment of options in 2016, before going on hold in approximately 2018.

32. Any flow regime for the Manuherekia Catchment that requires:

- The ability for storages to release flushing flows, or
- Water intakes which allow either flow sharing or variable rates of take, or
- Infrastructure that suitably allows for fish passage, would require considerable adjustment to the existing infrastructure. Such changes would require considerable time (likely to be decades) to implement.

CONCLUSION

33. The experience of the Manuherekia Catchment is that the development of a flow management regime takes considerable time. Lack of long-term regulatory certainty reduces investment, caused delays and results in the need to repeat investigations.

34. The uniqueness of the Manuherekia Catchment (both natural and human induced) requires a catchment specific approach to the development of flow management regimes.

35. When finalising the Proposed Otago Regional Policy Statement 2021 it is hoped that the experiences of the Manuherekia Catchment are considered, and that sufficient flexibility is included in the finalised document to allow catchment specific approaches to the development of flow management regimes.

IAN LLOYD
23 November 2022