

**IN THE ENVIRONMENT COURT OF NEW ZEALAND
CHRISTCHURCH REGISTRY**

**I TE KŌTI TAIAO O AOTEAROA
ŌTAUTAHI ROHE**

ENV-2020-CHC-127

UNDER the Resource Management Act 1991 (RMA)
IN THE MATTER of the Water Permits Plan Change - Plan Change 7, being
part of a proposal of national significance directed by the
Minister for the Environment to be referred to the
Environment Court under section 142(2)(b) of the RMA

AND

IN THE MATTER of an application under section 149T of the RMA

OTAGO REGIONAL COUNCIL

Applicant

**STATEMENT OF EVIDENCE OF SIMON WILSON ON BEHALF OF THE
OTAGO REGIONAL COUNCIL
7 December 2020**

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Introduction

- 1 My full name is Simon Shield Wilson.
- 2 I am the Manager Regulatory Data and Systems at Otago Regional Council (**Council**).
- 3 I hold a Bachelor of Arts, PgDip Arts, Master of Arts.
- 4 I have been the Manager of the Regulatory Data and Systems Team since July 2019.
- 5 I have been involved in the management of data and databases for more than seven years. This includes a year and a half at the Otago Regional Council in my current role. In addition, I spent four years and ten months working for the Dunedin City Council, with three years and four months spent in their Transport Department as a Systems and Information Team Leader and Officer and a year and a half in the Water Department as a Systems Analyst.
- 6 I provided technical input and assisted with the drafting of method 10A.4 for Plan Change 7 to the Water Plan (**PC7**).
- 7 I have been asked by the Otago Regional Council (**Council**) to prepare evidence for these proceedings.

Code of Conduct

- 8 I confirm that I have read the Code of Conduct for expert witnesses as contained in the Environment Court Practice Note 2014. I have complied with the Code of Conduct when preparing my written statement of evidence and will do so when I give oral evidence.
- 9 The data, information, facts and assumptions I have considered in forming my opinions are set out in my evidence. The reasons for the opinions expressed are also set out in my evidence.
- 10 Other than where I state I am relying on the evidence of another person, my evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope

- 11 I have been asked to provide evidence in relation to PC7. My evidence addresses:
- (a) An explanation of the methods in Schedule 10A.4; and
 - (b) A response to some of the concerns raised in submissions about Schedule 10A.4.
- 12 In preparing this evidence, I have read and considered the following documents:
- (a) Relevant parts of Regional Plan: Water for Otago (**Water Plan**);
 - (b) Relevant parts of Canterbury Land and Water Regional Plan (**Canterbury Water Plan**);
 - (c) Resource Management (Measurement and Reporting of Water Takes) Regulations 2010 and 2020 amendments (**Regulations**);
 - (d) Correspondence from the Hon David Parker to the Otago Regional Council *Section 24A Report: Investigation of Freshwater Management and Allocation Functions at Otago Regional Council under section 24A of the Resource Management Act 1991*;
 - (e) PC7 (notification version);
 - (f) Relevant submissions and further submissions; and
 - (g) The evidence prepared for the Council by Sean Leslie and Tom De Pelsemaeker.

Summary of Key Points

- 13 There is legal requirement set out in the Regulations for holders of water permits over a certain size to maintain metering records.
- 14 The Regulations place an obligation on the permit holder to maintain accurate records.
- 15 Under the current Water Plan the Council has been using historic water metering data to analyse past water use when assessing water permit applications.

- 16 Schedule 10A.4 of PC7 contains a proposed methodology for using water metering data to calculate the actual rates and volumes of water previously used by applicants seeking to renew their expiring water permits.
- 17 The proposed methodology differs from the Council's current practice.
- 18 The methodology in Schedule 10A.4 was designed to achieve three key outcomes:
- (a) To ensure that applicants were not allocated a higher instantaneous rate of take or volume of water compared to their existing water permit.
 - (b) To ensure that applicants are allocated water at a rate and at a volume that reflects their past actual water use.
 - (c) To provide a methodology which is simple to apply, objective, and certain, allowing a lower cost for processing applications for water permits.
- 19 Where an applicant's historic water use is consistent, then the methodology under Schedule 10A.4 will result in them being given an allocation of water reflective of their current use.
- 20 If applied across the Otago Region, proposed Schedule 10A.4 will result in a significant reduction in the paper allocation currently assigned to Deemed Permit and Water Permit holders. This will be particularly true when considering monthly and annual volume allocations. This is because many Deemed Permits do not contain volume limits. Where such limits do not exist, the permit can theoretically be exercised 365 days per year, 24 hours a day. In practice this is generally not the case, meaning that actual water usage does not come close to the amount of water allocated on paper.
- 21 The proposed Schedule 10A.4 method and the planning framework should be refined to address:
- (a) Takes below 5 L/s and non-consumptive takes;
 - (b) Data quality gaps;
 - (c) The date range for analysing water meter data; and

- (d) The method for calculating annual volumes so that the maximum annual volume used in any water year within the date range is used.

Background

- 22 Under the Regional Plan: Water (**Water Plan**) the Council uses water metering data to calculate historic use when assessing replacement water take applications. The exact methodology for calculating actual use is not set out in the Water Plan so in order to meet the outcomes referred to in Policy 6.4.2A. Council staff have developed a methodology. This is further discussed in the evidence of Mr Leslie.
- 23 Policy 6.4.2A states, relevantly:
- Where an application is received to take water and Policy 6.4.2(b) applies to the catchment, to grant from within primary allocation no more water than has been taken under the existing consent in at least the preceding five years, except in the case of a registered community drinking water supply where an allowance may be made for growth that is reasonably anticipated.
- 24 When implementing this Policy, the Council has adopted a practice of calculating the 80th, 90th and 95th percentile for the rate of take and reviewing actual water use for volume limits. This process is further explained by the evidence of Mr Leslie.
- 25 The Council's practice of calculating the 80th, 90th, and 95th percentile rates and volumes has been assisted by data collected in accordance with the Regulations. Those regulations require water permit holders to keep records that provide a continuous measurement of the water taken under a water permit, including water taken in excess of what the permit allows.¹ This requirement applies to all water permits with a consumptive take greater than 5 L/s.
- 26 The requirement to have water meters installed was phased in over time depending on the size of the water take authorised by the permit. Table

¹ Resource Management (Measurement and Reporting of Water Takes) Regulations 2010, Clause 6.

1 below shows the dates by which water metering requirements applied with respect to those takes.

Table 1

Size	Date metering requirement applied from
Permits over 20 L/s	10 November 2012
Permits with a rate of 10 L/s or more and less than 20 L/s	10 November 2014
Permits with a rate of 5 L/s or more and less than 10 L/s	10 November 2016

- 27 Proposed Schedule 10A.4 of PC7 sets out a methodology for using water metering data to calculate the actual rate and volume of water previously used by applicants seeking to replace their existing water permits.
- 28 The methodology in Schedule 10A.4 was designed to achieve three key outcomes:
- (a) To ensure that applicants were not allocated a higher instantaneous rate of take or volume of water compared to their existing water permit.
 - (b) To ensure that applicants are allocated water at a rate and at a volume that reflects their past actual water use.
 - (c) To provide a methodology which is simple to apply, objective, and certain, allowing a lower cost for processing applications for water permits.

Explanation of methods in Schedule 10A.4

- 29 Schedule 10A.4 sets out methodologies for calculating actual water usage for water permits. Calculating actual use is complicated by the fact that water use varies depending on a number of factors including the availability of water, the need for water, the season and the time of day. Schedule 10A.4 seeks to calculate the actual use across the period analysed by taking the maximum lawful rates and volumes of take in

each water year² and averaging it. It does so by calculating a 'Rate of Take Limit' and daily, monthly, and annual volume limits.

- 30 The intention is that each consent issued under PC7 will contain 4 separate limits.
- (a) Rate of Take Limit (L/s) – Being an average of the highest lawful rate of water taken in each water year.
 - (b) Daily Volume Limit (m³) – Being an average of the highest single daily volume taken in each water year.
 - (c) Monthly Volume Limit (m³) - Being an average of the highest single volume month taken in each water year.
 - (d) Annual Volume Limit (m³) - Being an average of the water taken in each water year.

Methodology for calculating 'Rate of Take Limit'

- 31 Section 10A.4.1 of the proposed Schedule is used to calculate the rate of take limit in L/s. The methodology comprises six steps, as outlined below.

Step 1 – Schedule 10A.4.1.1

- 32 Water metering data generally records volume taken over a set period. Schedule 10A.4.1.1 takes the volume reading over the time period and converts it into a L/s value by dividing the volume taken in litres by the number of seconds in the time period.

Step 2 – Schedule 10A.4.1.2

- 33 Under this step any values below 0 L/s are removed. This is because meters can return negative values to show an equipment error. This step is repeated later in the method where including negative values would skew the results in subsequent volume calculations, having the effect of erroneously reducing those volume calculations.

² Water year is defined in the Resource Management (Measurement and Reporting of Water Takes) Regulations 2010, clause 3.

Step 3 – Schedule 10A.4.1.3

- 34 Any measurement over the authorised (consented) rate of take by less than the margin of error is rounded down to the authorised rate. The margin of error will be 5% or 10% depending on the factors set out in Schedule 10A.4.1.5. This step when combined with Schedule 10A.4.1.4 ensures that permit holders cannot be allocated more water than their current allocation.

Step 4 - 10A.4.1.4

- 35 Any measurement over the authorised (consented) rate of take by more than the margin of error is deleted. This step has the effect of excluding data spikes and taking in excess of authorised limits.

Step 5 – Schedule - 10A.4.1.5.

- 36 This step defines the margin of error which is to be applied.

Step 6 - 10A.4.1.6

- 37 Once the above steps have been completed the data is then analysed to identify the highest remaining rate of take in each water year (1 July – 30 June). The highest rate in each water year is then summed and divided by the number of water years.
- 38 In practice this means that an applicant only needs to have taken water at their authorised rate of take once in each water year to receive their existing rate of take under Schedule 10A.4.

10A.4.2 Methodology for calculating Daily Volume Limit (m3)

- 39 Section 10A.4.2 of the proposed Schedule is used to calculate the daily volume limit in m3.
- 40 While Deemed Permits have a rate of take limit, most do not have any volume limits. When calculating existing volume limits the assumption is made that water can be taken 24 hours a day, 7 days a week.
- 41 In practice most Deemed Permit holders do not take water this often meaning that their actual water use is much lower than their theoretical on paper allocation.

Step 1 - 10A.4.2.1

- 42 Schedule 10A.4.2.1 provides a methodology for calculating an existing daily volume limit if one is not specified on the permit. The method assumes that the daily volume limit is the rate of take limit taken for an entire 24 hour day.

Step 2 - 10A.4.2.2 - 10A.4.2.5

- 43 This step repeats the steps outlined in paragraphs 33-36 above for the same reasons.

Step 3 - 10A.4.2.6

- 44 Once the steps described above have been completed the highest volume day in each water year (1 July – 30 June) is summed and divided by the number of water years. The result of the calculation is the Daily Volume Limit.

10A.4.3 Methodology for calculating Monthly Volume Limit (m3)

- 45 The steps for calculating a monthly volume limit follow the same formula as calculating a daily limit. For calculations of monthly volumes, the filtered daily volumes used for step 10A.4.2 are used. This includes the filtering steps undertaken in 10A.4.2.2 - 10A.4.2.5.
- 46 Data is then further filtered under 10A.4.3.3 - 10A.4.3.6. to remove any errors with the aggregated monthly data. In practice I would expect that once daily exceedances are removed monthly volume data should not require further filtering. This is because any exceedances have already been removed from the filtered daily volume data set.
- 47 Under step 10A.4.3.7 the highest volume month in each water year is summed and divided by the number of water years. The result of the calculation is the Monthly Volume Limit.

10A.4.4 Methodology for calculating Annual Volume Limit (m3)

- 48 The calculation of an Annual Volume Limit uses the filtered daily volumes used for 10A.4.2. This includes the filtering steps undertaken in 10A.4.2.2 - 10A.4.2.5.
- 49 Data is then further filtered under 10A.4.4.3 - 10A.4.4.
- 50 The volume taken in each water year is then divided by the number of water years to calculate an average volume used. The result of the calculation is the Annual Volume Limit.

Explanation of methods under the current operative Water Plan

- 51 In this part of my evidence I explain, by way of comparison, the methods used when calculating water permit limits under the Water Plan.
- 52 Under the Water Plan Council's Analysts prepare a range of historic use options which are then presented to the Consent Officer to consider along with the rates requested in the application. The information contained in this analysis has evolved over time.
- 53 For the instantaneous rate of take limit, the analysis includes a figure for the 80th, 90th and 95th percentiles as well as a maximum. The Consent Officer will then compare this to the details contained in the application and make a recommendation on which number is appropriate.
- 54 For Daily, Monthly and Annual volumes, the analysis is more limited. Analysts will provide the maximum volumes, but will also provide commentary if they are of the opinion that these results do not fit within the normal pattern of taking. The Consent Officer then needs to exercise his or her judgment to determine the appropriate limits.
- 55 For Monthly and Annual volumes, the Consent Officer will then compare these volumes to those recommended by Aqualinc. The Aqualinc report *Guidelines for Reasonable Irrigation Water Requirements in the Otago Region*³ was prepared for the Council in 2017. It provides guidelines on the volume of water required to efficiently irrigate different crop types in different soil types, in different parts of Otago. For monthly volumes the lower of the maximum monthly demand under Aqualinc and maximum

³ <https://www.orc.govt.nz/media/4499/aqualinc-irrigation-guidelines-2015.pdf>

monthly historic use is used. For annual volumes the lower of the 90th percentile demand (9 out of 10 years) in Aqualinc and the maximum annual historic use is used.

Key differences between the Water Plan Method and Proposed Schedule

10A.4

- 56 A key difference between Schedule 10A.4 and the methodology under the current Water Plan is that Schedule 10A.4 provides an objective and certain methodology with less room for subjective interpretation.
- 57 The methodology was designed in conjunction with the short-term consent duration policy in PC7.
- 58 For the majority of water permits, Schedule 10A.4 will result in a higher instantaneous rate of take than would be recommended under the existing water plan, using the 95th percentile. However, this will only occur over a much shorter duration compared to water permits that are renewed under the Water Plan with applicants typically seeking longer terms.
- 59 It is my expectation that across the Otago Region, Schedule 10A.4 will result in a significant reduction in the paper allocation currently assigned to Deemed Permit and other Water Permit holders. This is because many Deemed Permit and other Water Permit holders do not use their current paper allocation to the maximum extend authorised. This is particularly true when looking at monthly and annual volume allocations.
- 60 Most Deemed Permits do not contain volume limits. Where those limits do not exist the permit can theoretically be exercised all year round for 24 hours a day. In practice this is generally not the case, meaning that actual usage does not come close to the maximum paper allocation.

Consideration of amendments sought in submission to the methods in Schedule 10A.4 proposed by parties

Canterbury Land and Water Regional Plan

- 61 A number of submitters have suggested that Schedule 10A.4 be replaced by Schedule 10 of the Canterbury Water Plan.⁴ For ease of reference, Schedule 10 from that Plan is attached as **Appendix A**.
- 62 From a data perspective there would be a number of issues with applying Schedule 10 of the Canterbury Water Plan to PC7. The method refers to using “*Records of past use, moderated to ensure the annual volume is sufficient to meet demand conditions that occur in nine out of ten years.*” This is effectively a 90th percentile of annual volume which would require at least ten data points, or ten years’ worth of data. Most water permits in Otago would not have a full ten years’ worth of metering data so other “records of past use” would be required. This complicates data analysis and moves away from outcome 3 relating to proposed Schedule 10A.4 “*To provide a methodology which is simple to apply, objective, and certain, allowing a lower cost for processing consents.*”
- 63 In addition, the suggested amendment refers to moderating data but does not provide a method for doing so. In my experience, this lack of certainty adds significant time and cost to the processing of water permit applications.
- 64 Further discussion on the use of Schedule 10 of the Canterbury Water Plan is provided by Mr De Pelsemaeker.

Unavailability of Data

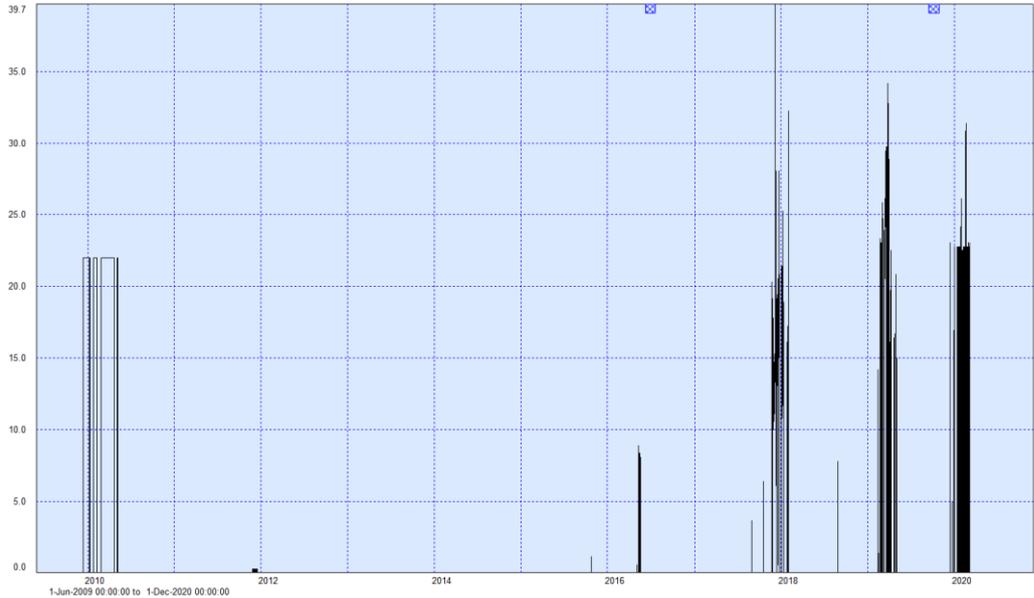
- 65 Unavailability of data has been raised by a number of submitters.⁵ There can be four main causes for this. The first is that required metering was not installed on time. The second is that metering was not required until part way through the 2012-2017 period. The third is that metering was not required. The fourth is that metering has been installed but there are data gaps due to a technical issue.

⁴ Submitters 71177, 70047.

⁵ Submitters 71011, 71013, 71052, 71114 and 71179.

- 66 No change is necessary to accommodate data which is missing due to required metering not being installed. The installation of metering is a requirement set out in the Regulations.
- 67 A change is, however, required to deal with situations where water metering was not required until part way through the 2012-2017 period. Under the Regulations, permits with a rate of take of 5 L/s or more and less than 10 L/s were not required to have metering installed until 10 November 2016. While it is possible to analyse sets of data shorter than five years under Schedule 10A.4 longer data sets are preferable as they provide more points of data, which minimise the impact of anomalies. A data set of around 8 months (November 2016-July 2017) is also impractically short as it does not provide a full year to analyse.
- 68 To address this issue, I recommend that PC7 is amended to analyse data from 1 July 2015- 30 June 2020. This will have the benefit of providing a more complete data set for smaller takes. This will also be beneficial for the analysis of larger takes as later data sets tend to be more complete and will be more reflective of current use.
- 69 For takes below 5 L/s and non-consumptive takes there is no requirement to have metering installed unless it has been stipulated in a consent. Without metering data Schedule 10A.4 will not work.
- 70 Mr De Pelsemaeker has recommended a change to the rule framework to address this gap.
- 71 Data gaps which exist due to technical issues pose a problem for the effectiveness of Schedule 10A.4. Technical data gaps can exist for a number of reasons including power problems, battery failure, meter failure, data logger failure and pump failure. In some cases these problems can take some time to fix. This can be due to a delay in acquiring parts or a delay in the availability of a certified meter provider. Schedule 10A.4 does not provide a methodology to correct data where gaps occur due to legitimate technical issues. It would be beneficial to both the Council and the Applicant if there was a consenting pathway available to consider data gaps and provide an alternative pathway to the applicant.
- 72 An example of a technical issue leading to a data gap can be seen below where an issue with wiring on a data logger appears to have led to a data gap of around 5 years.

Figure 1



73 Recommendations on how to address this are provided by Mr De Pelsemaeker.

Quality of Data

74 A number of submitters have expressed concern about the quality of water meter data.⁶

75 Data quality issues can occur for some of the same technical reasons outlined under my evidence around data gaps. They can though be harder to spot and can work either to the advantage or disadvantage of an applicant.

76 Data quality issues can also occur due to issues within an applicant's control such as the maintenance and cleaning of open channels, or the infrastructure in place at a take.

77 Schedule 10A.4 provides safeguards to ensure that any issues with data quality do not lead to an increase in the amount of water actually allocated for use.

78 I also note that the Regulations place the onus to accurately measure water taken on the holder of the water permit.

⁶ Submitters 71013, 71053, 71055, 71061, 71065, 71066, 71068, 71072, 71092, 71136, 71114, 71159, 71185, 71233, 71239 and 71253.

79 These requirements are set out in Clauses 6.1 and 6.6.A of the Regulations, as follows:

6.1 “A permit holder must keep records that provide a continuous measurement of the water taken under a water permit, including water taken in excess of what the permit allows.”

6.6A “The records must be kept using a device or system that—

(a) measures the volume of water taken—

- (i) to within $\pm 5\%$ of the actual volume taken, for water taken by a full pipe; or
- (ii) to within $\pm 10\%$ of the actual volume taken, for water taken by another method (including by an open channel or a partially full pipe); and”

80 The water meter data held by the Council represents the data provided by Deemed Permit and other Water Permit holders to demonstrate compliance with their consents and permits.

81 Where data quality problems exist due to technical issues there may be a practical need to provide a pathway to consider consent applications. I would like to consider any further relevant information provided by the parties in relation to this issue during the evidence exchange and hearing.

Submission by Landpro

82 In Paragraph 69.a Landpro⁷ discuss the wording around margins of error in 10A.4.1 (3), (4) & (5). I agree with their submission and recommend – that 10A.4.1.5, 10A.4.2.5 and 10A.4.3.6 be amended to read:

*“The margin of error to be applied to any calculation will be either 5% for piped takes and 10% for water taken by another method, including by an open channel or a partially full pipe. ~~depending on:~~
~~(d) the margin of error specified in any consent or permit being replaced, or~~*

⁷ Submitter 71159.

~~(e) the results of the last verification presented to the Otago Regional Council, or~~

~~(f) the margin of error specified by the meter's manufacturer.~~

- 83 This is consistent with the margins of error referred to in Clause 6.6 of the Regulations.
- 84 In Table 1 in their submission Landpro has provided a summary of an analysis of over 60 water permits using Schedule 10A.4 and the Water Plan. As discussed above, under the Water Plan the Council has adopted a practice to analyse data and provide information to the Consent team. The final decision on which numbers to use rests with that team. Without reviewing Landpro's calculations it is not possible for me to confirm whether their methodology matches that used by the Council.
- 85 Landpro's submission suggests that Schedule 10A.4 will always lead to a reduction in allocation compared to the Water Plan. Council's actual experience applying Schedule 10A.4 indicates that this is not correct.
- 86 For rate of take, the Council's method under the Water Plan provides consent officers with a range of numbers generated from analysis. The highest two of these are the 95th percentile and the max rate. For most consents Schedule 10A.4 will generate a number between the 95th percentile and the max.
- 87 For Daily volume limits Council's analysts advise the consent team the maximum volume used. They also provide commentary on the typical volume used when the max volume appears to be an outlier. Schedule 10A.4 uses an average of the maximum value in each year, and this value will be lower than the maximum value used across the data set but will not necessarily be lower than the typical value.
- 88 For Monthly volume limits Council's analysts advise the consent team the maximum volume used. They also provide commentary on the typical volume used when the max volume appears to be an outlier. The number is then compared to the number recommended by Aqualinc. Schedule 10A.4 uses an average of the maximum value in each year, and this value will be lower than the maximum value used across the

data set. However, it will not necessarily be lower than the typical value or the number recommended under Aqualinc.

- 89 Landpro is concerned that Schedule 10A.4 is likely to lead to a larger reduction in monthly allocation than in daily allocation. With 60 points of data to draw from I am comfortable that the methodology contained in Schedule 10A.4 will produce a result which reasonably reflects the applicant's actual use.
- 90 With regards to Annual Volume, Landpro is correct that Schedule 10A.4 is reducing annual allocation as compared to the Water Plan. With only five points of data to work from the methodology for calculating the Annual Volume Limit calculates the average of the volumes used across the years analysed. This can have the effect of generating a number significantly lower than would have been generated under the Water Plan methodology. PC7 did not intend to reduce the actual annual allocation being used, and so I recommend that Schedule 10A.4.4 be amended to read;

The 'Annual Volume Limit' shall be determined by calculating the ~~average of the actual volumes taken each year~~ maximum volume taken in any water year analysed.

- 91 I also Recommend that Schedule 10A.4.4.5 be amended to read;

~~The 'Annual Volume' taken in each water year will then be summed across the hydrological years analysed and divided by the number of hydrological years analysed~~ The actual highest volume taken in any water year analysed will be the Annual volume limit.

- 92 Worked examples of the difference between the methodology under the

current Water Plan and Schedule 10A.4 can be found in Mr Leslie's evidence.

Dated this 7th day of December 2020



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Simon Wilson

Appendix A

Three methods are provided for determining the seasonal irrigation demand.

- 1. Records of past use, moderated to ensure the annual volume is sufficient to meet demand conditions that occur in nine out of ten years for a system with an irrigation application efficiency of 80%; or*
- 2. Use of a model that has been field validated and shown to reliably predict annual irrigation volume within an accuracy of 15%. The annual volume calculated using the model shall be compliant with the following criteria:*
 - a. an irrigation application efficiency of 80%;*
 - b. a system capacity to meet peak demand;*
 - c. a nominal irrigation season from 1 September to 30 April; and*
 - d. demand conditions that occur in nine out of ten years.*
- 3. Using the methodology set out below and the figures set out in Table 10A.4.*

To determine the applicable seasonal irrigation demand standard and derive an annual volume:

- 1. find the total seasonal demand from Table 10A.4 for the particular soil PAW class. Where the soil PAW class is between 100 - 200 mm, insert the appropriate PAW for the soil to be irrigated into the formula to determine the total seasonal demand;*
- 2. determine effective irrigation season rainfall for the location;*
- 3. deduct this rainfall amount from the total seasonal demand amount to give the irrigation requirement in millimetres – this provides the seasonal irrigation demand standard;*
- 4. adjust this seasonal irrigation demand standard by multiplying by 10 to find the volume of water (cubic metres) per hectare per season; and*
- 5. multiply this amount by the area that is to be irrigated to give the annual volume.*

Table 10A.4

<u>Soil PAW Class</u>	<u>Total Seasonal Demand</u>
<u>< 100 mm</u>	<u>910 mm</u>
<u>100 – 200 mm</u>	<u>910 -1.6(PAW-100) mm</u>
<u>>200 mm</u>	<u>750 mm</u>

Soil PAW Class represents the upper and lower limits of the soils that are generally irrigated in Otago in terms of the profile available water (PAW) of the soils. Between

the upper and lower limits set out in Table 10A.4, a sliding scale is used to determine the relevant total seasonal demand.

Total seasonal demand is the total amount of water required to satisfy plant water needs during the main growing period. This demand can be satisfied by rainfall and irrigation. In determining the irrigation component, provision has been made for:

1. an irrigation application efficiency of 80%;
2. a system capacity to meet peak demand (between 4mm/ha/day and 6.5 mm/ha/day);
3. a nominal irrigation season from 1 September to 30 April;
4. demand conditions that occur in nine out of ten years; and

Effective irrigation season rainfall is the amount of rain that will contribute to crop growth over the nominal irrigation season. In determining this amount, provision has been made for:

1. rainfall that occurs on average in six out of ten years (which, together with a complementary seasonal irrigation allowance, is estimated to meet total water demand with a reliability of nine out of ten years based on analysis of long-term climate data); and
2. excluding daily rainfall amounts of less than 5 mm, or cumulative rainfall amounts in consecutive days in excess of 50 mm.

Seasonal irrigation demand standard for a given soil PAW the depth of water (measured in millimetres) per hectare per year required to be supplied by irrigation to satisfy plant water demand after allowing for effective irrigation season rainfall.”