BEFORE THE OTAGO REGIONAL COUNCIL

In the matter of the Resource Management Act 1991

And

In the matter of application **RM19.151** by **BSTGT Limited and Trustees of the A P McQuilkin Family Trust** for a permit to take and use water

STATEMENT OF EVIDENCE OF HILARY KAY LOUGH

25 MAY 2021

QUALIFICATIONS AND EXPERTISE

1. My name is Hilary Kay Lough.

2. I hold the qualifications of Bachelor of Engineering (Honours) in Civil Engineering and a Masters of Engineering in Civil Engineering, both from the University of Canterbury (NZ). My master's project was focused on groundwater-surface water interaction and my thesis project was carried out in collaboration with Environment Canterbury and Pattle Delamore Partners Ltd (PDP). I am a Chartered Professional Engineer (CPEng), a Professional Member of Engineering New Zealand (CMEngNZ) and a member of the New Zealand Hydrological Society

3. I am employed as a Technical Director (Water Resources) with the environmental engineering and science company PDP. I have been working at PDP since October 2004 on environmental engineering and water resources projects, with a specialist focus on groundwater resources.

4. My work experience relevant to this application includes a variety of groundwater-related work at sites throughout New Zealand; acting as a reviewer of journal articles on groundwater-surface water interaction for international publications; providing Regional Council consents and groundwater sections with technical advice on groundwater issues; predictive hydrogeological modelling, contaminant transport modelling and the analysis and interpretation of field data related to groundwater- surface water interaction.

5. I have been engaged by the Otago Regional Council to provide the following statement of evidence in relation to potential groundwater effects regarding consent application RM19.151 lodged by BSTGT limited and the Trustees of the A P McQuilkin Family Trust for a permit to take and use water.

6. I have read the Code of Conduct contained in the Environment Court's Practice Note for Expert Witnesses dated 1 December 2014 and agree to comply with it.

EXECUTIVE SUMMARY

7. Application RM19.151 has been by lodged by BSTGT limited and the Trustees of the A P McQuilkin Family Trust for a permit to take and use surface water.

8. Surface water takes can affect groundwater via a reduction in groundwater recharge. No assessment of groundwater effects was provided for this surface water take application.

9. I have identified a number of bores that could be potentially impacted by reduced aquifer recharge arising from the abstraction of surface water flow. In this evidence I provide comment on the potential effects on these bores based on the available information and the applicant's application, including the amendments dated 3 March 2021.

SCOPE OF EVIDENCE

10. The purpose of this evidence is to provide a review of the potential groundwater effects of the consent application RM19.151 lodged by BSTGT limited and the Trustees of the A P McQuilkin Family Trust for a permit to take and use water. This evidence covers:

    10.1 an overview of the groundwater environment and groundwater-surface water interaction

    10.2 the potential effects of the activity on groundwater recharge

    10.3 the potential effects of the activity on groundwater users

    10.4 response to points raised in submissions, and

    10.5 measures to avoid, remedy and mitigate effects and recommendations.

INTRODUCTION

11. The proposed activity includes the abstraction of surface water at three locations, from the Royal Burn North Branch (two locations) and New Chums Creek (one location). The applicant currently holds deemed permits and one water permit which allow abstraction from the same locations.

12. The applicant has proposed that the total rate of abstraction (from all three locations) must not exceed 89.5 L/s. According to the application, the current rate of abstraction authorised under the deemed permits and current water permit is 319.5 L/s. The applicant further proposes that:

    12.1 The rate of take at the Upper Royal Burn North Branch point of take shall not exceed 15 L/s.

    12.2 The rate of take at the Lower Royal Burn North Branch point of take shall not exceed 50 L/s.

    12.3 The rate of take at the New Chums Creek point of shall not exceed 24.5 L/s.

13. The application seeks an annual volume of 1,214,683 m^3/yr (equivalent to a combined average continuous rate of take of 38.5L/s), which is a reduction from the 5,266,200 m^3/yr stated to have been previously authorised.

14. The applicant proposes a residual flow condition where a visual residual flow shall be maintained for at least 50 m past the points of take at all times. On 3 March 2021, the applicant proposed a low flow cut-off equal to 5 L/s for the Royal Burn, located just upstream of the LOFTS water scheme.

15. The applicant acknowledges that a minimum flow for the Arrow River is expected to be set via a plan change and that this is expected to apply to existing consents via a plan change. The applicant notes that water

should still be able to be taken at the applicants' points of take for domestic and stock drinking water purposes.

DESCRIPTION OF THE GROUNDWATER ENVIRONMENT

16. No description of the groundwater environment has been provided by the applicant in the application, nor any assessment of the effects on groundwater.

17. A review of the hydrology is provided by my colleague, Bas Veendrick. The hydrological information of relevance to groundwater relates to the expected and observed losses of surface water flow to groundwater. Surface water takes can affect groundwater via a reduction in groundwater recharge, especially when an abstraction affects an intermittent surface waterway.

18. Regarding the Royal Burn and interaction with groundwater, at the time of a site visit on 31 January 2018, the applicant reports that the Royal Burn North Branch was gauged above the upper point of take and flow was estimated at 13 L/s. Less than 5 L/s of water was observed downstream of the upper point of take and was attributed to water seeping through the weir structure at the point of take. It was noted that the Royal Burn North Branch was dry at the lower take site (both above and below the site), and the applicant noted that this showed that the water seeping through the weir structure was disappearing to ground before reaching the lower point of take.

19. Losses to groundwater from the Royal Burn much greater than those observed above were observed during a fish survey. Matt Hickey of Water Resource Management Ltd undertook a fish survey on 28 January 2020. Mr Hickey states in the report on that work that: "*Downstream of take 97029 and 3073B the North Branch of the Royal Burn went dry despite two thirds of the flow passing the intake, indicating that the lower section of the Royal Burn North Branch is naturally intermittent*". Figure 4 from Mr Hickey's report showing the observed dry reach is reproduced below.

20. A NIWA letter dated 26 February 2021 reports on flow gaugings from 22 February 2021 that showed a flow of around 20 L/s both below and above the top intake, and 25.4 L/s above the lower intake, with gains observed downstream of a swamp/wetland area. A figure showing these gains and losses is included in the evidence of Mr Veendrick.

21. The information provided suggests that there may be losses from the Royal Burn to groundwater between the upper and lower intakes, although at times gains or very little flow change may also occur (as indicated by the 22 February 2021 gaugings).

Figure 4. Map showing the flow reaches of the Royal Burn (blue line) the dry reach (red line) and the point the North Branch went dry despite the majority of flow passing the intake for 97029 &3078B.

Figure 1: Figure 4, reproduced from fish survey report (Hickey, 2020)

22. Regarding New Chums Creek and interaction with groundwater, during this site visit on 31 January 2018, a stream gauging was also undertaken on New Chums Creek above the point of take with an estimated flow of 5 L/s. The applicant has stated in the AEE that "*with a MALF of less than 5 L/s, it is questionable whether New Chums Creek would maintain a meaningful, connected flow through the length of the creek at all times even if the abstraction activity was not occurring*".

23. During Mr Hickey's fish survey on 28 January 2020, the upper reaches of New Chums Creek were electric fished and Mr Hickey states in the report on that work that: "*On the day of the survey there was only a seepage flow passing the take, while in the middle survey reach flows had gained to be more than 10 l/s. At the confluence with the Arrow, flows were estimated to be in excess of 30 l/s.*"

24. From the information obtained, this indicates both losses to groundwater and gains from groundwater may occur in New Chums Creek.

25. In terms of the groundwater resource that may be affected, this occurs within the Crown Terrace. The Crown Terrace is situated about 200 to 300 m above the current Arrow River floodplain level extending southwest of the Applicant's surface water take locations. Geologic information available through GNS suggests that most of the Crown Terrace is overlain by old (Middle Pleistocene) gravelly river fan deposits comprised of locally derived sandy schist gravels originating from the basement schist rocks of the Crown Range. The same basement rocks are mapped at the land surface along the southwestern face of the terrace where it drops off to the Arrow River.

26. Bore F41/0448 is situated near the southern extent of the Applicant's New Chums Race above where it is piped south to the Brodie Race. This bore is a 42 m deep domestic bore (screened from 41 to 42 m) with a static groundwater level recorded at 35.1 m depth. The geologic log for this bore shows alluvium/fan deposits to about 42 m depth and no bedrock.

27. About 850 m to the south-southwest of bore F41/0448 (about 1 km northwest of Royal Burn) there is a borelog available for bore F41/0330 located within the Applicant's golf course. Although no depth to groundwater is recorded, its log shows that the depth of basement rock is about 30 m. This observation appears to suggest that the gravelly aquifer materials on the terrace probably thin toward the terrace edge.

28. The topography also suggests that the old alluvium comprising the aquifer across the Crown Terrace generally thins toward the terrace

drop off and thickens towards the Crown Range. The log for bore F41/0378 (about 1 km southeast of Royal Burn South Branch near the foothills/south eastern upper extent of the terrace alluvium extent) shows an 85 m thick sequence of gravelly alluvium. This bore apparently did not encounter the bedrock boundary, which suggests that (noting the topography drops off by about 100 m between the Crown Range foothills and the terrace edge) that the Crown Terrace aquifer alluvium could be over 85 m thick near the range and may pinch out to zero thickness towards the terrace edge.

29. The downstream reach of the Royal Burn above the terrace drop off is relatively incised according to topographic contours in an area of basement rock mapped at the ground surface. The geologic log for bore F41/0399 (about 240 m southeast near the downstream extent area noted above) available through ORC confirms this with a log of a dry 69 m hole only encountering weathered schist rock and schist rock. Further up the Royal Burn just below the confluence of the North and South branches (below the Applicant's take from the Royal Burn North Branch) bore F41/0176 (29.3 m deep) has a static groundwater level recorded at 11.2 m. According to its geologic log, it is completed within a sequence of gravels and sands comprised of the basement schist rock materials with no bedrock encountered. The borelogs described above suggest that any surface water features may be disconnected from groundwater in places, losing to groundwater in places as they flow towards the terrace edge. This corresponds well with the applicant's observations.

30. Although the surface waterways flowing across the terrace are likely to generally lose to groundwater, the terrace aquifer materials likely thin and pinch out towards the terrace edge where the surface waterways have locally incised the land and it is possible that the groundwater system then discharges back to the surface waterways in the vicinity/just above of the terrace edge. In terms of hydraulics, the basement rock boundary is likely to be of relatively low permeability and may force groundwater to emerge back at the land surface where the extent of the old alluvium ends (towards the terrace edge). This pattern of a gain in flow towards the terrace edge was supported by the 22 February 2021 NIWA gaugings.

31. Overall, the available information on groundwater surface-water interaction suggests that the surface water abstraction from both surface waterways could reduce groundwater recharge, which, in addition to reducing potential gains in flow further downstream, may impact on groundwater users via reduced aquifer recharge.

ASSESSMENT OF ACTUAL AND POTENTIAL EFFECTS ON GROUNDWATER

32. Although there is no operational or draft allocation aquifer designated by ORC for the Crown Terrace, there appears to be a low density of supply bores completed in the old alluvium described above that could theoretically be impacted by any long term reduction in water inputs to the groundwater system. As such, the Applicant's proposed surface water takes reduce inputs to the groundwater system that would normally occur as a result of natural surface water losses to the aquifer.

33. The Applicant's proposed take from New Chums Creek diverts surface water from the New Chums Creek surface water catchment to other surface water catchments to the south. According to the ORC database, there is only one groundwater bore downstream of the New Chums Creek take that could be expected to potentially be impacted from a long term decline in the groundwater resource. This bore is F41/0307 and is a 28 m deep domestic supply bore with a depth to groundwater of about 12.5 m. The setting is such that New Chums Creek is expected to lose to groundwater within the uppermost Crown Terrace area (on the northern side of Mt Beetham), although Mr Hickey's observations during the 28 January 2020 fish survey suggest gains may also occur. This area may be considered not technically part of the Crown Terrace aquifer as it is outside of the extent of the old alluvium noted above. The domestic supply bore is in the immediate vicinity of New Chums Creek downstream of the take and may rely on natural surface water losses. Given that the hydrology in this specific area could be complex with specific groundwater throughflows below the disconnected creek alignment being unknown (and potentially very limited/bounded by bedrock), water levels in this bore could potentially be sensitive to the Applicant's upstream surface water flow take. Although the magnitude of effects on the bore is uncertain, considering the reduction in the proposed rate of take from the originally proposed

45 L/s to 24.5 L/s (with a currently consented rate of take of 83.3 L/s) together with the observations of gains in flow during the fish survey, the effects on the bore may not be significant. The owner of the bore was notified but did not provide a submission. The suggested flow restriction in the evidence of Miss Bryony Miller would decrease the risk of adverse effects on this bore by increasing the likelihood of flow in Chums Creek at the location of the bore, which could maintain a degree of groundwater recharge.

34. The Applicant's two takes from the Royal Burn North Branch are (according to the ORC database) upgradient/upstream of five domestic/small community groundwater supply bores that flank the Royal Burn within the terrace aquifer area. Two of these bores (bore F41/0176 and F41/0277) are at the confluence of the South and North Branch of the Royal Burn while the other three are further downstream and flanking the main stem of Royal Burn above the terrace drop off (F41/0271, F41/0249, and F41/0218). ORC records show bore F41/0176 is owned by Barley Station Glencoe Trust (of which one of the applicants, BSTGT Ltd, is a trustee). In addition, there is a bore with a water permit to take groundwater (97184) from bore F41/0612, also near the confluence of the South and North Branch of Royal Burn, which expires May 2022. All of these bores may rely on a groundwater resource that, in the long term, may have limited sustainability and rely heavily on natural surface water losses from Royal Burn. The applicant has not provided information on the potential effects on these bores to enable a conclusion to be reached on the magnitude of effect, although I note that the further information provided on flows on 22 February 2021 and the proposed residual flow condition above the LOFTS scheme suggests that the effects on the bores near the edge of the terrace may be limited due to groundwater inflows. The suggested flow restrictions in the evidence of Miss Bryony Miller would also decrease the risk of adverse effects on the bores. In addition, the updated proposal is to reduce the magnitude of take to historic use, so the effects are not expected to increase. One submission was received from owners of these bores, which was from the owners of bore F41/0249, Jef Desbecker and Robina Bodle, which is discussed further below.

RESPONSE TO SUBMISSIONS/MATTERS RAISED

35. A number of submitters, including downstream groundwater users have submitted in opposition to this application in relation to groundwater effects. Concerns have been raised on groundwater recharge to the aquifer arising from the take of surface water together with concerns related to the use of water for irrigation, including of the golf course, on groundwater quality. I recommend that ORC consider appropriate consent conditions to control these potential water quality effects.

36. The concerns of the downstream water users reflect the potential effects identified above, whereby a reduction in groundwater recharge may impact on the water levels in their bores. This includes a submission by Jef Desbecker and Robina Bodle for their bore (F41/0249). As outlined above, the magnitude of effects is uncertain, although I note that the updated proposal to reduce the magnitude of take to historic use and the proposed residual flow condition by the applicant for the LOFTS scheme, together with the suggested flow restrictions in the evidence of Miss Bryony Miller would also decrease the risk of adverse effects on the bores. The location of bore F41/0249 near the terrace edge means it is less likely to be adversely affected due to the expected gains in flow in the Royal Burn, reflecting higher groundwater levels in that location.

MEASURES TO AVOID, REMEDY AND MITIGATE EFFECTS

37. At present, no specific mitigation measures for groundwater effects have been proposed. The residual flow condition of a visual flow 50 m past the points of take proposed has not been demonstrated to mitigate groundwater effects. However, as outlined above, the proposed residual flow condition by the applicant for the LOFTS scheme and suggested flow restrictions in the evidence of Miss Bryony Miller would decrease the risk of adverse effects on the bores.

MONITORING

38. At present, no monitoring measures for groundwater effects have been proposed. It would be difficult to isolate the effects of the scheme in

groundwater monitoring data, but given no quantitative assessment has been provided to establish the magnitude of potential effects, some form of groundwater monitoring should be considered to improve the understanding of the effects of the activity on the groundwater system and determine if any long term declining trend in groundwater levels occurs. This could involve the applicant monitoring groundwater levels in their 29.3 m deep bore F41/0176 and supplying these to ORC annually. These should be ideally recorded electronically with a pressure transducer at least daily, with manual measurements made at least quarterly. Specific mitigation is not considered necessary at this stage considering the amendments to the application including limiting the proposed volumes to match historic use, the single specific submission from a groundwater user near the terrace edge where effects are less likely (bore F41/0249) and provided the applicant accepts the flow restrictions in the evidence of Miss Bryony Miller.

RECOMMENDATIONS

39. The applicant has not undertaken any assessment of the potential effects on groundwater as part of the application. In the absence of information on groundwater impacts, some monitoring measures are considered appropriate involving long term monitoring of groundwater levels. Considering the amendments to the application and if the applicant accepts the flow restrictions in the evidence of Miss Bryony Miller, specific mitigation is not considered necessary based on the current information. I also acknowledge that the proposed magnitude of take is now consistent with historic use so the magnitude of effects would not be expected to increase.

CONCLUSION

40. Surface water takes can affect groundwater via a reduction in groundwater recharge. No groundwater assessment has been provided for this application to take surface water.

41. I have identified a number of bores that could be potentially impacted by the abstractions and recommended monitoring of groundwater levels. Considering the amendments to the application and if the

applicant accepts the flow restrictions in the evidence of Miss Bryony Miller, specific mitigation is not considered necessary based on current information.

Dated 25 May 2021

Hilary Lough