Before a Hearings Panel appointed by the Queenstown Lakes District Council

Under	the Resource Management Act 1991
And	
In the Matter of	a submission on the Proposed Queenstown Lakes District Council Urban Intensification Variation by John O'Shea, Helen Russell, John Russell and Mary-Louise Stiassny

Statement of Evidence of **Neil Malcolm Thomas** for John O'Shea, Helen Russell, John Russell and Mary-Louise Stiassny - Groundwater

Dated: 4 July 2025

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INTRODUCTION

Qualifications and Experience

1. My full name is Neil Malcolm Thomas.

2. I hold the qualifications of BSc (Geological Sciences) and MSc (Hydrogeology) both from the University of Leeds.

3. I am a Technical Director with Pattle Delamore Partners Limited (**PDP**) and have been employed at PDP since 2011. Prior to working at PDP, I was employed by Entec UK Ltd (now AMEC) in the United Kingdom for 5 years (from 2005 to 2010) as a hydrogeologist specialising in groundwater modelling. I have over 15 years of experience as a hydrogeologist in groundwater resources.

4. My role at PDP involves working on a wide range of groundwater management issues including assessments of groundwater quality and quantity within the Otago region, and elsewhere in New Zealand. These management issues include the effects of land use, abstractions and discharges on groundwater and the interaction between groundwater and surface waterways.

Background and Involvement

5. PDP was engaged by Otago Regional Council (**ORC**) to provide advice on groundwater allocation for the Wānaka Basin in 2018. I was the author of the resulting report that recommended an allocation approach for the Wānaka Basin. The report was based on a detailed numerical groundwater model of the Wānaka Basin which simulated groundwater levels as well as flows within the Cardrona River and Bullock Creek. As a result, I am very familiar with the groundwater setting of the Wānaka Basin, and the patterns of flows across the basin, including within Wānaka township.

6. I was asked to provide technical groundwater evidence on behalf of John O'Shea, Helen Russell, John Russell and Mary-Louise Stiassny (**Submitters**) to help support their proposed relief. I have carefully considered their request and whilst my comments in the following paragraphs of my evidence are not solely applicable to the Submitters' property at 3/61 Stratford Terrace, Wānaka (**Property**) or the adjoining

properties at Lot 2 DP 18304, Lot 1 DP 18304 and Lot 3 DP 25998 (**Warren Street Properties**), I have provided my opinion on technical background information to support the issues raised in their submission particularly as they apply to the Warren Street Properties and surrounding area.

7. In preparing my evidence I have read a series of background documents that provide context to the Submitters' proposed relief. These include:

   (a) the original submission prepared on behalf of the Submitters dated 21 September 2023 (**Submission**);

   (b) the s 32 evaluation report prepared by Queenstown Lakes District Council (**QLDC**) in relation to the proposed Urban Intensification Variation (**Variation**), dated 16 May 2023 and updated 21 August 2023;

   (c) the Consent Order (ENV-2007-CHC-317) relating to relief sought by Brian Kreft in relation to the QLDC Operative District Plan and development across the Property;

   (d) Consent 2006.151.V1 that authorises abstraction of groundwater at 25 Warren Street; and

   (e) the ORC recommending report for consent 2006.151.

8. In addition, I visited the Submitters' Property and viewed the Warren Street Properties from the street on 1 July 2025, and also entered the Belvedere Apartments site and basement to view the set-up of the augmentation pumping that supplements nearby springs as a result of the construction of the Belvedere Apartments in 2005. On the same day I also walked along Bullock Creek upstream of the Warren Street Properties and was able to observe several other spring fed tributaries that flow into the mainstem of the creek. Based on my observations, the occurrence of spring discharges similar to those around the Warren Street Properties extends at least to the trout hatchery on Stone Street close to the headwaters of Bullock Creek.

9. Based on these documents and my site visit, it is apparent that the Submitters have raised reasonable concerns and issues around the proposed intensification related to groundwater. My evidence intends to assist the commissioners around the technical aspects of the issues raised.

Code of Conduct

10. Whilst 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 2023. This evidence is within my area of expertise, except where I state that I am relying on material produced by another person. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

SCOPE OF EVIDENCE

11. My evidence addresses:

    (a) relief sought by the Submitters;

    (b) the Site and surrounding environment;

    (c) assessment of effects of the Variation on the groundwater environment; and

    (d) proposed rules and standards.

12. I have read the Section 42A Reports prepared by Ms Corrine Frischnecht, Mr Elias Jacobus Matthee and Ms Rachel Morgan (**s42A**). My evidence responds to the s42A.

EXECUTIVE SUMMARY

13. The Submission seeks targeted amendments to the proposed QLDC District Plan (**PDP**), particularly for the Warren Street Properties in Wānaka. The Submitters have proposed the inclusion of a new rule in the Medium Density Residential Zone (**MDRZ**) which would make buildings on the Warren Street Properties a restricted discretionary activity, with matters of discretion specifically addressing groundwater and foundation design. The Submitters also propose that effects on the groundwater table be a matter of discretion for various residential and subdivision activities in the MDRZ, and that a maximum building height of 7 metres be applied on the Warren Street Properties to reduce the need for deep foundations and associated dewatering.

14. The Warren Street Properties are situated in a hydrogeologically sensitive area adjacent to Bullock Creek, a predominantly groundwater-fed stream. The local geology comprises shallow groundwater levels and complex subsurface layering, with confined gravel strata and spring-fed stream discharges. Dewatering required for deeper foundations—more likely under MDRZ intensification—has the potential to lower groundwater levels, reduce flows in springs and streams, and cause ground settlement. This has already occurred at a nearby site (Belvedere Apartments), where long-term dewatering diminished spring flows and required mitigation through stream augmentation.

15. While the concerns raised by the Submitters are valid for the Warren Street Properties, in my opinion, similar groundwater risks likely apply more broadly along Bullock Creek. Therefore, the relief suggested by the Submitters—specifically the inclusion of groundwater-related matters of discretion in the district plan—should be extended to a wider buffer zone (100 m on the true right bank and 500 m on the true left bank of Bullock Creek). This would better safeguard groundwater-fed ecosystems, prevent cumulative dewatering impacts, and align urban development with environmental protection objectives.

16. The s42A concludes that existing provisions within the PDP would address the relief sought by the Submitters. However, I do not believe that these existing provisions address the issues raised by the Submitters and they therefore do not provide the necessary relief sought by the Submission. I consider that further provisions specific to the area around Bullock Creek are appropriate. I have described this further below.

RELIEF SOUGHT BY SUBMITTERS

17. The Submission seeks a number of amendments to the PDP including:

    (a) inclusion of a new rule for buildings on the Warren Street Properties as a restricted discretionary activity with matters of discretion related to groundwater and foundation design;

    (b) inclusion of matters of discretion including impacts on the groundwater table for residential units in the MDRZ;

(c) inclusion of matters of discretion including impacts on the groundwater table for breaches of building coverage and urban subdivision activities on the Warren Street Properties; and

(d) a maximum building height of 7 metres on the Warren Street Properties.

THE SITE AND SURROUNDING ENVIRONMENT

18. The underlying geology as well as the effects of groundwater flow patterns in the local area are important aspects to understand when considering the vulnerability of a site to dewatering and the requirements for dewatering. The following paragraphs intend to help paint that picture and illustrate the groundwater setting of the Warren Street Properties.

19. Broadly, the site is located within the Wānaka Basin, which is a large scale, fault controlled basin located at the south-eastern end of Lake Wānaka. Geologically, the basin is underlain and surrounded by lower permeability schist and basement strata, and infilled by Tertiary aged lake sediments, over which younger, Quaternary aged alluvial gravels and glacial strata have been deposited.

20. Drillers' logs from bores[1] in the Wānaka Basin to the west of the Cardrona River show a clear pattern. Consistent gravelly strata are present to depths of around 40 m or more in bores located between the Cardrona River and Bullock Creek. Between Bullock Creek and Lake Wānaka, the drillers' logs show intervals of silts and clays interfingered with the gravelly strata, with some drillers' logs close to the lake showing extensive thicknesses of silt to at least 50 m below ground level (**bgl**). I have provided a map and a cross section through Bullock Creek to illustrate the information available and the conceptual pattern of groundwater movement in **Figure 1** and **Figure 2**, attached to my evidence.

21. Groundwater that occurs within these strata in the Wānaka Basin is sourced from both land surface recharge (i.e. rainfall infiltration), and river seepage from the Cardrona River, in addition to some irrigation losses. Groundwater generally flows to the north and north-west from the higher ground to the

[1] As available through the Wells Aotearoa online GIS database (https://wellsnz.teurukahika.nz, accessed May 2025).

south and predominantly discharges into Lake Wānaka and the Clutha River, with some discharge into Bullock Creek and the lower reaches of the Cardrona River.

22. Groundwater levels across the basin are variable. In areas between the Cardrona River and Wānaka township, groundwater levels are typically relatively deep at around 20 m below the ground surface. However, within Wānaka township, groundwater levels are much shallower with information from bores showing that groundwater occurs within 1 to 2 m of the ground surface around Bullock Creek, with slightly deeper groundwater levels further to the north-west and closer to the lake at around 3 to 5 m bgl.

23. Although Bullock Creek and its tributaries makes up a relatively small proportion of the overall discharge of groundwater from the Wānaka Basin, it is an important surface waterway[2] within Wānaka Township and is almost entirely fed by groundwater discharge. It is located at the base of the terrace where the ground surface drops towards Wānaka township and Lake Wānaka and typical flows in the creek are in the order of 500 L/s at its confluence with Lake Wānaka.

24. In some areas where silts and clays are not found above the more permeable gravel strata, Bullock Creek is likely fed by general groundwater seepage into the stream. In other areas, where lower permeability silts and clays may provide some confinement to the gravelly strata, more discrete springs that represent weaknesses in the confining strata, such as those found around the Warren Street Properties, are likely to provide flow to the stream.

25. Although I am not aware of detailed hydrogeological information that would allow an assessment of how these mechanisms vary along Bullock Creek, based on my observations from my site visit, similar spring discharges occur elsewhere along the creek.

[2] Values associated with Bullock Creek identified in Schedule 1A of the Regional Plan: Water for Otago include trout spawning and juvenile trout habitat.

ASSESSMENT OF EFFECTS OF INTENSIFICATION VARIATION ON GROUNDWATER ENVIRONMENT

26. The Variation will enable medium density residential housing to occur within parts of Wānaka, including the area around the Warren Street Properties. In general, medium density residential areas are expected to include multi-storey townhouses on relatively small sites (a minimum of 250 m² or greater),[3] together with other forms of higher intensity housing.

27. As a general rule, larger scale buildings require larger, and/or deeper, foundations to support the structure. Dewatering is typically required in order to work the site in dry conditions and as foundations extend further beneath the water table, more dewatering is required. Groundwater levels are normally lowered to a depth of around 0.5 m below the base of foundations and therefore, where deeper foundations are required in areas where groundwater levels are very shallow, such as along Bullock Creek, greater dewatering will be required.

28. The impacts of dewatering on the surrounding environment will depend on the rate and volume at which groundwater is removed as well as the local hydrogeological setting. Broadly, the effects fall into three main categories:

    (a) abstraction of groundwater will cause groundwater pressures in surrounding strata to reduce, which can impact neighbouring bores used to take groundwater;

    (b) groundwater discharges to streams and springs can also reduce with associated impacts on stream ecology, where those features are hydraulically connected to groundwater impacted by the dewatering; and

    (c) in some situations, reducing groundwater pressures can cause ground settlement, particularly where organics, such as peat, occur within the dewatered strata.

29. As noted above, the proposed intensification will enable buildings with likely deeper foundations to be developed and, therefore, some of the effects I have outlined above may become more prevalent in areas where MDRZ

[3] Rule 27.6.1 Intensification Variation – Notified Proposed Provisions.

intensification is enabled by the Variation. I consider that this is likely to be an issue in the area around the Warren Street Properties but also along the line of Bullock Creek more generally where groundwater levels are typically shallower compared to other areas of Wānaka towards the lake. I note that whilst there is only a small number of drillers' logs available, none of the logs identify the presence of peat or other organic strata at shallow depths.

30. Examples of where the hydrological effects described above have occurred in the context of dewatering for deeper foundations include the Belvedere Apartments, located at 25 Warren Street and directly opposite the Warren Street Properties. Dewatering was required for the construction of those buildings and caused flows in the nearby springs to reduce within a radius of at least 100 - 200 m from the site, although groundwater pressures were likely reduced beyond that radius. In addition, ongoing dewatering is required to ensure that the basement car park for the building remains dry.[4] The ongoing dewatering has resulted in continued depletion of flows in the nearby springs, and discharges from the site were around 17 – 22 L/s[3]. This water is discharged back into Bullock Creek but conditions of Consent 2006.151.V1 also require the flows in nearby springs are augmented.

31. I note that in the case of the Belvedere Apartments, the depletion effects on nearby springs and on Bullock Creek are offset by the discharge of water back into Bullock Creek. However, stream depletion effects, as well as effects on springs will extend both upstream as well as downstream from the point of take. Therefore, the discharge does not offset effects on the stream upstream of the point of discharge and in some cases this can result in adverse effects.

32. In some cases, stream, or spring, flow augmentation can be required to support low flows in a stream, for example in order to maintain a minimum flow level for an ecological receptor. In those situations, flow augmentation is typically required infrequently. However, in the case of the Belvedere Apartments, the shallow groundwater environment in that area requires dewatering to occur permanently and therefore augmentation to offset the effects on the springs on the Property is required at all times.

[4] ORC recommending report for 2006.151, 25 Warren Street.

33. Despite the requirement via the resource consent that this augmentation occurs continuously, this is not achieved because the pump that lifts water up to the spring-fed ponds on the Property requires periodic maintenance during which time no augmentation occurs. Therefore, the augmentation in this situation is not necessarily an effective long term solution. A more detailed description of the groundwater issues and associated consent conditions is contained in Consent 2006.11.V1 and the Recommending Report. A copy of these documents is appended to my evidence at **Appendix 1**.

34. Whilst these effects are potentially enabled by the proposed Variation, as it is currently drafted, the PDP does not require consideration of these effects where a consent is required (i.e. as a matter of discretion or assessment matter). However, the regional plan does provide some consideration of these effects. I cover matters of discretion in the Variation below in my response to the s42A.

35. Dewatering and groundwater abstraction are also managed under the Otago Regional Plan: Water for Otago as well as the proposed Land and Water Regional Plan (**LWRP**). Under the existing regional plan, dewatering at rates more than 25 m^3/day (0.3 L/s) would be classified as a 'restricted discretionary activity' and resource consent would be required (Rule 12.2.3). Dewatering rates are typically greater than 0.3 L/s and therefore, considerations as to the effects on groundwater of dewatering that may be required for deeper foundations within a MDRZ are likely to be captured via that resource consent.

36. However, under the proposed LWRP, dewatering at rates up to 40 L/s for up to 60 days is a permitted activity provided various conditions are met (Rule EFL-R6-PER1). In my opinion, a typical dewatering activity, such as that which may be required for deeper foundations, would meet those conditions and the activity would therefore not require consent under the proposed LWRP (noting the example above where longer term dewatering may be required). As an example, I note that the dewatering for the Belvedere Apartments was recorded as being up to 22 L/s[5], which would be less than the threshold in the proposed LWRP. Furthermore, the conditions do not address effects on springs, nor do they allow for cumulative effects due to

[5] ORC Officers Recommending Report for consent 2006.151.V1.

multiple dewatering takes within a single catchment to be assessed, such as that around Bullock Creek.

37. In that respect, I note that Bullock Creek is somewhat unique, in that it is a predominantly groundwater fed stream within an urban environment where cumulatively, dewatering could have a large effect on flows within the stream and associated springs, and where increased levels of dewatering is a potential consequence of the MDRZ proposed. Individual settings such as this are difficult to capture through regional rules and it may not be sufficient to rely on those regional rules to address groundwater issues that could arise from the MDRZ around Bullock Creek.

PROPOSED RULES AND STANDARDS

38. As outlined in paragraphs 17a to 17d in my evidence above, the Submitters have sought relief via the inclusion of additional matters of discretion within specified rules. The additional matters of discretion relate to impacts on the groundwater table, land stability, foundation design, earthworks and retaining design and dewatering.

39. In my opinion, the proposed relief is likely to address groundwater issues that could arise as a direct result of intensification in the area of the Warren Street Properties. However, I note that some of the key issues regarding groundwater due to the proposed MDRZ will likely affect a wider area along Bullock Creek. As noted in my paragraph 25, the hydrogeological setting around the Warren Street Properties may not be unique to that location in the Bullock Creek catchment. It would be reasonable if similar matters of discretion were required within a wider area along Bullock Creek in order to protect flows in that surface waterway as well as addressing other potential issues around ground settlement together with effects on springs and bores.

40. Defining the extent of such an area is complex and depends on data that is not readily available including details of aquifer parameters and accurate maps of the depth to water. I note that stream depletion effects can potentially extend several hundred metres from a groundwater take. However, the extent of dewatering will depend on the depth to groundwater and the local aquifer parameters.

41. As noted earlier in my evidence, the depth to groundwater appears to be generally shallower around Bullock Creek and appears to be somewhat deeper closer to Lake Wānaka. Therefore, the area where matters of discretion regarding groundwater should extend to the base of the terrace to the south-east of Bullock Creek (i.e. the true right bank), which is approximately 100 m, and 500 m to the northwest of the Bullock Creek (i.e. the true left bank). The greater distance on the true left bank would allow for potential stream depletion effects, whilst acknowledging the available data suggesting deeper groundwater levels in the area, which would mean less dewatering would be required. On that basis, the potentially impacted area could be delineated on a plan and mapped.

42. I note that the Submitters' relief only seeks changes applying to the MDRZ on the Warren Street Properties so any mapping would only affect properties in these areas. However, as I mention earlier at paragraph 39, I consider it would not be unreasonable if the relief sought by the Submitters was applied to the area within the parameters above along Bullock Creek to address effects on groundwater.

RESPONSE TO SECTION 42A REPORT

43. The s42A reports note that groundwater management is a matter for ORC[6] however, as I have set out in my paragraphs 35 and 36, I do not believe that relying on the proposed Land and Water Regional Plan will be sufficient to address the issues raised by the Submitters in relation to adverse effects on groundwater.

44. The s42A reports also refer to the existing matters of discretion or assessment matters covered by the terms 'stormwater' and 'natural hazards' as being sufficient to address the concerns raised by the Submitters. It is not clear to me that these matters of discretion will ensure that effects on groundwater will be considered during processing of resource consent.

45. With respect to stormwater, the s42A report of Corinne Frischknecht[7] notes that the matters of discretion under rule 8.5.4 are proposed to include stormwater related effects and that this will partly address the relief sought by the Submitters. However, in my opinion, consideration of stormwater

[6] For example, the s42a report of Rachel Morgan at paragraph 13.9.
[7] Paragraph 4.54 in the s42a Report – Chapters 7-10, Corrine Frischknecht

effects will not address the issues raised by the Submitters. The issues raised by the Submitters are unrelated to stormwater which I consider to be rapid runoff from rainfall events. In contrast, the issues raised by the Submitters are related to shallow groundwater levels in the area of Bullock Creek, which are a product of the throughflow of groundwater from inland and will occur regardless of short term rainfall events.

46. Matters of discretion related to natural hazards are also unlikely to address the relief sought be the Submitters. Natural hazards are defined in the PDP (Chapter 28.2) and include flooding and inundation, erosion, land instability, earthquakes and liquefaction, avalanches, river avulsion, subsidence, tsunamis and fire. Whilst potential issues around land stability may be covered by natural hazards, I do not consider the issues raised by the Submitters, such as effects on the groundwater table, could be considered to be 'natural hazards'. In my opinion, groundwater is a constant feature of the landscape, whereas natural hazards relate to short term events.

47. The s42A reports[8] also note that the existing assessment matters for earthworks address dewatering effects because the earthworks will be restricted discretionary activities that allow consideration of effects on land stability (assessment matter 25.8.5) and water bodies (assessment matter 25.8.6). To some extent, these assessment matters may indirectly trigger the consideration of groundwater effects where dewatering is required to install foundations.

48. However, allowing excavation in areas where a previously unknown spring is encountered, can mean that ongoing dewatering is required and require longer term management of that discharge (as in the case of the Belvedere Apartments). Such an effect is, in my opinion, a notable possibility in the area around Bullock Creek where groundwater can occur within 1 to 2 m of the ground surface, which may not initially be captured by the earthworks rules and associated matters of discretion prior to earthworks being undertaken.

49. Furthermore, the permitted cut depth (i.e. earthworks depth) under rule 25.5.15 enables earthworks to a depth of 2.5 m, which may be below groundwater levels in the area around Bullock Creek. Earthworks that occur

[8] Paragraph 4.36 in the s42a report of Elias Jacobus Mathee, Subdivision and Development

within the permitted activity threshold would not trigger the matters of discretion covering land stability and water bodies and therefore no assessment of groundwater effects would occur prior to construction. Coupled with the permitted activity limits within the proposed LWRP, a reasonable volume of earthworks could take place without consideration of effects on groundwater, or associated springs.

50. With these issues in mind, including effects on groundwater in the matters of discretion as proposed by the Submitters in the Variation for the area around Bullock Creek would help to ensure that effects on groundwater and risks from dewatering are identified early on in a development so that they can be adequately mitigated and effectively managed through time. In my opinion, this would be a more appropriate approach than relying on the regional rules to capture dewatering effects which then develop into unplanned abstraction from the Wānaka Cardrona Aquifer. I note that discretionary assessment of land stability and water body issues under the PDP, in my opinion, only indirectly capture the risk of longer term issues because they are focussed on the short term impacts of dewatering for earthworks.

CONCLUSION

51. The Submitters have highlighted that the proposed MDRZ provisions could create issues regarding groundwater in an area close to Bullock Creek and where a number of springs rise that feed into the creek.

52. Higher intensity housing such as that proposed under the MDRZ rules can require deeper foundations with associated increased dewatering requirements in areas of shallow groundwater. Effects of dewatering on groundwater can include reduced groundwater levels in the local area together with reduced stream flows and, in some cases, ground settlement effects. Given the shallow groundwater environment along Bullock Creek, and in the area of the Warren Street Properties, in my opinion, the issues raised by the Submitters are reasonable.

53. However, I note that the area of the Warren Street Properties is not likely to be different, from a groundwater perspective, to other areas along Bullock Creek and similar issues could also arise in those areas. It would be appropriate if similar relief to that sought by the Submitters were applied to

those areas, which in my opinion could cover a buffer of 100 m on the true right bank of Bullock Creek and 500 m on the true left bank. This would protect flows (and ecology where it is dependent on flows) in Bullock Creek and help to maintain the values associated with the urban waterway.

54. The s42A reports note that existing rules, matters of discretion and assessment matters within the PDP would address the relief sought by the Submitters. However, I do not believe that these provisions provide adequate relief to address the concerns raised in the Submission. Further provisions specific to the area around Bullock Creek, which may include mapping, would be appropriate.

Neil Malcolm Thomas

4 July 2025

Figure 1

Bore Location Map

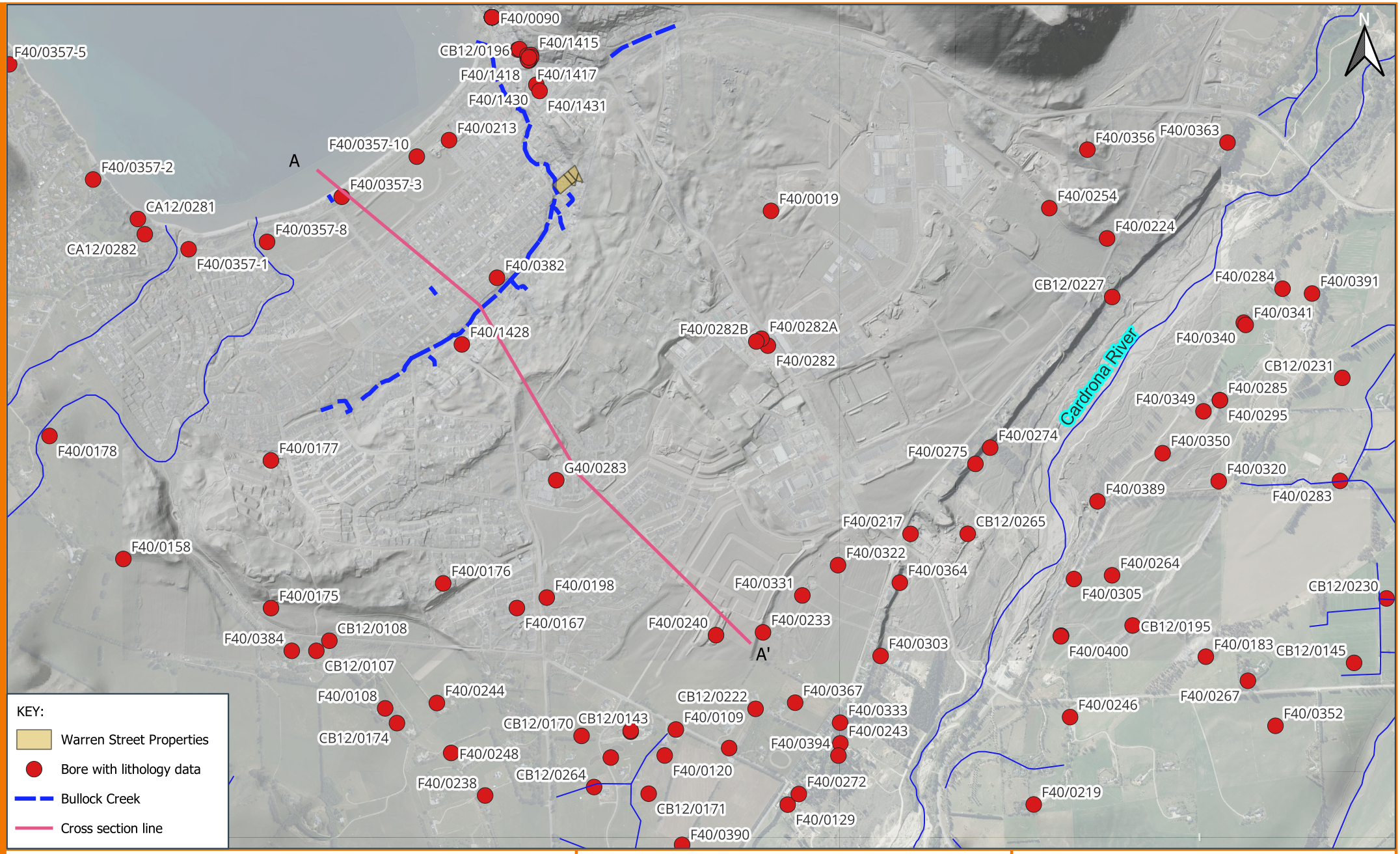

FIGURE 1: MAP SHOWING BORE LOCATIONS, BULLOCK CREEK AND THE WARREN STREET PROPERTIES

QLDC PLAN CHANGE - WARREN STREET PROPERTIES

NOTES:
1. AERIAL IMAGERY SOURCED FROM THE LINZ DATA SERVICE [https://data.linz.govt.nz] AND LICENCED BY LINZ FOR RE-USE UNDER THE CREATIVE COMMONS ATTRIBUTION 4.0 INTERNATIONAL LICENCE.
2. BOREHOLE DATA SOURCED FROM WELLS AOTEAROA

0 500 1,000 m

METRES (A4)

SCALE : 1:20,000

REVISION: 01 | DATE: JUNE 2025 | BY: NT
CLIENT: JOHN RUSSELL

Figure 2

Cross-section through Wanaka Township and Bullock Creek

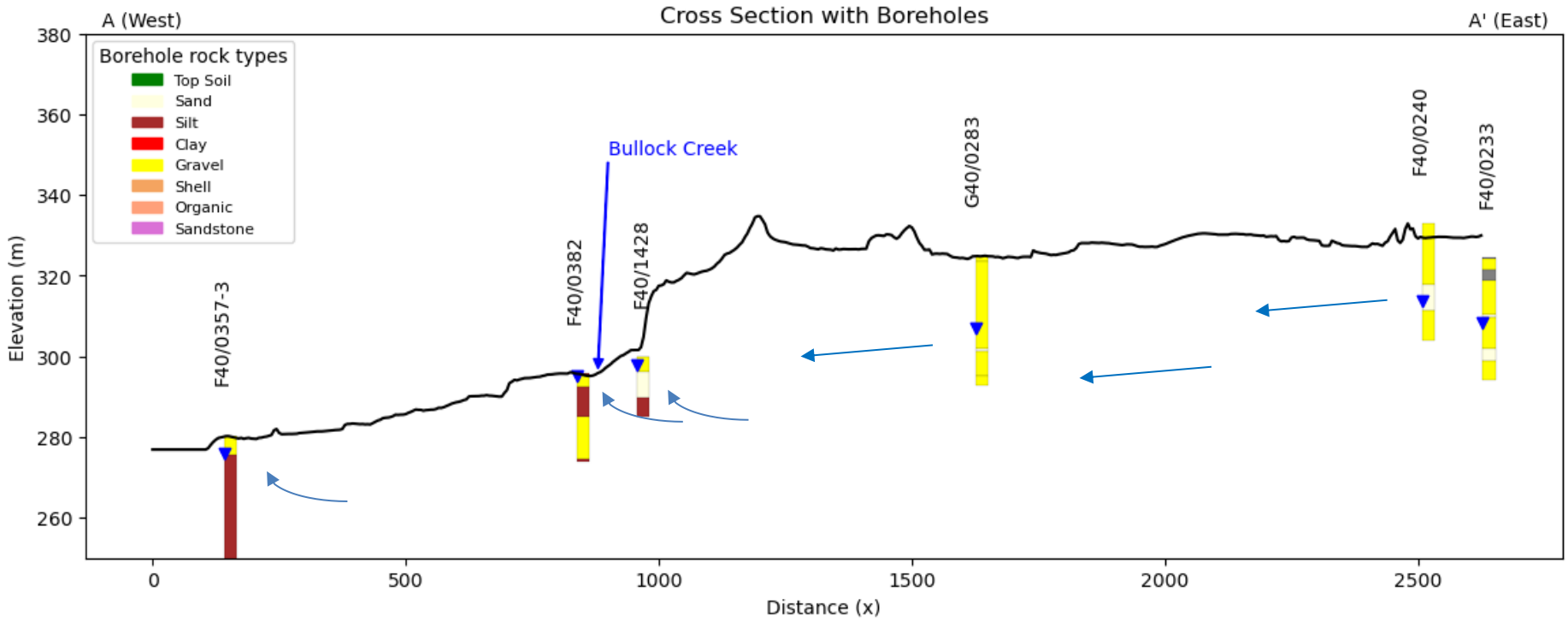

FIGURE 2: CROSS SECTION THROUGH WANAKA TOWNSHIP AND BULLOCK CREEK (BLUE TRIANGLES INDICATE GROUNDWATER LEVELS AND ARROWS INDICATE GROUNDWATER FLOW DIRECTION)

Appendix 1

ORC Consent and Reccomending Report

COUNTERPART

Otago Regional Council

Our reference: A102875

Consent No: 2006.151.V1

WATER PERMIT

Pursuant to Section 104B of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: [~~Warren Street Development Limited~~] *Removed 22nd November 2016*
Address: [~~Level 1, 6 Viaduct Harbour Avenue, Auckland~~]

Name: *Minister for the Treasury*
Address: *The Treasury, 1 The Terrace, Wellington*

To take groundwater

for the purpose of site dewatering to provide drainage for an apartment complex

for a term to expire on 1 October 2041

Location: 25 Warren Street, approximately 50 metres north east of the intersection of Warren and Helwick Streets, Wanaka

Legal description of consent location: Sec 6 Blk XXIX Wanaka Town SD

Map reference: NZMS 260 F40:040-050

Conditions:

1. The rate of abstraction shall not exceed 30 litres per second.

2. A peak monthly volume of abstraction shall not exceed 77,760 cubic metres and an annual volume of 709,560 cubic metres.

3. The consent holder shall maintain 2 observation bores shown as Piezometer ~~1~~ *PZC* and Piezometer ~~2~~ *PZM* on Appendix I- DWK 57711 C2*A*, which is attached to and forms part of this consent.

4. The static water level shall not be reduced to below 287.6 metres above mean sea level at either Piezometer ~~1~~ *PZC* or Piezometer ~~2~~ *PZM*, as a result of the consent holder's activity.

5. Both Piezometer ~~1~~ *PZC* and Piezometer ~~2~~ *PZM* shall be measured weekly to ensure that the static water level complies with condition 4. A record of each static water level reading shall be kept and forwarded to the Consent Authority by 30 January and 30 July of each year and upon request.

Telarc. Registered
Quality ISO 9001

Otago Regional Council

6. The consent holder shall install ~~three~~ *two* water measuring devices that comply with condition 8. One of the devices shall be installed ~~at the groundwater pipe entry to SWMH1~~ *in the groundwater rising main to record the total pumped flow* and the second shall be installed ~~at the groundwater pipe entry to the GMH 2 and the third at the groundwater pipe entry to the wet well as shown on Appendix I DWK 57711 C2.~~ *at SWMH3 to measure the groundwater flow entering Bullock Creek as shown in Appendix1, which is attached to and forms part of this consent.* Each water measuring device shall be fitted with a datalogger to record the extent to which this consent is exercised by recording the rate (litres per second) and daily volume of water (cubic metres) to an accuracy of +/- 2%.

7. A copy of the record of the water measuring readings required by condition 6 shall be forwarded to the Consent Authority by 30 January and 30 July of each year and upon request.

8. The installation and maintenance of the water measuring devices shall be performed in accordance with manufacturer's specifications and to New Zealand Quality Standard ISO 4064.

9. The consent holder shall ensure the full operation of the water measuring devices at all times during the exercise of this consent. All malfunctions of the water measuring devices during the exercise of this consent shall be reported to the Consent Authority within 2 working days of observation and appropriate repairs shall be performed within 7 working days or otherwise as soon as is practicable following the observation of malfunction.

10. The installation of the water measuring devices shall be completed to full and accurate operation ~~within two months of the issuing of this consent.~~ *by 31 October 2007.* The consent holder shall provide a copy of the installation certificate to the Consent Authority upon request.

    Note: The water measuring devices should be safely accessible by the Consent Authority and its contractors at all times.

11. The consent holder shall install and maintain a pump system to augment the flow of the four affected springs which are located on the following properties;

    (a) Lot 3 DP347224 and Lot 2 DP 18304

    (b) Sec 7 Blk XXIX Town of Wanaka

    (c) Sec 2 Blk XXIX Town of Wanaka

    (d) Sec 13 Blk XXV Town of Wanaka

    The amount of water to be provided to each spring shall be equivalent to the minimum flow of each spring prior to the start of the current development work on Sec 6 Blk XXIX Town of Wanaka SD or as otherwise agreed with the site owners of the properties described in (a)-(d) of this condition. Where agreement cannot be reached, the decision of the Consent Authority shall prevail.

12. All groundwater being taken from the site shall be clear and not contain any conspicuous suspended material.

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13. The consent holder shall provide an Operation and Maintenance manual for the drainage system which shall be provided to the Consent Authority ~~within one month of the granting of this consent.~~ *by 31 October 2007.*

14. The Operation and Maintenance manual required by condition 13 shall include but not be limited to:
    (a) a brief description of the drainage system, including a site map indicating the location of the points of discharge and any monitoring sites;
    (b) an outline of the procedures to be used for monitoring siltation in the drainage system;
    (c) key operational matters, including weekly, monthly and annual maintenance checks;
    (d) monitoring requirements and procedures;
    (e) the course of action that will be taken should the static water level reduce to below 287.6 metres Above Mean Sea Level;
    (f) contingency plans in the event of system malfunctions or breakdowns;
    (g) the means of receiving and dealing with any complaints;
    (h) provisions for reviewing and updating the Monitoring Plan in consultation with the Consent Authority, to ensure that it remains appropriate for the effects of the activity on the environment.

    Records of maintenance, complaints, malfunctions and breakdowns shall be kept in a log and a copy of the log made available to the Consent Authority on request. At all times the consent holder shall ensure that the Consent Authority has a copy of the most recent version of the Operations and Management Manual.

15. The consent holder shall undertake monitoring of the activity in accordance with the Operation and Maintenance manual required by condition 13 and shall provide the results of the monitoring to the Consent Authority upon request.

16. Within one month of the granting of this consent, the consent holder shall provide to the Consent Authority a photographic baseline survey of the following properties' topography;

    Sections 2,3,6, & 7 Blk XXIX Town of Wanaka SD, Lots 1 & 2 DP 21476, Lots 1 & 2 DP 21307, Lot 1 DP 9660, Lot 2 DP 11932, Lot 2 DP 18304, Lot 3 DP 25998

    Note: This consent does not authorise access onto private land. Where access is not possible site photography should be taken from public land.

17. The consent holder shall ensure that as a result of the exercise of this consent, there is no flooding of other person's property, erosion, land instability, sedimentation or property damage. Any such adverse effects shall be remedied by the consent holder to the satisfaction of the Consent Authority. All remedial works shall be undertaken within a timeframe agreed to by the consent holder and the Consent Authority.

18. The consent holder, before withdrawing all interest in the property, shall transfer the consent to a legal entity which undertakes the same functions and services for the property as a body corporate or similar.

Otago Regional Council

19. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent within 3 months of the commencement of this consent and annually thereafter for the purpose of:

    (a) determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage; or

    (b) determining whether the conditions of this consent are adequate to deal with any spring depletion or land instability which may occur as a result of exercising this consent; or

    (c) ensuring the reduction in water table levels are necessary and do not result in adverse effects on the environment or members of the public; or

    (d) ensuring the monitoring of the static water levels are adequate to ensure the static water level does not drop below the authorised levels under condition 4 of this consent; or

    (e) determining whether the exercise of this consent is resulting in an adverse effect on the aquifer; or

    (f) adjusting or altering the method of water take recording and transmission; or

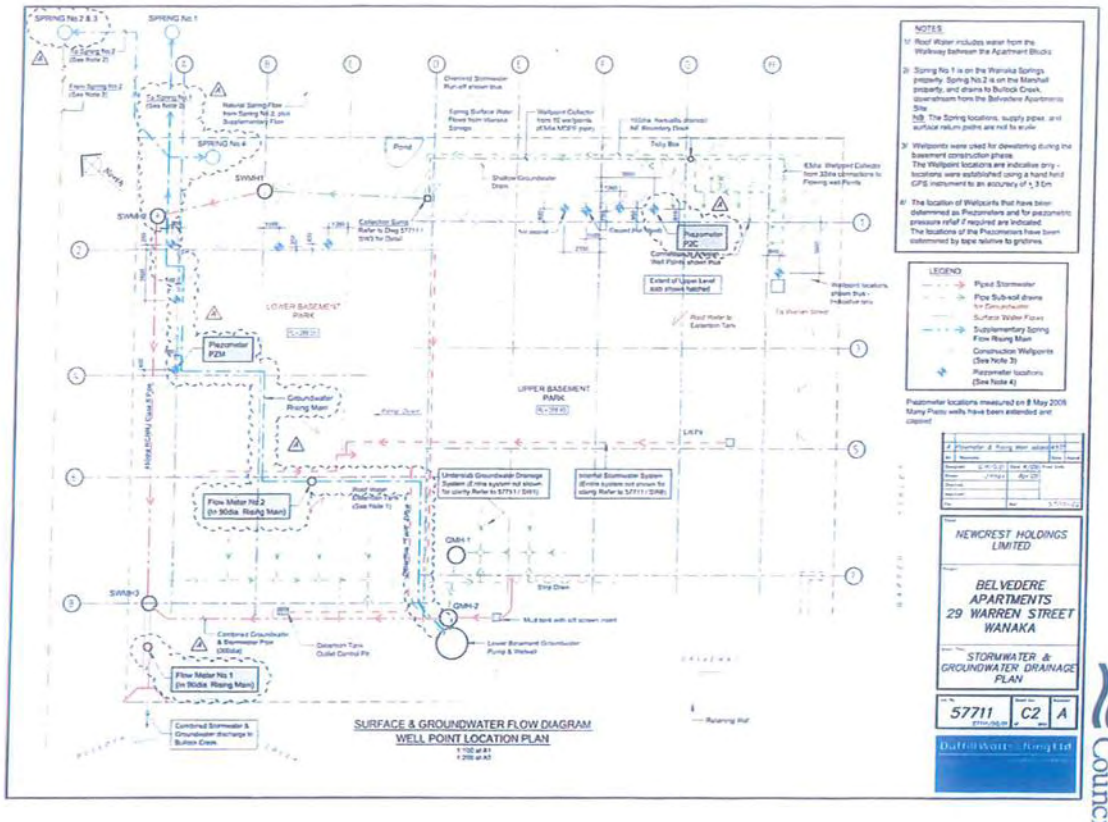
    (g) adjusting or altering the frequency of monitoring and reporting; or

    (h) adjusting or altering the rate or volume of take.

Issued at Dunedin this 22nd day of November 2006
Reissued at Dunedin this 21st day of December 2006 to reflect a correction to Appendix I.
Reissued at Dunedin this 25th day of September 2007 to reflect variations to Appendix 1, conditions (additions italicised, deletions struck through).
Reissued at Dunedin this 24th day of April 2018 to reflect a vesting of the consent to the Ministry for the Treasury from William Hill Limited (Removed).

Christopher P Shaw
Manager Consents

Appendix 1 of Water Permit 2006.151



REPORT

File No.: 2005.175
Consent Nos.: 2006.151

Report No.: 2006/514
Prepared for: Hearing Panel
Prepared by: Kirstyn Fitton, Resource Officer
Date: 30 August 2006

Subject: **Water Permit Application 2006.151 by Warren Street Developments Limited, to divert and take groundwater to permanently dewater a development site, Wanaka**

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1. Purpose

To report and make recommendations on the above application under the notified provisions (section 93) of the Resource Management Act 1991 (the Act).

2. Background

Applicant: Warren Street Developments Limited
Activity: To take up to 30 litres per second (l/s) of groundwater from the Wanaka Basin Cardrona Gravels Aquifer.
Location: 25 Warren Street, approximately 50 metres (m) north east of the intersection of Warren and Helwick Streets, Wanaka.
Reason: To dewater a site to provide ongoing drainage for an apartment development.

The applicant has applied to divert and take groundwater from the Wanaka Basin Cardrona Gravels Aquifer, at a rate of up to 30 l/s, 24 hours per day and 7 days per week for the purpose of dewatering their site. The applicant's ultimate outcome is to lower the static water level in order to allow the ongoing drainage of water from the basement and around an apartment complex.

The building site is situated above an artesian aquifer which erupts in springs at approximately the 290 m contour Above Mean Sea Level (AMSL). The building has been designed in a manner which involves excavation into the aquifer for the construction of basements and carpark.

The applicant's site has an area of 2023 square metres (m^2). Before the works began, the site sloped gently towards Bullock Creek which runs along the south western boundary of the site. The applicant has applied to divert and take groundwater at a rate of up to 30 l/s in perpetuity via a gravity drainage system. The gravity drains are an integral part of the building design and allow water to drain from under the apartments out to Bullock Creek.

The question of whether they are diverting or taking groundwater has been raised by the applicant. Technically, groundwater can be diverted under two circumstances. The first being where a structure is placed in the aquifer to deflect water i.e. sheet piles. This is a minor diversion. In mining activities or tunnelling activities groundwater flow tunnels

would be constructed to divert groundwater without having to extract/abstract groundwater. Both of these diversions occur underground. In the case of this application, the building has been constructed in the aquifer and the static water level has had to be lowered. This lowering has resulted in a take and a discharge.

The technical report (attached as appendix II) prepared by Sinclair Knight Merz (SKM) commissioned by Otago Regional Council (Council), states that in order to divert groundwater, there must be a means with which to obtain the ground water prior to any diversion and therefore to divert groundwater is technically implausible without an external device. In most cases the process converts groundwater to surface water resulting in a groundwater take. Once it has become surface water then it may be diverted or discharged. A legal opinion provided by Council's solicitor stated that the activities were both a diversion and a take of groundwater. In any event, for both activities Council can exercise its full discretion and will not alter the technical assessment or environmental outcomes of the application.

2.1 Site Application History

The applicant holds land use consent from Queenstown Lakes District Council (QLDC) to carry out earthworks and establish a visitor accommodation complex at 29 Warren Street Wanaka. The complex consists of 2 stories and 25 apartments, a manager's apartment and basement car parking.

Conditions of the QLDC consent stated that no works shall be undertaken until all necessary consents are obtained from the Otago Regional Council (Council), should they be required. The following applications were lodged with Council on 13 March 2005

Application 2005.175: to divert an existing stream; this flowed from east to the west across the property and discharged into Bullock Creek. This water permit was granted on 8 November 2005.

Application 2005.176: to disturb the bed of Bullock Creek for the purpose of placing pipe work. This land use consent was granted on 8 November 2005.

Application 2005.177: to take groundwater from the Wanaka Basin Cardrona Gravels Aquifer to dewater a site. This application was withdrawn on 9 June 2006 and re-submitted as application 2006.151 on 3 October 2005.

Application 2005.178: to discharge stormwater to Bullock Creek. This application was not required as of 30 June 2006 and a certificate of compliance 2006.C09 was applied for in its place. This certificate of compliance has not been issued yet.

In addition, Application 2006.152: to discharge groundwater to Bullock Creek was applied for on 3 October 2005 and was not required from 30 June 2005 as it is determined that the permitted activity rule 12.11.2.3 of the Regional Plan: Water for Otago (RPW) could be met. Land Use Consent 2006.004 was applied for to retrospectively authorise 64 vacuum wells and 4 piezometers. The vacuum wells and

piezometers were constructed in around April-June 2005 and consented in February 2006.

The vacuum wells were being pumped to draw the groundwater levels at the site down below ground level. The water being taken exceeded the permitted activity level and was observed to have a detrimental impact on neighbouring springs and properties. Council issued an abatement notice on 20 December 2005 requiring the applicant to cease all pumping. After negotiations, it was determined that a staged approach would be a safer option and that all pumps should be turned off by 28 February 2006. This direction was complied with.

This application (2006.151), which is the subject of this report, was applied for on 30 June 2006.

2.2 Activities on-site April 2005-February 2006

Geotechnical site investigation, undertaken by the applicant, indicated that the site consisted of glacial till and areas of alluvial gravels overlain by a layer of topsoil. It is considered that the till acts as a confining layer for the groundwater beneath, however artesian pressure means that groundwater moves through the coarser sediments and erupts in springs. Regionally, springs tend to appear along the 290 AMSL contour line.

According to the applicant, during excavations at their site which commenced around April 2006, an area of alluvial gravel was uncovered in the northern corner of the site. As a result of this disturbance a spring appeared in this corner with a flow of 5-10 litres per second (l/s). At the same time the applicant received advice that neighbouring springs to the northeast of the property were decreasing in flow. The flow from the spring also meant that silt was being discharged to Bullock Creek from the site.

The applicant constructed a silt retention pond to contain the discharge and installed sheet piling and vacuum wells at the northern end of the site. It was intended that the vacuum wells and the sheet piling would reduce groundwater pressure so that it remained at ground level but preferably reduced to 1 metre (m) below ground level across the site. The applicant believed that that by doing this the flow of silt from the site would be halted and no further discharges would occur while construction continued and the site would remain stable until the building had achieved critical mass so that groundwater pressure would not cause hydraulic jacking of the building.

While the vacuum wells were being operated to dewater the site, the applicant received further advice that flows of additional springs were continuing to decrease and that the spring situated on the northeast property had ceased to flow completely.

As the building progressed the groundwater abstraction decreased in stages. With the cessation of pumping which occurred after the abatement notice was served on the applicant, flows were reported to be returning to the two southernmost springs. Groundwater seepages were reported to be occurring in the south eastern corner of the site as the groundwater pressure increased. The applicant has been augmenting flows to two of the springs which were depleted as a result of the works undertaken at the site.

2.3 Site Compliance History

Concerns were first raised relating to this site with regard to a silty discharge from the site discharging into Bullock Creek. The applicant was served with an infringement notice and issued with a $750 fine on 11 August 2005.

Issues were then raised over the unlawful pumping of groundwater occurring at the site and Council was made aware of some spring depletion at neighbouring properties. Water was being carted from the site via tankers and makeshift drainage systems were set up across public roads to discharge silted water into soakholes located away from the site.

An abatement notice was served on the applicant by Council on 16 December 2005 and they were told to cease pumping water immediately. The applicant informed Council that they were unable to stop pumping. They asserted that this was because to stop pumping would place the site at risk as critical building mass had not been achieved and there was a possibility of a major building failure if pumping stopped suddenly. Council agreed to allow a staged stoppage with all pumps being turned off by 28 February 2006. This direction was complied with.

In addition, the applicant's 64 vacuum wells and 4 piezometers, through which they were extracting the water, had been constructed unlawfully and they were required to apply for retrospective consent for these.

2.4 Description of Proposed Activity

There are two main drainage systems present at the Warren Street site; the basement drainage system around and beneath the building and the northeast boundary drainage system originating in the eastern corner of the site and running along the north eastern and north western boundaries. Both of these systems discharge water to Bullock Creek.

2.4.1 Basement Drainage System

The basement drainage system is divided into two sub systems, servicing the upper and lower basement areas. The upper basement consists of five drain coils which lie beneath the concrete foundation and collects groundwater as it percolates up through the glacial till. The drains take the water through a series of man-holes to the western corner of the site where the water discharges to Bullock Creek. The drains are cross-connected with each other at regular intervals to ensure a continued free flow of water through the system. A secondary site drain runs around the outside of the building to intercept groundwater moving towards the building, and discharges this water into the upper basement sub-system.

The lower basement system is constructed in much the same way as the upper basement system. The groundwater collected flows into a wet well where it is lifted by 0.8 m by a pump to one of the man-holes through which the upper basement drains flow. The combined flow is then discharged to Bullock Creek.

While it would be possible for the system to operate via gravity, the construction of the wet well means that a greater fall can be achieved and any adverse effects on the car park resulting from excess moisture and potential silting of the drainage system can be

avoided. As in the case for the upper basement system, a secondary site drain runs around the outside of the lower basement area which collects ground water and discharges it into the lower basement sub-system.

Both systems function in the same manner, taking groundwater flowing under artesian pressure from around and under the building and discharging it to Bullock Creek.

2.4.2 Boundary Drainage System

The boundary drainage system is made up of three components. The first part is the permanent stream diversion authorised under Water Permit 2005.175. The stream originates from a spring fed pond on the north eastern boundary of the site. The stream is diverted into a pipe which runs through two man-holes and discharges to Bullock Creek in the western corner of the site. The second part of the system is a shallow ground water drain which collects groundwater from the eastern corner of the site and discharges it to the first of the man-holes through which the diverted stream passes. The drain collects groundwater springs which reappeared in the eastern corner of the site when pumping from the vacuum wells ceased and artesian pressure returned.

The third part of the system takes water released under artesian pressure from nine vacuum wells. The vacuum wells were installed for the dewatering operation during the construction phase of the site and while the wells are no longer being pumped, water is still being produced under artesian pressure.

The water is taken to a drain that discharges to a collection sump that shallow groundwater drain is connected to. The drainage system for the vacuum wells is constructed in such a way that the discharge can be stopped in order to allow piezometric pressure under the under the building to be monitored on a regular basis.

2.4.3 Flows on and off site

The applicant has measured groundwater flows on-site since January 2006 when the decommissioning of the vacuum wells commenced. Since the last of the wells ceased pumping, the flows on-site have remained fairly stable. Flows from the basement drainage system have varied between 11-15 l/s and surface water flow through the site (including the diverted stream) have been around 7 l/s, giving a total flow off site between 17- 22 l/s.

The sub-slab drainage system has been designed for a capacity of 30 l/s, which will allow for significant seasonal variations. Now that site disturbance has ceased it is expected that the water being discharged will not contain contaminants such as silt and suspended solids.

2.5 Site Geology

The applicant investigation at the site recorded the geology as a heterogeneous glacial till overlain by a layer of topsoil. In addition, localised areas of alluvial deposits are present on-site. The glacial till is comprised of medium dense to very dense silty to sandy gravels and silt with minor quantities of sand and gravels. The till was formed as a result of compression of sediments during advances of the Wanaka Glacier. As the

glacier retreated and the lake formed, it is assumed that streams from glacial moraine would have deposited the alluvial material present on site.

2.6 Climate

Information provided by the applicant gives an overview of the general climatic conditions in the area sourced from the "*Summaries of Climatological Observations to 1980*" (New Zealand Meteorological Service, 1983). The mean rainfall recorded at the Wanaka Climate Station is 661 millimetres (mm) per annum from 1927 to 1980. Throughout the year, rain was spread fairly evenly, with rainfall equal to or greater than 1mm falling between 6 and 7 days each month. Temperatures recorded between 1973 and 1980 ranged from -8.2 degrees Celsius (ºC) and 33 ºC.

2.7 Description of the Aquifer

Council staff drafted a report on the aquifer entitled *Wanaka Basin Groundwater Modelling Report-DRAFT* (Otago Regional Council, 2003), which provides the description for the aquifer below:

The Wanaka Basin Cardrona Gravels Aquifer in the Wanaka Basin forms a groundwater resource extending from the Clutha River/Mata-Au and Lake Wanaka to the north, and the Criffel and Mt Alpha ranges to the south and west. It is defined as materials from the Wanaka Moraine – Hawea/Clutha outwash gravels and Cardrona outwash alluvium. The topography of the area is generally flat to gently rolling with little prominent surface drainage apart from the Cardrona River channel.

Two significant local basement highs that outcrop the aquifer are Mt Barker and Mt Iron. The basement is defined as a complex of undifferentiated igneous and metamorphic rocks underlying sedimentary strata. The Cardrona River recharges the underlying aquifer, with groundwater flow directions emerging from both banks of the river around the Ballantyne Road area.

Seasonal variations in groundwater levels in the Wanaka Basin have historically been relatively small (1-2 m). The apparent uniformity of piezometric levels suggests that there is no major seasonal stress due to pumping withdrawal on the groundwater supplies in the Wanaka Basin. However, since the late 1990s some well levels in the Wanaka Basin used for long term monitoring have exhibited greater variability, with some falling by up to 4.5 m. This is twice the expected groundwater level fluctuation based on earlier data collected by Council.

Since the low levels of mid 2001 there was some recovery, particularly in fringe areas of the aquifer where rainfall recharge has a significant effect. After this recovery the water table levels in the aquifer during 2005 had declined by about 1 – 2.5 m due to low rainfall and low flows in the Cardrona River. Currently, water table levels could be described as "below normal" though the current decline is not as severe as the reduction in water levels measured in wells during 2001 (of about 2.5 – 5 m).

The groundwater resource of the Wanaka Basin is relatively deep (generally >20m below ground level), and is essentially one unconfined unit with a basement elevation of 250-330m above mean sea level. Groundwater movement is generally from the

extremities of the aquifer to the central basin area with flow from the Cardrona River to Lake Wanaka and the Clutha River/Mata-Au. Hydraulic conductivity of the aquifer is generally medium to high (20-60 m/day).

The groundwater is used mainly for irrigation and domestic drinking water supply. The demand for drinking and irrigation water from the aquifer has been increasing, particularly as more land is converted to more intensive rural lifestyle blocks.

2.8 De-watering Activities in Wanaka

Council staff are becoming increasingly concerned over the number of developments within the Wanaka area which are proposing to remove groundwater from the aquifer in order to construct buildings. The drainage of aquifers and the relieving of artesian pressure in order to place buildings within an aquifer system is a new and unanticipated activity within the Otago region. Whist this drainage results in non-consumptive water takes, the impact and extent of these water takes on the aquifer is unknown.

Drainage of these springs may be preferred by some property owners to aid in the development of their sites, however, a number of these springs have been developed into water features and add amenity value to properties in the area.

Recent developments operating without consent, have resulted in spring depletion on neighbouring properties and have also raised concerns over land stability. Each dewatering situation, in isolation, may have mitigation measures in place to reduce any adverse effects, however, should a number of these dewatering sites operate cumulatively, mitigation measures may be insufficient to negate the impact of adverse effects on the aquifer.

The Wanaka area is a sensitive, unique environment and while development is encouraged in this area, regard should be given to the particular sensitivities of the location. Council staff would encourage any new developments to redesign building footprints so that excavation into the water table is avoided, and short and long term drainage of the aquifer is not required.

Had the applicant not already undertaken the construction of the complex, been so contractually committed to the project and already authorised to undertake the apartment development by other consent authorities, the Council would have discouraged this application from being lodged. Council would have recommended, to the applicant, that other building designs be investigated as it would be unlikely that this application, given the lack of information regarding adverse effects and unknown extent of those effects, would have been accepted.

3. Status of the Applications

The sub-slab drainage activity involves the lowering of the water table, removing water from the aquifer and discharging it off site for the purpose of dewatering to enable site development. The proposed rate and volume of the take exceeds that allowed by the permitted activity rules. The activity is therefore a discretionary activity pursuant to Rule 12.2.4.1 of the Regional Plan: Water for Otago (RPW).

Council may grant or decline the application and, if granted, may impose conditions in accordance with section 108 of the Act.

The applicant will also need to discharge the groundwater taken from the site into Bullock Creek. The water being discharged will be of aquifer quality and is expected to meet the permitted activity provisions of Rule 12.11.2.3 of the RPW. Consent for the discharge will not be required providing the provisions of the above rule are met.

4. Notification

A decision was made on 7 July 2006 to process this application under the notified provisions of the Act because actual adverse effects has occurred and were ongoing. In addition, it was considered the extent of the adverse effects would be uncertain given the perpetual nature of the activities and the heterogeneous nature of the aquifer. It was also considered that it would be difficult to determine who may be potentially adversely affected by the activities in the long term. The applications were notified on 13 July 2006 and the submission period closed on the 10 August 2006.

5. Submissions

A total of fifteen submissions were received for the application, one unconditionally supporting the application and one supporting with conditions. Thirteen submissions were in opposition and one was neutral**.** Four of the submitters wished to be heard and one has not indicated whether they wish to be heard or not. Each submission is outlined below.

5.1 Supporting Submission

P A & LM Marshall & HA Gledhill: support the application so that the applicant provides groundwater to their spring which has become depleted as a result of the applicant's activity.

5.2 Conditional Supporting submission

Wanaka Springs Lodge Limited & LM & MC Finn: support the application providing remedial work is carried out as per the agreement with the applicant to ensure that the spring flows are replenished in perpetuity. They would like to see a covenant placed on the title of the applicants land to ensure that all future owners are also required to augment their spring flow and take responsibility for associated costs of doing so.

5.3 Neutral Submission

John Davis: did not indicate whether he was in support or opposed to the application. He raises concerns over cumulative effects of further developments in the Wanaka Region that would result in site dewatering. He would like to see a rigorous monitoring programme for the site.

5.4 Opposing submissions

Mainston Properties Limited and JP Russel: stated that water flow from a spring bordering their property has been substantially depleted since construction began on the applicant's site and they also have concerns regarding land instability on their property and other adjoining properties. The submitter raised questions regarding restoration of spring flow to their pond in perpetuity. They also had questions relating to the

associated costs of monitoring and maintaining that flow, in addition to monitoring the stability on their land.

JWA and DV Smith: were concerned about the reduction in spring flows to the pond on their property. They would be prepared to withdraw their submission if the applicant augmented flows to their spring fed pond.

RA and SA Mayes: raised concerns over the timeliness of the public consultation undertaken by Council. They believe that the applicant has not demonstrated the impacts of the long-term drainage will have on the aquifer or the stability of neighbouring slopes or landforms.

DR & LS Kane: highlighted concerns over the way in which the works were undertaken. They believe that retrospective consents should not be permitted.

A J McKay: believes that this type of development is inappropriate in this area. He believes that an adequate assessment has not been undertaken by the applicant to assess the effect of a lower groundwater table outside of the site boundary and any subsidence of land that this may cause.

RM & DA Ward: raise the same concerns as AJ McKay.

K & P Stuart: share a boundary with Mainston Properties Limited and JP Russel would like the same issues addressed as raised in the Mainston Properties Limited and JP Russel submission**.**

Upper Clutha Angling Club (UCAC): are concerned that this application applies for a retrospective consent and is concerned with the way Council have dealt with the activity. The UCAC raises concerns over the impact on Bullock Creek and the groundwater flows leaving the site and potential subsidence. UCAC would like to see all future development of this nature prohibited.

J & I Harper: raise similar concerns to AJ McKay and RM & DA Ward.

WR James and R Simpson: object to groundwater being removed or diverted from the site as there may be a negative or undesired impact on the groundwater table below other properties in the locality.

Stuart Landsborough: is concerned at the impact this development may have on his spring fed creek. He also believes that granting this application will set a bad precedent for Wanaka development. He would like the applicant to remove the sheet piling which has remained in-situ and provide reassurances that site stability outside of the boundary is not an issue.

GA & BR Thompson being the Trustees of the GA Thompson Family Trust: raise the same concerns as those of J & I Harper**,** AJ McKay and RM & DA Ward.

5.5 Pre-Hearing Meeting

Generally**,** pre-hearing meetings are held to ensure that contentious issues are discussed and resolved with the applicant and submitters before the consent hearing to ensure an uncomplicated hearing for the applicant. In this instance, the applicant requested that a pre-hearing meeting not be arranged. They believed that it would be more productive for them to meet with the submitters individually to resolve any issues. Given the retrospective nature of the application, it is considered that it would be in the best

interests of the applicant to arrive at a satisfactory agreement with any adversely affected submitters.

Council does not have any records of the applicant's consultation with submitters and any agreements or outcomes achieved.

6. Assessment of Effects on the Environment

6.1 Dewatering tests

No numerical groundwater model of the aquifer has been undertaken because of the heterogeneous geology underlying the site. The applicant's consultant considers it is too difficult to model a theoretical cone of depression which will result from the removal of groundwater from the site, given that the geology and groundwater characteristics vary so much within such relatively short horizontal distances. Instead, field observations of the effects of the drainage system on local groundwater have been used.

Prior to the development commencing, the unnamed tributary of Bullock Creek which flowed through the site, was visually observed to flow at between 1 and 5 l/s. Other springs were assumed to flow at a few hundreds of litres per minute. This assumption was based on downstream channel dimensions.

The installation of the sheet piling and vacuum wells was intended to reduce the piezometric pressure and ensure dry conditions during site excavation. A consequence of reducing the pressure was to reduce spring flows on neighbouring properties. Over a period of months commencing in mid-June 2005 flows slowed in one spring and by late July, the spring had stopped flowing altogether. The reduction flows coincided with the installation of man-holes to control flows from a spring which had developed during excavation. The applicant arranged a temporary solution of re-circulating spring flows via a pump in order to maintain flow from the dewatered springs.

Following the commissioning of the vacuum wells in late September 2005, another spring was reportedly demonstrating reduced flows also. This spring did not cease flowing altogether and following the staged decommissioning of the vacuum wells, this spring has been reported to have recovered its flow. It is assumed that this recovery is due to a partial recovery of piezometric pressure at the site. The springs, which were impacted most by the dewatering operation, have not recovered at all.

The applicant is unable to provide any information on the sequence of events which resulted in other springs flows reducing in the area. However, the applicant has augmented the flows of one other spring, once the applicant became aware that the dewatering operation was impacting on its flow. The applicant is aware of another spring which has shown a sign of reduced flow coinciding with the vacuum well pumping and since the application was publicly notified, other landowners have informed Council that their springs have also been affected.

Spot flow measurements, during the vacuum well operation, of the total flow off site indicated flows of approximately 25 l/s. Now pumping has ceased, flows from the drainage system measure approximately 13 l/s and, when combined with the surface water flows, a total of 20 l/s is currently being discharged into Bullock Creek.

The applicant has quoted anecdotal evidence, provided by landowners in the area, that the springs exhibit seasonal fluctuations in flow. These seasonal fluctuations are likely to be tied into the seasonal flow patterns of the Cardrona River, which is a major recharge source of the aquifer.

The applicant believes that groundwater levels at the Envirowaste Cardrona bore, monitored by Council that groundwater levels have been decreasing since March 2005. The recharge of the aquifer from Cardrona River leakage is discussed in the SKM Report .

6.2 Dewatering Flows

The aquifer system performance has been included in the SKM report. The water take for the initial dewatering was up to 30 l/s which has now reduced to a steady state flow of approximately 13 l/s. The applicant notes that the nominal take is likely to be between 11-15 l/s, with a peak abstraction of 30l/s during seasonal fluctuations. The current groundwater take from the site of 13 l/s implies that the net abstraction from the site allowing for the existing spring flow of 1 l/s (estimated) is 12 l/s. The current total flow off-site is approximately 18.3 l/s, including the augmenting of existing supplementary flow to the Wanaka Springs Lodge.

The dewatering levels on-site within sheet piling areas range from about 5 m at the maximum invert for the lower carpark, to 1.5 m with foundations/structures just below ground level. The SKM report estimated that the dewatering is required to create an average -3 m reduction in static water level over the development area. This requirement is the basis for the modelling and subsequent calculations provided in the SKM report.

6.3 Dewatering Drainage

The drainage system for the dewatering has been discussed in section 2.3 of this report. Regular maintenance of the discharge system will be required and a maintenance log should be kept. The applicant has stated the water being discharged from the drainage system is not expected to contain any contaminants. If this is the case and only groundwater is being discharged, then it is acceptable that no treatment is proposed before being discharged. As the discharge is unlikely to cause flooding, erosion, scouring, land instability or property damage, it is expected that it will meet the permitted activity provisions listed in the RPW.

The applicant has stated that the system will also be connected to the site's stormwater disposal system. Stormwater may contain hydrocarbons, heavy metals and other contaminants, unless it is treated to a high standard and all contaminants removed, before mixing. It is important to eliminate all potential contaminants from any discharge, especially if the water may be used to augment neighbouring spring flows as discussed in section 6.5.1 of this report. The applicant has applied for a certificate of

compliance for its stormwater discharge from the site as the level of treatment it proposes should mean that the discharge is able to meet the permitted activity rules of 12.4.1.1 of the RPW.

6.4 Effects of the Take on Surrounding Groundwater Users

The abstraction of groundwater creates a drawdown cone that extends laterally from the dewatering system, and this may result in lowering groundwater levels in neighbouring bores or springs. Such lowering may prevent existing users from taking their authorised or permitted amount. An existing groundwater take with an abstraction rate of 15 l/s is located due south of the applicant's site and operated by Wanaka Golf Club, northeast of Dungarvon Street. The bore is located at the bottom of a terrace in an area of springs similar to those located at Warren Street. It is not anticipated that there will be any adverse effect on the groundwater take of the Wanaka Golf Club.

6.4.1 Groundwater Allocation

The current groundwater allocation for the Wanaka Basin Cardrona Gravels Aquifer based on assessed recharge is calculated at 11.6 % of total aquifer recharge, of which a recommended volume of 20% of that recharge may be available for allocation. The SKM report estimates that this groundwater take of up to 30 l/s will increase net discharge of the aquifer by approximately 2-5 l/s. Both the total take and the assessed net increase in discharge fall within the available allocation for the aquifer. The SKM report recommends that the net increase in discharge from the aquifer not be added to groundwater allocation for the aquifer.

6.5 Effects on Surface Water Bodies

6.5.1 Springs

Wanaka has several springs located within the area. These springs evoke mixed feelings from the community. Some landowners regard the springs as a nuisance and pipe them off their properties, however, other landowners have created water features out of them, named their businesses after them and advocate for the springs' conservation. This development has caused a number of these springs to have suffered depleted flows, or have disappeared entirely. The distance from the springs to the dewatering site are listed in Table 3 of the SKM report.

According to the applicant, the closest springs to the site are located on the Wanaka Springs lodge property directly northeast of the site. There are two springs on this property, both of which have been developed by the landowner so that they flow through the Wanaka Springs Lodge property and meet at a pond on the south western boundary. The pond then forms the small stream which flows onto the applicant's site and which the applicant has diverted as authorised by Water Permit 2005.175.

Springs also rise at the Marshall Property directly north of the applicant's property. These springs have also been developed to form a significant garden feature which flows through one other property before discharging to Bullock Creek. Within the water feature there are three ponds, two of which (the top and bottom) are spring fed.

In addition to the spring mentioned there are another two springs which have been either completely or partially depleted by the development.

As shown in the SKM report, there is potential for other springs within a 300 m radius to be affected by the development.

It is a recommended condition of consent should it be granted that any adverse effects on neighbouring springs be remedied by the applicant to the satisfaction of the spring owners and Council.

6.5.1.1 Spring Depletion Mitigation

The application was publicly notified and all landowners with springs had the opportunity to raise concerns. The resulting submissions are discussed in section 5 of this report.

The applicant has attempted negotiation with their neighbours whose springs have been adversely affected by the dewatering. The applicant proposes to maintain any shortfall in natural inflow into the springs by piping water from the dewatering system on the site to the springs. Given natural seasonal variations in the level of the springs, it is recommended that the applicant maintains a minimum flow to each of the impacted springs. Consideration will need to be given to the on-going expense and maintenance of the pumps required to augment the depleted spring flows. The practicalities of implementing such a system will involve easements through other properties and on-going pump and system maintenance.

Concerns have been raised by submitters with regards to the responsibilities of any such consent conditions relating to future consent holders such as a body corporate. This is not a concern that can be addressed in the context of a consent, however failure of the consent holder to transfer the consent, once their interest in the building has been removed will result in them being liable for any non-compliance. Should the applicant company no longer be solvent then the new owners of the development will be responsible for any non-compliance and will be required to apply for consent.

A copy of this report and consent should it be granted will be forwarded to the Queenstown Lakes District Council for their records with a request that the conditions of consent be placed on the Land Information Memorandum for the apartment site.

In addition to the springs which have already been depleted, the SKM report (Appendix 1) highlights the fact that other springs may be affected by the dewatering works. Recommended conditions of consent will require mitigation measures to be put in place to rectify any unwanted spring depletion. The condition recognises that some site owners may not want their springs reinstated.

6.5.2 Surface Water Resources

There are two surface water resources located within the vicinity of the site. The first is the spring-fed stream which is an unnamed tributary of Bullock Creek. The applicant is already authorised to divert the stream around the site and discharge it to Bullock Creek. The second surface watercourse is Bullock Creek itself, which discharges to Lake Wanaka.

Bullock Creek is sourced from artesian springs above the Wanaka Township and is listed schedule 1A of the RPW as having the following values:

- *A large waterbody supporting high numbers of specific species, which can provide for diverse life cycle requirements of a particular species, or a range of species;*
- *A bed composition of importance to resident biota namely sand substrate*
- *A Significant presence of eels, trout and salmon;*
- *A presence of significant indigenous aquatic vegetation;*
- *A presence of indigenous fish species threatened with extinction; and*
- *A presence of indigenous invertebrates threatened with extinction.*
- *A rare association of aquatic plants; and*
- *An outstanding natural landscape which contains scenic values within the wider landscape context of the surrounding mountains, particularly the unmodified lake level, water quality and colour of the water.*

It is estimated that the Wanaka Basin Cardrona Gravels Aquifer contributes up to 450 l/s to Bullock Creek flows. It is not anticipated that Bullock Creek will be adversely affected by the groundwater take in this instance, given the groundwater is discharged directly to Bullock Creek.

Consideration must be given to the cumulative effect should several of these developments be permitted to take water and lower the ground water table level permanently. Several developments removing ground water from this aquifer has the potential to impact on the natural flows of Bullock Creek. While potentially any water taken will be discharged 'point source' into Bullock Creek or the Lake Wanaka, instead of the defuse nature which occurs at present, this has the potential to upset the natural water balance of the aquifer.

With regard to Lake Wanaka, it is not anticipated that there will be any adverse effect on the lake resource as a result of the proposed groundwater take.

6.5.3 Amenity and Recreational Values

As stated in section 6.5.1 of this report springs have already been depleted as a result of the dewatering activity. Landowners who have developed their springs into water features have lost this amenity feature of their property. These landowners have made submissions on the application and, in the main, have requested that the spring flows running through their properties are restored to a flow rate equal to that of pre-development. This is a recommended condition on the draft consent.

It is not anticipated that any recreational value will be lost through the proposed groundwater take.

6.5.4 Spiritual and Cultural Values

It is not anticipated that any spiritual or cultural values will be affected by the groundwater take.

6.6 Groundwater Quality

According to the applicant there are no septic tanks within 50 m of the construction site. Council's records show that the nearest consented discharge of wastewater to the site is more than 1,000 m away. Council's records also indicate that there are a number of potentially contaminated sites within a 2,000 m radius of the site. The nearest potentially contaminated site is a service station 400 m to the north of the site. Given that the applicant is not proposing to use the water either for irrigation or as a potable water supply and the distance between the applicant's bore, it is likely that no contamination of groundwater is expected as a result of the applicant's groundwater take from the bores or gravity drainage.

6.7 Monitoring

As the ultimate outcome of the activity is to lower the static water level by -3.0 m on average, it is a recommended condition of consent that the static water level be monitored via the monitoring bores already positioned on-site to ensure that a static water level of -3.0 m is maintained.

In addition, compliance with consent conditions relating to the instantaneous rate of take, daily, and monthly volumes cannot be assessed unless the water take is monitored. Therefore, should consent be granted, it is recommended that the consent holder install suitable and appropriate water measuring device, such as a v-notched weir and record manually at weekly intervals the rate at which water is taken and the volume of water taken, and forward a copy of that record to the Consent Authority. Once construction is completed, monitoring could be reduced to monthly with a condition allowing a review of the frequency of monitoring.

6.8 Potential for land subsidence

Concerns were raised by Council staff relating to the stability of land surrounding the site. The initial excavation of the site was carried out without retaining measures and the difficulties with local groundwater conditions may have resulted in cracking of the land just beyond the north eastern boundary of the applicant's site. The applicant stated that these local effects were rectified by the installation of deep sheet piling. The area of land between the building walls and the cut batters has now been backfilled and ground levels are close to those that existed before the works began. The applicant has stated that no further instances of land instability effects and the Tonkin and Taylor Limited report commissioned by the applicant notes that the with the building design close to normal code requirements for the local land conditions and with the retention of the sheetpiling to provide an additional safety factor, it is anticipated that there will be no further effects on land instability.

The SKM report assessed that the potential for slumping or compaction as a result of site dewatering is unlikely outside the boundary of the dewatered site. SKM believe that at a 20 m radius from the centre of the site (approximately 10 m from the site boundary), the estimated reduction in water table level will be 2.9 m. This is based on SKM's assumption of an average -3.0 m drawdown and a 30 l/s take.

There are no building foundations or permanent structures present within 10 m of the site boundary. Furthermore, there are no indications on site or otherwise, that highly confined conditions are present which may serve to promote slumping around adjacent structures. Many of the submitters wished to have assurances over land stability provided for in the consent conditions should consent be granted.

In addition, Council's Natural Hazards Unit has assessed the application. They have requested that the proposed monitoring suggested by the applicant, be undertaken for the life of the building. The monitoring should include a maintenance schedule for the monitoring wells and all other groundwater and slope stability measures.

A recommended condition of consent will require that no land instability and property damage shall occur as a result of groundwater being taken.

6.9 SKM Recommended Conditions

The SKM report recommended that the following conditions be placed on the consent should it be granted.

- *Groundwater shall only be taken via the on-site drainage network installed for the long term dewatering of the site.*

This is a recommended condition of consent, should it be granted.

- *The site dewatering flow shall not exceed 30 L/s on any day. This level of outflow would normally be associated with site establishment.*

- *The average site dewatering flow over any 30-day period shall not exceed 77,760 m^3 (30 L/s). This is the assessed long term dewatering flow to allow for variability in aquifer head and outflow.*

- *The average dewatering flow over an annual period shall not exceed 709,560 m^3 (75% of peak dewatering flow).*

These conditions outline volumes which, should they be exceeded, would demonstrate unforeseen conditions at the site and would be cause for concern and therefore they are recommended as conditions of consent. It is important that Council has some control over the rate and volume of water taken from the aquifer to ensure when conditions are reviewed they are able to be accurately assess the environmental impacts as a result of the take. Recommended review conditions will ensure that this issue may be revisited, if required, to address any adverse effects on the environment.

- *The total site dewatering discharge flow, exclusive of any storm water flow should be measured and recorded on a daily basis, and provided to council upon request. A simple calibrated v-notch or similar weir may be used to read flow accurately enough for this purpose. If dewatering flows (exclusive of storm water) do not vary by more than 10% over a minimum of 7-days, then weekly measurements of the flow may be made. A copy of measured flows shall be forwarded to the Compliance Unit of the consent authority each six months from the date of exercise of this consent or upon request.*

This recommendation is included as a condition of the draft consent.

- *The aquifer potentiometric surface shall not be reduced by more than xxx.x metres above mean sea level over any part of the Warren Street site as measured at Bores xxx and xxx.*

- *Bores xxx and xxx shall be located substantially as shown on Appendix 1 attached to this consent.*

- *Observation bores shall be monitored daily during peak pumping to ensure that the potentiometric surface complies with condition x of this resource consent. A record of bore observation data shall be kept by the applicant and forwarded to the Compliance Unit of the consent authority each six months from the date of exercise of this consent or upon request.*

The drainage system has been set at between 289.95 and 288.55 AMSL depending on the upper or lower basement section and this level is included as a recommended condition on the draft consent. The piezometers which have been left in-situ post active pump-dewatering will be monitored and records of that monitoring will be forwarded to Council.

- *The discharge from the site shall be collected to a sump (on-site) before discharge to Bullock Creek. This is to enable removal of erroneous material prior to discharge.*

This condition would ensure that the discharge into Bullock Creek does not require a discharge permit. However, as it relates to the discharge of water it cannot be placed on either of the water permits. The applicant has applied for certificate of compliance to discharge stormwater.

- *Provision should be made for continuous supply of water to the adjacent springs where depletion has been noted. Provision of remedy for other springs for unwanted spring depletion. Decision of the consent authority where agreement cannot be reached shall be final.*

- *There shall be no flooding or damage to properties as a result of the discharge. There shall be no settlement or erosion of property or land instability as a result of the groundwater take. Any such effects shall be remedied immediately by the consent holder.*

A recommended condition of the consent will ensure that flows are provided to the neighbouring springs which have been adversely affected by the dewatering activity. In addition, should the dewatering activity result in any other unwanted spring depletion, the applicant will also be required to rectify this adverse effect to the satisfaction of the consent authority.

- *No net increase in aquifer outflow (2 - 5 L/s) should be accrued to groundwater allocation for the aquifer.*

Given the proximity of the site to Bullock Creek and that the net increase is estimated as less than minor, Council staff do not consider that the water taken, will become part of the allowable allocation of the Wanaka Basin Cardrona Gravels Aquifer.

- *Review clause to cover adverse effects, conditions for spring depletion and land instability, reduction in aquifer potentiometric surface, monitoring required, and rate and volumes of take.*

This recommendation is discussed in section 6.10 of this report.

6.10 Review Conditions

Given that this is an unusual application with uncertain adverse effects and unidentified potential affected parties, there should be comprehensive review conditions placed on the consents should it be granted. The review of the consent will be frequent and allow Council to place additional conditions on it to address any adverse effects which may arise as a result of the dewatering activity. The review of the consent will also take into account any non-compliance of consent conditions and will require the remedy of any adverse effects by the applicant.

6.11 Transfer of Consent

Given a proposed term of consent of 35 years, the consent will need to be transferred to the new property owners, once the applicant no longer has an interest in the property. This will help to ensure the on-going compliance with the recommended conditions of the consent.

6.12 Conclusion

The applications are to take groundwater for the purpose of perpetual site dewatering to facilitate the on-going drainage for an apartment complex. Neighbouring springs have been partially or fully depleted completely as a result of the works.

Had the applicant not been so committed to the project and already completed the works, Council would have discouraged this application from being lodged. Council would have recommended to the applicant that other building designs be investigated as it would be likely that this application, as it stands, would not have been accepted.

All potentially affected parties have been given the right to be heard with regard to these applications via the public notification process. The effects of the activity are more than minor and the applicant has been working with the affected parties to come to a satisfactory outcome. Council still has an obligation to ensure that any adverse effects on the environment arising from this activity are avoided, remedied or mitigated.

Recommended conditions are in the draft consent to mitigate and remedy adverse effects. In addition, review conditions have been recommended to address the extent of any adverse or unforeseen effects on the environment.

7. Statutory Considerations

7.1 Part 2 of the Act

The purpose and principles of the Act are outlined in Sections 5 – 8.

Section 5 of the Act seeks to promote the sustainable management of natural and physical resources, to ensure that the water resource is managed sustainably and the potential needs of future generations are provided for.

While the groundwater take for the purpose of dewatering in this instance alone, will not limit the amount of water allocation available from the aquifer. The cumulative effect of several such dewatering takes may impact adversely on the aquifer. Such takes are discouraged by Council staff with a preference for alternative building designs as opposed to engineered solutions which result in groundwater being taken and run to waste. This type of water take is not an efficient use of the water resource and had the applicant not already been committed and consented by other Consent Authorities, Council would have advised the applicant to redesign his proposal so that perpetual dewatering of the site was not necessary.

The take will discharge immediately into Bullock Creek, therefore it is considered that, in this instance, the take is sustainable. However, future takes of this nature may not occur in a discharge zone of an aquifer nor may the water discharge directly to the destination water body and therefore may adversely impact on the sustainability of the aquifer.

The dewatering of the site in perpetuity is necessary for the stability and amenity of the apartment building. This means that adverse effects on nearby springs, and possibly land, is likely to be on-going. As these effects are more than minor and cannot be avoided, the emphasis is then on mitigation and remediation which must be carried out in order for the granting of this consent to be consistent with part 2 of the Act.

In this instance, the water being taken will not reduce the available allocation in the aquifer. Suggested conditions of consent have been recommended to mitigate adverse effects on the environment resulting from this proposal. Any further developments which result in groundwater being taken from sensitive aquifer systems will be strongly discouraged by Council.

There are no matters of national importance under section 6 of the Act that will be affected by this application.

Under section 7 of the Act, Council is required to have particular regard to:
(b) The efficient use and development of natural and physical resources; and,
(g) Any finite characteristics of natural and physical resources.

Particular regard has been had to the finite characteristics of the aquifer, and to the efficient use of the resource. Concerns have been raised over the cumulative effect several takes similar to this would have on the finite characteristics of the aquifer. If less water becomes available in the aquifer, then the discharge will reduce and this will be beneficial to the applicant, however if a number of similar developments were to operate simultaneously then the cumulative effect may adversely affect the finite nature of the aquifer. In addition, it is considered that the adverse effects on the environment are more than minor, given the reductions on neighbouring spring flows. Recommended conditions have been included to ensure flows are provided to these diminished springs to mitigate these adverse effects.

Section 8 of the Act requires Council to take into account the principles of the Treaty of Waitangi. The application has been processed in accordance with Council's protocol for consultation with Iwi.

7.2 Section 104 of the Resource Management Act 1991

Section 104(1) requires the Consent Authority to have regard to the following matters in considering resource consent applications:

(a) Any actual effects on the environment of allowing the activity;
(b) Any relevant provisions of:
  (i) a national policy statement;
  (ii) a New Zealand coastal policy statement;
  (iii) a regional policy statement or proposed regional policy statement;
  (iv) a plan or proposed plan;
(c) Any other matter the consent authority considers relevant and reasonably necessary to determine the application.

The relevant matters are discussed below.

7.2.1 Environmental Effects

The actual and potential effects of the proposed activity are considered in section 6 of this report. The applications were publicly notified and 15 submissions were received. The points of concern raised in the submissions have been discussed in section 5 of this report. The adverse effects on the environment are more than minor. Should the consent be granted, recommended conditions have been included to mitigate and remedy those adverse effects. Council would strongly discourage other developments of a similar nature in this area as cumulative effects may impact on the sustainability of the aquifer and may reduce the options available for future generations.

7.2.2 Regional Policy Statement for Otago

The Regional Policy Statement for Otago contains several policies relevant to groundwater takes, in particular Objective 6.4.1 and Policy 6.5.11.

Objective 6.4.1 provides for the allocation of Otago's water resources, in a sustainable manner, which meets the present and reasonable needs of Otago's people and communities.

The water takes applied for are not considered consumptive uses of the water resource and the water is being discharged directly to Bullock Creek. This water take will not be considered part of the allocation of the Wanaka Basin Cardrona Gravels Aquifer because the take will discharge directly to Bullock Creek and increased net discharge from the aquifer is only increasing by 2-5 l/s as indicated by the SKM report. If further water was to be taken from the aquifer up-gradient of the applicant's dewatering site by other water users, this would reduce the amount discharged via the sub surface drainage and would ultimately benefit the applicant. However, further development of a similar nature should be discouraged as it may impact on the sustainability of the aquifer.

Policy 6.5.11 seeks to promote the allocation of groundwater within the sustainable yield of the water body.

As discussed, in this instance the water take is not considered as part of the allocation of the Wanaka Basin Cardrona Gravels Aquifer, as it is not consumptive and will discharge directly into Bullock Creek. Future developments may result in an adverse redistribution of allocation.

Therefore, in this instance, the application is considered to be consistent with Objective 6.4.1 and Policy 6.5.11.

7.2.3 Regional Plan: Water for Otago

The RPW contains several policies relevant to groundwater takes, including Objective 9.3.2, and Policies 9.4.2, 9.4.3, 9.4.7 and 9.4.8.

Objective 9.3.2, and Policies 9.4.2 and 9.4.3 seek to ensure that water takes do not adversely affect the long-term yield of an aquifer or surface waterways. Given that the take and associated discharge are occurring at a similar location into Bullock Creek, in this instance, it is not anticipated that it will affect the long-term yield of the aquifer, Bullock Creek or Lake Wanaka. Future developments of a similar nature may impact on the aquifer and surface water bodies. The proposed groundwater take is therefore consistent with these objectives and policies.

Policy 9.4.7 provides for existing groundwater users, by ensuring that the proposed take does not adversely affect them unless their approval has been obtained. The application was publicly notified on 13 July 2006. It is anticipated that there will be adverse effects on artesian springs in the area and mitigating conditions have been recommended to rectify these depleted flows.

Policy 9.4.8 requires Council to ensure that the quantity of water granted under a resource consent is no more than that required for the intended use of that water. As discussed the water will not be used but discharged at approximately the same location that it would have without the applicant's intervention, albeit not at such an increased rate. The water take is not considered an efficient use of the water resource even though the take is located in a discharge zone of the aquifer and the water is discharge to the destination waterbody. It is unlikely that future developments would be permitted to remove water in this fashion and "run it to waste".

Policy 9.4.2 provides for the volume and rate of take to be measured, in a manner satisfactory to the Council, unless it is impractical or unnecessary to do so. In this instance, there is a requirement for the applicant to measure the volumes and rates of take from a water measuring device. A record of those measurements is required to be forwarded to the consent authority. This is considered sufficient to ensure that the amount of water taken is within the specified recommended consent conditions.

Overall, if the effects on neighbouring springs can be adequately mitigated, the application could be considered to be consistent with the relevant objectives and policies of the RPW.

7.2.4 Other Matters

There are no other matters that Council considers relevant and reasonably necessary to determine the application.

8. Recommendations

That the Otago Regional Council grants Water Permit Application 2006.151 to Warren Street Developments Limited to take up to 30 l/s of groundwater for the purpose of site dewatering, subject to the terms and conditions as set out in the attached draft consent.

9. Term of the Consent

As the water take required to drain the accommodation development is considered necessary for the apartment's structural safety, it is recommended that a term of 35 years be granted to application 2006.151. Recommended review conditions have been discussed in section 6.10 of this report.

Selva Selvarajah
Director Resource Management
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WATER PERMIT

Pursuant to Section 104B of the Resource Management Act 1991, the Otago Regional Council grants consent to:

Name: Warren Street Developments limited

Address: Level 1, 6 Viaduct Harbour Avenue, Auckland

To take groundwater

for the purpose of site dewatering to provide drainage for an apartment complex

for a term to expire on 1 October 2041

Location: 25 Warren Street, approximately 50 metres north east of the intersection of Warren and Helwick Streets, Wanaka

Legal description of consent location: Sec 6 Blk XXIX Wanaka Town SD

Map reference: NZMS 260 F40:040-050

Conditions:

1. The rate of abstraction shall not exceed 30 litres per second.

2. A peak monthly volume of abstraction shall not exceed 77,760 cubic metres and an annual volume of 709,560 cubic metres.

3. The consent holder shall maintain 2 observation bores shown as Piezometer 1 and Piezometer 2 on Appendix I- DWK 57711 C2 which is attached to and forms part of this consent.

3A. The static water level at each observation bore shall not be reduced by more than 287.6 metres Above Mean Sea Level at either Piezometer 1 or Piezometer 2:

4. Both Piezometer 1 and Piezometer 2 shall be measured weekly to ensure that the static water level complies with condition 3A. A record of each static water level reading shall be kept and forwarded to the Consent Authority by 30 January and 30 July of each year and upon request.

5. The consent holder shall install three water measuring devices that comply with condition 7. One of the devices shall be installed at the groundwater pipe entry to SWMH1 and the second shall be installed at the groundwater pipe entry to the

GMH-2 and the third at the groundwater pipe entry to the wet well as shown on Appendix I- DWK 57711 C2. Each water measuring device shall be fitted with a datalogger to record the extent to which this consent is exercised by recording the rate (litres per second) and daily volume of water (cubic metres) to an accuracy of +/- 2%.

6. A copy of the record of the water measuring readings required by condition 5 shall be forwarded to the Consent Authority by 30 January and 30 July of each year and upon request.

7. The installation and maintenance of the water measuring device shall be performed in accordance with manufacturer's specifications and to New Zealand Quality Standard ISO 4064.

8. The consent holder shall ensure the full operation of the water measuring devices at all times during the exercise of this consent. All malfunctions of the water measuring devices during the exercise of this consent shall be reported to the Consent Authority within 2 working days of observation and appropriate repairs shall be performed within 7 working days or otherwise as soon as is practicable following the observation of malfunction.

9. The installation of the water measuring devices shall be completed to full and accurate operation within one month of the issuing of this consent. The consent holder shall provide a copy of the installation certificate to the Consent Authority upon request.

Note: The water measuring devices should be safely accessible by the Consent Authority and its contractors at all times.

10. The consent holder shall install and maintain a pump system to augment the flow of the four affected springs which are located on the following properties;

    (a) Lot 2 DP 18304
    (b) Sec 7 Blk XXIX Town of Wanaka
    (c) Sec 2 Blk XXIX Town of Wanaka
    (d) Sec 13 Blk XXV Town of Wanaka.

    The amount of water to be provided to each spring shall be equivalent to the minimum flow of each spring prior to the start of the current development work on Sec 6 Blk XXIX Town of Wanaka SD or as otherwise agreed with the site owners of the properties described in (a)-(d) of this condition. Where agreement cannot be reached, the decision of the Consent Authority shall prevail.

11. The consent holder shall provide an Operation and Maintenance manual for the drainage system which shall be provided to the Consent Authority within one month of the granting of this consent.

12. The Operation and Maintenance manual required by condition 11 shall include but not be limited to:
    (a) a brief description of the drainage system, including a site map indicating the location of the points of discharge and any monitoring sites;
    (b) key operational matters, including weekly, monthly and annual maintenance checks;
    (c) monitoring requirements and procedures;
    (d) contingency plans in the event of system malfunctions or breakdowns; and
    (e) the means of receiving and dealing with any complaints.

    Records of maintenance, complaints, malfunctions and breakdowns shall be kept in a log and a copy of the log made available to the Consent Authority on request. At all times the consent holder shall ensure that the Consent Authority has a copy of the most recent version of the Operations and Management Manual.

13. The consent holder shall ensure that as a result of the exercise of this consent, there is no flooding of other person's property, erosion, land instability, sedimentation or property damage. Any such adverse effects shall be remedied by the consent holder to the satisfaction of the Consent Authority. All remedial works shall be undertaken within a timeframe agreed to by the consent holder and the Consent Authority.

14. The consent holder, before withdrawing all interest in the property, shall transfer the consent to a legal entity which undertakes the same functions and services for the property as a body corporate or similar.

15. The Consent Authority may, in accordance with Sections 128 and 129 of the Resource Management Act 1991, serve notice on the consent holder of its intention to review the conditions of this consent within 3 months of the commencement of this consent and annually thereafter for the purpose of:

    (a) determining whether the conditions of this consent are adequate to deal with any adverse effect on the environment which may arise from the exercise of the consent and which it is appropriate to deal with at a later stage; or
    (b) determining whether the conditions of this consent are adequate to deal with any spring depletion or land instability which may occur as a result of exercising this consent; or
    (c) ensuring the reduction in water table levels are necessary and do not result in adverse effects on the environment or members of the public; or
    (d) ensuring the monitoring of the static water levels levels are adequate to ensure the static water level do not drop below the authorised levels under condition 3 of this consent; or
    (e) determining whether the exercise of this consent is resulting in an adverse effect on the aquifer; or
    (f) adjusting or altering the method of water take recording and transmission;
    (g) adjusting or altering the frequency of monitoring and reporting;
    (h) adjusting or altering the rate or volume of take.

Appendix I
DWK- 57711 C2

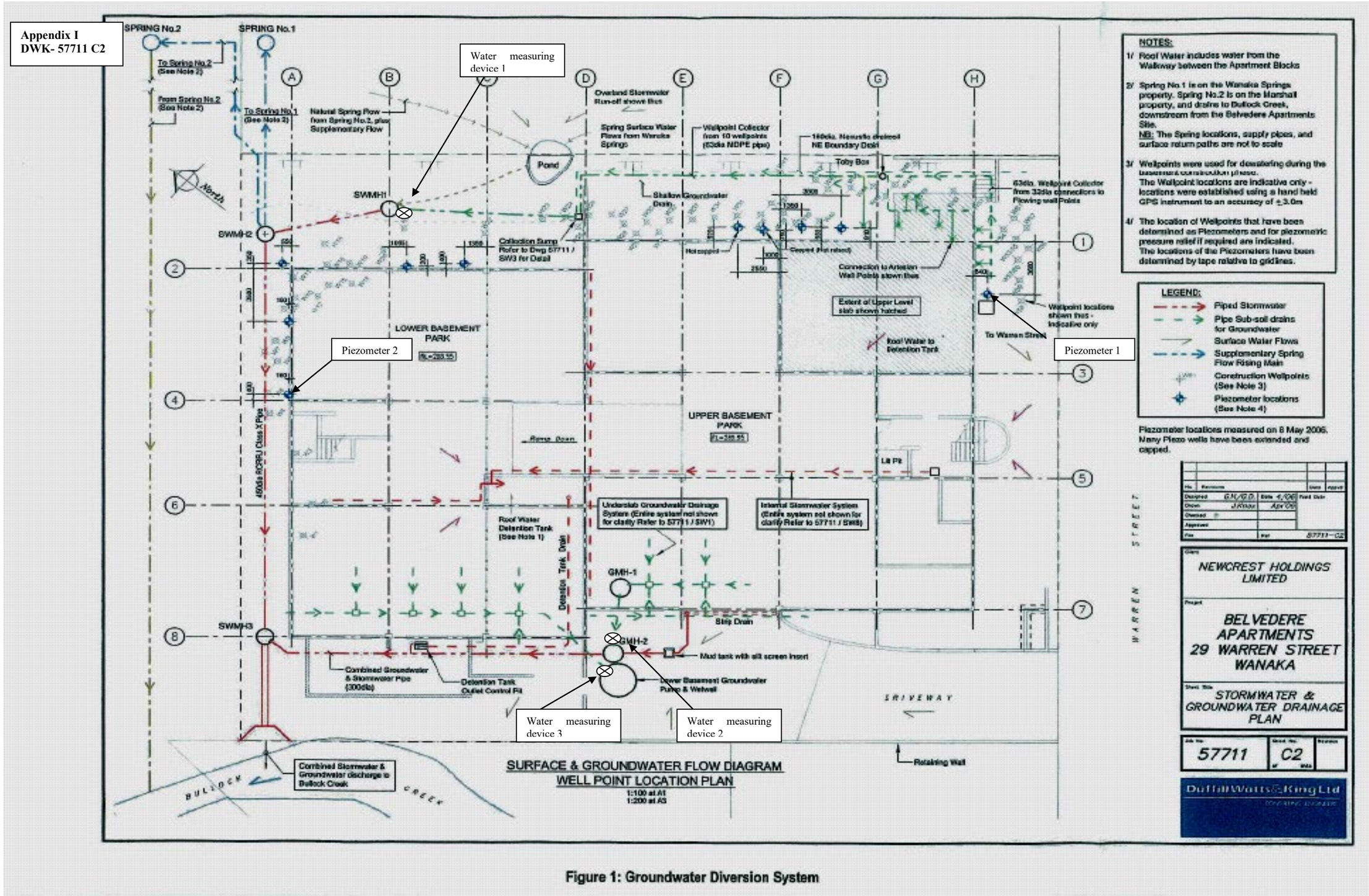

Figure 1: Groundwater Diversion System

Appendix II: SKM Report

Dear Selva

Warren Street Developments Ltd – Groundwater Diversion/Take for the purposes of Dewatering.

I have reviewed the proposal to divert/take groundwater for the purposes of permanently dewatering a building site in the township of Wanaka, located at coordinates 2204060 E – 5605089 N, Warren Street. The following technical assessment is provided to address the potential impact of the activity on groundwater and surface water resources. Specific issues reviewed in the assessment include:

- Aquifer hydrogeology
- Existing site details and local aquifer hydraulics
- Simple modelling of the effects of the proposed take
- Assessment of the impacts on the environment resulting from the proposed take
- Suggested conditions for monitoring and mitigation.

The applicant has applied for a diversion/take (and discharge) of up to 30 L/s of groundwater from the Wanaka Basin Aquifer for 12 months per year, for the purposes of permanent dewatering of an urban dwelling/complex (MWH NZ Ltd, 2006).

The issue of "diversion" versus "take" of groundwater for this application may not necessarily alter the outcome of this technical assessment as both activities are essentially the same in terms of potential environmental impact. However, to technically "divert" groundwater as implied for this activity, there must be facility to dig, drill or otherwise obtain groundwater prior to the diversion. To divert groundwater in-situ is technically implausible without an external device as a means of either, abstracting, injecting or providing an impermeable barrier such as sheet piling. In most cases the process converts groundwater to surface water, which then may be diverted but more appropriately, as in this case, discharged. Thus, whilst the activity is not a take for consumptive use, it is technically a groundwater take with a corresponding discharge. Based on the above discussion, the activity shall be referred to as a "groundwater take" in the following report.

Limited hydro-geological and environmental/water resources information has been provided by the applicant in support of the application. The application appears to hinge on observed environmental impact of the current dewatering (groundwater take) and the assessment of the potential environmental impact is based solely on that information. This assessment attempts to provide an independent calculation of the potential environmental impact of the activity. However, as little technical information has been

obtained to support the application, the results from this report should be viewed as conservative estimates only.

Information for this assessment has been obtained from Otago Regional Council (2003), updated wells and bore-log details for the Wanaka Basin, piezometric, stream flow and rainfall data (Otago Regional Council, 2006), on-site drilling, spring/flow observations and measurements, and site dewatering results (MWH NZ Ltd, 2006).

1. Aquifer hydro-geology

Aquifer occurrence

The regional aquifer system located in the Wanaka area is defined as the Wanaka Basin Aquifer - Cardrona Gravels, which mainly consists of Quaternary gravels silts and sands. Available well log information shows there is generally about 10 - 30 m of saturated gravels at up to 75 m below the ground surface (GL) across a majority of the basin area. The well log information obtained to date suggests that the permeability of these gravels is high with limited low permeability horizons present in the majority of the basin. Thus, based on the well log data for the area, it is expected that the aquifer is mostly unconfined over its extent and that the Quaternary gravels exhibit reasonable uniformity in bulk hydraulic conductivity or permeability.

Natural recharge for the aquifer is dominated by leakage from the Cardrona River in the Ballantyne Road area. This leakage occurs from the Cardrona River mainly in the reach of the "Larches" to below Ballantyne Road. Rainfall infiltration also recharges the aquifer to a lesser extent. Groundwater flow is from the Cardrona River toward the Wanaka Township and the Clutha River/Mata-Au in the direction of the Wanaka Airport area.

The area surrounding the Wanaka Township incorporating Bullock Creek is known to be a discharge zone for the aquifer, ultimately to Lake Wanaka. This area has a relatively more complex hydro-geology than the remainder of the Wanaka Basin Aquifer, with a series of spring outflows emerging from the semi-permeable lakeshore sediments at around the NZMS 260 series map 300 m contour. It is the lakeshore sediments overlying the Quaternary gravel aquifer which provides some localised confinement, with preferential flow zones in the aquiclude allowing springs to flow to Bullock Creek and then to Lake Wanaka.

Hydraulic parameters

Aquifer parameters obtained from Otago Regional Council reports are listed in Table 1. These parameters represent a conservative assessment of regional aquifer properties, based on regional modelling and assessment.

Table 1 Wanaka Basin Aquifer parameters

Parameter	Value	Units
Saturated thickness (b)	10 – 30 (estimated as 18 at Warren Street site)	m
Hydraulic conductivity (K)	10 – 70 (estimated as 30.5 at Warren Street site)	m/day
Transmissivity (T)	100 – 2000 (estimated as 550 at Warren Street site)	m^2/day
Gradient (i)	0.006 – 0.2 (unknown at Warren Street site. Note that the area does have spring emergence and is a natural discharge area for the aquifer)	
Specific yield (Sy)	0.2 estimated, however confined conditions may allow a specific storage (Ss) of an estimated 0.001	
Porosity (n)	0.3	
Darcy velocity	2.3 average	m/day
Direction of groundwater flow	Generally toward Wanaka Township and Wanaka Airport areas from the Cardrona River below the Larches to Ballantyne Road.	

Note: The estimates of hydraulic parameters for the Warren Street site are mainly based on pumping test information obtained from the Lakeport Developments site, resource consent application 2006.241.

Aquifer system performance

Water table levels in the Wanaka Basin Aquifer during 2005 had declined by about 1 – 2.5 m due to low rainfall and Cardrona River flows. Currently, water table levels could be described as "normal". However, the 2005 decline was not as severe as the reduction in water levels measured in wells during 2001 (of about 2.5 – 5 m), post the 1999 Cardrona River flood and subsequent "clogging" of the river bed.

Gauging information from measurements undertaken on 26 January 2004 shows that the leakage from the Cardrona River at that time, was consistent with those levels measured prior to the 1999 flood. Thus, there is no evidence of any reduced conductance of the Cardrona River bed as experienced post the 1999 flood and the recent declines in water table levels were likely to be associated with climatic variation rather than a physical event or change to a recharge mechanism for the aquifer.

There has been some variation noted in the spring outflows from Bullock Creek in the Wanaka Township area. Outflows had invariably reduced in response to the reduced water table levels during 2001, 2003, and 2005. However, current flows in Bullock Creek are nearer to "normal" than those measured during the 2001 - 2002 period. Flow measurements undertaken on 23 September 2005 showed that Bullock Creek flows in the upper to mid reaches were consistent with those measured prior to the 1999 flood, and a recent gauging run undertaken on 20 April 2006 showed that flows in Bullock Creek had returned to "normal" with some of the highest flows measured since the 1999 flood.

By comparing the water table measurements for the Wanaka Enviro-Tip bore situated close to the Cardrona River and selected manual piezometric bore/sites in the Wanaka

Basin, an approximate time delay in responses for Bullock Creek flows to changes in Cardrona River recharge can be made. The time delay for responses is conservatively estimated at 3 years, which compares favourably to the distance from Bullock Creek to the Cardrona River of over 2,600 m and applying the average groundwater velocity of 2.3 m/day in Table 1.

This implies that variation of recharge from Cardrona River leakage does not show up in spring outflows adjacent to Bullock Creek for approximately 3 years, although it is likely that high water table responses will progress faster through the aquifer system than responses to water table decline. This hypothesis is consistent with Cardrona River flows, measured well levels, spring flows, and Bullock Creek flows.

Thus, the spring outflows and Bullock Creek flows which have been experienced during 2006 may reflect Cardrona River leakage during 2003. During that time water table levels at the Enviro-Tip bore were rising, and the peak water table levels measured during 2004 are not likely to be reflected in spring outflows or Bullock Creek flows as yet.

This finding implies that climatic variation and specifically Cardrona River leakage is not likely to have had any impact on spring flows or Bullock Creek flows during the period of dewatering at the Warren Street site from February 2006 to date. However, it is noted that rainfall for the 2005 – 2006 period has been below normal for the Wanaka area.

Water balance and allocation

The basic water balance for the Wanaka Basin Aquifer system is shown in Table 2.

Table 2 Wanaka Basin Aquifer steady state water balance (Otago Regional Council, 2003)

Water balance	Flow (L/s)
Cardrona River recharge	900
Rainfall and irrigation recharge	200
Total recharge	1100
Groundwater use	87 (assumes 66% of paper allocation is actually used)
Bullock Creek spring outflows	450
Outflow to Lake Wanaka and Clutha River/Mata-au	563
Total outflow	1100

Existing well use in terms of paper allocation is assessed at 128 L/s and actual use has been estimated at 66% for modelling purposes in Otago Regional Council (2003). The recommendations from that report suggest that allocation of the groundwater from the Wanaka Basin Aquifer should be no more than 20% of recharge, leaving sufficient groundwater to maintain water table levels and spring outflows to Bullock Creek.

Otago Regional Council (2003) has identified Bullock Creek and the associated springs sourced from the Wanaka Basin Aquifer, as having a high amenity value for the Wanaka Township.

Based on Otago Regional Council (2003) there is 11.6% consented or allocated from groundwater in the Wanaka Basin Aquifer. The allocation may increase by a further 92 L/s to 220 L/s as a steady state flow to be consistent with the regional modelling work undertaken by the Council.

2. Site details and hydraulic parameters

Site well log and pumping test data

To date there has been no specific hydraulic testing done for the Warren Street site. Measurements have been undertaken of drainage flows and aquifer potentiometric surface from piezometers placed on-site. Well logs for wells drilled on site show the presence of a thick, highly variable lakeshore sediment/till layer, which is thought to overly the Quaternary outwash gravels and moraine debris of the Wanaka Basin Aquifer.

The logs obtained for the Warren Street, Heartland and Lakeport Developments sites confirm variable thicknesses of low permeability material (glacial till and lakeshore sediments) medium dense to very dense silts overlying alluvial sandy gravels comprising moraine gravels and Cardrona outwash alluvium. The overlying low permeability till layer has been formed by compaction during glacial advances (MWH NZ Ltd, 2006). The base of the low permeability layer has been estimated to be at least 12 m below the maximum invert for the Warren Street foundation (MWH NZ Ltd, 2006).

The geologic profile displayed at the Warren Street site is different to that supported by the Wanaka High School well log and a well log for a bore located adjacent to the Wanaka Golf Course (B Ford). The strata reported appears to be reasonably consistent, consisting of Quaternary gravels for the general area and there is no evidence of a low permeability horizon that may serve as a low conductance barrier to flow within the aquifer, such as the lakeshore sediments that occur on site. This type of horizon is regionally evident in the Bullock Creek springs area located within the Wanaka Township from the Cardrona highway to Mt Aspiring Road. Major springs exist in those areas which emerge within preferential zones between the Quaternary gravels and low permeability lakeshore sediments and then flow to Bullock Creek.

The extent of the low permeability lakeshore sediment layer is unknown, however it is thought to “pinch out” at or within the Moraine terrace that surrounds the Wanaka Township. This analogy is also backed up by the height of the potentiometric surface measured in wells at the Warren Street site. The head above ground level in the immediate site area is only about 1 – 1.5 m.

The activity at the Warren Street site provides for the excavation of a basement carpark and on-going dewatering of approximately 15 L/s outflow, based on current flow measurements. The semi-confining layer is not likely to be completely removed by the excavation. However, the excavation is likely to increase the conductance of the semi-confining layer and induce further leakage to the base of the excavation. A spring was

also located on-site and the excavation is likely to increase the conductance/flow of the spring through the semi-confining layer.

Based on regional hydro-geology and reported hydraulic parameters from the Lakeport Developments site (consent application 2006.241), estimates of hydraulic parameters have been made for the Warren Street site to allow assessment of potential environmental impact for the groundwater take. These estimates have also been derived from successive modelling of the current groundwater take from the site, in association with observed effects on adjacent spring flows.

Site dewatering and preferential flows

Site dewatering has been performed by the applicant as building foundation placement has already occurred at the site. The take of groundwater for the initial dewatering was up to 30 L/s of which has now reduced to approximately 13 L/s as a steady state flow. The applicant notes that the nominal take is likely to be between 11 – 15 L/s, with the consent application for a peak abstraction of 30 L/s to provide for variation in aquifer flow and climatic conditions. The current take of groundwater from the site of approximately 13 L/s implies that the net abstraction from the site allowing for the existing spring flow of 1 L/s (estimated) is 12 L/s. The application AEE indicates that the current total flow off-site is approximately 18.3 L/s including the drainage of existing supplementary flow to the Wanaka Springs Lodge.

The dewatering levels on site within sheet piling areas range from about 5 m at the maximum invert for the lower carpark, to 1.5 m with foundations/structures just below ground level. An estimate of an average dewatering level of 3 m for the overall site has been made to allow modelling of the current take of groundwater and examination of resultant effects on spring flows.

Apart from the local spring source, the observed well logs and the excavation for the site together with the resulting dewatering flows, indicate that there are no other preferential flows on or adjacent to the site.

Spring flows adjacent to the site

Spring flows reported in vicinity of the site have not been specifically measured by the applicant. However the applicant did provide an inventory of springs in the immediate vicinity of the Warren Street site. The springs encountered, emerge from the aquifer through the lakeshore sediments to flow as drainage water to Bullock Creek (Table 3).

Table 3 Springs observed in vicinity of the Warren Street site

Spring	Distance and direction from centroid of site (m)	Estimated flow prior to dewatering (L/s)
Located on site	8.0	1.0 It was noted that this flow increased to 5 – 10 L/s upon excavation
Wanaka Springs Lodge	45.2 NE	0.5
Wanaka Springs Lodge	50.0 NE	1.5

Marshall	77.0 N	2.5
Acton Smith	90.0 N	1.0
Stewart	63.0 SE	1.0
Unknown	85.7 S	2.0
Total spring outflow		**9.5**

Note: Spring flows are estimated only and may contain errors of +/- 50%. The spring flows identified above are estimated for flow prior to site dewatering of the Warren Street excavation. The position of springs indicated relates to the estimated point of emergence through the semi-confining layer to the ground surface.

3. Modelling effects of the proposed take

The potential effects of the proposed activity have been assessed on the following basis:

- Confirmation of required dewatering flows
- Local site effects of aquifer head decline and reduction in spring flows and surface water resources
- Regional effects of the take on basin outflows, water table levels and water balance.

Dewatering flows

The required dewatering at the Warren Street site is for an average of 3.0 m reduction in aquifer head over the construction area. This requirement is the basis for the modelling and subsequent calculations provided in this report. Flows required to dewater the site to an average of -3.0 m were simulated using a single abstraction bore with Theis methodology (Freeze and Cherry, 1979), allowing for average drawdown at a mean distance from the centroid of the site. This method gives a reasonable indication of the required pump rate to dewater, given the estimated hydraulic parameters of the aquifer (Table 1). The resulting dewatering flow to achieve the required drawdown over the site was 15.5 L/s as an average flow over a 150 day period. This then indicates the potential long term flow requirement for dewatering. The analysis also showed that up to 30 L/s may be required to dewater the site over any one day period, and this confirms the applicant requirement for a maximum of 30 L/s to account for initial dewatering, storm flows and aquifer head variation. There is likely to be a requirement for a higher initial dewatering flow, reducing to maintain steady state and any likely seasonal variation.

Spring flow impacts

The measured spring flow reduction as a result of the take for dewatering of the Warren Street site is based on observed spring flow depletion in the area. It was reported in the application AEE that the depletion of springs at the Wanaka Springs Lodge was quite rapid after the onset of site dewatering. This was as result of the depressurisation of the adjacent aquifer surrounding the spring source. No detail is given for the spring source, but a measurement of 50.0 m from the centroid of the Warren Street site to the main spring source has been estimated from GIS information (Table 3). This is consistent with the spring source locations shown on the mapped area surrounding the site, provided by the applicant. The current average dewatering (net) groundwater discharge

is 12 L/s, which has caused the spring to completely disappear. Thus, given the initial estimated spring flow of 1.5 L/s, the reduction of aquifer head at that location (from site dewatering) has served to completely deplete that flow. Observations of spring flow depletion have been used to calibrate the likely regional effects of the site dewatering.

It is noted that the 1.5 L/s reduction in spring discharge for the Wanaka Springs Lodge is likely to be a result of lowering the aquifer head in that location by about 1 – 1.5 m, consistent with the observed potentiometric surface at the Warren Street site.
Further spring flow impacts from site dewatering are discussed below.

Radius to potential impacts
Considering the assessed transmssivity and estimated storage for the aquifer system and ignoring effects of recharge to the site either by aquifer through-flow or spring depletion, the radius of potentially adverse effects for a 30 L/s groundwater take for site dewatering is potentially 100 - 250 m, and a radius for a minor effect is 300 – 1000+ m. These calculations are based on the requirements of Schedule 5 in the Regional Plan: Water for Otago (Otago Regional Council, 2004), and utilise either Sy of 0.2 or Ss of 0.001 (Table 1). Table 4 and Table 5 show the predicted drawdown or depressurisation of the aquifer based on the current net take of 12 L/s, and potential maximum take of 30 L/s.

Table 4 Drawdown calculated by the Theis solution for a net 12 L/s dewatering flow

Distance from site centroid (m)	Lateral drawdown predicted by Theis after 150 days using Sy of 0.2 (m)	Lateral drawdown predicted by Theis after 150 days using Ss of 0.001 (m)
50	0.81	1.54
100	0.62	1.35
250	0.38	1.10

Table 5 Drawdown calculated by the Theis solution for a 30 L/s dewatering flow

Distance from site centroid (m)	Lateral drawdown predicted by Theis after 150 days using Sy of 0.2 (m)	Lateral drawdown predicted by Theis after 150 days using Ss of 0.001 (m)
50	2.07	3.92
100	1.59	3.44
250	0.96	2.80

The level of drawdown predicted by the Theis method reflects the estimated hydraulic parameters used in conjunction with observed spring flow reductions for the current 12 L/s (net) groundwater take. The resulting potential impact of the 30 L/s peak take is indicative only and is likely to be much reduced at distance from the site due to the transition of confined to unconfined conditions in the aquifer, up-gradient of the lakeshore sediments. It is likely that when the cone of depression reaches the unconfined state, drawdown will be much limited thereafter. This analogy necessitated

providing both the confined and unconfined storage coefficients in the calculation of potential drawdown in the aquifer.

Spring flow reduction

The calculation of spring flow reduction is based on the relationship to aquifer depressurisation as identified above. It is likely that a reduction of aquifer head in the order of 1 – 1.5 m, would completely deplete spring flows in the area.

The long term reduction in spring flow is estimated using this relationship and by considering the long term steady state drawdown predicted by Theis for a 150 day abstraction without recharge. The calculated spring flow reductions are shown in Table 6 and Table 7 for springs identified in the immediate vicinity of the Warren Street site.

Table 6 Calculated spring flow reduction for a net 12 L/s dewatering flow

Spring	**Distance from centroid of site (m)**	**Estimated Flow prior to dewatering (L/s)**	**Drawdown calculated from dewatering (m)**	**Reduction in spring flow (L/s)**	**Resulting spring flow (L/s)**
Located on site	8.0	1.0	1.44 – 2.23	1.0	0
Wanaka Springs Lodge	45.2	0.5	0.92 – 1.71	0.5	0 Spring still showing some seepage
Wanaka Springs Lodge	50.0	1.5	0.89 – 1.68	1.5	0
Marshall	77.0	2.5	0.76 – 1.55	2.5	0
Acton Smith	90.0	1.0	0.71 – 1.51	0.9	0.1 Observed
Stewart	63.0	1.0	0.82 – 1.61	1.0	0
Unknown	85.7	2.0	0.73 – 1.52	1.0	1.0 Observed
Total spring outflow		**9.5**		**8.4**	**1.1**

Note: Drawdown calculated using Sy of 0.2 and Ss of 0.001.

Table 7 Calculated spring flow reduction for a 30 L/s dewatering flow

Spring	**Distance from centroid of site (m)**	**Estimated Flow prior to dewatering (L/s)**	**Drawdown calculated from dewatering (m)**	**Reduction in spring flow (L/s)**	**Resulting spring flow (L/s)**
Located on site	8.0	1.0	3.00 Maximum allowed for site	1.0	0
Wanaka Springs Lodge	45.2	0.5	2.29	0.5	0
Wanaka Springs Lodge	50.0	1.5	2.22	1.5	0
Marshall	77.0	2.5	1.90	2.5	0
Acton Smith	90.0	1.0	1.78	1.0	0
Stewart	63.0	1.0	2.05	1.0	0
Unknown	85.7	2.0	1.82	2.0	0
Total spring		**9.5**		**9.5**	**0**

outflow					

Note: Calculated only using Sy of 0.2 as maximum dewatering level will be maintained at an average of 3 m irrespective of aquifer state.

The calculated effect of the current (net) 12 L/s required for dewatering implies that local springs will almost completely dry up, with only the "Unknown" spring in vicinity maintaining reasonable surface water flow. The effect of a 30 L/s dewatering flow would dry the remaining local spring.

It should be noted that the calculation of potential spring flow reduction is based on limited data, and that whilst the zone of potential impact has been determined, the magnitude of spring flow reduction remains an estimate only and is mainly based on calibration of estimated hydraulic parameters with observed spring flow depletion adjacent to the Warren Street site.

Surface water effects

Depletion of flow from Bullock Creek as a result of the dewatering is unlikely, as the creek is hosted within the low permeability sediments of the lakeshore till. Groundwater derived from the dewatering is from the alluvial aquifer beneath the site, as there is a natural upward hydraulic gradient and the aquifer would tend to discharge to the site with removal of overlying sediments. No information is available to quantify the likely reworking of Bullock Creek flow. However, any abstraction from Bullock Creek (which is likely to be a small proportion of the total dewatering flow) would be discharged back into the creek in any instance.

The potential for flooding of the lower carpark area from Bullock Creek is a possibility, as floor levels appear to coincide closely with existing surface water levels. The creation of a flood wall to contain Bullock Creek flows would be sufficient of minimise this risk. Bullock Creek is largely confined to a narrow stream channel in this location.

Regional effects

Natural outflow from the aquifer is likely to be increased as a result of the site dewatering. The actual net use is difficult to determine and has not been provided in the application AEE. However, the current dewatering flow of a net 12 L/s serves to reduce adjacent spring flows by approximately 8.4 L/s, implying that no more than 3.6 L/s (ignoring aquifer contribution) is potentially a net use from the aquifer. A simplistic approach is to estimate that 50% of the aquifer contribution provides recharge to the dewatering process, then at least approximately 2 L/s of the dewatering flow is an exaggerated/increased outflow for the aquifer. This may roughly translate to a 5 L/s increased outflow for a 30 L/s groundwater take. These estimates are not verified, and can only be used as a rough guide as to the likely effect of artificially increased aquifer outflow from site dewatering at this location.

Regional Plan: Water for Otago, Schedule 5

The assessed drawdown impact for the proposed activity is shown to be adverse at approximately 100 – 250 m from the centroid of the site. A minor effect of drawdown is predicted to within 300 – 1000+ m of the site (average of 650 m). These effects are calculated consistent with Schedule 5 of the Regional Plan: Water for Otago. Within the adverse predicted zone of impact (maximum of 250 m from the site) there are no other consented activities to take water from either surface waters or groundwater, and there are no wells in existence according to the 'ORC Wells' database. Site maps are given in Appendix 1.

Within the predicted zone of impact for a minor effect (estimated at 650 m from the site) of the take there are springs and groundwater wells used for irrigation and domestic water supply. The nearest consented groundwater take is for the Wanaka Golf Course, from the disused Wanaka Township supply spring, 300 m from the site. The nearest domestic supply bore is 515 m from the site. There are no other current dewatering activities known-of within 350 m of the site. Thus, there is likely to be a minor impact on any consented groundwater or surface water take, well or dewatering function in vicinity of the activity.

Springs

Spring flows in vicinity of Warren Street have already been shown to be affected by the activity. Nearby springs have reduced in flow or have completely dried up as a result of the dewatering. It is highly likely that within a 100 m radius of the site, springs may be adversely impacted on by the activity. Photographs showing developed spring areas are given in Appendix 2.

Spring flows located at greater than 100 m, but to within 250 m radius of the site, may also be potentially adversely impacted on by the activity. There are likely to be a number of springs located within a 250 m radius of the site, however these springs have not been detailed by the applicant.

It should be noted that as discussed in Section 1 above, the current state of spring flow is likely to be close to "normal". As such, it could be expected that the level of potential spring flow impact from the proposed activity may be reduced, given any future rise in aquifer water levels or increased given a reduction in aquifer recharge.

Aquifer outflow and allocation

The current groundwater allocation volume based on assessed recharge for the aquifer is at 11.6%, of which a recommended maximum of 20% may be allocated. The total take for the activity as assessed is approximately 30 L/s with a net increase in discharge for the aquifer of approximately 2 - 5 L/s. There is a further 92 L/s available from the aquifer as a steady state allocation of groundwater. Both the total take and the assessed net increase in discharge falls within the available allocation for the aquifer. Thus the impact of the activity on aquifer allocation is less than minor. It is recommended that the net increase in discharge from the aquifer as a result of the proposed activity, not be added to groundwater allocation for the aquifer, as there is no consumptive use of the groundwater.

Potential for slumping, subsidence and flooding

The potential for slumping or compaction as a result of site dewatering is unlikely outside of the site boundary. At a 10 m radius from the centroid of the site, just outside of the site boundary, the reduction in the potentiometric surface of the aquifer from dewatering is estimated to be no more than 2.9 m. There are no building foundations or permanent structures present at that proximity to the site. There are no indications on site or otherwise that the confined conditions present may serve to promote any slumping around adjacent structures. The potential impact of the activity in terms of aquifer compression and/or associated slumping (based on the information provided by the applicant) may be regarded as minor to less than minor on the environment.

The excavation of a maximum invert of 5 m would allow a maximum pressure head of 6 m of water. This level of water pressure is not likely to cause foundation rupture or movement given the size and volume of foundation material present. However, if adequate control of permanent site dewatering is not achieved then decay of the outer foundation may result along with possible water creep into the basement of the structure.

Discharge water quality

The water quality of the discharge from the site to Bullock Creek is not visibly different to the natural spring sources adjacent to the site. The dewatering flow is visually clear and is not envisaged to contain any contaminants that would be in addition to the natural groundwater seepage to Bullock Creek. The discharge of the proposed dewatering flow to Bullock Creek may be regarded as having a less than minor impact on the environment.

5. Suggested conditions for mitigation and monitoring

It is recommended that some conditions, mitigation and monitoring be imposed on the activity:

- Groundwater shall only be taken via the on-site drainage network installed for the long term dewatering of the site.

- The site dewatering flow shall not exceed 30 L/s on any day. This level of outflow would normally be associated with site establishment.

- The average site dewatering flow over any 30-day period shall not exceed 77,760 m^3 (30 L/s). This is the assessed long term dewatering flow to allow for variability in aquifer head and outflow.

- The average dewatering flow over an annual period shall not exceed 709,560 m^3 (75% of peak dewatering flow).

- The aquifer potentiometric surface shall not be reduced by more than xxx.x metres above mean sea level over any part of the Warren Street site as measured at Bores xxx and xxx.

- Bores xxx and xxx shall be located substantially as shown on Appendix 1 attached to this consent.

- Observation bores shall be monitored daily during abstraction to ensure that the potentiometric surface complies with condition x of this resource consent. A record of bore observation data shall be kept by the applicant and forwarded to the Compliance Unit of the consent authority each six months from the date of exercise of this consent or upon request.

- The total site dewatering discharge flow, exclusive of any storm water flow should be measured and recorded on a daily basis, and provided to council upon request. A simple calibrated v-notch or similar weir may be used to read flow accurately enough for this purpose. Otherwise, if flow meters are to be used, standard metering conditions should be applied to the consent. If dewatering flows (exclusive of storm water) do not vary by more than 10% over a minimum of 7-days, then weekly measurements of the flow may be made. A copy of measured flows shall be forwarded to the Compliance Unit of the consent authority each six months from the date of exercise of this consent or upon request.

- The discharge from the site shall be collected to a sump (on-site) before discharge to Bullock Creek. This is to enable removal of erroneous material prior to discharge.

- Provision should be made for the continuous supply of water to the adjacent springs where depletion has been noted. Provision shall be made for future remedy of other unwanted spring depletion. Decision of the consent authority where agreement cannot be reached shall be final.

- There shall be no flooding or damage to properties as a result of the discharge. There shall be no settlement or erosion of property or land instability as a result of the groundwater take. Any such effects shall be remedied immediately by the consent holder.

- Review clause to cover adverse effects, conditions for spring depletion and land instability, reduction in aquifer potentiometric surface, monitoring required, and rate and volumes of take.

- No net increase in aquifer outflow (2 - 5 L/s) should be accrued to groundwater allocation for the aquifer.

I trust the above information is sufficient for the processing of the Groundwater Take Consent application made by Warren Street Developments Ltd. Should any further information be required, please do not hesitate to contact me.

Yours faithfully

Tom Heller
Senior Environmental Scientist and Resource Planner

Reviewed by:

Name
Title

References:

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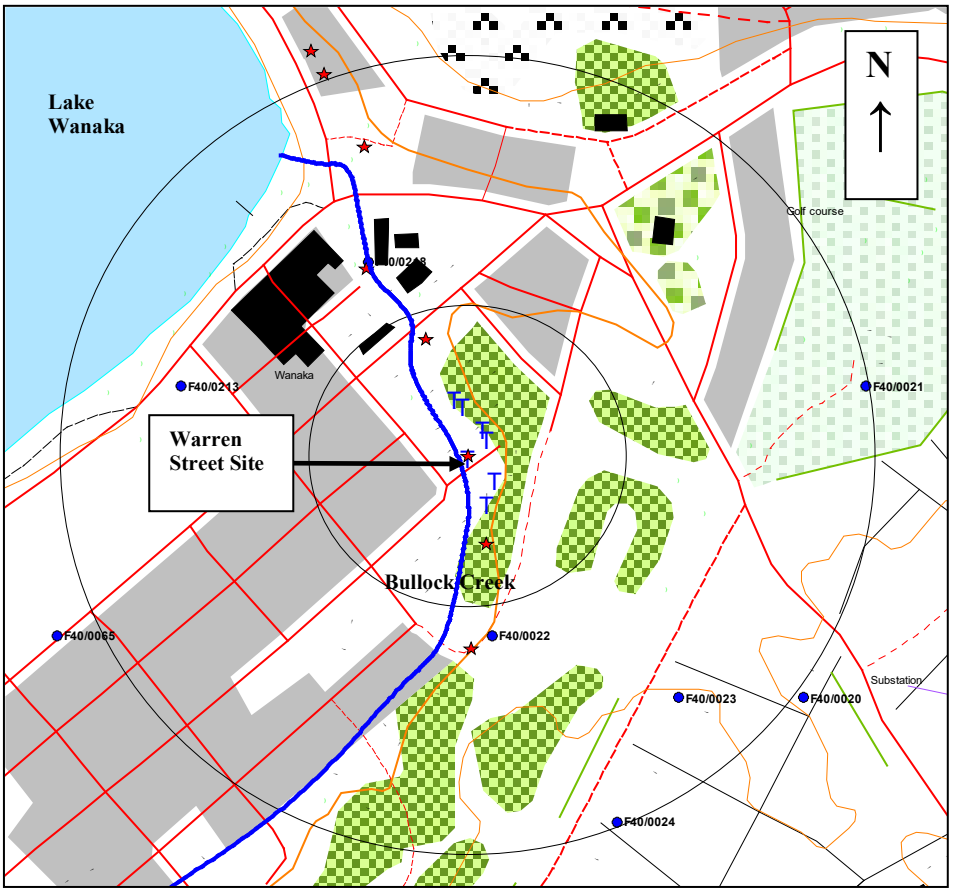
Appendix 1: Site Maps



Location of Warren Street Site at Wanaka Township

Notes: Inner and outer radius shows extent of potentially adverse to minor effects of aquifer drawdown resulting from the activity.

Springs identified are shown in vicinity of the site.

Red markers show existing and potential sites for dewatering based on QLDC Land Use consent information.

Blue labelled markers show all registered Wells for the area.

Location of Springs adjacent to the Warren Street Site

Appendix 2: Site Photographs

Wanaka Springs Lodge, spring flow (augmented)

Marshall spring flow (augmented)