Before the Independent Hearings Panel
at Waimakariri District Council

under: the Resource Management Act 1991

in the matter of: Proposed private plan change RCP31 to the Operative Waimakariri District Plan

and: Rolleston Industrial Developments Limited
Applicant

Evidence of Carl Cedric Steffens

Dated: 7 July 2023

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EVIDENCE OF CARL CEDRIC STEFFENS

1 My full name is Carl Cedric Steffens and I am a Technical Director, Water Resources at Pattle Delamore Partners Ltd. My qualifications are Post Graduate Diploma in Science (Engineering Geology) and Bachelor of Science (Geology) from the University of Canterbury. I am a member of the New Zealand Hydrological Society.

2 I have nearly 19 years of professional work experience as a hydrogeologist and environmental scientist. I specialise in groundwater assessments and have carried out numerous assessments relating to groundwater sources for community supply throughout Canterbury and New Zealand.

3 Since 2004, I have been employed by Pattle Delamore Partners Ltd (*PDP*), an environmental consulting firm with my specialist focus being groundwater investigations. During my employment with PDP I have carried out and presented evidence for district and regional authorities, and for water users. In addition, I have also presented evidence for arbitration. I have recently undertaken the following projects related to new groundwater community supply sources or related groundwater supply assessments specifically related to urban development:

3.1 Pump testing, groundwater technical assessments and consenting work related to proposed new Christchurch City community supply bores.

3.2 Groundwater technical assessments and consenting relating to new Marlborough District Council water supply bores in Blenheim, Picton, Wairau Valley and Havelock.

3.3 Expert witness acting for Rau Paenga at arbitration hearing to decide a claim by the contractor relating to construction dewatering at the Christchurch Metro Sports Centre (Parakiore Recreation and Sports Centre).

3.4 Investigation of maximum abstraction yields and discharge capacity of confined aquifer bores used for heating and cooling of a Christchurch City office development.

3.5 Effects of construction dewatering effects at proposed Bellgrove Subdivision near Rangiora and long-term development effects on nearby spring flows.

CODE OF CONDUCT

4 Although this is not an Environment Court hearing, I note that in preparing my evidence I have reviewed the Code of Conduct for Expert Witnesses contained in Part 9 of the Environment Court

Practice Note 2023. I have complied with it in preparing my evidence. I confirm that the issues addressed in this statement of evidence are within my area of expertise, except where I have stated that I am relying on the opinion or evidence of other witnesses. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed.

SCOPE OF EVIDENCE

5 In my evidence I will cover the following matters:

5.1 A brief overview of the hydrogeological setting of the site, including groundwater flow patterns;

5.2 A review of bore and aquifer performance in the area around the site;

5.3 Comments on the water demand considerations and likely number of new public water supply bores needed to supply the proposed plan change area;

5.4 A preliminary assessment of effects based on existing aquifer test information from the nearby Ōhoka township supply bore BW24/0262, particularly including well interference and stream depletion effects;

5.5 Comments on the viability of consenting new public water supply bores for the proposed plan change area;

5.6 Response to S42A report by Mr Andrew Willis; and

5.7 Response to submitters.

SUMMARY

6 In my evidence I have summarised a preliminary assessment of the feasibility of establishing a community drinking water supply at the site of the proposed plan change in Ōhoka. This assessment includes the water demand requirements, a preliminary assessment of environmental effects, and planning considerations.

7 I consider it viable to establish a supply, with an estimated total of four new bores providing adequate redundancy, assuming that the performance of any new bores is similar to that of existing Ōhoka community supply bore BW24/0262.

8 The preliminary assessment predicts that well interference and stream depletion effects are less than minor. In addition, while the groundwater allocation zone is considered to be over-allocated, the existing irrigation allocation onsite means that no additional

allocation would be required, although even if it were, there is provision in the Canterbury Land and Water Regional Plan for additional allocation to be available for new community supplies in over-allocated catchments. As a result, I consider the available information indicates there are no significant barriers to prevent consenting of new public water supply bores.

9 Overall, I consider that the preliminary assessments described in my evidence demonstrate that establishing a new public water supply that meets the anticipated demand for the plan change area is viable and therefore, the plan change can be supported from a water supply perspective.

10 At the resource consenting stage site specific pumping tests and an assessment of environmental effects will be required to support a resource consent application (which is a typical requirement for groundwater abstraction applications).

EVIDENCE

Hydrogeological Setting

11 The Canterbury Plains comprise a series of large coalescing fluvio-glacial fans built by large braided rivers (e.g. the Rangitata, Rakaia and Waimakariri) that transported detritus (gravel with sand and silt) eastwards from rapidly rising and eroding mountains in the west. Most of the gravel deposition occurred during successive glaciations, when glaciers partly occupied the inland valleys and extended to the eastern foothills (Brown 2001[1]).

12 The GNS geological map of the area (Forsyth *et al.*, 2008[2]) maps the near-surface geology of the site as late Pleistocene brownish-grey river alluvium (Q2a). Geotechnical investigations at the proposed subdivision site encountered silt and clayey silt to a depth of 0.6 to 1.5 m below ground level (bgl), and sandy gravel below this (Tetra Tech Coffey, 2021[3]). The borelog for the existing Ōhoka drinking water supply bore BW24/0262 (adjacent to the site) shows a sequence of predominantly interbedded clayey gravel and sandy gravel down to at least 84.7 m below ground level (bgl), with a clay layer from 21.7 to 26.6 m bgl.

13 On the Waimakariri-Ashley Plains, groundwater is dominantly sourced from infiltrating rainwater (i.e., land surface recharge)

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[1] Brown, L. J. (2001). Canterbury. In M. Rosen, & P. White (eds), *Groundwaters of New Zealand* (pp. 441-459). New Zealand Hydrological Society Inc., Wellington.

[2] Forsyth, P., Barrell, D., & Jongens, R. (2008). *Geology of the Christchurch area.* 1:250 000 geological map 16, Institute of Geological & Nuclear Sciences, Lower Hutt.

[3] Tetra Tech Coffey. (2021). *535 Mill Road, Ōhoka - Geotechnical Assessment Report.* Report reference number 773-CHCGE288040 prepared for Rolleston Industrial Developments Ltd. Dated 1 June 2021.

across the inland plains (to the north-west (upgradient) of the site), together with some seepage losses from the Ashley and Waimakariri rivers. A map showing the location of the site within the context of the northern Canterbury Plains is provided in Figure 1 attached to my evidence. This Figure also shows the general direction of groundwater movement in the overall area, indicating that groundwater generally flows to the southeast, towards the coast. Some of the groundwater throughflow also discharges into spring fed streams, including Ōhoka Stream and the Cam River/Ruataniwha.

14 Throughout the Canterbury Plains, vertical hydraulic conductivity is usually significantly lower than the horizontal hydraulic conductivity, due to the presence of silt and clay strata, and gravel layers with varying amounts of silt and clay matrix (Lough and Williams, 2009[4]). Vertical groundwater flow (also called 'leakage') is therefore usually significantly slower than horizontal groundwater flow, and pumping from greater depths generally results in drawdown and stream depletion effects at the water table that are more widely distributed and delayed in time, compared to comparable rates of pumping from shallower depths.

Ōhoka Water Supply

15 Ōhoka is serviced by a reticulated water supply, which currently has 118 connections (WDC, 2021[5]). The supply is owned and operated by Waimakariri District Council (*WDC*) and is principally sourced from Ōhoka Well No. 2 (ECan bore number BW24/0262). This bore has a screened intake zone from 78.0 – 84.0 m deep, and its location is shown on Figure 2.

16 A backup supply bore (ECan bore number M35/5609) is also owned by WDC and has a screened intake zone from 16.8 – 18.8 m deep, however I understand that this bore is not regularly used as it is less than 30 m deep which makes it more vulnerable to *E. coli* contamination. The location of this bore is also shown in Figure 2.

Bore and Aquifer Performance

17 Any new community water supply bores established to service the proposed plan change area would likely be at a similar or greater depth than existing community water supply bore BW24/0262 to minimise the risk of *E. coli* contamination. This existing supply bore can therefore give an indication of the likely yield and performance of any new community supply bores.

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[4] Lough, H., & Williams, H. (2009). *Vertical flow in Canterbury groundwater systems and its significance for groundwater management. Environment Canterbury Technical Report U09/45, 69 p.*

[5] Waimakariri District Council. (2021). Activity Management Plan 2021 - Ōhoka Water Supply Scheme.

18 The assessment of environmental effects (*AEE*) prepared during the consent application for BW24/0262 (PDP, 2016[6]) indicated that it has a potential long term sustainable yield of 13 L/s. If any new water supply bores are screened at a similar depth as BW24/0262 (i.e., approximately 78 to 84 m below ground level) it is reasonable to expect that the long-term sustainable yield would be of a similar magnitude.

19 It is not clear whether drilling to a greater depth than BW24/0262 could result in higher yields. A plot of maximum yield versus depth for bores within 5 km of the site is shown on Figure 3 and does not show any clear pattern, although the highest yields have generally been obtained from shallow bores in the depth range of around 10 to 30 m. However, it is noted that there are significantly more shallow bores than deeper bores, which may skew the results. There are two relatively high yielding bores (M35/12017 and M35/10768) that are 122 m and 109 m deep (screened between 118 – 120 m and 103 – 109 m, respectively) that have reported maximum yields of 50 L/s and 64 L/s, respectively. These bores (M35/12017 and M35/10768) are 4 to 4.5 km south of the site (Shown on Figure 4) and it is not known whether similar yields would be encountered in the proposed plan change area over comparable depth zones . It should also be noted that the reported bore yield can also reflect the particular water requirements for a bore, i.e., domestic supply bores are generally only tested at low rates, even if higher rates were achievable.

20 Specific capacity is a measure of bore performance, measured as units of litres, per second, per metre of drawdown in the bore. This can give an approximate indication of zones where higher bore yields could be achieved. A plot of specific capacity versus bore depth is presented in Figure 5. As shown, higher specific capacity values have generally been obtained from bores at shallow depths. Although, it is also noted that some deeper bores in excess of 100 m deep have reported specific capacities of up to 10 L/s/m. This is a good level of bore performance for deep bores, which have more available drawdown than shallower bores to accommodate self-induced drawdown effects.

21 Overall, the yield information from deep bores is quite variable in this area, although the nearby bore B24/0262 provides a useful guide as to what can be expected. Consideration could be given to extending the first bore drilled for the plan change water supply to

[6] Pattle Delamore Partners. (2016). Application for Resource Consent to Abstract Groundwater from Bore BW24/0262 (Ōhoka Public Supply Bore): Assessment of Environmental Effects. Report prepared for Waimakariri District Council, dated January 2016.

deeper depths to investigate the performance of deeper strata at the site.

Water Demand Considerations and Number of Public Supply Bores Required

22 I have based my assessment on the key water demand requirements of the plan change as notified (being a lot distribution of 700 Res 2 zoned lots, 150 Res 4a zoned lots, 305 Res 8 zoned lots (lifestyle or retirement villas) and two areas of business zones). In terms of consenting of a new water supply source the following will apply:

22.1 A maximum annual volume of 412,000 m^3/year.

22.2 A peak daily rate of 2,412 m^3/day.

22.3 A peak instantaneous flow rate of 33.5 L/s.

23 I understand that the lot numbers are now comprised slightly differently under the most recent ODP. However, I note the total lot numbers sought to be enabled by the plan change are now lower than those in the notified version of the plan change. On that basis, my assessment is conservative.

24 The water demand calculations conducted by Inovo indicate that the average daily demand would be 980 m^3. The maximum annual volume of 412,000 m^3/year includes a 15% allowance for deviation from the average and leakage (i.e., 980m^3/day + 15%).

25 WDC have indicated that for a proposed water supply of the scale proposed for the proposed plan change, "N + 1" redundancy would be appropriate. This means that the water supply must be able to meet peak network demand with one bore offline. The Engineering Code of Practice also stipulates that water supply design assume a maximum of 20 hours of pumping per day.

26 Correspondence with WDC has also indicated that any excess capacity available in existing water supply bore BW24/0262 can be included for assessment of N + 1 redundancy and the required total number of bores, taking into account any projected increase in demand from the existing water supply bore. The existing shallow (18.8 m deep) emergency backup supply bore (M35/5609) cannot be included in the existing redundancy assessment, as it is understood to be subject to water quality issues (although in my opinion this could likely be addressed through a greater level of treatment, if required).

27 The 2021 Ōhoka Water Supply Scheme Activity Management Plan (WDC, 2021[7]) indicates that there are currently (as reported in 2021) 118 connections with an average daily flow of 159 m^3 and a peak daily flow of 532 m^3, which equates to 2.2 L/s and 7.4 L/s average and peak daily flow, respectively, assuming 20 hours per day of pumping. This is projected to increase to 225 connections between 2051/2052 to 2070/2072, with a projected average daily flow of 309 m^3/day (4.3 L/s over 20 hours) and peak daily flow of 807 m^3 (11.2 L/s over 20 hours).

28 The resource consent abstraction limit for the existing WDC Ōhoka supply is 1,555 m^3/day, which equates to 21.6 L/s, however the duty set point for the supply is 12.8 L/s (WDC, 2021), which equates to 921.6 m^3/day at 20 hours per day of pumping. This is consistent with the 13 L/s long term sustainable yield estimated from aquifer testing on the supply bore (PDP, 2016).

29 Considering the usage data and projected growth, approximately 114.6 m^3/day (1.6 L/s over 20 hours) of excess capacity is available from the existing water supply to contribute to redundancy in the proposed community water supply for the plan change area.

30 Therefore, based on the peak daily rate requirement of 2,412 m^3/day noted in paragraph 22, the new water supply bores for the proposed subdivision will need to supply 2,298 m^3/day, which equates to pumping at 31.92 L/s for 20 hours per day. In addition, the N + 1 redundancy requirements mean that the full peak water demand of both the existing supply and the plan change area can be met when one bore is offline.

31 If the maximum duty point of any new supply bores within the proposed plan change area is assumed to be 12.8 L/s (i.e. the same as the existing deep supply bore BW24/0262), then three new supply bores would be required to meet (and would exceed) the plan change area water demand requirements. An extra bore would also be required to meet N + 1 redundancy requirements, as the full combined peak daily water demand from the plan change area and the existing water network (including the projected increase in the next 31 to 50 years) can only be met with a minimum of four bores.

32 Therefore, it would be expected to have to drill four new water supply bores, resulting in a total of five deep water supply bores (including the existing bore BW24/0262) for the Ōhoka area. It is expected that the existing shallow backup emergency supply bore (M35/5609) would be able to be retired, unless a greater level of treatment and monitoring is carried out in that bore so as to address the current water quality issues. It is also understood that

[7] Waimakariri District Council. (2021). Activity Management Plan 2021 - Ōhoka Water Supply Scheme.

the current Ōhoka supply can have reliability issues and therefore the proposed additional supply bores will help to alleviate any issues with the reliability of the overall water supply network.

33 Further to the above, it is noted that if aquifer testing of any newly drilled bores indicated that one or more of the new bores had a higher long term sustainable yield than 12.8 L/s, then it could be possible for fewer bores to provide the necessary water demand and redundancy requirements. Likewise, if aquifer testing shows that one or more of the new bores had a lower long term sustainable yield, then additional bores would be required.

Preliminary Assessment of Effects

34 In terms of obtaining resource consents for new public water supply bores for the proposed development, there are three feasible options, that I outline at paragraph 67 below. The key environmental effects that must be considered for any consenting pathway are well interference, stream depletion, the allocation status of the groundwater allocation zone, and community drinking water protection zones. I consider these now.

Well Interference

35 When groundwater is abstracted from a bore the water level lowers in the bore. This is known as drawdown which also occurs outside the well in the surrounding saturated strata. The magnitude of drawdown will decrease with distance from the pumping bore but when the drawdown extends to a neighbouring bore it is termed 'well interference'. If significant, well interference has the potential to adversely affect neighbouring bore users by reducing the available drawdown (required for their own yield requirements) in their bore and in the worst case, can result in the inability of neighbouring bores to abstract water. In general, pumping from shallow bores will cause the greatest drawdown interference in other shallow bores, and pumping from deep bores will cause the greatest drawdown interference effects in other deep bores.

36 Most bores surrounding the proposed plan change area are shallow (i.e. less than 31 m deep), and the existing irrigation consents on the site that are proposed to be surrendered or transferred (CRC991022 and CRC991827) involve abstraction from shallow bores (locations shown in Figure 2). Therefore, it is expected that the transfer of abstraction from shallow irrigation bores to deep water supply bores will result in less well interference effects for most neighbouring bores (which are shallow) than might currently be experienced.

37 Schedule 12 of the Canterbury Land and Water Regional Plan (*LWRP*) outlines the approach ECan uses to assess and manage well interference effects. As a conservative (though not realistic) approach, I have used the Schedule 12 methodology and assumed

that the long-term (150-day) pumping rate assessment required by Schedule 12 would be 2,412 m^3/day, i.e. the maximum daily volume, which results in a 150-day volume of 361,800 m^3/day, which is 88% of the total proposed annual volume. A short term (7-day) pumping rate assessment is also required under Schedule 12, however the rate cannot exceed the maximum proposed daily volume and therefore would also be 2,412 m^3/day.

38 There are many very shallow bores near the plan change area, and Schedule 12 states that "*where an existing bore inadequately penetrates an aquifer, the interference effect of a new bore will be assessed as if the existing bore is also adequately penetrating".* The adequate penetration depth is defined as a "*... level to which 50% of bores within 2 km penetrating the aquifer are already established at 1 January 2002".* Based on that definition, the adequate penetration depth for the proposed plan change area has been calculated at 15 m.

39 As stated above, drawdown effects in neighbouring shallow bores can generally be expected to reduce due to the transfer of groundwater abstraction from the existing shallow irrigation bores to deeper community drinking water supply bores. Drawdown effects in neighbouring bores of similar depth to the new drinking water supply bores would be expected to increase, however these bores have more available drawdown to accommodate well interference due to their greater depth.

40 This has been demonstrated by way of carrying out Schedule 12 assessments comparing the drawdown interference effects resulting from the consented abstractions via the shallow onsite irrigation bores with the proposed abstraction from deep bores as follows:

40.1 Simulated abstraction from deep bores with drawdown estimated using the average aquifer parameters estimated from bore BW24/0262, and a pumping rate of 24.92 L/s for 150 days. Five individual assessments have been carried out, each of which conservatively assumes abstraction of this quantity of groundwater via a single deep bore. These five simulations cover a wide range of potential bore sites to consider potential impacts of variations in bore locations. The locations of each of the five assessment sites are shown in Figure 6 of my evidence. The Hunt and Scott (2007[8]) solution was used to estimate drawdown for this scenario.

40.2 Simulated abstraction from the existing shallow irrigation bores based on the consented short term and long-term rates as per the ECan Schedule 12 program. In this case,

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[8] Hunt, B., & Scott, D. (2007). Flow to a well in a two-aquifer system. *Journal of Hydraulic Engineering, 12*(2), 146-155.

drawdown is estimated using the Theis (1935[9]) solution, with a transmissivity of 975 m^2/day, and a storativity of 0.1. The transmissivity was estimated from an empirical relationship between the specific capacity of a bore and transmissivity derived from pumping tests in Canterbury (Bal, 1996[10]). Based on bores less than 31 m deep within 2 km of the pumped bore, the average transmissivity using that empirical relationship was 975 m^2/day (PDP, 2016).

40.3 Comparison of the five deep simulations versus existing shallow scenarios was done to show the potential change in well interference from replacing the current consented shallow irrigation takes at the site with a deep groundwater take for community supply.

41 I note that the separation distances of each simulated deep bore in the assessment are greater than 700 m in all cases and up to nearly 2 km for the largest separation (between sites 1 and 3 as per Figure 6) due to the large size of the site. In my opinion the deep abstraction bores could be separated by between 300 to 500 m to minimise excessive drawdown interference effects between individual supply bores. However, onsite testing following drilling could also confirm that closer spacing may be acceptable.

42 The results of the Schedule 12 assessments are consistent with the assumptions in paragraph 39 of my evidence, where the predicted effects indicate a reduction in drawdown interference in nearly all neighbouring shallow bores within 2 km of each of the five separate deep water supply bore assessments simulated. There were a low number of shallow neighbouring bores where there was an increase in drawdown interference, however the assessments all indicated that these bores still had sufficient available drawdown based on the Schedule 12 methodology (once cumulative effects were also considered). As expected, there are some deep neighbouring bores where drawdown interference effects increase, however they all have significant available drawdown (due to their depth) and therefore the remaining drawdown is also still within the Schedule 12 criteria for deep bores. Overall, the assessments indicate a level of effects that are less than minor.

43 Based on the assessments carried out, I consider it is reasonable to expect that drawdown interference effects are likely to be less than minor. While the actual assessments that will be required during consenting will need to be based on site specific pump tests in the

[9] Theis, C. (1935). The relation between lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage. *Transactions of the American Geophysical Union, 16*, 519-524.

[10] Bal, A. A. (1996). Valley fills and coastal cliffs buried beneath an aluvial plain: evidence from variation of permeabilities in gravel aquifers, Canterbury Plains, New Zealand. *New Zealand Journal of Hydrology*, 1-27.

actual community supply bores (following drilling) and these tests may show different aquifer parameters, the assessments that have been carried out and the nature of the proposal (replacing shallow abstraction with deep abstraction) is supportive of a reduction in effects on existing shallow bores and indicates existing deep bores are not particularly sensitive to drawdown interference.

44 It is also noted that many of the shallow neighbouring bores are listed as being used for domestic supply. In the unexpected event that a full well interference assessment identifies neighbouring bores that could be adversely affected by well interference, mitigation options are available for potentially affected bore owners, which could include expanding the extent of the Ōhoka reticulated public water supply network.

Stream Depletion

45 Stream depletion is a reduction in stream flow resulting from groundwater pumping. In general, pumping from a deeper bore will result in a lesser and more widely distributed stream depletion effect than pumping from a shallow bore, assuming the pumping rate and location are the same.

46 There are a large number of streams across the site, the most significant of which is the South Branch of Ōhoka Stream, which crosses the northern part of the proposed plan change area (Figure 2). Due to the number of streams across the site, the overall potential stream depletion effects from any proposed water supply bores are not expected to be highly dependent on the exact placement of the supply bores.

47 Stream depletion is assessed according to Schedule 9 of the LWRP, based on the effect of *"150 days of steady continuous groundwater abstraction"*. A low degree of stream depletion effect is defined as where the effect is *"... less than 40% of that abstraction rate and the effect of pumping the proposed annual volume over 150 days at a continuous steady rate is less than 5 L/s…"*. Schedule 9 also indicates that when there is more than one bore on a property abstracting water, the stream depletion effect for each bore must be determined independently and the stream depletion effect of the bores shall be determined in combination as a borefield.

48 A preliminary stream depletion assessment has been conducted, using the same aquifer parameters as for the well interference assessment. The Ward and Lough (2011[11]) solution is considered most applicable to the conceptual setting at Ōhoka, where the proposed pumped bore(s) is in a semi-confined aquifer, overlain by

[11] Ward, N., & Lough, H. (2011). Stream depletion from pumping a semiconfined aquifer in a two-layer leaky aquifer system. *Journal of Hydrologic Engineering, 16*, 955-959.

an unconfined aquifer that is hydraulically connected with the surface waterway(s). The stream depletion effect is generally highly sensitive to the streambed conductance (λ), which for Ward and Lough (2011) is defined as the streambed width multiplied by the depth of the streambed "clogging" layer multiplied by the hydraulic conductivity of the streambed.

49 The streambed conductance of Ōhoka Stream has been estimated from field measurements in several locations near the proposed plan change area, as presented in Appendix C of the ECan guidelines for the assessment of groundwater abstraction effects on stream flow (PDP and ECan, 2000[12]). A streambed conductance of 0.8 m/day was estimated, and this value has been used for this preliminary assessment.

50 The LWRP Schedule 9 assessment is focussed on irrigation abstractions, based on its specification of the proposed annual volume being taken over 150 days, which would be unrealistic for a subdivision water supply. Therefore, for this assessment I have assumed a 150-day pumping rate of 1,696 m^3/day, which is equivalent to 75 days of abstraction at the maximum daily rate (2,412 m^3/day) and 75 days of abstraction at the average daily rate (980 m^3/day). This represents over 60% of the proposed annual volume over the 150-day assessment period and is therefore considered to be a conservative representation of actual use, given that sufficient volume must still be available for the additional 215 days of a year.

51 The preliminary assessment using the parameters described above indicates that the stream depletion effect would be considered 'Low' at all distances from any surface water bodies, based on the aquifer parameters derived from bore BW24/0262. This would mean that rule 8.5.12 of the LWRP (Plan Change 7) would likely be applicable to the proposal and provide a consenting pathway, as discussed in paragraphs 71 and 72 below. A stream depletion assessment is highly dependent on the aquifer parameters estimated from a constant rate pumping test, and a final stream depletion assessment would have to be conducted after a pumping test has been conducted in each new proposed water supply bore.

52 However, stream depletion will also be occurring as a result of the existing shallow irrigation abstractions onsite. In addition, where individual bores are close to existing streams, the existing effects are likely greater than the proposed abstraction from deep bores. Therefore, there is a high likelihood that actual depletion will be less than is currently occurring from the shallow bores and even if that

[12] Pattle Delamore Partners and Environment Canterbury. (2000). Guidelines for the Assessment of Groundwater Abstraction Effects on Stream Flow. Report dated June 2000.

were not the case, it is reasonable to expect the degree of connection would be 'Low' as discussed above and therefore management of any effect would not be required.

Allocation status of the Groundwater Resource

53 The site is in the Eyre Groundwater Allocation Zone, which has an allocation limit of 75,330,000 m^3 per year based on recent correspondence with ECan. In late June 2023 ECan indicated that the current allocation is around 100 million m^3 and therefore, this Allocation Zone is over-allocated, with a current allocation of around 133%. The boundary with the Cust Groundwater Allocation Zone is adjacent to the site, along Mill Road. The Cust Allocation Zone is also over-allocated at around 130% of the allocation limit (13,250,000 m^3).

54 The site currently has two active groundwater take consents, CRC991022 and CRC991827, which both expire on 12 September 2041:

54.1 Consent CRC991022 authorises abstraction from three bores (M35/9423, M35/3064 and M35/3065), with a maximum instantaneous rate for each bore of 30 L/s, a combined maximum instantaneous rate of 60 L/s and a maximum daily volume of 2,484 m^3/day for each bore and maximum combined daily volume of 4,968 m^3/day. No annual volume is specified in the consent documents, although ECan has calculated an annual volume of 566,032 m^3 for their accounting tally in the Eyre Groundwater Allocation Zone. Bore M35/9423 is 30 m deep, M35/3064 is 12.5 m deep, and M35/3065 is 12 m deep.

54.2 Consent CRC991827 authorises abstraction from two bores (M35/0326 and M35/0367), with the maximum instantaneous rate from each being 22.8 L/s and a maximum daily volume from each of 1,806 m^3/day. No annual volume is specified in the consent documents, although ECan has calculated an annual volume of 113,536 m^3 for their accounting tally in the Eyre Groundwater Allocation Zone. The maximum instantaneous rate and daily volume are also limited according to the flow in Ōhoka Stream, taken from measurements at the confluence with the Kaiapoi River. Bore M35/0326 is 13.7 m deep and M35/0367 is 9.4 m deep.

55 It is intended that the groundwater take consents described above would be surrendered or transferred if the proposed development proceeds. The combined maximum daily volume authorised by the two existing consents is 6,774 m^3/day, which is significantly higher than the maximum daily volume of 2,412 m^3/day that would be required for public water supply for the proposed development. Similarly, the combined existing annual volume assumed in ECan's

allocation tally of 679,567 m^3 is significantly more than the 412,000 m^3/year required for the subdivision.

56 The proposed plan change would therefore result in a significant reduction in the maximum consented daily volume of groundwater that is authorised to be abstracted from the site.

57 Depending on the consenting pathway used for any new public water supply bores, actual past usage of the irrigation consents may be considered, rather than the allocated volume. Possible consenting pathways are discussed further in paragraphs 65 to 73 of my evidence.

58 It is also noted that Policies 4.49 and 4.50 allow a pathway for the allocation of groundwater for community supply purposes even where the groundwater allocation limit is exceeded for the applicable allocation zone. Therefore, it is not strictly necessary for the proposal to rely on the transfer of existing allocation.

Community Drinking Water Protection Zones and Water Quality

59 Any new drinking water supply bore would have a surrounding Community Drinking Water Protection Zone, the size of which would be determined in accordance with Schedule 1 of the LWRP.

60 Schedule 1 of the LWRP states that any consent for a new community drinking-water supply must provide the dimensions of a specific protection zone, determined using site specific information, including the geology of the site, the depth of the bore, the bore construction, pumping rates, the type of aquifer, types of actual or potential contaminants, the proposed level of treatment and any potential risk to water quality.

61 As has been discussed earlier in this evidence, it would be prudent for water quality and safety reasons for the new supply bore to be relatively deep, similar to existing neighbouring supply bore BW24/0262. The protection zone around BW24/0262 is circular, extending 100 m in all directions and is a provisional protection zone due to it being an existing water supply at the time Schedule 1 of the LWRP became operative.

62 Generally speaking, deep bores have a relatively small protection zone. The default protection zone for bores deeper than 70 meters at the plan change area is 100 meters (extending in all directions from the bore). The dimensions of any proposed site-specific Community Drinking Water Protection Zone will depend on the results of hydrogeological investigations.

63 Information from WDC (as of 2016) indicated that bore BW24/0262 was fully compliant with the Drinking Water Standards for New

Zealand (DWSNZ) at that time in terms of bacterial and protozoal compliance. This provides an indication that the deeper water quality in the vicinity of the site and for a potential new deep bore supply should be of a quality that satisfies drinking water criteria.

64 The WDC 3-Waters Source Testing Results[13], last updated in April 2023, indicate that the Ōhoka water supply is fully compliant with the new standards set in the Water Services (Drinking Water Standards for New Zealand) Regulations 2022 in terms of bacterial and protozoal compliance. A more detailed review of water quality in bore BW24/0262 and in the vicinity of the site should be undertaken at the subdivision consent stage to confirm that there are no potential water quality issues.

65 If in the unexpected situation that shallower bores (such as the existing irrigation bores at the site) are required to be utilised for the proposed supply, they are still able to meet the Drinking Water Quality Assurance Rules (2022) specified by Taumata Arowai. The difference would be that a shallow source requires a higher level of treatment and monitoring to ensure it is a safe drinking-water source.

Viability of Consenting New Public Water Supply Bores

66 The proposed plan change area is within the area covered by the Waimakariri area of the LWRP (Section 8). Plan Change 7 (*PC7*) to the LWRP is relevant to the proposed plan change. Any water take consent application will need to consider PC7 and therefore the changes to the LWRP proposed by PC7 are included in this preliminary assessment of relevant planning considerations.

67 I consider there are three primary viable consenting pathways for new public water supply bores under the LWRP, which are as follows:

67.1 Apply for a transfer under rule 5.133, which is modified by PC7 rule 8.5.17.

67.2 Apply for a transfer under PC7 rule 8.5.12 for substitution of a stream depleting take with a take with low stream depletion effect.

67.3 Apply for a new take and use under rule 5.115.

68 Rule 5.133 is relevant to transfers within a groundwater allocation zone where the annual volume is less than or equal to the existing

[13] https://www.waimakariri.govt.nz/__data/assets/pdf_file/0022/92227/QD-3W-Form-003-Source-Testing-Results-April-2023.pdf

take, and the stream depletion effect is no greater than the original take. Such a transfer is a restricted discretionary activity.

69 It is expected that all of the conditions of rule 5.133 (as supplemented by rule 8.5.17) will be able to be met, however, a full well interference assessment will need to be conducted after the bores have been drilled and pump testing conducted. Item 7 in the matters of discretion (groundwater allocation limits) may be mitigated due to the proposed abstraction being similar or less than the water allocated for the existing irrigation takes, and policies 4.49 and 4.50 support the continued allowance of allocation for community drinking water supplies.

70 Waimakariri sub-regional rule 8.5.17 introduced as part of PC7 provides additional conditions for rule 5.133 and states that the volume of water able to be transferred is restricted to the annual average volume of water used in the preceding five years. If the usage records indicate that sufficient volume would be available to meet the plan change water demand requirements, then the application would still be restricted discretionary. If the annual volume applied for is larger than average use over the previous 5 years (but lower than the allocated annual volume) then it would default to rule 5.134 and the application would be non-complying.

71 Rule 8.5.12 indicates that substitution of a stream depleting take (i.e., a take with at least a moderate stream depletion effect) with a take with a low stream depletion effect is a restricted discretionary activity. For a transfer under this rule, the allocated annual volume (i.e., from Irricalc) would be relevant, not actual use over the previous 5 years, in contrast with rule 8.5.17.

72 Rule 8.5.12 is a potential consenting pathway for the site, as the existing irrigation takes are relatively shallow and are expected to have at least a moderate degree of stream depletion effect. Deeper takes for drinking water supply would be expected to have a lower degree of stream depletion effect, though assessment of whether the effect is low will need to be confirmed by the results of site-specific pump testing.

73 Rule 5.115 is a consenting pathway allowed for in the LWRP for establishing a community drinking water supply, in accordance with policies 4.49, 4.50 and 8.4.16. The groundwater take application for community drinking water supply would be assessed as a restricted discretionary activity.

74 The rules and policies discussed above indicate that there are three viable consenting pathways for the establishment of new community drinking water supply bores on the site. The preferred pathway is likely to depend on the results of pump testing, and subsequent stream depletion assessment, as well as the final groundwater

usage records from the existing groundwater take consents over the five years preceding the consent application.

Response to Section 42A Report and Submissions Received

75 I have reviewed the s42A report prepared by Mr Andrew Willis and make the following comments relevant to the proposed water supply.

76 In paragraph 5.2.9 of the s42A report Mr Willis states that potable water will either be supplied via the existing Ōhoka Water supply scheme or from a community drinking water scheme by transferring existing water take consents, or a combination of the two. As described previously in my evidence there is limited additional capacity in the existing WDC supply bore and therefore new supply bores will be required. It is correct that a transfer of existing water take consents may be a pathway for consenting of a new supply, however there is also an additional pathway in the LWRP (Policies 4.49 and 4.50 and rule 5.115) which allows for allocation of a new community supply scheme, even if the groundwater allocation limit is exceeded.

77 In section 6.6 of the s42A report Mr Willis considers submissions received with regard to three waters infrastructure. Potential concerns relevant to water supply in his Section 6.6 are as follows:

77.1 Impacts on submitters bores and availability of water (interference effects) (N Jones – 288, The Residents of Birchdale Place – 518, WDC – 216).

77.2 No testing is proposed until subdivision or resource consent stage (B Davey – 130, WDC – 216).

77.3 No clear understanding of the capacity of the bores (WDC – 216).

77.4 No clear understanding of the potability of the water (WDC – 216, ECan - 507).

77.5 Uncertainties of the transfer process due to the recent Aotearoa Water decision by the Court of Appeal (WDC – 216).

77.6 Prohibited status of a groundwater take in an over-allocated zone (WDC – 216).

78 Taken as a whole, the submissions relating to water supply identified in the s42A are concerned with the degree of uncertainty around whether a water supply can be provided to the site and the potential effects of the proposal.

79 With regard to these issues, I consider the available information is supportive with relatively high confidence of a deep water supply source being achievable at the site. Overall, the required rates and volumes are not significantly high and therefore I consider it is reasonable to assume that the yield requirements can be provided by multiple deep bores. With regard to drawdown interference effects, most existing bores in the area are shallow and therefore, it is not unreasonable to assume that a deep water source for community water supply instead of the current shallow irrigation bores on the property is likely to reduce the existing effects in the majority of bores in the area. Existing deep bores have greater amounts of available drawdown and are therefore, less sensitive to drawdown interference effects.

80 The results of preliminary drawdown interference assessments based on a reasonable estimation of aquifer parameters indicate that most bores in the area will experience a reduction in drawdown interference and the small number of bores that may experience a slight increase have sufficient remaining drawdown to achieve their yield requirements. The predicted effects resulting from these assessments are less than minor, even though the assessments have used conservatively large 150 day Schedule 12 abstraction rates for the proposed supply bores and also assumed the full take will occur from a single bore (at five individual assessment points spread across the extents of the site).

81 While actual pump testing results may show different aquifer parameters, for the majority of bores in the area the effects on existing shallow bores (sensitive to drawdown interference) must be less than is currently consented given that abstraction will be from deeper strata and the proposed rates are lower than the currently consented irrigation rates. As a result, I do not consider it to be a concern that drilling and testing has not been carried out.

82 With regard to potability of the supply, I am aware that existing WDC supply bore BW24/0262 provides suitable water quality for drinking water purposes. It is reasonable to assume that similarly deep bores at the site will have similar water quality results. However, the key issue here is that there are no potential contaminants in the proposed supply bores that cannot be addressed via treatment. I consider potential contaminants in the proposed supply bores that cannot be addressed by treatment are unlikely.

83 Regarding the Aotearoa Water Action decision, I understand the legal submissions on behalf of the applicant will comment on this issue.

84 I consider the over-allocated status of the groundwater allocation zone is also not a significant concern. That is because there is a

clear pathway to a consent via rule 5.115 of the LWRP, taking into account Policies 4.49 and 4.50, even if the transfer option turned out to not be viable.

85 Based on the above, I consider there is a high likelihood that a deep groundwater community supply can be provided to the site. However, even in the unlikely event that is not the case, there are two additional options for a water supply as follows:

85.1 Utilising the existing shallow irrigation bores. While ideally a new deeper source would be provided, the existing bores are also a viable option. While the quality of groundwater from shallow bores is likely to be lower than a deep source, this issue can likely be managed such that relevant drinking water criteria can still be met. The main disadvantage is that a higher level of treatment and monitoring would likely be required. Given the proposed rates and volumes of take are less than the existing consented quantities, drawdown interference effects will not be a concern.

85.2 An offsite source could also be provided to the site with high certainty. An example of this is the Rangiora water supply, which utilises the deep high-yielding confined aquifer source in Kaiapoi. Therefore, if in the unlikely event that no on-site source of supply water was suitable, consideration could be given to off-site sources.

CONCLUSION

86 A preliminary assessment of the feasibility of establishing a community drinking water supply at the site of the proposed plan change in Ōhoka has been undertaken, in terms of water demand requirements, preliminary assessment of environmental effects, and planning considerations.

87 The available information indicates it is viable to establish a deep community supply at the site, with an estimated total of four new bores providing adequate redundancy, assuming that the performance of any new bores is similar to that of existing community supply bore BW24/0262.

88 The preliminary assessment suggests that well interference and stream depletion effects are estimated to be less than minor and it is reasonable to assume that effects of a deep supply source in the majority of neighbouring bores in the area (mostly shallow) will be less than that which currently occurs via abstraction from the onsite shallow irrigation bores. Therefore, potential interference effects, are not likely to prevent consenting of new public water supply bores.

89 At the resource consenting stage site specific pumping tests and an assessment of environmental effects will be required to support the resource consent application which is typical for all groundwater take applications.

90 Over-allocation of groundwater in the area is ultimately not a significant concern because there is a pathway in the LWRP for consenting of groundwater for community supply even when allocation volumes are exceeded.

91 Overall, I consider that the preliminary assessments described in my evidence demonstrate that establishing a new public water supply that meets the anticipated demand for the plan change area is viable and therefore, the plan change can be supported from a water supply perspective.

Dated: 7 July 2023

Carl Cedric Steffens

EVIDENCE FIGURES

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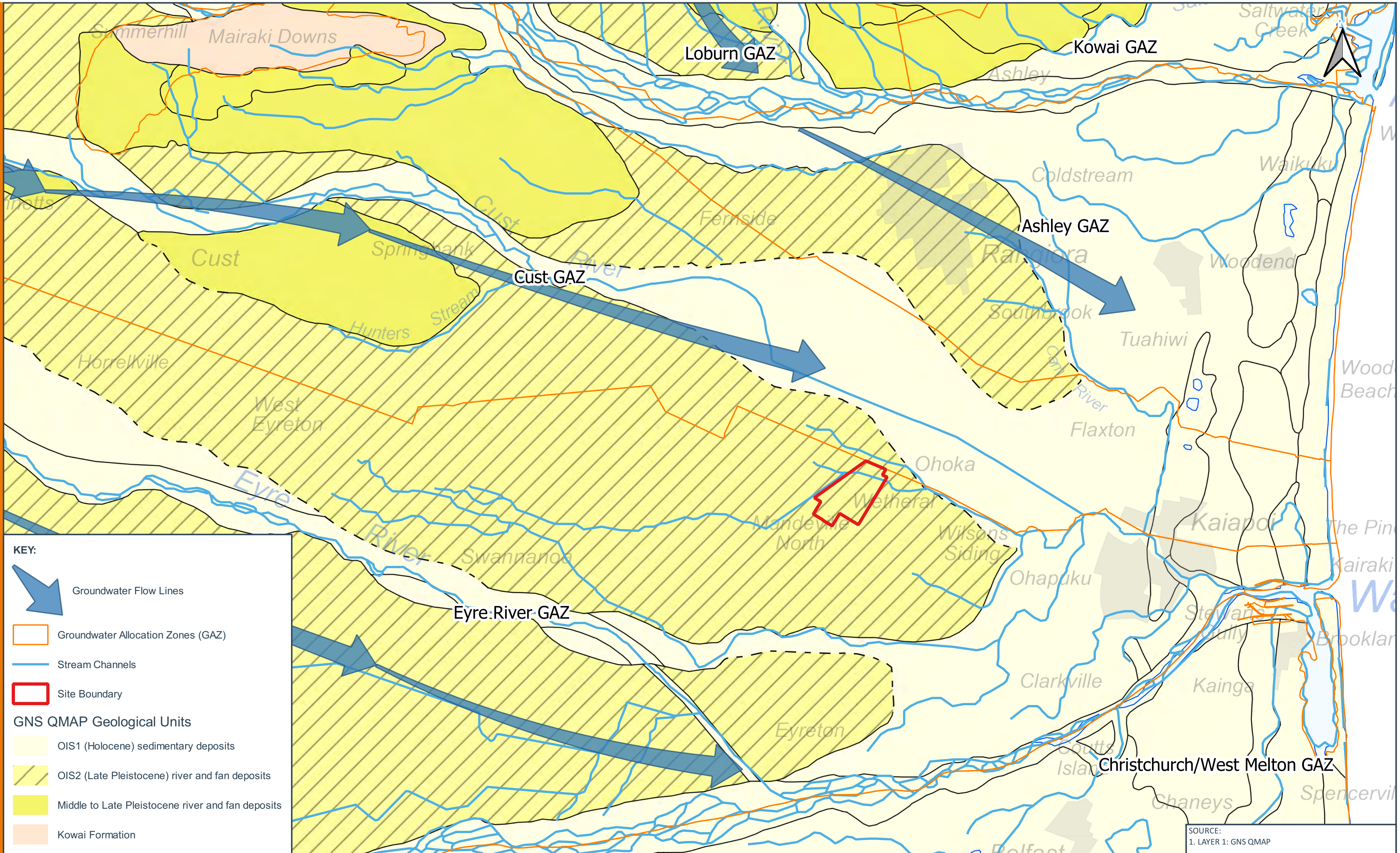

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FIGURE

FIGURE 1: GROUNDWATER FLOW PATHS AND HYDROGEOLOGICAL SETTING

PROJECT

PRELIMINARY WATER SUPPLY ASSESSMENT - OHOKA PLAN CHANGE

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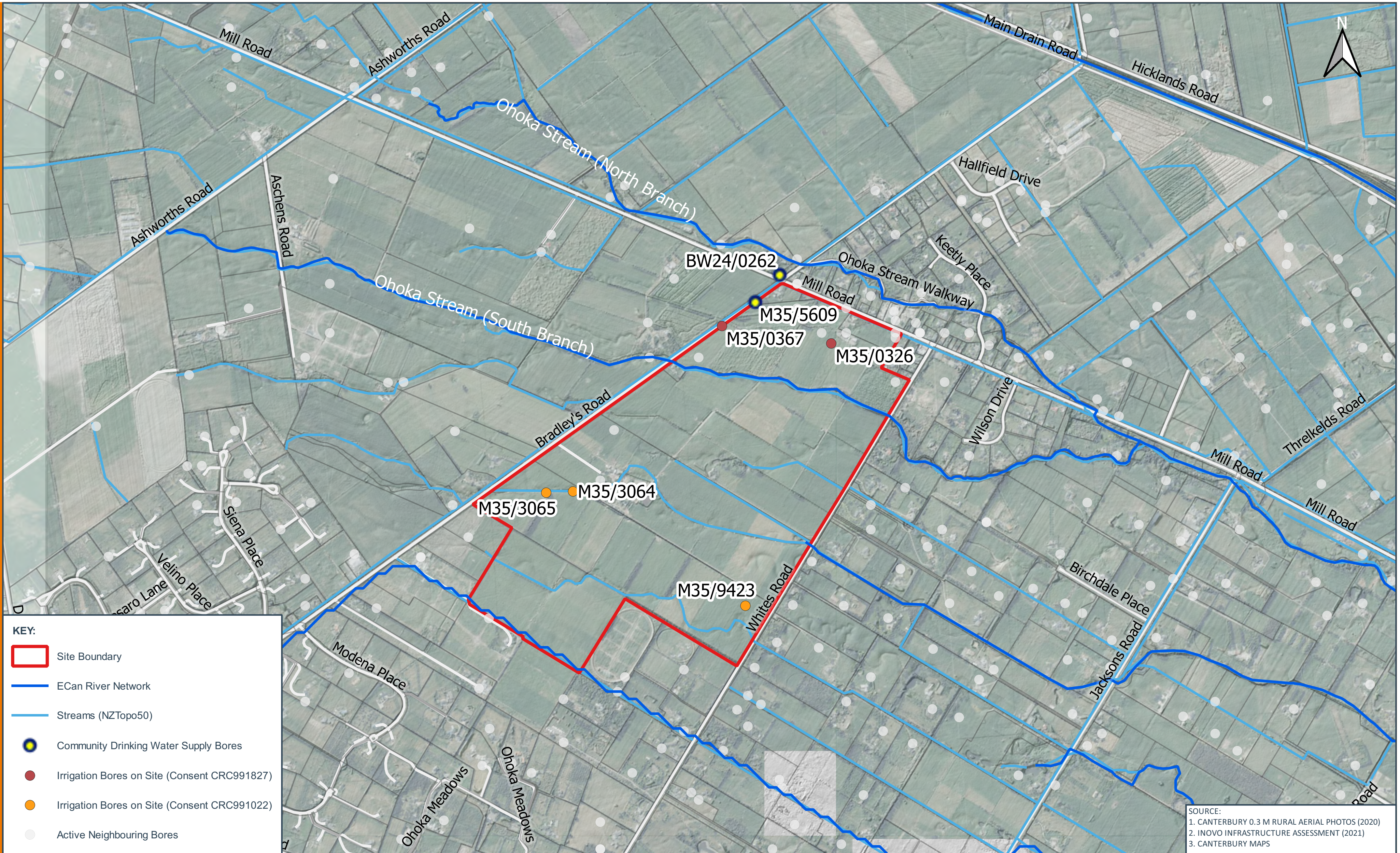

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FIGURE

FIGURE 2: SITE OVERVIEW

PROJECT

PRELIMINARY WATER SUPPLY ASSESSMENT - OHOKA PLAN CHANGE

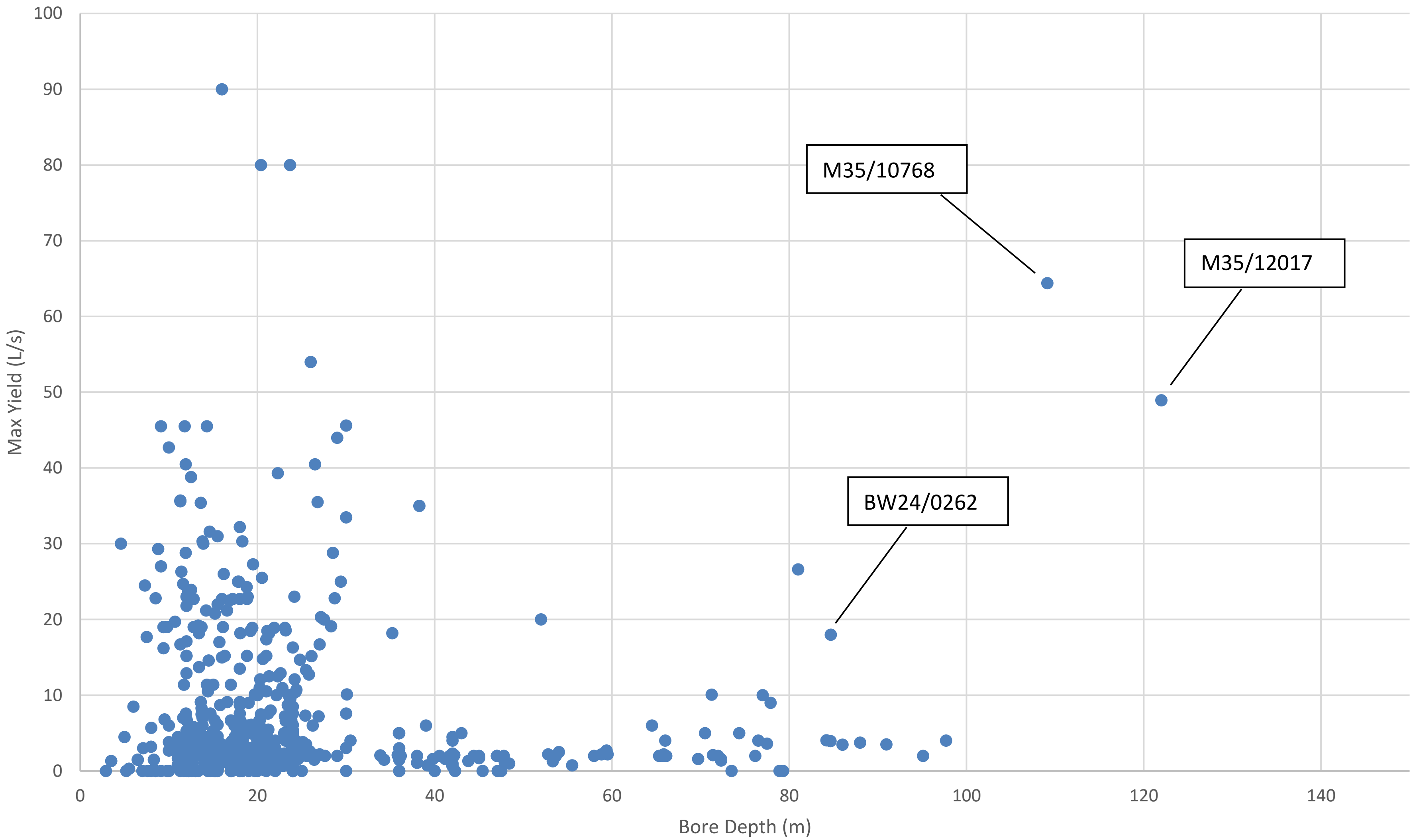

FIGURE 3: MAXIMUM YIELD VERSUS DEPTH FOR BORES WITHIN 5 KM OF SITE

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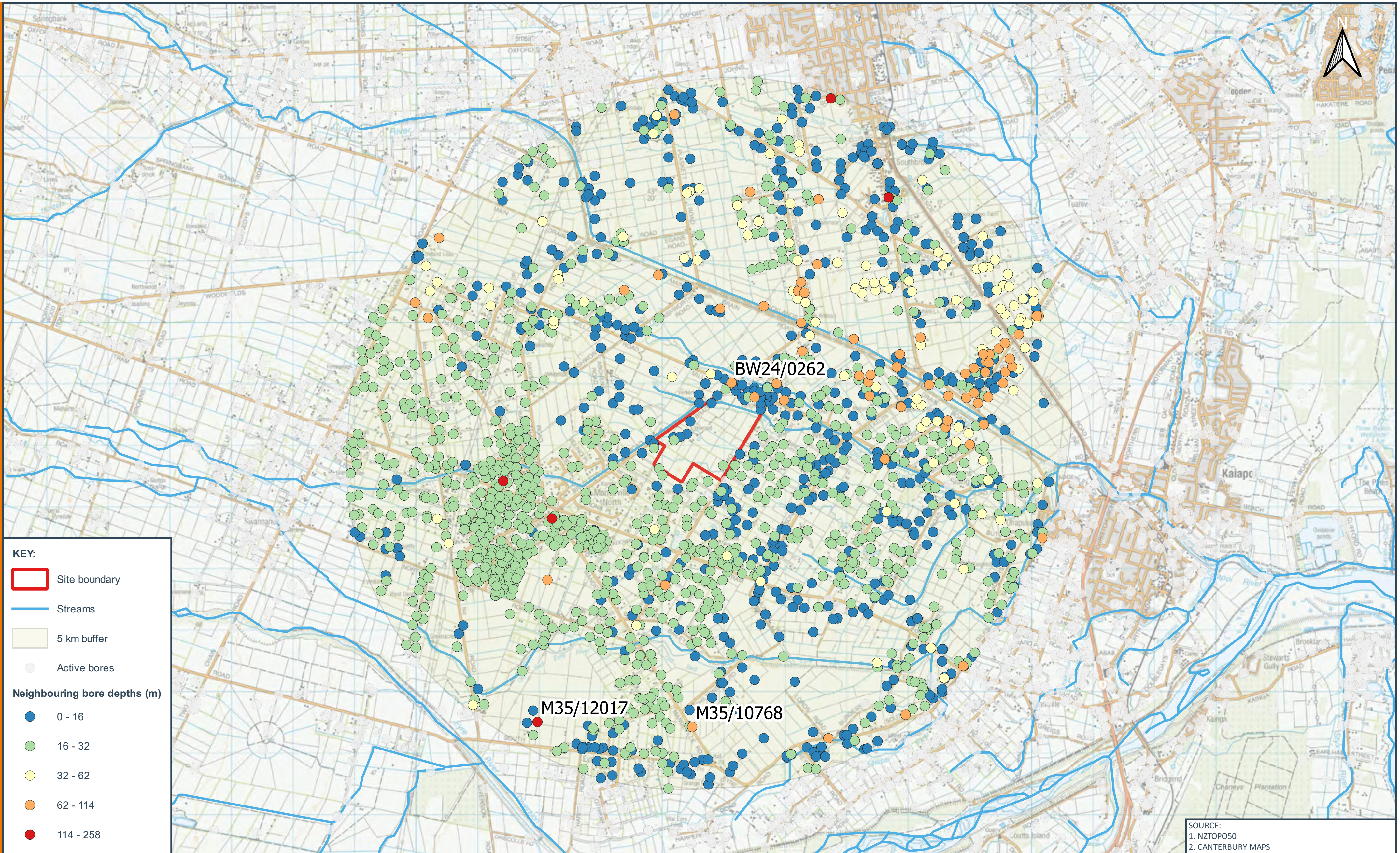

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FIGURE

FIGURE 4: NEIGHBOURING BORE DEPTHS

PROJECT

PRELIMINARY WATER SUPPLY ASSESSMENT - OHOKA PLAN CHANGE

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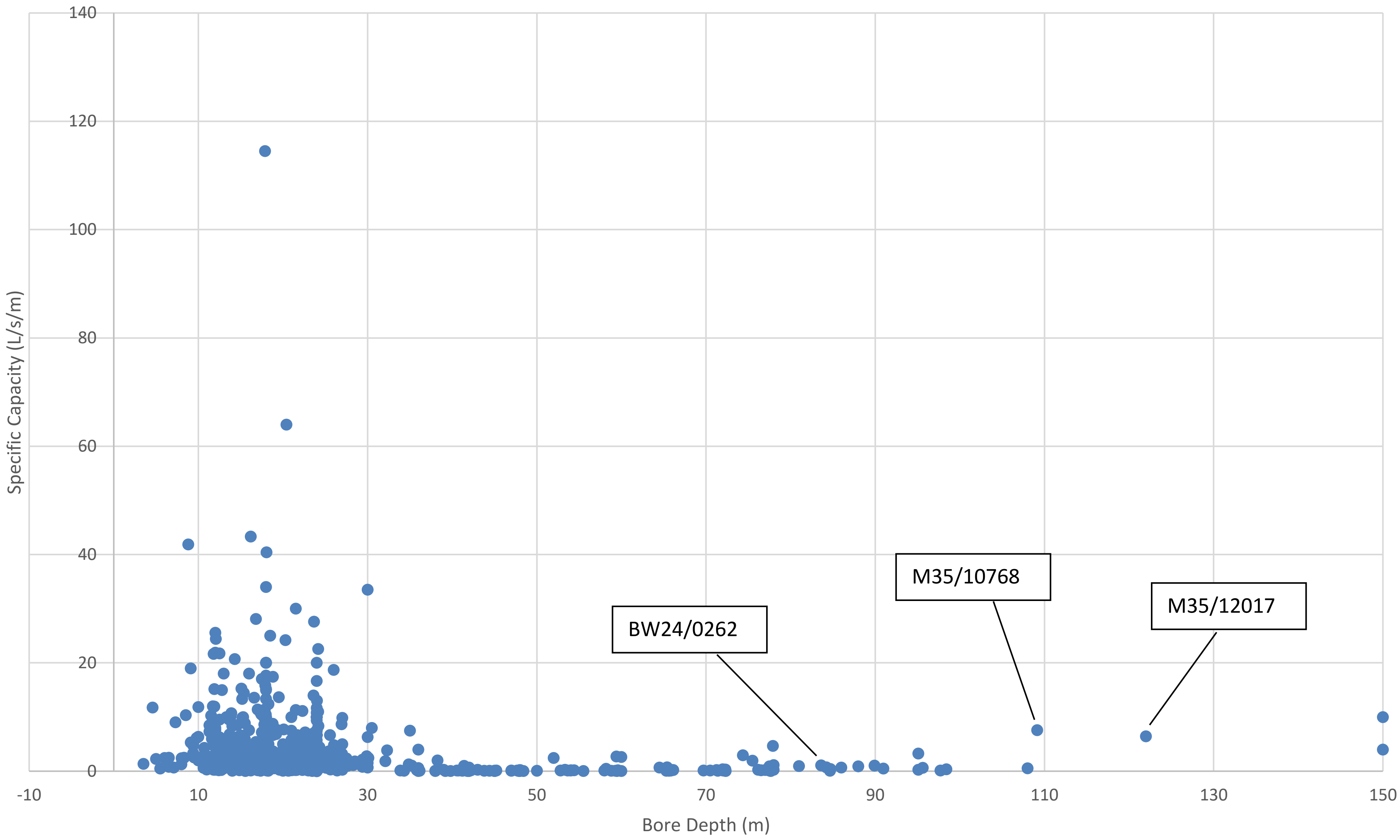

FIGURE 5: SPECIFIC CAPACITY VERSUS DEPTH FOR BORES WITHIN 5 KM OF SITE

FIGURE 6: VIRTUAL BORE LOCATIONS AND NEIGHBOURING BORE DEPTHS

PROJECT

PRELIMINARY WATER SUPPLY ASSESSMENT - OHOKA PLAN CHANGE

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