Before the Selwyn District Council

under:	the Resource Management Act 1991
in the matter of:	Proposed Private Plan Change 69 to the Operative District Plan: Lincoln South
and:	**Rolleston Industrial Developments Limited** *Applicant*

Statement of Evidence of Bas Veendrick (Hydrology)

Dated: 4 November 2021

Reference: JM Appleyard (jo.appleyard@chapmantripp.com)
LMN Forrester (lucy.forrester@chapmantripp.com)

chapmantripp.com
T +64 4 499 5999
F +64 4 472 7111

PO Box 993
Wellington 6140
New Zealand

Auckland
Wellington
Christchurch

STATEMENT OF EVIDENCE OF BAS VEENDRICK (HYDROLOGY)

INTRODUCTION

1 My full name is Bas Veendrick and I am a Technical Director Water Resources at Pattle Delamore Partners Ltd. My qualifications are Master of Science (Hydrology) and Bachelor of Science (Earth Sciences) from Utrecht University in the Netherlands. I am a member of the New Zealand Hydrological Society.

2 I have 15 years of professional work experience as a senior hydrologist and environmental scientist. I specialise in surface water assessments including surface water – groundwater interaction and have undertaken several assessments on the effects of urban development on spring flows.

3 Since 2008, I have been employed by Pattle Delamore Partners Ltd (PDP), an environmental consulting firm specialising in surface water and groundwater investigations. During my employment with PDP I have carried out and presented evidence for corporate clients, district and regional authorities and the Environmental Protection Agency. I have recently undertaken the following projects related to the effects of urban development on spring flows:

- Anticipated Baseflow and Water Balance Changes in South-West Christchurch resulting from Stormwater Management Plans in the Heathcote and Halswell Catchments.
- Effect of proposed Bellgrove Subdivision on 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 7 of the Environment Court Practice Note 2014. 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 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, groundwater flow patterns and water table depth at and in the vicinity of the proposed Lincoln South Development.

5.2 Comments on the anticipated change in groundwater recharge and spring flow as a result of the proposed plan change.

5.3 Comments on the potential for short-circuiting groundwater flow paths caused by hard fill, drains and service trenches including suggested buffer zones around springs, from a hydrological perspective.

6 In addition to the desktop analysis described in this evidence, I have visited the site to familiarise myself with the site characteristics, including the key springs.

EVIDENCE

Hydrogeological setting, groundwater flow patterns and water table depth

7 The Canterbury Plains comprise a series of large coalescing fluvio-glacial fans built by the main stem rivers (e.g the Rangitata, Rakaia and Waimakariri). During successive glaciations when glaciers partly occupied the inland valleys and extended to the eastern foothills, great quantities of detritus eroded from rapidly rising mountains. Gravel with sand and silt material was transported eastwards and deposited to form the fans of gravel-dominated sediments that extend beyond the present-day coastline. During these glacial periods, some re-sorting of the gravel deposits occurred due to alluvial processes (Brown 2001[1]).

8 During the warmer interglacial periods, the glaciers retreated up the valleys and less new gravel material was transported out onto the plains. However, alluvial processes continued to re-work the gravels. Sea levels rose during these interglacial periods and the Christchurch confined aquifer system is defined by the inland extent of marine transgressions. These marine transgressions resulted in the deposition of silt and clays over the glacial gravels and the repeated sequence of glacial and interglacial periods gives rise to the sequences of gravels and silts observed in the strata beneath Christchurch and in areas north and south of the city, including in the vicinity of the Lincoln area.

9 In the area around Lincoln and the site, groundwater is dominantly sourced from infiltrating rainwater (i.e., land surface recharge) across the inland plains (to the north-west (upgradient) of the site), together with some seepage from the Waimakariri River. A map showing the location of the site within the context of the Canterbury Plains aquifer system is provided in Figure 1. Figure 1 also shows the general direction of groundwater movement in the overall area,

[1] Brown, LJ, 2001. Regional groundwater summary – Canterbury. In MR Rosen& PA White(eds), Groundwaters of New Zealand

indicating that groundwater generally flows to the east and south-east, towards the coast. Groundwater originating from seepage from the Waimakariri River and from land surface recharge discharges into spring fed streams, including the LII stream and the Halswell River.

10 The springs as depicted in Figure 1 represent the regional groundwater discharge points and as a result the source of water for the springs is likely to represent a spatially large groundwater catchment that extends a substantial distance upgradient (i.e. north-west and inland) from the site.

11 Delineating the precise capture zone for springs is uncertain, but based on groundwater chemistry data from the general area (Stewart, 2002[2]) groundwater discharging via the springs is expected to be dominantly rainfall derived. Given the relatively high permeability of the deeper underlying strata that makes up much of the Canterbury plains, a large overall spring capture zone.

12 Based on Figure 1 and Figure 2, the site is located at the edge of the inland boundary of the surface confining, lower permeability marine strata that occurs closer to the coast. Consequently, lower permeability strata are expected to occur at, or close to the surface, as is discussed in the evidence of **Katherine McCusker**. As detailed in paragraph 12 of her evidence the majority of the site has imperfectly or poorly drained soils.

Local Groundwater Information

13 Drillers logs for shallow and deeper bores around the site generally indicate lower permeability strata at the surface to a depth of around 5 to 10 m, particularly across the eastern part of the site. Information from the geotechnical report for the site (Coffey, 2021[3]) indicates low permeability strata to a depth of around 3.5 – 5.5 m on the site east of Springs Road. Beneath the lower permeability strata are gravels, which are occasionally interbedded with silty intervals. Data to the west of the site indicates the presence of more permeable gravels closer to the surface.

14 The shallow groundwater levels around the site are reflected in the presence of numerous springs across the eastern half of the site, which appear to discharge into Springs Creek, Collins Road Drain and the LII River. These springs occur where lower permeability shallow strata are mapped across the site.

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[2] Stewart, M., Trompetter, V., van der Raaij, R., Age and source of Canterbury plains groundwater. ECan Report No. U02/30

[3] Coffey (2021), Geotechnical Assessment Report – Rev 2, Rolleston Industrial Developments Ltd.

15 Data showing groundwater levels (Figure 3) that has been collected on site indicates patterns that are consistent with the more regional information described above. Shallow groundwater levels (< 1 m below ground level) appear to have been observed in CPT logs across the eastern part of the site, where the springs are mapped (Coffey, 2021) and some bores located across the eastern low lying part of the site indicate groundwater levels as shallow as 0.2 m below ground level. Across the western half of the site, observed groundwater levels are deeper, around 2 m below ground level.

16 It is important to note that these data represent a single snapshot in time. There are few local, shallow bores with groundwater level time series available. The closest bore is M35/0599 (9.1 m deep and around 4 km to the west of the site, refer to Figure 2 for location). Groundwater levels in this bore range between 1 and 2 m below ground level although the bore is also used for irrigation, which will likely contribute to lower levels in summer. In general, given the presence of the springs which will act as a controlling head boundary, seasonal variations in groundwater levels are likely to be small. However, it will be important to derive on site information to determine maximum groundwater levels at the site.

Potential Hydrological Effects of the Plan Change

17 The two key potential hydrological effects in relation to spring flows resulting from rezoning the land are:

- A potential decrease in groundwater recharge contributing flow to springs due to an increase in impervious area;
- The potential for re-directing/short-circuiting groundwater flow away from springs as a result of hardfill, drains, and service trenches.

I address the potential effects of these matters separately below.

Change in groundwater recharge as a result of the rezoning

18 The proposed urban development has the potential to change (reduce) the groundwater recharge from the site due to the increase in impervious surfaces (roofs and pavements).

19 As detailed in paragraph 10 and 11 of my evidence the available information indicates a large overall spring capture zone. In addition the soils on the site are generally poorly or imperfectly drained indicating that in the current (rural) state groundwater recharge from the development footprint area contributing to spring flow is likely to be small. Groundwater generally flows to the east and south-east indicating that the majority of the rezoned land does not contribute to spring flow (refer to Figure 1).

20 Based on these considerations I consider that the change in groundwater recharge contributing to spring flows as a result of the plan change is relatively small and unlikely to be an issue.

Potential for re-directing/short-circuiting of groundwater flowpaths

21 One of the key potential effects of urban development on spring flows is the potential for drains, service trenches (for stormwater, sewer, telecommunication and electrical networks) and hardfill areas to intercept shallow groundwater and re-direct groundwater flow away from springs. Service trenches backfilled with gravels and hardfill areas can be much more permeable than the surrounding strata and if shallow groundwater is intercepted they may act as preferential groundwater flow paths lowering the groundwater level, diverting water away from spring heads. This potentially results in reduced spring flows.

22 Based on these considerations' construction measures should be utilised to ensure that shallow groundwater is not diverted away from its natural flow path. I note that this approach is not new. For example Christchurch City Council (CCC) require that any new stormwater pipe networks will be designed and constructed so that any diversion and discharge of shallow groundwater that might impact baseflow in streams and springs is avoided by implementing appropriate mitigation measures (as noted in section 5.10.8 of the Council's Infrastructure Design Standard[4]). These measures involve ensuring that any groundwater in the water bearing layers will not be diverted to a new exit point through the backfill. More specifically they require that backfill material with the same permeability as the surrounding ground will be used. In addition, CCC require low permeability backfill material to be used in trenches for underground services to provide a plug that avoids diversion of groundwater into a different catchment.

23 As detailed in the evidence of Mr. McLeod hardfill will only be used under the roads and the excavation depth for roads is likely to be in the order of 0.6 m, much shallower than the anticipated excavated depth of service trenches (1.0-1.2 m deep).

24 I understand from Mr McLeod that apart from shallow swales no new drains will be dug on the site. Therefore, there is no risk for drains to redirect groundwater away from springs. Further details on this in relation to the proposed infrastructure for the development is provided in the evidence of Mr. McLeod.

25 As detailed in paragraph 15 and 16 of my evidence groundwater levels on the site appear to vary from around 0.2 – 1.0 m below

[4] https://ccc.govt.nz/consents-and-licences/construction-requirements/infrastructure-design-standards/download-the-ids/

ground level across the eastern part of the site (where the springs are mapped) to around 2 m below ground level across the western part of the site. Although seasonal variation in groundwater levels is likely to be small especially in the eastern part of the site near the springs (refer to paragraph 16 of my evidence), I note that this groundwater level information is from one off groundwater level measurements and does not capture any potential seasonal groundwater level fluctuations. To help inform the mitigation measures I recommend that piezometers will be installed to determine the groundwater level range and maximum groundwater levels on the site.

26 This information can then be used to determine where excavations (for example for service trenches) are likely to intercept shallow groundwater. For these areas the mitigation measures described above should be implemented to ensure spring flows on the site are not adversely affected by the proposed urban development.

27 As an initial indication and based on the one off groundwater level data available for the site I anticipate that these measures may be required for the developed area between the RL 4 and 6 m RL contour line (Refer to Figure 3 and Figure 4) where the groundwater levels for the developed areas on the updated ODP are relatively shallow. This is an initial indication only and this area may be greater or smaller depending on the data collected from the recommended groundwater level monitoring for the site.

28 I note that the risk for intercepting groundwater by hardfill underneath roads is much lower than for service trenches due to the anticipated relatively shallow depth of the excavation (around 0.6 m). Irrespective of these considerations and as detailed in the evidence of Mr. McLeod it is proposed that in the unlikely event that water bearing layers with shallow groundwater are intercepted similar measures will be implemented as those outlined for the service trenches.

29 The Outline Development Plan text now includes a requirement to undertake groundwater level investigations across the site. For those areas where the shallow groundwater is likely to be intercepted by service trenches and hardfill areas the mitigation measures described in my evidence should be implemented.

30 With the mitigation measures in place, I consider that the potential adverse effects of the proposed plan change on spring flows can be adequately mitigated. I note that the updated ODP text specifies a buffer distance of 30 meters between the developed areas and springs. Based on my understanding of the hydrogeologic characteristics of the site, that separation should be more than sufficient to avoid any adverse hydrological effects on the springs.

31 Figure 4 of my evidence shows the latest version of the ODP along with the approximate location of the springs (as identified by Mr. Taylor) including the 30 meter buffer distance. This clearly shows that the springs (including the 30 meter buffer distances) all lie in reserve land. The exact location of all the springs on the site will be confirmed during the subdivision consent stage and in line with the ODP text any identified springs will have a buffer distance of 30 meters.

COMMENTS ON S42A REPORT

32 Dr. Burrell provides some comments on the potential hydrological effects of the plan change in paragraph 16 to 21 of his Ecology Report. I agree with Dr. Burrell that the key issue is about the potential for short-circuiting of groundwater flowpaths caused by hardfill, drains and service trenches with the risk that groundwater flow is being channelised away from headwater springs, into constructed stormwater facilities.

33 As detailed in my evidence I consider that these potential issues can be adequately mitigated through appropriate design and construction of the services in areas where they intercept groundwater levels. In these areas appropriate mitigation measures will be implemented to ensure spring flows areas are not adversely affected.

34 With these measures in place, I consider that the potential adverse effects of the proposed plan change on spring flows can be adequately mitigated.

35 In paragraph 16, Dr. Burrell also comments on the potential for reduced groundwater recharge from the increased impervious area and considers this to be less of an issue in terms of potential effects on spring flows.

36 I have commented on this potential effect in paragraph 18 to 20 of my evidence and agree with Dr. Burrell that these effects are less of an issue due to the large groundwater recharge area for the springs, the relatively low permeability of the soils on the site and the groundwater flow direction.

CONCLUSION

37 In my evidence I have considered the key potential hydrological effects in relation to spring flows as a result of the plan change.

38 In summary I consider that:

- The potential for re-directing shallow groundwater flow away from springs can be adequately mitigated through the appropriate design and construction of underground services in areas where they are likely to intercept shallow groundwater. In these areas appropriate mitigation measures are available to ensure spring flows are not adversely affected. The increased buffer distance of 30 meters between the developed areas and the springs as outlined in the ODP text further reduces the risk of any potential adverse hydrological effects on spring flows.

- the potential decrease in groundwater recharge contributing flow to springs due to an increase in impervious area is unlikely to be an issue. I note that the Ecology Report prepared for Selwyn District Council by Dr. Burrell agrees with this conclusion.

Dated: 4 November 2021

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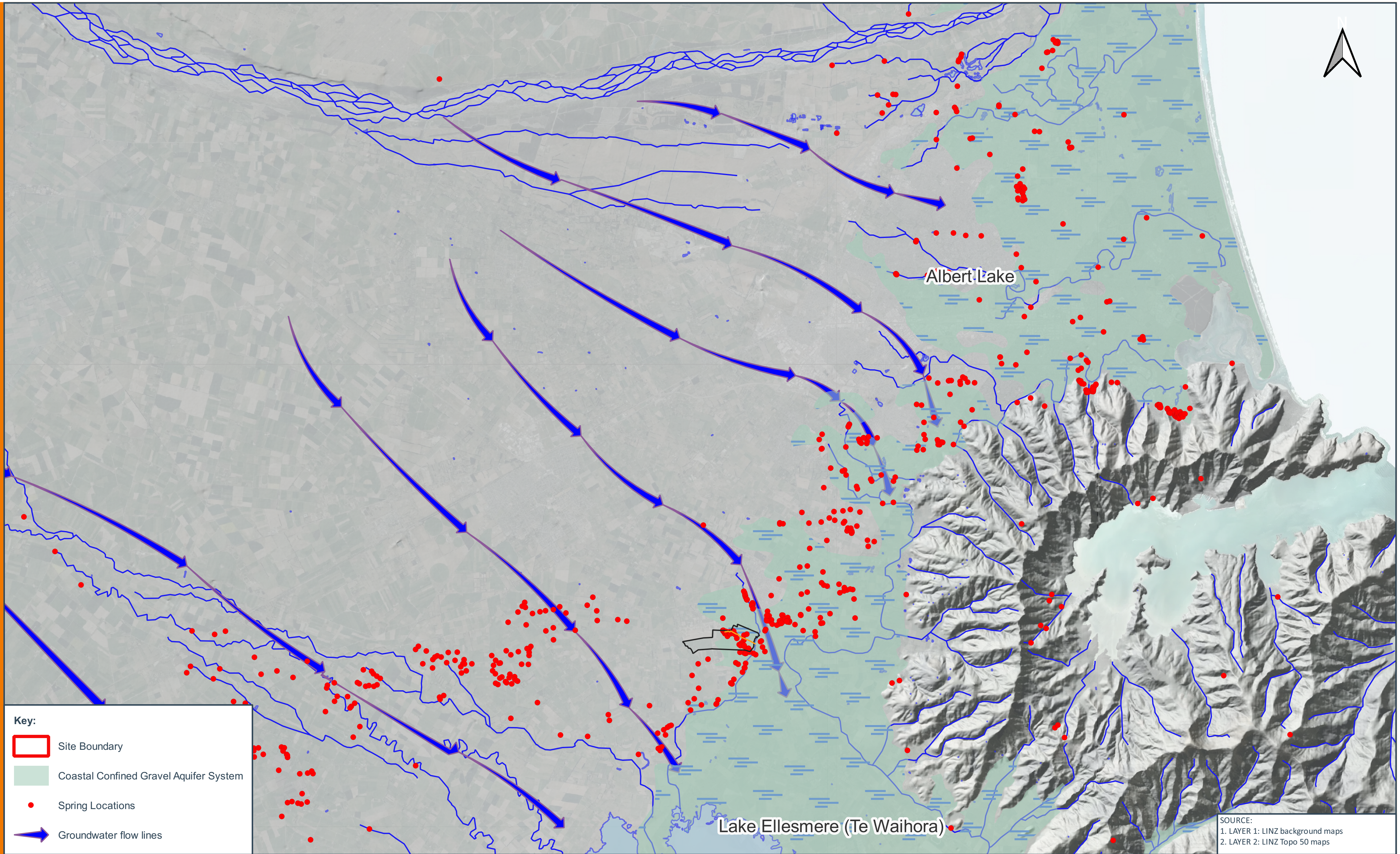
Bas Veendrick



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CLIENT

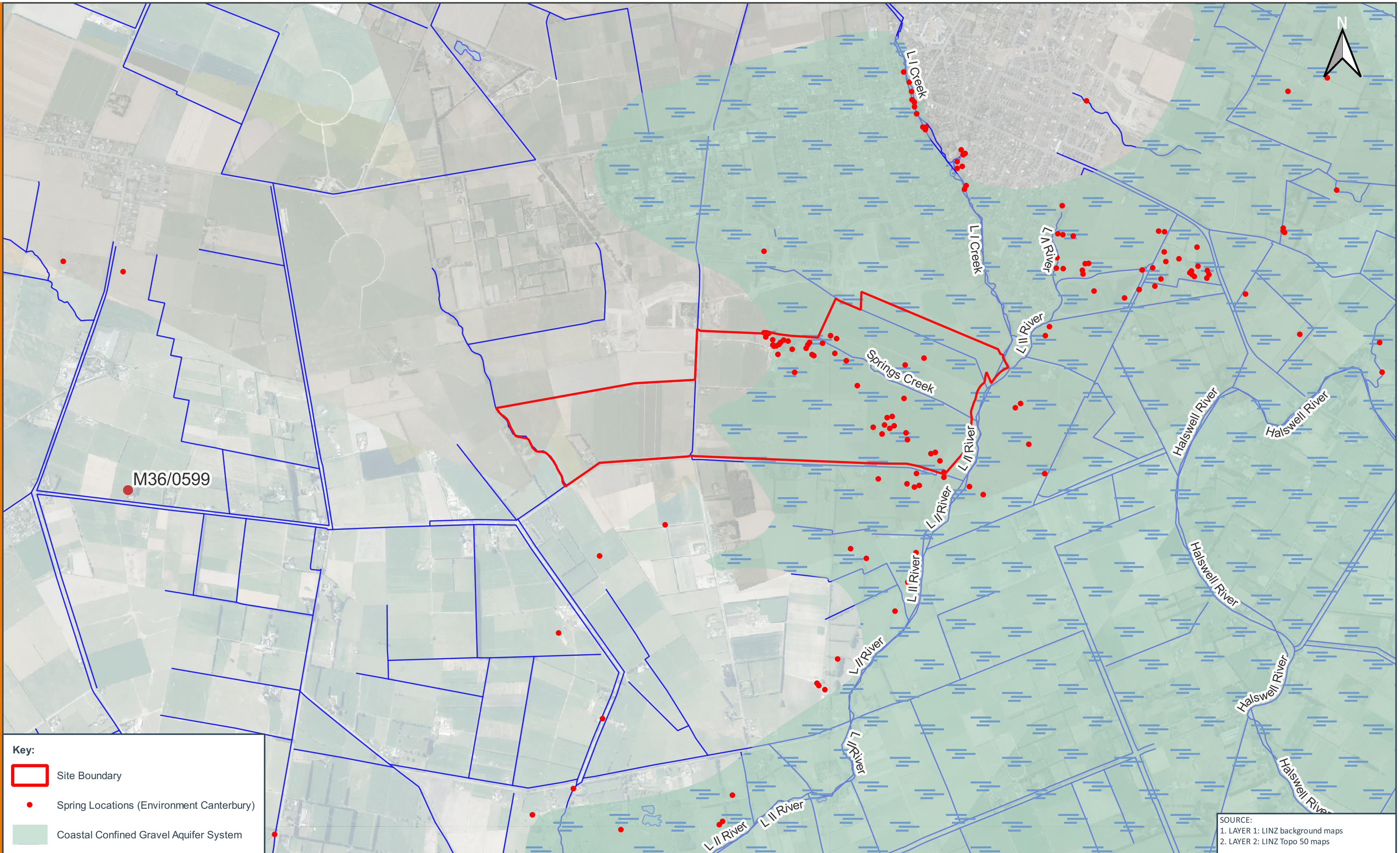
Rolleston Industrial Developments Limited

FIGURE

FIGURE 1: Groundwater flow paths and hydrogeological setting

PROJECT

Evidence of Bas Veendrick for Rolleston Industrial Developments Limited



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Rolleston Industrial Development Limited

FIGURE

FIGURE 2: Spring locations across the proposed development area

PROJECT

Evidence of Bas Veendrick for Rolleston Industrial Developments Limited

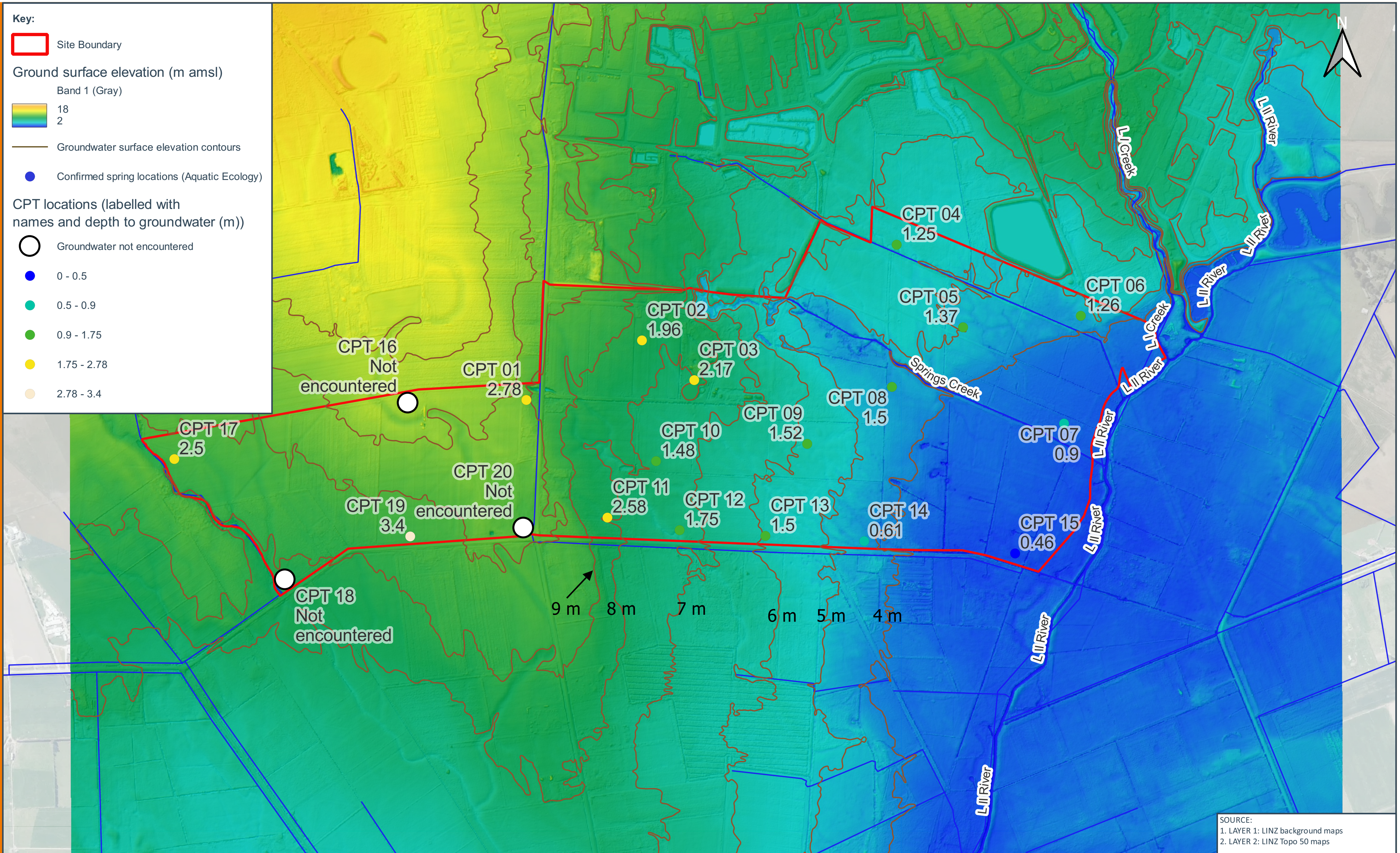

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FIGURE
FIGURE 3: Depth to groundwater across the proposed development area

PROJECT
Evidence of Bas Veendrick for Rolleston Industrial Developments Limited

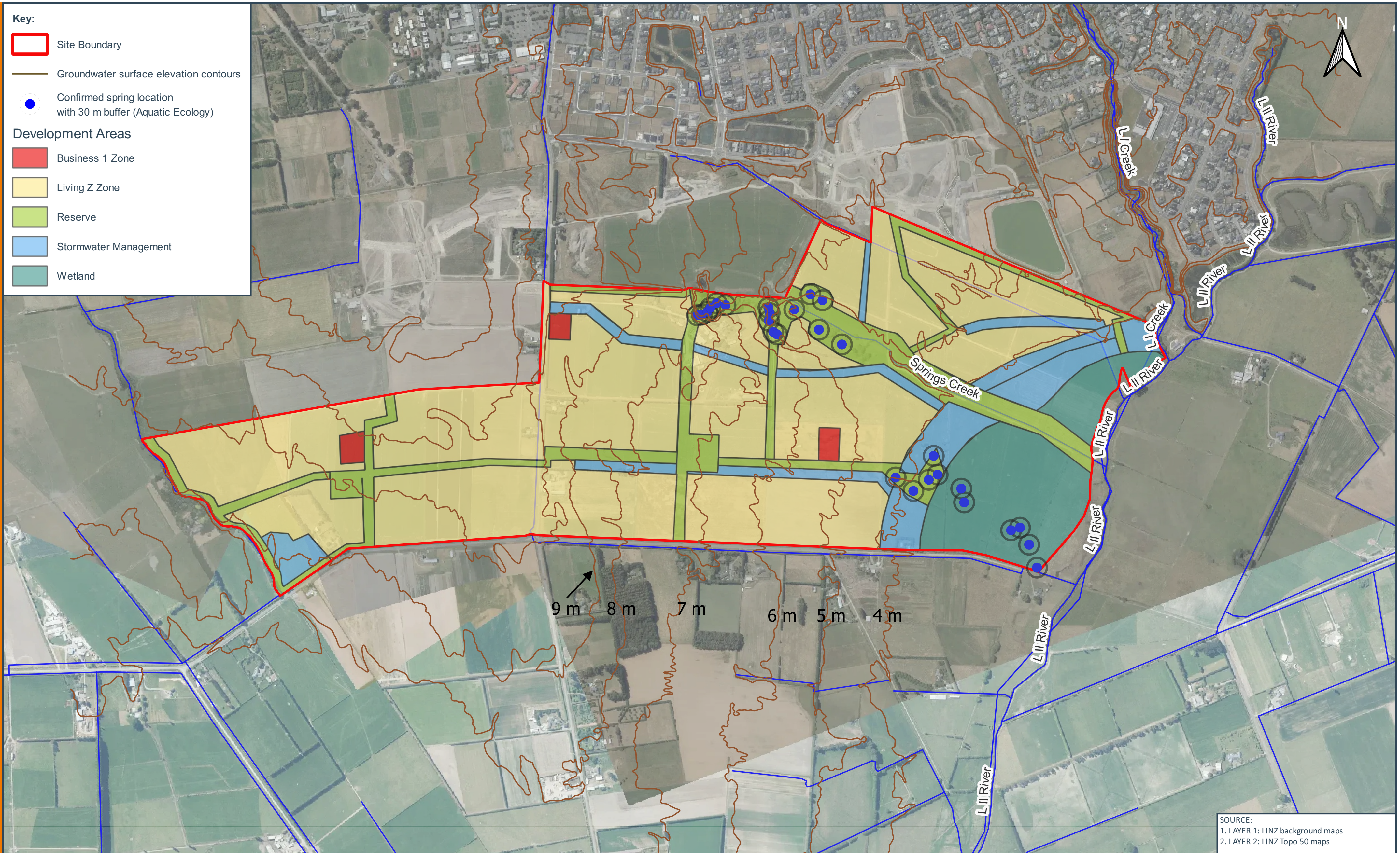

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FIGURE
FIGURE 4: Development areas and setback from confirmed spring locations

PROJECT
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