



Auckland Council

Ngā Wairau - Stage 1 AF Thomas Park

Fast Track Referral – Preliminary Hydrogeology Assessment

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Blue-Green Network - AF Thomas Park
Fast Track Referral – Hydrogeology Preliminary Assessment

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TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	GENERAL	1
1.2	PROJECT BACKGROUND	1
1.3	SCOPE AND OBJECTIVES	1
1.4	VERTICAL DATUM AND PROJECTION	1
2	PROJECT DESCRIPTION	2
2.1	PROJECT AREA	2
2.2	SITE ADDRESS	2
2.3	PROPOSED WORKS AND END STATE OF THE PROJECT.....	3
2.4	PROPOSED GROUNDWATER DRAINAGE SYSTEM.....	4
3	ASSESSMENT METHODOLOGY	7
3.1	GENERAL	7
3.2	FIELD INVESTIGATIONS.....	7
3.3	LITERATURE REVIEW AND DESKTOP STUDY	7
3.4	ANALYSIS AND INTERPRETATION	8
4	DESCRIPTION OF THE ENVIRONMENT	9
4.1	SITE SETTINGS.....	9
4.2	SURFACE WATER	10
4.3	GROUNDWATER LEVELS AND FLOWS	10
4.4	GEOLOGY.....	10
4.5	HYDROGEOLOGY	12
4.6	WATER QUALITY	12
4.7	SENSITIVE BUILDINGS AND STRUCTURES	13
4.8	NEARBY WATER USERS AND SENSITIVE WETLANDS AND STREAMS.....	14
5	ASSESSMENT OF EFFECTS	16
5.1	INTRODUCTION	16
5.2	POTENTIAL LAND SETTLEMENT EFFECTS ON BUILDINGS AND STRUCTURES FROM DRAINAGE	16
5.3	STREAM AND WETLAND DEPLETION EFFECTS	18



5.4	POTENTIAL EFFECTS ON GROUNDWATER QUALITY	18
5.5	POTENTIAL EFFECTS ON NEARBY WATER USERS	19
6	MONITORING.....	21
7	CONCLUSIONS AND RECOMMENDATIONS.....	22
	REFERENCES.....	23
8	USE AND RELIANCE	24

1 INTRODUCTION

1.1 GENERAL

Auckland Council Healthy Waters and Flood Resilience is lodging a referral application to increase flood storage at A F Thomas Park, Wairau Valley under the Fast-track Approvals Act 2024.

The project broadly involves:

- a) Flood resilience infrastructure works; and
- b) Reserve reinstatement, including site stabilisation, landscaping, new footpaths/boardwalks, and formal and informal recreation.

This memorandum provides a preliminary groundwater assessment of the proposal.

1.2 PROJECT BACKGROUND

The Ngā Wairau project is part of Auckland Council's Making Space for Water – Blue-green Network programme and is focused on the key areas within the Wairau catchment that were impacted by the 2023 storm events. Given the large scale of the Wairau catchment, the Ngā Wairau project is being delivered in three stages. This proposal covers Stage 1, which involves increasing the existing flood storage at A F Thomas Park, together with reserve reinstatement. The stormwater detention capacity created through Stage 1 works is critical to enabling future Stages 2 and 3. Further design development and funding confirmation is required for Stages 2 and 3, and they therefore do not form part of this proposal.

The works proposed under Stage 1 enable the delivery of flood resilience in the catchment by increasing flood storage within A F Thomas Park, initially for the downstream residential area, and undertaking additional stormwater improvement works.

1.3 SCOPE AND OBJECTIVES

The increased storage at A F Thomas Park can be achieved by lowering the ground surface through excavations of the northern part of the area. Because groundwater levels in A F Thomas Park are naturally high, continuous groundwater drainage is required during both the construction phase and in the final state of the project. The lowering of the groundwater level has the potential to cause various adverse effects as outlined in this report.

The purpose of this report is to assess effects on groundwater resources during construction and after completion of the project in support of the Referral application. This assessment:

- Describes the existing hydrogeological environment.
 - Assesses the effects on groundwater of temporary dewatering for construction works.
-

1.4 VERTICAL DATUM AND PROJECTION

All elevations listed in this report are in Auckland Vertical Datum 1946. Projections are in New Zealand Transvers Mercator (NZTM) 2000 projection.

2 PROJECT DESCRIPTION

2.1 PROJECT AREA

The project boundary is outlined in Figure 2-1 below; the red line is the project boundary and the parcels that make up the project area are shown with yellow lines and associated numbering.



Figure 2-1 Project area overview map

2.2 SITE ADDRESS

The site addresses and the legal descriptions for the project area are as follows:

Property address	Legal description
R 21 and 21 Northcote Road	Lot 1 DP 150598, Lot 3 DP 150598, Lot 4 DP 150598, Lot 8 DP 150598 and Lot 8 DP 101760
17 Silverfield Lane	Lot 2 DP 150598
17A Silverfield Lane	Lot 5 DP 150598
17B Silverfield Lane	Lot 6 DP 150598
17C Silverfield Lane	Lot 7 DP 150598
Nil	Part Allot 103 PSH OF Takapuna

2.3 PROPOSED WORKS AND END STATE OF THE PROJECT

The proposed works to increase flood storage at A F Thomas Park include the following (proposed future layout is shown in Figure 2-2):

- Excavate the park to increase the existing flood storage to reduce flood flows and flood levels. Formalisation of a wetland on the northern end of the park where water naturally ponds as a result of the works and dry detention in other areas of the park. At this stage the earthworks on the site are indicatively estimated to be in the order of 700,000 m³ – 800,000 m³ (cut and fill) to achieve a flood storage volume of approximately 550,000 m³. All excavated material is to remain onsite unless unsuitable.
- The proposed flood storage changes will amend the consented dam. At this stage, the proposed changes may include reducing the dam height, increasing the flood storage capacity and providing an additional spillway.
- Construct a new spillway channel linking the existing channel north of A F Thomas Park that flows east under State Highway 1 to A F Thomas Park to optimise storage and release of flood flows in the park to maximise benefits.
- Reshaping ground using cut material to convey flood flows between proposed raise areas.
- Vegetation removal is required to facilitate the works.
- A temporary construction laydown area will be established on-site (location TBC).
- Reinstatement of A F Thomas Park and constructing new multi-use maintenance accessways.

The technical parameters provided above are indicative, as design is ongoing. The referral is sought on the basis of the broader project description provided above (i.e. (a) flood resilience infrastructure works and (b) reserve reinstatement, including site stabilisation, landscaping, new footpaths/boardwalks, and formal and informal recreation), with final design specifications and precise quantities to follow in the substantive application.



Figure 2-2 Overview map proposed layout of the project

2.4 PROPOSED GROUNDWATER DRAINAGE SYSTEM

The proposed cutting and filling to create depressed areas (Figure 2-3) to the north of the site and a mount at the south of the site which is the fill area. The depressed areas are cut to a level ranging from approximately 10.6 to 11.1 m RL. The mount will rise up to approximately 27.5 m RL. Further design work is currently being conducted, and the final cut and fill plan may differ from that presented in Figure 2-3. Because the groundwater table is close to the surface in A F Thomas Park, especially in the north and east of the site, the proposed excavations will intercept groundwater. This will be managed as follows:

- Temporary dewatering will be installed during the construction phase to enable the required excavations. It is anticipated that the groundwater table will be drawn down to about 10 m RL, which will in some parts mean that the groundwater table is drawn down by up to 3.5 m.
- The water level in the proposed permanent wetland (Figure 2-2) will be controlled at about 11.1 m RL by an outfall structure (e.g., a weir) that manages outflows to the Wairau Creek to the north. This will also manage groundwater inflows into the permanent wetland.
- A network of subsoil drains will be installed in the low-lying detention areas. These will flow into the permanent pool and as such have a drainage level of 11.1 m RL. Because groundwater mounds between drainage features, the distance between the drains needs to be limited to avoid groundwater mounding to the surface.

Proposed Topography

Scale 1:5000 @ A3

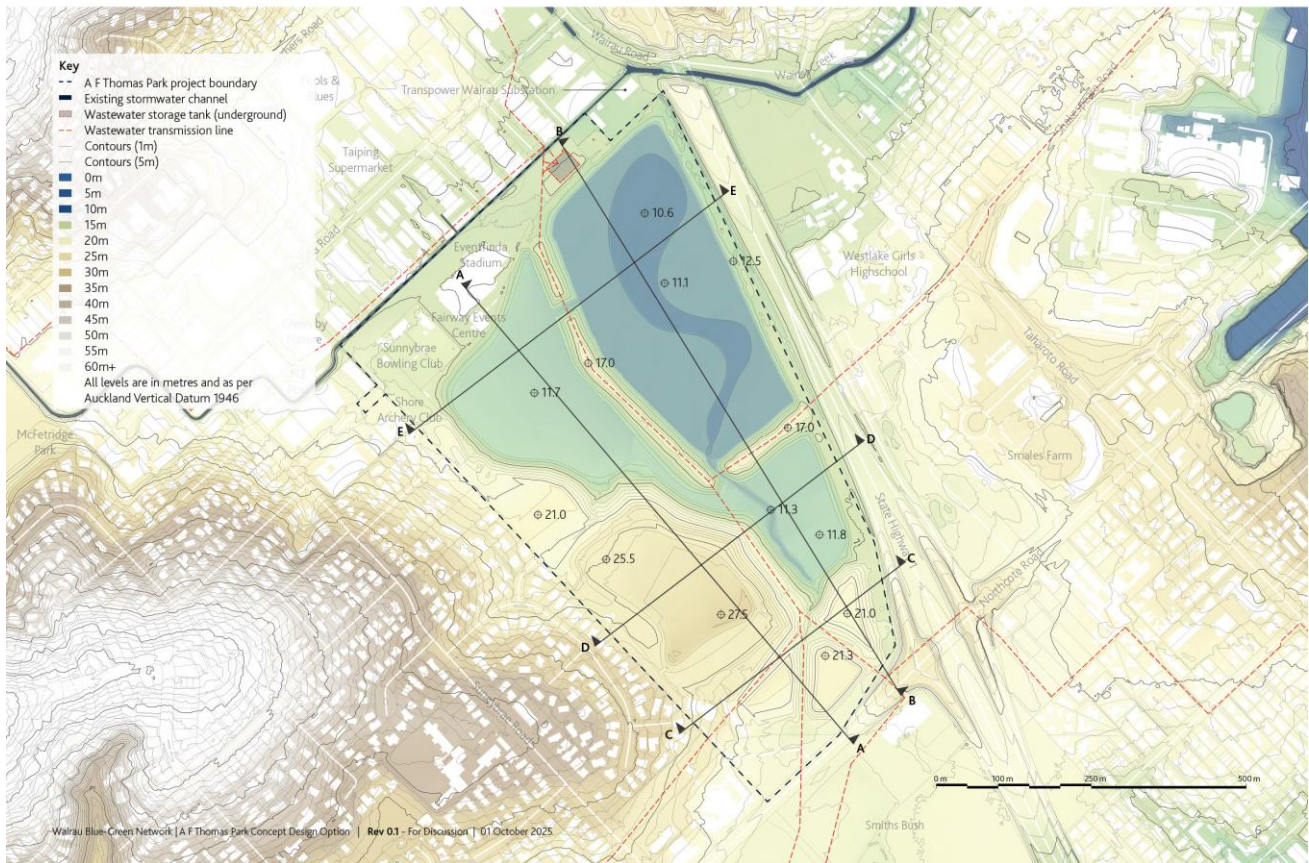


Figure 2-3 Overview map of proposed topography of the project (based on concept design)

The required distance between subsoil drains is a function of rainfall recharge to groundwater, hydraulic conductivity of the soils, the drainage level, and the free board between drainage level and ground elevation. This is illustrated in Figure 2-4 for a case in which rainfall recharge is about 1.2 mm/day and soil hydraulic conductivity (explained in Section 4.5) is 0.01 m/day, based on indicative drainage calculations. Note that hydraulic conductivity could be notably higher in areas where basalts are present in the subsurface.

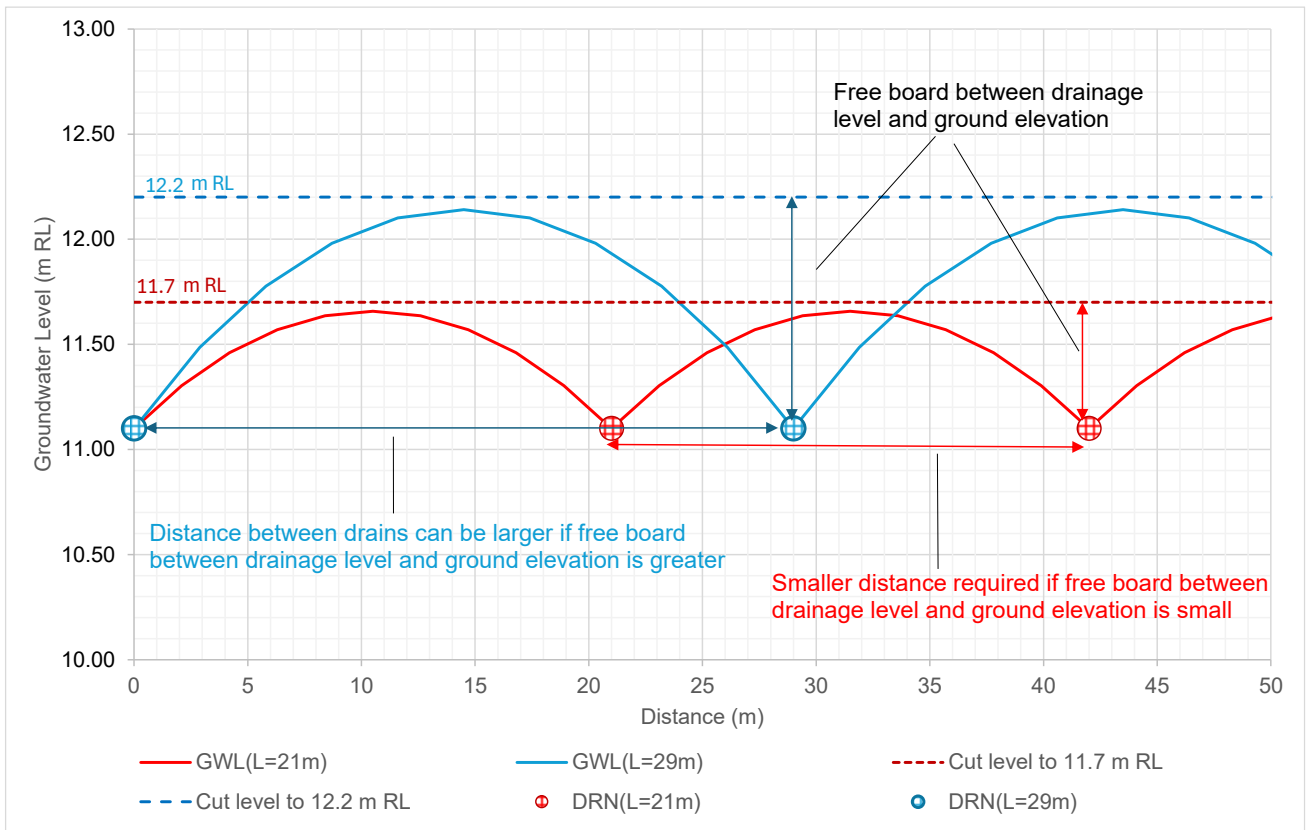


Figure 2-4 Illustration of required drain spacing at different free board between drainage level and ground elevation (based on indicative drainage calculations)

3 ASSESSMENT METHODOLOGY

3.1 GENERAL

The hydrogeology assessment undertaken for this project, includes a literature study, interrogation of databases, field investigations, analysis and interpretation of data and information, technical discussions with other technical experts, and the development and use of numerical groundwater modelling, to understand the existing environment and assess effects. Further details of the applied methodology are described in this section.

3.2 FIELD INVESTIGATIONS

The following field investigations undertaken for the Project have been used in the hydrogeology assessment:

- Installation of 11 hand augers and drilling of 7 machine-drilled boreholes across the project area. Investigations are ongoing and the locations of completed drill holes and hand augers to date are shown in Figure 3-1. Soil materials in the cores were logged by geologists for each of the hand augers and boreholes. Two of the hand augers and 7 of the drill holes were completed as monitoring wells, which means PVC cased piezometers were installed to various depths to record groundwater levels. Automatic water level loggers were installed in all monitoring wells. They record groundwater levels every 15 minutes and this continues to date.
- Cone Penetration Testing (CPT) at various locations across the project area for geotechnical investigations to a variable depth of up to 10 m.
- Hydraulic tests (slug tests) will be undertaken in the monitoring wells installed during the field investigation programme to determine the aquifer hydraulic conductivities.
- All monitoring wells will be equipped with water level loggers that will record groundwater levels every 15 minutes for a period of at least 6 months.
- Contaminated land testing of soils and groundwater was undertaken at key locations to confirm the presence of contaminants on site.

The sites selected for hydrogeological investigation and testing are considered generally representative of the broader environment in which the project's effects on groundwater are likely to occur.

3.3 LITERATURE REVIEW AND DESKTOP STUDY

Data and information relevant to the project have been obtained from publicly available online databases from several research institutes (GNS Science and NIWA) and on the New Zealand Geotechnical Database (NZGD). This data and information cover geology, surface water and previous geotechnical drilling investigations. It also includes information on existing water supply wells, and groundwater abstraction resource consents within or near the project area. Various relevant reports and textbooks on hydrogeology, geology and hydrology have been reviewed to support the hydrogeology investigations. A reference list of relevant literature is included at the end of this report.



Figure 3-1 Overview map of field investigation locations

3.4 ANALYSIS AND INTERPRETATION

Based on the above information, discussions with various experts, and results from various field investigations, WSP hydrogeologists will develop a Hydrogeology Conceptual Model of the groundwater system in the vicinity of the project once all field investigations have been completed and interpreted. The Hydrogeology Conceptual Model will form the basis for the development of numerical models, which will be used to quantify the effects of the project on groundwater resources. The data and information described above and presented in Section 4 underpin the Hydrogeology Conceptual Model, which is a pictorial representation of the groundwater flow system (Anderson and Woessner, 1992) combined with a summary of key aspects that define the groundwater system.

A 3 dimensional numerical groundwater model is currently being developed in FeFlow so that more detailed and quantitative effects assessments can be undertaken for the Substantive Fast Track consent application. FeFlow is a commonly used 3-dimensional numerical groundwater modelling tool. The numerical groundwater modelling for the project will be undertaken in accordance with recommendations and best practices outlined in the Australian Groundwater Modelling Guidelines (Barnett et al, 2012).

4 DESCRIPTION OF THE ENVIRONMENT

4.1 SITE SETTINGS

The site is located in Wairau, on Auckland’s North Shore as shown in Figure 4-1. The site is currently in use as the Takapuna Golf Course. The surrounding land use is mainly urban developments, including residential areas to the west, south and east, and commercial/industrial areas to the north. State Highway 1 (SH1) abuts the site to the east.

The Takapuna Golf Course is mainly grassed and has lines of trees in between the fairways, tees and greens. The site is relatively low-lying with residential subdivisions located on the gentle rolling hills to the west and east. SH1 adjacent to the eastern boundary is built on an embankment and rises above the eastern side of the site. The site’s topography is elevated in the south and southeast to about 25 m RL and gradually falls to a level of about 12 m RL in the lower lying parts to the north and east.

The median annual rainfall of the area is about 1,200 mm/year (NIWA, 2012).

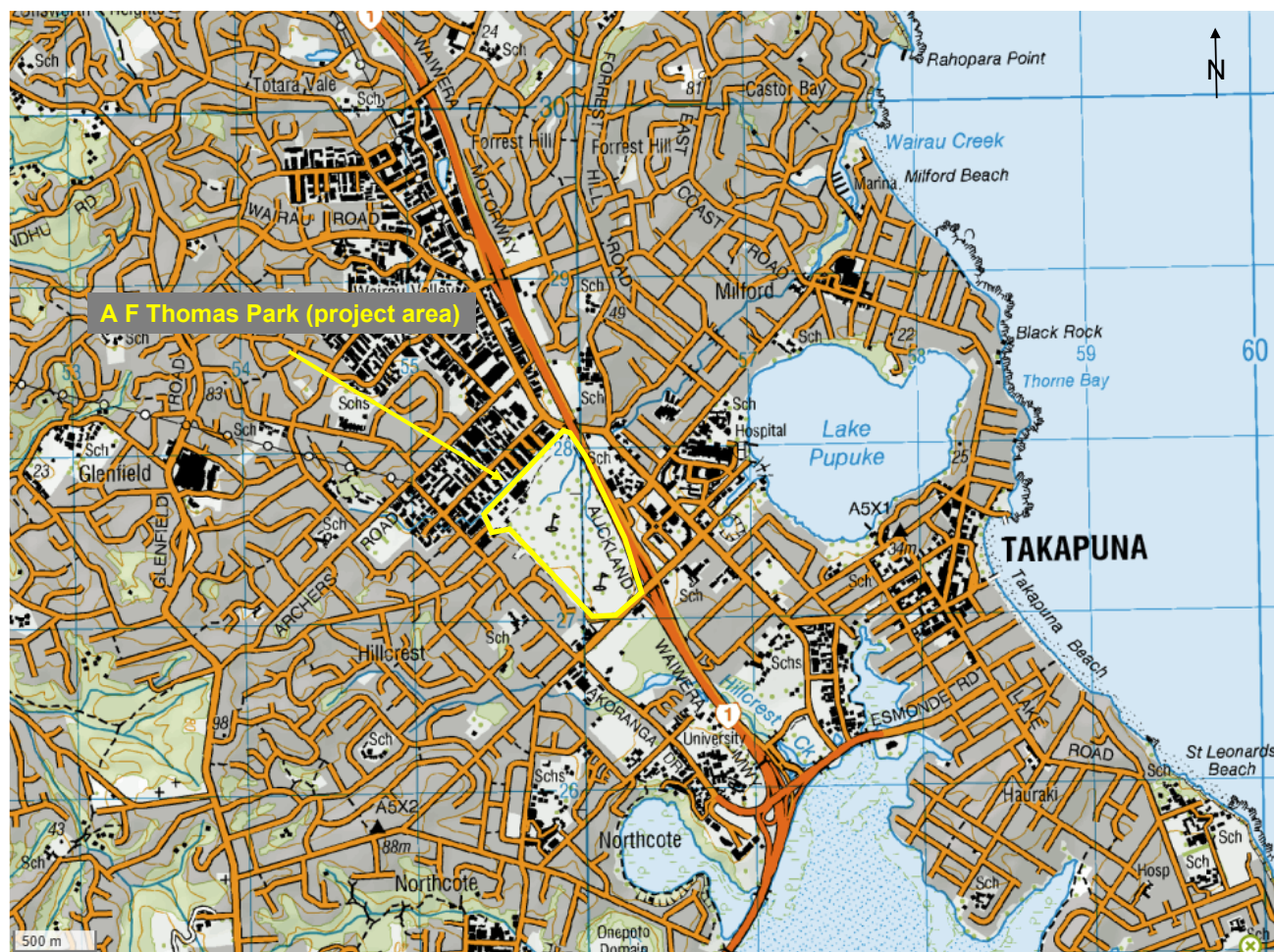


Figure 4-1 Regional overview map of the site

4.2 SURFACE WATER

Several urban streams transect the general area around the site. The nearest stream is the Wairau Creek which flows directly north of the site and discharges out in Castor Bay towards the northeast of the site. A network of streams, drains and ponds is located on the east and north of the site and drain both stormwater and groundwater from the site under gravity into the Wairau Creek (Figure 4-2). The median stage height (i.e., the water level) of the Wairau Creek nearest to the site (at 40 m to the north) is about 11.1 m RL, which is lower than the site's elevation and thus allows for gravity drainage. According to NIWA's NZ River Maps¹ website, the Wairau Creek has a median flow of 75 L/s and a Mean Annual Low Flow (MALF) of 21 L/s downstream of the project area.

Other notable surface water features near the site are the Hillcrest Creek to the south which flows out in Shoal Bay to the south of the site, and Lake Pupuke to the east of the site. Lake Pupuke is an old volcanic lake near the coast. It is a freshwater lake that is filled by stormwater runoff from the surrounding catchment and does not have an outlet. Lake water drains to groundwater through the volcanic soils and emerges as freshwater springs along the coastline. The Lake water level is about 5.8 m RL, hence lower than site's ground elevation thus unlikely to impede free drainage.

4.3 GROUNDWATER LEVELS AND FLOWS

Limited groundwater level information is available at this time from the bore log, with groundwater monitoring and data collection still ongoing. Groundwater levels appear to be about 2 m below ground level (m bgl) in the middle and southern part of the site, and about 1 m bgl at the northern end of the site. This is very shallow and the proposed excavations (Section 2) will likely intercept the groundwater table.

WSP prepared an initial groundwater contour map, based on available data as shown in Figure 4-2.

Groundwater levels are higher in the south and west and lower in the north and east, suggesting groundwater flows to the north and east towards the network of land drains and ponds on the site.

4.4 GEOLOGY

The published geological map (Edbrooke, 2001) shows the site is underlain by Tauranga Group Holocene alluvial river deposits comprising sand, silt mud and clay with localised gravel and peat beds. This is underlain by alternating sandstone and mudstone layers of the East Coast Bays Formation (ECBF), Waitematā Group.

The golf course is underlain with Holocene marine sediments of the Tauranga Group up to at least 11 m depth, generally consisting of sandy and clayey silts, in the middle and west of the project area. Auckland Volcanic Field soil materials (i.e., basalts) were encountered in the north of the site beneath the proposed wetland. Volcanic tuff and lapilli were encountered more to the southeast, predominantly consisting of silty sands, silty gravels and clays.

¹ <https://shiny.niwa.co.nz/nzrivermaps/>

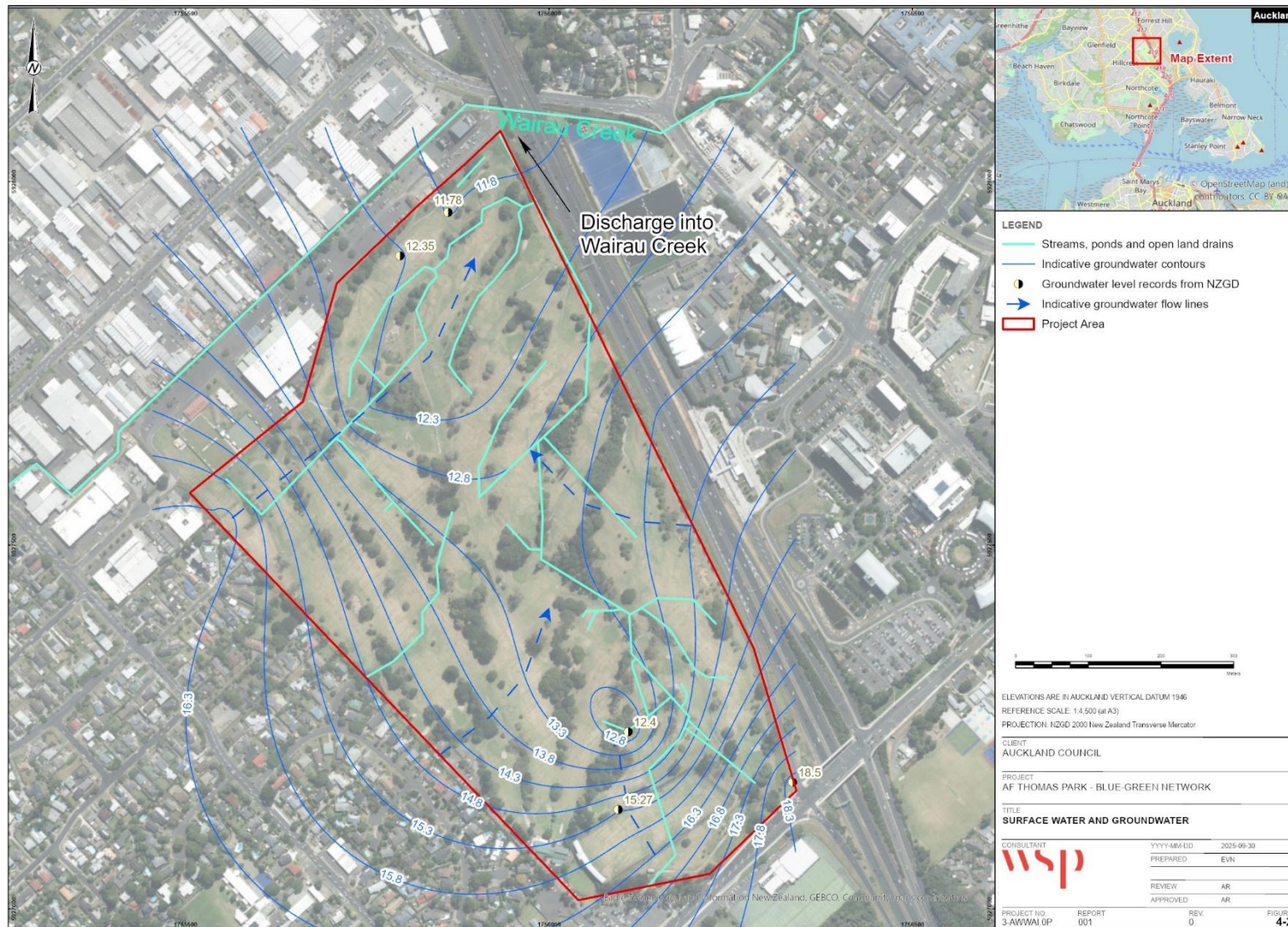


Figure 4-2 Surface water and groundwater at the project area

4.5 HYDROGEOLOGY

The hydraulic conductivity governs the groundwater flow and thus the amount of groundwater mounding that occurs in response to rainfall recharge. No site-specific data on hydraulic conductivity of these materials is available but can generally be expected to be low. At this stage no clearly distinguishable hydrostratigraphic units² (water bearing or confining geological formations) can be identified for the project area. These will be confirmed once field investigations have been fully completed and interpreted.

Based on literature, the hydraulic conductivity of the encountered Tauranga Group sediments in the west of the golf course can vary but are generally between 0.002 and 0.2 m/day (2E-08 m/s to 2E-06 m/s; see Table 1 below). A value of 0.01 m/day would appear to be the most likely for this site, but this will be confirmed during further site investigations.

However, basalts have been encountered to the east of the site, which have a considerably higher permeability ranging from 0.1 to 100 m/day (1E-06 m/s to 1E-03 m/s; see Table 1 below). A value of 1 m/day appears to be the most likely for this site for the basalts, but this will be confirmed during further site investigations.

Table 1 Summary of hydraulic conductivities per geological unit (after T+T, 2012)

Geological unit	Permeability (m/s) assumed isotropic where not otherwise noted		
	Assessed minimum	Assessed mean	Assessed maximum
Basalt	1×10^{-6}	1×10^{-4}	1×10^{-3}
Tuff	1×10^{-7}	1×10^{-5}	1×10^{-3}
Estuarine Sediments	1×10^{-9}	2×10^{-7}	1×10^{-6}
Tauranga Group Alluvium /Upper Puketoka Formation	2×10^{-8}	2×10^{-7}	2×10^{-6}
Lower Puketoka Formation	2×10^{-7}	2×10^{-6}	2×10^{-5}
Kaawa Sands	1×10^{-7}	1×10^{-6}	1×10^{-4}
Weathered ECBF	2×10^{-8}	2×10^{-7}	2×10^{-6}
ECBF	$K_h = 2 \times 10^{-8} K_v/K_h = 0.1$	$K_h = 2 \times 10^{-7} K_v/K_h = 0.1$	$K_h = 2 \times 10^{-6} K_v/K_h = 0.1$
Fractured ECBF	NA	5×10^{-4}	NA

4.6 WATER QUALITY

Water quality will change as water runs off and discharges into streams or flows through aquifers. Factors such as land use, geology, hydrogeochemical reactions and travel time through aquifers will all influence

² A hydrostratigraphic unit can be defined as a part of a body of rock that forms a distinct hydrologic unit with respect to the flow of groundwater (Maxey, 1964)

water quality. As such, the composition of naturally occurring surface water and groundwater will often reflect the origin of the water and the pathway it has followed.

Foster and Johnson (2021) provide some general indication of groundwater quality that can be expected within the Auckland urban environment, in particular where volcanic deposits are present.

Urban shallow volcanic aquifers are predominantly affected by stormwater and wastewater. The basalt aquifers have high infiltration rates and throughflow, contributing to their important role in stormwater discharge via soakage. Elevated zinc concentrations in groundwater have been encountered and are likely linked to urban sources and stormwater. Overall, results from the groundwater quality monitoring programme indicate that nitrate is the foremost contaminant of concern for shallow volcanic aquifers in the Auckland region. High nitrate observed in groundwater coincides with both horticultural and urban land uses. E. coli (a faecal indicator bacteria) was present in groundwater samples for the Three Kings volcanic aquifer in a State of the Environment monitoring well at Watson Ave, near Auckland's CBD, most likely linked to stormwater and wastewater leakage in urban areas.

There is no groundwater quality data available to confirm conditions in the project area. A preliminary site investigation (PSI) into possible historic activities at the site that could have led to contamination by WSP (2025), concluded that it is highly likely that herbicides, pesticides and fertilisers have been applied to the golf course over the period of its use to manage the tee, greens and fairways. It is possible that soils in the immediate vicinity of the substation are contaminated with heavy metals, polychlorinated biphenyls (PCBs), hydrocarbons and asbestos. It is not known if these activities have led to detectable groundwater contamination. The PSI does not cover any area beyond the site boundary.

4.7 SENSITIVE BUILDINGS AND STRUCTURES

An existing wastewater sewer main cuts through the middle of the project area, roughly from south to north, as shown in Figure 4-3.

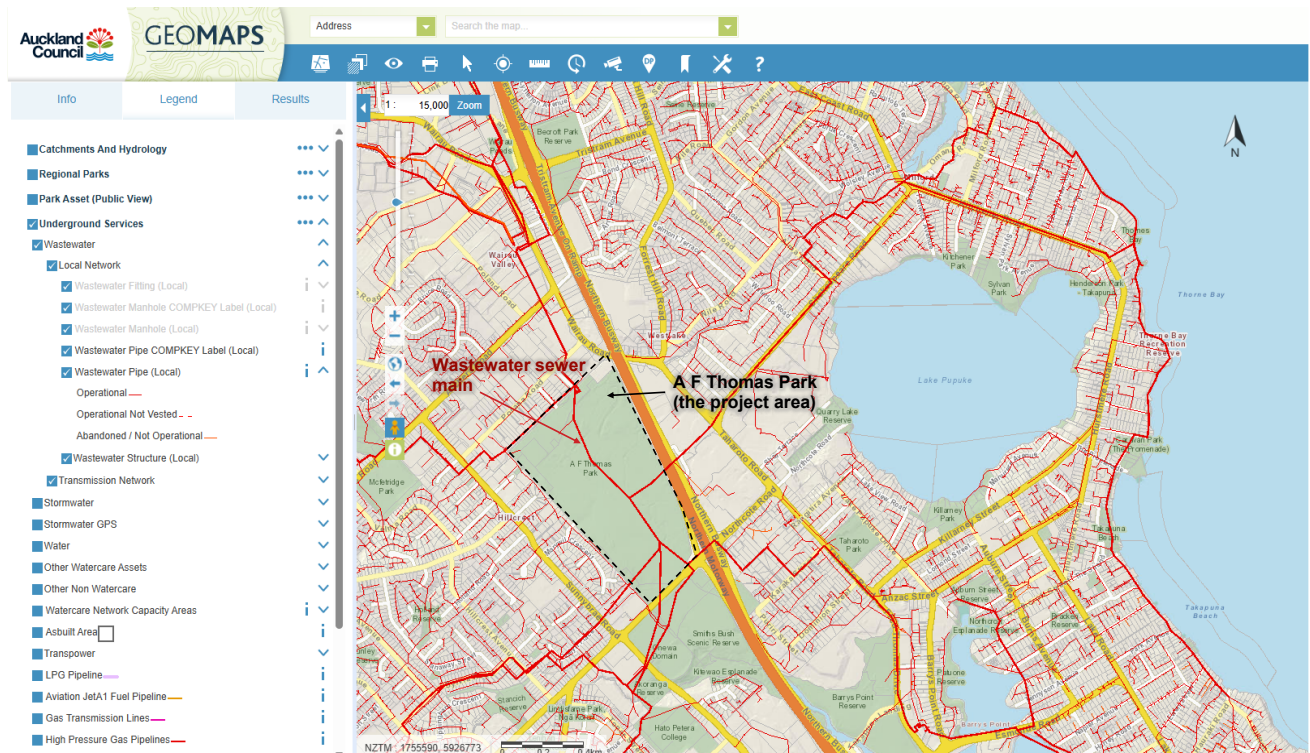


Figure 4-3 Overview map location wastewater sewer main at the project area

The nearest historic heritage overlay extent of place is indicated to be at more than 400 m distance to the southwest from the project area according to Auckland Council Geomaps website (Figure 4-4), listed as Cobblestone Lane townhouses. The historic heritage overlay identifies historic heritage extents of place as set out in the policy framework of D17 Historic Heritage Overlay and Schedule 14 of the Auckland Unitary Plan.

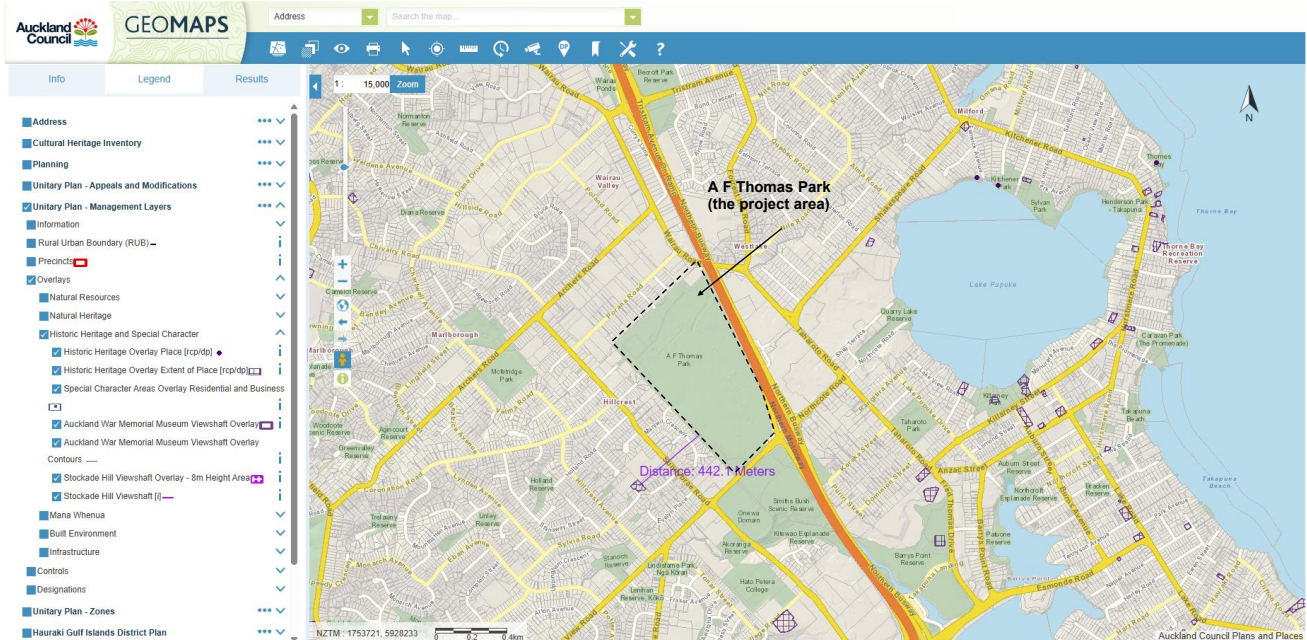


Figure 4-4 Overview map location of historic heritage overlay near the project area

4.8 NEARBY WATER USERS AND SENSITIVE WETLANDS AND STREAMS

The nearest sensitive wetland to the project area is Lake Pupuke and its riparian margins at 1 km to the east. About 350 m to the south flows Hills Creek at its closest location, and Wairau Creek flows 40 m north of the site (Figure 4-5).

Lake Pupuke is identified as a Wetland Management Areas as set out within the policy framework of D8 Wetland Management Areas Overlay and Schedule 1 Wetland Management Areas Schedule of the Auckland Unitary Plan. Lake Pupuke is also identified as a natural and urban lake management areas as set out in the policy framework of provisions in D5 Natural Lake Management Areas Overlay and D6 Urban Lake Management Areas Overlay and Schedule 2 Natural Lake Management Areas of the Plan.

Auckland Council does not maintain a publicly accessible database that lists the assets of nearby private water users, such as water supply wells or surface water intake structures. There are no public drinking water sources listed anywhere near the project area.

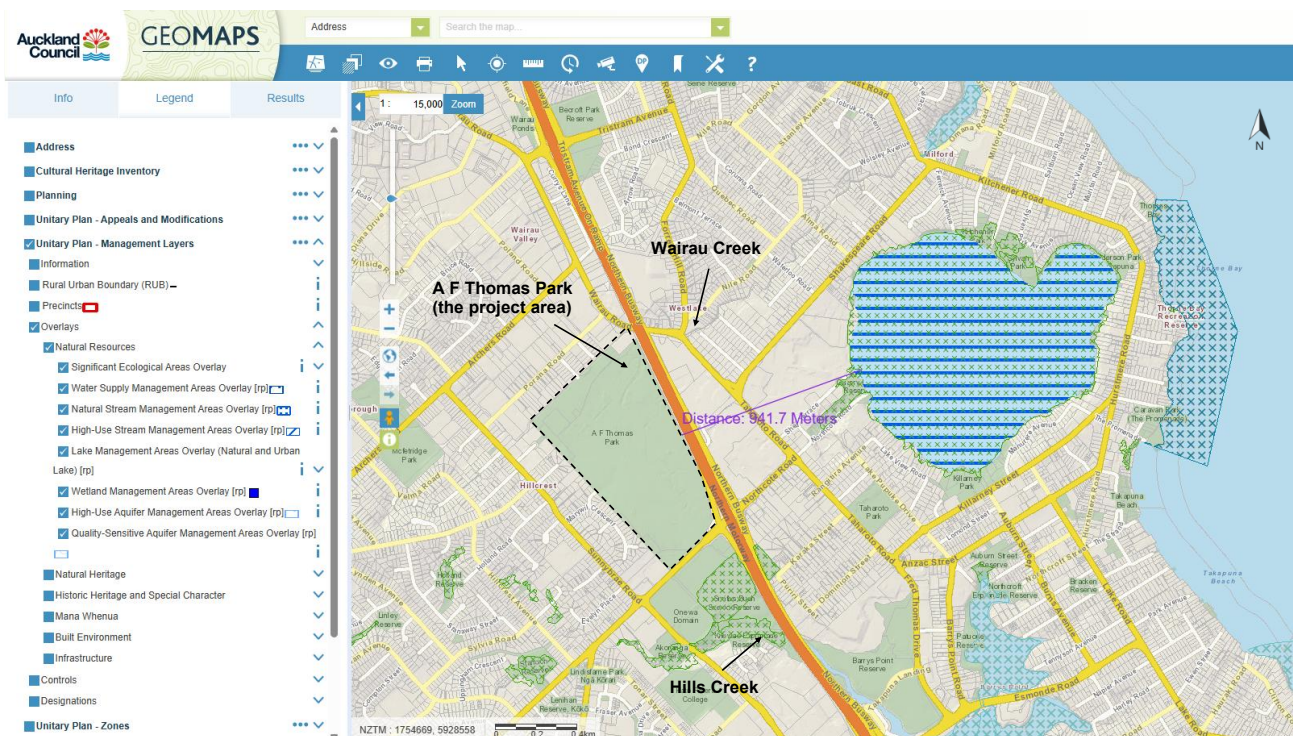


Figure 4-5 Overview map of listed wetlands and streams near the project area

5 ASSESSMENT OF EFFECTS

5.1 INTRODUCTION

The proposed construction and operation of a groundwater drainage system and a wetland in which water levels are controlled will draw groundwater levels down. This could cause environmental effects and affect nearby groundwater users. The effects are associated with the drawdown of groundwater levels and a change in groundwater flow directions as a result of various construction related activities, and the installation of a permanent drainage system in the north of the site.

The following potential groundwater effects are assessed in this section:

- Land settlement as a result of project dewatering, either for project construction or throughout its operation, and potential impacts on nearby structures.
- Stream and wetland depletion can occur as a result of temporarily or permanently lowering groundwater levels. The potential ecological effects of this depletion are considered in separate reports.
- Change in groundwater flow direction or velocities that could affect groundwater quality when contaminants are drawn into a drainage system, or into a well that is used for water supply. Contaminants could also be diverted into groundwater dependent wetlands after a change in flow direction.
- Groundwater level drawdown interference effects from the project on nearby water supply wells could reduce the yield of those wells and affect the water supply for domestic, agricultural or industrial uses, such as stock drinking water.

The expected groundwater drawdowns will commence during the construction phase when earthworks for the stream diversion and wetland restoration are undertaken. The groundwater drawdowns will remain post-construction of the flood attenuation project. As such, there is both a temporary and a permanent groundwater drawdown effect associated with the proposed flood attenuation project. However, the drawdown effects in the temporary and permanent state are the same.

An initial assessment of possible groundwater level drawdown in the end state, after the proposed drainage system has been operational for several years, is shown in Figure 5-1. This suggests groundwater level drawdown will not exceed 0.5 m at a distance of more than 350 m from the project area. The modelled 1 m drawdown contour is expected to remain within 200 m from the site boundary. This figure represents the groundwater level drawdown for average conditions. Drawdown during summer may be less. Further modelling, and model calibration to improve the model's accuracy, will be completed for the substantive application.

5.2 POTENTIAL LAND SETTLEMENT EFFECTS ON BUILDINGS AND STRUCTURES FROM DRAINAGE

Land settlement can occur from dewatering activities as a result of reduced pore water pressure and subsequent consolidation of the soil structure. Certain soil materials are particularly vulnerable to settlement, such as unconsolidated and saturated clay and peat. If land settlement occurs, nearby structures and services or productive land could be damaged, particularly if the land subsidence is uneven meaning that one part of a site settles more than another part. This process is referred to as differential settlement and damage is most likely to occur where differential settlements are the largest.

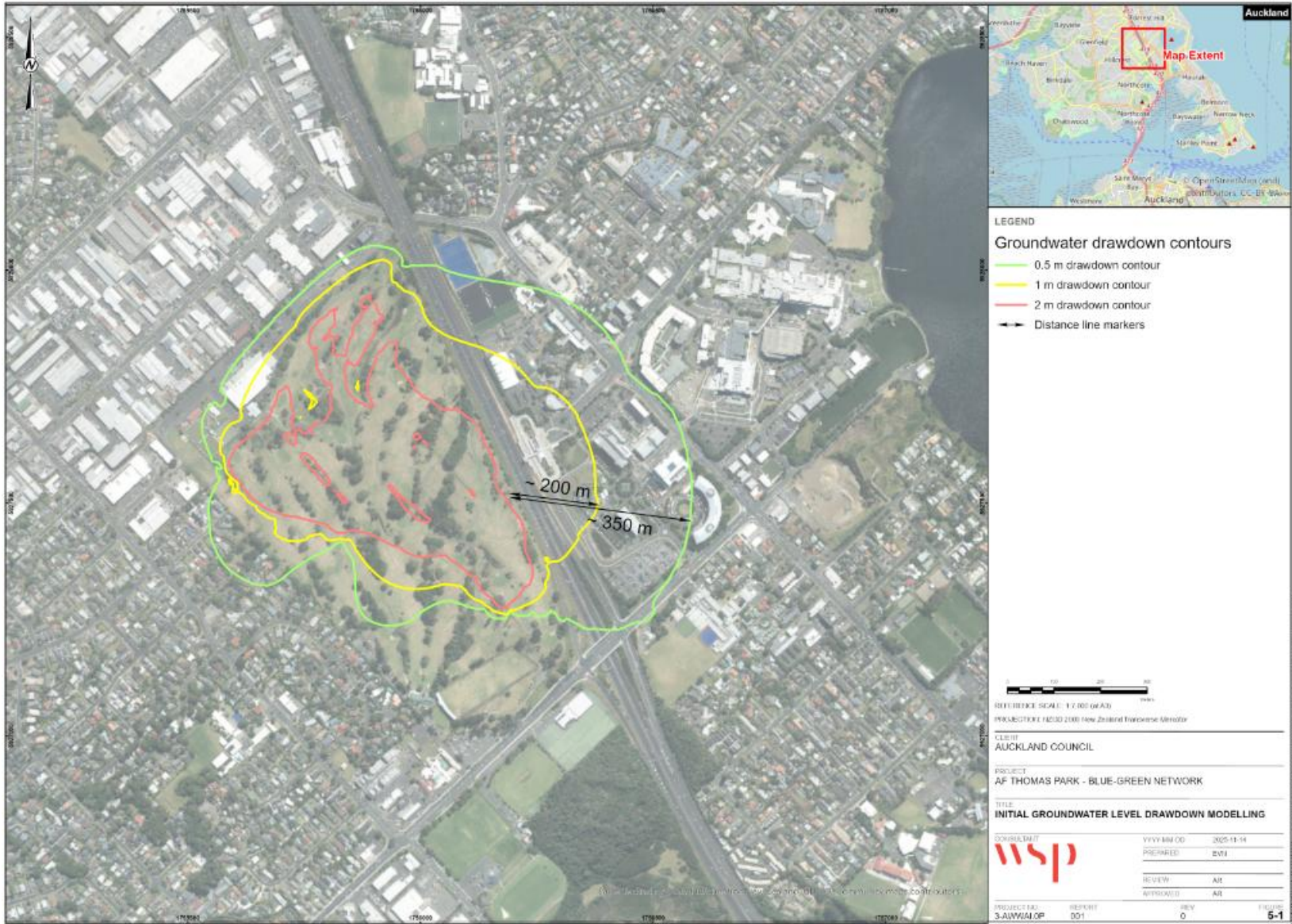


Figure 5-1 Initial groundwater level drawdown modelling assuming average conditions

Because groundwater levels are drawn down in the shape of a cone during abstraction any land settlement resulting from dewatering is likely to be differential. The maximum differential settlement will occur where the groundwater gradient is largest.

Land settlement could occur both in the construction and operational phase. It will be most severe relatively close to the point of groundwater abstraction, which will be the project's permanent drainage system or any dewatering for pits or trenches during the construction phase.

The shallow groundwater table will be drawn down by up to 3.5 m at certain parts of the site. The existing wastewater sewer main that cuts across the project area is likely to be vulnerable to land settlement, from both groundwater drawdown and earthworks (i.e., mechanical settlement from excavations and filling). Mitigation measures (structural lining, pipe restraints, bridging etc) to minimise the risk to the existing wastewater pipeline may be required.

Groundwater drawdown beyond the project area boundary will be less but could be more than 2 m at nearby buildings and structures. The greatest extent of the groundwater drawdown area is to the east of the site (Figure 5-1). This is where Auckland Volcanic Field materials are present, including basalts, which are expected to be considerably less prone to land settlement than the Tauranga Group sediments to the west and north of the site.

Further technical assessments are required to confirm if notable land settlement can occur beyond the project area that could lead to potential damage of buildings and structures. This will be undertaken as part of the substantive application. Earthworks design optimisation is ongoing. If needed mitigation of notable land settlement effects can be incorporated (e.g. adjust earthworks extents and appropriate clearance to structures), should potential effects be identified beyond the project area.

5.3 STREAM AND WETLAND DEPLETION EFFECTS

Groundwater drawdown and accompanying potential effects on baseflows to wetlands and streams, may occur where the drainage systems will be installed to collect groundwater seepage from the excavated land. This will permanently draw groundwater levels down and reduce baseflows to nearby groundwater-receiving streams or wetlands.

The proposed activities include excavations that will increase the groundwater seepage to the newly constructed wetland and to the Wairau Creek. The baseflows to this surface water will therefore increase. As such, no adverse temporary or permanent effects due to stream baseflow reduction are anticipated for the Wairau Creek.

Lake Pupuke is the nearest wetland management area at 1 km east of the site. It is unlikely that the lake will be affected by the groundwater drawdown from the proposed drainage system. This will be confirmed once the field investigations have been completed and interpreted, so that more detailed technical assessments can be completed.

No other wetlands or streams are present near the site that are deemed to be sensitive. Baseflows to any onsite streams or wetlands are likely to stay the same as current or increased due to increased inflows from drainage water.

5.4 POTENTIAL EFFECTS ON GROUNDWATER QUALITY

Groundwater flow directions will change locally as a result of temporary dewatering during the construction of the project and the permanent drainage system. This change is unlikely to cause a notable change in the groundwater quality in the area surrounding the site because the existing contamination concentration in groundwater is expected to be low-level.

Contaminated land investigations (WSP, 2025) have not confirmed if historic activities have led to detectable groundwater contamination on site or on adjacent properties. However, there is no indication of any historic activity that would have led to a substantial groundwater contamination. It is therefore unlikely that the proposed permanent drainage would draw in highly contaminated groundwater. Further assessments will be undertaken as part of the substantive application. Mitigation options are available, such as pump and treat solutions or cut-off walls, to minimise the risks of groundwater contaminants being drawn into the drainage system.

Temporary drainage of groundwater during construction of the project will be diverted to stormwater treatment facilities, such as Sediment Retention Ponds (SRPs), and discharged to nearby streams after treatment. No water quality effects on surface water from drained groundwater discharges are therefore expected.

Saline intrusion typically only establishes after a long period of time with groundwater levels reduced to below average sea level at or near the coast. The time for saline intrusion response will depend on the hydraulic conductivity of the formation that is dewatered, the distance to the coast, the natural groundwater gradient and the average dewatering level near the coast. This typically occurs only after years of groundwater levels reducing below sea level. With lower hydraulic conductivity sediments, the establishment of groundwater drawdown that can result in saline intrusion will take even longer to establish, because of the slow movement of both the fresh groundwater and saline water.

The part of the site where land will be excavated and drainage systems installed is at least 2 km from the sea and the proposed drainage levels at 11.4 m RL is well above sea level. This is highly unlikely to result in saline intrusion. The effect of saline intrusion is thus considered to be negligible.

5.5 POTENTIAL EFFECTS ON NEARBY WATER USERS

The lowering of groundwater levels can affect people's ability to abstract water from water supply wells. Figure 5-2 provides a schematic overview of an abstraction well. If a well is pumped, the well water level will be drawn down. The drawdown in a pumped well (i.e., self-induced drawdown) consists of two components: the aquifer losses and the well losses. Aquifer losses are the head losses that occur in the aquifer where the flow is laminar (Kruseman and de Ridder, 2000). Well losses are additional drawdowns caused by friction losses and turbulent flow inside the well, when the well is pumped (Figure 5-2). The well loss and aquifer loss can be derived from step test results.

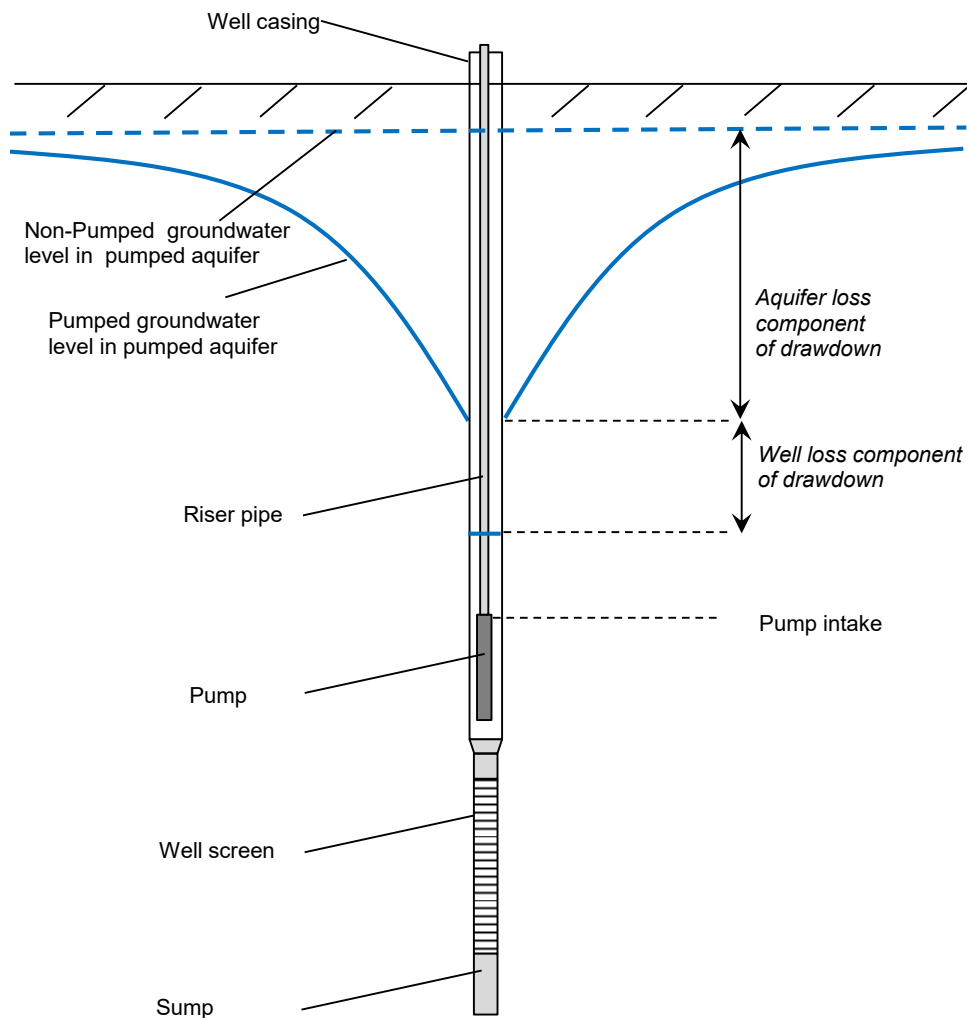


Figure 5-2 : Schematic overview of groundwater abstraction wells.

Pumping from a nearby well may draw water levels down in the subject well. Natural groundwater fluctuations may also cause the subject well water level to decline. If the sum of the self-induced drawdown, the drawdown caused by nearby pumping, and seasonal groundwater level decline, falls below the pump intake (Figure 5-2), no water can be taken from the well. If the well has sufficient depth it is in some cases possible to install the pump deeper into the well so that groundwater can be abstracted again. However, in some cases the well is too shallow, in which case a deeper well could be considered to secure a water supply.

Information on possible water supply wells being present near the project area is not readily available. This information is to be requested from Auckland Council and will be included in the substantive application. Because the general area around the site is predominantly urban the likelihood of any nearby water supply wells being present is small. However, this is to be confirmed at a later stage.

6 MONITORING

The following monitoring is recommended prior to, during and for some time after construction:

- Groundwater level monitoring to understand how the groundwater drawdown is within expected levels, and how groundwater levels change seasonally.
- If potentially sensitive buildings and structures are identified during the substantive assessment of land settlement effects, monitoring of ground settlement and possible deflection monitoring of buildings and structures is recommended during the construction phase.
- Water quality monitoring of water discharges during the construction phase is recommended to confirm if it meets the standards as part of the erosion and sediment control planning.

7 CONCLUSIONS AND RECOMMENDATIONS

The proposed Blue-Green Network (BGN) Ngā Wairau – Stage 1 A F Thomas Park project will involve excavations and the installation of a permanent drainage system to enable the creation of a stormwater storage area.

Groundwater levels are expected to be drawn down by up to 3.5 m locally, and drawdowns could be more than 2 m beyond the project area. The existing wastewater sewer pipe in the project area may be at risk of damage due to land settlement induced by groundwater drawdown. Whether other buildings or structures could be affected by land settlement will be further understood as additional field investigations and technical assessments are completed. Groundwater level, ground settlement and building deflection monitoring may be required and mitigation options are available to minimise the risks of possible adverse effects.

No water quality effects are expected and no increase in flood risks due to construction dewatering discharge are anticipated in either the temporary (i.e. construction phase) or permanent state. However, the possibility of the presence of localised groundwater contamination needs to be confirmed. Mitigation options are available to minimise the risks of groundwater contaminations being drawn into the drainage system.

No effects on baseflows of nearby streams and wetlands are expected. Groundwater level monitoring is recommended to confirm if groundwater level drawdown is within the expected range.

Water to be discharged during the construction phase will be pre-treated before discharge to the environment. Construction discharge water quality monitoring is recommended during the construction phase as part of an erosion and sediment control plan.

This is a preliminary assessment only and some findings, such as the potential for land settlement beyond the project area, will become better understood as further field investigations and modelling are completed. It is also noted that drawdown during summer may be less than currently modelled; further modelling and model calibration to improve the model's accuracy will be completed for the substantive application. Accordingly, the findings and recommendations in this report should be revisited and updated as additional data and refined modelling become available, to ensure robust and effective management of groundwater-related risks.

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8 USE AND RELIANCE

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