WAKA KOTAHI
NZ TRANSPORT AGENCY

DRURY ACCESS RAMP PROJECT

Appendix E – Groundwater Assessment Report

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New Zealand Government

More information

NZ Transport Agency
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Document Control

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Abbreviations

Abbreviation	Term
AEE	Assessment of Environmental Effects
AUP	Auckland Unitary Plan (Operative in Part 2016)
CEMP	Construction Environment Management Plan
CIA	Cultural Impact Assessment
CNVMP	Construction Noise and Vibration Management Plan
CTMP	Construction Traffic Management Plan
CVA	Cultural Values Assessment
DSI	Detailed Site Investigation
ESCP	Erosion Sediment Control Plan
GD05	Guideline Document 2016/005
HNZPT	Heritage New Zealand Pouhere Taonga
LVA	Landscape and Visual Assessment
NES Contaminated Soil	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2011
NES Freshwater	National Environmental Standards for Freshwater 2020
NIMT	North Island Main Trunk
NOR	Notice of Requirement
NPSFM	National Policy Statement for Freshwater Management 2020
NPSUD	National Policy Statement for Urban Development 2020
NUMP	Network Utilities Management Plan
NUO	Network Utility Operator
P2B	SH1 Upgrades Project between Papakura to Bombay

RMA	Resource Management Act 1991
RIA	Relevant Iwi Authorities
SH1	State Highway 1 Motorway, the Southern Motorway
SH22	State Highway 22, Great South Road
SMAF-1	Stormwater Management Areas – Flow 1
Southern IIG	Southern Iwi Integration Group
SUP	Shared Use Path
TEAP	Transport Emissions Action Plan 2021
the Project	Proposed Access Ramp at Drury Interchange
Waka Kōtahi	Waka Kōtahi NZ Transport Agency

EXECUTIVE SUMMARY

This assessment of effects on groundwater has been undertaken in accordance with the definitions set out in the Auckland Unitary Plan – Chapter E 7.6.1.10.

Excavations proximal to groundwater regimes may induce mechanical and groundwater drawdown settlement, resulting potential damage to the existing environment. To assess the potential for groundwater drawdown induced by the proposed works, groundwater monitoring has been carried out across the project area to establish an understanding of the local and regional groundwater levels across the site. Recorded levels have been assessed against the proposed earthworks and concept design to asses any potential effects on groundwater.

Based on groundwater monitoring completed to date, the proposed earthworks are not anticipated to intersect groundwater levels. Deep pile foundations associated with the proposed viaduct structure will intersect groundwater, however any drawdown will be temporary and possible resultant damage to nearby utilities and structures is assessed as negligible based on the current design.

This report outlines the measures required to ensure any effects related to groundwater interaction remain negligible, a summary of the measures is as follows:

- Ongoing groundwater monitoring should reach a full annual cycle and be undertaken prior to construction commencing, during construction and following completion of the proposed earthworks and piling, as discussed in Section 4.1; and
- To limit groundwater drawdown from the proposed piling works fluid support (bentonite or similar) will be used during drilling to support from hole collapse and will limit drawdown. Casing and/or other protection measures will be assessed as design progresses. The likelihood of localised groundwater drawdown and resultant settlement of the ground adjacent to the pile excavations is considered very low. For piles proximal to existing utilities on Flanagan Road that will not be relocated as part of the Papakura to Drury Project will be assessed and consulted with the respective NUO.

1 INTRODUCTION

1.1 Project Background Drury Interchange

This Groundwater Assessment Report supports the application lodged by Waka Kōtahi NZ Transport Agency (Waka Kōtahi) for the construction of a new southbound access ramp at Drury Interchange to provide access to the Drury Centre Project.

The proposed access ramp will tie into the Papakura to Drury Project (P2D), which is Waka Kōtahi project set to improve the safety and functionality of State Highway 1 (SH1) whilst enabling long term growth in the south of Auckland. Waka Kōtahi has structured P2D in to five stages. The most pertinent of these is Stage 1B1, which pertains to the approved upgrades of Drury Interchange. Stage 1B1 was approved under the COVID-19 Recovery (Fast Track Consenting) Act 2020 ("FTA").

In addition, the proposed site interfaces the following consented and future developments in the area:

- Future development areas in Drury;
- The Drury Centre Project
- Realigned SH1 corridor and SH22 / Great South Road as consented in Stage 1B1 of the Papakura to Drury ("P2D") project by Waka Kōtahi;
- Future proofing works along North Island Main Trunk (NIMT) rail corridor by KiwiRail as part of Papakura to Pukekōhe (P2P) rail electrification works; and

1.2 Project Description Drury Centre Access Ramp

Concept design drawings (523844-W00001-DRG-RO-0201) present a new southbound access ramp diverging from the Drury SH1 southbound off ramp north of Drury Interchange, the alignment will tie into the proposed realigned SH1 Drury Interchange approach embankment (P2D Stage B1 Project) from Ch.0 to Ch. 320. To achieve the vertical geometry to pass over Great South Road, NIMT and Flanagan Road a seven span viaduct structure will be constructed from Ch. 320 to Ch. 550, the structure will be supported using precast concrete Super-T beams and six monopile pier foundations. From Ch. 550 to 1061.75 the alignment will traverse moderately sloping ground west of the Drury Centre Project, to achieve design levels a series of cuts and fills will be adopted. At the time of preparing this report no earthworks plans had yet to be developed. The alignment will terminate at CH. 1061.75 where it connects with the Drury Centre Project and Pitt Street to the south.

In relation to this groundwater assessment the following design features have been considered:

- Foundation piling works for the construction of a 260m long seven span viaduct structure from SH1 Drury Interchange to the proposed Pitt Street intersection;
- Bulk excavations for the proposed alignment required to achieved proposed design levels.
- Two 8 m high fill retaining walls proposed from Ch. 550 to Ch. 620 and Ch. 830 to Ch. 1050, wall type yet to be confirmed, however are likely to be mechanically-stabilised earth (MSE) walls.
- Stormwater swales shown west of the proposed alignment from Ch. 190 to Ch. 300, and east of the alignment from Ch. 575 to Ch. 620 and Ch. 730 to Ch. 960. Stormwater is proposed to discharge into the Hingaia Stream using a combination vegetated berms, rock chutes and outlet downslope (west) of the alignment. No design levels for the proposed swales are shown on the Resource Consent Plans to determine proposed cut depths.

The Project takes place within the existing Flanagan Road (considered as a local road in the AUP) and existing services and utilities, which include:

- 1200mm diameter underground Waikato watermain parallel to the NIMT corridor;
- underground sewer and watermain pipes along Flanagan Road; and
- high voltage overhead lines located directly above the proposed ramp, planned to be decommission and removed prior to construction.

Further details of the proposed access ramp are shown on the Kiwi Property Drury Off Ramp Design and Consenting Multiple Disciplines Plan Set (523844-W00001-DRG-MC-0001) and plans attached in **Appendix A**.

1.3 Purpose of this Report

This groundwater assessment forms part of a suite of technical reports prepared for the proposed access ramp. Its purpose is to inform the AEE for resource consents for regional plan matters in the Auckland Unitary Plan (Operative in Part) 2016 (AUP).

Groundwater is not a matter for consideration in a NoR and so does not need to be addressed in the context of any NoR required for the Project. This assessment is therefore restricted to an assessment of groundwater effects as they relate to regional plan matters, as discussed in Section 3 of this report.

This report assesses potential groundwater drawdown resultant from construction related activities and alterations to the current environment related to the proposed Drury Access Ramp works and recommends measures to address potential adverse effects.

1.4 Available Information

Assessments discussed within this report draw on a series of information available at the time of reporting:

1.4.1.1 Drury Centre Project

The Drury Centre Geotechnical Investigation (GI) refers to ground investigations carried out by between October 2020 to March 2021. The works comprised:

- Fifteen rotary cored machine boreholes;
- Fifty five Cone Penetration Tests (CPTs);
- Five Seismic Dilatometer Tests (sDMT);
- Thirty two test pits;
- Ten hand-augered holes; and
- 5.7 km of MASW geophysical investigation surveys, as well as collating and utilizing any previous investigation data available.

The Drury Centre GI is reported in 510611-002-REP-GG-001[5] – Drury Centre Geotechnical Investigation Report dated 10th April 2022.

1.4.1.2 Papakura to Drury Stage 1B1

The P2D Stage 1B1 investigation refers to ground investigations carried out between July 2020 to October 2020, investigations were undertaken between Drury Interchange to Pitt Road, Bremner Road extending west of Ngaakooroa Stream. The works comprised:

- Nineteen rotary cored machine boreholes;
- Two hand augered holes for falling head testing;
- Thirty-six cone penetration tests;
- Six seismic cone penetration tests; and
- Eight telemetered groundwater monitoring instrumentation installations.

The Stage 1B1 GI is reported in 506207-0410-REP-GG-0079[B] - Stage 1B-1 Ground Investigation Factual Report, dated 24 January 2022.

1.4.1.3 Papakura to Drury Stage 1B1 NIMT Early Works

Additional ground investigations were undertaken by Fulton Hogan and their sub-consultant Fraser Thomas Ltd to support the Stage 1B1 NIMT early works programme. Investigations were carried out between November and December 2021. The works comprised:

- Five machine boreholes;
- Seven cone penetration tests;
- Two direct-push cross hole tests; and
- Two seismic dilatometer tests.

The Stage 1B1 NIMT Early Work GI is reported in P2D Stage 1B1 Geotechnical Factual Report 1 Fraser Thomas, dated 24 February 2022.

1.4.1.4 Proposed Access Ramp at Drury Interchange

A series of project-specific ground investigations have been undertaken to provide data on the subsurface conditions along the proposed alignment and will be presented in a forthcoming Ground Investigation Factual Report. The investigation works comprised:

- Five rotary cored machine boreholes;
- Six cone penetration tests;
- Five seismic cone penetration tests;
- Four hand augers;
- One machine auger; and
- Four test pits.

Locations for the ground investigation locations where groundwater monitoring was undertaken is shown in Appendix A Table 7-1.

1 EXISTING ENVIRONMENT

1.1 Topography and Drainage

The Project is situated in the south-east of the Manukau Lowlands, a fault-bounded sedimentary basin, with the Manukau Harbour occupying the north-west, and gently undulating lowland plains to the east and south. The Project alignment straddles the boundary between the lowland plains and the northern extent of the rolling hills of the South Auckland Volcanic Field (SAFV). Roughly 2.5 to 3 kilometres to the east of the alignment there is a marked topographic change to the much more rugged Hunua Ranges, underlain by basement greywacke (with Tertiary sedimentary and Quaternary volcanic rocks locally).

1.2 Published Geology

The published near surface geology of the project area is presented Figure 1-1. Sections 1.2.1 to 1.2.4 describe each geological unit as shown in Figure 1-1 and/ or expected within the project area. The materials encountered in the investigations appended to this report are generally consistent with the published geology presented in the Edbrooke, S.W., 2001. Geology of the Auckland area, map 3, Scale 1:250,000.

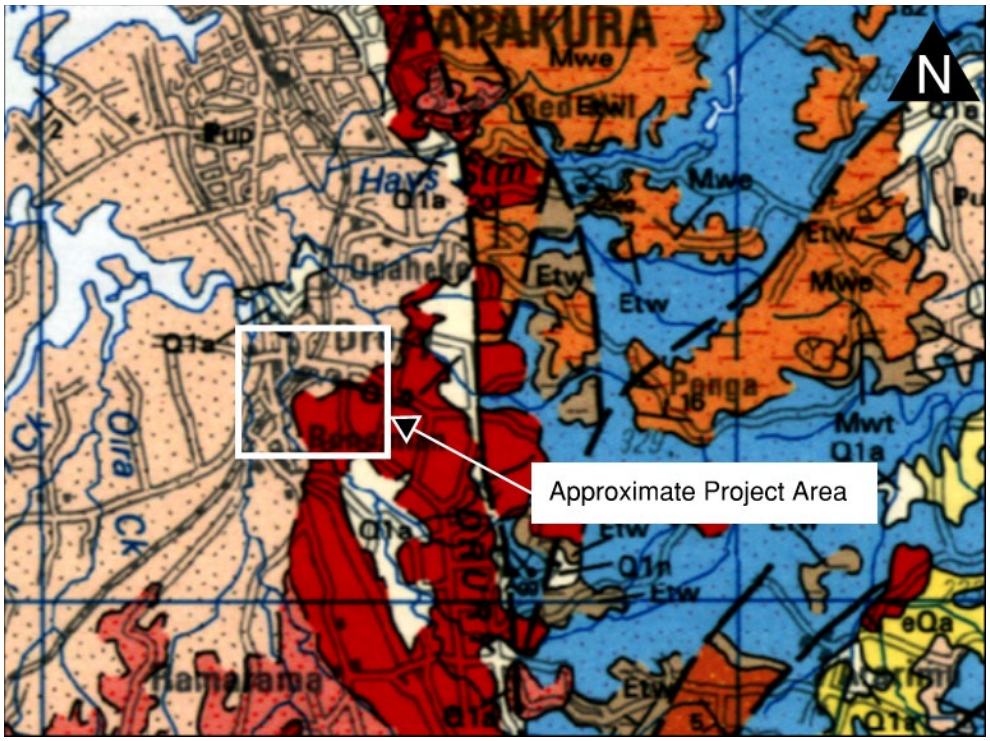

Figure 1-1: Edbrooke, S.W., 2001. Geology of the Auckland area, map 3, Scale 1:250,000.

A project-specific ground model will be presented in the forthcoming Geotechnical Interpretative Report, in the interim this groundwater assessment references ground models presented for the Drury Centre Geotechnical Investigation Report (510611-002-REP-GG-001[5], dated 10 April 2022) and the Papakura to Drury Stage 1B1 Geotechnical Interpretative Report (506207-0410-REP-GG-0080[C], dated 1 May 2023).

1.2.1 Kaawa Formation:

Pliocene aged Kaawa Formation is widely distributed in the South Auckland region and unconformably overlies the Waitamata Group. Thickness of the Kaawa Formation varies depending on the paleotopography of the Waitemata Group, regional tectonics and the local depositional environment (typically shallow marine and estuarine)

Based on the investigations completed to date, lithofacies include an upper unit of uncemented sands, approximately 20-30 m thick with interbedded sequences of shelly (varying content) sandstone, siltstone and conglomerate of variable induration, strength and weathering. Sequences are often weakly bedded and variable in thickness. The

upper uncemented sands are typically clean of clay and silt content and likely form part of the South Auckland Kaawa Aquifer.

1.2.2 Tauranga Group Alluvium (Undifferentiated):

Late Pliocene to Early Pleistocene aged alluvium is typically 5 m to 60 m thick in the Auckland region and comprises unconsolidated silts and clays, sand, gravelly sand, often interbedded with peat and organic rich clays, and pumiceous materials grading from silt to gravel clasts. These near surface deposits are mapped in the lowlands from Mangere to Drury and underlie much of the project area.

1.2.3 South Auckland Volcanic Field:

Pliocene to mid-Pleistocene basaltic lava flows, ash, lapilli, and tuff deposits of the South Auckland Volcanic Field (SAVF) are mapped in the southern section of the site. Lithofacies of the SAVF are highly variable due to age, erosion, and weathering (Qvs). The proposed alignment is mapped to run parallel to western extent of basaltic lava flows sourced from volcanism south-east of the project area.

1.2.4 Fill

Fill of variable thickness is present beneath existing carriageways (SH1, Great South Road) and the existing NIMT corridor to achieve the current alignment grade. Fill associated with existing structures is typically more than two metres in thickness and is comprised of either compacted locally sourced cohesive material or compacted granular material. Zones of non-engineered fill are expected immediately adjacent to the project designation boundary within privately owned land parcels. Areas of localised uncontrolled filling containing waste materials and/or contaminants may be present within the proposed earthworks area.

1.5 South Auckland (Pukekohe) Geological Map

On 2 May 2023, GNS released the 1:50,000-scale geological map of the South Auckland (Pukekohe) area and revised lithostratigraphic framework. Most relevant to the Project is that GNS considered the usage of Tauranga Group (originally defined in the Waikato) and Kaawa Formation (Awhitu) extended too far from their original definitions (in terms of geography, lithology and age). GNS observed that the application of these units across much of Auckland (in engineering geology and for groundwater purposes) had become confused and contradictory (as users have tried to apply inadequate existing published units). As part of the revised framework the former Tauranga Group and Kaawa Formation units now form part of the Takaanini Formation which is further divided into sub-units differentiated by their lithofacies.

In order to maintain consistency with both the Papakura to Drury (P2D) and Drury Centre Projects Aurecon continues to in log in accordance with Kermode's framework.

1.3 Groundwater Flow

1.3.1 Regional overview

The South Auckland region comprises various groundwater regimes; shallow and perched groundwater networks, and aquifer groundwater regimes classified as the Pukekohe Volcanics, Kaawa Formation and Waitemata Group aquifers.

Groundwater regimes within the Manukau Lowlands are generally recharged from the south-east, sourced from the Bombay Hills and Hunua Ranges and flow in a north-west direction discharging into tributaries of the Manukau Harbour. Depth of the near surface groundwater regimes typically follow local topography, controlled by surficial confining units.

Perched groundwater tables may be encountered within the South Auckland region, heterogeneous profiles of alternating cohesive and granular layers and/or rock from the Tauranga Group and South Auckland Volcanic Field

act as confining units enabling horizontal flow but restrict vertical seepage. Perched groundwater may form from springs, rainfall, surface runoff, or groundwater separation from confining layers.

South Auckland aquifer regimes are generally interconnected enabling recharge and discharge between the networks. The Kaawa aquifer which intersects the alignment is known to recharge from the Bombay Hills and the Pukekohe Volcanics aquifer. Rock and cohesive soils within the Kaawa Formation and the Tauranga Group confine groundwater forming a pressurised artesian system, flow is understood to be through the uncemented, porous sands, studies completed by Viljevac (2002) infer the Kaawa Formation aquifer is constrained by regional faulting and discharge is likely along ENE-trending faults (Karaka, Waiau and Glenbrook Faults).

1.3.2 Groundwater Heads

Available groundwater level (head) data collected for the Project was collected in two forms:

- Dip measurements during drilling operations and post piezometer standpipe installation; and
- Continuous groundwater monitoring remotely collected from five Solinst Leveloggers.

Groundwater monitoring records are presented in Appendix B Table 7-1.

2 ASSESSMENT METHODOLOGY

2.1 Proposed Project Design

At the time of preparing this report the Project is in the conceptual design stage; groundwater assessments discussed within this report are based on the relevant design stage. As design progresses, we anticipate changes or modifications to design may require revisions or reassessment of groundwater effects, as such, this assessment will be further developed as required.

2.2 Sources of Settlement

Groundwater drawdown may occur from bulk excavations intersecting groundwater, effects of drawdown may result in settlement to adjacent buildings or structures. Settlement is considered the potential effect to groundwater modifications. Potential settlement of land or foundations adjacent to the proposed Project area may result from two settlement mechanisms:

- Mechanical settlement – Physical movement of the ground due to stress change in a soil profile. Mechanical settlement may be induced by volume loss from underground or supporting structures, or through bulk excavation / trenching. Typically, mechanical settlement occurs relatively quickly and can be mitigated through design and construction methodology.
- Consolidation settlement – formed through the lowering of a static groundwater level. Volume reduction within a soil profile occurs following the reduction of porewater pressure in a soil profile. Consolidation settlement outside the designation boundary may occur where the groundwater is permanently lowered due to excavation of retaining walls, trenches or swales below groundwater level. The zone of influence is dependent on soil compressibility, make-up of the soil layer and the groundwater regime.

Settlement can generally be managed during design staging or by the adoption of sound construction practices. The contractor shall utilise best practice construction methodologies for proposed excavations, trenching and structures.

3 ASSESSMENT OF EFFECTS

This section discusses the potential effects to groundwater related to the proposed works; the magnitude and location of anticipated drawdown and associated potential settlement of adjacent buildings or structures.

Assessments draw on the conceptual design, as design progresses the potential effects should be re-evaluated.

3.1 Cuts

The impact of the Project on groundwater should largely arise from bulk excavation in the form of cuts for carriageway construction. Based on Roads Plan and Longitudinal Section (523844-W00001-DRG-RO-0201) two significant cuts are proposed, details are as follows:

- A proposed cut from Ch. 620 to Ch. 720 will grade in height but proposed to reach a maximum depth of 4m to achieve a design elevation of 17.9mRL. Groundwater data from BH011, located approximately 30m from the proposed cut, shows the groundwater to range between 8.35m and 9.95m BGL (9.65m and 8.45mRL), indicating the proposed cut will not interact with or drawdown local groundwater levels.
- From Ch. 780 to Ch. 860 a 1.5m deep cut is proposed to achieve a design level of 17.9mRL. Groundwater data from BH006 which is located approximately 75m from the proposed cut shows groundwater to range between 4.99m and 7.35m BGL (14.01m and 11.65mRL). It is therefore unlikely that this proposed cut will intersect the groundwater.
- As the proposed cuts are not predicted to intersect the groundwater, drawdown and subsequent settlement is not anticipated. However, if groundwater drawdown were to occur, no existing structures fall within 100m of the proposed cut locations, as such potential effects would be negligible.
- As these cuts are not predicted to intercept groundwater, they are considered a Permitted Activity based on the definitions set out in the Auckland Unitary Plan – Chapter E 7.6.1.10.

3.2 Viaduct Pier Foundations

The viaduct structure will be supported on pier foundations using deep monopile solutions, design depths have yet to be confirmed, however due to the deep alluvial profile it is anticipated the piles will extend 60m or greater to found in the underlying Kaawa Formation sandstone. The following is assessed:

- Although the proposed pile foundations are expected to intersect the groundwater, it is proposed that the pile foundations will be drilled with fluid support (bentonite or similar) to eliminate the need for de-watering and short term groundwater drawdown. Long term groundwater drawdown caused from deep piling is considered negligible due to the temporary nature of the works, it is anticipated each pile will be completed within 20 consecutive days.
- Two existing watermains fall within 10m of the proposed Pier 5 location. A summary of the utilities is outlined in Table 3-1.

Table 3-1: Pipe details in the vicinity of the works

Utility	Predicted min horizontal clearance	Requested min horizontal clearance to Utility Owner		Material	Approx. depth below construction work level
Watercare 1200 Watermain (WW-03) (concrete pipe)	1.5m	1.5m		Concrete Lined Steel	1.6m

Utility	Predicted min horizontal clearance	Requested min horizontal clearance to Utility Owner		Material	Approx. depth below construction work level
Watercare Double Rising Wastewater (WW-01 and WW-02) (plastic pipe)	1.35m	1.0m		315OD and 450OD PE	6.2m
Veolia 450 Watermain (VW-01) (plastic pipe)	1.4m	1.0m		450OD PE	1.4m

- Groundwater data from AU22-BH003 which is our nearest data point to Pier 5 shows the groundwater at levels of between 2.28m and 2.55m BGL or between RL +7.13mRL and +7.65mRL.
- The nearest piling location at Pier 5 is at least 10m from the identified services, given the proposed construction methodology and provided the location of the pile locations does not change, we do not anticipate long term groundwater drawdown, therefore consider the likelihood of drawdown related settlement within the vicinity of the utilities is considered to be negligible. Following confirmation of the pier locations a reassessment will be completed to determine potential effects to the existing utilities.
- We note that a Works Over approval from Watercare Services Limited (WSL) will likely be required for the proposed pile excavation at Pier 5. Ongoing consultation with WSL will take place during detailed design.
- The proposed pile foundations are expected to be approximately 2 in diameter, under the guidelines set out in the Auckland Unitary Plan (Rule E7.4.1 (A28)), this exceeds the Permitted Activity standards and will require Resource Consent as a Restricted Discretionary Activity. However as stated above, the proposed pile excavations will be drilled with fluid support, thus eliminating any short-term groundwater drawdown. Long term groundwater drawdown caused from deep piling is considered negligible due to the temporary nature of the works, it is anticipated each pile will be completed within 20 consecutive days.
- The site does not fall within either the “High Use Aquifer Management Areas” or the “Quality-Sensitive Aquifer Management Areas” presented by Auckland Council.

3.3 Trenching

At the time of preparing this report trenching for the provision of horizontal infrastructure has not been assessed in detail for the design. It is anticipated that trenching will be required to accommodate stormwater and utilities.

Trenching has the potential to result in long-term groundwater drawdown as trench lines are typically backfilled with higher permeability fill that can create flow paths for groundwater. Trench lines for services are typically in the order of 2 m deep, however, may extend deeper locally to meet clearance requirements or to avoid clashing for other services. The Project trenching requirements will vary to accommodate clearance and design requirements.

All nominated trenching for the Project is currently defined as a Permitted Activity based on the definitions set out in the Auckland Unitary Plan – Chapter E 7.6.1.10.

Trench lines for stormwater, water and wastewater mains are often set deeper to achieve the required longitudinal grades, all deep trenches will be reassessed as the design progresses to assess potential groundwater drawdown and associated effects. Groundwater drawdown in trenches will be mitigated in design through installation of water-stops as required.

4 RECOMMENDATIONS

4.1 Mitigation and Monitoring

Although no settlement related effects are predicted for the proposed development it is good practice to continue groundwater monitoring, this report will be updated as more groundwater data becomes available.

Monitoring should be undertaken before construction commences, during construction and following completion, paying close attention to peaks and troughs in the groundwater levels near the alignment.

Pile foundation excavations are proposed to be drilled with fluid support eliminating the need for dewatering and potential drawdown. If the proposed construction methodology changes, pile excavations should be undertaken in a timely manner, with the piles being constructed as soon as possible after excavation to minimise any effects on groundwater, and resultant drawdown related settlement.

Specific construction methodology should be adopted and provided in the Construction Management plans, considering the presence of a designated aquifer nearby, and should contain contingency plans for the event that artesian water pressure is encountered.

4.2 Limitations and Further Work

The assessment completed to date has been based on several assumptions and limitations and will need to be refined during detailed design. These assumptions and further works / next steps are likely to include, but are not limited to:

- Updating the assessment to reflect the detailed alignment;
- Updating the assessment as further site investigations are undertaken;
- Updating the assessment as monitoring continues and more groundwater data becomes available;
- An assessment of the effects of vibrations and piling and construction equipment which also has the potential to cause damage to the existing environment and has been assessed within Proposed Access Ramp at Drury Interchange – Appendix P – Noise and Vibration Assessment (Ref 523844-W00001-REP-EN-0007, dated 13/07/2023).

5 LIMITATIONS

5.1 Available Information

5.1.1 Groundwater Data

- Groundwater levels vary seasonally, as such greater confidence should be applied to monitoring presenting a full annual cycle (one year or longer). This report presents limited groundwater data due to recent installations within the Project area, on this basis it is recommended this assessment is reviewed after monitoring has reached a full annual cycle.
- Monitoring devices installed for the Project are intended to present the total Project area and key structures; however, variability in both the geology and hydrology may contribute to variability in the groundwater levels presented at monitoring locations and the offset to the assessed location or feature.

6 CONCLUSIONS

Based on our understanding of the local groundwater regime and proposed design of the Project, the following conclusions can be made:

- The groundwater depths vary across the Project alignment with elevations ranging from 17.9m RL to 3.5m RL. Groundwater is recharged from the Hunua Ranges and Bombay Hills and discharged along tributaries of the Drury-Opaheke catchment and intersecting fault lineaments. Flow is in a north-east direction.
- No cut locations have been identified to intersect near surface groundwater:
- The proposed pier foundations are to be approximately 2 m in diameter, under the guidelines set out in the Auckland Unitary Plan (Rule E7.4.1 (A28)), this exceeds the Permitted Activity standards and will require Resource Consent as a Restricted Discretionary Activity. No long term drawdown will occur from the proposed piling works. Potential effects of groundwater drawdown related settlement are considered to be negligible.
- At the time of preparing this report the Project is at concept design stage, we anticipate changes to design will occur through later design stages. As design progresses this assessment will be revised.

7 REFERENCES

Viljevac, Z., Murphy, G., Smaill, A., Crowcroft, G. & Bowden, D. (2002). South Auckland Groundwater, Kaawa Aquifer Recharge Study and Management of the Volcanic and Kaawa Aquifers, Auckland Regional Council, 1-85.

Edbrooke, S.W., 2001. Geology of the Auckland area, map 3, Scale 1:250,000.

APPENDIX A – GROUNDWATER MONITORING LOCATIONS

LEGEND

- HAND AUGER (AURECON)
- MACHINE AUGER (AURECON)
- BOREHOLE (AURECON)
- CPT (AURECON)
- SEISMIC CPT (AURECON)

EXTENT OF WORKS

JOINS SHEET 2

10 15

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SCALE 1:500 (5 0 10 20m)

All written dimensions take precedence over scaled dimensions.

PREPARED BY

aurecon
www.aurecongroup.com

CLIENT

Kiwi Property
WAKA KOTAHI NZ TRANSPORT AGENCY

CLIENT DOCUMENT NUMBER | REV

Coordinate system MT EDEN 200
Height datum NZVD16

PRINT ALL COPIES IN COLOUR

CONSTRUCTION STATUS: NOT FOR CONSTRUCTION

DRAWN BY: S.GOURLEY

DESIGNED BY: J.HARRISON

STATUS: STARTED | CODE: W1

DOCUMENT STATE: WORK IN PROGRESS

PROJECT: KIWI PROPERTY DRURY OFF RAMP RESOURCE CONSENT

TITLE: GEOTECHNIAL GROUND INVESTIGATION LAYOUT PLAN SHEET 1

DOCUMENT CODE: 523844-W00001-DRG-GG-0101

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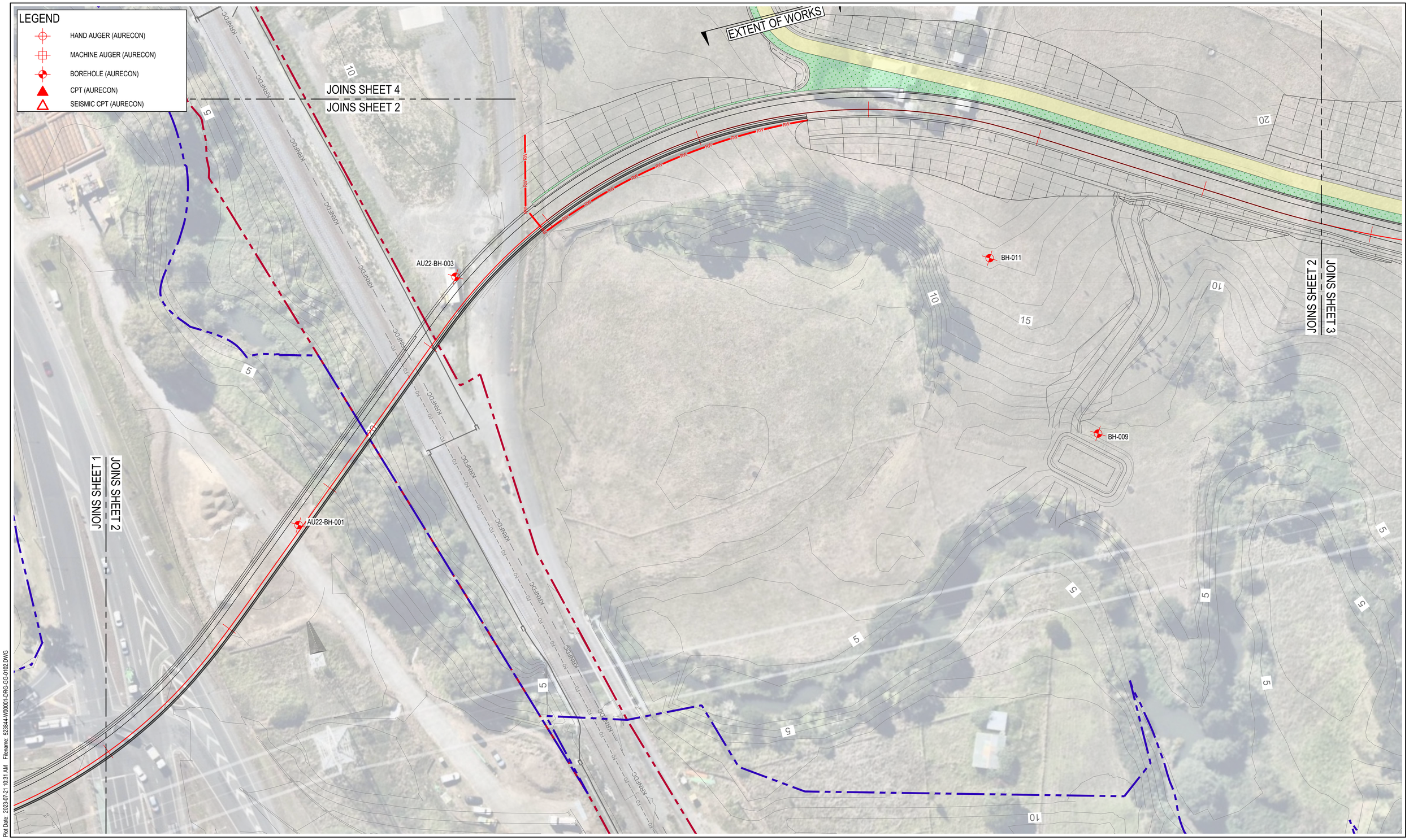

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5 0 10 20m
SCALE 1:500

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Coordinate system
MT EDEN 200
Height datum
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PROJECT
KIWI PROPERTY DRURY OFF RAMP RESOURCE CONSENT

TITLE
GEOTECHNIAL GROUND INVESTIGATION LAYOUT PLAN SHEET 2

DOCUMENT CODE
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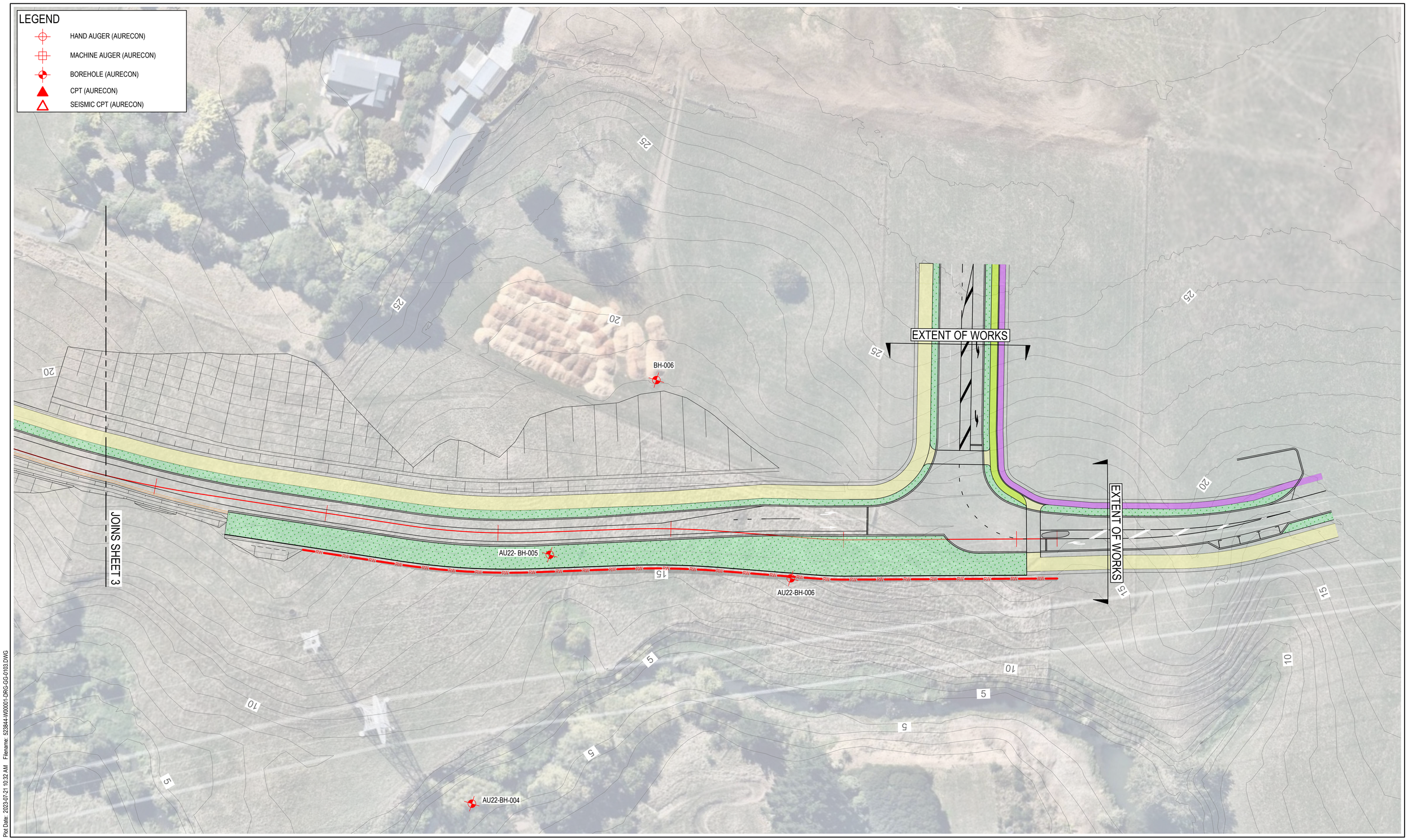

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REV	DATE	REVISION DETAILS	REV	DRAWN	DESIGNED	VERIFIED	APPROVED
A01.01	2023-07-21	FOR INFORMATION	A01.01	S.GOURLEY	J.HARRISON	S.MACKAY	L.LAING

5 0 10 20m
SCALE 1:500

All written dimensions take precedence over scaled dimensions.

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CLIENT

Kiwi Property
WAKA KOTAHI NZ TRANSPORT AGENCY

CLIENT DOCUMENT NUMBER | REV

Coordinate system
MT EDEN 200
Height datum
NZVD16

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CONSTRUCTION STATUS
NOT FOR CONSTRUCTION

DRAWN BY
S.GOURLEY

DESIGNED BY
J.HARRISON

STATUS | CODE
STARTED | W1

DOCUMENT STATE
WORK IN PROGRESS

PROJECT
KIWI PROPERTY DRURY OFF RAMP RESOURCE CONSENT

TITLE
GEOTECHNIAL GROUND INVESTIGATION LAYOUT PLAN SHEET 3

DOCUMENT CODE
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REV	DATE	REVISION DETAILS	REV	DRAWN	DESIGNED	VERIFIED	APPROVED
A01.01	2023-07-21	FOR INFORMATION	A01.01	S.GOURLEY	J.HARRISON	S.MACKAY	L.LAING

5 0 10 20m
SCALE 1:500

All written dimensions take precedence over scaled dimensions.

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CLIENT DOCUMENT NUMBER | REV

Coordinate system MT EDEN 200
Height datum NZVD16

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CONSTRUCTION STATUS: NOT FOR CONSTRUCTION
DRAWN BY: S.GOURLEY
DESIGNED BY: J.HARRISON
STATUS: STARTED | CODE: W1
DOCUMENT STATE: WORK IN PROGRESS

PROJECT: KIWI PROPERTY DRURY OFF RAMP RESOURCE CONSENT
TITLE: GEOTECHNIAL GROUND INVESTIGATION LAYOUT PLAN SHEET 4
DOCUMENT CODE: 523844-W00001-DRG-GG-0103

SCALE	SIZE	REFERENCE No.	REV
AS SHOWN	A1	DRG-GG-0104	A01.01

APPENDIX B – GROUNDWATER MONITORING

Groundwater Monitoring

Groundwater monitoring locations and installations details are listed in Table 7-1 and presented in Appendix A.

Table 7-1 Drury Off Ramp Location and installation details

Borehole ID	Coordinates (1)		Collar (m RL) (2)	Screened Interval		Screened Unit
	Easting (mE)	Northing (mN)		m BGL	m RL (2)	
AU22-BH003	416424.82	774695.61	9.62	3.0 to 5.5	6.62 to 4.12	silt/clay mixtures (Tauranga Group)
AU22-BH004	416455.16	774667.07	10.93	9.0 to 11.0	1.93 to -0.07	sand/silt/clay mixtures (Tauranga Group)
AU22-BH005 (Deep Screen)	416530.6	774332.3	11.096	14.0 to 16.0	-2.90 to -4.90	silt (Tauranga Group)
AU22-BH006	416544.9	774263.8	11.256	5.5 to 7.5	5.76 to 3.76	silt/clay mixtures (SAVF)

1. Coordinates and bearings are with reference to Mount Eden 2000 Circuit (NZGD2000) coordinate projection.
2. Elevations are with reference to New Zealand Vertical Datum 2016 (NZVD2016).

Table 7-2 Drury Centre Location and installation details

Borehole ID	Coordinates (1)		Collar (m RL) (2)	Screened Interval		Screened Unit
	Easting (mE)	Northing (mN)		m BGL	m RL (2)	
BH001	417191	774155	24	12.2 to 15.2	11.8 to 8.8	Weathered basalt (SAVF)
BH003	416917	774329	23	6.1 to 9.1	16.9 to 13.9	Silt/clay/gravel mixtures (SAVF)
BH005	416795	774189	22	9.0 to 12.0	13.0 to 10.0	Silt/clay and weathered basalt (SAVF)
BH006	416588	774318	19	12.0 to 15.0	7.0 to 4.0	Weathered basalt (SAVF)
BH007	416790	774485	15	9.0 to 11.0	6.0 to 4.0	Gravel/clay mixtures (SAVF)
BH009	416437	774505	8	6.0 to 9.0	2.0 to -1.0	Clay/silt mixtures (Tauranga Group)
BH011	416476	774550	18	12.0 to 15.0	6.0 to 3.0	Sand/silt mixtures (Tauranga Group)
BH015	416594	774710	18	3.0 to 6.0	15.0 to 12.0	Clay/silt mixtures (SAVF)
BH016	416713	774752	12.5	7.0 to 10.0	5.5 to 2.5	Silt/sand/clay mixtures (Tauranga Group)

1. Coordinates and bearings are with reference to Mount Eden 2000 Circuit (NZGD2000) coordinate projection.
2. Elevations are with reference to New Zealand Vertical Datum 2016 (NZVD2016).

Summary of groundwater elevation ranges are presented in Table 7-3 and represent monitoring through to 30 May 2023.

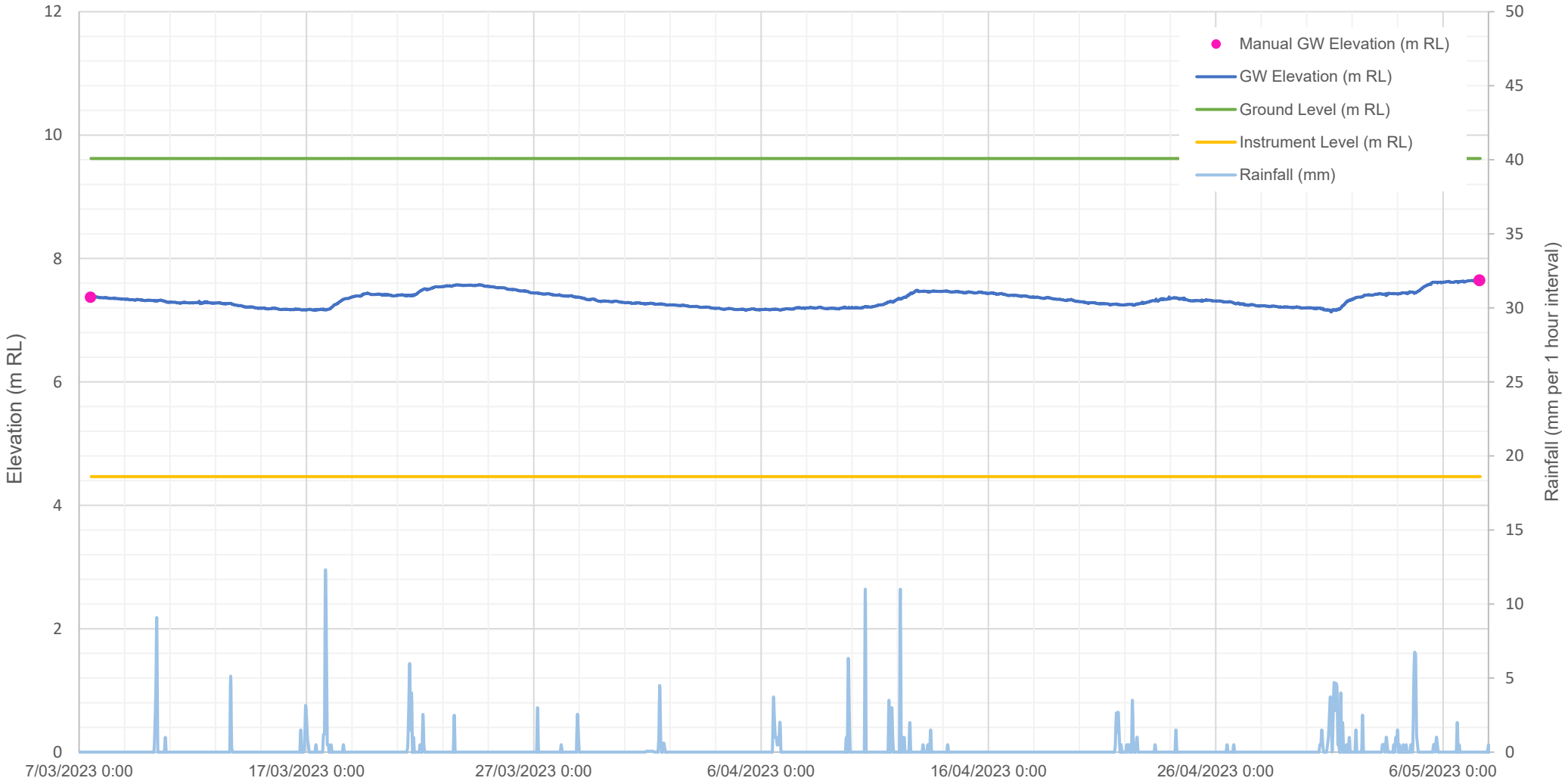
Table 7-3 Summary of groundwater data

Piezometer ID	Date of Installation	Static Groundwater Level (m, RL)			Groundwater Level from top of collar (m, BGL) (1)		
		Minimum	Mean	Maximum	Minimum	Mean	Maximum
AU22-BH003	28/11/2022	7.13	7.65	7.33	2.28	2.80	2.60
AU22-BH004	14/11/2022	6.88	6.79	6.88	4.05	4.14	4.32
AU22-BH005	20/02/2023	6.13	6.60	6.29	4.50	4.96	4.81
AU22-BH006	21/02/2023	7.53	8.12	7.66	3.13	3.73	3.60
BH001	22/11/2020	12.55	14.25	17.7	6.30	9.75	11.45
BH003	02/12/2020	14	15.67	16.51	6.49	7.33	9.00
BH005	30/11/2020	13.29	14.39	17.93	4.07	7.61	8.71
BH006	17/12/2020	11.65	12.32	14.01	4.99	6.68	7.35
BH007	03/12/2020	10.19	10.47	10.75	4.25	4.53	4.81
BH009	18/12/2020	3.53	3.61	3.67	4.33	4.39	4.47
BH011	15/01/2021	8.45	8.76	8.65	9.35	9.24	9.55
BH015	09/12/2020	12.23	12.42	12.77	5.23	5.58	5.77
BH016	08/12/2020	7.48	7.71	7.95	4.55	4.79	5.02

1. Maximum and minimum readings between static groundwater levels presented in m RL and groundwater levels from top of collar m BGL are the inverse of one another, i.e. *minimum reading in m BGL is the equivalent to maximum m RL readings*.

Depths of groundwater were recorded during the progression of each boreholes and immediately following completion. These groundwater levels are presented on each respective investigation record, it should be noted that borehole drilling methods introduce water to the ground formation as a drilling fluid, use of groundwater levels recorded during and immediately following completion of drilling should be used with caution and indicative only.

AU22-BH003 - Groundwater Monitoring



1) Groundwater is barometric corrected.
2) Rainfall source is approx. 4.6 km (Karaka Walters Rd) from the Drury Central Station project area, measurements are up to 7 May 2023, source - Auckland Council Environmental Data Portal.
3) AU22-BH003 collar is 9.92 m RL.
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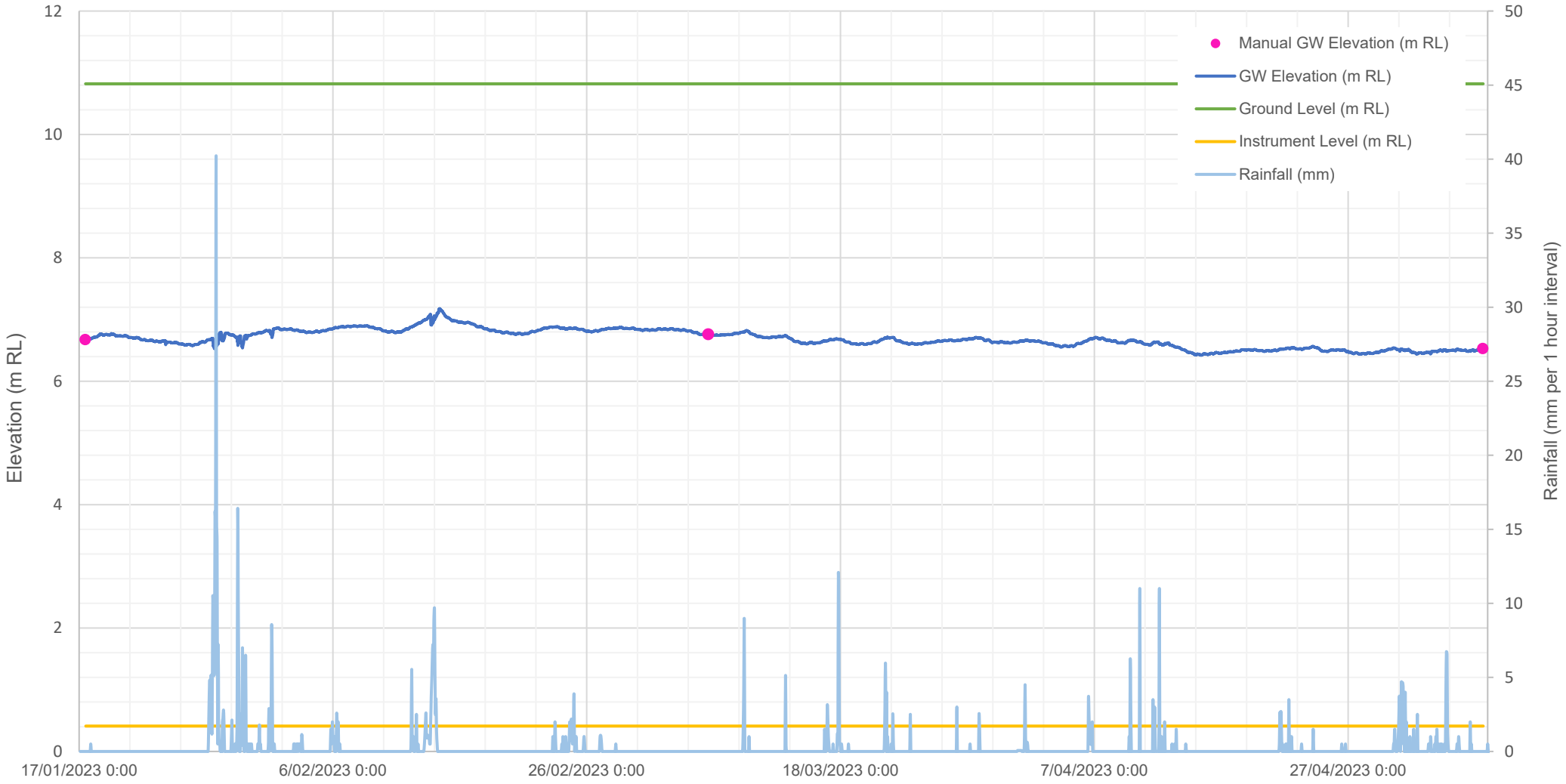
AU22-BH004 - Groundwater Monitoring



1) Groundwater is barometric corrected.
2) Rainfall source is approx. 4.6 km (Karaka Walters Rd) from the Drury Central Station project area, measurements are up to 7 May 2023, source - Auckland Council Environmental Data Portal.
3) AU22-BH004 collar is 10.82 m RL.
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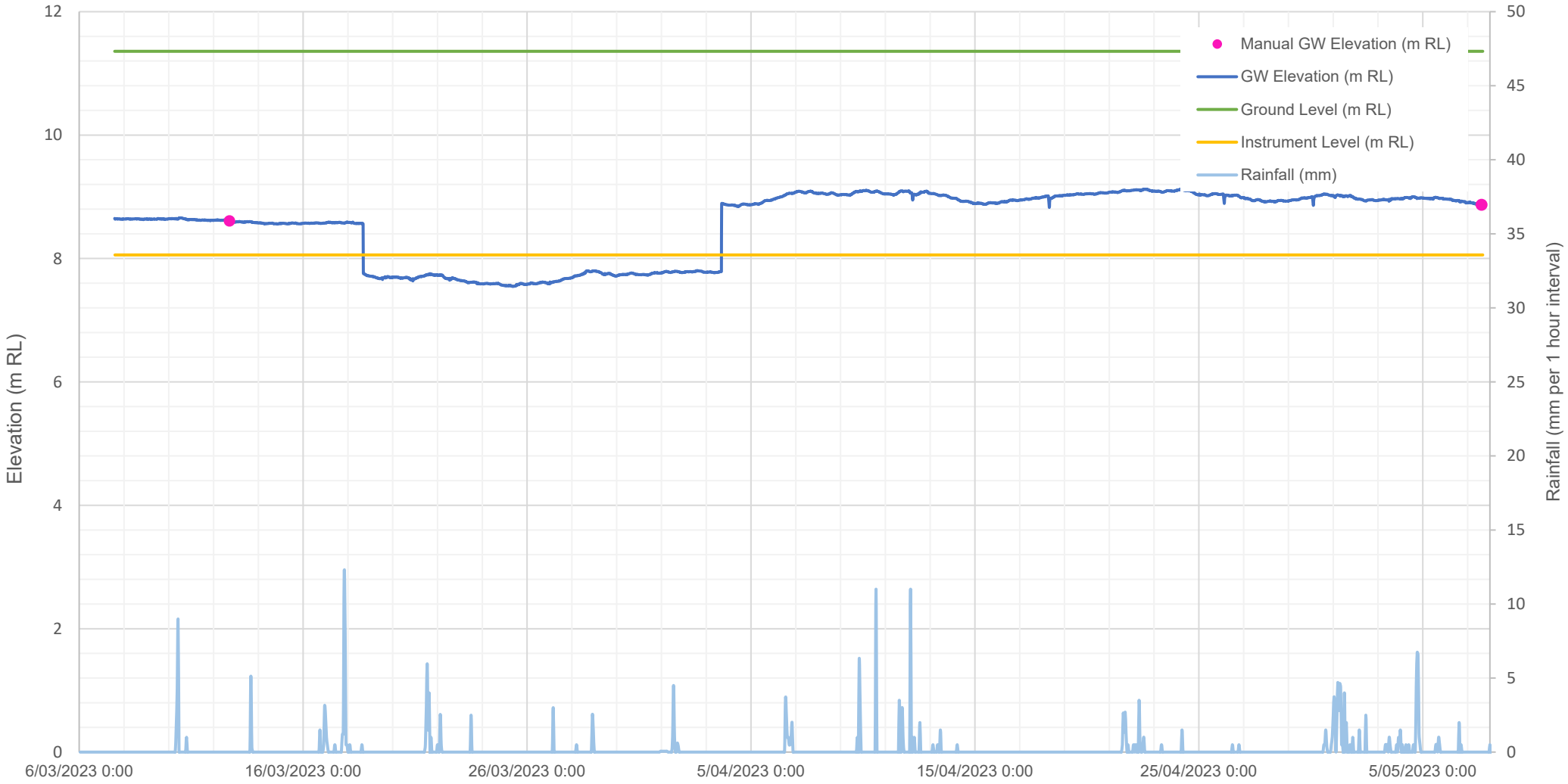
AU22-BH005 - 1.5 - 3.5 m Screen (Bgs) - Groundwater Monitoring



1) Groundwater is barometric corrected.
2) Rainfall source is approx. 4.6 km (Karaka Walters Rd) from the Drury Central Station project area, measurements are up to 7 May 2023, source - Auckland Council Environmental Data Portal.
3) AU22-BH005 (1.5 - 3.5m) collar is 11.358 m RL.
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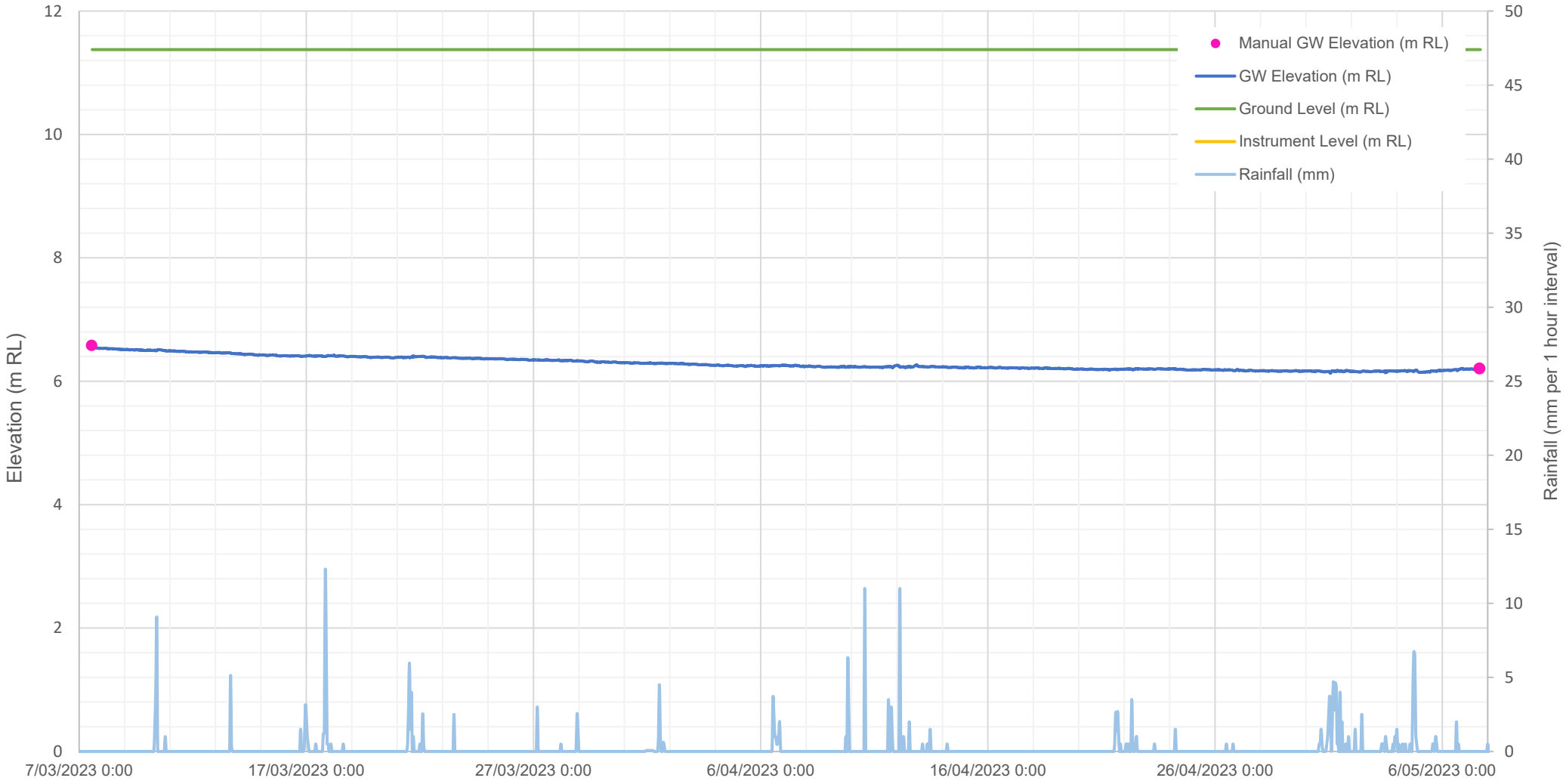
AU22-BH005 - 14.0 - 16.0 m Screen (Bgs) - Groundwater Monitoring



1) Groundwater is barometric corrected.
2) Rainfall source is approx. 4.6 km (Karaka Walters Rd) from the Drury Central Station project area, measurements are up to 7 May 2023, source - Auckland Council Environmental Data Portal.
3) AU22-BH005 (14.0 - 16.0m) collar is 11.375 m RL.
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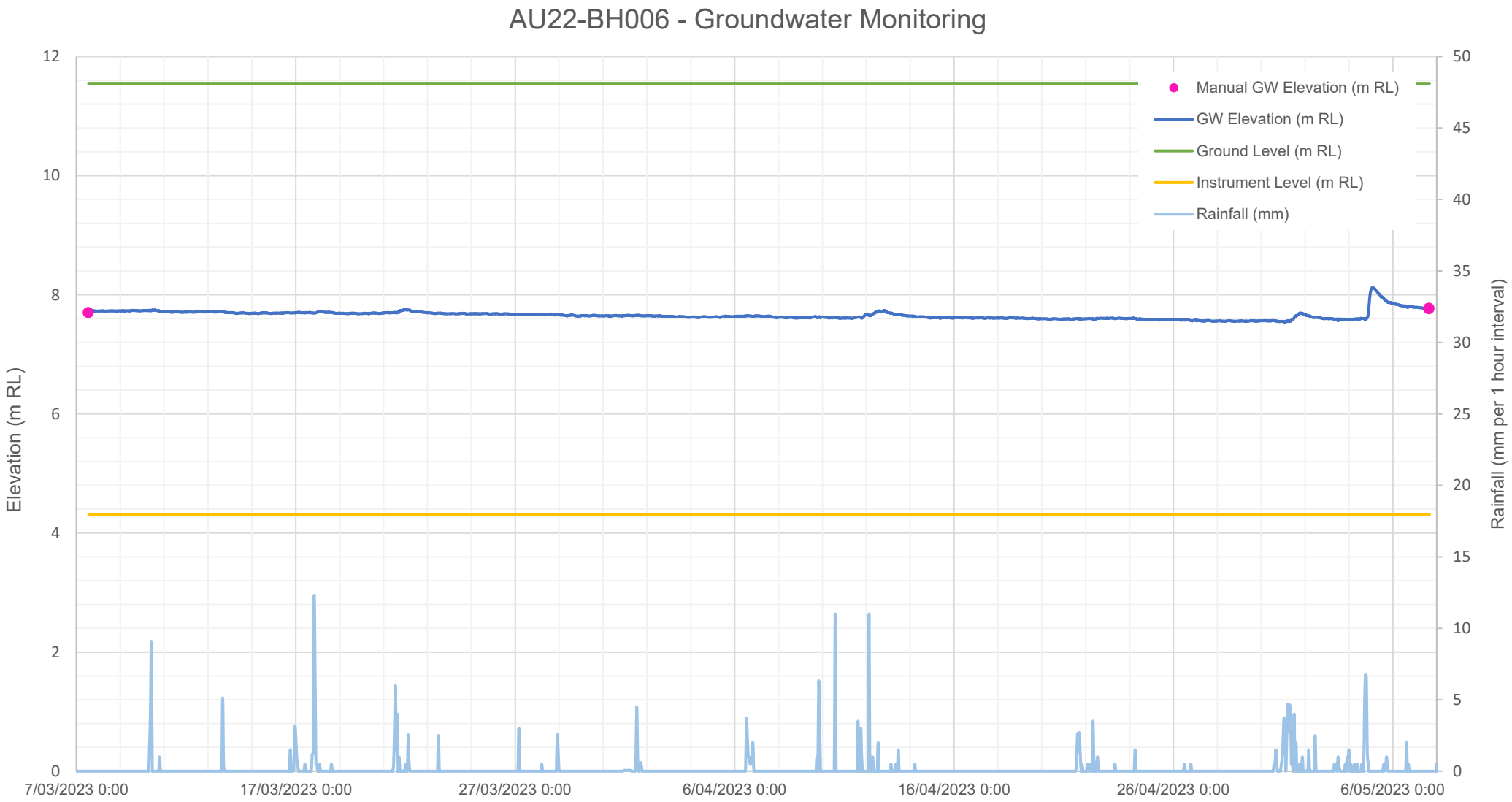

1) Groundwater is barometric corrected.
2) Rainfall source is approx. 4.6 km (Karaka Walters Rd) from the Drury Central Station project area, measurements are up to 7 May 2023, source - Auckland Council Environmental Data Portal.
3) AU22-BH006 collar is 11.55 m RL.
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