Eastern Busway
EB2 and EB3 Residential

Groundwater Permitted Activity Assessment

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Eastern Busway

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List of Abbreviations and Definitions

Abbreviation and Definitions	Description
AEE	Assessment of Effects on the Environment
AUP(OP)	Auckland Unitary Plan (Operative in part) 2016
BPO	Best practicable option
CMA	Coastal Marine Area
EB1	Eastern Busway 1 (Panmure to Pakuranga)
EB2	Eastern Busway 2 (Pakuranga Town Centre)
EB3 Commercial/ EB3C	Eastern Busway 3 (Pakuranga Creek to Botany)
EB3 Residential/ EB3R	Eastern Busway 3 (SEART to Pakuranga Creek)
EB4	Eastern Busway 4 (link between Ti Rakau Drive and Te Irirangi Drive, Botany Town Centre Station)
EBA	Eastern Busway Alliance
km	Kilometre(s)
m	Metre(s)
m^2	Square Metre(s)
m^3	Cubic Metre(s)
NoR	Notice of Requirement
AUP(OP)	Auckland Unitary Plan (Operative in part) 2016
RTN	Rapid Transit Network
RRF	Reeves Road Flyover
RMA	Resource Management Act 1991

1 Introduction

1.1 Overview of the Eastern Busway Project

The Project is a package of works focusing on promoting an integrated, multi-modal transport system to support population and economic growth in southeast Auckland. This involves the provision of a greater number of improved public transport choices and aims to enhance the safety, quality and attractiveness of public transport and walking and cycling environments, and includes:

- 5km of two-lane busway
- New bridge for buses across Pakuranga Creek
- Improved active mode infrastructure (walking and cycling) along the length of the busway
- Three intermediate bus stations
- Two major interchange bus stations.

The Project forms part of the previous Auckland Manukau Eastern Transport Initiative (AMETI) programme (the programme) which includes a dedicated busway and bus stations between Panmure, Pakuranga and Botany town centres. The dedicated busway will provide an efficient rapid transit network (RTN) service between the town centres, while local bus networks will continue to provide more direct local connections within the town centre areas. The Project also includes new walking and cycling facilities, as well as modifications and improvements to the road network.

The programme includes the following works which do not form part of the Eastern Busway Project:

- Panmure Bus and Rail Station and construction of Te Horeta Road (completed)
- Eastern Busway 1 (EB1) – Panmure to Pakuranga (completed).

The Project consists of the following packages:

- Early Works Consents – William Roberts Road (WRR) extension from Reeves Road to Ti Rakau Drive (LUC60401706); and Project Construction Yard at 169 – 173 Pakuranga Road (LUC60403744).
- Eastern Busway 2 (EB2) – Pakuranga Town Centre, including the Reeves Road Flyover (RRF) and Pakuranga Bus Station **(this Assessment)**
- Eastern Busway 3 Residential (EB3R) – Ti Rakau Drive from the South Eastern Arterial (SEART) to Pakuranga Creek, including Edgewater and Gossamer Intermediate Bus Stations **(this Assessment)**
- Eastern Busway 3 Commercial (EB3 Commercial) – Gossamer Drive to Guys Reserve, including two new bridges, and an offline bus route through Burswood
- Eastern Busway 4 – Guys Reserve to a new bus station in the Botany Town Centre, including a link road through Guys Reserve.

The overall Project is shown in Figure 1 below.

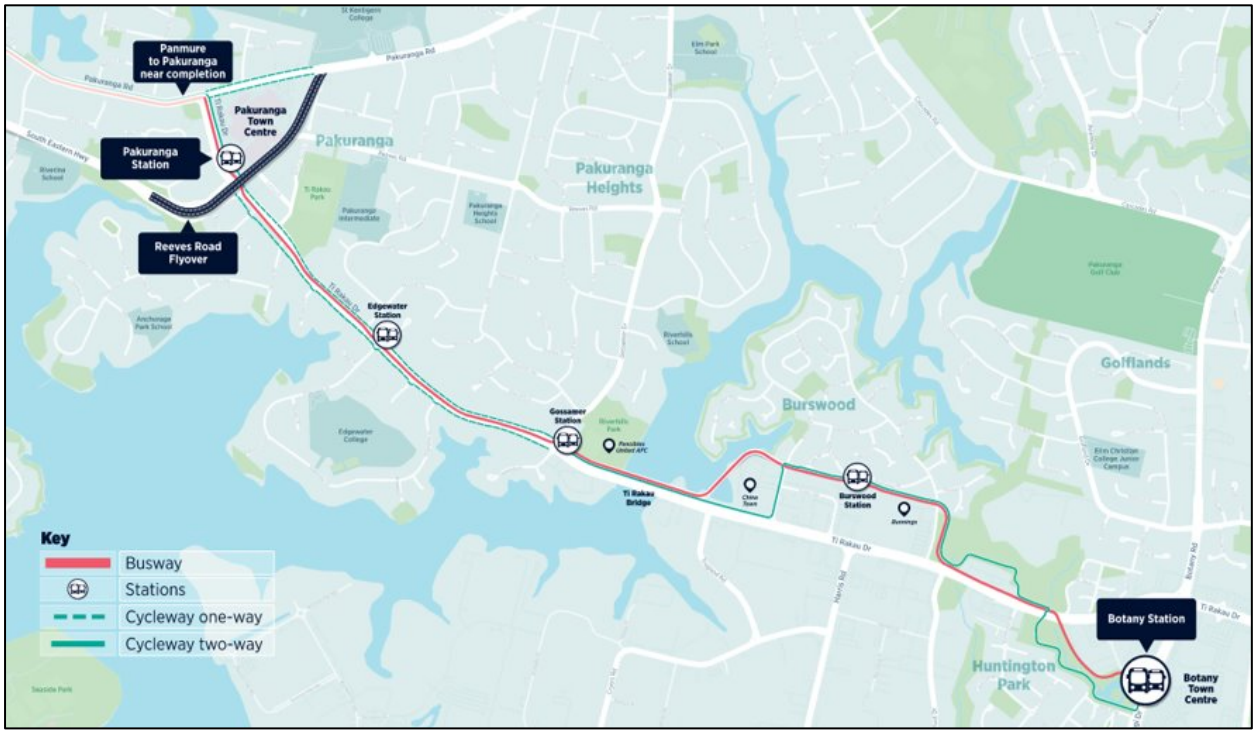

Figure 1. Project alignment

1.2 Project Objectives

The Project objectives are:

1. Provide a multi modal transport corridor that connects Pakuranga and Botany to the wider network and increases access to a choice of transport options
2. Provide transport infrastructure that integrates with existing land use and supports a quality, compact urban form
3. Provide transport infrastructure that improves linkages, journey time and reliability of the public transport network
4. Contribute to accessibility and place shaping by providing better transport connections between, within and to the town centre
5. Provide transport infrastructure that is safe for everyone
6. Safeguard future transport infrastructure required at (or in vicinity of) Botany Town Centre to support the development of a strategic public transport connection to Auckland Airport.

2 Proposal Description

The below is a summary of the works proposed within the EB2 and EB3R packages. Refer to the Assessment of Effects on the Environment (AEE) for additional detail on the works proposed.

2.1 Eastern Busway 2

The EB2 section of the Project commences from the intersection of Ti Rakau Drive and Pakuranga Road, connecting with EB1, and traverses west along Ti Rakau Drive to the intersection of SEART. The north-south extent of EB2 is between SEART and Pakuranga Road along Reeves Road and William Roberts Road. The main components of EB2 are described below.

2.1.1 Busway and Pakuranga Town Centre Bus Station

A segregated dedicated two-way busway is proposed along Ti Rakau Drive to provide prioritised access for bus services between Pakuranga Town Centre and Botany. From Pakuranga Road to SEART, the busway will run on the northern side of Ti Rakau Drive.

The proposed Pakuranga bus station is a key facility for services running to and from the Panmure Station Interchange, Howick, Highland Park, Eastern Beach, Bucklands Beach and Sunnyhills. The bus station will be located along the northern side of Ti Rakau Drive, on land currently occupied for Pakuranga Plaza and 26 Ti Rakau Drive. The bus station will feature two platforms and will contain a mixture of street furniture and structures, including bus shelters, electronic messaging signage and seating. New proposed pedestrian crossings will provide connections to the bus station and Pakuranga Plaza. Modifications to the Ti Rakau Drive median strip, landscaping, and general traffic lane reconfiguration will enable safe and efficient bus movement for the busway once it becomes operative.

2.1.2 Reeves Road Flyover (RRF)

The RRF will provide two general traffic lanes in each direction connecting SEART to Pakuranga Road, to reduce local traffic congestion along Pakuranga Road and Ti Rakau Drive. The RRF will start opposite Paul Place Reserve, pass over Ti Rakau Drive and Reeves Road, before finishing at a new intersection with Pakuranga Road. Traffic lanes for the RRF will be elevated and run through the centre of SEART, requiring the relocation of the SEART off-ramp to the north of the existing off-ramp.

2.1.3 Walking and Cycling Facilities

EB2 includes improvements to active transport infrastructure and connections. This includes a new cycleway, improved footpaths, and new pedestrian crossings. These works will improve the safety and connectivity of walking and cycling links across Pakuranga Town Centre.

2.1.4 Supporting Works

A range of works will be undertaken in support of the EB2 package. This includes the relocation of network utility services, new street lighting, earthworks, removal of vegetation, landscaping, stormwater upgrades, environmental restoration and mitigation and temporary construction sites.

2.2 Eastern Busway 3 Residential

The EB3R section of the busway is a continuation of EB2 from the intersection of SEART and Ti Rakau Drive, with the proposed dedicated busway proceeding centrally along Ti Rakau Drive towards Gossamer Drive and Riverhills Park in the east. EB3R will largely occur within land vested as road or land currently owned by Auckland Transport. The construction of EB3R will take a staged approach to minimize disruption to the existing road network and its users. The main components of EB3R have been described below.

2.2.1 Edgewater and Gossamer Intermediate Bus Stations

EB3R includes two intermediate bus stations on Ti Rakau Drive, located within the vicinity of Edgewater Drive and Gossamer Drive. Both stations will have separate platforms for eastbound and westbound bus movements. A range of street furniture and structures will also be constructed, such as modular bus shelters pedestrian linkages, electronic messaging signage, seating and cycling storage facilities.

2.2.2 Western Bridge Abutment

EB3R includes construction of the western bridge abutment for a new future bridge across Pakuranga Creek. The abutment will be located within the area that is currently the south-eastern section of Riverhills Park. Only the bridge abutment is included in the EB3R package of works. The remaining parts of the bridge will form part of the EB3C approval package.

2.2.3 Walking and Cycling Facilities

Provision has been made for walking and cycling along the route of EB3R. This includes footpaths and uni-directional cycleways located on either side of Ti Rakau Drive from SEART to Gossamer Drive. Signalised pedestrian crossings will be provided at key intersections along Ti Rakau Drive, including adjacent to the proposed Edgewater bus station.

2.2.4 Associated changes the road network

The proposed changes to the road network include lane arrangement and intersection reconfigurations and changes to the parking arrangement and access to Edgewater Drive Shops. Changes are also proposed to the access arrangements for residential properties along the EB3R alignment. New westbound lanes for general traffic will be established within the land which has been acquired by Auckland Transport and will be vested as road once it becomes operative, as the busway alignment replaces the existing westbound lanes.

2.2.5 Supporting Works

A range of works will be undertaken in support of the EB3R package. This includes the relocation of network utility services, new street lighting, removal of vegetation, earthworks, landscaping, stormwater upgrades, environmental restoration and mitigation and temporary construction sites.

Figure 2 Project Packages

3 Specialist Assessment

3.1 Assessment Content

The purpose of this memo is to document the process for assessing groundwater effects associated with the construction of EB2 and EB3R sections of the Eastern Busway (Project) and to demonstrate compliance with the Auckland Unitary Plan Operative in Part (AUP(OP)) rules relating to groundwater.

A high-level conceptual groundwater model has been developed to provide an understanding of the expected groundwater levels across EB2 and EB3R. This model was developed using the geological investigation logs and active groundwater level monitoring piezometers across EB2 and EB3R.

This groundwater assessment involves:

- Creating a hydrogeological flow map model
- Converting the expected maximum trenching/excavation depths into elevations (in m RL) and comparing them to local groundwater elevations
- Assessing if the proposed excavations are likely to extend below the top of the shallow groundwater table.

3.2 Specific Project Elements

The specific Project elements related to this groundwater assessment include the following:

- Stormwater drainage
- Underground utilities
- Road cuts
- Piling
- Ground improvements (if required)
- MSE walls.

This groundwater assessment looks at whether the excavation of trenches for stormwater and utilities along with any excavation of new road levels will impact natural groundwater level.

3.3 Construction Approach

3.3.1 Open Trenching

Open trenching will be used for the installation and relocation of underground services and utilities, including stormwater pipes. There are several deep trench stormwater and water lines to be installed (<5m BGL), primarily as part of the EB2 works. The trenching operations will be staged operations and will comprise a cut to waste trenching excavation, civil works and a stabilised backfill. A detailed methodology for these works can be found in the construction methodology appended to the Assessment of Environmental Effects. Water diversion for trenching associated with utility relocation is expected to take no more than 10 days.

3.3.2 Piling

Piling works greater than 1.5m in diameter are to be undertaken for the Reeves Road flyover (RRF), and a detailed methodology for these works can be found in the construction methodology. Piling works are

to be conducted using drilling fluid, maintaining a positive pressure head inside the pile bore, and with no dewatering expected. Therefore, groundwater inflow will not be an issue during construction. Based on this methodology, this groundwater memo will not consider the effects piling will have on natural groundwater.

3.3.3 Excavation

The expected earthworks are largely at or above grade with limited cuts comprising approximately 30,000m^3 for EB2 and 20,000m^3 for EB3R of approximately <1.5m BGL. Further details on the estimated earthworks areas and volumes are detailed in the Erosion and Sediment Control Report. Due to the gentle slopes of the Project area, the relatively small area of earthworks proposed for a project of this scale, and the staged nature of the works, these works are considered very unlikely to have an effect on the groundwater system. Further to this, any excavation that is expected to extend below the natural groundwater surface is expected to take no more than 10 days.

3.3.4 Retaining Wall 214

A retaining wall (RW214) is planned near the Ti Rakau Drive bridge adjacent to Riverhills Park. The design details include a typical section. This drawing details a mechanically stabilised earth (MSE) wall with a maximum embedment of 0.6m BGL. Both the shallow foundation of this MSE wall, and the included subsoil drain design, indicate that groundwater is unlikely to be impacted.

4 Methodology and Analysis

4.1 Data collection

4.1.1 Groundwater Data

Groundwater flow maps are created to determine the direction of groundwater flow within an aquifer (a water bearing geological formation). To create a groundwater flow map, first the depths to water measured in each piezometer installed within the same aquifer across the site area are converted into elevations relative to a consistent datum (Depth to water [m RL] = collar elevation [m RL] – depth to water [m BGL]). Then the groundwater elevations are posted and contoured on a site plan (see Appendix C - Flow Maps for these groundwater levels). These contours infer lines of equal hydraulic head. Groundwater flow lines can then be drawn perpendicular to these hydraulic head contours, to infer groundwater flow direction.

The data considered in this groundwater flow map (Appendix C – Flow Maps) was collected from the six piezometers installed in 2021, and two historical piezometers installed in 2018. These piezometers were selected as they contained groundwater data that had been collected over the same week, reducing the impact of climate variability. These piezometers have been surveyed using the Auckland 2016 Vertical Datum. A summary of these piezometers can be found in Table 2 with graphs presented in Appendix B.

Information regarding existing bores within EB2 and EB3R was requested from Auckland Council in 2021 (Appendix D – Existing Bores). There are no known current consents for groundwater takes in the EB2 or EB3R area.

4.1.2 Excavation Levels

To determine the maximum excavation depth across EB2 and EB3R, the following reference design drawings were reviewed:

- For permanent excavations:
    - Geometric Reference Design.
- For temporary excavations:
    - Utilities Reference Design
    - Stormwater Design.

The geometric reference design drawings for EB2 and EB3R show that the road is to be constructed on fill or at grade with minor cuts of approximately <1.5m BGL. The excavations required for the utilities trenches are expected to be shallower than the excavations required for the stormwater lines. Therefore, this groundwater model has been developed using stormwater invert levels (IL) as the maximum excavation trench depths expected during construction (<5m BGL). The excavation depths were converted to relative elevations and posted on the groundwater flow map. This was done to assess whether the excavations extend below the top of the shallow groundwater table. Note that these excavations are temporary and will be backfilled after the stormwater line has been installed or upgraded.

4.1.3 Assumptions and Background

- To assess the annual groundwater fluctuation, two piezometers from historic investigations have been used (DH18_103 and DH18_104)

- The levels for the road extension have been taken from appended geometric drawings, dated 13/08/2021
- Stormwater has been assumed to be the deepest underground installation and therefore will have the deepest associated trenches
- The pipe levels have been taken from the appended stormwater drawings, dated 13/08/2021 (EB2) and 17/08/2021 (EB3R).

5 Existing Environment

5.1 Existing Land Use and Topography

The land use surrounding Ti Rakau Drive in the EB2 and EB3R areas is a mixture of predominately low-rise one to two storey residential properties, with occasional Council reserves which are recorded as being landfill (inert) and commercial properties near Edgewater Drive. Within the EB2/ EB3 project areas the elevation of the existing Ti Rakau Drive varies from approximately RL 8.5 m in the west to RL 9.5 m (min) the east (Mt Eden 2000). To the south, the elevation reduces to about RL 5 m towards Tamaki River. To the north, the topography rises to Pakuranga Heights at approximately RL 20 m.

5.2 Geological Model

The published geological map for the area, Kermode 1992, suggests the site is underlain by Tauranga Group (alluvium) over Waitemata Group East Coast Bays Formation (ECBF). The ground conditions across this section of the Project are well understood and comprise a mixture of fine-grained soils, mainly clays, silts and sands, with a less than 0.5 m thick peat layer at about 16 m depth (RL -5 m), over rock. The geological model, presented in the Geotechnical Interpretative Report –(EB-2-D-2-GT-RP-000001), is based on site investigation data and indicates an approximately 20 m thick sequence of alluvium overlying weathered ECBF bedrock.

Near surface the soils are firm to stiff overlying a layer of saturated dense pumiceous silty fine and medium sand underlain by firm locally low strength silts and clays with sand lenses.

Below the superficial deposits, at about 20 m depth (RL -8.9 m) extremely weak to weak alternating mudstones, siltstones and fine sandstone were proven to at least 27 m depth (RL--18.9 m). The interpretation of the available geotechnical information from both the 2021 ground investigations and historic data led to the differentiation of the soils into the following layers (Table 1):

Table 1. Geotechnical Units

Geotechnical Unit			Material Description
Existing Fill	Uncontrolled	Fx	Uncontrolled Fill (silt, clay sand and gravel). Soft to firm or loose.
	Stiff Cohesive	Fc	Cohesive Fill (silt and clay). Stiff.
	Compacted Granular	Fg	Granular Fill (including volcanic boulder fill). Dense.
Tauranga Group (TG)	Cohesive Soils	T3	Clay and silt. Very soft to soft.
		T2	Clay and silt. Firm to stiff.
		T1	Clay and silt. Very stiff.
	Granular Soils	Tg	Silty sand. Loose to very dense.
	Organic Soils	To	Organic clay and silt. Firm to stiff.

Geotechnical Unit			Material Description
	Peat	Tp	Peat. Fibrous, amorphous and spongy. Also includes very soft to soft organic silt and clays.
East Coast Bays Formation (ECBF)	Residual Soil / Completely Weathered	Er	Clay, silt and sand. Stiff to very stiff & medium dense to very dense.
	Highly / Moderately Weathered	Ew	Highly to moderately weathered, Muddy Sandstone and Siltstone. Extremely weak.
	Slightly Weathered / Un-weathered	Eu	Slightly to un-weathered interbedded Muddy Sandstone and Siltstone. Very weak to weak.
	Parnell Grit	Eg	Moderately to un-weathered Volcaniclastic Sandstone. Weak.

5.3 Natural Groundwater

5.3.1 Piezometer levels

Standpipe piezometers were installed in six drillholes during the 2021 investigations to monitor groundwater levels. Two historical piezometers DH18_103 and DH18_104, installed by the EBA in 2018 are operational in 2022 and have been included in this flow map.

Of the piezometers listed in Table 2Table 2, seven are screened within alluvial material of the Tauranga Group and one extends within the top of the East Coast Bays Formation (ECBF).

Table 2. Standpipe Piezometer Summary (Active)

Drillhole ID	Collar Elevation [m RL]	Top of Slotted Screen (m RL)	Base of Slotted Screen (m RL)	Piezometer Base (m RL) (manual dip)	Response Zone (m RL)	Depth to water (m RL) *Included in the flow maps*	Depth to water (m BGL)	Date of Recorded Depth to water	Screened Geology
DH18_103	11.66	8.16	3.66	3.58	3.0-8.5	6.58	5.08	09/02/22	Completely to Slightly Weathered Sandstone and Siltstone [ECBF]
DH18_104	4.85	3.35	1.35	1.53	1.0-4.0	4.05	0.80	09/02/22	Clayey SILT, Silty CLAY [Fill]
DH204_P	8.14	1.14	-1.86	-2.20	6.2-10.5	5.64	2.50	09/02/22	Silty Clay [Alluvium]
DH205_P	7.68	3.68	1.68	1.58	3.5-6.5	5.48	2.20	09/02/22	Sandy CLAY [Alluvium]

Drillhole ID	Collar Elevation [m RL]	Top of Slotted Screen (m RL)	Base of Slotted Screen (m RL)	Piezometer Base (m RL) (manual dip)	Response Zone (m RL)	Depth to water (m RL) *Included in the flow maps*	Depth to water (m BGL)	Date of Recorded Depth to water	Screened Geology
DH210_P	11.82	9.82	6.82	6.77	1.5-5.3	8.55	3.27	10/02/22	Silty CLAY, Silty SAND, Organic CLAY [Alluvium]
DH212_P	15.87	11.37	8.37	8.12	3.8-8.2	13.71	2.16	09/02/22	SAND, Organic CLAY [Alluvium]
WB203_P	6.56	0.56	-2.44	-2.62	5.5-9.5	1.76	4.80	09/02/22	CLAY [Alluvium]
WB213_P	17.12	11.12	9.12	8.98	5.5-8.5	13.66	3.46	09/02/22	SAND [Alluvium]

5.3.2 Seasonal Fluctuations

One historic piezometer (DH18_103) was actively recording groundwater levels between 11 June 2018 and 4 November 2019 in the EB3R area (Table 3). Groundwater levels showed a variability of approximately +0.9m in the winter and -0.7m in the summer months from the median. Using this data, we expect to see seasonal variations in groundwater of approximately ± 1.0m. Groundwater from the piezometers listed in Table 2 Table 2are expected to be retrieved monthly to confirm the seasonal groundwater variations across EB2 and EB3R. To date, the manual depth to ground water levels fall within the variability noted above.

Table 3: Seasonal Variation

Drillhole ID	Date Range	Collar Elevation [m RL]	Maximum Water Level [m RL]	Minimum Water Level [m RL]	Average Water Level [RL]
DH18_103	11/06/2018 to 4/11/2019	11.66	7.99	6.36	7.06

5.3.3 Groundwater flow

The maps in **Error! Reference source not found.** show the inferred direction of the shallow groundwater flow and that the excavations are unlikely to extend below the top of the groundwater table for the majority of the area covered by EB2 and EB3R. For the areas where groundwater is likely to sit above trench depths, this is likely to be by <1.0m. It should be noted that these flow maps were constructed using the available data collected during summer 2021/2022 and therefore the seasonal fluctuations described above should also be taken into account.

6 Compliance with AUP(OP) Permitted Activity Status

6.1 Activity Status

Chapter E7 of the AUP (OP) sets out criteria under which the diversion of groundwater is considered a Permitted Activity. Table 4 provides a comparison of the proposed activity against the permitted activity standards set out in Rules E7.6.1.6 and E7.6.1.10.

Groundwater flow within EB2 and EB3R is summarised in **Error! Reference source not found.**. However, as the stormwater excavations are a road network linear trenching activity, where no one part of the trench will be open for more than 10 days, this is considered permitted activity. The piling works will involve piles with an external diameter of greater than 1.5m, which will be drilled into rock head. However, these do no exceed 1 hectare in total area and do not impede the flow of groundwater over a length of more than 20 m. Therefore, these are also considered a permitted activity.

Table 4: Permitted activity criteria for groundwater diversion.

Rule	Complies	Notes
Rule E7.6.1.6 – water take for dewatering or groundwater level control associated with a groundwater diversion permitted under standard E7.6.1.10		
(1) Water take must not be geothermal water	✓	No geothermal water take is anticipated
(2) Water take must not be for a period of more than 10 days where it occurs in peat soils, or 30 days in other types of soils or rock	✓	Water take will only occur during pipe or service trench installation for no more than 10 days.
(3) The water take must only occur during construction	✓	Construction only.
Rule E7.6.1.10 – diversion of groundwater caused by any excavation, including trench or tunnel		
(1) All of the following activities are exempt from the standards E7.6.1.10 (2-6):		
a. Pipes, cables, or tunnels which are drilled or thrust and are up to 1.2m in external diameter	N/A	N/A network utility are exempt as per (d & e).
b. Pipes including associated structures up to 1.5m in external diameter where a closed faced or earth pressure balanced machine is used	N/A	N/A network utility are exempt as per (d & e).

Rule	Complies	Notes
c. Piles up to 1.5m in external diameter are exempt from this standard	×	Piles up to 3m diameter, no diversion anticipated.
d. Diversion for no longer than 10 days; Or	✓	Diversions not expected to take longer than 10 days, utility trenches are therefore exempt.
e. Diversion for network utilities and road network linear trenching activities that are progressively opened, closed and stabilised where the part of the trench that is open at any given time is no longer than 10 days.	✓	Diversions for utility trenches will not be open for more than 10 days.
(2) Any excavation that extends below natural ground level, must not exceed:		
a. 1 hectare in total area; and	✓	Piles will be socketed into rock (>6m), however only cover a 3m diameter.
b. 6 m depth below the natural surface		
(3) Natural groundwater level must not be reduced by more than 2 m on the boundary of any adjoining site	✓	No groundwater takes expected during piling.
(4) Any structure, excluding sheet piling that remains in place for more than 30 days, that physically impedes the flow of groundwater through the site must not:		
a. Impede the flow of groundwater over a length of more than 20 m; and	✓	Piles have a diameter of 3m and will not impede the flow of groundwater for more than 20m but will extend to more than 2m below natural GWL.
b. Extend more than 2 m below natural groundwater level		
(5) The distance to any existing building or structure, excluding timber fences and small structures on the boundary, on an adjoining site from the edge of any:		
a. Trench or open excavation that extends below natural groundwater level must be at least equal to the depth of the excavation.	✓	No open trenches, excavations, tunnels or pipes involved with

Rule	Complies	Notes
b. Tunnel or pipe with an external diameter of 0.2 m – 1.5m that extends below groundwater level must be 2m or greater, or	✓	piling work. Service trenches exempt as per E7.6.1.10, 1 (d & e).
c. Tunnel or pipe with an external diameter of up to 0.2 m that extends below groundwater level has no separation requirement.	✓	
(6) The distance from the edge of any excavation that extends below natural groundwater level, must not be less than:		
a. 50 m from a Wetland Management Areas Overlay (WMAO)	✓	Greater than 50 m from WMAO
b. 10 m from a scheduled Historic Heritage Overlay (HHO)	✓	Greater than 10m from HHO
c. 10 m from a lawful groundwater take	✓	Greater than 10 m from groundwater take

Based on the above, the works fully comply with the **permitted activity** rules and related standards.

7 Recommendations and Conclusions

To conclude, the construction process is likely to have little to no effects on the natural groundwater or geology of the areas within and surrounding EB2 and EB3R. In any event the works required are permitted activities.

Appendix A – Borehole Logs

TERMINOLOGY AND SYMBOLS

Eastern Busway

Drilling / Investigation Methods

CFHSA	- Continuous Flight Hollow Stem Auger.
CFSSA	- Continuous Flight Solid Stem Auger.
DC	- Dynamic Coring (eg Terrier Rig).
DCP	- Dynamic Cone Penetrometer.
HA	- Hand Auger.
HQ3	- HQ Triple Tube.
HQWL	- HQ Wire Line.
HWOB	- Heavy Weight Open Barrel.
NQ3	- NQ Triple Tube.
NQWL	- NQ Wire Line.
OB	- 100mm diameter Open Barrel.
OB70	- 70mm diameter Open Barrel.
PERC	- Percussion.
PS	- Piston Sample.
PQ3	- PQ Triple Tube.
PQWL	- PQ Wire Line.
RC	- Reverse Circulation.
RCDHH	- Reverse Circulation Down Hole Hammer.
SPT	- Standard Penetration Test.
SPERC	- Sonic Percussion.
PT	- Push Tube Sample
VAC EX	- Vacuum Excavation.
WASH	- Wash Drilling.

Test Results

SPT "N" value; uncorrected blow count for 300 mm penetration
/# / # / # / # / # blows per 75 mm penetration

ss - Standard Penetration Test - split spoon
sc - Standard Penetrattion Test - solid cone (no sample recovery)
SUOW - Sunk Under Own Weight

Vane Shear Strength Tests

/ # Vane shear strength test results given as peak / remoulded shear strengths (kPa). Test as per NZGS Guideline, 2001.

$^{\#}$ = Vane test performed on core recovered prior to extrusion from core barrel.
* = Vane test performed on excavated material of suitable size.

UTP - Unable to penetrate.

Unit/Geological Boundary Lines

———— Known

— — — - Inferred/Unknown

Installation & Backfill

Standpipe		Grout	
Slotted Standpipe		Cement	
Collapse/Cuttings /Spoil		Gravel Pack Filter	
Bentonite		Sand Pack Filter	
Inclinometer		Gravel Backfill	

Groundwater Records

Water Level (During Drilling)	2.0
Water Inflow/Seep	
Water Outflow	
Complete Water Loss	
Regain Circulation	

2.0 Fluid level measurement during drilling

Samples

PT	- Thin Wall Push Sample
PS	- Piston Sample
U	- Undisturbed
D	- Disturbed (Core)
B	- Disturbed (Pit)

Rock Descriptions

Relative Strength

		USC (MPa)
ES	- Extremely strong	> 250
VS	- Very Strong	100 - 250
S	- Strong	50 - 100
MS	- Moderately Strong	20 - 50
W	- Weak	5 - 20
VW	- Very Weak	1 - 5
EW	- Extremely Weak	< 1

Weathering

UW	- Unweathered
SW	- Slightly Weathered
MW	- Moderately Weathered
HW	- Highly Weathered
CW	- Completely Weathered

Soil Descriptions

Consistency Cohesive Soils

	Su (kPa)
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	200 - 500

Relative Density Non-cohesive soils

	SPT "N" Value (uncorrected)
Very Loose	< 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Rock Defect Abbreviations

Defect Type
BP = Bedding Plane Defect
CZ = Crush Zone
DB = Drilling Break
FZ = Fracture Zone
HJ = Healed Joint
J = Joint
SZ = Shear Zone
Ve = Vein

Defect Aperture
T = Tight (Nil)
VN = Very Narrow (>0-2mm)
N = Narrow (2-6mm)
MN = Moderately Narrow (6-20mm)
MW = Moderately Wide (20-60mm)
W = Wide (60-200mm)
VW = Very Wide (>200mm)

Defect Roughness
Pl = Planar
St = Stepped
Ud = Undulating
Ro = Rough
Sm = Smooth
Slk = Slickensided
\\ = Parallel
Po = Polished

Infill Thickness
Sn = Stained
Vn = Veneer (<0.5mm)
Cg = Coating
P = Partially infilled
C = Completely Infilled

Infill Colour
bl = Blue
bn = Brown
bk = Black
gn = Green
gy = Grey
or = Orange
pk = Pink
rd = Red
wh = White
ye = Yellow

Infill Material
Calc = Calcareous
Cb = Carbonaceous
Cc = Calcite
Cl = Clay
Fe = Iron Oxide
Mn = Manganese
NF = No Infill
Py = Pyrite
Qtz = Quartz
S = Sand
Slt = Silt

Graphic Log (typical symbols)

Peat	Mudstone
Clay	Siltstone
Silt	Sandstone
Sand	Basalt
Gravel / Cobbles	No recovery
Welded Tuff	

Core Measurements

TCR - Total Core Recovery
RQD - Rock Quality Designation

Soil and rock descriptions generally as in "Guidelines for the Field Description of Soil and Rock for Engineering Purposes" by the NZ Geotechnical Society Inc, December 2005.

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH203**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409363.21mE 796020.82mN
Orientation -90° Elevation 6.54m
Location Opposite 10 Seven Oaks Drive
Feature Fill slope/MSE wall

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc	

FILL

0.0m: FILL comprising asphalt road surface and clayey gravel subgrade.

0.0m: Asphalt.

0.08m: Clayey fine to coarse GRAVEL; yellowish brown.

VAC EX — 0

TAURANGA GROUP

1.5m: ALLUVIUM comprising clay, organic clay and pumiceous sand.

ss 1,2,2, 2,3,3 N=10 — SPT — 100

1.5m: Pumiceous silty fine SAND; brownish grey. Medium dense, moist, uniformly graded.

HQ3 — 100

1.65m: Silty CLAY; dark brown. Firm to stiff, moist, high plasticity.
1.68 to 2.0m: Brown.
2.0 to 2.6m: Trace fine sand and grey with orange staining.

ss 1,1,1, 1,2,2 N=6 — SPT — 100

2.6m: CLAY with trace silt and fine mica sand; bluish grey with orange staining. Stiff, moist, high plasticity.

HQ3 — 100

3.65 to 3.7m: Very soft.
3.7 to 4.2m: With some fine micaceous sand lenses.

4.2 to 5.45m: Trace rootlets.

4.5m: 114mm diameter, HWT casing to 4.5m depth.

ss 0,0,0, 0,1,1 N=2 — 114 HWT SPT — 100

4.6 to 5.0m: With some fine micaceous sand lenses, dark bluish grey. Organics include decomposed rootlets. Overall still behaving as clay but lenses behave as fine sand.

PT — 100

HQ3 — 100

5.45 to 18.02m: Trace decomposed wood.

ss 0,0,0, 0,0,0 N=0 SUOW — SPT — 100

HQ3 — 100

57/19 ss 0,0,0, 0,0,0 N=0 SUOW — SPT — 100

PT — 100

HQ3 — 100

22/5 ss 0,0,0, 0,0,0 N=0 SUOW — SPT — 100

Instrumentation: 2.8 ▽, 3.6 ▽, 3.95 ▽

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth
16/08/2021 17:00	15.45	3.0	3.95
17/08/2021 08:00	15.45	3.0	2.8
17/08/2021 13:00	24.00	4.5	3.6

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 17/08/2021
Logged SK
Checked GP

Remarks

Hole backfilled with 0.0 to 0.2m: Cold mix asphalt, 0.2 to 2.0m: Gravel, 2.0 to 24.0m: Grout.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 16/08/2021
Finished 17/08/2021
Drill Rig N119
Core Boxes 8

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION **DH203**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409363.21mE 796020.82mN
Orientation -90° Elevation 6.54m
Location Opposite 10 Seven Oaks Drive
Feature Fill slope/MSE wall

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				(mm) 500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
TAURANGA GROUP	77/20 ss 0,0,0, 1,1,1 N=3	HQ3						100		2.6m: CLAY with trace silt and fine mica sand; bluish grey with orange staining. Stiff, moist, high plasticity. *(continued)* 10.2 to 10.95m: With some fine micaceous sand lenses.	
		SPT						100			
		HQ3				11		100		10.95 to 12.3m: With trace fine micaceous sand lenses.	
	94/28 ss 0,0,1, 0,1,1 N=3	SPT				12		100			
		HQ3						100		12.3 to 12.7m: With some fine micaceous sand lenses. 12.7 to 18.02m: With trace fine micaceous sand.	
	ss 0,0,0, 0,1,2 N=3	SPT				13		100			
		HQ3				14		100		13.8m: Organic silty CLAY; black. Soft to firm, moist, high plasticity. Spongy. 14.0m: CLAY with trace silt; bluish grey. Stiff to very stiff, moist, high plasticity.	
	ss 1,2,2, 3,2,3 N=10	SPT				15		100			
		HQ3				16		100			
	ss 0,0,0, 0,0,0 N=0 SUOW	SPT						100			
		HQ3				17		100			
	49/13 ss 8,14,18, 19,12,1 for 5mm N>50	SPT				18		100		18.02m: Silty medium SAND; grey. Very dense, moist. 18.33m: CLAY; grey. Very Stiff, moist, high plasticity. 18.55 to 18.67m: Dark brown, gently inclined, thin carbonaceous laminations. 18.99 to 19.08m: J, 60°, Pl, Sm, Vn, Qtz, opened up through drilling 19.2 to 19.36m: Gently inclined light and dark laminations. 19.36 to 19.41m: Sandstone. 19.41 to 19.5m: Steeply inclined light and dark laminations.	
18.02m: HW, medium SANDSTONE. EW. 18.33m: HW, SILTSTONE. Extremely weak. 18.55m: Unweathered, grey, fine to medium SANDSTONE. Weak 19.05m: Unweathered, grey SILTSTONE. Weak. Moderately thinly bedded.		HQ3				19		100 [85]			
	ss 8,18,45, 5 for 5mm	SPT						43			

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
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Date logged 17/08/2021
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Remarks

Hole backfilled with 0.0 to 0.2m: Cold mix asphalt, 0.2 to 2.0m: Gravel, 2.0 to 24.0m: Grout.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 16/08/2021
Finished 17/08/2021
Drill Rig N119
Core Boxes 8

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION **DH203**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409363.21mE 796020.82mN
Orientation -90° Elevation 6.54m
Location Opposite 10 Seven Oaks Drive
Feature Fill slope/MSE wall

GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc.))	Test Records: Shear Vane/ SPT	Test Records: SPT N Values (0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift (0 - 100%)	Relative Strength (S, MS, W, VW)	Rock Weathering (SW, MW, HW)	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm: 500, 100, 50, 10)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
EAST COAST BAYS FORMATION 19.7m: Unweathered, grey, fine to medium SANDSTONE. Very weak. Thickly bedded. *(continued)*	N>50		HQ3				21		100 [100]		19.8 to 22.75m: Trace fine gravel, white, subangular. 20.26m: DB, 30°	
	ss 12,38 for 70mm N>50		SPT						28			
			HQ3				22		100 [100]		21.42m: DB, 10° 22.41m: DB, 0°	
22.7 to 23.2m: Fine sandstone.							23				22.71m: J, 30°, Pl, Sm, Cg, Slt 23.26m: J, 25°, Pl, Sm, NF 23.31m: J, 30°, Pl, Sm, NF	
23.2 to 23.6m: Slightly weathered.			HQ3						100 [97]		23.35 to 23.41m: Drilling disturbed, recovered as gravel. 23.55m: DB, 0°	
23.6m: Moderately weathered, grey, fine to medium SANDSTONE. Extremely weak.							24				23.6m: Silty fine to medium SAND; grey. Core sample dropped out of barrel, was re-cored and recovered as silty sand and gravel. DH203 terminated at 24.0m Depth Criteria Achieved	
							25					
							26					
							27					
							28					
							29					

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

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Date logged 17/08/2021
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Checked GP

Remarks
Hole backfilled with 0.0 to 0.2m: Cold mix asphalt, 0.2 to 2.0m: Gravel, 2.0 to 24.0m: Grout.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 16/08/2021
Finished 17/08/2021
Drill Rig N119
Core Boxes 8

Box: 1 of 8 - Depth: 00.00m to 04.50m of 24.00m

Date Drilled 16/08/2021 to 17/08/2021 - Date Photographed: 16/08/2021

Box: 2 of 8 - Depth: 04.50m to 07.70m of 24.00m

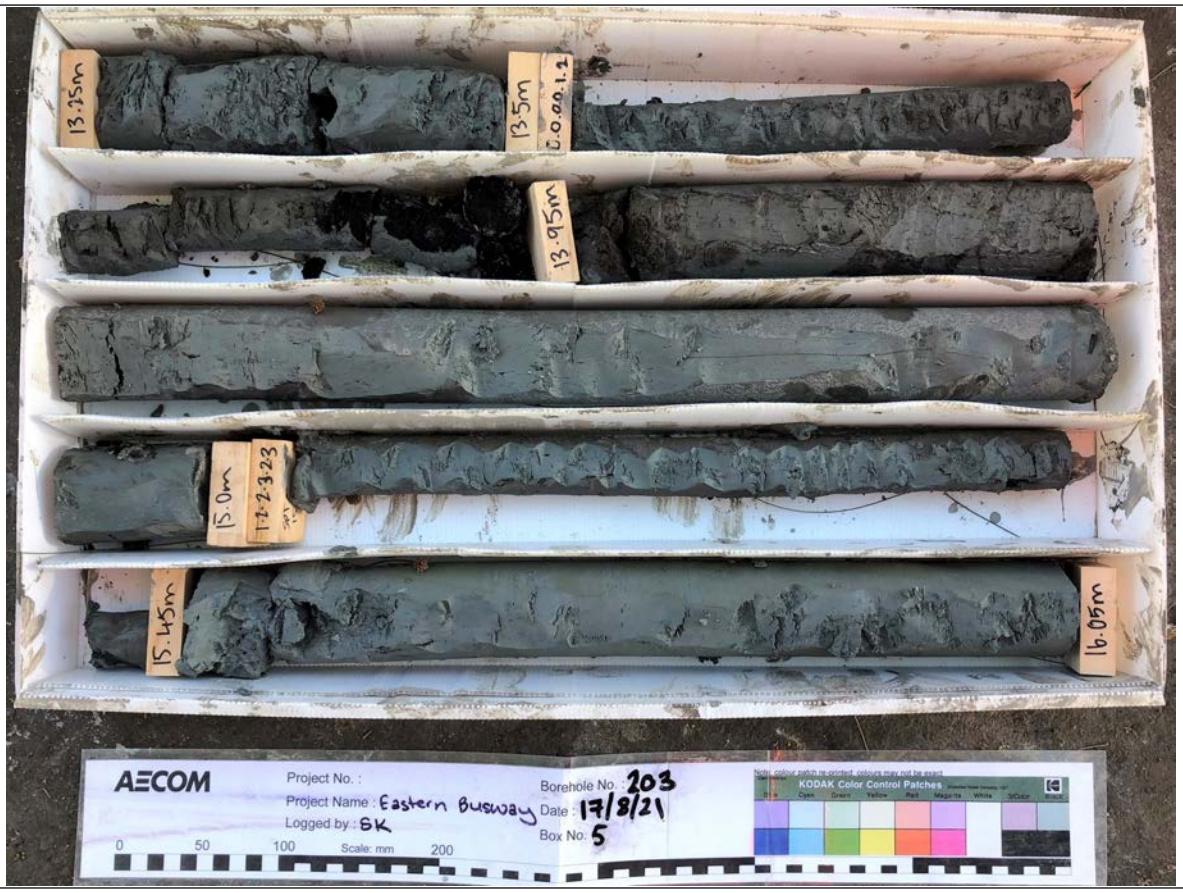
Date Drilled 16/08/2021 to 17/08/2021 - Date Photographed: 16/08/2021

Box: 3 of 8 - Depth: 07.70m to 10.80m of 24.00m

Date Drilled 16/08/2021 to 17/08/2021 - Date Photographed: 16/08/2021

Box: 4 of 8 - Depth: 10.80m to 13.25m of 24.00m

Date Drilled 16/08/2021 to 17/08/2021 - Date Photographed: 17/08/2021



Box: 5 of 8 - Depth: 13.25m to 16.05m of 24.00m

Date Drilled 16/08/2021 to 17/08/2021 - Date Photographed: 17/08/2021

Box: 6 of 8 - Depth: 16.05m to 18.65m of 24.00m

Date Drilled 16/08/2021 to 17/08/2021 - Date Photographed: 17/08/2021

Eastern Busway

PHOTOGRAPHIC LOG OF DRILLHOLE

Project Eastern Busway

Location Opposite 10 Seven Oaks Drive

HOLE IDENTIFICATION **DH203**

Box: 7 of 8 - Depth: 18.65m to 21.65m of 24.00m

Date Drilled 16/08/2021 to 17/08/2021 - Date Photographed: 17/08/2021

Box: 8 of 8 - Depth: 21.65m to 24.00m of 24.00m

Date Drilled 16/08/2021 to 17/08/2021 - Date Photographed: 17/08/2021

TERMINOLOGY AND SYMBOLS

Eastern Busway

Drilling / Investigation Methods

CFHSA	- Continuous Flight Hollow Stem Auger.
CFSSA	- Continuous Flight Solid Stem Auger.
DC	- Dynamic Coring (eg Terrier Rig).
DCP	- Dynamic Cone Penetrometer.
HA	- Hand Auger.
HQ3	- HQ Triple Tube.
HQWL	- HQ Wire Line.
HWOB	- Heavy Weight Open Barrel.
NQ3	- NQ Triple Tube.
NQWL	- NQ Wire Line.
OB	- 100mm diameter Open Barrel.
OB70	- 70mm diameter Open Barrel.
PERC	- Percussion.
PS	- Piston Sample.
PQ3	- PQ Triple Tube.
PQWL	- PQ Wire Line.
RC	- Reverse Circulation.
RCDHH	- Reverse Circulation Down Hole Hammer.
SPT	- Standard Penetration Test.
SPERC	- Sonic Percussion.
PT	- Push Tube Sample
VAC EX	- Vacuum Excavation.
WASH	- Wash Drilling.

Test Results

SPT "N" value; uncorrected blow count for 300 mm penetration
/# / # / # / # / # blows per 75 mm penetration

ss - Standard Penetration Test - split spoon
sc - Standard Penetrattion Test - solid cone (no sample recovery)
SUOW - Sunk Under Own Weight

Vane Shear Strength Tests

/ # Vane shear strength test results given as peak / remoulded shear strengths (kPa). Test as per NZGS Guideline, 2001.

$^{\#}$ = Vane test performed on core recovered prior to extrusion from core barrel.
* = Vane test performed on excavated material of suitable size.

UTP - Unable to penetrate.

Unit/Geological Boundary Lines

———— Known

— — — - Inferred/Unknown

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Standpipe		Grout	
Slotted Standpipe		Cement	
Collapse/Cuttings /Spoil		Gravel Pack Filter	
Bentonite		Sand Pack Filter	
Inclinometer		Gravel Backfill	

Groundwater Records

Water Level (During Drilling)	2.0
Water Inflow/Seep	
Water Outflow	
Complete Water Loss	
Regain Circulation	

2.0 Fluid level measurement during drilling

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Soil Descriptions

Consistency Cohesive Soils

	Su (kPa)
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	200 - 500

Relative Density Non-cohesive soils

	SPT "N" Value (uncorrected)
Very Loose	< 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Rock Defect Abbreviations

Defect Type
BP = Bedding Plane Defect
CZ = Crush Zone
DB = Drilling Break
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HJ = Healed Joint
J = Joint
SZ = Shear Zone
Ve = Vein

Defect Aperture
T = Tight (Nil)
VN = Very Narrow (>0-2mm)
N = Narrow (2-6mm)
MN = Moderately Narrow (6-20mm)
MW = Moderately Wide (20-60mm)
W = Wide (60-200mm)
VW = Very Wide (>200mm)

Defect Roughness
Pl = Planar
St = Stepped
Ud = Undulating
Ro = Rough
Sm = Smooth
Slk = Slickensided
\\ = Parallel
Po = Polished

Infill Thickness
Sn = Stained
Vn = Veneer (<0.5mm)
Cg = Coating
P = Partially infilled
C = Completely Infilled

Infill Colour
bl = Blue
bn = Brown
bk = Black
gn = Green
gy = Grey
or = Orange
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wh = White
ye = Yellow

Infill Material
Calc = Calcareous
Cb = Carbonaceous
Cc = Calcite
Cl = Clay
Fe = Iron Oxide
Mn = Manganese
NF = No Infill
Py = Pyrite
Qtz = Quartz
S = Sand
Slt = Silt

Graphic Log (typical symbols)

Peat	Mudstone
Clay	Siltstone
Silt	Sandstone
Sand	Basalt
Gravel / Cobbles	No recovery
Welded Tuff	

Core Measurements

TCR - Total Core Recovery
RQD - Rock Quality Designation

Soil and rock descriptions generally as in "Guidelines for the Field Description of Soil and Rock for Engineering Purposes" by the NZ Geotechnical Society Inc, December 2005.

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION **DH204_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409410.83mE 796033.07mN
Orientation -90° Elevation 8.14m
Location SEART, Ti Rakau Dr Intersection
Feature MSE Wall/Abutment piles

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				(mm) 500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
0.0m: TOPSOIL.											
FILL: 0.25m: FILL comprising clay and gravel.											
0.6m: ALLUVIUM comprising clay, silt, organic clay and sandy silt.	148/62 121/61 126/64 109/58 132/50 148/47	HA				1		100		0.0m: CLAY with some rootlets; dark brown. Very stiff, moist, high plasticity.	0.4
	ss 0,1,1, 2,2,2 N=7	SPT						100		0.25m: CLAY with some fine to medium gravel and trace rootlets; dark brown mottled orange. Very stiff, moist, high plasticity. Gravel is basalt. 0.3 to 0.6m: Trace fine gravel. Light brown mottled orange. Iron oxide bands.	
		HQ3				2		100		0.6m: CLAY with some rootlets; light grey mottled orange. Very stiff, moist, high plasticity. 1.2 to 1.6m: Some silt and minor fine sand.	1.95 2.15
										1.6m: Silty CLAY with trace indistinct organics; light grey mottled orange and flecked black. Stiff, moist, high plasticity. 2.2 to 2.6m: White mottled yellow flecked black.	
	ss 1,2,2, 2,2,1 N=7	114 HWT SPT				3		100		2.6m: Silty fine to coarse SAND; light yellowish white. Tightly packed, moist. Sand is pumiceous. 3.0m: 114mm diameter, HWT casing to 3.0m depth.	3.3 3.4
		HQ3				4		100		3.2m: Organic CLAY with some silt; dark brown. Stiff, moist, high plasticity. Organics are indistinct.	
	37/15	HQ3						100		3.5m: Silty CLAY with minor indistinct organics and trace fine micaceous sand; dark grey speckled black. Firm, moist, high plasticity. 4.5 to 5.55m: Trace indistinct organics.	
		PT				5		100		5.25 to 5.55m: Minor fine micaceous sand. 5.5 to 6.0m: High water loss.	
		HQ3						100		5.55m: Fine sandy SILT with some clay and trace indistinct organics; dark grey. Soft, moist, low plasticity. Sand is micaceous. 5.65 to 5.75m: Silty SAND. Loosely packed, moist, dilatant.	
	ss 0,1,0, 0,0,1 N=1	SPT				6		100		6.1m: Silty CLAY with trace fine micaceous sand and indistinct organics; grey speckled black. Stiff, moist, high plasticity.	
		HQ3				7		100			
	56/13 ss 0,0,0, 1,1,1 N=3	SPT						100			
		HQ3				8		100			
	47/12					9				8.9 to 9.2m: Firm. 9.2 to 9.8m: Soft.	
		HQ3						100			

TAURANGA GROUP

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth
06/10/2021 16:40	15.45	3.0	3.4
07/10/2021 08:25	15.45	3.0	1.95
07/10/2021 16:20	25.50	3.0	2.15
08/10/2021 08:30	25.50	3.0	3.3
08/10/2021 13:40	25.50	0.0	0.4

Hand Held Shear Vane
GEOVANE1179: 19mm blade: Cal. 10/21: Correction Factor = 1.478
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 8/10/2021
Logged GS
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 6/10/2021
Finished 8/10/2021
Drill Rig N118
Core Boxes 11

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH204_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409410.83mE 796033.07mN
Orientation -90° Elevation 8.14m
Location SEART, Ti Rakau Dr Intersection
Feature MSE Wall/Abutment piles

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method / Casing remarks	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50		0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
TAURANGA GROUP	30/6	PT						100		9.8m: Silty CLAY with trace fine micaceous sand and indistinct organics; grey speckled black. Firm, moist, high plasticity. *(continued)*	
	ss 1,0,0, 1,1,1 N=3	122 PQ3 SPT						100		10.5m: Reamed 122mm PQ3 to 10.5m post drilling for piezometer installation.	
		HQ3				11		100		10.95 to 13.0m: Stiff.	
	62/15 ss 1,0,1, 2,2,2 N=7	SPT				12		100			
		HQ3						100			
	62/12 ss 1,1,2, 2,1,2 N=7	SPT				13		100		13.0m: Silty CLAY; light grey. Firm, moist, moderate plasticity. Interbedded with sub-horizontal thinly laminated to thinly bedded, silty fine micaceous SAND.	
		HQ3				14		57		14.05 to 14.48m: Damaged removing from splits.	
	UTP									14.48m: PEAT; dark brownish black. Very stiff, moist. Fibrous, highly decomposed wood fragments. No material or water released when squeezed. Friable.	
	ss 1,1,1, 2,2,3 N=8	SPT				15		100		14.55 to 15.0m: Core Loss: Infer peat washed out.	
		HQ3				16		100		15.0m: CLAY with some silt and trace fine micaceous sand and indistinct organics; light grey speckled black. Very stiff, moist, high plasticity. 15.0 to 15.3m: Light brownish grey.	
	183/28 ss 1,2,1, 2,2,2 N=7	SPT						67		16.8 to 16.95m: Core Loss: Unknown.	
		HQ3				17		100			
	44/12 ss 0,0,0, 0,0,1 N=1	SPT				18		100		17.85m: CLAY with some silt and trace fine micaceous sand; light grey. Firm, moist, high plasticity. 18.7m: J, 35°, Ud, Ro	
18.7m: Highly weathered, grey, fine to coarse SANDSTONE. Extremely weak. 19.5 to 19.91m: Fine SANDSTONE.		HQ3				19		76		18.7m: Silty fine to coarse SAND with minor organics; light grey speckled black. Dense, moist. Sand includes pink and grey siltstone clasts. 18.74 to 19.0m: Sub-horizontal carbonaceous laminations. 19.25 to 19.5m: Core Loss: Infer weak material washed away. 19.5 to 21.0m: Added drilling mud to help water return.	
	UTP ss 2,9,17, 16,13,4 for 35mm	SPT						98			

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
GEOVANE1179: 19mm blade: Cal. 10/21: Correction Factor = 1.478
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 8/10/2021
Logged GS
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 6/10/2021
Finished 8/10/2021
Drill Rig N118
Core Boxes 11

2021 EB DRILLHOLE LOG 2021-12-21 SBS MASTER.GPJ BASE.GDT 21/12/21

21/12/2021

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION **DH204_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409410.83mE 796033.07mN
Orientation -90° Elevation 8.14m
Location SEART, Ti Rakau Dr Intersection
Feature MSE Wall/Abutment piles

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	

EAST COAST BAYS FORMATION

19.91m: Slightly weathered, grey fine SANDSTONE. Very weak. *(continued)*

20.64m: Slightly weathered, grey, fine to coarse SANDSTONE. Very weak. With subangular fine to medium gravel sized clasts, dark grey, brown, pink and orange clasts.

20.95m: Slightly weathered, grey, fine to coarse SANDSTONE. Very weak. With a trace of dark grey fine gravel size clasts. Moderately thickly bedded.

23.0 to 24.0m: Moderately thin, sub-horizontal beds of coarse gravel SILTSTONE clasts (<50mm). Grey and pink. 23.00 to 23.08m, 23.16 to 23.17m, 23.44 to 23.50m, 23.80 to 24.00m.

24.0 to 25.95m: Thickly bedded.

25.8m: Moderately weathered grey matrix supported CONGLOMERATE. Very weak. Clasts subrounded fine to coarse gravel, grey, pink and white. Matrix fine to coarse sand.

26.34m: Slightly weathered, grey, fine to coarse SANDSTONE. Very weak. With a trace of dark grey fine gravel sized clasts. Thickly bedded.

28.35 to 28.9m: Gently inclined moderately thickly bedded.

28.9m: Slightly weathered grey fine to coarse SANDSTONE with some subangular fine gravel size clasts, light and dark grey. Gently inclined moderately thickly bedded.

Depth	Test Records	Drilling Method	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION
	N>50	HQ3	100 [41]		19.91 to 20.8m: Extremely closely to closely spaced, gently inclined and sub-vertical joints and drilling breaks. Recovered as fragments, 20mm to 100mm.
					20.04 to 20.31m: J, 5°, Ud, Ro, 3 no. at 20.04, 20.1 & 20.31m.
					20.7 to 20.77m: J, 85°, C
21	sc 15,35 for 60mm N>50	SPT	96		21.14 to 21.33m: J, 45°, Ud, Ro
					21.14 to 21.35m: Core damaged by drilling, closely spaced sub-horizontal and sub-vertical breaks.
		HQ3	94 [37]		21.55m: J, 5°, Ud, Ro
22					21.5 to 22.13m: Core broken by extremely closely to closely spaced, gently inclined and sub-vertical defects.
					21.85 to 22m: J, 75°, Ud, Ro
					22.07m: J, 5°, Ud, Ro
	sc 6,44 for 65mm N>50	SPT	71		
23		HQ3	99 [99]		23.22m: J, 0°, Ud, Ro
					23.48m: HJ, 5°
					23.64m: J, 5°, Ud, Ro
24	sc 14,36 for 30mm N>50	SPT	95		24.11 to 25.5m: Drilling breaks, 0°, 24.18, 24.31 & 25.18m.
		HQ3	97 [97]		
25					25.21m: HJ, 10°, VN, C, Cc
					25.24m: HJ, 10°, VN, C, Cc
					25.95 to 26.23m: J, 5°, 3 No.
26		HQ3	100 [80]		25.85 to 26.34m: Extremely to very closely spaced, gently to moderately inclined joints and drill breaks. Recovered as coarse angular gravel and fragments (<80mm).
					26.11m: HJ, 10°
					26.1 to 26.29m: Drilling breaks, 0° at 26.12, 26.17, 26.20 & 26.29m.
					26.55m: J, 30°, Ud, Ro
27					26.76m: HJ, 10°, VN, C, Cc, 2 No.
					27.0 to 28.5m: Drilling breaks, 0° at 27.35, 27.60 and 27.63m.
		HQ3	100 [93]		27.4m: HJ, 0°, VN, C, Cc
28					27.8m: J, 20°, Ud, Ro
					28.15 to 28.35m: Extremely to closely spaced, gently inclined joints at 28.15, 28.25, 28.33 & 28.35m.
					28.37 to 28.39m: HJ, 10°, Ud, Ro, 2 No.
					28.55 to 28.85m: J, 20°, Ud, Ro, 2 No.
					28.65 to 29m: J, 20°, Ud, Ro, P, Cc, 2 No.
29		HQ3	100 [81]		29.01 to 29.17m: HJ, 20°, C, Cc, 8 No.
					29.26 to 29.32m: J, 10°, Ud, Ro, 2 No.
					29.35 to 29.58m: J, 20°, Ud, Ro, 7 No.
					28.5 to 30.0m: Extremely to closely to moderately widely, gently to moderately inclined joints and healed joints. Drilling breaks, 0° at 29.79, 29.82 & 29.85m.
					29.8m: HJ, 0°, C, Cc, 4 No.

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth

Hand Held Shear Vane
GEOVANE1179: 19mm blade: Cal. 10/21: Correction Factor = 1.478
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 8/10/2021
Logged GS
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 6/10/2021
Finished 8/10/2021
Drill Rig N118
Core Boxes 11

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH204_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409410.83mE 796033.07mN
Orientation -90° Elevation 8.14m
Location SEART, Ti Rakau Dr Intersection
Feature MSE Wall/Abutment piles

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				(mm) 500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
	sc 40,10 for 5mm N>50	SPT				31 32 33 34 35 36 37 38 39		0		DH204_P terminated at 30.13m Depth Criteria Achieved	

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
GEOVANE1179: 19mm blade: Cal. 10/21: Correction Factor = 1.478
vane shear strength per NZGS guideline

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50 mm standpipe piezometer installed upon completion.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 6/10/2021
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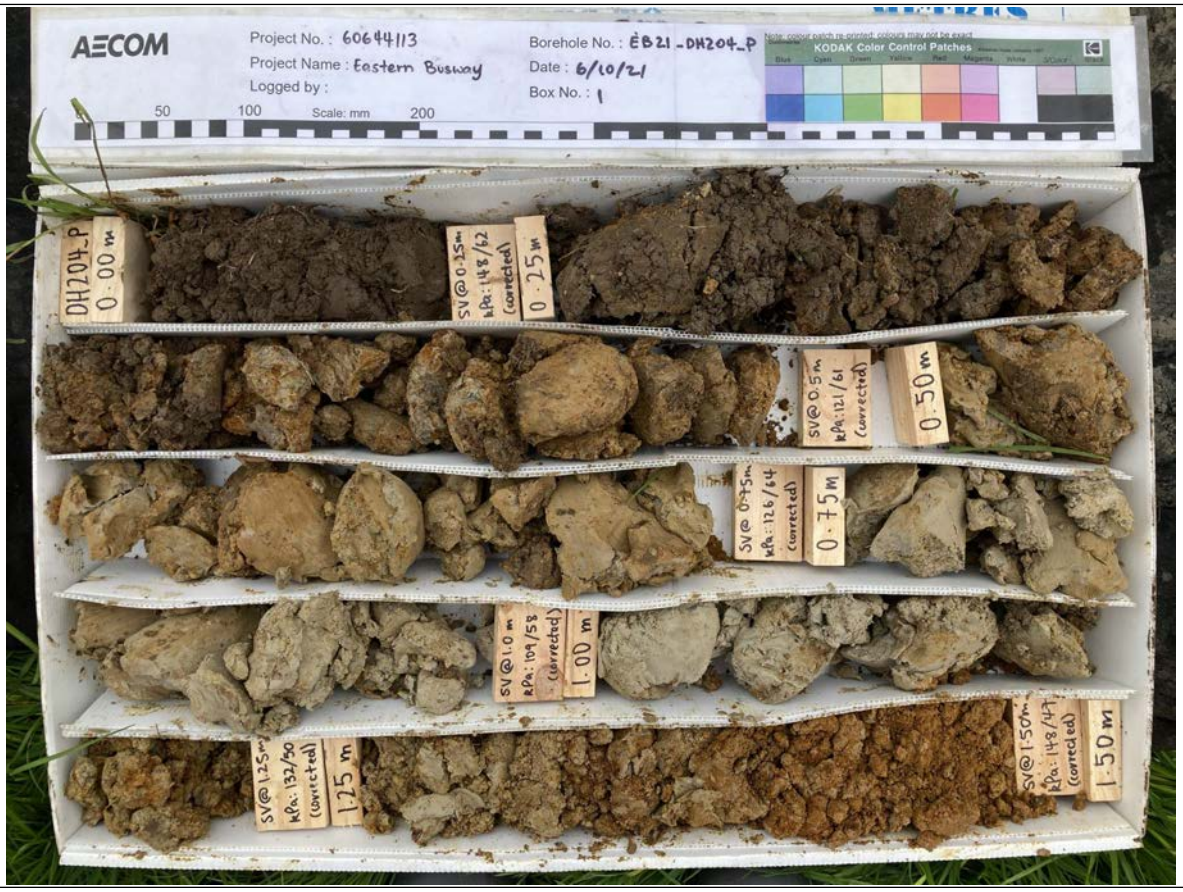
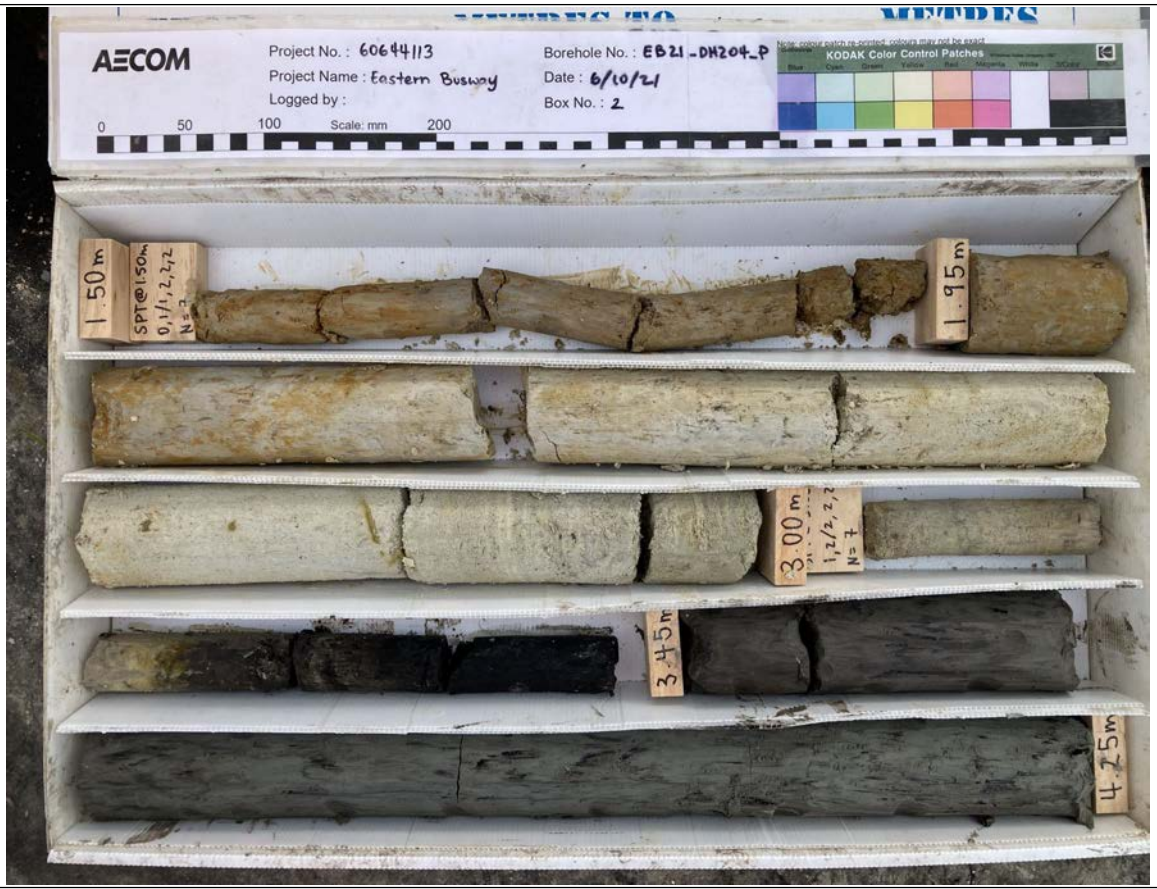


Box: 1 of 11 - Depth: 00.00m to 01.50m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021



Box: 2 of 11 - Depth: 01.50m to 04.25m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021

Box: 3 of 11 - Depth: 04.25m to 07.50m of 30.13m

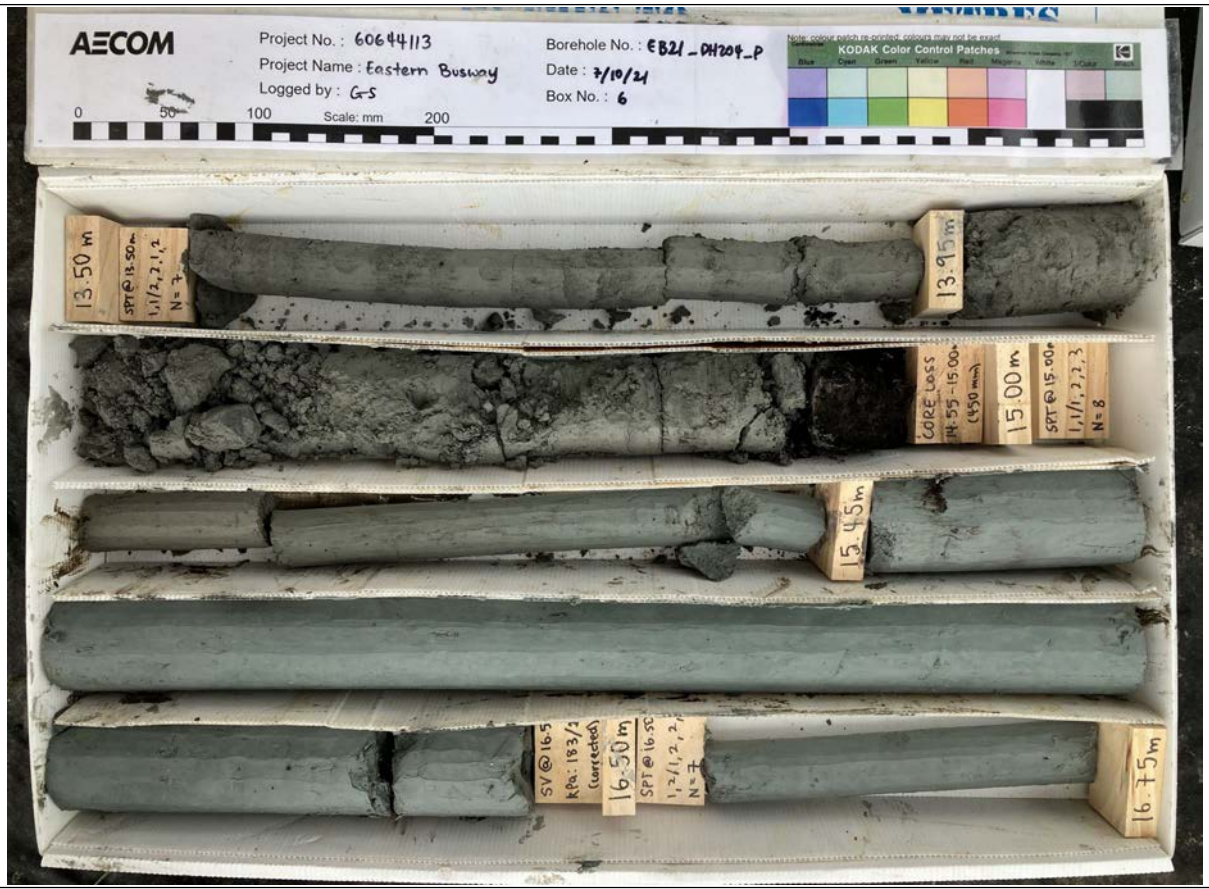
Date Drilled 6/10/2021 to 8/10/2021

Box: 4 of 11 - Depth: 07.50m to 10.65m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021

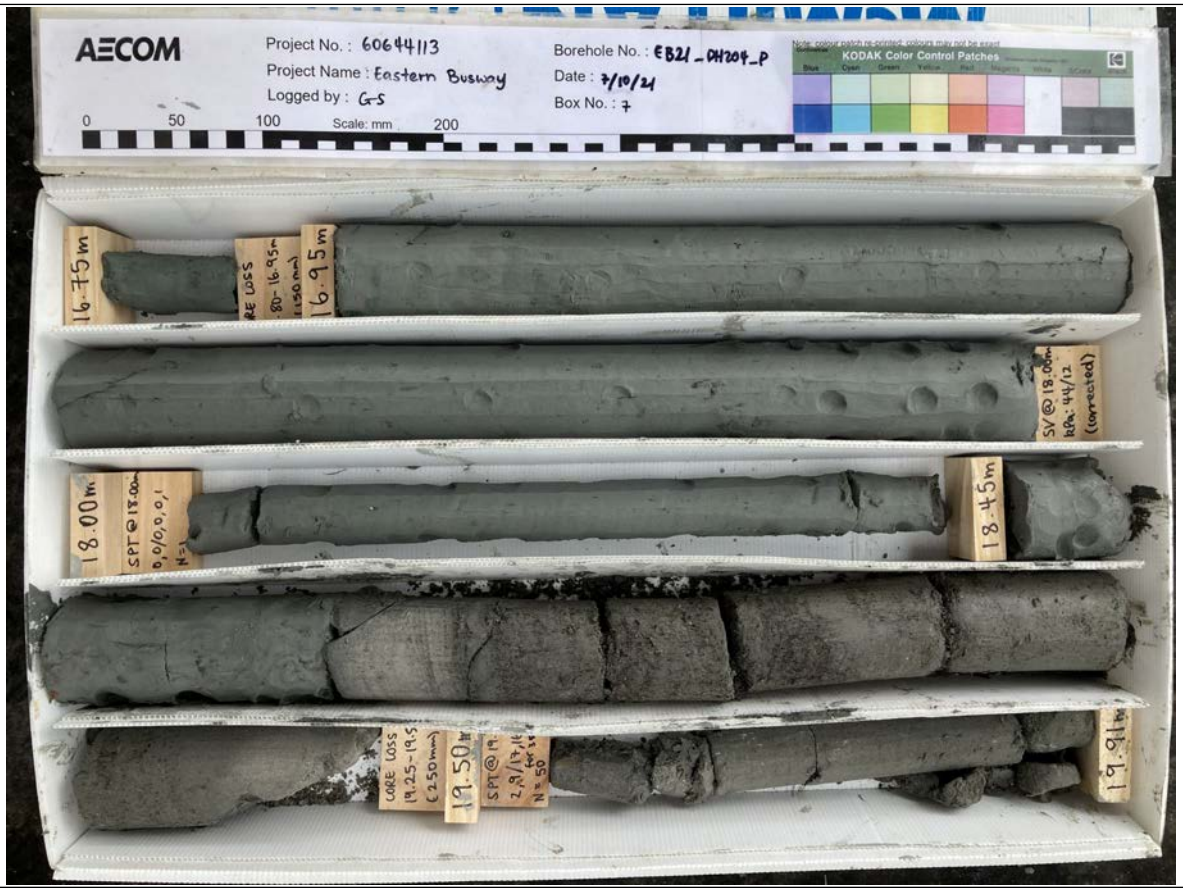
Box: 5 of 11 - Depth: 10.65m to 13.50m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021



Box: 6 of 11 - Depth: 13.50m to 16.75m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021



Box: 7 of 11 - Depth: 16.75m to 19.91m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021

Box: 8 of 11 - Depth: 19.91m to 22.64m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021

Box: 9 of 11 - Depth: 22.64m to 25.50m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021

Box: 10 of 11 - Depth: 25.50m to 28.15m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021

Eastern Busway

PHOTOGRAPHIC LOG OF DRILLHOLE

Project Eastern Busway

Location SEART, Ti Rakau Dr Intersection

HOLE IDENTIFICATION **DH204_P**

Box: 11 of 11 - Depth: 28.15m to 30.13m of 30.13m

Date Drilled 6/10/2021 to 8/10/2021

2021 EB DRILLHOLE LOG 2021-10-07 GS FIELD FILE (DH'S).GPJ BASE.GDT 08/10/21

TERMINOLOGY AND SYMBOLS

Eastern Busway

Drilling / Investigation Methods

CFHSA	- Continuous Flight Hollow Stem Auger.
CFSSA	- Continuous Flight Solid Stem Auger.
DC	- Dynamic Coring (eg Terrier Rig).
DCP	- Dynamic Cone Penetrometer.
HA	- Hand Auger.
HQ3	- HQ Triple Tube.
HQWL	- HQ Wire Line.
HWOB	- Heavy Weight Open Barrel.
NQ3	- NQ Triple Tube.
NQWL	- NQ Wire Line.
OB	- 100mm diameter Open Barrel.
OB70	- 70mm diameter Open Barrel.
PERC	- Percussion.
PS	- Piston Sample.
PQ3	- PQ Triple Tube.
PQWL	- PQ Wire Line.
RC	- Reverse Circulation.
RCDHH	- Reverse Circulation Down Hole Hammer.
SPT	- Standard Penetration Test.
SPERC	- Sonic Percussion.
PT	- Push Tube Sample
VAC EX	- Vacuum Excavation.
WASH	- Wash Drilling.

Test Results

SPT "N" value; uncorrected blow count for 300 mm penetration
/# / # / # / # / # blows per 75 mm penetration

ss - Standard Penetration Test - split spoon
sc - Standard Penetrattion Test - solid cone (no sample recovery)
SUOW - Sunk Under Own Weight

Vane Shear Strength Tests

/ # Vane shear strength test results given as peak / remoulded shear strengths (kPa). Test as per NZGS Guideline, 2001.

$^{\#}$ = Vane test performed on core recovered prior to extrusion from core barrel.
* = Vane test performed on excavated material of suitable size.

UTP - Unable to penetrate.

Unit/Geological Boundary Lines

———— Known

— — — - Inferred/Unknown

Installation & Backfill

Standpipe		Grout	
Slotted Standpipe		Cement	
Collapse/Cuttings /Spoil		Gravel Pack Filter	
Bentonite		Sand Pack Filter	
Inclinometer		Gravel Backfill	

Groundwater Records

Water Level (During Drilling)	2.0
Water Inflow/Seep	
Water Outflow	
Complete Water Loss	
Regain Circulation	

2.0 Fluid level measurement during drilling

Samples

PT	- Thin Wall Push Sample
PS	- Piston Sample
U	- Undisturbed
D	- Disturbed (Core)
B	- Disturbed (Pit)

Rock Descriptions

Relative Strength

		USC (MPa)
ES	- Extremely strong	> 250
VS	- Very Strong	100 - 250
S	- Strong	50 - 100
MS	- Moderately Strong	20 - 50
W	- Weak	5 - 20
VW	- Very Weak	1 - 5
EW	- Extremely Weak	< 1

Weathering

UW	- Unweathered
SW	- Slightly Weathered
MW	- Moderately Weathered
HW	- Highly Weathered
CW	- Completely Weathered

Soil Descriptions

Consistency Cohesive Soils

	Su (kPa)
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	200 - 500

Relative Density Non-cohesive soils

	SPT "N" Value (uncorrected)
Very Loose	< 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Rock Defect Abbreviations

Defect Type
BP = Bedding Plane Defect
CZ = Crush Zone
DB = Drilling Break
FZ = Fracture Zone
HJ = Healed Joint
J = Joint
SZ = Shear Zone
Ve = Vein

Defect Aperture
T = Tight (Nil)
VN = Very Narrow (>0-2mm)
N = Narrow (2-6mm)
MN = Moderately Narrow (6-20mm)
MW = Moderately Wide (20-60mm)
W = Wide (60-200mm)
VW = Very Wide (>200mm)

Defect Roughness
Pl = Planar
St = Stepped
Ud = Undulating
Ro = Rough
Sm = Smooth
Slk = Slickensided
\\ = Parallel
Po = Polished

Infill Thickness
Sn = Stained
Vn = Veneer (<0.5mm)
Cg = Coating
P = Partially infilled
C = Completely Infilled

Infill Colour
bl = Blue
bn = Brown
bk = Black
gn = Green
gy = Grey
or = Orange
pk = Pink
rd = Red
wh = White
ye = Yellow

Infill Material
Calc = Calcareous
Cb = Carbonaceous
Cc = Calcite
Cl = Clay
Fe = Iron Oxide
Mn = Manganese
NF = No Infill
Py = Pyrite
Qtz = Quartz
S = Sand
Slt = Silt

Graphic Log (typical symbols)

Peat	Mudstone
Clay	Siltstone
Silt	Sandstone
Sand	Basalt
Gravel / Cobbles	No recovery
Welded Tuff	

Core Measurements

TCR - Total Core Recovery
RQD - Rock Quality Designation

Soil and rock descriptions generally as in "Guidelines for the Field Description of Soil and Rock for Engineering Purposes" by the NZ Geotechnical Society Inc, December 2005.

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION **DH205_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409468.12mE 796009.94mN
Orientation -90° Elevation 7.68m
Location Berm, SEART SB
Feature MSE Abutment Wall

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	

FILL

0.0m: TOPSOIL.

0.2m: FILL comprising silty clay, sand and gravel.

HA — 100

ss 0,0,2, 2,2,2 N=8 — SPT — 100

0.0m: Sandy SILT; dark brown. Soft, dry, low plasticity.

0.2m: Silty CLAY with some fine to coarse sand and minor fine to medium subangular gravel; light brown and grey. Stiff, moist, high plasticity.

TAURANGA GROUP

1.95m: ALLUVIUM comprising clay with sand and silt, organic clay and peat.

HQ3 — 100

104/27 ss 0,0,1, 1,1,1 N=4 — SPT — 100

1.95m: Fine sandy CLAY with some silt; light grey. Stiff, moist, high plasticity.

2.6m: Organic CLAY; black. Stiff, moist, high plasticity.

HQ3 — 100

63/19 — HQ3 — 100

PT — 100

ss 0,1,0, 1,1,1 N=3 — SPT — 100

3.25m: Fine micaceous sandy CLAY with some silt and minor organics; bluish grey. Firm, moist, high plasticity.

HQ3 — 100

47/9 ss 0,0,0, 1,0,1 N=2 — SPT — 100

HQ3 — 100

33/6 — PT — 100

ss 0,1,0, 1,0,1 N=2 — SPT — 100

6.45m: Silty CLAY with minor fine micaceous sand; bluish grey. Firm, moist, high plasticity.

HQ3 — 100

ss 0,1,0, 1,1,1 N=3 — SPT — 100

9.0 to 13.0m: Stiff.

Instrumentation: 0.53; 1.5; 1.6; 1.7; 2.05; 2.1

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth
01/11/2021 15:30	09.45	-	2.1
02/11/2021 09:30	09.45	-	0.53
02/11/2021 15:00	19.50	-	1.7
03/11/2021 09:10	19.50	-	1.65
05/11/2021 09:15	20.60	-	1.76
05/11/2021 12:40	24.00	-	2.05
24/11/2021 14:00	28.00	-	1.5

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 25/11/2021
Logged SK
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 1/11/2021
Finished 24/11/2021
Drill Rig N118
Core Boxes 11

2021 EB DRILLHOLE LOG 2022-01-24 SBS MASTER.GPJ BASE.GDT 24/01/22

24/01/2022

LOG OF DRILLHOLE

Eastern Busway

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Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409468.12mE 796009.94mN
Orientation -90° Elevation 7.68m
Location Berm, SEART SB
Feature MSE Abutment Wall

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				(mm) 500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	

TAURANGA GROUP

6.45m: Silty CLAY with minor fine micaceous sand; bluish grey. Firm, moist, high plasticity. *(continued)*

93/17 ss 1,1,1, 1,2,2 N=6 — HQ3 / SPT

ss 1,2,2, 3,4,5 N=14 — HQ3 / SPT

31/6 — HQ3

HQ3

HQ3

PT

13.8m: Spongy PEAT; black. Firm, moist, high plasticity.

HQ3

14.25m: Silty CLAY with minor fine micaceous sand; bluish grey. Stiff, moist, high plasticity.

55/8 ss 2,2,3, 2,4,3 N=12 — HQ3 / SPT

99/24 ss 0,0,1, 0,1,1 N=3 — HQ3 / SPT

EAST COAST BAYS FORMATION

17.5m: Slightly weathered, grey, volcaniclastic fine to coarse SANDSTONE. Moderately strong. Containing subrounded and subangular fine gravel, light grey, dark grey and red. Very thickly bedded.

sc 45,5 for 5mm N>50 — HQ3 / SPT

17.55m: DB, 0°
17.75 to 17.81m: J, 60°, St, Sm
18.0 to 18.09m: J, 70°, Ud, Ro
18.17 to 18.54m: J, 70°, Ud, Sm, VN, NF
18.27m: DB, 0°

18.54 to 19.36m: Core broken into coarse gravel and cobble sized fragments by several sub-vertical and closely spaced sub-horizontal joints, undulose rough.

19.37m: J, 30°, Ud, Sm
19.5 to 20.14m: Recovered as coarse gravel, drilling issues.

sc 11,13,20, 30 for 10mm — HQ3 / SPT

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 25/11/2021
Logged SK
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 1/11/2021
Finished 24/11/2021
Drill Rig N118
Core Boxes 11

2021 EB DRILLHOLE LOG 2022-01-24 SBS MASTER.GPJ BASE.GDT 24/01/22

24/01/2022

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH205_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409468.12mE 796009.94mN
Orientation -90° Elevation 7.68m
Location Berm, SEART SB
Feature MSE Abutment Wall

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	

EAST COAST BAYS FORMATION

17.5m: Slightly weathered, grey, volcaniclastic fine to coarse SANDSTONE. Moderately strong. Containing subrounded and subangular fine gravel, light grey, dark grey and red. Very thickly bedded. *(continued)*

N>50 — HQ3 — 99 [99]

21.0 to 21.24m: Fine SANDSTONE, light grey.

HQ3 — 100 [100]

22.0 to 22.25m: Apparent channel of fine sandstone.

22.85 to 22.9m: Fining downwards at base of bed.

22.9m: Slightly weathered, grey, fine to medium SANDSTONE. Weak.

HQ3 — 100 [89]

sc 21,29 for 35mm N>50 — SPT — 0

24.0m: Slightly weathered, grey, SILTSTONE. Very weak.
24.06 to 24.11m: Sandstone.
24.25 to 24.44m: Fine to medium SANDSTONE.

HQ3 — 100 [100]

25.2m: Slightly weathered, grey, fine to medium SANDSTONE. Weak.

25.65m: Slightly weathered, grey, SILTSTONE. Very weak.

26.0m: Slightly weathered, grey, fine to medium SANDSTONE. Extremely weak, weakly cemented.

HQ3 — 100 [67]

HQ3 — 100 [0]

20.28 to 20.6m: J, 70°, Ud, Sm

20.6 to 20.74m: J, 70°, Ud, Sm, VN, C, Cc, & Ve, 85º, Ud, Cc
20.81m: DB, 0°
20.86 to 21m: J, 65°, Ud, Sm, N, C, Cc, Joint defines base of sandstone bed
21.16 to 21.33m: J, 70°, Ud, Sm

21.51m: DB, 0°

22.25m: DB, 0°

22.5 to 22.8m: Core Loss.

22.8 to 22.86m: J, 60°, Ud, Sm
22.88 to 22.96m: J, 70°, Ud, Sm
22.96m: DB, 0°
23.15 to 23.2m: Recovered as siltstone gravel.

23.95m: DB, 0°
24.11 to 24.88m: Drilling Breaks: 0°, at 24.11, 24.23, 24.37, 24.42 & 24.88m.

24.77m: J, 5°, Ud, Ro

25.29 to 26.15m: Drilling Breaks: 0°, at 25.29, 25.36, 25.4, 25.47, 26.1 & 26.15m.

26.0m: Silty fine to medium SAND; grey.

DH205_P terminated at 28.0m
Depth Criteria Achieved

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

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Date logged 25/11/2021
Logged SK
Checked GP

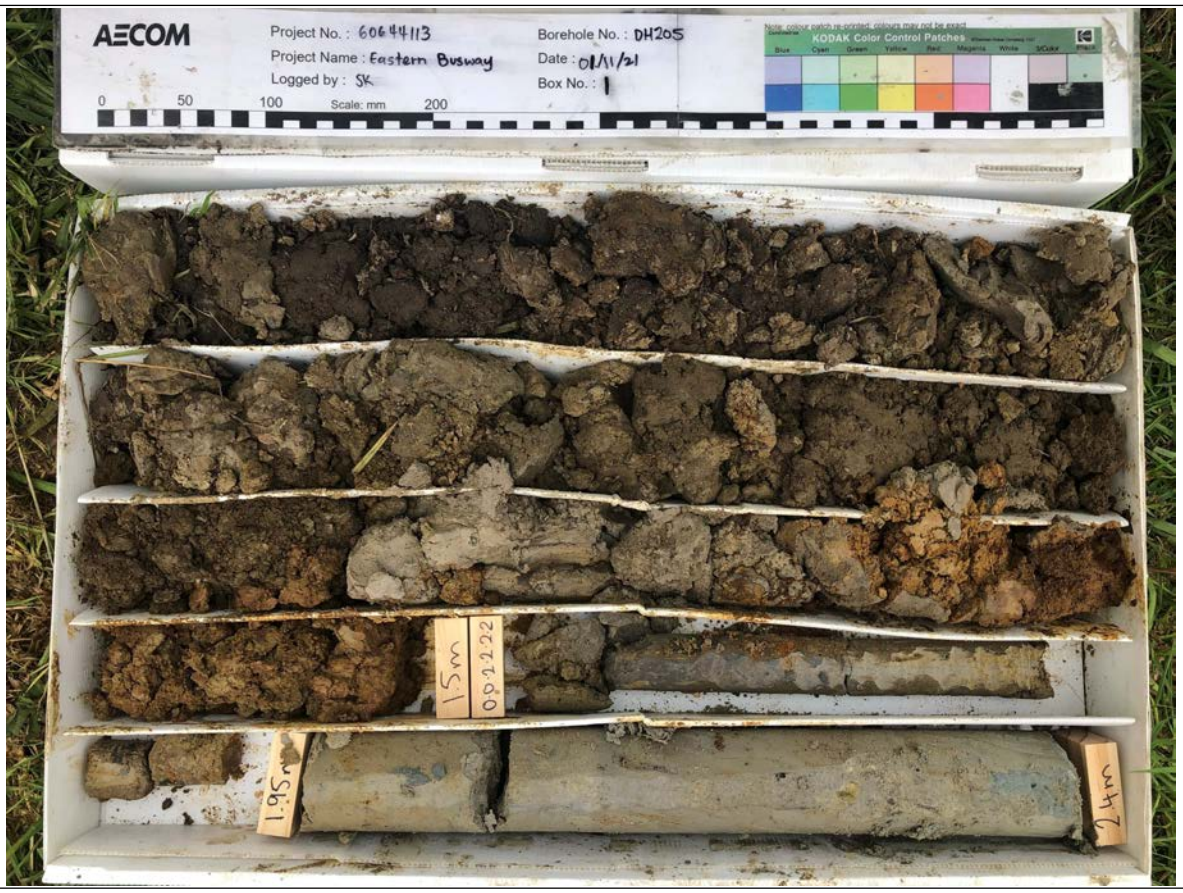
Remarks
50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 1/11/2021
Finished 24/11/2021
Drill Rig N118
Core Boxes 11

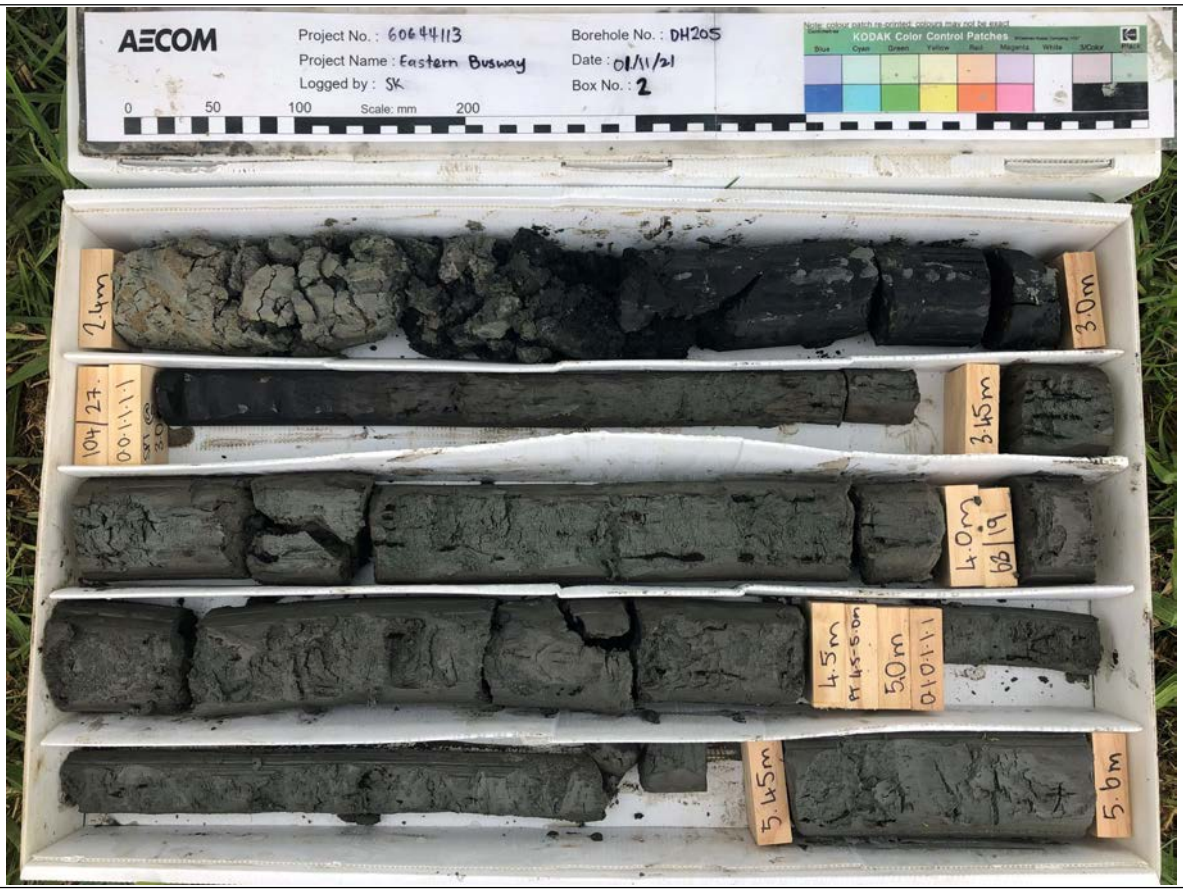
2021 EB DRILLHOLE LOG 2022-01-24 SBS MASTER.GPJ BASE.GDT 24/01/22

24/01/2022



Box: 1 of 11 - Depth: 00.00m to 02.40m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 1/11/2021

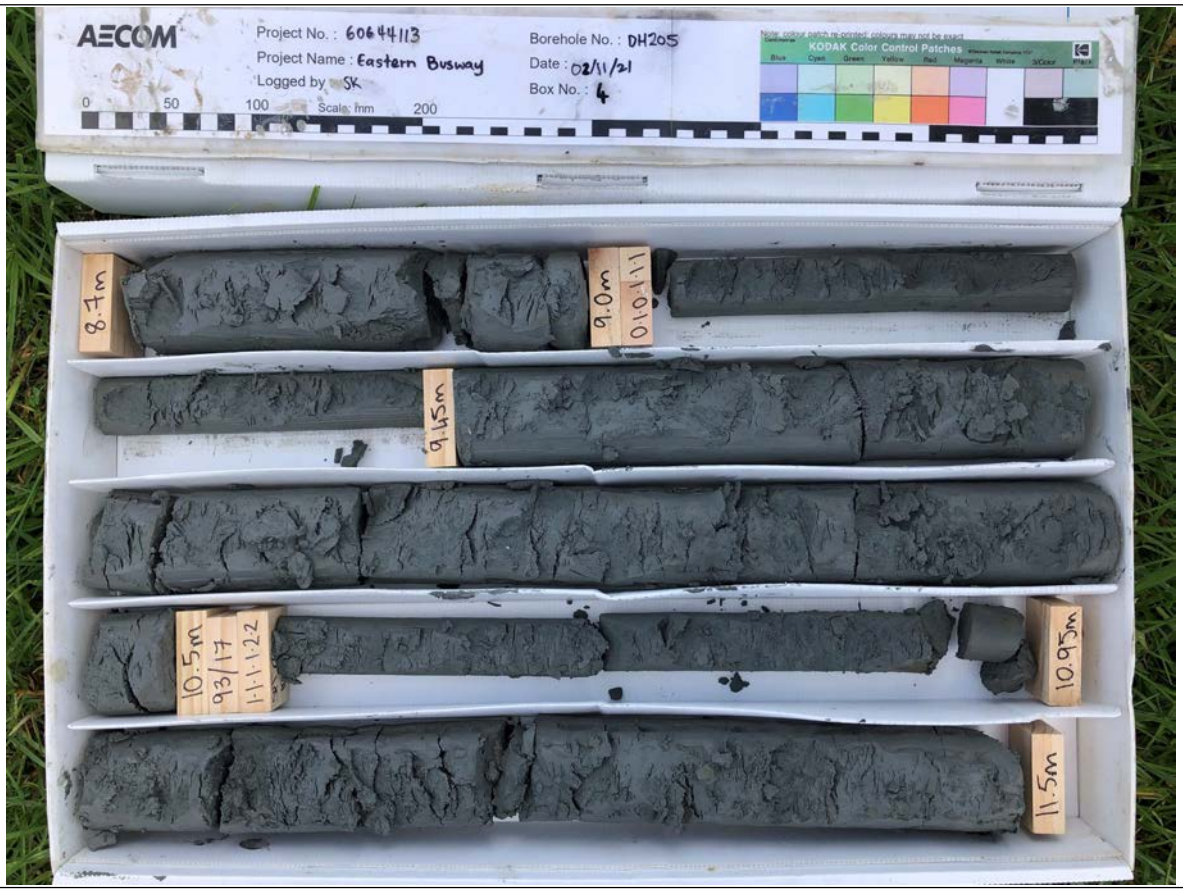


Box: 2 of 11 - Depth: 02.40m to 05.60m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 1/11/2021

Box: 3 of 11 - Depth: 05.60m to 08.70m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 1/11/2021



Box: 4 of 11 - Depth: 08.70m to 11.50m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 2/11/2021

Box: 5 of 11 - Depth: 11.50m to 14.70m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 2/11/2021

Box: 6 of 11 - Depth: 14.70m to 17.40m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 2/11/2021

Box: 7 of 11 - Depth: 17.40m to 20.60m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 3/11/2021

Box: 8 of 11 - Depth: 20.60m to 23.20m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 5/11/2021

Box: 9 of 11 - Depth: 23.20m to 24.00m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 5/11/2021

Box: 10 of 11 - Depth: 24.00m to 26.10m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 24/11/2021

Eastern Busway

PHOTOGRAPHIC LOG OF DRILLHOLE

Project Eastern Busway

Location Berm, SEART SB

HOLE IDENTIFICATION **DH205_P**

Box: 11 of 11 - Depth: 26.10m to 28.00m of 28.00m

Date Drilled 1/11/2021 to 24/11/2021 - Date Photographed: 24/11/2021

TERMINOLOGY AND SYMBOLS

Eastern Busway

Drilling / Investigation Methods

CFHSA	- Continuous Flight Hollow Stem Auger.
CFSSA	- Continuous Flight Solid Stem Auger.
DC	- Dynamic Coring (eg Terrier Rig).
DCP	- Dynamic Cone Penetrometer.
HA	- Hand Auger.
HQ3	- HQ Triple Tube.
HQWL	- HQ Wire Line.
HWOB	- Heavy Weight Open Barrel.
NQ3	- NQ Triple Tube.
NQWL	- NQ Wire Line.
OB	- 100mm diameter Open Barrel.
OB70	- 70mm diameter Open Barrel.
PERC	- Percussion.
PS	- Piston Sample.
PQ3	- PQ Triple Tube.
PQWL	- PQ Wire Line.
RC	- Reverse Circulation.
RCDHH	- Reverse Circulation Down Hole Hammer.
SPT	- Standard Penetration Test.
SPERC	- Sonic Percussion.
PT	- Push Tube Sample
VAC EX	- Vacuum Excavation.
WASH	- Wash Drilling.

Test Results

SPT "N" value; uncorrected blow count for 300 mm penetration
/# / # / # / # / # blows per 75 mm penetration

ss - Standard Penetration Test - split spoon
sc - Standard Penetrattion Test - solid cone (no sample recovery)
SUOW - Sunk Under Own Weight

Vane Shear Strength Tests

/ # Vane shear strength test results given as peak / remoulded shear strengths (kPa). Test as per NZGS Guideline, 2001.

$^{\#}$ = Vane test performed on core recovered prior to extrusion from core barrel.
* = Vane test performed on excavated material of suitable size.

UTP - Unable to penetrate.

Unit/Geological Boundary Lines

———— Known

— — — - Inferred/Unknown

Installation & Backfill

Standpipe		Grout	
Slotted Standpipe		Cement	
Collapse/Cuttings /Spoil		Gravel Pack Filter	
Bentonite		Sand Pack Filter	
Inclinometer		Gravel Backfill	

Groundwater Records

Water Level (During Drilling)	2.0
Water Inflow/Seep	
Water Outflow	
Complete Water Loss	
Regain Circulation	

2.0 Fluid level measurement during drilling

Samples

PT	- Thin Wall Push Sample
PS	- Piston Sample
U	- Undisturbed
D	- Disturbed (Core)
B	- Disturbed (Pit)

Rock Descriptions

Relative Strength

		USC (MPa)
ES	- Extremely strong	> 250
VS	- Very Strong	100 - 250
S	- Strong	50 - 100
MS	- Moderately Strong	20 - 50
W	- Weak	5 - 20
VW	- Very Weak	1 - 5
EW	- Extremely Weak	< 1

Weathering

UW	- Unweathered
SW	- Slightly Weathered
MW	- Moderately Weathered
HW	- Highly Weathered
CW	- Completely Weathered

Soil Descriptions

Consistency Cohesive Soils

	Su (kPa)
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	200 - 500

Relative Density Non-cohesive soils

	SPT "N" Value (uncorrected)
Very Loose	< 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Rock Defect Abbreviations

Defect Type
BP = Bedding Plane Defect
CZ = Crush Zone
DB = Drilling Break
FZ = Fracture Zone
HJ = Healed Joint
J = Joint
SZ = Shear Zone
Ve = Vein

Defect Aperture
T = Tight (Nil)
VN = Very Narrow (>0-2mm)
N = Narrow (2-6mm)
MN = Moderately Narrow (6-20mm)
MW = Moderately Wide (20-60mm)
W = Wide (60-200mm)
VW = Very Wide (>200mm)

Defect Roughness
Pl = Planar
St = Stepped
Ud = Undulating
Ro = Rough
Sm = Smooth
Slk = Slickensided
\\ = Parallel
Po = Polished

Infill Thickness
Sn = Stained
Vn = Veneer (<0.5mm)
Cg = Coating
P = Partially infilled
C = Completely Infilled

Infill Colour
bl = Blue
bn = Brown
bk = Black
gn = Green
gy = Grey
or = Orange
pk = Pink
rd = Red
wh = White
ye = Yellow

Infill Material
Calc = Calcareous
Cb = Carbonaceous
Cc = Calcite
Cl = Clay
Fe = Iron Oxide
Mn = Manganese
NF = No Infill
Py = Pyrite
Qtz = Quartz
S = Sand
Slt = Silt

Graphic Log (typical symbols)

Peat	Mudstone
Clay	Siltstone
Silt	Sandstone
Sand	Basalt
Gravel / Cobbles	No recovery
Welded Tuff	

Core Measurements

TCR - Total Core Recovery
RQD - Rock Quality Designation

Soil and rock descriptions generally as in "Guidelines for the Field Description of Soil and Rock for Engineering Purposes" by the NZ Geotechnical Society Inc, December 2005.

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION **DH210_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409737.34mE 796330.84mN
Orientation -90° Elevation 11.82m
Location 19 Williams Roberts Rd
Feature Reeves Rd Flyover Pier

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc.)	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
FILL		VAC EX				1		0		0.0m: ASPHALT.	
0.0m: ASPHALT.										0.2m: Sandy fine to coarse GRAVEL with some cobbles. Gravel comprises sandstone [Greywacke], basalt and concrete with basalt cobbles.	0.7
0.2m: FILL comprising gravel and clay.	ss 0,1,1, 2,3,2 N=8	SPT						100		0.7m: Silty CLAY with minor fine sand; grey. Very stiff, moist, high plasticity.	
		HQ3				2		88		1.5 to 1.55m: Dark grey, soft. 1.55 to 3.1m: Trace decomposed wood, light brownish grey mottled orange, firm	2.2 2.3 2.4 2.65
	46/3 ss 2,5,9, 11,13,10 N=43	114 HWT SPT				3		100		3.0m: 114mm diameter, HWT casing to 3.0m depth.	
3.1m: ALLUVIUM comprising clay, peat and sand.		HQ3				4		100		3.1m: Silty fine SAND with trace clay; light grey. Medium dense, moist, uniformly graded. Pumice sand. 3.45 to 3.55m: Clay ceases, dilatant behaviour. 3.6m: Organic CLAY with flecks of decomposed wood; dark brown. Soft, moist, high plasticity. Extremely sticky.	
	25 ss 0,0,1, 1,2,1 N=5	SPT						100			4.8
TAURANGA GROUP		PT				5		100			
		HQ3						100		5.45m: Bottom of push tube has trace fine sand. 5.6 to 6.45m: Brownish grey streaked dark brown.	
	57/6 ss 0,0,0, 0,1,1 N=2	SPT				6		100			
		HQ3				7		100		6.45m: CLAY with trace silt and organics; bluish grey. Stiff, moist, high plasticity. Organics are decomposed wood streaks. Gradational change from 6.45-6.65 m. 6.45 to 6.65m: Gradational change from 6.45-6.65m.	
	UTP ss 3,3,4, 4,4,4 N=16	SPT						100			
		HQ3				8		100			
	60/13 ss 0,1,0, 1,1,1 N=3	SPT				9		100		9.25 to 9.45m: Increased organic content to minor.	

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth
06/08/2021 14:30	06.45	-	0.7
09/08/2021 08:30	06.45	-	2.2
09/08/2021 16:30	22.50	-	4.8
10/08/2021 08:30	22.50	-	2.4
10/08/2021 16:50	33.00	-	2.3
11/08/2021 08:30	33.00	-	2.65

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
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Date logged 10/08/2021
Logged SK
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 6/08/2021
Finished 10/08/2021
Drill Rig N119
Core Boxes 12

2021 EB DRILLHOLE LOG 2021-12-20 SBS MASTER.GPJ BASE.GDT 20/12/21

20/12/2021

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH210_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409737.34mE 796330.84mN
Orientation -90° Elevation 11.82m
Location 19 Williams Roberts Rd
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Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	

TAURANGA GROUP

Depth	Test	Drilling Method	TCR [RQD] (%)	SOIL PROPERTIES / DEFECT DESCRIPTION
11	66/14 ss 0,0,0, 1,1,0 N=2	SPT	100	6.45m: CLAY with trace silt and organics; bluish grey. Stiff, moist, high plasticity. Organics are decomposed wood streaks. Gradational change from 6.45-6.65 m. *(continued)*
		HQ3	100	
12	108/11 ss 0,0,0, 1,1,0 N=2	SPT	100	11.7 to 11.9m: Drilling disturbed. 11.9 to 12.1m: Very stiff.
		PT	100	
13		HQ3	100	
	50/13 ss 0,1,0, 2,1,2 N=5	SPT	100	
14		HQ3	100	
15	52/6 ss 0,0,0, 2,1,1 N=4	SPT	100	15.0 to 17.5m: With some fine micaceous sand lenses ~8 mm thick and ~5 mm apart.
16		HQ3	100	
	UTP/0 ss 2,1,1, 2,1,2 N=6	SPT	100	
17		HQ3	100	17.3m: Spongy PEAT; dark brown. Firm, moist, high plasticity.
18	91/16 ss 0,1,1, 2,2,4 N=9	SPT	100	18.15m: CLAY with trace silt and organics; bluish grey. Stiff, moist, high plasticity. Organics are decomposed wood streaks. 18.4 to 20.5m: Becomes very stiff. 18.5m: Trace organics cease.
19		HQ3	100	
	ss 0,0,0, 0,1,1 N=2	SPT	100	19.6m: Trace fine micaceous sand lenses ~8 mm thick and ~5 mm apart.

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
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Started 6/08/2021
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EAST COAST BAYS FORMATION

20.5m: Highly weathered, grey, fine SANDSTONE. Extremely weak.

20.7m: Slightly weathered, grey, fine SANDSTONE. Weak. Gravel inclusions, subangular dark grey fine to medium.

20.9m: Unweathered, grey, fine SANDSTONE. Weak. Some fine subangular dark grey gravel inclusions.

22.35m: Unweathered, grey, fine to coarse volcaniclastic SANDSTONE. Moderately strong. Gravel fine to coarse subangular, light grey and dark grey, thickly bedded.

25.3m: Unweathered, grey, medium SANDSTONE. Weak. Some fine subangular dark grey gravel inclusions.

26.4m: Unweathered, grey, volcaniclastic SANDSTONE. Moderately strong. Gravel fine to coarse subangular, dark grey.

Test Records: sc 11,39 for 65mm N>50; sc 30,20 for 60mm N>50; sc 7,43 for 30mm N>50; SPT

Drilling Method: HQ3

Depth: 21 22 23 24 25 26 27 28 29

TCR [RQD] (%): 100 [19]; 0; 100 [100]; 0; 100 [100]; 0; 100 [100]; 100 [100]; 100 [100]

20.5m: Silty fine SAND; grey. Tightly packed, moist.

20.5 to 21.0m: Drilling breaks, sub-horizontal, at 20.67, 20.74 & 20.87m.
21.0 to 21.14m: Recovered as medium to coarse, subrounded gravel.
21.14 to 22.5m: Drilling breaks, sub-horizontal, at 21.29, 21.37, 21.6, 21.84, 21.93, 22.07 & 22.35m.
21.21 to 21.44m: J, 70°, Ro, T, Cg, gy Slt
21.41 to 21.56m: Ve, 65°, Ro, T, Qtz, <1mm
21.67 to 21.96m: J, 70°, Ro, T, NF
21.87 to 22.08m: J, 70°, Ro, T, NF
21.98 to 22.28m: J, 80°, Ro, T, NF
22.5 to 22.6m: Recovered as medium subrounded gravel.
22.9 to 23.1m: Drilling breaks, 0°, at 22.9, 22.93, 22.96 & 23.1m.
23.4 to 23.6m: HJ, 60°, Sm, NF, Opened up through drilling.
23.85 to 23.9m: HJ, 45°, Sm, NF, Opened up through drilling.
23.95 to 24m: HJ, 45°, Sm, NF, Opened up through drilling.
24.11 to 25.5m: Drilling breaks, sub-horizontal, at 24.3, 24.44, 24.8, 24.9, 24.95, 25.05 & 25.28m.
24.65 to 24.68m: HJ, 25°, Ro, Calc, Opened up through drilling.
24.8 to 24.9m: Extremely closely spaced sub-horizontal incipient joints, undulating.
25.5 to 27.0m: Drilling breaks, sub-horizontal, at 26.24, 26.47, 26.61, 26.63, 26.71, 26.73 & 26.75m.
26.15 to 26.25m: HJ, 60°, Ro, Qtz, Opened up through drilling.
26.55 to 26.63m: HJ, 65°, Ro, NF, Opened up through drilling.
26.63 to 26.7m: HJ, 70°, Ro, Qtz, Opened up through drilling.
27.01m: DB, 0°
28.9 to 29.13m: HJ, 60°, Ro, T, Qtz, <1mm
29.39m: DB, 0°
29.52m: Ve, 5°, Ro, Qtz, 5mm

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 10/08/2021
Logged SK
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 6/08/2021
Finished 10/08/2021
Drill Rig N119
Core Boxes 12

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH210_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409737.34mE 796330.84mN
Orientation -90° Elevation 11.82m
Location 19 Williams Roberts Rd
Feature Reeves Rd Flyover Pier

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
EAST COAST BAYS FORMATION 26.4m: Unweathered, grey, volcaniclastic SANDSTONE. Moderately strong. Gravel fine to coarse subangular, dark grey. *(continued)*		HQ3				31		100 [100]		29.9 to 30.15m: HJ, 65°, Ro, T, Qtz, <1mm, Partially opened up through drilling. 30.91 to 30.93m: HJ, 30°, Ro, T, Qtz, <1mm 30.97 to 31.2m: HJ, 60°, Ro, T, Qtz, <1mm 31.21 to 31.3m: HJ, 60°, Ro, T, Qtz, <1mm 31.5 to 33.0m: 15+ drilling/manual handling breaks, core largely returned as gravel. 32.26 to 32.3m: HJ, 30°, Sm, NF, Opened up through drilling. 32.32 to 32.42m: HJ, 70°, Sm, NF, Opened up through drilling. 31.78m: HJ, 60°, Sm, NF, 3no. at 31.78-31.95. 31.84-31.95 & 32.0-32.11m, opened up through drilling.	
31.41m: Unweathered, grey, fine SANDSTONE. Moderately strong. 31.58m: Unweathered grey SILTSTONE. Very weak.		HQ3				32		100 [100]		32.42 to 33.0m: Recovered as gravel.	
						33				DH210_P terminated at 33.0m Target Depth	
						34					
						35					
						36					
						37					
						38					
						39					

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
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CW - Completely weathered

Date logged 10/08/2021
Logged SK
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 6/08/2021
Finished 10/08/2021
Drill Rig N119
Core Boxes 12

2021 EB DRILLHOLE LOG 2021-12-20 SBS MASTER.GPJ BASE.GDT 20/12/21

20/12/2021

Box: 1 of 12 - Depth: 00.00m to 04.20m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 6/08/2021

Box: 2 of 12 - Depth: 04.20m to 07.00m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 9/08/2021

Box: 3 of 12 - Depth: 07.00m to 09.50m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 9/08/2021

Box: 4 of 12 - Depth: 09.50m to 12.10m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 9/08/2021

Box: 5 of 12 - Depth: 12.10m to 15.00m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 9/08/2021

Box: 6 of 12 - Depth: 15.00m to 17.45m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 9/08/2021

Box: 7 of 12 - Depth: 17.45m to 19.95m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 9/08/2021

Box: 8 of 12 - Depth: 19.95m to 22.60m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 10/08/2021

Box: 9 of 12 - Depth: 22.60m to 25.50m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 10/08/2021

Box: 10 of 12 - Depth: 25.50m to 27.95m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 10/08/2021

Box: 11 of 12 - Depth: 27.95m to 30.50m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 10/08/2021

Box: 12 of 12 - Depth: 30.50m to 33.00m of 33.00m

Date Drilled 6/08/2021 to 10/08/2021 - Date Photographed: 10/08/2021

TERMINOLOGY AND SYMBOLS

Eastern Busway

Drilling / Investigation Methods

CFHSA	- Continuous Flight Hollow Stem Auger.
CFSSA	- Continuous Flight Solid Stem Auger.
DC	- Dynamic Coring (eg Terrier Rig).
DCP	- Dynamic Cone Penetrometer.
HA	- Hand Auger.
HQ3	- HQ Triple Tube.
HQWL	- HQ Wire Line.
HWOB	- Heavy Weight Open Barrel.
NQ3	- NQ Triple Tube.
NQWL	- NQ Wire Line.
OB	- 100mm diameter Open Barrel.
OB70	- 70mm diameter Open Barrel.
PERC	- Percussion.
PS	- Piston Sample.
PQ3	- PQ Triple Tube.
PQWL	- PQ Wire Line.
RC	- Reverse Circulation.
RCDHH	- Reverse Circulation Down Hole Hammer.
SPT	- Standard Penetration Test.
SPERC	- Sonic Percussion.
PT	- Push Tube Sample
VAC EX	- Vacuum Excavation.
WASH	- Wash Drilling.

Test Results

SPT "N" value; uncorrected blow count for 300 mm penetration
/# / # / # / # / # blows per 75 mm penetration

ss - Standard Penetration Test - split spoon
sc - Standard Penetrattion Test - solid cone (no sample recovery)
SUOW - Sunk Under Own Weight

Vane Shear Strength Tests

/ # Vane shear strength test results given as peak / remoulded shear strengths (kPa). Test as per NZGS Guideline, 2001.

$^{\#}$ = Vane test performed on core recovered prior to extrusion from core barrel.
* = Vane test performed on excavated material of suitable size.

UTP - Unable to penetrate.

Unit/Geological Boundary Lines

———— Known

— — — - Inferred/Unknown

Installation & Backfill

Standpipe		Grout	
Slotted Standpipe		Cement	
Collapse/Cuttings /Spoil		Gravel Pack Filter	
Bentonite		Sand Pack Filter	
Inclinometer		Gravel Backfill	

Groundwater Records

Water Level (During Drilling)	2.0
Water Inflow/Seep	
Water Outflow	
Complete Water Loss	
Regain Circulation	

2.0 Fluid level measurement during drilling

Samples

PT	- Thin Wall Push Sample
PS	- Piston Sample
U	- Undisturbed
D	- Disturbed (Core)
B	- Disturbed (Pit)

Rock Descriptions

Relative Strength

		USC (MPa)
ES	- Extremely strong	> 250
VS	- Very Strong	100 - 250
S	- Strong	50 - 100
MS	- Moderately Strong	20 - 50
W	- Weak	5 - 20
VW	- Very Weak	1 - 5
EW	- Extremely Weak	< 1

Weathering

UW	- Unweathered
SW	- Slightly Weathered
MW	- Moderately Weathered
HW	- Highly Weathered
CW	- Completely Weathered

Soil Descriptions

Consistency Cohesive Soils

	Su (kPa)
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	200 - 500

Relative Density Non-cohesive soils

	SPT "N" Value (uncorrected)
Very Loose	< 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Rock Defect Abbreviations

Defect Type
BP = Bedding Plane Defect
CZ = Crush Zone
DB = Drilling Break
FZ = Fracture Zone
HJ = Healed Joint
J = Joint
SZ = Shear Zone
Ve = Vein

Defect Aperture
T = Tight (Nil)
VN = Very Narrow (>0-2mm)
N = Narrow (2-6mm)
MN = Moderately Narrow (6-20mm)
MW = Moderately Wide (20-60mm)
W = Wide (60-200mm)
VW = Very Wide (>200mm)

Defect Roughness
Pl = Planar
St = Stepped
Ud = Undulating
Ro = Rough
Sm = Smooth
Slk = Slickensided
\\ = Parallel
Po = Polished

Infill Thickness
Sn = Stained
Vn = Veneer (<0.5mm)
Cg = Coating
P = Partially infilled
C = Completely Infilled

Infill Colour
bl = Blue
bn = Brown
bk = Black
gn = Green
gy = Grey
or = Orange
pk = Pink
rd = Red
wh = White
ye = Yellow

Infill Material
Calc = Calcareous
Cb = Carbonaceous
Cc = Calcite
Cl = Clay
Fe = Iron Oxide
Mn = Manganese
NF = No Infill
Py = Pyrite
Qtz = Quartz
S = Sand
Slt = Silt

Graphic Log (typical symbols)

Peat	Mudstone
Clay	Siltstone
Silt	Sandstone
Sand	Basalt
Gravel / Cobbles	No recovery
Welded Tuff	

Core Measurements

TCR - Total Core Recovery
RQD - Rock Quality Designation

Soil and rock descriptions generally as in "Guidelines for the Field Description of Soil and Rock for Engineering Purposes" by the NZ Geotechnical Society Inc, December 2005.

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION **DH212_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409778.86mE 796356.53mN
Orientation -90° Elevation 15.87m
Location 15 William Roberts Rd
Feature MSE Abutment Wall

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				(mm) 500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
TAURANGA GROUP											
0.0m: TOPSOIL comprising clayey silt.										0.0m: Clayey SILT; dark brown. Soft, moist, low plasticity.	
0.4m: ALLUVIUM comprising clay, silt and sand, in places pumiceous or organic.	76/42	HA						100		0.4m: Silty CLAY; light grey with orange staining/mottling. Stiff to very stiff, moist, high plasticity.	0.5 ▽
	120/46					1					0.9 ▽
	151/60 ss 0,1,1, 2,2,3 N=8	SPT						100		1.5 to 3.2m: Orange staining lessens.	1.52 ▽
		HQ3				2		100		2.4 to 2.6m: Firm. 2.6 to 2.8m: Soft. 2.8 to 4.15m: Very soft. 3.0m: 114mm diameter, HWT casing to 3.0m depth. 3.2 to 4.15m: Grades to dark grey.	
	ss 0,0,0, 0,0,0 N=0 SUOW	114 HWT SPT				3		100			
		PT						100		3.9 to 4.0m: Push Tube: SILT.	
		HQ3				4		100		4.15m: Fine to medium SAND with trace silt, fine subrounded pumice gravel and organics; grey. Dense, moist to wet, poorly graded.	
	ss 2,3,3, 4,6,6 N=19	SPT						100			5.7 ▽
		HQ3				5		100			
	ss 4,6,9, 8,9,9 N=35	SPT				6		100			6.5 ▽
		HQ3				7		100			
	6/0 ss 0,0,0, 1,0,1 N=2	SPT						100		7.35m: Organic CLAY; dark brown to black. Very soft, moist, high plasticity.	
		PT				8		100			
		HQ3						100		8.7m: Fine SAND with some silt and trace organics; brown. Dense, dry to moist, uniformly graded. Organics are decomposed black streaks.	
	ss 2,2,2, 1,1,1 N=5	SPT				9		100		9.1m: Organic CLAY; dark brown. Soft, moist, high plasticity. 9.5m: CLAY with trace silt and wood; bluish grey. Soft, moist, high plasticity.	9.9 ▽

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth
29/07/2021 17:00	04.50	3.0	0.5
30/07/2021 08:20	04.50	3.0	1.52
30/07/2021 15:45	22.50	3.0	0.9
02/08/2021 08:45	22.50	3.0	6.5
03/08/2021 08:15	34.00	3.0	9.9
03/08/2021 17:00	35.00	-	5.7

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
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MS - Moderately strong
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WEATHERING
UW - Unweathered
SW - Slightly weathered
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HW - Highly weathered
CW - Completely weathered

Date logged 3/08/2021
Logged SK
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 29/07/2021
Finished 3/08/2021
Drill Rig N119
Core Boxes 13

2021 EB DRILLHOLE LOG 2021-12-21 SBS MASTER.GPJ BASE.GDT 21/12/21

21/12/2021

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH212_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409778.86mE 796356.53mN
Orientation -90° Elevation 15.87m
Location 15 William Roberts Rd
Feature MSE Abutment Wall

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	

TAURANGA GROUP

Test Records	Drilling Method	Depth	TCR [RQD] (%)	SOIL PROPERTIES / DEFECT DESCRIPTION
	HQ3		100	9.6 to 9.8m: With some fine to medium sand. 9.8 to 11.0m: Firm. 9.5m: CLAY with trace silt and wood; bluish grey. Soft, moist, high plasticity. *(continued)*
ss 0,1,1, 2,1,2 N=6	SPT		100	
	HQ3	11	100	11.0 to 11.4m: Stiff. 11.4 to 12.75m: Very stiff.
ss 1,1,1, 1,2,2 N=6	SPT	12	100	
	HQ3	13	100	12.7 to 12.75m: Large chunk of decomposing wood takes up whole core. 12.75 to 13.95m: Soft with small organic streaks.
ss 0,0,0, 0,1,1 N=2	SPT		100	
	HQ3	14	100	13.95 to 16.0m: Firm.
38/5 ss 0,0,1, 0,1,2 N=4	SPT	15	100	
	HQ3	16	100	16.0 to 19.3m: Stiff.
69/16 ss 0,0,0, 0,0,2 N=2	SPT		100	
	HQ3	17	100	
63/9 ss 0,0,0, 1,1,1 N=3	SPT	18	100	18.2 to 19.3m: Trace fine micaceous sand lenses.
	HQ3	19	100	
60/6 ss 0,0,1, 0,2,1 N=4	SPT		100	19.3m: Fine SAND with some clay; bluish grey. Medium dense, moist, uniformly graded. 19.35m: CLAY with trace silt and fine micaceous sand lenses; bluish grey. Stiff, moist, high plasticity.

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

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2021 EB DRILLHOLE LOG 2021-12-21 SBS MASTER.GPJ BASE.GDT 21/12/21

21/12/2021

LOG OF DRILLHOLE

Eastern Busway

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Project number 60644113

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TAURANGA GROUP

HQ3 — 100

102/16 ss 0,0,0, 0,0,0 N=0 SUOW — SPT — 100

HQ3 — 100

ss 1,1,1, 2,1,1 N=5 — SPT — 100

HQ3 — 100

19.35m: CLAY with trace silt and fine micaceous sand lenses; bluish grey. Stiff, moist, high plasticity. *(continued)*

20.95m: Trace sand ceases.

21.3 to 21.6m: Trace organic flecks.

21.6m: Organic silty CLAY with some wood fibres; black. Firm, moist, low plasticity. (Bordering on fibrous peat)

22.0m: CLAY with trace silt; bluish grey. Stiff, moist, high plasticity.

23.5 to 24.07m: Trace organic flecks and wood.

23.8 to 24.07m: Firm with trace fine sand.

71/14 ss 13,23,31, 19 for 25mm N>50 — SPT — 100

24.07m: MW, grey, fine to medium SANDSTONE. Weak. Subrounded mudstone inclusions (3-10mm).
24.15 to 24.3m: SW.

HQ3 — 100 [7]

24.3m: Unweathered, grey, fine to medium SANDSTONE. Moderately strong, gently inclined moderately thickly bedded. Trace subrounded mudstone inclusions (3-10mm) and fine subangular gravel, dark grey and red.

24.25 to 25.5m: Drilling breaks, 0°, at 24.5, 24.7, 24.8 & 25.0m.

24.85m: HJ, 45°, Pl, Ro, NF
24.95m: HJ, 45°, Pl, Ro, NF
25.0m: Coarse gravel cease.

sc 40,10 for 5mm N>50 — SPT — 6

25.5 to 27.0m: Drilling breaks, 0°, at 25.7, 25.9, 26.4, 26.55, 26.7 & 26.9m.

EAST COAST BAYS FORMATION

HQ3 — 97 [92]

26.3m: Slightly weathered, grey speckled white and dark grey, volcaniclastic, fine to coarse SANDSTONE. Moderately strong, moderately inclined moderately thinly to thickly bedded. Containing fine to coarse, red and dark grey, subangular to angular gravel.

26.15m: J, 60°, Pl, Ro, NF
26.23m: J, 45°, Pl, Ro, NF
26.34m: J, 30°, Pl, Ro, NF
26.6m: J, 50°, Pl, Ro, NF
26.77m: J, 30°, Pl, Ro, NF

sc 28,22 for 20mm N>50 — SPT — 95

27.05m: J, 10°, Pl, Ro, NF
27.13m: J, 25°, Pl, Ro, NF

27.46m: J, 65°, Pl, Ro, NF
27.54m: J, 30°, Pl, Ro, NF

HQ3 — 94 [88]

27.0 to 28.5m: Drilling breaks, 0°, at 27.2, 27.6, 27.7, 28.05, 28.1 & 28.2m.

28.2m: HJ, 25°, Ro, NF

28.5 to 30.0m: Drilling breaks, 0°, at 28.65, 28.8, 28.9, 29.25, 29.4 & 29.65m.

29.1m: Unweathered, grey SILTSTONE. Weak.

HQ3 — 100 [100]

28.91m: J, 60°, Pl, Ro, NF
29.0m: HJ, 5°, Ro, VN, S, filled with sandstone material
29.2m: J, 70°, Ud, Ro, N, S, filled with grit material
29.27m: Ve, 80°, Ro, T, Cc

29.75m: Ve, 20°, Ro, T, Cc

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 3/08/2021
Logged SK
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 29/07/2021
Finished 3/08/2021
Drill Rig N119
Core Boxes 13

2021 EB DRILLHOLE LOG 2021-12-21 SBS MASTER.GPJ BASE.GDT 21/12/21

21/12/2021

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH212_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409778.86mE 796356.53mN
Orientation -90° Elevation 15.87m
Location 15 William Roberts Rd
Feature MSE Abutment Wall

GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).)	Test Records: Shear Vane/ SPT	Test Records: SPT N Values 0 - 50	Drilling Method / Casing remarks	Core Loss/Lift 0 - 100%	Relative Strength (S, MS, W, VW)	Rock Weathering (SW, MW, HW)	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm) 500 100 50 10	SOIL PROPERTIES / DEFECT DESCRIPTION (Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc; Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	Instrumentation
EAST COAST BAYS FORMATION 29.3m: Unweathered, grey, volcaniclastic, fine to coarse SANDSTONE. Moderately strong, gently inclined thickly bedded. Containing fine to coarse subangular to angular gravel, red and dark grey in color. *(continued)* 31.1m: Unweathered, grey, fine SANDSTONE. Weak. Subhorizontal, moderately thinly to thickly bedded with indistinct laminations. 31.5 to 31.7m: Trace carbonaceous laminations.			HQ3 HQ3 HQ3				31 32 33 34 35 36 37 38 39		100 [100] 100 [100] 75 [75]		29.84m: Ve, 30°, Ro, T, Cc 29.97m: Ve, 30°, Ro, T, Cc 30.0 to 31.5m: Drilling breaks, 0°, at 30.45, 30.65, 31.3 & 31.4m. 31.0m: HJ, 45°, Ud, Ro, NF 31.03m: Ve, 10°, Sm, T, Cc 31.05 to 31.1m: Inverse grading at base of bed. 31.1m: BP, 10°, Pl, Sm, NF 31.7m: HJ, 20°, Pl, Sm, NF 31.5 to 33.0m: Drilling breaks, 0°, at 31.55, 31.6, 32.15, 32.55, 32.6, 32.71, 32.76, 32.79, 31.87 & 31.9m. 33.0 to 33.75m: Drilling breaks, 0°, at 33.15, 33.25, 33.35, 33.4 & 33.45m. 33.75 to 34.0m: Core Loss: Damaged during drilling. DH212_P terminated at 34.0m Target Depth	

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 3/08/2021
Logged SK
Checked GP

Remarks
50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 29/07/2021
Finished 3/08/2021
Drill Rig N119
Core Boxes 13

Box: 1 of 13 - Depth: 00.00m to 02.35m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 2 of 13 - Depth: 02.35m to 05.75m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 3 of 13 - Depth: 05.75m to 08.70m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 4 of 13 - Depth: 08.70m to 11.15m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 5 of 13 - Depth: 11.15m to 13.95m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 6 of 13 - Depth: 13.95m to 16.65m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 7 of 13 - Depth: 16.65m to 19.35m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 8 of 13 - Depth: 19.35m to 21.75m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 9 of 13 - Depth: 21.75m to 24.15m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 10 of 13 - Depth: 24.15m to 27.00m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 11 of 13 - Depth: 27.00m to 29.75m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Box: 12 of 13 - Depth: 29.75m to 32.70m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

Eastern Busway

PHOTOGRAPHIC LOG OF DRILLHOLE

Project Eastern Busway

Location 15 William Roberts Rd

HOLE IDENTIFICATION **DH212**

Box: 13 of 13 - Depth: 32.70m to 34.00m of 34.00m

Date Drilled 29/07/2021 to 2/08/2021

TERMINOLOGY AND SYMBOLS

Eastern Busway

Drilling / Investigation Methods

CFHSA	- Continuous Flight Hollow Stem Auger.
CFSSA	- Continuous Flight Solid Stem Auger.
DC	- Dynamic Coring (eg Terrier Rig).
DCP	- Dynamic Cone Penetrometer.
HA	- Hand Auger.
HQ3	- HQ Triple Tube.
HQWL	- HQ Wire Line.
HWOB	- Heavy Weight Open Barrel.
NQ3	- NQ Triple Tube.
NQWL	- NQ Wire Line.
OB	- 100mm diameter Open Barrel.
OB70	- 70mm diameter Open Barrel.
PERC	- Percussion.
PS	- Piston Sample.
PQ3	- PQ Triple Tube.
PQWL	- PQ Wire Line.
RC	- Reverse Circulation.
RCDHH	- Reverse Circulation Down Hole Hammer.
SPT	- Standard Penetration Test.
SPERC	- Sonic Percussion.
PT	- Push Tube Sample
VAC EX	- Vacuum Excavation.
WASH	- Wash Drilling.

Test Results

SPT "N" value; uncorrected blow count for 300 mm penetration
/# / # / # / # / # blows per 75 mm penetration

ss - Standard Penetration Test - split spoon
sc - Standard Penetrattion Test - solid cone (no sample recovery)
SUOW - Sunk Under Own Weight

Vane Shear Strength Tests

/ # Vane shear strength test results given as peak / remoulded shear strengths (kPa). Test as per NZGS Guideline, 2001.

$^{\#}$ = Vane test performed on core recovered prior to extrusion from core barrel.
* = Vane test performed on excavated material of suitable size.

UTP - Unable to penetrate.

Unit/Geological Boundary Lines

———— Known

— — — - Inferred/Unknown

Installation & Backfill

Standpipe		Grout	
Slotted Standpipe		Cement	
Collapse/Cuttings /Spoil		Gravel Pack Filter	
Bentonite		Sand Pack Filter	
Inclinometer		Gravel Backfill	

Groundwater Records

Water Level (During Drilling)	2.0
Water Inflow/Seep	
Water Outflow	
Complete Water Loss	
Regain Circulation	

2.0 Fluid level measurement during drilling

Samples

PT	- Thin Wall Push Sample
PS	- Piston Sample
U	- Undisturbed
D	- Disturbed (Core)
B	- Disturbed (Pit)

Rock Descriptions

Relative Strength

		USC (MPa)
ES	- Extremely strong	> 250
VS	- Very Strong	100 - 250
S	- Strong	50 - 100
MS	- Moderately Strong	20 - 50
W	- Weak	5 - 20
VW	- Very Weak	1 - 5
EW	- Extremely Weak	< 1

Weathering

UW	- Unweathered
SW	- Slightly Weathered
MW	- Moderately Weathered
HW	- Highly Weathered
CW	- Completely Weathered

Soil Descriptions

Consistency Cohesive Soils

	Su (kPa)
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	200 - 500

Relative Density Non-cohesive soils

	SPT "N" Value (uncorrected)
Very Loose	< 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Rock Defect Abbreviations

Defect Type
BP = Bedding Plane Defect
CZ = Crush Zone
DB = Drilling Break
FZ = Fracture Zone
HJ = Healed Joint
J = Joint
SZ = Shear Zone
Ve = Vein

Defect Aperture
T = Tight (Nil)
VN = Very Narrow (>0-2mm)
N = Narrow (2-6mm)
MN = Moderately Narrow (6-20mm)
MW = Moderately Wide (20-60mm)
W = Wide (60-200mm)
VW = Very Wide (>200mm)

Defect Roughness
Pl = Planar
St = Stepped
Ud = Undulating
Ro = Rough
Sm = Smooth
Slk = Slickensided
\\ = Parallel
Po = Polished

Infill Thickness
Sn = Stained
Vn = Veneer (<0.5mm)
Cg = Coating
P = Partially infilled
C = Completely Infilled

Infill Colour
bl = Blue
bn = Brown
bk = Black
gn = Green
gy = Grey
or = Orange
pk = Pink
rd = Red
wh = White
ye = Yellow

Infill Material
Calc = Calcareous
Cb = Carbonaceous
Cc = Calcite
Cl = Clay
Fe = Iron Oxide
Mn = Manganese
NF = No Infill
Py = Pyrite
Qtz = Quartz
S = Sand
Slt = Silt

Graphic Log (typical symbols)

Peat	Mudstone
Clay	Siltstone
Silt	Sandstone
Sand	Basalt
Gravel / Cobbles	No recovery
Welded Tuff	

Core Measurements

TCR - Total Core Recovery
RQD - Rock Quality Designation

Soil and rock descriptions generally as in "Guidelines for the Field Description of Soil and Rock for Engineering Purposes" by the NZ Geotechnical Society Inc, December 2005.

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION **DH213**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409778.54mE 796464.74mN
Orientation -90° Elevation 17.01m
Location 3 William Roberts Rd
Feature Validate CPT514 & confirm settlement

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				(mm) 500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
		VAC EX				1		0		0.0m: Vacuum excavation not witnessed.	0.9 1.2 1.3
TAURANGA GROUP 1.5m: ALLUVIUM comprising clay, silt and sand, in places pumiceous or organic.	ss 0,1,1, 1,1,2 N=5	SPT				2		100		1.5m: Silty CLAY with trace fine sand; Light brownish grey with mottled orange. Stiff, moist, high plasticity.	
		HQ3						100		2.6 to 3.2m: Some fine sand.	2.68
	65/3 ss 0,1,1, 1,1,2 N=5	114 HWT SPT				3		100		3.0m: 114mm diameter, HWT casing to 3.0m depth.	
		HQ3						100		3.2m: CLAY with trace silt; brownish grey. Firm, moist, high plasticity . 3.45 to 3.7m: Some fine to medium sand. 3.9 to 5.55m: Trace organic flecks. 4.6 to 5.55m: Dark grey.	3.5 3.8
	24/0 ss 0,0,0, 0,0,0 N=0 SUOW	SPT				4		100			
		WASH				5		0			
		PT						100			
		HQ3						100		5.55m: Fine SAND with minor silt and trace medium sand; light grey. Dense, moist, uniformly graded.	
	ss 4,9,10, 10,10,10 N=40	SPT				6		100		6.15 to 6.4m: Trace fine to coarse gravel. Medium to coarse gravel is angular and volcanic, fine gravel is subrounded pumice.	
		HQ3				7		100		6.75 to 8.3m: Fine to medium sand.	7.1
	UTP ss 7,8,10, 10,10,10 N=40	SPT						80			
		WASH				8		0		8.0 to 8.5m: No recovery in push tube.	
		PT						0			
		HQ3						100		8.3m: CLAY with trace silt; greyish brown. Firm, moist, high plasticity. Trace dark organic flecks.	
	ss 0,0,0, 0,0,1 N=1	SPT				9		100			
		WASH						0			
		PT						100			

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth
26/07/2021 14:30	01.50	3.0	1.3
26/07/2021 17:00	04.50	3.0	1.2
27/07/2021 08:00	04.50	3.0	0.9
27/07/2021 17:00	21.00	3.0	3.8
28/07/2021 08:00	21.00	3.0	2.68
28/07/2021 17:00	35.00	3.0	3.5
29/07/2021 08:00	35.00	3.0	7.1

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
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W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 29/07/2021
Logged SK
Checked GP

Remarks
Backfilled with bentonite cement grout upon completion.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 27/07/2021
Finished 28/07/2021
Drill Rig N119
Core Boxes 13

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH213**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409778.54mE 796464.74mN
Orientation -90° Elevation 17.01m
Location 3 William Roberts Rd
Feature Validate CPT514 & confirm settlement

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
TAURANGA GROUP	57/7 ss 0,0,0, 0,1,1 N=2	HQ3						100		9.8m: Organic silty CLAY with some fibres; black. Firm becoming soft, moist, high plasticity. *(continued)*	
		SPT						100			
		HQ3				11		100		10.95m: Silty CLAY with minor fine to medium sand and trace organics; bluish grey with black flecks. Stiff, moist, high plasticity.	
	UTP ss 2,3,2, 3,4,5 N=14	SPT				12		100		11.9 to 12.3m: Grades to brown.	
		HQ3						100		12.3m: Silty fine to coarse SAND; brownish grey. Medium dense, moist, well graded. 12.5 to 13.0m: Sand if fine to medium, dense. 12.5 to 13.5m: Light grey.	
	ss 1,1,1, 2,2,3 N=8	SPT				13		100		13.45 to 13.5m: Sand is fine to medium, dense, poorly graded.	
		HQ3						100		13.5m: Silty CLAY with trace organics (wood); brown. Firm, moist, high plasticity. 13.8 to 14.0m: Minor fine to medium sand, grey, without organics.	
	ss 2,2,2, 2,3,3 N=10	SPT				14		100		14.0m: Fine sandy SILT with some clay; bluish grey. Stiff, moist, low plasticity.	
		HQ3				15		100		15.15m: Silty CLAY; dark brown. Firm, moist, high plasticity. (Graded contact above).	
	ss 1,1,1, 1,2,1 N=5	SPT				16		100		15.35m: CLAY with trace silt; bluish grey. Firm, moist, high plasticity.	
		HQ3						100			
	44/0 ss 0,0,0, 1,1,1 N=3	SPT				17		100			
		HQ3				18		100			
	76/5 ss 1,1,1, 1,2,2 N=6	SPT				19		100		19.5 to 22.9m: Stiff.	

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
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VW - Very weak
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WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 29/07/2021
Logged SK
Checked GP

Remarks
Backfilled with bentonite cement grout upon completion.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 27/07/2021
Finished 28/07/2021
Drill Rig N119
Core Boxes 13

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH213**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409778.54mE 796464.74mN
Orientation -90° Elevation 17.01m
Location 3 William Roberts Rd
Feature Validate CPT514 & confirm settlement

GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc.))	Test Records: Shear Vane/ SPT	Test Records: SPT N Values (0 - 50)	Drilling Method / Casing remarks	Core Loss/Lift (0 - 100%)	Relative Strength (S, MS, W, VW)	Rock Weathering (SW, MW, HW)	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm: 500, 100, 50, 10)	SOIL PROPERTIES / DEFECT DESCRIPTION (Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	Instrumentation
TAURANGA GROUP			HQ3				21		100		15.35m: CLAY with trace silt; bluish grey. Firm, moist, high plasticity. *(continued)*	
	77/5 ss 0,0,1, 1,1,1 N=4		SPT						100			
			HQ3				22		100			
	81/8 ss 0,0,0, 2,2,2 N=6		SPT						100			
			HQ3				23		100		22.9m: Organic silty CLAY; dark brownish black. Soft to firm, moist, high plasticity. 23.1m: CLAY with trace silt; bluish grey. Very stiff, moist, high plasticity.	
EAST COAST BAYS FORMATION: 23.95m: Highly weathered, grey, SILTSTONE. Extremely weak.	UTP ss 2,1,3, 3,3,3 N=12		SPT				24		100		23.95m: Silty CLAY, grey. Very stiff. 24.45 to 25.5m: Drilling breaks, 0°, at 25.27, 25.32, 25.35 & 25.45m.	
			HQ3				25		100 [38]			
25.1 to 25.2m: MW, very weak. 25.2m: Slightly weathered, grey, fine to medium SANDSTONE. Weak. Subrounded mudstone inclusions (5-10mm).	ss 22,28 for 30mm N>50		SPT						100		25.5 to 27.0m: Drilling breaks, 0°, at 26.1, 26.35, 26.37, 26.47 & 26.6m. 25.91m: J, 25°, Pl, Sm, VN, NF	
25.6m: Unweathered, grey, massive, fine to medium SANDSTONE. Moderately strong. Subrounded mudstone inclusions (5-10mm).			HQ3				26		100 [100]			
	sc 50 for 70mm N>50		SPT				27		14		27.0 to 28.5m: Drilling breaks, 0°, at 27.15, 27.75, 27.79 & 27.93m.	
			HQ3				28		100 [69]		27.79m: J, 25°, Pl, Sm, VN, NF 27.85m: J, 30°, Pl, Sm, VN, NF 27.88m: J, 75°, Ud, Ro, N, NF 28.0m: Large siltstone inclusion, 11mm high and half width of core, fracture running through, drilling induced horizontal fractures throughout. 28.45m: 40mm rounded siltstone inclusion.	
28.63m: Unweathered, grey, thickly bedded, volcaniclastic fine to coarse SANDSTONE. Moderately strong. Contains subangular to angular gravel, red are fine, light grey and dark grey are fine to coarse.	sc 20,30 for 20mm N>50		SPT						0			
			HQ3				29		100 [100]		28.5 to 30.0m: Drilling breaks, 0°, at 28.65, 28.75, 28.95, 29.1, 29.6 & 29.8m. 29.7 to 29.85m: Trace gravel.	

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
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vane shear strength per NZGS guideline

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Date logged 29/07/2021
Logged SK
Checked GP

Remarks
Backfilled with bentonite cement grout upon completion.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 27/07/2021
Finished 28/07/2021
Drill Rig N119
Core Boxes 13

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **DH213**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409778.54mE 796464.74mN
Orientation -90° Elevation 17.01m
Location 3 William Roberts Rd
Feature Validate CPT514 & confirm settlement

GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).)	Test Records: Shear Vane/ SPT	Test Records: SPT N Values 0 - 50	Drilling Method / Casing remarks	Core Loss/Lift 0 - 100%	Relative Strength (S, MS, W, VW)	Rock Weathering (SW, MW, HW)	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm) 500 100 50 10	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
EAST COAST BAYS FORMATION 28.63m: Unweathered, grey, thickly bedded, volcaniclastic fine to coarse SANDSTONE. Moderately strong. Contains subangular to angular gravel, red are fine, light grey and dark grey are fine to coarse. *(continued)*			HQ3				31		100 [100]		30.0 to 31.2m: Largest granules are fine gravel. 30.0 to 31.5m: Drilling breaks, 0°, at 30.25, 30.5, 31.25, 31.3, 31.32, 31.4 & 31.47m.	
			HQ3				32		100 [100]		31.5 to 33.0m: Drilling breaks, 0°, at 31.6, 31.65, 31.75, 31.95, 32.5, 32.75 & 32.9m. 31.5 to 35.0m: 66% Flush Return. 32.6m: J, 60°, Ud, Ro, VN, NF	
33.1m: Unweathered, grey, massive, fine SANDSTONE. Weak.			HQ3				33		100 [100]		33.0 to 34.5m: Drilling breaks, 0°, at 33.4, 33.6, 33.9, 34.2 & 34.45m.	
			HQ3				34		100 [100]			
							35				DH213 terminated at 35.0m Target Depth	
							36					
							37					
							38					
							39					

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane
DR2272: 19mm blade: Correction Factor = 1.572
vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 29/07/2021
Logged SK
Checked GP

Remarks
Backfilled with bentonite cement grout upon completion.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 27/07/2021
Finished 28/07/2021
Drill Rig N119
Core Boxes 13

2021 EB DRILLHOLE LOG 2021-10-21 SBS MASTER.GPJ BASE.GDT 21/10/21

21/10/2021

Box: 1 of 13 - Depth: 00.00m to 04.20m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 27/07/2021

Box: 2 of 13 - Depth: 04.20m to 07.15m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 27/07/2021

Box: 3 of 13 - Depth: 07.15m to 10.60m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 27/07/2021

Box: 4 of 13 - Depth: 10.60m to 13.20m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 27/07/2021

Box: 5 of 13 - Depth: 13.20m to 15.70m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 27/07/2021

Box: 6 of 13 - Depth: 15.70m to 18.30m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 27/07/2021

Box: 7 of 13 - Depth: 18.30m to 21.15m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 28/07/2021

Box: 8 of 13 - Depth: 21.15m to 23.40m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 28/07/2021

Box: 9 of 13 - Depth: 23.40m to 25.91m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 28/07/2021

Box: 10 of 13 - Depth: 25.91m to 28.75m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 28/07/2021

Box: 11 of 13 - Depth: 28.75m to 31.75m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 28/07/2021

Box: 12 of 13 - Depth: 31.75m to 34.50m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 28/07/2021

Box: 13 of 13 - Depth: 34.50m to 35.00m of 35.00m

Date Drilled 27/07/2021 to 28/07/2021 - Date Photographed: 28/07/2021

TERMINOLOGY AND SYMBOLS

Eastern Busway

Drilling / Investigation Methods

CFHSA	- Continuous Flight Hollow Stem Auger.
CFSSA	- Continuous Flight Solid Stem Auger.
DC	- Dynamic Coring (eg Terrier Rig).
DCP	- Dynamic Cone Penetrometer.
HA	- Hand Auger.
HQ3	- HQ Triple Tube.
HQWL	- HQ Wire Line.
HWOB	- Heavy Weight Open Barrel.
NQ3	- NQ Triple Tube.
NQWL	- NQ Wire Line.
OB	- 100mm diameter Open Barrel.
OB70	- 70mm diameter Open Barrel.
PERC	- Percussion.
PS	- Piston Sample.
PQ3	- PQ Triple Tube.
PQWL	- PQ Wire Line.
RC	- Reverse Circulation.
RCDHH	- Reverse Circulation Down Hole Hammer.
SPT	- Standard Penetration Test.
SPERC	- Sonic Percussion.
PT	- Push Tube Sample
VAC EX	- Vacuum Excavation.
WASH	- Wash Drilling.

Test Results

SPT "N" value; uncorrected blow count for 300 mm penetration
/# / # / # / # / # blows per 75 mm penetration

ss - Standard Penetration Test - split spoon
sc - Standard Penetrattion Test - solid cone (no sample recovery)
SUOW - Sunk Under Own Weight

Vane Shear Strength Tests

/ # Vane shear strength test results given as peak / remoulded shear strengths (kPa). Test as per NZGS Guideline, 2001.

$^{\#}$ = Vane test performed on core recovered prior to extrusion from core barrel.
* = Vane test performed on excavated material of suitable size.

UTP - Unable to penetrate.

Unit/Geological Boundary Lines

———— Known

— — — - Inferred/Unknown

Installation & Backfill

Standpipe		Grout	
Slotted Standpipe		Cement	
Collapse/Cuttings /Spoil		Gravel Pack Filter	
Bentonite		Sand Pack Filter	
Inclinometer		Gravel Backfill	

Groundwater Records

Water Level (During Drilling)	2.0
Water Inflow/Seep	
Water Outflow	
Complete Water Loss	
Regain Circulation	

2.0 Fluid level measurement during drilling

Samples

PT	- Thin Wall Push Sample
PS	- Piston Sample
U	- Undisturbed
D	- Disturbed (Core)
B	- Disturbed (Pit)

Rock Descriptions

Relative Strength

		USC (MPa)
ES	- Extremely strong	> 250
VS	- Very Strong	100 - 250
S	- Strong	50 - 100
MS	- Moderately Strong	20 - 50
W	- Weak	5 - 20
VW	- Very Weak	1 - 5
EW	- Extremely Weak	< 1

Weathering

UW	- Unweathered
SW	- Slightly Weathered
MW	- Moderately Weathered
HW	- Highly Weathered
CW	- Completely Weathered

Soil Descriptions

Consistency Cohesive Soils

	Su (kPa)
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	200 - 500

Relative Density Non-cohesive soils

	SPT "N" Value (uncorrected)
Very Loose	< 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Rock Defect Abbreviations

Defect Type
BP = Bedding Plane Defect
CZ = Crush Zone
DB = Drilling Break
FZ = Fracture Zone
HJ = Healed Joint
J = Joint
SZ = Shear Zone
Ve = Vein

Defect Aperture
T = Tight (Nil)
VN = Very Narrow (>0-2mm)
N = Narrow (2-6mm)
MN = Moderately Narrow (6-20mm)
MW = Moderately Wide (20-60mm)
W = Wide (60-200mm)
VW = Very Wide (>200mm)

Defect Roughness
Pl = Planar
St = Stepped
Ud = Undulating
Ro = Rough
Sm = Smooth
Slk = Slickensided
\\ = Parallel
Po = Polished

Infill Thickness
Sn = Stained
Vn = Veneer (<0.5mm)
Cg = Coating
P = Partially infilled
C = Completely Infilled

Infill Colour
bl = Blue
bn = Brown
bk = Black
gn = Green
gy = Grey
or = Orange
pk = Pink
rd = Red
wh = White
ye = Yellow

Infill Material
Calc = Calcareous
Cb = Carbonaceous
Cc = Calcite
Cl = Clay
Fe = Iron Oxide
Mn = Manganese
NF = No Infill
Py = Pyrite
Qtz = Quartz
S = Sand
Slt = Silt

Graphic Log (typical symbols)

Peat	Mudstone
Clay	Siltstone
Silt	Sandstone
Sand	Basalt
Gravel / Cobbles	No recovery
Welded Tuff	

Core Measurements

TCR - Total Core Recovery
RQD - Rock Quality Designation

Soil and rock descriptions generally as in "Guidelines for the Field Description of Soil and Rock for Engineering Purposes" by the NZ Geotechnical Society Inc, December 2005.

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION **WB203_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409364.66mE 796020.26mN
Orientation -90° Elevation 6.56m
Location Opposite 10 Seven Oaks Drive
Feature Fill slope/MSE wall

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
0.0m: Wash boring for iVane & piston samples. Refer to adjacent drillhole log (DH203) for soil properties/geological description.		VAC EX				1		0		0.0 to 1.8m: Vacuum excavation not witnessed.	
		WASH				2		0		1.8 to 1.9m: iVane test.	2.45 ▽ 2.65 ▽
		140 PWT WASH				3		0		3.0m: 140mm diameter PWT casing installed to 3m depth.	3.45 ▽
		WASH				4		0			
		WASH				5		0			
		WASH				6		0		6.0 to 6.1m: iVane test.	
		PT				7		100		7.0m: Push Tube (100% recovery): Top & Base: Silty CLAY; bluish grey. Firm, moist, high plasticity.	
		WASH				8		0		7.5 to 7.6m: iVane test.	
		PT				9		100		8.5m: Push Tube (100% recovery): Top & Base: Silty CLAY; bluish grey. Firm, moist, high plasticity.	
		WASH						0			

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth
07/12/2021 08:30	09.50	3.0	2.65
08/12/2021 08:15	16.50	3.0	2.45
09/12/2021 08:30	17.80	3.0	3.45

Hand Held Shear Vane

vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 9/12/2021
Logged SK
Checked GP

Remarks

Wash bore for iVane and Push Tube sampling. 50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 6/12/2021
Finished 9/12/2021
Drill Rig N118
Core Boxes 0

2021 EB DRILLHOLE LOG 2022-01-24 SBS MASTER.GPJ BASE.GDT 24/01/22

24/01/2022

Eastern Busway

LOG OF DRILLHOLE

HOLE IDENTIFICATION **WB203_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409364.66mE 796020.26mN
Orientation -90° Elevation 6.56m
Location Opposite 10 Seven Oaks Drive
Feature Fill slope/MSE wall

GEOLOGICAL DESCRIPTION (Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).)	Test Records: Shear Vane/ SPT	Test Records: SPT N Values 0 - 50	Drilling Method / Casing remarks	Core Loss/Lift 0 - 100%	Relative Strength (S, MS, W, VW)	Rock Weathering (SW, MW, HW)	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm) 500 100 50 10	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
			WASH				10					
			WASH				11		0			
			WASH				12		0			
			WASH				13		0			
			WASH				14		0		13.65 to 13.75m: iVane test.	
			WASH				15		0			
			PT				16		100		16.0m: Push Tube (100% recovery): Top & Base: Silty CLAY; bluish grey. Firm, moist, high plasticity.	
			WASH				17		0		16.5m: iVane test.	
							18				17.8 to 17.9m: iVane test. WB203_P terminated at 17.8m Target Depth	
							19					

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)
Date Time Drilled Depth Casing Depth Fluid Depth

Hand Held Shear Vane

vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 9/12/2021
Logged SK
Checked GP

Remarks

Wash bore for iVane and Push Tube sampling. 50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 6/12/2021
Finished 9/12/2021
Drill Rig N118
Core Boxes 0

2021 EB DRILLHOLE LOG 2022-01-24 SBS MASTER.GPJ BASE.GDT 24/01/22

24/01/2022

TERMINOLOGY AND SYMBOLS

Eastern Busway

Drilling / Investigation Methods

CFHSA	- Continuous Flight Hollow Stem Auger.
CFSSA	- Continuous Flight Solid Stem Auger.
DC	- Dynamic Coring (eg Terrier Rig).
DCP	- Dynamic Cone Penetrometer.
HA	- Hand Auger.
HQ3	- HQ Triple Tube.
HQWL	- HQ Wire Line.
HWOB	- Heavy Weight Open Barrel.
NQ3	- NQ Triple Tube.
NQWL	- NQ Wire Line.
OB	- 100mm diameter Open Barrel.
OB70	- 70mm diameter Open Barrel.
PERC	- Percussion.
PS	- Piston Sample.
PQ3	- PQ Triple Tube.
PQWL	- PQ Wire Line.
RC	- Reverse Circulation.
RCDHH	- Reverse Circulation Down Hole Hammer.
SPT	- Standard Penetration Test.
SPERC	- Sonic Percussion.
PT	- Push Tube Sample
VAC EX	- Vacuum Excavation.
WASH	- Wash Drilling.

Test Results

SPT "N" value; uncorrected blow count for 300 mm penetration
/# / # / # / # / # blows per 75 mm penetration

ss - Standard Penetration Test - split spoon
sc - Standard Penetrattion Test - solid cone (no sample recovery)
SUOW - Sunk Under Own Weight

Vane Shear Strength Tests

/ # Vane shear strength test results given as peak / remoulded shear strengths (kPa). Test as per NZGS Guideline, 2001.

$^{\#}$ = Vane test performed on core recovered prior to extrusion from core barrel.
* = Vane test performed on excavated material of suitable size.

UTP - Unable to penetrate.

Unit/Geological Boundary Lines

———— Known

— — — - Inferred/Unknown

Installation & Backfill

Standpipe		Grout	
Slotted Standpipe		Cement	
Collapse/Cuttings /Spoil		Gravel Pack Filter	
Bentonite		Sand Pack Filter	
Inclinometer		Gravel Backfill	

Groundwater Records

Water Level (During Drilling)	2.0
Water Inflow/Seep	
Water Outflow	
Complete Water Loss	
Regain Circulation	

2.0 Fluid level measurement during drilling

Samples

PT	- Thin Wall Push Sample
PS	- Piston Sample
U	- Undisturbed
D	- Disturbed (Core)
B	- Disturbed (Pit)

Rock Descriptions

Relative Strength

		USC (MPa)
ES	- Extremely strong	> 250
VS	- Very Strong	100 - 250
S	- Strong	50 - 100
MS	- Moderately Strong	20 - 50
W	- Weak	5 - 20
VW	- Very Weak	1 - 5
EW	- Extremely Weak	< 1

Weathering

UW	- Unweathered
SW	- Slightly Weathered
MW	- Moderately Weathered
HW	- Highly Weathered
CW	- Completely Weathered

Soil Descriptions

Consistency Cohesive Soils

	Su (kPa)
Very Soft	< 12
Soft	12 - 25
Firm	25 - 50
Stiff	50 - 100
Very Stiff	100 - 200
Hard	200 - 500

Relative Density Non-cohesive soils

	SPT "N" Value (uncorrected)
Very Loose	< 4
Loose	4 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

Rock Defect Abbreviations

Defect Type
BP = Bedding Plane Defect
CZ = Crush Zone
DB = Drilling Break
FZ = Fracture Zone
HJ = Healed Joint
J = Joint
SZ = Shear Zone
Ve = Vein

Defect Aperture
T = Tight (Nil)
VN = Very Narrow (>0-2mm)
N = Narrow (2-6mm)
MN = Moderately Narrow (6-20mm)
MW = Moderately Wide (20-60mm)
W = Wide (60-200mm)
VW = Very Wide (>200mm)

Defect Roughness
Pl = Planar
St = Stepped
Ud = Undulating
Ro = Rough
Sm = Smooth
Slk = Slickensided
\\ = Parallel
Po = Polished

Infill Thickness
Sn = Stained
Vn = Veneer (<0.5mm)
Cg = Coating
P = Partially infilled
C = Completely Infilled

Infill Colour
bl = Blue
bn = Brown
bk = Black
gn = Green
gy = Grey
or = Orange
pk = Pink
rd = Red
wh = White
ye = Yellow

Infill Material
Calc = Calcareous
Cb = Carbonaceous
Cc = Calcite
Cl = Clay
Fe = Iron Oxide
Mn = Manganese
NF = No Infill
Py = Pyrite
Qtz = Quartz
S = Sand
Slt = Silt

Graphic Log (typical symbols)

Peat	Mudstone
Clay	Siltstone
Silt	Sandstone
Sand	Basalt
Gravel / Cobbles	No recovery
Welded Tuff	

Core Measurements

TCR - Total Core Recovery
RQD - Rock Quality Designation

Soil and rock descriptions generally as in "Guidelines for the Field Description of Soil and Rock for Engineering Purposes" by the NZ Geotechnical Society Inc, December 2005.

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION	**WB213_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409779.80mE 796470.43mN
Orientation -90° Elevation 17.12m
Location 3 William Roberts Road
Feature Validate CPT514 & confirm settlement

GEOLOGICAL DESCRIPTION	Test Records		Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects (mm)	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT	SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
			WASH				1		0		0.0m: Wash boring for iVane & piston samples. Refer to adjacent drillhole log (DH213) for soil properties/geological description.	
			WASH				2		0			2.4 ▽ 2.8 ▽
			140 PWT WASH				3		0		3.0m: 140mm diameter PWT casing installed to 3m. depth.	
			PT				4		84		3.8 to 3.9m: iVane test. 4.3m: Push Tube (84% recovery): Top & Base: Silty CLAY with some fine to medium sand; brownish grey.	
			WASH				5		0		4.8 to 4.9m: iVane test.	
			WASH				6		0			
			WASH				7		0			
			PT				8		100		8.5m: Push Tube (100% recovery): Top: Pumiceous sand with trace organic clay. Base: Silty CLAY with some organics; bluish grey.	
			WASH				9		0		9.0 to 9.1m: iVane test.	

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth
13/12/2021 17:15	09.00	3.0	2.4
15/12/2021 08:00	09.00	3.0	2.4
15/12/2021 12:30	18.50	3.0	2.8

Hand Held Shear Vane

vane shear strength per NZGS guideline

RELATIVE STRENGTH
VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING
UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 15/12/2021
Logged SK
Checked GP

Remarks

Wash bore for iVane and Push Tube sampling. 50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

Driller McMillan
Started 13/12/2021
Finished 15/12/2021
Drill Rig N118
Core Boxes 0

2021 EB DRILLHOLE LOG 2022-01-28 SBS MASTER.GPJ BASE.GDT 28/01/22

28/01/2022

LOG OF DRILLHOLE

Eastern Busway

HOLE IDENTIFICATION	**WB213_P**

Client Auckland Transport
Project Eastern Busway
Project number 60644113

Co-ordinates 409779.80mE 796470.43mN
Orientation -90° Elevation 17.12m
Location 3 William Roberts Road
Feature Validate CPT514 & confirm settlement

GEOLOGICAL DESCRIPTION	Test Records	Drilling Method	Core Loss/Lift	Relative Strength	Rock Weathering	Depth	Graphic Log	TCR [RQD] (%)	Spacing of Natural Defects	SOIL PROPERTIES / DEFECT DESCRIPTION	Instrumentation
Weathering, Colour, Fabric, ROCK NAME. Strength, Discontinuities, Lithological Features (bedding, foliation, mineralogy, cement, etc).	Shear Vane/ SPT; SPT N Values 0 - 50	Casing remarks	0 - 100%	S MS W VW	SW MW HW				(mm) 500 100 50 10	Subordinate MAJOR minor; colour, structure. Strength, moisture condition, grading, bedding, plasticity, sensitivity, major fraction description, subordinate fraction description, minor fraction description, additional structures, additional information, etc. (Joints, Bedding Seams, Shatter, Shear and Crush Zones, Foliation, Schistosity, Attitude, Spacing, continuity, roughness, infilling, etc.)	
		PT						100		10.0m: Lab Description: Organic silty CLAY, dark brown and black; soft to stiff, moist, high plasticity.	
		WASH				11		0		10.28m: SILT with minor clay, trace sand, light bluish grey mixed with dark brown-black, stiff, moist, medium to high plasticity, few rootlets. 10.5 to 10.6m: iVane test.	
		WASH				12		0			
		WASH				13		0			
		WASH				14		0			
		WASH				15		0			
		WASH				16		0			
		WASH				17		0			
		PT				18		100		18.0m: Push Tube (100% recovery): Top: Silty CLAY; bluish grey. Base: Fine micaceous SAND; bluish grey.	
						19				WB213_P terminated at 18.5m Target Depth	

For explanation of symbols and observations, see key sheet

FLUID DEPTHS AND DRILLING PROGRESS (m)

Date Time	Drilled Depth	Casing Depth	Fluid Depth

Hand Held Shear Vane

vane shear strength per NZGS guideline

RELATIVE STRENGTH

VS - Very strong
S - Strong
MS - Moderately strong
W - Weak
VW - Very weak
EW - Extremely weak

WEATHERING

UW - Unweathered
SW - Slightly weathered
MW - Moderately weathered
HW - Highly weathered
CW - Completely weathered

Date logged 15/12/2021
Logged SK
Checked GP

Remarks

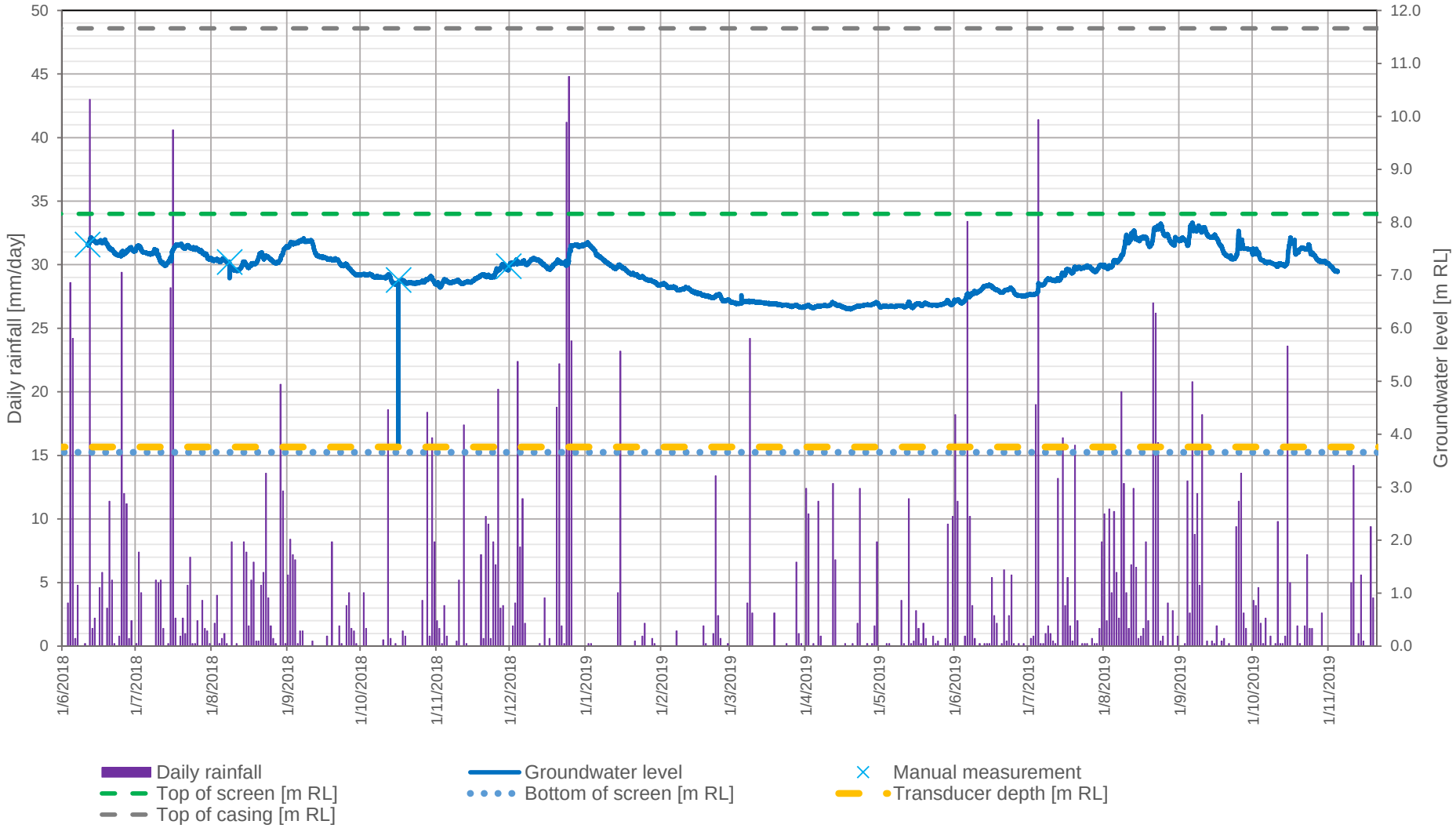
Wash bore for iVane and Push Tube sampling. 50 mm standpipe piezometer installed upon completion of drilling. Piezometer developed by air lift.

Horizontal / Vertical Survey Datums: NZGD2000 / Mount Eden 2000 / New Zealand Vertical Datum 2016

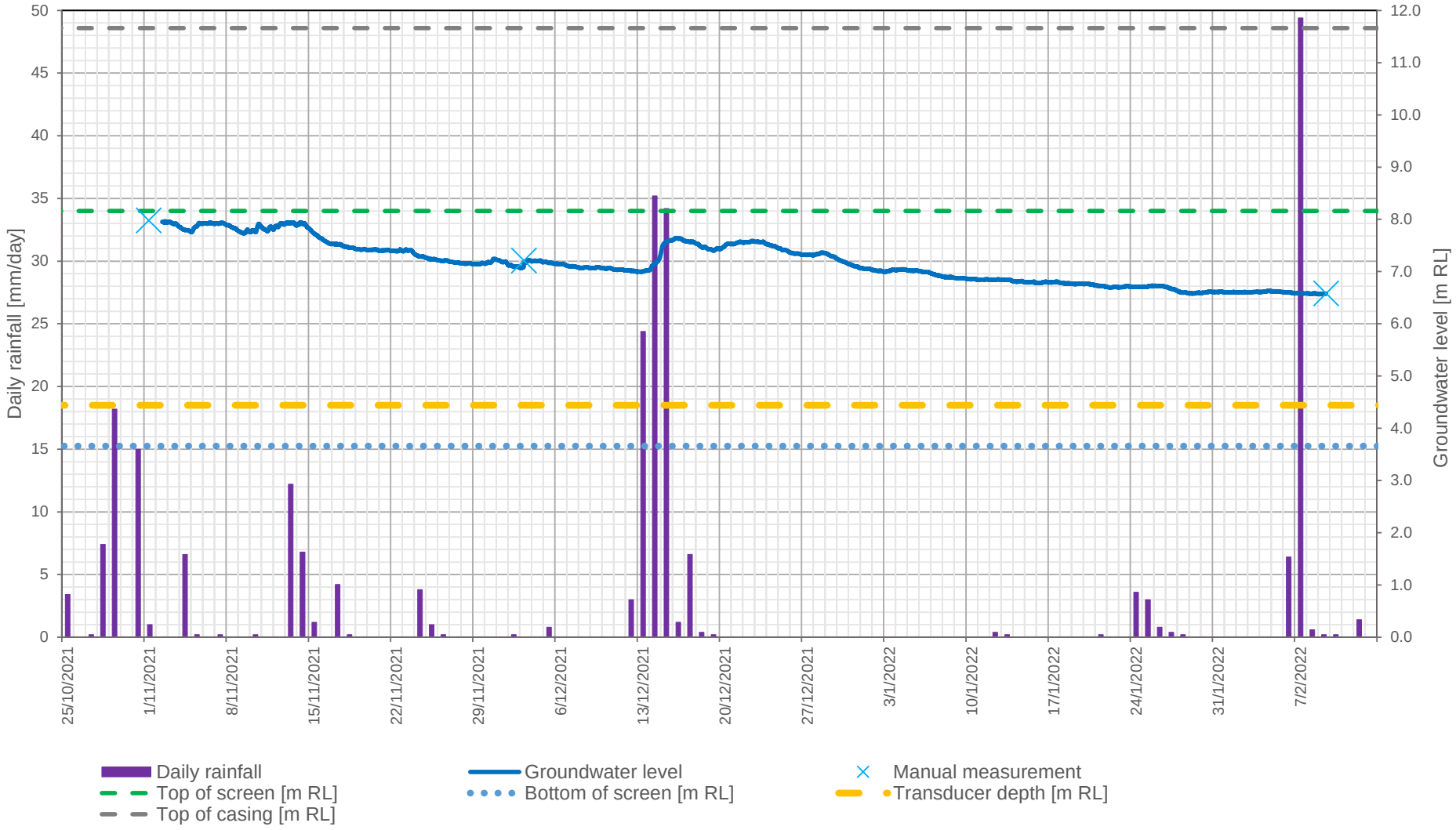
Driller McMillan
Started 13/12/2021
Finished 15/12/2021
Drill Rig N118
Core Boxes 0

28/01/2022

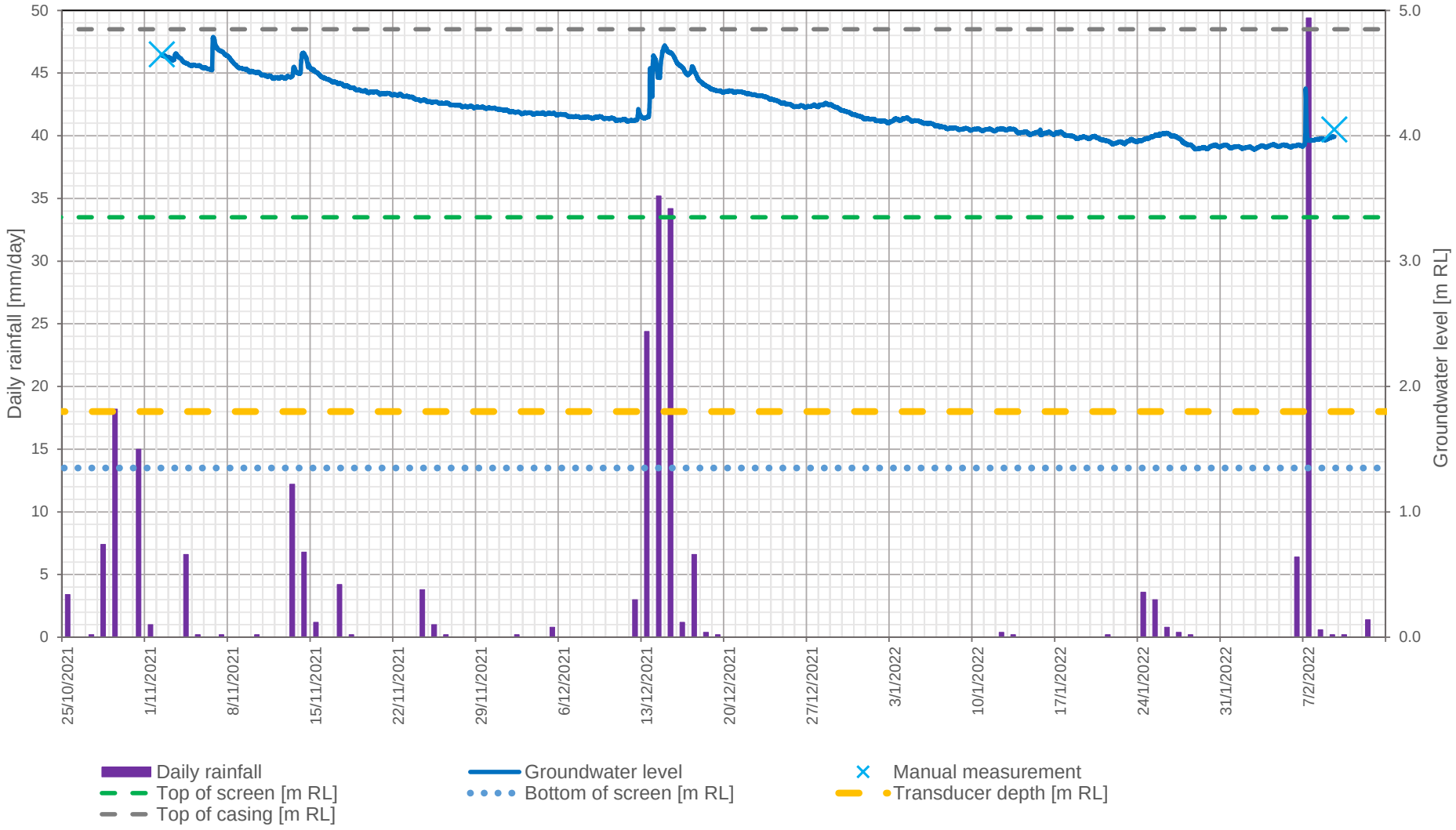
Appendix B – Groundwater Graphs



Eastern Busway	Prepared by:	G. Sturgess	**Eastern Busway**
	Checked by:	E. Eddington	**Groundwater Level Monitoring**
	Date:	2/25/2022	**DH18_103 Piezometer Results**
	Figure No.:	1	

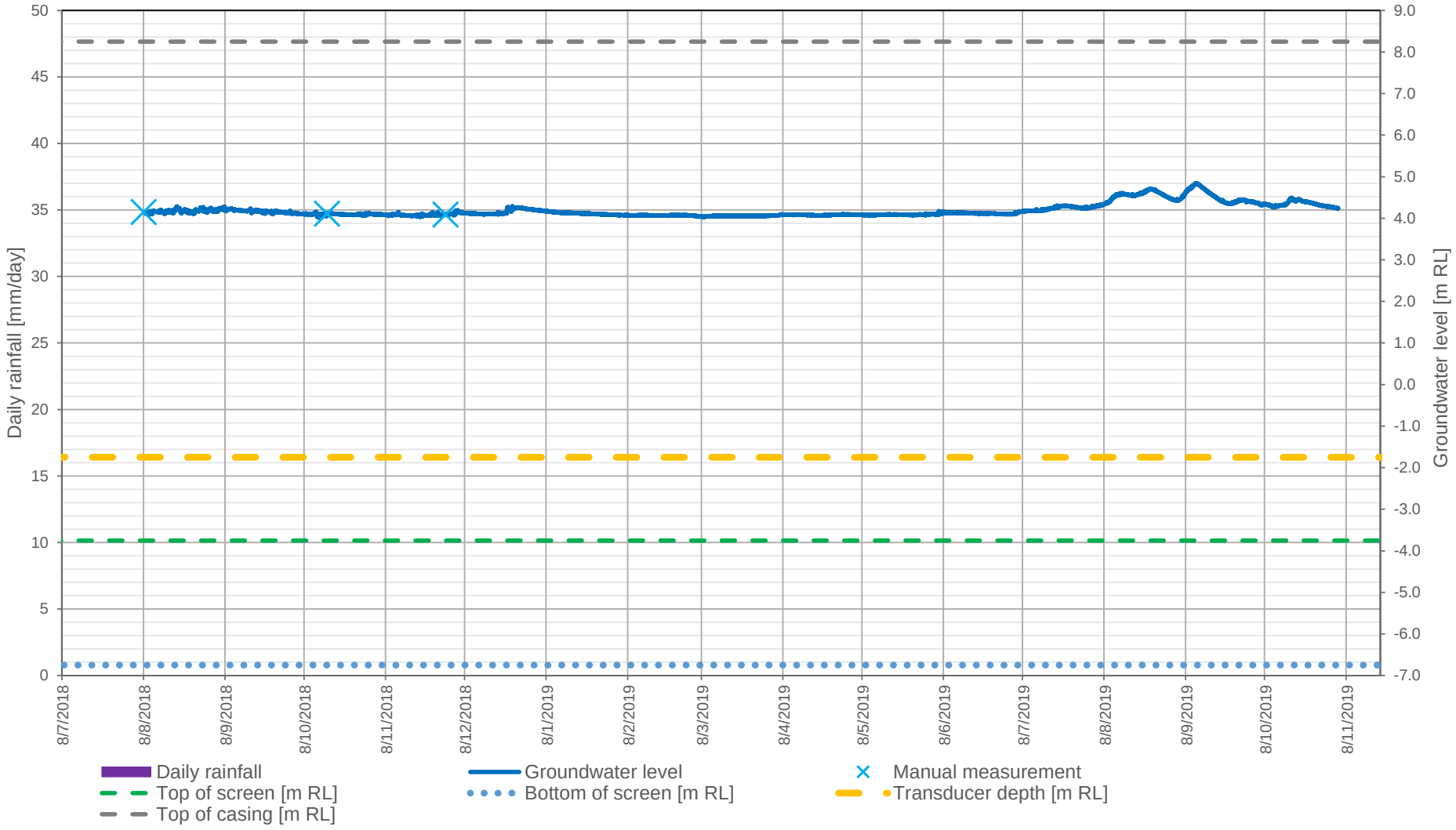


Eastern Busway	Prepared by:	G. Sturgess	**Eastern Busway**
	Checked by:	E. Eddington	**Groundwater Level Monitoring**
	Date:	2/25/2022	**DH18_103 Piezometer Results**
	Figure No.:	1	

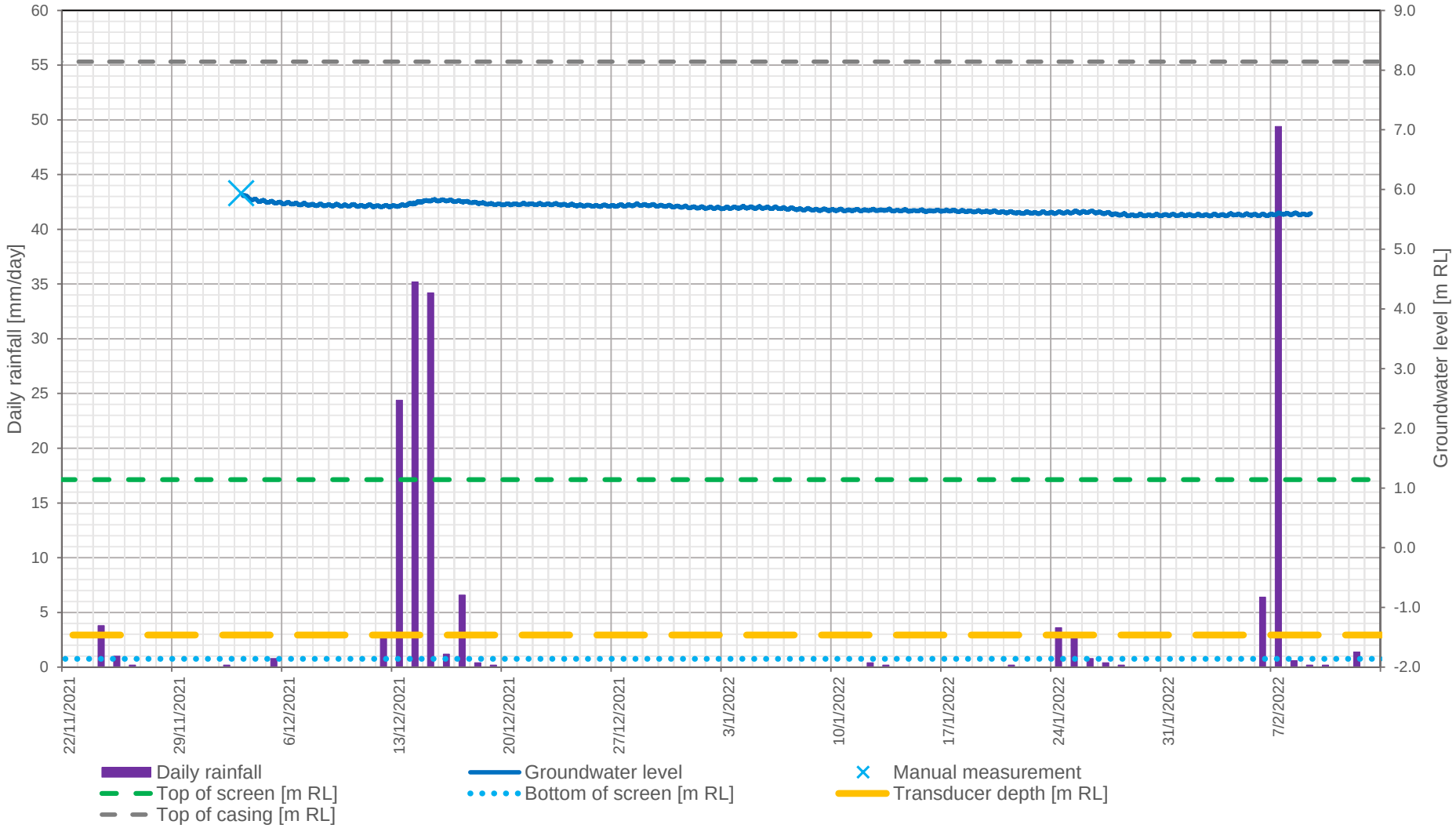


Eastern Busway

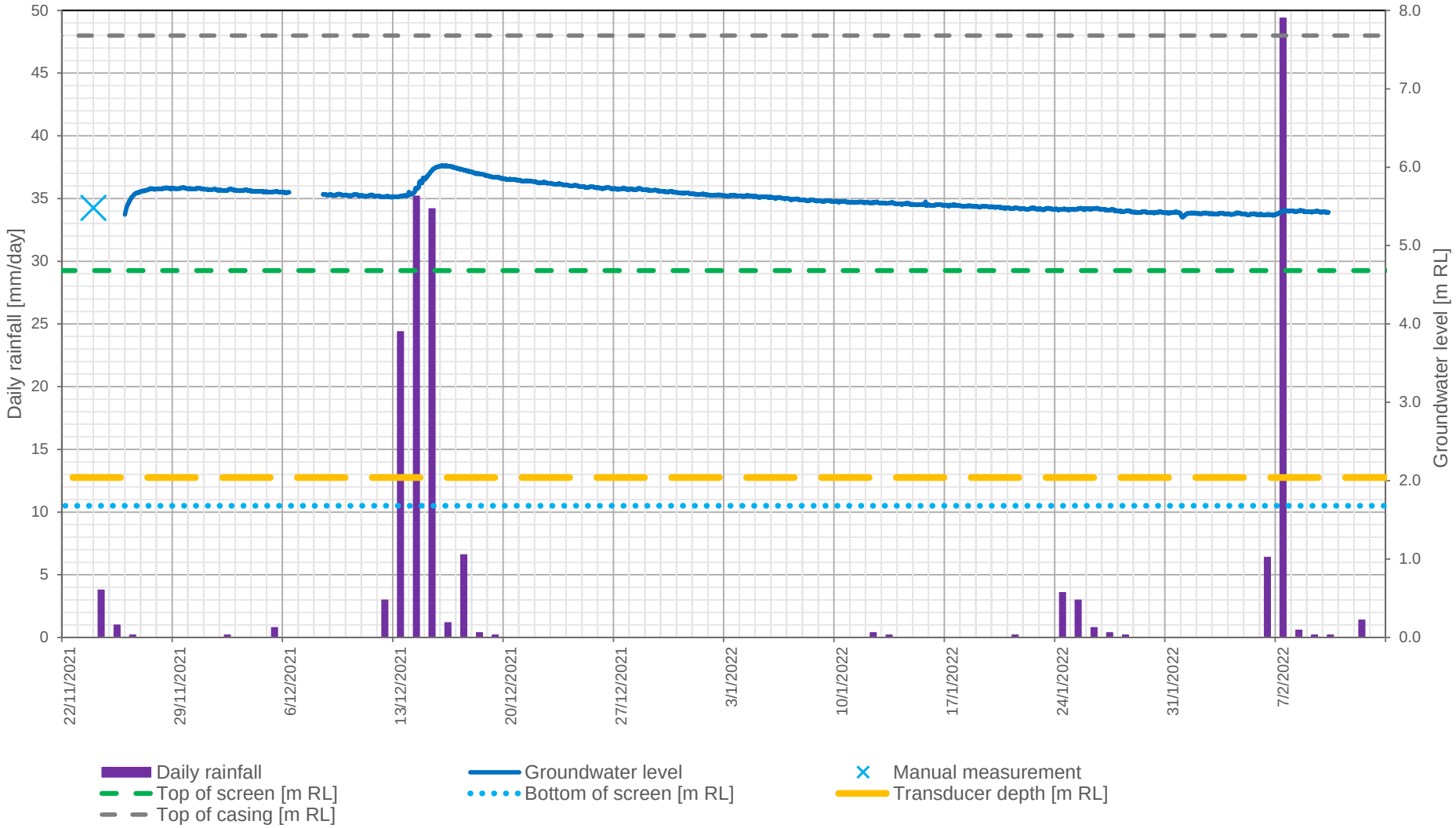
Prepared by:	G. Sturgess	**Eastern Busway**
Checked by:	E. Eddington	**Groundwater Level Monitoring**
Date:	2/25/2022	**DH18_104 Piezometer Results**
Figure No.:	1	



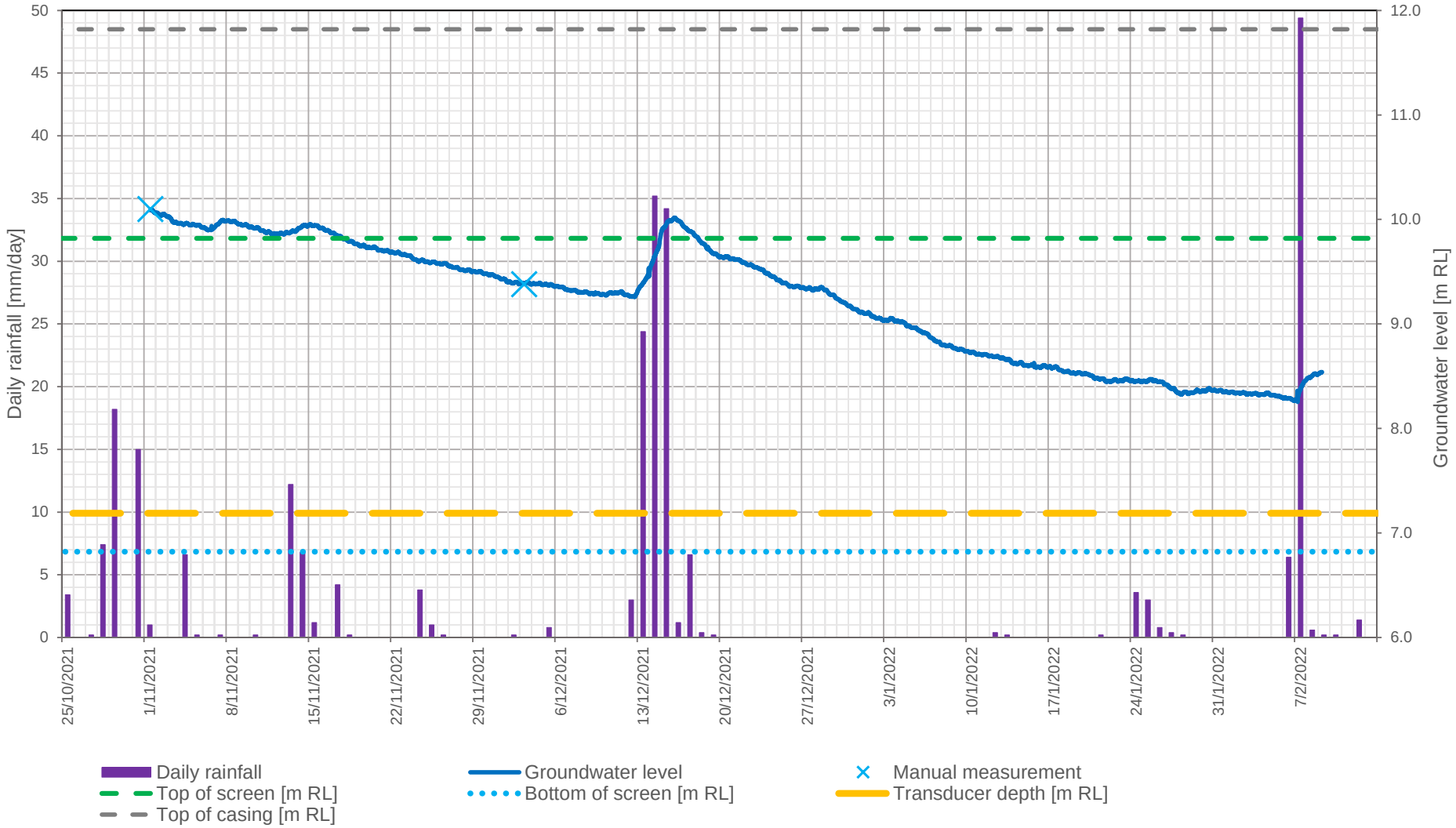
Eastern Busway	Prepared by:	G. Sturgess	**Eastern Busway**
	Checked by:	E. Eddington	**Groundwater Level Monitoring**
	Date:	2/25/2022	**DH18_108 Piezometer Results**
	Figure No.:	1	



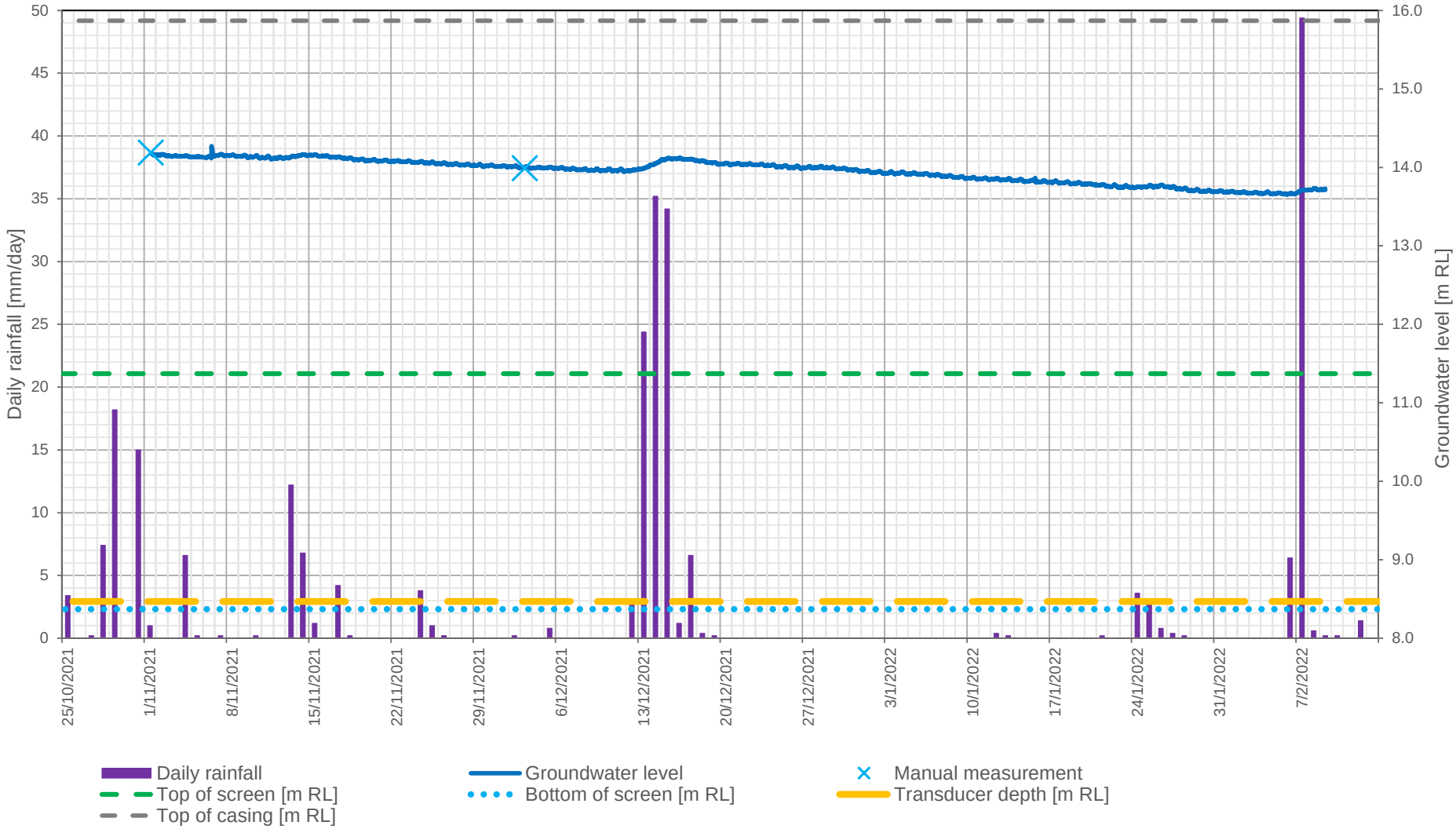
Prepared by:	S. Kirkman	**Eastern Busway**
Checked by:	E. Eddington	**Groundwater Level Monitoring**
Date:	2/25/2022	**EB21_DH204 Piezometer Results**
Figure No.:	1	



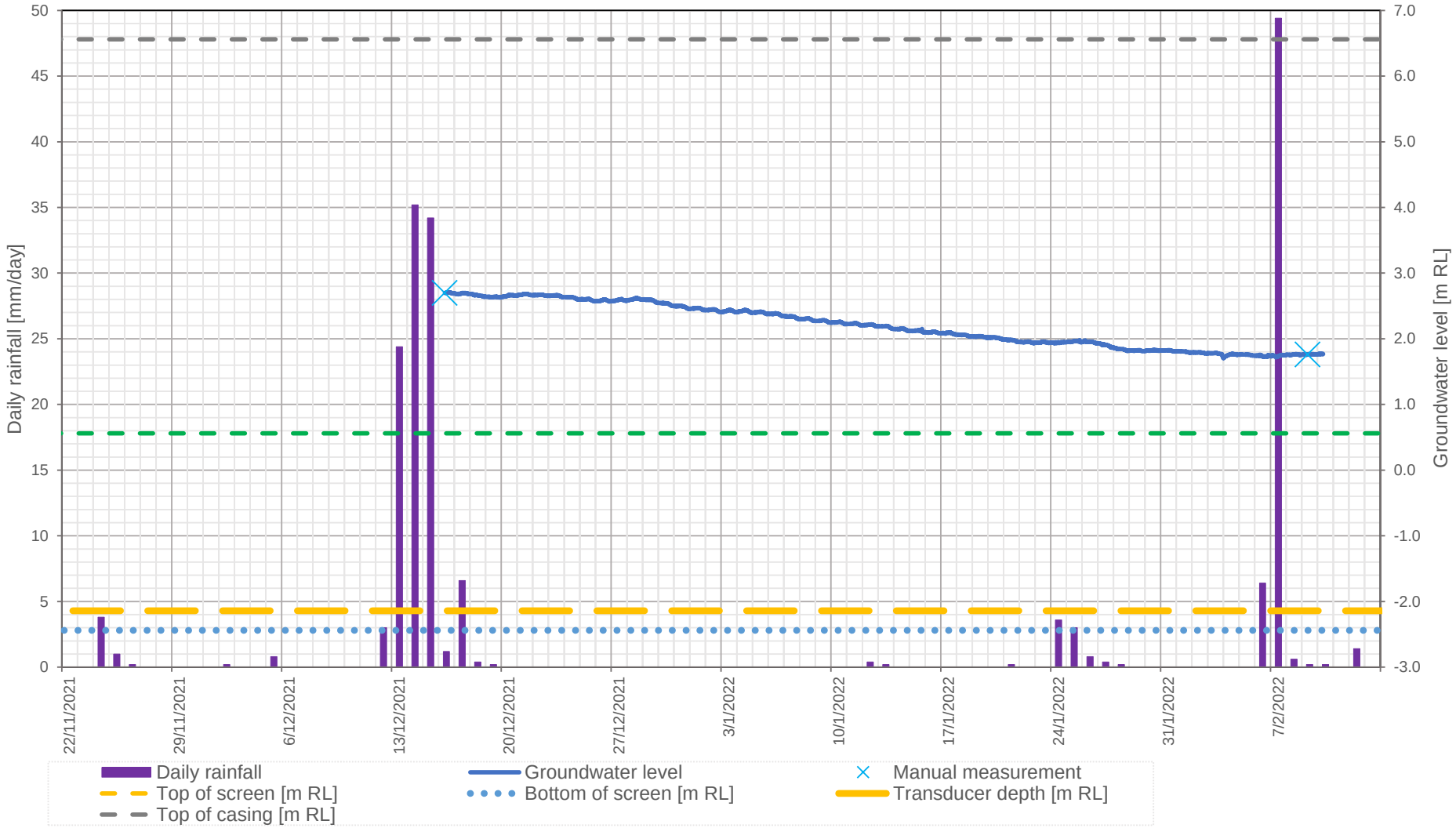
Eastern Busway	Prepared by:	S. Kirkman	**Eastern Busway**
	Checked by:	E. Eddington	**Groundwater Level Monitoring**
	Date:	2/25/2022	**EB21_205_P Piezometer Results**
	Figure No.:	1	



Prepared by:	S. Kirkman	**Eastern Busway**
Checked by:	E. Eddington	**Groundwater Level Monitoring**
Date:	2/25/2022	**EB21_210 Piezometer Results**
Figure No.:	1	

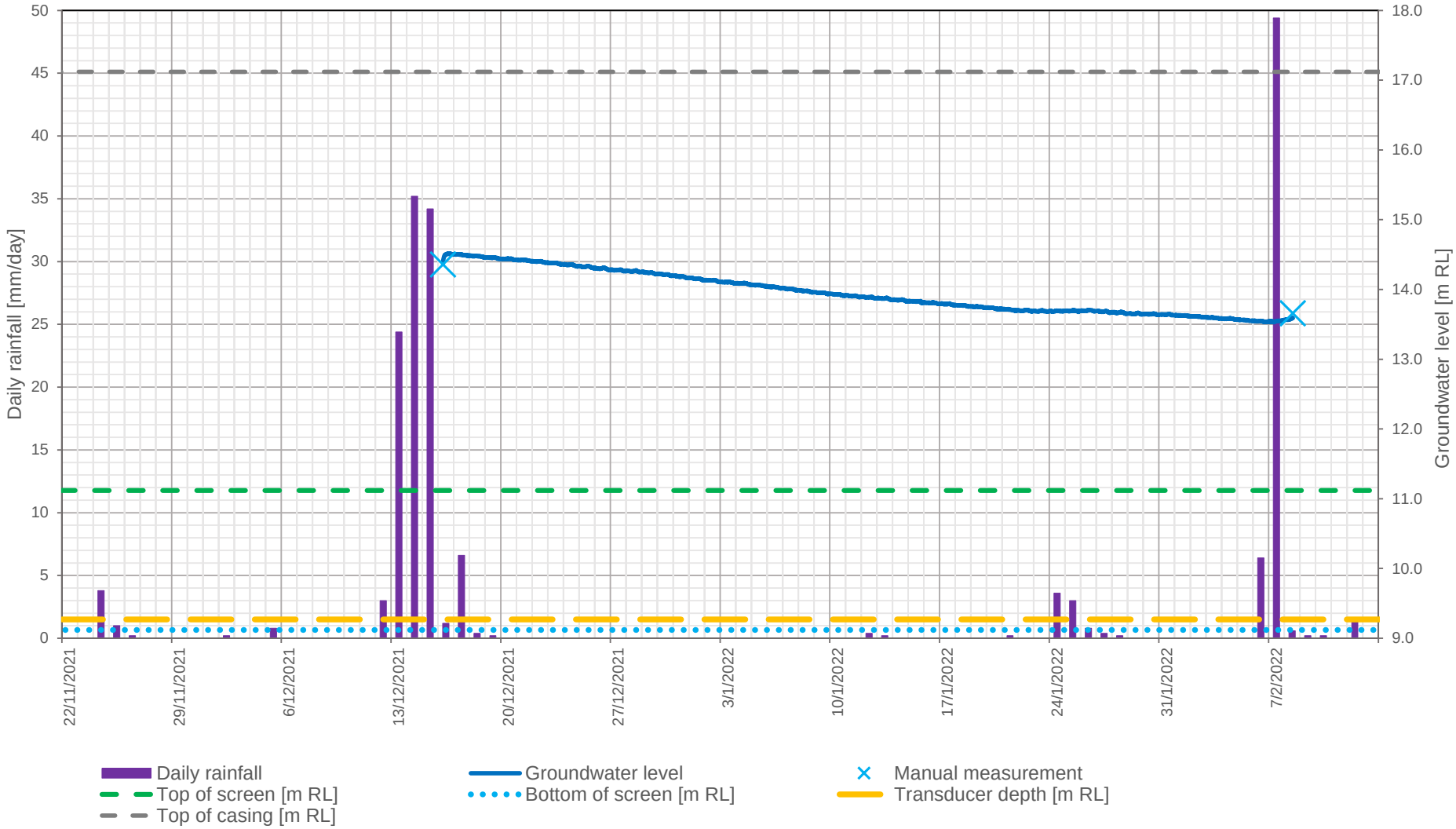


Eastern Busway	Prepared by:	S. Kirkman	**Eastern Busway**
	Checked by:	E. Eddington	**Groundwater Level Monitoring**
	Date:	2/25/2022	**EB21_DH212 Piezometer Results**
	Figure No.:	1	



Eastern Busway

Prepared by:	G. Sturgess	**Eastern Busway**
Checked by:	E. Eddington	**Groundwater Level Monitoring**
Date:	2/25/2022	**EB21_WB203 Piezometer Results**
Figure No.:	1	



Prepared by:	S. Kirkman	**Eastern Busway**
Checked by:	E. Eddington	**Groundwater Level Monitoring**
Date:	2/25/2022	**EB21_WB213 Piezometer Results**
Figure No.:	1	

Appendix C – Flow Maps

EB2 Flow Map

Eastern Busway Stage 2 — Eastern Busway Stage 2

Eastern Busway Stage 3 Residential — Eastern Busway Stage 3 Residential

2m Contours

5m Contours

Inferred flow direction

Inferred excavations may be below <1.0m of SWL

Inferred excavations may be below <0.6m of SWL

Inferred excavations to be above SWL

Abbreviations

IL: Invert level

SWL: Standing water level

IL @ Xm RL — Deepest Stormwater trench invert level in area

IL @ 3.46 m RL

IL @ 6.31 m RL

IL @ 14.24m RL

IL @ 16.92m RL

IL @ 13.97m RL

EB21_WB213_P
Collar @ 17.12m RL
SWL @ 13.66m RL
09/02/2022

IL @ 16.21m RL

EB21_DH212_P
Collar @ 15.87m RL
SWL @ 13.71m RL
09/02/2022

IL @ 6.18 m RL

EB21_DH210_P
Collar @ 11.82m RL
SWL @ 8.55m RL
10/02/2022

IL @ 12.57m RL

IL @ 8.14m RL

IL @ 6.45 m RL

IL @ 9.81m RL

IL @ 7.92m RL

IL @ 6.82 m RL

IL @ 7.05m RL

IL@ 7.81m RL

13m RL

8m RL

IL @ 5.90m RL

IL @ 6.68m RL

7m RL

IL @ 7.28m RL

EB21_DH204_P
Collar @ 8.14m RL
SWL @ 5.64m RL
09/02/2022

EB21_WB203_P
Collar @ 6.56m RL
SWL @ 1.76m RL
09/02/2022

IL @ 6.18m RL

IL @ 5.63m RL

IL @ 5.41m RL

6m RL

IL @ 3.59m RL

IL @ 6.02m RL

IL @ 7.01m RL

IL @ 7.97m RL

IL @ 1.81m RL

IL @ 5.74m RL

IL @ 1.18m RL

5m RL

IL @ 5.46m RL

EB21_DH205_P
Collar @ 7.68m RL
SWL @ 5.48m RL
09/02/2022

IL @ 6.75m RL

IL @ 9.00m RL

Two piezometers still to be installed.

IL @ 4.27m RL

IL @ 5.50m RL

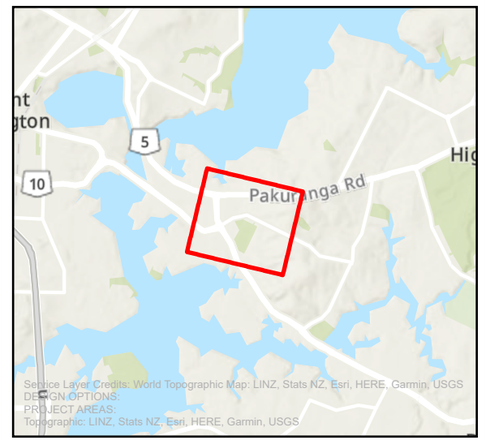
IL @ 6.39m RL

Eastern Busway Stage 3 Residential

Eastern Busway Stage 2

N

0 62.5 125 250 m



Map Creation Date: 2/23/2022 Scale: 1:4,514

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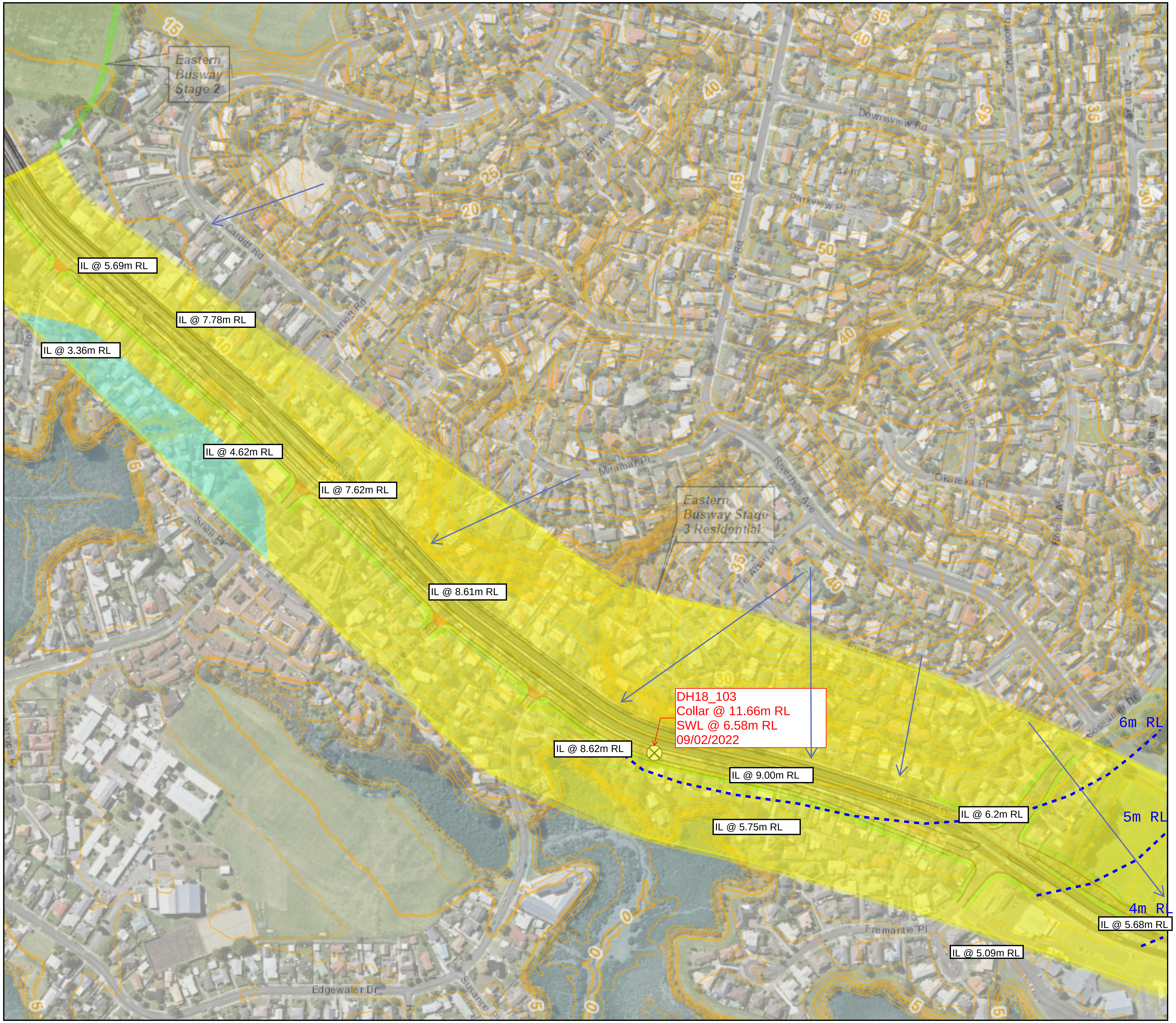


EB3R Flow Map (North)

Eastern Busway Stage 2	Eastern Busway Stage 2
Eastern Busway Stage 3 Residential	Eastern Busway Stage 3 Residential

- 2m Contours
- 5m Contours
- Inferred flow direction
- Inferred equipotential hydraulic head
- Inferred excavations may be below <1.5m of SWL
- Inferred excavations to be above SWL

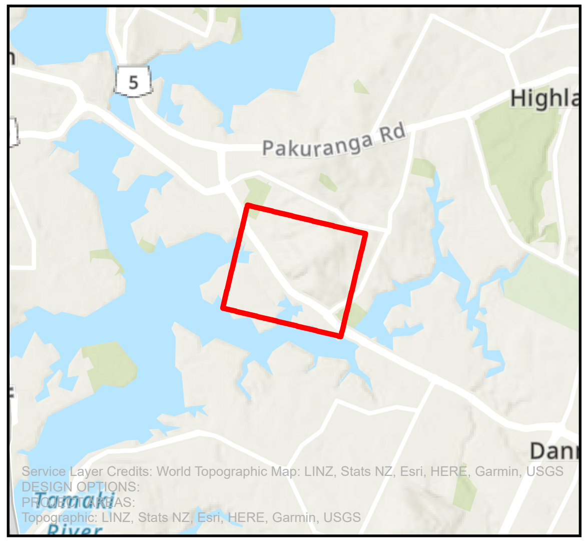
Abbreviations

IL: Invert level
SWL: Standing water level

IL @ Xm RL — Deepest Stormwater trench invert level in area

N

0 62.5 125 250 m

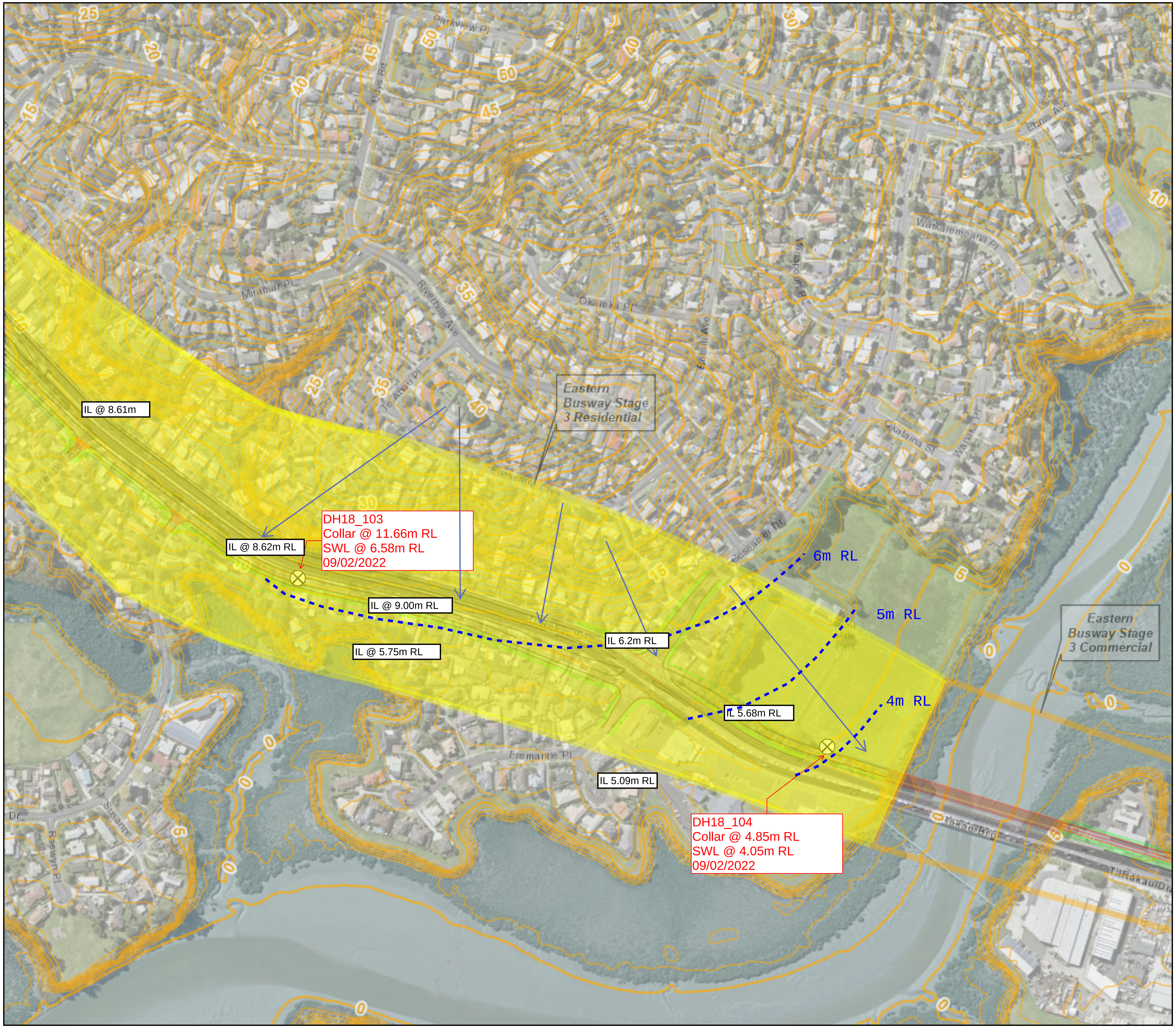


Map Creation Date: 2/24/2022

Scale: 1:4,514

Eastern Busway Alliance

Fletcher acciona AECOM Jacobs



EB3R Flow Map (South)

Eastern Busway Stage 2 — Eastern Busway Stage 2

Eastern Busway Stage 3 Residential — Eastern Busway Stage 3 Residential

2m Contours

5m Contours

Inferred flow direction

Inferred equipotential hydraulic head

Inferred excavations may be below <1.5m of SWL

Inferred excavations to be above SWL

Abbreviations

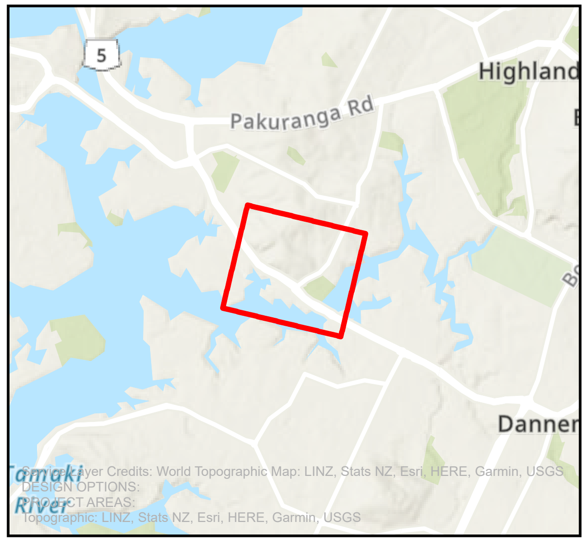
IL: Invert level

SWL: Standing water level

IL @ Xm RL — Deepest Stomwater trench invert level in area

N

0 62.5 125 250 m



Map Creation Date: 2/23/2022 Scale: 1:4,514

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Eastern Busway Alliance

Fletcher acciona AECOM Jacobs

Appendix D – Existing Bores


Williams Avenue
Dowling Place
Tamaki Bay Drive
Pakuranga Road
Pakuranga Road
Pakuranga Road
Pakuranga Road
Pakuranga Road
Pakuranga Road
Pakuranga Road
William Roberts Road
Bennett Road
Lewis Road
Ayr Road
Ayr Road
Lewis Road
Paul Place
Dale Crescent
Dale Crescent
Dale Crescent
Anthony Place
Palm Avenue
Ti Rakau Drive
Ti Rakau Drive
Ti Rakau Drive
Ti Rakau Drive
Reeves Road
Reeves Road
Reeves Road
Reeves Road
Reeves Road
Reeves Road
Reeves Road
Pakuranga Highway
Dale Crescent
Dale Crescent
Seven Oaks Drive
Pakuranga Highway
Cortina Place
Rosina Place
Ti Rakau Drive
Ti Rakau Drive
Ti Rakau Drive
Tiraumea Drive
Bolina Crescent
Dolphin Street
Pandora Place
Pandora Place
Osprey Street
Undine Street
Tiraumea Drive
Tiraumea Drive
Mattson Road
Cindy Place
Legend
Buffered
ClosedLandfill
ContaminatedSubTypes
PossibleContamRecords
PropertyNotesFromSAP
LegacyApplicationsAll
LegacyBores
LegacyConsentsAll
LegacyPermittedActivities
OAS_CONS_D_CONTAMINATED_SITE
Land Outside
Sea Outside
Water
Sea Outside


Legend
Buffered
ClosedLandfill
ContaminatedSubTypes
PossibleContamRecords
PropertyNotesFromSAP
LegacyApplicationsAll
LegacyBores
LegacyConsentsAll
LegacyPermittedActivities
OAS_CONS_D_CONTAMINATED_SITE
SIIEDPollution
Ti Rakau Drive
Dolphin Street
Mattson Road
Aurea Avenue
Roseburn Place
Carole Crescent
Cardiff Road
Udys Road
Reeves Road
Downsview Road
Blyton Lane
Parkview Place
Marriott Road
Chatsworth Crescent
Ennis Avenue
Heron Place
Miramar Place
Okareka Place
Te Anau Place
Riverhills Avenue
Rotoiti Avenue
Gossamer Drive
Ellesmere Crescent
Edgewater Drive
Mangos Place
Riverina Avenue
Raewyn Place
Fremantle Place
Trugood Drive