REPORT

Tonkin+Taylor

Sewer Connection (CC9) - Keith Hay Park

Assessment of Environmental Effects Report

Prepared for
Watercare Services Ltd
Prepared by
Tonkin & Taylor Ltd
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Table of contents

1 Introduction 1
1.1 Overview of proposed works 1
1.2 Applicant and property details 1
1.3 Overview of resource consent requirements 2
2 Environmental setting 3
2.1 Site location and description 3
2.2 Geology 3
2.3 Hydrology and Hydrogeology 4
2.4 Site history and ground contamination 5
2.5 Cultural and archaeological values 5
3 Description of proposed works 6
3.1 Overview 6
3.2 Trenchless construction 6
3.3 Open trench construction 6
3.4 Construction lay-down areas 7
3.5 Proposed earthworks 7
3.6 Erosion and sediment controls 8
3.7 Proposed tree removal and alteration 9
3.8 Construction noise and programme of work 9
3.9 Construction traffic 9
4 Resource consent requirements 11
4.1 AUP zoning and notations 11
4.2 Auckland Unitary Plan 12
4.2.1 AUP resource consent requirements 12
4.2.2 Assessment criteria – restricted discretionary activities 13
4.3 NES Soil 16
4.4 Permitted activities 16
4.5 Existing resource consents 17
4.6 Other consents and approvals required 17
4.6.1 Corridor Access Request 17
4.7 Reserves Act 1977 17
4.8 Section 176 Approval 17
5 Assessment of effects on the environment 18
5.1 Introduction 18
5.2 Existing management plans 18
5.3 Positive effects 19
5.4 Temporary construction effects 19
5.4.1 Erosion and sedimentation effects 19
5.4.2 Transport and tracking of material off-site effects 19
5.4.3 Construction traffic effects 20
5.4.4 Construction noise and vibration effects 21
5.4.5 Public access effects 21
5.5 Human health effects 22
5.6 Flooding effects 22
5.7 Groundwater and settlement effects 22
5.8 Cultural heritage effects 23
5.9 Arboricultural effects 24
5.10 Conclusion 24

6 Statutory assessment 25

- 6.1 Section 104 of the RMA 25
- 6.2 Part 2 of the RMA 25
- 6.3 National Environmental Standards 25
  - 6.3.1 Resource Management (National Environmental Standards for Freshwater) Regulations 2020 25
  - 6.3.2 National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health 26
- 6.4 National Policy Statements 26
  - 6.4.1 National Policy Statement for Freshwater Management 2020 26
  - 6.4.2 Auckland Unitary Plan Assessment 27

7 Consultation and notification assessment 31

- 7.1 Consultation 31
- 7.2 Notification assessment 31
  - 7.2.1 Public notification 31
  - 7.2.2 Limited notification 32

8 Conclusion 34

9 Applicability 35

Appendix A : Records of Title

Appendix B : Site Plans

Appendix C : Preliminary Site Investigation

Appendix D : Erosion and Sediment Control Plans

Appendix E : Construction Traffic Effects Assessment

Appendix F : Construction Noise and Vibration Assessment

Appendix G : Groundwater and Settlement Assessment

Appendix H : Archaeological Assessment

Appendix I : Arboricultural Impact Assessment

1 Introduction

1.1 Overview of proposed works

Watercare Services Ltd (Watercare) is proposing to undertake construction of a sewer connection (CC9) at Keith Hay Park, Mt Roskill. The proposed works involve the installation of an approximately 810 m long sewer pipeline beneath Keith Hay Park from Watercare's Central Interceptor (CI) Keith Hay shaft construction site to a termination manhole at Richardson Road. The sewer will be located next to the existing Branch 9 trunk sewer alignment. The CC9 sewer will provide overflow mitigation within the local catchment an-d will provide additional network capacity to support intensification in this part of the Auckland region.

This Assessment of Effects on the Environment (AEE) report has been prepared on behalf of Watercare to support a resource consent application to authorise the CC9 works. This report has been prepared in fulfilment of section 88 of the Resource Management Act 1991 (RMA), and in accordance with Tonkin & Taylor Ltd's (T+T) letter of engagement dated 16 November 2020.

1.2 Applicant and property details

Table 1.1: Applicant and property details

Applicant	Watercare Services Ltd
Owners / occupiers of application site	Keith Hay Park (southern extent of site): Her Majesty The Queen Cameron Leisure Pool (northern extent of site): Auckland Council Hay Park School, Waikowhai Intermediate School, Hillsborough Kindergarten: Ministry of Education Road reserve: Auckland Transport
Site address / map reference	Arundel Street, Mt Roskill
Site area	Approx. 1 ha (approx. works area along route alignment - 8,200 m^2)
Legal description	**Keith Hay Park South and Cameron Pool and Leisure Centre:** PT ALLOT 77 SEC 13 Suburbs AUCKLAND, ALLOT 78 SEC 13 Suburbs AUCKLAND, ALLOT 85 SEC 13 Suburbs AUCKLAND, ALLOT 120 SEC 13 Suburbs AUCKLAND, ALLOT 79 SEC 13 Suburbs AUCKLAND **Hay Park School:** Lot 174 DP 17584, Pt Lot 1466 DP 22827, PT ALLOT 9 SEC 13 Suburbs AUCKLAND
Record of Title	Keith Hay Park north: NA8D/230 Keith Hay Park south: NA626/60
Council / Plans	Auckland Council Auckland Unitary Plan Operative in Part (AUP)
Address for service during consent processing	Tonkin & Taylor Ltd Attention: Laila Alkamil Phone: 09 352 5948 Email: LAlkamil@tonkintaylor.co.nz
Address for service during consent implementation and invoicing	Watercare Services Ltd Attention: Xenia Meier Phone: 021 574 585 Email: Xenia.Meier@water.co.nz

We attach copies of the relevant Record of Titles in **Appendix A**.

1.3 Overview of resource consent requirements

Resource consent is required from Auckland Council under the AUP under the following rules:

- **Rule E25.4.1 (A2)** – Construction noise that does not comply with a permitted activity standard as a restricted discretionary activity;
- **Rule E26.4.3.1 (A84)** – Tree trimming or alteration in the open space zone that does not comply with Standard E26.4.5.1 as a restricted discretionary activity;
- **Rule E26.4.3.1 (A88)** – Works within the protected root zone not otherwise provided for as a restricted discretionary activity;
- **Rule E26.4.3.1 (A92)** – Tree alteration or removal of any tree greater than 4m in height and/or greater than 400mm in girth in the open space zone as a restricted discretionary activity;
- **Rule E26.5.3.1 (A97/A97A)** – Earthworks greater than 2,500 m^3 and 2,500 m^2 as a restricted discretionary activity;
- **Rule E26.5.3.2 (A107)** – Earthworks greater than 2,500 m^2 within the Sediment Control Protection Area as a restricted discretionary activity;
- **Rule E36.4.1 (A56)** – Infrastructure in a floodplain and overland flow path as a restricted discretionary activity;
- **Rule E7.4.1 (A20)** – Dewatering and groundwater level control exceeding the permitted activity duration limit of 30 days and 10 days in peat soil under Standard E7.6.1.6(2) as a restricted discretionary activity;
- **Rule E7.4.1 (A28) –** Groundwater diversion exceeding Standard E7.6.1.10 as a restricted discretionary activity; and
- **Rule E30.4.1 (A7)** – Discharge of contaminants (not complying with Standard 30.6.2.1 as no DSI has been prepared) onto or into land from the disturbance of potentially contaminated soil as a discretionary activity.

Resource consent is also required from Auckland Council under the National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health (NES Soil) under the following regulation:

- Regulation 11: Disturbance of potentially contaminated soil not meeting requirements 10(2)(a-d) as a discretionary activity.

Overall, resource consent is required from Auckland Council under the AUP and NES Soil as a discretionary activity. For the avoidance of doubt, Watercare is seeking resource consents under the rules described above and any other rules which may apply to the activity, even if not specifically noted.

Pursuant to Section 125 of the RMA, a standard lapse date of 5 years is sought.

2 Environmental setting

2.1 Site location and description

The CC9 connection extends approximately 810 m from the Keith Hay CI shaft construction site located at the Cameron Leisure Pool carpark, along the eastern edge of Keith Hay Park and through the Eden Roskill Cricket Club carpark, Hay Park School and the boundary with Hillsborough Kindergarten, and Waikowhai Intermediate School (southeast corner) to a termination manhole at Richardson Road (see Figure 2.1 below).

The site is next to and within the surface catchment area of Oakley Creek which is an urban stream that flows from Mt Roskill through the western suburbs of Central Auckland before entering the Motu Manawa Marine Reserve in the Waitemata Harbour.

Key land uses in the immediate area include Keith Hay Park and associated facilities including playing fields and the Eden Roskill Cricket Club and cricket pitches. There are two schools (Waikowhai Intermediate School and Hay Park School) and the Hillsborough Kindergarten at the southern extent of the alignment near Richardson Road. To the east of the proposed CC9 route land use is primarily residential.

Figure 2.1: Aerial view of the proposed alignment (Source: Auckland Council Geomaps, 2021)

2.2 Geology

The published geological map of the area[1] indicates that the site is located at the boundary of two geological units. The southern part of the project is expected to be underlain by the Tauranga Group river deposit described as sand, silt mud and clay with local gravel and peat beds. The northern part of the project is expected to comprise the Waitamata Group soils described as alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits. The location of the site in the context of the regional geology is shown on Figure 2.2.

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[1] Kermode, L.O. 1992. *Geology of the Auckland urban area.* Scale 1:50 000. Institute of Geological & Nuclear Sciences geological map 2. 1 sheet + 63 p. Institute of Geological & Nuclear Sciences Ltd., Lower Hutt, New Zealand.

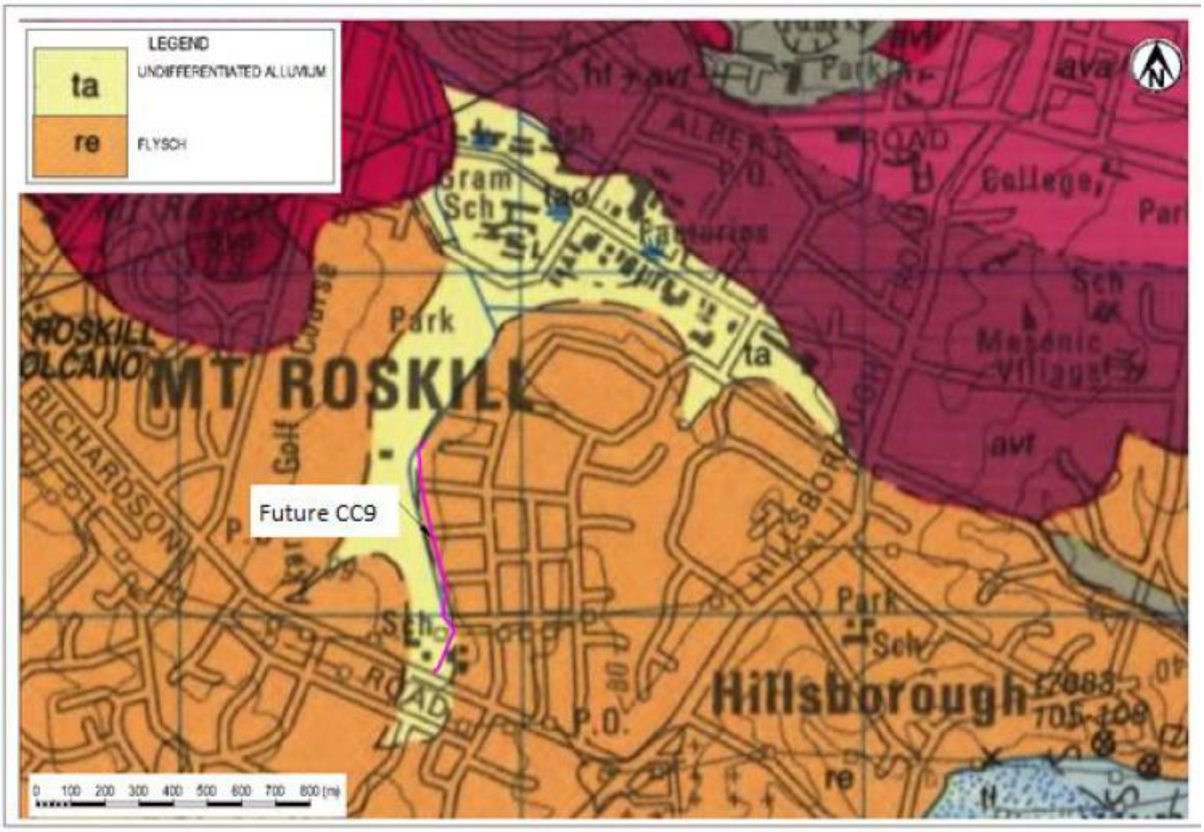

Figure 2.2: Published geology of the site. (Source: Kermode, 1992).

2.3 Hydrology and Hydrogeology

A desktop Groundwater and Settlement Report has been prepared by T+T (**Appendix G**). A groundwater measurement taken during the drilling of a borehole recorded static groundwater at 0.9 mbgl.

Based on topography, surface water is predicted to flow from the south and east towards and through Keith Hay Park (south) and northwards towards Keith Hay Park (north). Shallow groundwater flows within the Tauranga Group materials are expected to follow the surface topography and surface water flows, and flow in a generally north westerly direction towards and through Keith Hay Park from the CC9 route.

Auckland Council has identified Keith Hay Park as a flood prone area and flood plain. A large overland flowpath which connects to Oakley Creek is also identified along the western edge of Keith Hay Park.

2.4 Site history and ground contamination

A Preliminary Site Investigation (PSI) has been undertaken for the site (See **Appendix C**), which determined that HAIL[2] activities are more than likely than not to have undertaken at the site from the following activity:

- A10 – Persistent pesticide bulk storage or use including sport turfs.

In addition, the PSI found the following:

- Buildings located close to the proposed works were completed between the 1940s and 1950s and therefore there is the potential for contamination with regards to asbestos containing materials (ACM) and lead-based paint products. However, as the proposed works are likely to be located more than 5 m from existing buildings this is not considered to be a HAIL activity.
- A potential HAIL activity may have occurred in relation to the placement of unverified fill at Keith Hay Park, however any potential contamination would be limited to shallow soils only. The potential to encounter contaminated soil during micro-tunnelling work in the northern part of the site is considered negligible.

Overall, the extent and magnitude of site contamination is assessed as being low, with the only HAIL activities identified to have taken place being the use of pesticides in Keith Hay Park and potential presence of fill.

Contamination risk will be managed in accordance with the measures set out in the approved Site Management Plan (SMP) prepared for the wider CI works at Keith Hay Park[3]. The SMP will also assist in the event of any accidental contamination discovery during works due to the previous HAIL activity on the site.

2.5 Cultural and archaeological values

The site is not within an area of significant cultural value or within a statutory acknowledgement area. A review of the ArchSite[4] database shows there are no identified archaeological items within the site. However, there is a number of archaeological sites in the form of shell middens recorded to the south of the site, which indicates Māori occupation in the wider area.

An Archaeological Assessment (**Appendix H**) has been undertaken for the site, which identified no archaeological deposits or features within the proposed CC9 route and found that the overall the risk of uncovering archaeological items is low. However, in the event this does occur the Accidental Discovery Protocol set out under the AUP will be adhered to and any necessary heritage authorities will be obtained. In addition to this, the accidental discovery protocols set out under the CI Construction Management Plan (CMP) will also be utilised in the event that archaeological remains are discovered during the works.

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[2] Hazardous Activities and Industries List

[3] Watercare Services Limited and Ghella Abergeldie Joint Venture, June 2020. *Contaminated Land Site Management Plan Central Interceptor Project – Main Project Works Version 1.1.*

[4] Archaeological Site Recording Scheme: http://ww.archsite.org.nz/

3 Description of proposed works

3.1 Overview

The proposed works involve the installation of a sewer beneath Keith Hay Park in Mt Roskill. The CC9 sewer extends from the Keith Hay Park Central Interceptor (CI) shaft construction site located at the Cameron Leisure Pool carpark off Arundel Street, beneath Keith Hay Park and beneath Hay Park School, Hillsborough Kindergarten and Waikowhai Intermediate School to a termination manhole at Richardson Road (refer to **Appendix B**).

The total pipeline length is approximately 810 m with an external diameter of up to 1200 mm (ID 900 mm). The CC9 pipeline will be located next to the existing Branch 9 trunk sewer alignment. The northern section of the CC9 route through Keith Hay Park will be trenchless (likely pipe-jacked or possibly via HDD methods). The remaining section of the CC9 route from the Eden Roskill Cricket Club to Richardson Road will potentially be trenched to a maximum depth of up to 5 m but may also be installed via trenchless methods or a combination of trenchless and trenched construction methodologies.

Construction activities are expected to take up to 12 months including over the winter period, with trenching works including works within the school grounds anticipated to take between 2-3 months (and possibly up to 4 months). The existing concrete walkway through this section of Keith Hay Park will need to be closed for the works' duration, however an alternative walkway will be provided for park users.

3.2 Trenchless construction

The construction methodology is expected to be primarily trenchless, likely pipe-jacked or possibly via HDD methods, from the CI Keith Hay construction site through to the Eden Roskill Cricket Club carpark (at or about MH05 or MH06) at a depth to invert of between approximately 4 to 8 m.

The trenchless methodology will require intermediate manholes located between 65 to 150 m apart along the CC9 route. Launch pits will be required at every second manhole location along the trenchless section of the alignment. These require a working area of up to approximately 50 x 20 m (1,000 m^2) and will potentially be located at MH01, MH03 and either MH05 or MH06.

In the case of HDD, a laydown area immediately adjacent to the pipeline alignment will be required along the length of the route to enable pipe stringing prior to installation. Initial set-up would occur at the CI shaft with a reception shaft likely to be located at the existing manhole in the Cameron Pool car park (MH01) with a drive from this point through to MH03 (or alternatively from MH03 to MH01). Reception points require a limited area of earthworks to access the reception shaft (i.e. an earthworks area of approximately 5 x 5 m (25 m^2) within a working area of approximately 15 x 15 m (225 m^2)).

3.3 Open trench construction

The remaining section of the CC9 route will be installed via a trenchless construction methodology as outlined above, or by open trenching or a combination of both.

In the case of open trenching, this would occur from around the Eden Roskill Cricket Club (i.e. manhole MH05 or MH06) approximately 300m southwards to Richardson Road at a maximum depth to invert of up to 5 m. Three alignment options for this section of pipeline are being considered as follows (refer to **Appendix B**):

1 Option 1: An alignment through the Hay Park School playground and Hillsborough Kindergarten carpark to connect to three manholes (MH08, MH09, MH10) at Richardson Road.
2 Option 2: An alignment through the existing walkway between the Hillsborough Kindergarten and Hay Park School grounds to connect to three manholes (MH08, MH09, MH10) at Richardson Road (note: this option is likely to be trenchless).
3 Option 3: An alignment through Hay Park School playground with MH08 placed approximately 2 m to the east of the playground. This option also includes a temporary pit between MH05 and MH06 to retrieve a pipe jacking drill head if required.

The final route will be determined during detailed design with both the vertical and horizontal alignment to be confirmed.

In terms of the construction methodology, depending on the depth of the trench it will potentially be benched with the width at the base approximately 1.5 m and 3-4 m wide at the top. Pipes will be lowered into the trench, with sections of the trench widened to enable in-trench welding of pipes to occur should this be required. Trenching is likely to require a construction area at each manhole location of typically approximately 300 m^2 (but could be up to 1,000 m^2).

Trenching is anticipated to be undertaken over a 2-3 month period (and possibly up to 4 months). Open trenching will be undertaken in sections, typically approximately 100 m sections however with shorter sections at the southern end through the school grounds (e.g. around 40 m sections). Access is likely to be from Noton Place and Keith Hay Park, as well as access from Richardson Road.

Trenching through Hay Park School would be programmed to occur outside of the school term as far as practicable. To minimise the overall construction period, trenching works may be undertaken 24 hours a day, 7 days a week (or alterative extended hours).

The final alignment and construction methodology will be decided by the contractor at the detailed design stage.

3.4 Construction lay-down areas

Construction lay-down areas will be required for the storage of machinery and construction materials during the works. These areas are intended to maintain a clean working surface and to minimise the risk of silt and sediment to be tracked onto the public roads.

The exact site configuration will be determined by the Contractor and will vary depending on site constraints along the proposed alignment. However at this point in time a main construction lay-down area is expected to be located within the Cameron Leisure Pool carpark and will comprise an area of approximately 1,000 m^2. This main construction lay-down area will be in place for the duration of works.

Secondary construction lay-down areas (up to a maximum area of approximately 1,000 m^2) will be required around each manhole while that section of the pipeline is laid. Earthworks to construct these areas will be limited to topsoil stripping and the placement of aggregate to form the lay-down area. It is likely that no more than two secondary lay-down areas will be in place at any one time. Each area will be reinstated to its original state once that section of the pipeline is complete.

3.5 Proposed earthworks

Proposed earthwork activities include shaft excavations, open trenching and pipe jacking operations, as well as transporting excess materials off-site. Overall earthworks volumes and areas are set out in Table 3.1 below. For further information see the Erosion and Sediment Control Report in **Appendix D**. It is important to note this represents a conservative (or 'worst case') scenario in that is based on both trenching and trenchless construction methodologies. However if the contractor determines that a trenchless construction methodology is appropriate for the entire route, then the area and volumes below will reduce.

Table 3.1: Summary of total earthwork excavation volumes and areas

Methodology	Work Area (m^2)	Excavation Vol (m^3)
Open Trench – Alignment Option 1	6,000	5,500
Open Trench – Alignment Option 3 (and 2^+)	5,000	5,500
Trenchless (up to approx. 510m)	2,200	2,000
TOTAL	Up to approximately 8,200 m^2	Up to approximately 7,500 m^3

$^+$ *Option 2 alignment is likely trenchless.*

3.6 Erosion and sediment controls

The majority of the CC9 sewer will be constructed using trenchless installation techniques, with limited potential for sediment generation. However, as outlined in Section 3.2 above, open cut trenching could also be used to install the southern section of the pipeline, which is approximately 300 m in length. There will also be localised earthworks at the manhole construction sites and laydown area(s).

Site topography is very flat which reduces the potential for erosion and sediment run-off, however as set out in the outline Erosion and Sediment Control Plan (ESCP) provided in **Appendix D,** standard erosion and sediment control measures will be incorporated into the works methodology. The key measures recommended to address sediment control are:

- Silt fences will be required around construction areas, and in particular any exposed areas and stockpiled excavated material and all water removed from the excavation will require treatment prior to discharge.
- Any water removed through either open trenching or trenchless processes will need to be treated and then appropriately discharged.
- Undertaking any open trenching in short (e.g. up to approximately 100 m) sections with each section stabilised immediately on completion of the works.
- Entrance ways, other areas subject to vehicle traffic and work areas will be stabilised in accordance with GD05.
- Existing stormwater catch pits, adjacent to the site that could receive runoff from the site will be protected to GD05 standards.

A detailed ESCP will be prepared by the contractor prior to commencement of works and will be consistent with those in the approved Site-Specific Erosion and Sediment Control Plan: Site 3 – Keith Hay Park[5]. The ESCP will also provide additional mitigation measure for earthworks that may be required during the winter months (May to September). Importantly, all earthworks will be undertaken in accordance with the best practice guidelines of Auckland Council's *Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region* (GD05).

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[5] Approved 25 May 2020.

Erosion and sediment control measures will remain in place until earthworks are complete and the area of earthworks stabilised.

3.7 Proposed tree removal and alteration

There are a number of trees located in close proximity to the proposed sewer alignment (see the Arboricultural Impact Assessment in **Appendix I**). As set out in the assessment, the proposed works will prioritise tree-retention wherever practicable through the alignment. Furthermore, works within the dripline of trees will be limited as far as practicable and if any removal or pruning is required this will be undertaken in accordance with best arboricultural practice.

These measures include the following:

- Ensuring all works and activities within the protected root zone are supervised by a suitably qualified arborist;
- Positioning machinery to ensure there is no contact with any parts of retained trees; and
- Avoiding placing any machinery, vehicles or equipment within the root zone of any tree.

3.8 Construction noise and programme of work

Site operational arrangements will likely occur on the following basis:

- Micro tunnelling/HDD and trenching activities – this work would generally occur during normal working hours, 7 am to 6 pm, Monday to Friday and 8 am to 6pm Saturday. However, in particular circumstances, Watercare may need to undertake micro tunnelling/HDD 24 hours a day 7 days a week (or alternative extended hours) to meet construction demands, provided that construction work can be managed to meet construction noise and vibration (along with construction traffic requirements).
- Trenching activities – To restrict the overall duration of trenching activities, Watercare proposes to undertake the trenching works 24 hours a day 7 days a week (or alternative extended hours) provided that construction work can be managed to meet construction noise and vibration requirements (along with traffic requirements). This is to shorten the construction period such that as far as practicable construction activities occur outside of school term.
- General site activities – normal working hours, 7 am to 6 pm, Monday to Friday, 8 am to 6 pm Saturday, with provision to extend hours during summer daylight savings periods and under certain circumstances as outlined in the Construction Management Plan.
- Sheet piling and tree chipping will not need to take place outside normal daytime working hours unless otherwise authorised in the Construction Noise and Vibration Management Plan.

For works outside of normal hours, appropriate measures will be implemented to ensure that the relevant construction noise, vibration and traffic management standards are met where practicable. These measures are set out in the certified Construction Noise and Vibration Management Plan (CNVMP) approved for the wider CI works (see Section 5.2) The CNVMP will recommend noise mitigation measures and will manage construction noise in order to meet the requirements of New Zealand Standard *NZS 6803: 1999 – Construction Noise.*

3.9 Construction traffic

The Construction Traffic Effects Assessment (**Appendix E**) provides an estimate of the anticipated construction traffic volumes. For the trenched section of the CC9 alignment between Eden Roskill Cricket Club and Richardson Road, a site entrance will be established from Noton Road and from the Richardson Road entrance to Hillsborough Kindergarten. For the trenchless section between the CI shaft site and the Eden Roskill Cricket Club carpark, access to the site is proposed to be primarily from Noton Road. However if access is required via Arundel Street, this will be undertaken in accordance with the approved Construction Traffic Management Plan (CTMP) for Keith Hay Park[6].

The proposed works within the vicinity of the schools will be scheduled outside of school (and kindergarten) terms where practicable. In the event that works need to be undertaken during school and kindergarten terms, temporary traffic management measures will be used (see **Appendix E**) in liaison with affected stakeholders.

During peak construction season, the following traffic volumes are anticipated:

- 14 standard vehicle movements per day (4 vehicle movements during peak hour).
- 25 heavy vehicle movements per day (average of 2 - 3 heavy vehicles movements per hour over the course of an 11-hour day).

In total, it is estimated that the proposed works will generate no more than 40 vehicle movements per day during the construction period, with up to 4 vehicle movements during peak hour. This estimate is based on the maximum number of trucks per day and therefore represents a conservative or 'worst-case' scenario (i.e. on any particular day the number of truck movements may be less than this, and on some days significantly less). These truck movements are also spread out across the project access points (i.e. predominantly Noton Road and Richardson Road, and potentially Arundel Street) at different stages of the construction period.

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[6] Batch 2, approved December 2019.

4 Resource consent requirements

4.1 AUP zoning and notations

The requirements for resource consents are determined by the rules in the AUP and NES Soil. The rules which apply are determined by the zoning of the site, any identified notions in the AUP and the nature of the activities proposed. The relevant zones and planning limitations are identified in Table 4.1 and resource consent requirements are identified in Table 4.2 and Table 4.4 below.

Table 4.1: Zoning and planning notations

Zoning / planning	Comment
Designation 9466 - Construction, operation and maintenance of wastewater infrastructure, Watercare	This designation applies to the Keith Hay CI shaft construction site to the north of the CC9 pipeline route. Although the proposed works are consistent with the purpose of this designation, most of the works are located outside of the designation boundaries and therefore cannot be relied on for the works.
Designation 4792 – Educational purposes – primary school (years 0-8), Minister of Education	These designations apply to Waikowhai Intermediate School, Hillsborough Kindergarten and Hay Park School located to the south of the site. The proposed works are located partially within these respective designation boundaries and therefore approval from the Minister of Education is required in accordance with section 176(1)(b) of the RMA.
Designation 4732 – Educational purposes –primary school (years 0-8), Minister of Education	
Residential – Mixed Housing Suburban Zone	Underlying zoning of Waikowhai Intermediate School and Hay Park School and adjacent residential areas.
Open Space – Sport and Active Recreation Zone	Applies to Keith Hay Park.
Road reserve	The proposed CC9 sewer intersects the road reserve at Richardson Road.
National Grid Corridor Overlay	This overlay seeks to protect high-voltage transmission lines and support structures. It applies towards the southern end of the alignment (across Noton Road) where high-voltage transmission lines are located.
1 percent annual exceedance probability (AEP) floodplain	Applies across the greater extent of the Keith Hay Park part of the site.
Overland flow paths	The proposed CC9 route will intersect and cross overland flow paths in Keith Hay Park.
Sediment Control Protection Area	Applies to land within 50 m landward of the edge of a watercourse (i.e. Oakley Creek).
Macroinvertebrate Community Index Control - Urban	This control indicates the presence of both exotic and urban macroinvertebrate on the site. There are no corresponding consenting requirements under this control.
Macroinvertebrate Community Index Control – Exotic	

4.2 Auckland Unitary Plan

4.2.1 AUP resource consent requirements

Resource consent requirements under the AUP are identified below. For the avoidance of doubt, Watercare is seeking resource consents under the rules described in Table 4.2 below and any other rules which may apply to the activity, even if not specifically noted.

Table 4.2: AUP resource consents requirements

Proposed activity	Rule reference / description	Activity status	Comment
Earthworks associated with tunnelling and trenching including works and laydown areas	**E26.5.3.1 (A97 / 97A)** [dp] – Earthworks greater than 2,500 m^2 / 2,500 m^3	Restricted discretionary	The proposed works exceed the permitted area and volume of earthworks (i.e. 2, 500 m^2 and 2,500 m^3), including within the Sediment Protection Area.
	E26.5.3.2 (A107) [rp] – Earthworks greater than 2,500 m^2 within the Sediment Control Protection Area.	Restricted discretionary	
Infrastructure (sewer network) in a floodplain and overland flow path	**E36.4.1 (A56)** – Infrastructure in areas not otherwise provided for.	Restricted discretionary	The proposed works are located within a floodplain and overland flow paths.
Take and use of groundwater	**E7.4.1 (A20)** – Dewatering and groundwater level control.	Restricted discretionary	The proposed construction works and associated dewatering will exceed the permitted activity duration limit of 30 days and 10 days in peat soil under standard E7.6.1.6(2).
Groundwater diversion associated with trenched construction methodology	**E7.4.1 (A28)** – Groundwater diversion.	Restricted discretionary	The trenched section will be at a maximum depth of 5m. It does not exceed 1 ha in total area and 6m depth below natural ground level. However sheet piling may be in place for more than 30 days in which case the permitted activity limit set out in E7.6.1.10 may be exceeded.
Construction noise	**E25.4.1 (A2)** –Activities that do not comply with a permitted activity standard.	Restricted discretionary	Most general construction activities and equipment are predicted to comply (or only negligibly exceed) the daytime noise limits at residential properties. Sheet piling and wood chipping is likely to exceed daytime noise limits by 11-14 dB at a distance of 20 m.
Vegetation alteration / removal for infrastructure in the open space zone	**E26.4.3.1 (A84)** – Tree trimming or alteration that does not comply with Standard E26.4.5.1 (Trees	Restricted discretionary	The proposed works will likely involve the removal of branches greater than 100 mm and will therefore not comply with permitted activity standard E26.4.5.1.

Proposed activity	Rule reference / description	Activity status	Comment
	in streets and open space zones)		
	E26.4.3.1 (A88) – Works within the protected root zone not otherwise provided for.	Restricted discretionary	The proposed works will involve trenching in proximity to the protected root zone of trees and therefore will not comply with permitted activity standard E26.4.5.2.
	E26.4.3.1 (A92) – Tree alteration or removal of any tree greater than 4m in height and/or greater than 400mm in girth.	Restricted discretionary	The proposed works involve removing trees greater than 4m in height within Keith Hay Park.
Disturbance of potentially contaminated soil	**E30.4.1 (A7)** – Discharge of contaminants into air, or into water, or onto or into land.	Discretionary	A detailed site investigation does not exist for the site and therefore the proposed works do not comply with standard E30.6.2.1.

4.2.2 Assessment criteria – restricted discretionary activities

Under Rules E26.5.3.1 (A97), (A97A) and (A107) in relation to earthworks; E36.4.1(A56) in relation to infrastructure within a floodplain and overland flow path; E7.4.1 (A20 / A28) in relation to groundwater diversion and dewatering, and E26.4.3.1(A92) in relation to vegetation alteration/removal, the Council has restricted its discretion. These matters are identified in Table 4.3 below. The assessment in Section 5 of this AEE addresses these matters.

Table 4.3: RDA matters of discretion

Rule reference	Matters of discretion
E26.5.3 (A96), **(A97/A97A)** and **(A107)** – Earthworks associated with tunnelling and trenching	(1) all regional restricted discretionary activities [rp]: a compliance with the standards; b the design and suitability of erosion and sediment control measures to be implemented; c adverse effects of land disturbance and sediment discharge on water bodies, particularly sensitive receiving environments; d effects on cultural and spiritual values of Mana Whenua including water quality, preservation of wāhi tapu, and kaimoana gathering; e the proportion of the catchment which is exposed; f staging of works and progressive stabilisation; g timing and duration of works; h term of consent; i potential effects on significant ecological and indigenous biodiversity values; j the treatment of stockpiled materials on the site including requirements to remove material if it is not to be reused on the site; and k information and monitoring requirements. (2) All district restricted discretionary activities [dp]: a compliance with the standards; b effects of noise, vibration, odour, dust, lighting and traffic on the surrounding environment;

	c effects on the stability and safety of surrounding land, buildings and structures; d effects on overland flow paths and flooding; e protocol for the accidental discovery of kōiwi, archaeology and artefacts of Māori origin; f the treatment of stockpiled materials on the site including requirements to remove material if it is not to be reused on the site; g staging of works and progressive stabilisation; h information and monitoring requirements; i timing and duration of works; j term of consent; k potential effects on significant ecological and indigenous biodiversity values; l risk that may occur as a result of natural hazards; m protection of or provision of network utilities and road networks. n potential effects on the natural character and values of the coastal environment, lakes, rivers and their margins, where works encroach into riparian or coastal yards; and o positive effects enabled through the land disturbance.
E36.4.1(A56) - Infrastructure within a floodplain and overland flow path	(18) Operation, maintenance, renewal, repair and minor infrastructure upgrading, of infrastructure in areas listed in the heading above that do not comply with Standard E36.6.1.13: a the functional and/or operational need to locate within the hazard area; b the risk of adverse effects to other people, property and the environment including all of the following: (i) risk to public health and safety; (ii) impacts on landscape values and public access associated with the proposed activity including a need for hard protection structures to be required to protect the utility from the natural hazard; (iii) the management or regulation of other people and property required to mitigate natural hazard risks resulting from the location of the infrastructure; (iv) the storage or use of hazardous substances in relation to the activity; (v) any exacerbation of an existing natural hazard or creation of a new natural hazard as a result of the structure; and (vi) the use of non-structural solutions instead of hard engineering solutions; and (vii) the ability to relocate or remove structures.
E7.4.1 (A20/A28) – Groundwater dewatering and diversion	(6) Diversion of groundwater: a how the proposal will avoid, remedy or mitigate adverse effects: (i) on the base flow of rivers and springs; (ii) on levels and flows in wetlands; (iii) on lake levels; (iv) on existing lawful groundwater takes and diversions; (v) on groundwater pressures, levels or flow paths and saline intrusion; (vi) from ground settlement on existing buildings, structures and services including roads, pavements, power, gas, electricity, water mains, sewers and fibre optic cables; (vii) arising from surface flooding including any increase in frequency or magnitude of flood events; (viii) from cumulative effects that may arise from the scale, location and/or number of groundwater diversions in the same general area; and

	(ix) from the discharge of groundwater containing sediment or other contaminants; (x) on any scheduled historic heritage place; and (xi) on terrestrial and freshwater ecosystems and habitats. b the need for mineral extraction within a Special Purpose - Quarry Zone to carry out dewatering or groundwater level control and diversion and taking of groundwater in the context of mineral extraction activity. c monitoring and reporting requirements incorporating, but not limited to: (i) the measurement and recording of water levels and pressures; (ii) the measurement and recording of the settlement of the ground, buildings, structures and services; (iii) the measurement and recording of the movement of any retaining walls constructed as part of the excavation or trench; and (iv) requiring the repair, as soon as practicable and at the cost of the consent holder, of any distress to buildings, structures or services caused by the groundwater diversion. d the duration of the consent and the timing and nature of reviews of consent conditions; e the requirement for and conditions of a financial contribution and/or bond; and f the requirement for a monitoring and contingency plan or contingency and remedial action plan.
E25.4.1 (A2) – Construction noise that does not comply with all the permitted activity standards	(1) For noise and vibration: a The effects on adjacent land uses, particularly activities sensitive to noise; and b Measures to avoid, remedy or mitigate the adverse effects of noise.
E26.4.3.1(A84/A88/A92) – Vegetation / alteration in the open space zone and works within the protected root zone	(1) Trees in roads and open space zones: a For tree trimming or alteration not meeting Standard E26.4.5.1: (i) the methods proposed to reduce any adverse effects; and (ii) the extent of the alteration of the trees or trees. b For works within the protected root zone not otherwise provided for: (i) the methods proposed to reduce any adverse effects of the works, including the depth of the works; and (ii) the extent of the area of the protected root zone or zones that is affected. c tree alteration or removal of greater than 4 m in height and trees 400 mm in girth: (i) the effect on the values of the tree or trees; and (ii) any loss or reduction of amenity values provided by the tree or trees; (iii) any mitigation proposed; and (iv) the functional and operational requirements and benefits derived from infrastructure.

4.3 NES Soil

Table 4.4: NES Soil resource consent requirements

Proposed activity	Rule reference / description	Activity status	Comment
Disturbance of potentially contaminated soil	Regulation 11 – Discretionary activities This regulation applies to an activity described in any regulation 5(2) to (6) on a piece of land described in regulation 5(7) or (8) that is not a permitted activity, controlled activity, or restricted discretionary activity.	Discretionary	The proposed works exceed the maximum permitted volumes for soil disturbance and removal offsite described in regulation 8(3). A detailed site investigation for the piece of land does not exist, as required under regulation 10(2)(a) and therefore consent is required under regulation 11.

4.4 Permitted activities

An assessment of the permitted activities relevant to the proposed works is provided in Table 4.5 below.

Table 4.5: Permitted activities relevant to the proposed activity

Proposed activity	Rule	Comment on compliance
Construction and operation of wastewater infrastructure in residential and open space zones and the road reserve	**E26.2.3.1 (A49)** - Underground pipelines and ancillary structures for the conveyance of wastewater **E26.2.5.3 (Permitted activity standard 24)** – Any aboveground section of underground pipeline for the conveyance of gas, water, wastewater and stormwater must not exceed: a 25m continuous length of pipe that is aboveground in any one section; and b 300mm in diameter.	The proposed CC9 sewer connection is entirely underground – therefore these standards do not apply.
Earthworks within the National Grid Yard	**D26.6.1.1** – Land disturbance within the National Grid Yard (2) Standards D26.6.1(1)(a)-(d) do not apply to: c Land disturbance for a network utility (excluding buildings and structures for irrigation).	The proposed works are for a network utility (sewer pipeline) and are therefore exempt from these standards.
Groundwater diversion	**E7.6.1.10** – Diversion of groundwater caused by any excavation, (including trench) or tunnel	The proposed CC9 pipe will not exceed 1.2m in external diameter. Therefore the

Proposed activity	Rule	Comment on compliance
	(1) All of the following activities are exempt from the Standards E7.6.10(2) – (6): a. Pipes cables or tunnels including associated structures which are drilled or thrust and are up to 1.2m in external diameter; b. Pipes including associated structures up to 1.5m in external diameter where a closed face or earth pressure balanced machine is used.	trenchless section is exempt from Standards E7.6.10(2) – (6).

4.5 Existing resource consents

Watercare holds a suite of regional and district resource consents[7] which authorise the wider works at the Keith Hay CI shaft site. In addition, the Keith Hay CI shaft site is designated by Watercare (ref. 9466) for the purposes of 'Construction, operation and maintenance of wastewater infrastructure'.

4.6 Other consents and approvals required

4.6.1 Corridor Access Request

A Corridor Access Request (CAR) is required to be submitted to Auckland Transport prior to any works in the road reserve commencing.

4.7 Reserves Act 1977

The project involves work within a reserve (Keith Hay Park). Keith Hay Park is classified under the Reserve Act as a recreation reserve and landowner approval is being sought from Auckland Council – Parks.

4.8 Section 176 Approval

The proposed works are located partially within the Minister of Education designations (ref. 4732 and 4792). As such, approval from the Minister of Education has been sought in accordance with Section 176(1)(b) of the RMA.

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[7] R/LUC/2012/2846, R/LUC/2012/2846/1, PRC40962, PRC40963, 40834, 40835, 40836, 40837, 40838, 40839, 40840, 40841, 40842, 40843, 40844, 40845, 40846, 40848, 40849 and 40850

5 Assessment of effects on the environment

5.1 Introduction

The following assessment identifies and assesses the types of effects that may arise from the proposed works. This assessment also outlines the measures that the applicant proposes to avoid, remedy or mitigate any potential adverse effects on the environment.

Actual and potential effects on the environment have been identified as including:

- Positive effects;
- Temporary construction effects;
  - Erosion and sedimentation effects;
  - Transport, disposal and tracking of material off-site effects;
  - Construction traffic effects;
  - Construction noise effects; and
  - Public access and safety.
- Human health effects;
- Flooding effects;
- Groundwater and settlement effects;
- Cultural heritage effects;
- Arboricultural effects; and
- Public amenity and access effects.

5.2 Existing management plans

The proposed CC9 sewer forms part of the wider CI scheme, which has been developed to provide network capacity for growth and to mitigate wastewater network overflows in the Auckland region. While the CC9 works subject to this application are outside of Watercare's CI designation for its Keith Hay Park shaft construction site, the works are a connection to the local network required as part of the broader CI works.

CI is being undertaken in accordance with a suite of approved management plans and mitigation measures. The CC9 works will be implemented in accordance with the applicable management plans for CI. This includes (but is not limited to) the following management plans:

- Construction Management Plan (CMP) (Doc No. GAVJV-PLN-0017, Version 2.3 Final, approved 6 May 2020);
- Construction Noise Management Plan (CNMP) (Doc No. GAJV-PLN-0043, Version 0.4 Final, approved 18 December 2019);
- Construction Noise and Vibration Management Plan (Keith Hay Park shaft site, 49 Arundel Street and 20 and 22 Gregory Place, Mount Roskill) (CNVMP) (Doc No. GAJV-PLN-0043, Version 0.4 Final, approved 18 December 2019);
- Activity Specific Construction Noise Management Plan – Keith Hay Park Sheet Piling (ASCNMP) (Doc No. GAJV-PLN-0079, Version 0.3 Final, approved 18 March 2020);
- Construction Traffic Management Plan (CTMP)(Doc No. GAJV-PLN-00129, Version 0.4 Final, approved 11 December 2019);
- Site Management Plan (SMP)(Doc No. GAJV-PLN-00026, Version 2.0 Final, approved 30 April 2020); and

- Site-Specific Erosion and Sedimental Control Plan (Site 3 – Keith Hay Park) (SSESCP) (Doc No. GAJV-00063, Version 1.1, approved 25 May 2020).

These plans include a range of mitigation measures to address potential adverse effects as described below. The CC9 works will rely on and be undertaken in accordance with the relevant management plans, with specific CC9-related mitigation methodologies set out in an update to the CI management plans (through an addendum or similar to those plans). This allows for an integrated and consistent approach to be taken, while also noting that the CI management plans have been subject to review and approval by Auckland Council and are demonstrated to have worked across the course of the wider CI works.

5.3 Positive effects

The CC9 pipeline forms part of the larger CI scheme. The CI scheme has been developed to provide network capacity for growth and mitigate any potential for wastewater network overflows in the Auckland region. Specifically in relation to CC9 it provides for residential intensification that is envisaged within the immediate and surrounding area by agencies such as Kāinga Ora.

The proposed CC9 works will have important positive effects in relation to supporting development in the Auckland region, while reducing the risk of overflows from the wastewater network into the Oakley Creek catchment. This will result in positive environmental effects, including:

- Improved water quality, specifically in relation to Oakley Creek, by reducing nutrient and organic loads entering freshwater ecosystems;
- Enhanced amenity and recreational values, by reducing wastewater discharges which can create odour and visual nuisances; and
- An improvement in freshwater quality which recognises and restores the mauri of waterways and the importance of land and water resources to tangata whenua.

The proposed CC9 connection will provide an improved local wastewater system that will enable the communities of Auckland to provide for their health and wellbeing, and more broadly support continued intensification and economic development across the region.

5.4 Temporary construction effects

5.4.1 Erosion and sedimentation effects

As discussed in Section 3, best practice erosion and sediment control in accordance with GD05 guidelines will be implemented (see the ESCP report in **Appendix D**). The works will also be undertaken in accordance with the approved SSESCP for CI, which will be updated to include CC9-specific measures where relevant. All erosion and sediment controls measures will be regularly monitored and maintained, and upgraded/modified where necessary. Weather conditions along with the performance of the erosion and sediment control measures will be monitored and appropriate actions taken in a timely manner.

Given the application of standard control measures and noting the flat topography and that the proposed works will be primarily (or entirely) trenchless, with little potential for sediment generation, any adverse erosion and sediment effects are considered to be less than minor.

5.4.2 Transport and tracking of material off-site effects

The use of earthworks machinery and exposing bare ground has the potential for the generation of dust and for the tracking of soil off-site onto the surrounding road network. The implementation of procedures and controls set out in SSESCP for CI will manage these effects. These include:

- Erosion and sediment control procedures, including:
    - Vehicle wheel wash areas;
    - Stablished vehicle access;
    - Progressively stabilising the site and maintaining sediment controls;
- Dust control procedures; and
- Accidental contamination discovery protocols in the event that any unexpected contamination is noted during site excavation works.

As discussed above, the proposed works are anticipated to be completed largely be micro-tunnelling and therefore the potential for dust generation is limited. Given this and the control measures set out in the CI SMP and the CMP, potential effects from transport and tracking of material off-site are considered to be less than minor.

5.4.3 Construction traffic effects

As set out in the Construction Traffic Effects Assessment (**Appendix E**), the proposed works will result in a marginal increase in traffic only. During peak construction season it is anticipated that there will be 14 standard vehicle movements per day (4 vehicle movements during peak hour), as well as 25 heavy vehicle movements per day (average of 2-3 heavy vehicle movements per hour over the course of an 11 hour day). Furthermore, this number represents a conservative assessment in that the additional vehicle demand that the site will generate will vary throughout the construction programme i.e. on any particular day the number of truck movements may be less than this, and on some days, significantly less. These truck movements are also spread out across the project access points (i.e. Arundel Street, Noton Road and Richardson Road) at different stages of the construction period.

Construction traffic effects will be managed in accordance with the mitigation measures set out in the approved CI CTMP. These measures include:

- Ensuring all construction areas are contained and cordoned off;
- Ensuring appropriate access is provided to each work site along the proposed alignment and required turning circles are provided for; and
- Implementing appropriate temporary traffic management measures to advise other road users of construction traffic.

In addition to this, an update to the approved CI CTMP will be prepared by the contractor prior to works commencing. This will contain additional measures to manage and mitigate the construction traffic related effects of CC9. In particular, the proposed works within the vicinity of the schools will be scheduled outside of school (and kindergarten) terms where practicable. In the event that works are required to be undertaken during school and kindergarten terms, additional temporary traffic management measures will be established in the vicinity of the school and kindergarten during peak drop-off and pick-up times. These measures will be detailed in the update to the CI CTMP and any associated site specific management strategies to be developed by the contractor for Council approval prior to the works commencing.

In terms of cumulative effects, the approved CTMP for the CI works at Keith Hay Park estimates low heavy vehicle movements per day as follows:

- Arundel Street: 8 – 12 per day.
- Rainford Street: 5 – 10 per day.
- Frost Road: 4-8 per day.

Considering the low overall volumes of heavy vehicles and other construction traffic, and that construction traffic is spread across different access points with access for CC9 is typically located further to the south from Noton Road and Richardson Road, the cumulative effects of the CC9 works are considered to be less than minor.

Overall, the proposed works will result in low construction traffic volumes which are considered to be within the typical hourly fluctuations of the nearby roads. Effects on surrounding road network are therefore expected to be minimal. With the control measures set out above, in addition to the measures in the updated CTMP, construction traffic effects are overall considered to be no more than minor.

5.4.4 Construction noise and vibration effects

A Construction Noise and Vibration Assessment has been prepared (**Appendix F**). This assessment finds that most general construction activities and equipment are predicted to comply (or only negligibly exceed) the daytime noise limits at residential properties. The exception is sheet piling (should this be required) which would exceed daytime noise limits at receivers up to 50 m away, and wood chipping (if unscreened) which would likely exceed daytime noise levels by 11-14 dB at a distance of 20 m.

The nearest residential receivers and noise sensitive receivers (i.e. the school and kindergarten) are located approximately 15 m plus from noise generating activities. Any particularly noisy works will need to be closely managed in consultation with these facilities to ensure effects are minimised – a key component of this will be the timing of these works and in relation to wood chipping, the location/orientation and potential screening options. Watercare is working closely with the schools, kindergarten and Ministry of Education through the landowner approval process and management and mitigation measures in relation to noise effects on these facilities will be discussed and confirmed through this process.

In terms of vibration effects, the proposed works are expected to give rise to only low levels of vibration (primarily from sheet piling). This is expected to be compliant with a limit of 2 mm/s at a distance of 20 m or less.

To manage potential effects, the measures set out in the approved CNVMP for the CI Keith Hay shaft site will be relied upon for these works. These controls include the following (see **Appendix F**):

- Communication and consultation with stakeholders;
- Generally limiting the timing of noisy construction works to between 0730 and 1800 hrs;
- Establishment of noise screening where possible (such as around wood chipping machinery) and orienting machining away from noise sensitive receivers where practicable; and
- Avoidance of unnecessary noise such as horns, reversing alarms, people noise and music.

Given the controls contained in the approved CI CNVMP and ASCNMP for Keith Hay Park along with the CI CMP, noise and vibration effects will be sufficiently managed and will be temporary in nature. Overall, the noise and vibration effects are considered to be no more than minor.

5.4.5 Public access effects

The proposed works will involve the use of earthwork machinery and the establishment of construction lay-down areas around each manhole within Keith Hay Park. Existing public access to Keith Hay Park itself will not be affected by the proposed works. However to ensure public safety, temporary restrictions on public access will be required around the immediate construction area including works and laydown areas. These restrictions will be in place for the construction period, although are likely to move along the alignment as construction progresses, and therefore will be for a limited duration in any one location.

The existing concrete walkway within Keith Hay Park from the Eden Roskill Cricket Club carpark to the Cameron Leisure Pool carpark will need to be closed for the works' duration, however a suitably surfaced temporary shared path will be provided during the construction phase. This is subject to discussion and confirmation through the landowner approval process currently underway with Auckland Council – Parks.

Overall, effects on public access are considered to be temporary, can be appropriately managed with standard public safety measures and provision for alternative access, and are no more than minor.

5.5 Human health effects

Exposure to contaminated soil has the potential to increase risk to human health for workers undertaking the proposed works.

Overall, the extent and magnitude of site contamination is assessed as being low, with the only HAIL activity identified to have taken place being the use of pesticides in Keith Hay Park and potential presence of fill. As the proposed works are located more than 5 m from nearby buildings, the likelihood of disturbing soil impacted by asbestos and lead paint is low.

Notwithstanding this, the CI SMP contains procedures for the handling and disposal of material excavated from the site. These procedures include implementing good hygiene practices and following accidental discovery protocols if any unexpected contamination is discovered.

Taking into account the low levels of contamination assessed on site and the control measures contained in the CI SMP, effects on human health are considered to be less than minor.

5.6 Flooding effects

The CC9 pipeline has a functional and operational need to be located within a floodplain and overland flow path in order to connect to existing wastewater infrastructure.

The CC9 pipeline will be entirely underground and therefore there will be no exacerbation of an existing natural hazard. There is no change to the existing public health and safety risk from flooding as a consequence of the proposed works. Overall, effects on flooding are considered to be less than minor.

5.7 Groundwater and settlement effects

T+T has undertaken an assessment of potential groundwater and settlement effects that can be reasonably expected from the construction of the CC9 pipeline (see **Appendix G**). The assessment considers potential effects, including potential effects in a conservative or 'worst case' scenario in the event the face pressure of the slurry machine is lost, or groundwater drawdown occurs.

No groundwater drawdown is expected to occur from the trenchless component of the works. However a conservative assessment based on a 20-day machine breakdown with groundwater inflow at the machine face indicates a minimal drawdown of 2.38 m is estimated to occur at the tunnel face. If complete drawdown is to develop during a worst case scenario (i.e. prolonged machine breakdown), there is likely to be 7.1 m of drawdown at the tunnel face. In both cases groundwater drawdown will extend approximately 10 m from the tunnel face.

For the trenched section, groundwater will flow freely and dewatering will be required for the installation of the pipe. On the basis that there is a limited construction time for any one section of the trench to be open (10 days), approximately 2.1 m of drawdown is estimated to occur with a radius of influence of 4.5 m from the trench edge. If complete drawdown was to occur (after approximately 32 days), 3.1 m of drawdown is estimated to occur with a radius of influence of 4.5 m from the trench edge.

In the scenario where groundwater inflow occurs and complete drawdown is induced, there is potential for structures and utilities nearby to the pipeline alignment to be affected. The tolerable settlement for infrastructure is considered to be approximately 25 mm (this can vary depending on the structure). For the trenched construction methodology, at least 25 mm of settlement is expected to occur within 2.0 m of the trench edge after 10 days of groundwater drawdown, and within 2.3 m of the trench edge for complete drawdown (i.e. >30 days). When considering the trenchless methodology, at least 25 mm of settlement is expected to occur within 5.8 m from the tunnel machine after 20 days of groundwater drawdown, and within 7.6 m from the tunnel machine face in the worst case scenario (i.e. very unlikely scenario of a prolonged machine breakdown >100 days). Given there are no buildings or structures located within the 25 mm zone of settlement, there are no expected effects on buildings near the alignment. However, underground services may be impacted.

To mitigate potential risk of groundwater drawdown and effects on utilities, the following measures will be implemented:

- Trenched sections will be open and closed as soon as practical to avoid extended drawdown of groundwater and reduce the magnitude of settlement;
- Dewatering of excavations will only be undertaken at the base of the excavation;
- Trench supports (such as face shields or similar) should be considered to prevent mechanical settlement of the ground;
- All utilities exposed during the trenched sections will be supported;
- For the trenchless alignment, a risk-based analysis will be undertaken for all utilities within the identified radius of influence. Any high-risk utilities (such as critical services) may be realigned to avoid the proposed trenchless section; and
- Contingency plans will be provided to protect and repair (if required) any utilities that are of lesser-risk and remain in place.

With these control measures in place, adverse groundwater and settlement effects are considered to be no more than minor.

5.8 Cultural heritage effects

No archaeological deposits or features were identified within the proposed CC9 route and it is considered unlikely that intact subsurface archaeological remains survive in the project area given the level of overall development and the presence of existing services along the proposed CC9 alignment (refer to **Appendix H**). Given this, there are no effects on known archaeological or other historic heritage sites from the proposed works.

In the unlikely event that unrecorded subsurface remains are exposed during the proposed works, the accidental discovery protocols set out under both the AUP and the CI CMP will be implemented. Overall, adverse effects on cultural heritage effects are considered no more than minor.

In terms of effects on cultural values, engagement with mana whenua is ongoing (see Section 7). To date, no feedback from iwi on this project specifically has been received. However, Watercare recognises the importance of land and water resources to tangata whenua. The CC9 works comprise a connection to the local network which is required as part of the broader CI works. The CI works will result in a significant reduction in the frequency and volume of network overflows and will reduce the quantity of wastewater contaminants entering freshwater. As a result, it is expected that this project will assist with the restoration of the mauri of waterways and coastal receiving environments. At a local level the proposed CC9 works will have important positive effects in relation to supporting development in the area while reducing the risk of overflows from the wastewater network into the Oakley Creek catchment.

5.9 Arboricultural effects

The proposed CC9 alignment has been developed with the focus on minimising the need for any tree alteration or removal. Works within the dripline of trees will be avoided as much as possible and in the event tree alteration/removal is required, works will be undertaken in accordance with best practice arboricultural practice (see **Appendix I**).

The assessment has been undertaken on a worst-case basis, in which tree retention is not possible. In this scenario up to 22 protected trees could potentially be required to be removed (and replaced). Of these trees, the following is noted:

- Five trees will require removal;
- A further seventeen trees may be potentially retained, however consent is sought on a worst-case basis i.e. that retention is not possible; and
- Two of the trees identified for removal are considered to be in poor condition.

This constitutes the maximum number of trees for removal, noting that if trenchless methods are utilised to install the pipeline, the requirement for tree removal is significantly reduced.

For every tree that requires removal, a replacement will be replanted as close as possible to the original tree as well as an additional 10 m^2 of native planting that will be planted elsewhere subject to obtaining landowner approval (see **Appendix I**).

Overall, given the maximum extent of tree removal and the replacement planting proposed, adverse effects on arboricultural values are considered to be no more than minor.

5.10 Conclusion

The proposed CC9 sewer will provide numerous positive effects in relation to providing network capacity for development, whilst reducing the risk of wastewater overflows into the Oakley Creek catchment. The proposed works will support future development and intensification to occur within Auckland, whilst protecting freshwater quality. Overall, the provision of resilient wastewater infrastructure will ensure the health and wellbeing of communities across Auckland are provided for.

The proposed works will be temporary in nature and have the potential to give rise to no more than minor adverse effects on the receiving environment. The control measures set out in the respective management plans and technical assessments included within this application will enable the proposed works to be undertaken in a manner that appropriately manages and mitigates adverse effects such that the short-term construction-related effects are no more than minor, and the long-term effects of the local sewer connection are positive.

6 Statutory assessment

6.1 Section 104 of the RMA

Section 104 of the RMA sets out the matters to which a consent authority must have regard to, subject to Part 2 of the RMA, when considering an application for resource consent. These are:

- Any actual and potential effects on the environment of allowing the activity (refer Section 5 above);
- Any measure proposed or agreed to by the applicant for the purpose of ensuring positive effects on the environment to offset or compensate for any adverse effects on the environment that will or may result from allowing the activity;
- Any relevant provisions of:
  - a national environmental standard;
  - a national policy statement;
  - a regional policy statement or proposed regional policy statement;
  - a plan or proposed plan; and
- Any other matter the consent authority considers relevant and reasonably necessary to determine the application.

6.2 Part 2 of the RMA

Part 2 of the RMA sets out the purpose and principles of the Act. The purpose of the RMA is to promote the sustainable management of natural and physical resources. Traditionally, an analysis of the consistency of an application with Part 2 of the RMA has been fundamental to the overall assessment of applications for resource consents. Section 104(1) of the RMA requires that consideration of applications for resource consents be ‘subject to Part 2’. Until recently this has been considered to require an ‘overall broad judgement’ approach in the form of a fulsome Part 2 analysis. However, this traditional approach has been called into question through decisions on R J Davidson Family Trust v Marlborough District Council (Davidson)[8].

The AUP has been prepared recently and is considered to contain provisions prepared having regard to Part 2 and a coherent set of policies to achieve clear environmental outcomes. Based on the direction established by the Court of Appeal, an assessment against Part 2 matters is considered to add little if anything to the overall evaluation. Rather, the focus of this assessment is on the relevant AUP provisions.

6.3 National Environmental Standards

6.3.1 Resource Management (National Environmental Standards for Freshwater) Regulations 2020

The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 regulates activities that pose risks to the health of freshwater and freshwater ecosystems. The standards apply to activities in relation to farming activities, natural wetlands, instream structures and the reclamation of rivers. There are no applicable standards relevant to this application.

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[8] R J Davidson Family Trust v Marlborough District Council [2018] NZCA 316.

6.3.2 National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health

The NES Soil provides national planning controls that direct the requirement for consent or otherwise for activities on contaminated or potentially contaminated land. The proposal is a discretionary activity under the NES Soil, as described in Section 4.

6.4 National Policy Statements

6.4.1 National Policy Statement for Freshwater Management 2020

The National Policy Statement for Freshwater Management 2020 (NPS-FM) provides guidance on how freshwater is to be managed in a manner that gives effect to Te Mana o te Wai. Table 6.1 below provides an assessment against the relevant provisions of the NPS-FM. Overall, the proposed works are considered consistent with the objective of the NPS-FM, in terms of providing firstly for the health of freshwater ecosystems as well as the social, economic and cultural well-being of communities.

Table 6.1: NPS-FM assessment

Reference	**Comment**
Objective (1) – The objective of this National Policy Statement is to ensure that natural and physical resources are managed in a way that priorities: a First, the health and well-being of water bodies and freshwater ecosystems; b Second, the health needs of people (such as drinking water); and c Third, the ability of people and communities to provide for their social, economic and cultural well-being, now and in the future.	• The proposed works will be managed in a way that prioritises the health and well-being of water bodies (including groundwater) and freshwater ecosystems. • The proposed works will provide an improvement to the wastewater network by reducing the potential for wastewater contamination in freshwater ecosystems as a result of future intensification and development. • The proposed works form part of the CI project, which a piece of regionally important wastewater infrastructure which enables people and communities to provide for their social, economic and cultural well-being, now and in the future.
Policy 1 – Freshwater is managed in a way that gives effect to Te Mana o te Wai.	The proposed works will be undertaken in a manner that protects the health of freshwater and contributes to improved freshwater outcomes by reducing the risk of wastewater contamination as a result of development, thereby making a positive contribution to giving effect to Te Mana o te Wai.
Policy 2 - Tangata whenua are actively involved in freshwater management (including decision making processes), and Māori freshwater values are identified and provided for.	The site itself is not located in an area of significant cultural value or within a statutory acknowledgement area.
Policy 3 - Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.	By addressing effects on water quality as a component of land use, the potential effects of the proposed activity are being considered in an integrated way. Policy 3 refers to the use and development of land on a whole-of-catchment basis. This application concerns the development of a wastewater sewer

Reference	Comment
	pipeline which will provide network capacity to enable future development to occur while minimising the risk of wastewater overflows to freshwater ecosystems.
Policy 5 - Freshwater is managed through a National Objectives Framework to ensure that the health and well-being of degraded water bodies and freshwater ecosystems is improved, and the health and well-being of all other water bodies and freshwater ecosystems is maintained and (if communities choose) improved.	While unable to be quantified through reference to the NOF attributes, the proposed works will improve the health and wellbeing of waterbodies and freshwater ecosystems by reducing the risk of wastewater overflows to surface water as a result of future development. Therefore the works will improve the resilience of the wastewater infrastructure and help maintain and improve the health and well-being of water bodies and freshwater ecosystem. The works will not affect groundwater and will maintain the quality of this waterbody.
Policy 12 - The national target (as set out in Appendix 3) for water quality improvement is achieved.	The proposed works will contribute to an improvement in water quality by reducing the risk of wastewater overflows to freshwater ecosystems as future development occurs. The proposed works will help contribute to the achievement of national targets for water quality by improving the resilience of wastewater infrastructure.
Policy 15 – Communities are enabled to provide for their social, economic, and cultural well-being in a way that is consistent with this National Policy Statement.	The proposed works are associated with the construction of a local wastewater sewer pipeline which will reduce the risk of wastewater overflows to freshwater ecosystems as a result of future development. These works form a connecting part of the wider Central Interceptor project, which is a regionally important wastewater infrastructure upgrade that enables communities to provide for their social, economic and cultural wellbeing.

6.4.2 Auckland Unitary Plan Assessment

An assessment against the relevant objectives and policies of the AUP is set out in Table 6.2 below.

Table 6.2: Auckland Unitary Plan objectives and policies

Reference	Comment
Chapter B3 – Infrastructure, transport and energy	
B3.2.1 Objective (1) – Infrastructure is resilient, efficient and effective	The proposed works provide for an extension of the wastewater network, which enables this infrastructure network to be more resilient, efficient and effective in addressing wastewater overflows as future development occurs.
B3.2.1 Objective (2)- The benefits of infrastructure are recognised, including: a Providing essential services for the functioning of communities, business and industries within and beyond Auckland;	The proposed works are for the purposes of upgrading the existing wastewater network which is essential for the functioning of communities, business and industries within Auckland.

Reference	Comment
d Providing for public health, safety and well-being of people and communities;	The works will also reduce the risk of wastewater contamination overflow as future development occurs, which in turn will provide positive benefits in terms of providing for public health, safety and well-being of people and communities.
B3.2.1 Objective (4) – The functional and operational needs of infrastructure are recognised.	There is a functional and operational need for the proposed work to be located where they are in order to align with existing wastewater infrastructure and support future intensification.
B3.2.2 Policy (1) – Enable the efficient development, operation, maintenance and upgrading of infrastructure.	The proposed works provide for the efficient development of wastewater infrastructure which will provide for positive benefits in relation to reducing the risk of wastewater overflows to enable future development.
B3.2.2 Policy (8) – Avoid, remedy or mitigate the adverse effects from the construction, operation, maintenance or repair of infrastructure.	The construction methodology is designed to first avoid adverse effects where practicable. Where adverse effects cannot be avoided, the measures set out in the relevant management plans provide robust measures to minimise and mitigate effects.
Chapter E1 – Water quality and integrated management	
E1.2 Objective (3) – Stormwater and wastewater networks are managed to protect public health and safety and prevent or minimise adverse effects of contaminants on freshwater and coastal water quality.	The proposed works will be managed to protect public health and safety and minimises adverse effects of contaminants on freshwater by ensuring the risk of wastewater overflows are reduced as future development occurs.
E1.3 Policy (19) – Ensure wastewater networks are designed and operated to minimise wet weather overflows by: a Requiring wastewater networks to be designed and constructed in accordance with recognised industry standards, including being sized to cater for the maximum probably development level of the area to be serviced; b Requiring the management of connections to the wastewater network; c Requiring wastewater networks to be managed in accordance with a network operations plan including an overflow mitigation plan with clear requirements and timeframes; and d Designing and locating overflow points to minimise nuisance, damage, public health risk and adverse ecological effects.	• The proposed works are for the purposes of extending the existing local network connection to CI in order to reduce wastewater overflows entering freshwater ecosystems. • The CC9 connection will be designed and constructed in accordance with recognised industry standards and will be sized to accommodate for future growth in the area. • The CC9 connection is designed and located to manage overflows to reduce the risk of wastewater overflows.
Chapter E2 – Water quantity, allocation and use	
E2.3 Policy (23) – Require all proposal to take and use groundwater to ensure that: a The proposal avoids, remedies or mitigates any adverse effects on:	The proposed works are not located within any scheduled historic heritage place of place or significance to Mana Whenua.

Reference	Comment
i Scheduled historic heritage places and scheduled sites and places of significance to Mana Whenua; and ii People and communities.	The proposed groundwater diversion will be undertaken in accordance with the measures set out in Section 5 to ensure adverse effects on people and communities are avoided, remedied or mitigated.
b The groundwater diversion does not cause or exacerbate any flooding.	The proposed groundwater diversion will not cause or exacerbate flooding.
c Monitoring has been incorporated where appropriate, including: i Measurement and recording of water levels and pressures; and ii Measurement and recording of the movement of ground, buildings and other structures.	Appropriate monitoring recording water levels and ground settlement has been included in the Groundwater Settlement Assessment (**Appendix G**).
Chapter E26 – Infrastructure	
E26.2.1 Objective (1) – The benefits of infrastructure are recognised	The proposed CC9 sewer will improve the resilience of the wastewater network and increase the capacity of the system to allow for future growth and development in the Auckland region. Furthermore, the proposed CC9 sewer will provide benefits in relation to reducing the risk of wastewater overflows entering freshwater ecosystems.
E26.6.1 Objective (9) – The adverse effects of infrastructure are avoided, remedied or mitigated.	The proposed mitigation measures set out in Section 5 and the relevant management plans will adequately avoid, remedy or mitigate adverse effects associated with the proposed works.
E26.2.2 Policy (1) – Recognise the social, economic and cultural and environmental benefits that infrastructure provides, including: … b Providing for public health and safety; … e Enabling growth and development; f Protecting and enhancing the environment	The proposed works will provide for a reduction in the risk of wastewater overflows, thereby providing social, economic, cultural and environmental benefits. Specifically, public health and safety will be provided for by reducing the risk of wastewater contamination. In addition the proposed works improve wastewater infrastructure, which enables future growth and development in the area. A reduction in wastewater overflows will also protect and enhance freshwater ecosystems.
Chapter E30 – Contaminated Land	
E30.2 Objective (1) – The discharge of contaminants from contaminated land into air, or into water, or onto land are managed to protect the environment and human health and to enable land to be used for suitable activities now and in the future.	The proposed works will be managed in a manner that ensures the protection of the environment and human health, while enabling upgrades to the wastewater infrastructure system to be undertaken. Adequate measures are set out in Section 5 to ensure adverse effects on the environment are prevented. In any case, the potential for contamination is very limited and effects are assessed as negligible.
E30.3 Policy (2)(g) – Require any use or development of land containing elevated levels of contaminants resulting in discharges to air, land or water to manage or remediate the contamination to a level that: c Avoid, remedies or mitigates significant adverse effects on ecological values, water	

Reference	Comment
quality, human health and amenity values while. Taking into account all of the following: a Whether adequate measures are in place for the transport, disposal and tracking of contaminated soil and other contaminated material removed from the site to prevent adverse effects on the environment.	
Chapter E36 – Natural hazards and flooding	
E36.2 Objective (4) – Where infrastructure has a functional or operational need to be locate in a natural hazard area, the risk of adverse effects to other people, property, and the environment shall be assessed and significant adverse effects are sought first to be avoided or, if avoidance is not able to be totally achieved, the residual effects are otherwise mitigated to the extent practicable.	The proposed works involve the installation of underground infrastructure only (i.e. a wastewater pipeline). The works have a functional need to be located in the floodplain, due to the need to connect to existing wastewater infrastructure. There will be no adverse effects on flood risk as a result of the proposed works.
E36.3 Policy (35) – Allow for the operation, maintenance, upgrading and construction of infrastructure, in areas subject to natural hazards when: a Infrastructure is functionally or operationally required to locate in hazard areas or it is not reasonably practicable that it be located elsewhere. … c In all flood hazard areas risks to people, property and the environment are mitigated to the extent practicable.	
Chapter H7 – Open Space zones	
H7.3 Policy (4) – Enable the construction, operation and maintenance, repair and minor upgrading of infrastructure located on open spaces.	The proposed works are for the purposes of upgrading wastewater infrastructure and have a functional and operational need to be located within the open space zone.

6.4.2.1 Summary of objectives and policies assessment

Both the Regional Policy Statement and Regional/District Plan components of the AUP include a suite of objectives and policies that recognise the benefits of infrastructure and explicitly recognise the functional and operational needs of infrastructure. The objectives and policies set out an approach to managing the adverse effects of infrastructure on the environment, while providing for infrastructure and its associated benefits. This application is supported and enabled by the relevant provisions in the AUP as they relate to infrastructure.

7 Consultation and notification assessment

7.1 Consultation

As part of the wider authorisation process for the CI consents and designations, Watercare undertook extensive consultation with a broad range of stakeholders – including Mana Whenua, Local Boards and communities, Auckland Council, Auckland Transport and landowners.

In relation to CC9, Watercare has undertaken targeted consultation with Auckland Council Parks, Eden Roskill Cricket Club and the Ministry of Education (MoE) with regards to the proposed works located on the school grounds and Keith Hay Park. Landowner approval from MoE and Auckland Council (Parks) is pending and will be provided to Auckland Council in due course.

Iwi have been engaged through Watercare's Mana Whenua Kaitiaki Forum. Engagement with iwi is ongoing and will continue through the project development and delivery phases. The CC9 project was added to the Mana Whenua Kaitiaki project list in February 2021. A subset of this Forum's Managers' Group meets with CI representatives as a working group to support the project team in delivering project outcomes with cultural aspects. The group provides specialist advice particularly in the areas of consent compliance, new consent applications and social outcomes as well as reporting back to the Forum's Managers' Group. CC9 was added to the monthly agenda in February 2021. Te Ākitai Waiohua and Ngāti Whātua Ōrākei have expressed an interest in the application which will be provided to them once completed. Feedback will be provided to Council either directly or at their request.

Watercare has also undertaken consultation with the following parties:

- Keith Hay Park User Group (includes the Cameron Pool), Eden-Roskill Cricket Club: timetable of works within the park and effects on pathways and vehicle movements.
- Waikowhai Intermediate, Hillsborough Kindergarten, Hay Park School: detailed project information and timeline, with an offer to meet and discuss their individual situations, with a view to mitigating effects on their staff and pupils and educational operations as far as practicable.
- Residents adjoining the existing CI construction site and new proposed works: personalised letters explaining the project along with potential noise exceedances, with mitigation measures being undertaken. Offer of meeting with works project manager and/or acoustics specialist to discuss their individual situation.
- Other local residents within 200 m radius: currently receive regular site bulletins on construction activities in relation to CI works and this will continue for CC9 related works.

Watercare will continue consultation with the relevant stakeholders for the project and will provide the results of consultation to Council. In addition, as noted above some landowner approvals and affected party approvals are expected shortly and will be provided to Council on receipt.

7.2 Notification assessment

7.2.1 Public notification

Section 95A of the RMA is relevant when a consent authority is considering whether a consent application should be considered with or without public notification.

Section 95A identifies a four step process. In relation to these steps we note the following:

- The applicant does not request public notification of the application;

- There is no rule or national environmental standard that precludes or requires public notification of this application;
- An assessment of effects on the environment is provided in Section 5 of this AEE report. This assessment concludes that the adverse effects on the environment will be no more than minor;
- The application is not for any of the activities identified in section 95A(5)(b) (i.e. a controlled activity, subdivision of land or a residential activities, a boundary activity, or an activity prescribed in section 360H(1)(a)(i)); and
- No special circumstances are considered to exist in relation to the application.

In terms of Section 95E(1), the application is for the construction of a sewer pipeline. As outlined in Section 5, the proposed works are anticipated to have no more than minor adverse effects on the environment and will provide numerous positive effects in relation to reducing wastewater overflows to the local receiving environment, as well as supporting future intensification in the surrounding area. We therefore consider that this proposal meets the tests of the RMA to be processed without public notification.

7.2.2 Limited notification

For applications that are not publicly notified, under section 95B the consent authority must determine whether to give limited notification of an application to any affected parties. Section 95B identifies a four step process. In relation to these steps we note the following:

- The application does not need to be notified to any parties under section 95B(4). The proposed change will not affect any customary rights;
- The proposed activity is not on or adjacent to, or does not affect, land that is the subject of a statutory acknowledgement;
- There are no applicable rules or national environmental standards precluding limited notification; and
- No special circumstances are considered to exist in relation to the application that warrant notification of the application to any other persons not already determined to be eligible for limited notification.

In accordance with Section 95E, for the purpose of determining limited notification of an application for a resource consent, a person is an affected person if the consent authority decides that the activity's adverse effects on the person are minor or more than minor (but are not less than minor). However in accordance with subsection (3), a person is not an affected person if they have given their written approval for the proposed activity.

In terms of Section 95E, we note the following:

- Watercare has undertaken targeted consultation with Auckland Council Parks and the Ministry of Education with regards to the proposed works and written approval is expected shortly for works in Keith Hay Park, and in Waikowhai Intermediate, Hay Park School and Hillsborough Kindergarten, respectively.
- In terms of traffic effects, the proposed works will result in low construction traffic volumes which are within the typical hourly fluctuations of the nearby roads. Effects on the surrounding road network are expected to be minimal.
- In terms of noise effects, the Construction Noise and Vibration Assessment finds that most general construction activities and equipment are predicted to comply (or only negligibly exceed) the daytime noise limits at residential properties. The exception is sheet piling, should this be required along the southern part of the alignment. However Watercare is working

closely with the schools, kindergarten and Ministry of Education through the landowner approval process, and management and mitigation measures in relation to noise effects on these facilities will be discussed and confirmed through this process.

- Watercare has also undertaken consultation with residents adjoining the existing CI construction site and proposed CC9 works. CI is being undertaken in accordance with a suite of approved management plans and mitigation measures, including the measures set out in the CI CNVMP developed to manage construction noise and vibration from the Keith Hay Park shaft site, along with the Activity Specific Construction Noise Management Plan – Keith Hay Park Sheet Piling where relevant. The CC9 works will be implemented fully in accordance with the applicable management plans for CI. This allows for an integrated and consistent approach, while also noting that the CI CNVMP and ASCNMP represent a best-practice approach which have been subject to review and approval by Auckland Council and are demonstrated to have worked across the course of the wider CI works.

8 Conclusion

This AEE report has been prepared on behalf of Watercare Services Ltd to accompany a resource consent application to Auckland Council for the construction of a sewer pipeline (CC9) at Keith Hay Park, Mt Roskill.

The proposed works involve earthworks, disturbance of potentially contaminated soil, works within floodplains and overland flow paths, construction noise and dewatering activities during the construction period. Overall, resource consent is sought as a discretionary activity.

The proposed works and associated effects are temporary and localised in nature. As set out in Section 5, the works will be undertaken in accordance with robust mitigation measures and management plans to ensure that adverse effects on the receiving environment are no more than minor. These measures will be consistent with those already employed for the CI project and in accordance with the suite of management plans for CI which have been canvassed and approved by Auckland Council.

The proposed works provide a local connection to the CI project and will improve the resilience of wastewater infrastructure, which will have benefits in terms of supporting intensification in this area of Auckland and improving freshwater quality by reducing the risk of wastewater overflows. The works are therefore consistent with Part 2 of the RMA and with the relevant objectives and policies of the NPS-FM, and are supported and enabled by the relevant provisions of the AUP. It is therefore considered that consent can be granted for this application subject to fair and reasonable conditions that are consistent with the conditions included in the CI consents.

9 Applicability

This report has been prepared for the exclusive use of our client Watercare Services Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that this report will be submitted to Auckland Council in support of an application for resource consent for the works described herein and that council will rely on this report for the purposes of assessing that application.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Laila Alkamil Planner	Peter Roan Project Director

2-Jul-21

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Appendix A: Records of Title

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA8D/230**
Land Registration District	**North Auckland**
Date Issued	19 May 1966

Part-Cancelled

Prior References
NA1644/26

Estate	Fee Simple
Area	15.7802 hectares more or less
Legal Description	Allotment 77 Section 13 Suburbs of Auckland
Purpose	Recreation reserve

Registered Owners
Auckland Council

Interests

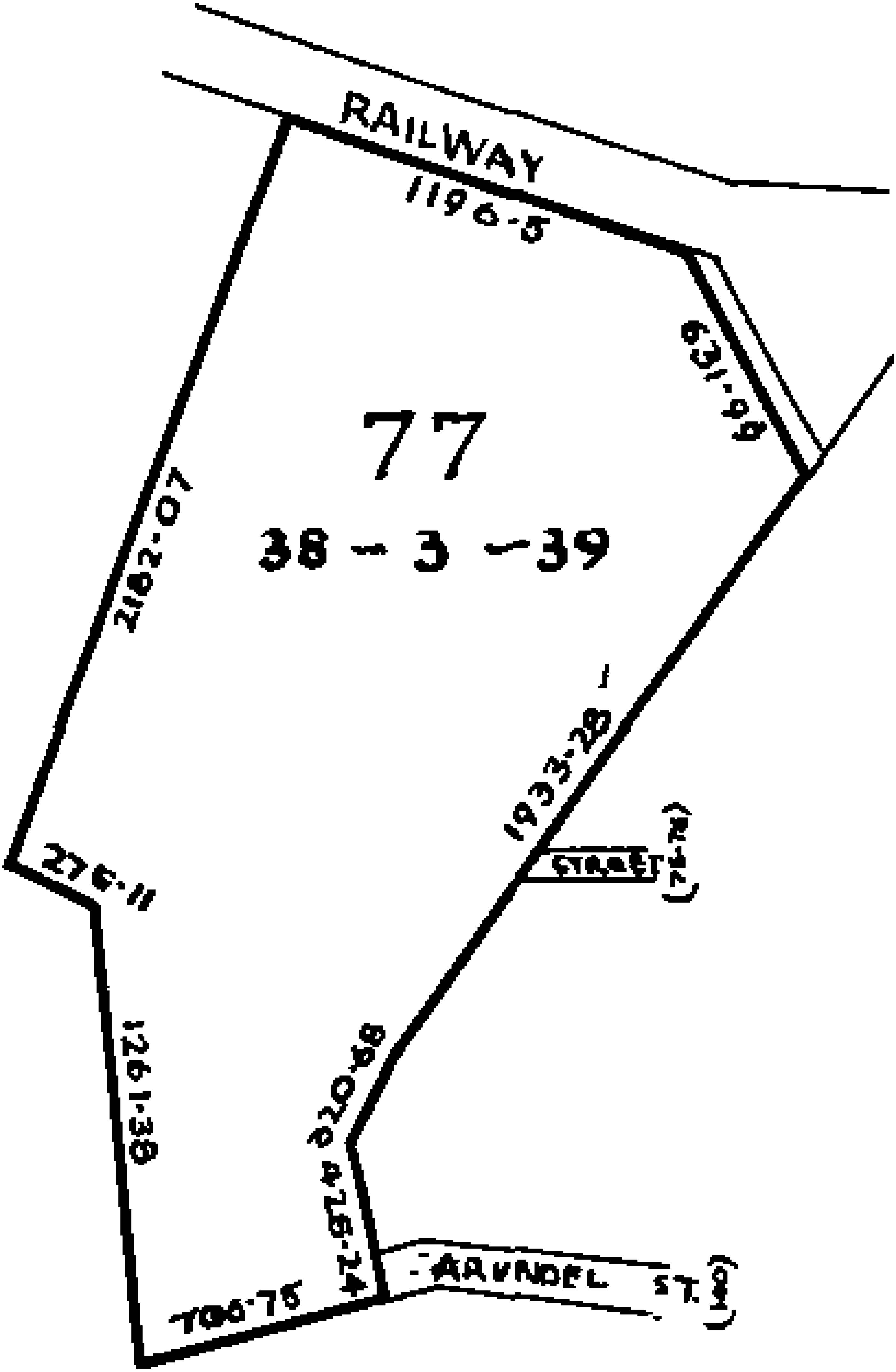
Subject to Section 59 Land Act 1948

SUBJECT TO THE RESERVES AND DOMAINS ACT 1953

8618489.2 Gazette Notice (2010/2913) declaring part within land now know as Section 71 SO 421535 (7705m²) to be road, which pursuant to Section 5 Land Transport Management Act 2003, forms part of State Highway 20 and vests in Her Majesty The Queen - 20.10.2010 at 4:18 pm

Subject to a right (in gross) to convey electricity over parts marked A and B on DP 479126 in favour of Vector Limited created by Easement Instrument 10853240.1 - 4.10.2017 at 9:57 am

Subject to a right (in gross) to convey electricity over part marked A on DP 459146 in favour of Vector Limited created by Easement Instrument 10853194.1 - 21.9.2018 at 8:13 am


RAILWAY
1196·5
631·99
77
38 - 3 - 39
2182·07
1933·28
STREET
275·11
1261·38
820·68
475·24
700·75
ARUNDEL ST.

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA626/60**	**Part-Cancelled**
Land Registration District	**North Auckland**	
Date Issued	22 June 1931	

Prior References
NA122/143

Estate	Fee Simple
Area	4.2674 hectares more or less
Legal Description	Lot 1466 Deposited Plan 22827

Registered Owners
Her Majesty The Queen

Interests

17876 Proclamation setting apart parts for a public school - 16.11.1960 at 2.35 pm

18652 Gazette Notice declaring that the part Mount Roskill Domain over Lot 1466 DP 22827 shall cease to be subject to the provisions of Part III of the Reserves and Domains Act 1953, and shall be deemed to be a recreation reserve subject to Part II of the said Act and, further revokes the reservation for recreation purposes over the said reserve - 15.11.1961 at 9.00 am

A456124 Gazette Notice authorization of exchange of part of the within described lands for Lots 1, 2 and 3 DP 60415 (CT NA621/207) - 31.3.1970 at 9.00 am

059119.1 Gazette Notice declaring that, part of the Mount Roskill Domain shall cease to be subject to Part III of the Reserves and Domains Act 1953 and shall be deemed to be a recreation reserve, subject to Part II of the said act - 21.2.1974 at 2.10 pm

9889372.1 Certificate under section 148 of the Nga Mana Whenua o Tamaki Makaurau Collective Redress Act 2014 that the within land is RFR land as defined in section 118 and is subject to Subpart 1 of Part 4 of the Act (which restricts disposal, including leasing of the land) - 10.11.2014 at 7:00 am

4·2674 ha

REA IS

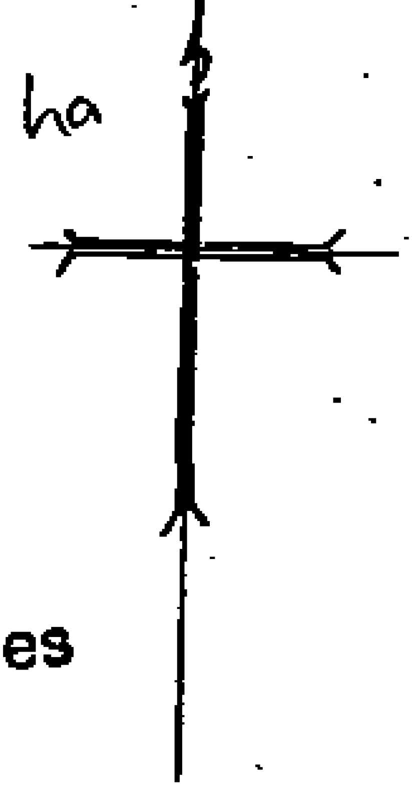
2674 ha

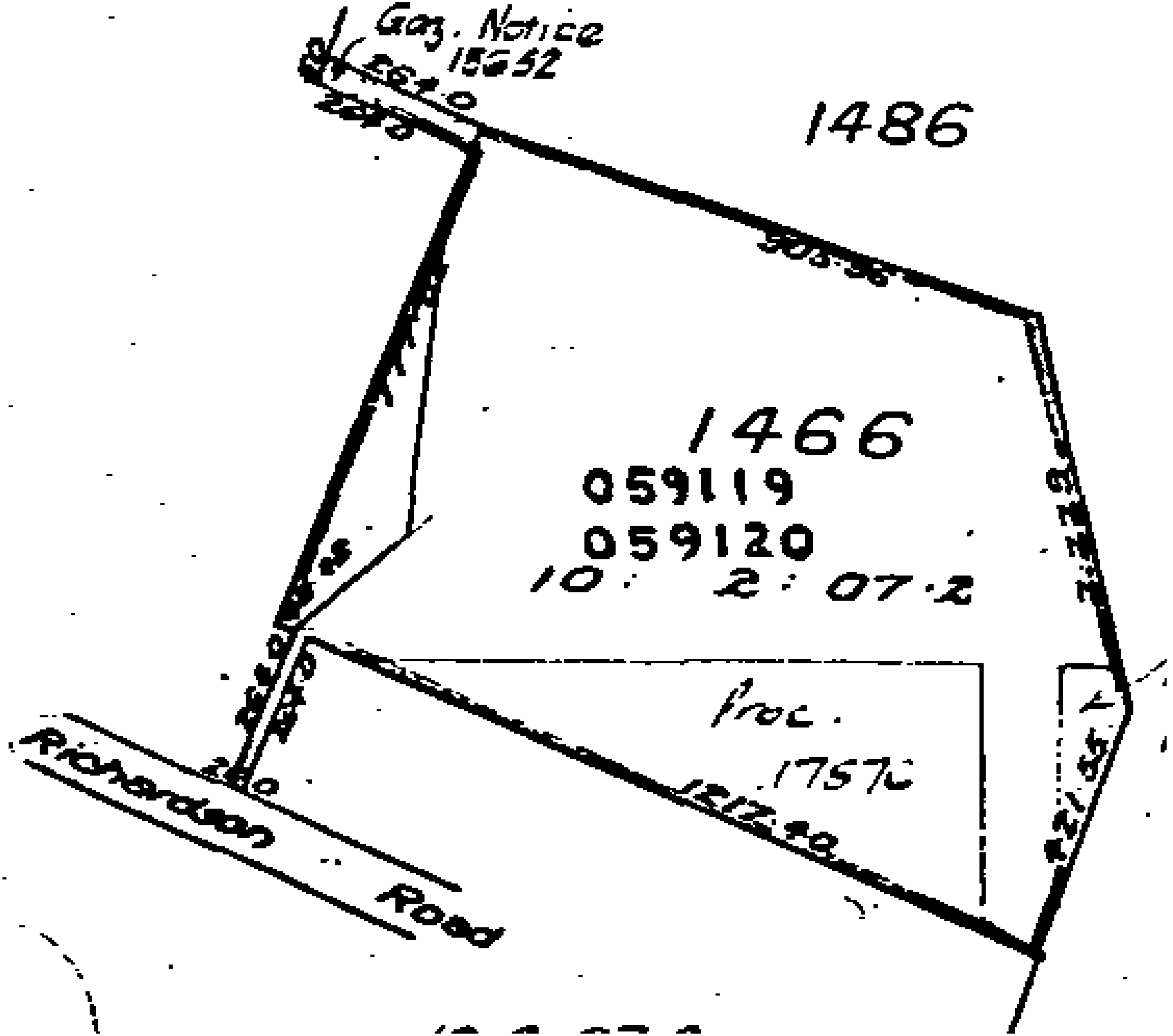
sion Factors:

= 4046m^2

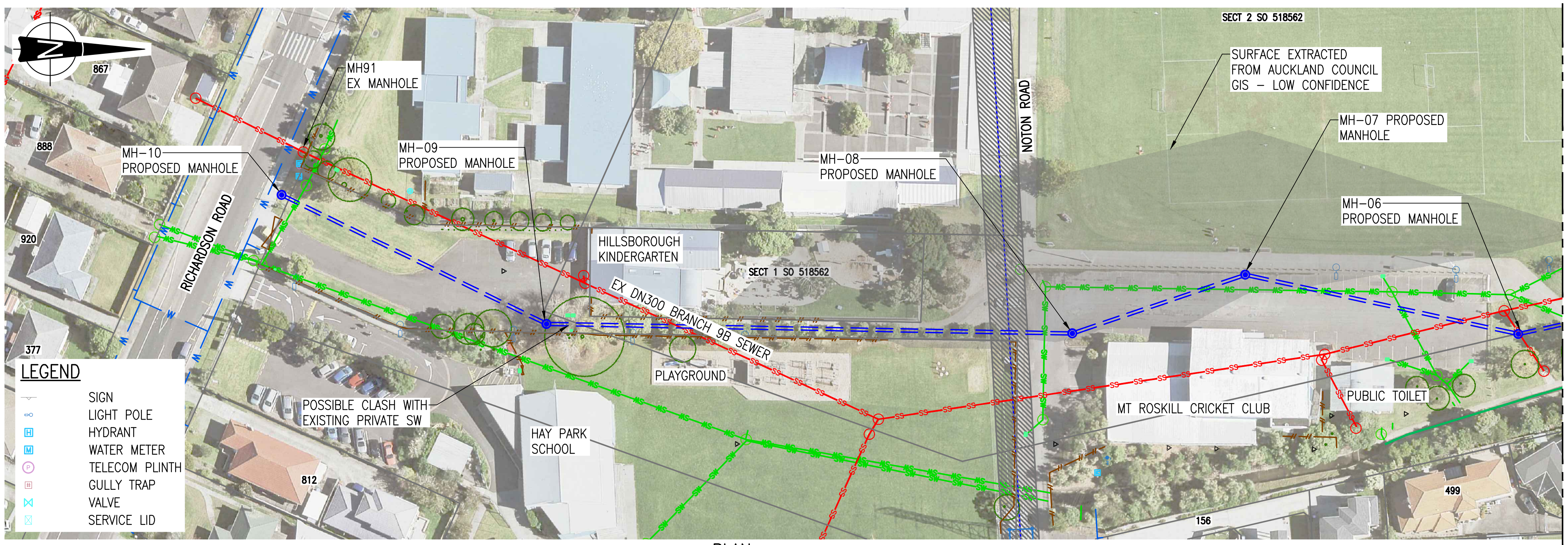
h = 25.29m^2

= ·2012 metres

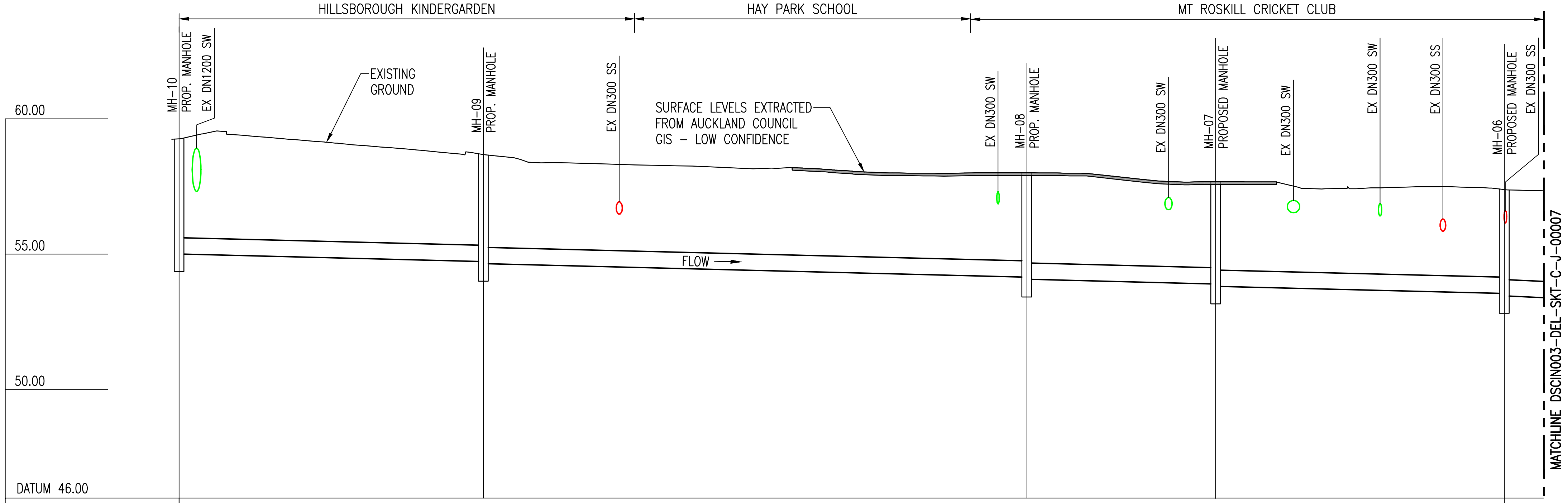




Appendix B: Site Plans



PLAN
SCALE 1:500 (A1)



PIPE DIAMETER AND GRADE	600 ID (1:200) PIPE				
EXISTING GROUND LEVELS (mRL)	59.25	58.67	58.00	57.67	57.38
PROPOSED INVERT LEVELS (mRL)	55.01	54.73 54.65	54.15 54.07	53.90 53.82	53.55 53.47
DEPTH TO INVERT (m)	4.24	3.94 4.02	3.85 3.93	3.77 3.85	3.83 3.91
CHAINAGE (m)	100.00	156.18	256.47	291.33	344.61

LONGITUDINAL SECTION
SCALE 1:100 V 1:500 H (A1)

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
2. LOCATION OF EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GIS AND UTILITIES PLANS AND ARE INDICATIVE. CONTRACTOR IS RESPONSIBLE FOR ASSESSING DIAL B 4 U DIG INFORMATION PRIOR TO CONSTRUCTION. PHYSICAL LOCATION OF AFFECTED SERVICES WILL BE REQUIRED PRIOR TO CONSTRUCTION. ALL AFFECTED SERVICES SHALL BE PROTECTED DURING CONSTRUCTION.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN OF PIPE STRUCTURE CLASS AND PRESSURE RATING TO BOTH LONG-TERM PERMANENT-CASE AND TEMPORARY LOADS.

LEGEND

═ ═ ═	PROPOSED MAIN TUNNEL
═ ═ ═	PROPOSED LINK SEWER
═●═	FUTURE CSO COLLECTOR SEWER AND MANHOLE
═ ═ ═	PROPOSED SEWERAGE
═ ═ ═	PROPOSED STORMWATER
═ : ═	PROPOSED POWER/CONTROL DUCT
— SW —	EXISTING STORMWATER
～	EXISTING STORMWATER STREAM
— SS —	EXISTING NETWORK WASTEWATER
-SS-SS-SS-	EXISTING TRANSMISSION WASTEWATER
— W —	EXISTING WATERMAIN
— LV —	LV POWER CABLE
— HV —	HV POWER CABLE
— MV —	MV POWER CABLE
▨	TRANSPOWER LINE
■ ■ ■	DESIGNATION BOUNDARY
▭	PROPOSED ALL WEATHER TRAFFICABLE ACCESS
═:═:═	PROPOSED AIR DUCT
—	CADASTRAL BOUNDARY
—	OPEN WATER CHANNEL
-//- -//-	FENCE
△	SURVEY MARK
PP	POWER POLE
●	BOLLARD
⋈	GATE
▤	CESSPIT SINGLE
◎	MANHOLE
×	STORMWATER PIPE INVERT
⊙	TREE TRUNK & APPROXIMATE DRIP LINE

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m
SCALE 1:500 (A1) 108 6 4 2 0 10 20 30 40 50m

INFORMATION ISSUE

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

Plot Date: Feb 03, 2021 - 11:38am c:\users\pfar\appdata\local\projectwise\watercare_ltd_projects\dms51944\ DSCIN003-DEL-SKT-C-J-00006.dwg

ISSUE	DATE	AMENDMENT
A	03.02.21	IFI - CC9 CONSENT OPTION ISSUE

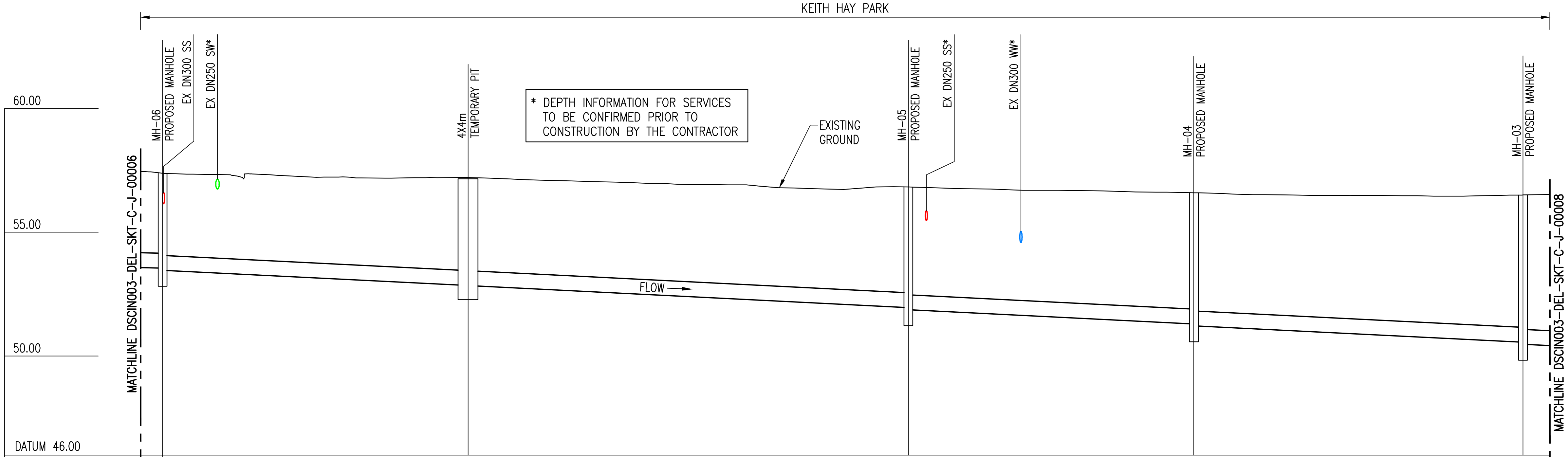
Watercare

KEITH HAY PARK - BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION - CONSENT OPTION 2 - SHEET 1 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00006.DWG
REF No. CI-CIVIL
ORIGINAL SCALE A1 AS SHOWN
SKETCH No. DSCIN003-DEL-SKT-C-J-00006
ISSUE A

PLAN

SCALE 1:500 (A1)



* DEPTH INFORMATION FOR SERVICES TO BE CONFIRMED PRIOR TO CONSTRUCTION BY THE CONTRACTOR

PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS				
EXISTING GROUND LEVELS (mRL)	57.38	56.80	56.83	56.60	56.51
PROPOSED INVERT LEVELS (mRL)	53.55 53.47	52.86 52.83	51.96 51.88	51.30 51.22	50.56 50.48
DEPTH TO INVERT (m)	3.83 3.91	3.94 3.97	4.87 4.95	5.30 5.38	5.95 6.03
CHAINAGE (m)	344.61	406.31	495.26	552.93	619.42

LONGITUDINAL SECTION

SCALE 1:100 V 1:500 H (A1)

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
2. LOCATION OF EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GIS AND UTILITIES PLANS AND ARE INDICATIVE. CONTRACTOR IS RESPONSIBLE FOR ASSESSING DIAL B 4 U DIG INFORMATION PRIOR TO CONSTRUCTION. PHYSICAL LOCATION OF AFFECTED SERVICES WILL BE REQUIRED PRIOR TO CONSTRUCTION. ALL AFFECTED SERVICES SHALL BE PROTECTED DURING CONSTRUCTION.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN OF PIPE STRUCTURE CLASS AND PRESSURE RATING TO BOTH LONG-TERM PERMANENT-CASE AND TEMPORARY LOADS.

LEGEND

== == ==	PROPOSED MAIN TUNNEL
— — —	PROPOSED LINK SEWER
═ ◉ ═	FUTURE CSO COLLECTOR SEWER AND MANHOLE
━ ━ ━ ━	PROPOSED SEWERAGE
═ ═ ═ ═	PROPOSED STORMWATER
═ : ═ : ═	PROPOSED POWER/CONTROL DUCT
— SW —	EXISTING STORMWATER
〰	EXISTING STORMWATER STREAM
— SS —	EXISTING NETWORK WASTEWATER
—SS—SS—SS—	EXISTING TRANSMISSION WASTEWATER
— W —	EXISTING WATERMAIN
— LV —	LV POWER CABLE
— HV —	HV POWER CABLE
— MV —	MV POWER CABLE
▨	TRANSPOWER LINE
■ ■ ■ ■	DESIGNATION BOUNDARY
▭	PROPOSED ALL WEATHER TRAFFICABLE ACCESS
≡≡≡	PROPOSED AIR DUCT
——	CADASTRAL BOUNDARY
——	OPEN WATER CHANNEL
—//— //— //—	FENCE
△	SURVEY MARK
● PP	POWER POLE
●	BOLLARD
⋈	GATE
▤	CESSPIT SINGLE
◎	MANHOLE
×	STORMWATER PIPE INVERT
⊙	TREE TRUNK & APPROXIMATE DRIP LINE

INFORMATION ISSUE

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

ISSUE	DATE	AMENDMENT
A	03.02.21	IFI – CC9 CONSENT OPTION ISSUE

Watercare

KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CONSENT OPTION 2 – SHEET 2 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00007.DWG

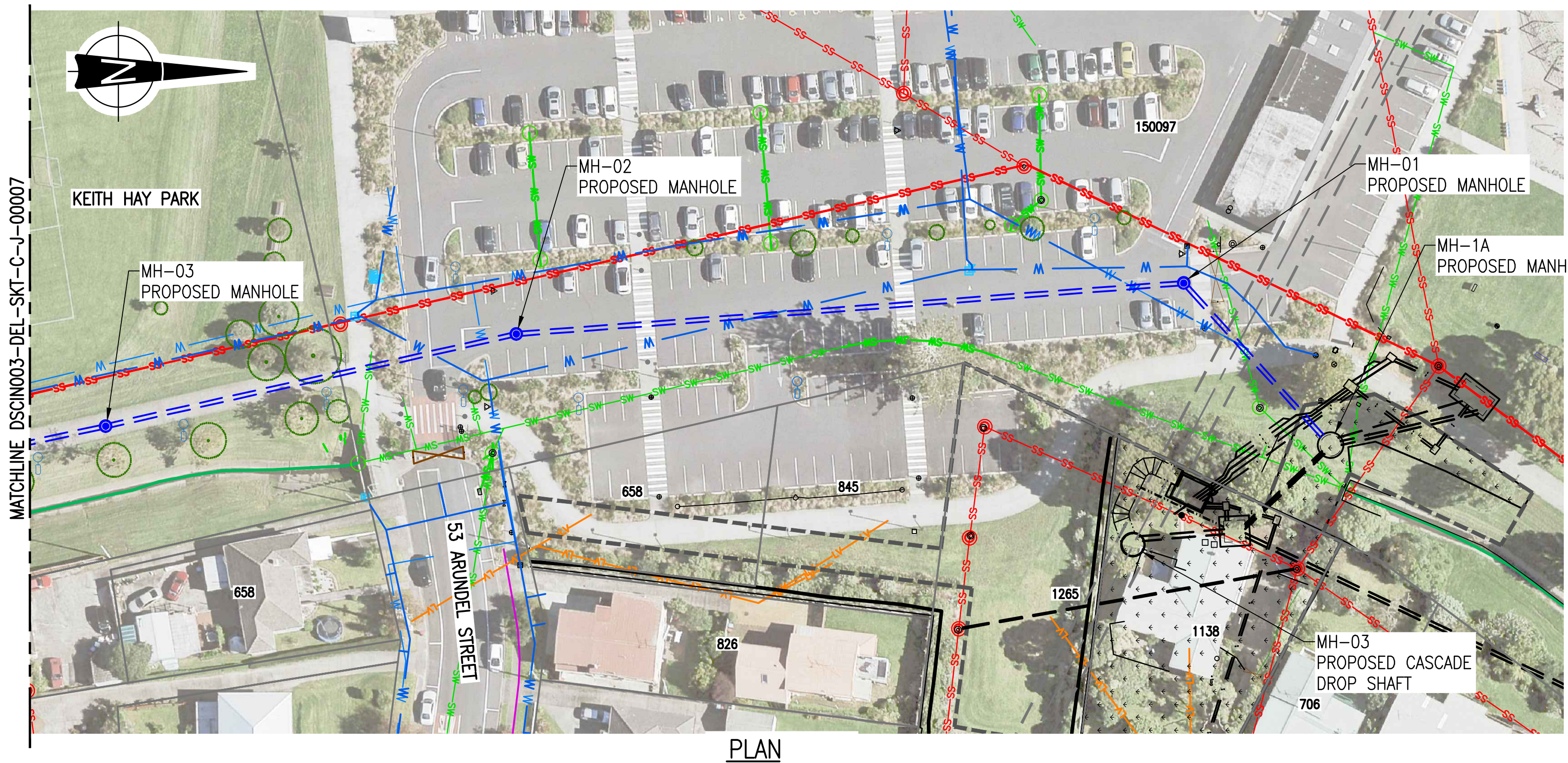
REF No. CI-CIVIL

ORIGINAL SCALE A1 AS SHOWN

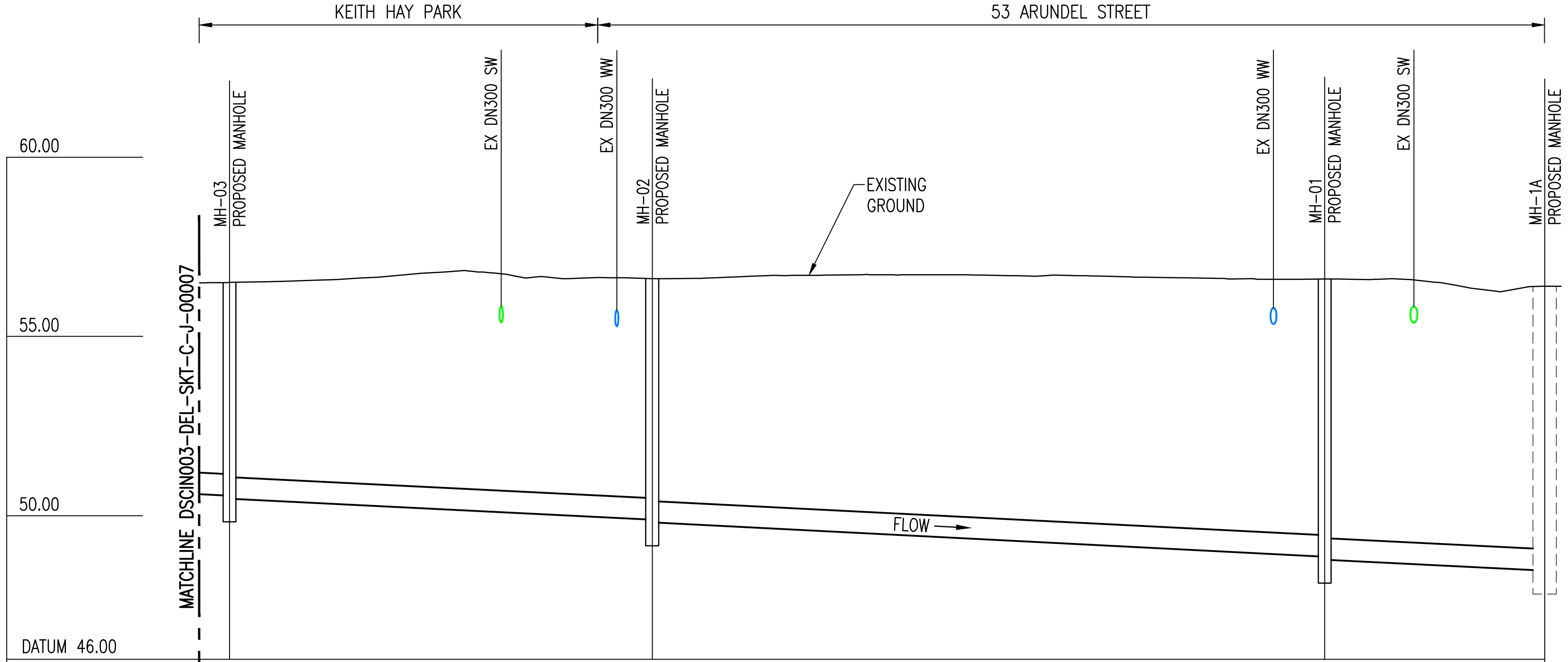
SKETCH No. DSCIN003-DEL-SKT-C-J-00007

ISSUE A

Plot Date: Feb 03, 2021 – 11:38am c:\users\pfar\appdata\local\projectwise\watercare_ltd_projects\dms51944\DSCIN003-DEL-SKT-C-J-00007.dwg



PLAN
SCALE 1:500 (A1)



	MH-03	MH-02	MH-01	MH-1A
PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS			
EXISTING GROUND LEVELS (mRL)	56.51	56.61	56.60	56.40
PROPOSED INVERT LEVELS (mRL)	50.56 50.48	49.89 49.81	48.86 48.78	48.47
DEPTH TO INVERT (m)	5.95 6.03	6.72 6.80	7.74 7.82	7.93
CHAINAGE (m)	619.42	678.36	772.12	802.79

LONGITUDINAL SECTION
SCALE 1:100 V 1:500 H (A1)

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
2. LOCATION OF EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GIS AND UTILITIES PLANS AND ARE INDICATIVE. CONTRACTOR IS RESPONSIBLE FOR ASSESSING DIAL B 4 U DIG INFORMATION PRIOR TO CONSTRUCTION. PHYSICAL LOCATION OF AFFECTED SERVICES WILL BE REQUIRED PRIOR TO CONSTRUCTION. ALL AFFECTED SERVICES SHALL BE PROTECTED DURING CONSTRUCTION.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN OF PIPE STRUCTURE CLASS AND PRESSURE RATING TO BOTH LONG-TERM PERMANENT-CASE AND TEMPORARY LOADS.

LEGEND

- PROPOSED MAIN TUNNEL
- PROPOSED LINK SEWER
- FUTURE CSO COLLECTOR SEWER AND MANHOLE
- PROPOSED SEWERAGE
- PROPOSED STORMWATER
- PROPOSED POWER/CONTROL DUCT
- SW EXISTING STORMWATER
- EXISTING STORMWATER STREAM
- SS EXISTING NETWORK WASTEWATER
- SS SS SS EXISTING TRANSMISSION WASTEWATER
- W EXISTING WATERMAIN
- LV LV POWER CABLE
- HV HV POWER CABLE
- MV MV POWER CABLE
- TRANSPOWER LINE
- DESIGNATION BOUNDARY
- PROPOSED ALL WEATHER TRAFFICABLE ACCESS
- PROPOSED AIR DUCT
- CADASTRAL BOUNDARY
- OPEN WATER CHANNEL
- FENCE
- SURVEY MARK
- PP POWER POLE
- BOLLARD
- GATE
- CESSPIT SINGLE
- MANHOLE
- × STORMWATER PIPE INVERT
- TREE TRUNK & APPROXIMATE DRIP LINE

LEGEND

- SIGN
- LIGHT POLE
- H HYDRANT
- M WATER METER
- T TELECOM PLINTH
- GULLY TRAP
- VALVE
- SERVICE LID

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

INFORMATION ISSUE

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

ISSUE	DATE	AMENDMENT
A	03.02.21	IFI – CC9 CONSENT OPTION ISSUE

Watercare

KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CONSENT OPTION 2 – SHEET 3 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00008.DWG
REF No. CI-CIVIL
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SKETCH No. DSCIN003-DEL-SKT-C-J-00008
ISSUE A

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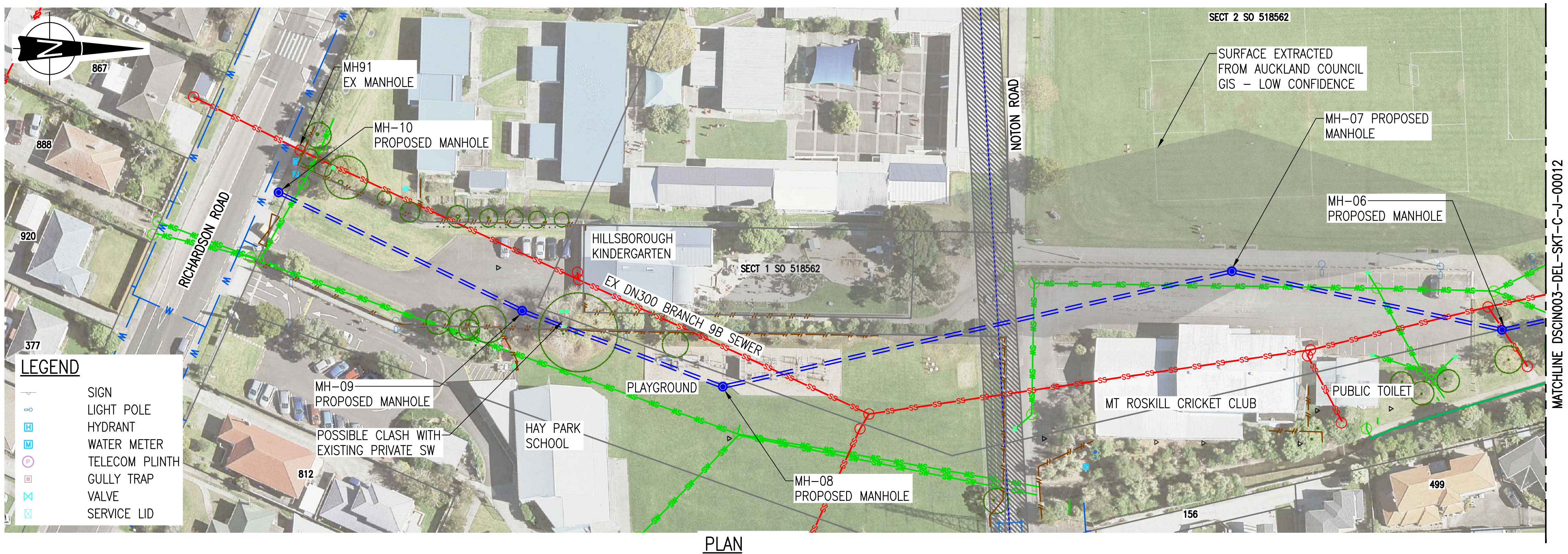
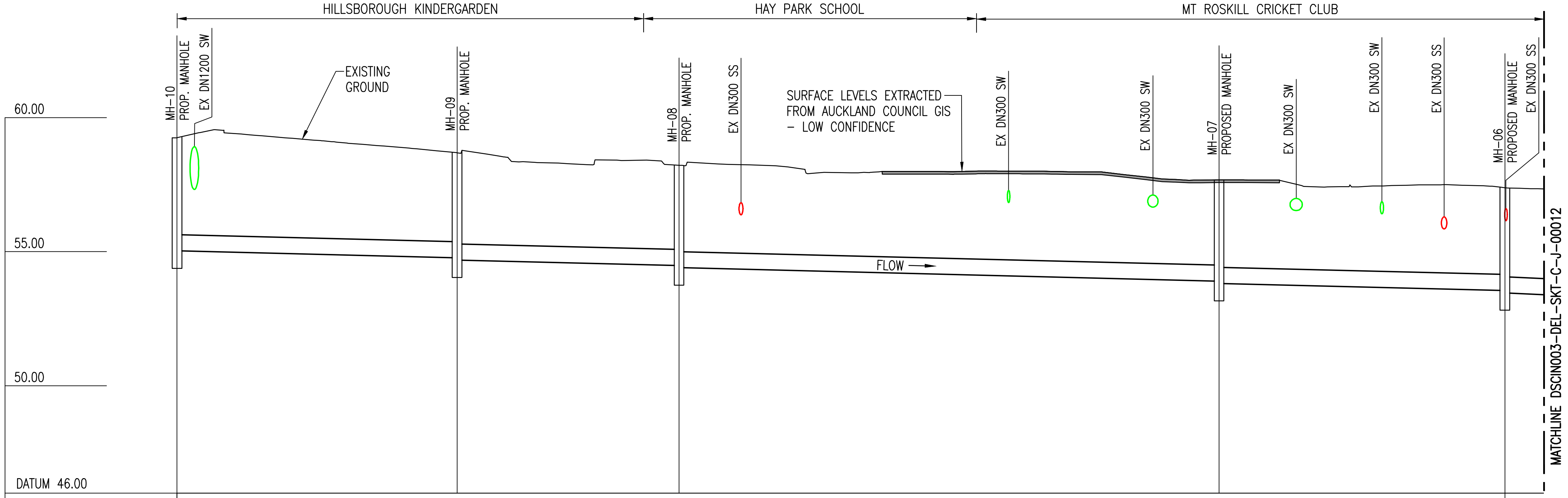


PLAN
SCALE 1:500 (A1)



DATUM 46.00					
PIPE DIAMETER AND GRADE	600 ID (1:200) PIPE				
EXISTING GROUND LEVELS (mRL)	59.25	58.69	58.22	57.67	57.38
PROPOSED INVERT LEVELS (mRL)	55.03	54.77 54.69	54.48 54.40	53.90 53.82	53.55 53.47
DEPTH TO INVERT (m)	4.22	3.92 4.00	3.74 3.82	3.77 3.85	3.83 3.91
CHAINAGE (m)	100.00	152.20	193.57	294.23	347.50

LONGITUDINAL SECTION
SCALE 1:100 V 1:500 H (A1)

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
2. LOCATION OF EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GIS AND UTILITIES PLANS AND ARE INDICATIVE. CONTRACTOR IS RESPONSIBLE FOR ASSESSING DIAL B 4 U DIG INFORMATION PRIOR TO CONSTRUCTION. PHYSICAL LOCATION OF AFFECTED SERVICES WILL BE REQUIRED PRIOR TO CONSTRUCTION. ALL AFFECTED SERVICES SHALL BE PROTECTED DURING CONSTRUCTION.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN OF PIPE STRUCTURE CLASS AND PRESSURE RATING TO BOTH LONG-TERM PERMANENT-CASE AND TEMPORARY LOADS.

LEGEND

- PROPOSED MAIN TUNNEL
- PROPOSED LINK SEWER
- FUTURE CSO COLLECTOR SEWER AND MANHOLE
- PROPOSED SEWERAGE
- PROPOSED STORMWATER
- PROPOSED POWER/CONTROL DUCT
- SW EXISTING STORMWATER
- EXISTING STORMWATER STREAM
- SS EXISTING NETWORK WASTEWATER
- SS SS SS EXISTING TRANSMISSION WASTEWATER
- W EXISTING WATERMAIN
- LV LV POWER CABLE
- HV HV POWER CABLE
- MV MV POWER CABLE
- TRANSPOWER LINE
- DESIGNATION BOUNDARY
- PROPOSED ALL WEATHER TRAFFICABLE ACCESS
- PROPOSED AIR DUCT
- CADASTRAL BOUNDARY
- OPEN WATER CHANNEL
- FENCE
- SURVEY MARK
- PP POWER POLE
- BOLLARD
- GATE
- CESSPIT SINGLE
- MANHOLE
- STORMWATER PIPE INVERT
- TREE TRUNK & APPROXIMATE DRIP LINE

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m
SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

INFORMATION ISSUE

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

ISSUE	DATE	AMENDMENT
A	03.02.21	IFI – CC9 CONSENT OPTION ISSUE

Watercare

KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CONSENT OPTION 3 – SHEET 1 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00011.DWG
REF No. CI-CIVIL
ORIGINAL SCALE A1 AS SHOWN
SKETCH No. DSCIN003-DEL-SKT-C-J-00011
ISSUE A

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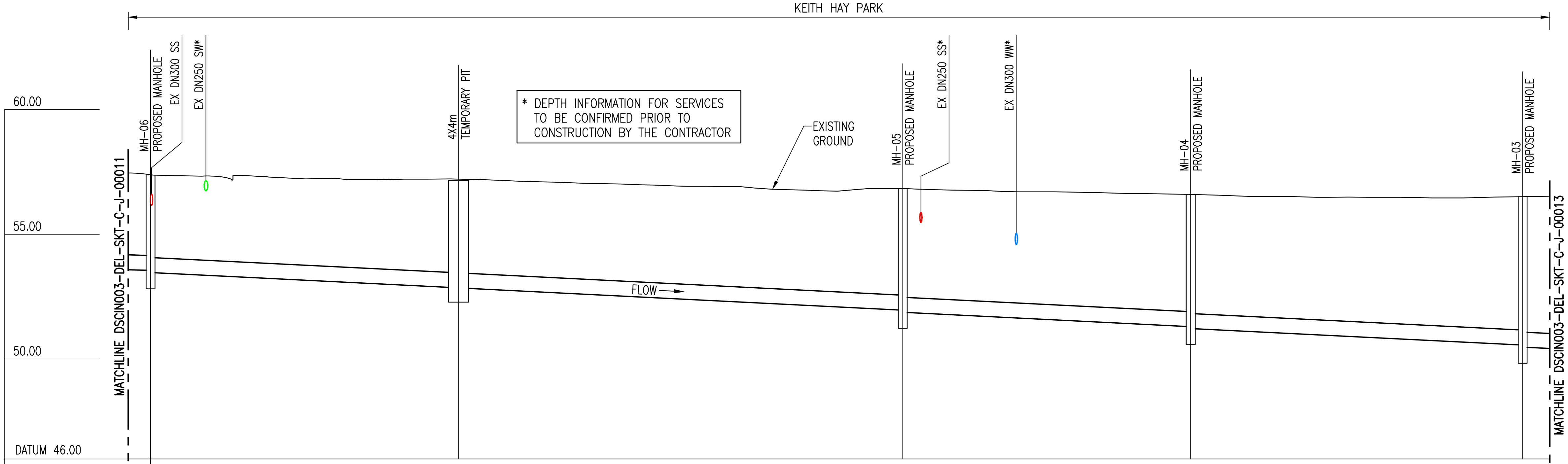
PLAN
SCALE. 1:500 (A1)



PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS				
EXISTING GROUND LEVELS (mRL)	57.38	56.80	56.83	56.60	56.51
PROPOSED INVERT LEVELS (mRL)	53.55 53.47	52.86 52.83	51.96 51.88	51.30 51.22	50.56 50.48
DEPTH TO INVERT (m)	3.83 3.91	3.94 3.97	4.87 4.95	5.30 5.38	5.95 6.03
CHAINAGE (m)	347.50	406.31	498.15	555.83	622.31

LONGITUDINAL SECTION
SCALE. 1:100 V 1:500 H (A1)

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
2. LOCATION OF EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GIS AND UTILITIES PLANS AND ARE INDICATIVE. CONTRACTOR IS RESPONSIBLE FOR ASSESSING DIAL B 4 U DIG INFORMATION PRIOR TO CONSTRUCTION. PHYSICAL LOCATION OF AFFECTED SERVICES WILL BE REQUIRED PRIOR TO CONSTRUCTION. ALL AFFECTED SERVICES SHALL BE PROTECTED DURING CONSTRUCTION.
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LEGEND

PROPOSED MAIN TUNNEL
PROPOSED LINK SEWER
FUTURE CSO COLLECTOR SEWER AND MANHOLE
PROPOSED SEWERAGE
PROPOSED STORMWATER
PROPOSED POWER/CONTROL DUCT
SW EXISTING STORMWATER
EXISTING STORMWATER STREAM
SS EXISTING NETWORK WASTEWATER
SS EXISTING TRANSMISSION WASTEWATER
W EXISTING WATERMAIN
LV LV POWER CABLE
HV HV POWER CABLE
MV MV POWER CABLE
TRANSPOWER LINE
DESIGNATION BOUNDARY
PROPOSED ALL WEATHER TRAFFICABLE ACCESS
PROPOSED AIR DUCT
CADASTRAL BOUNDARY
OPEN WATER CHANNEL
FENCE
SURVEY MARK
PP POWER POLE
BOLLARD
GATE
CESSPIT SINGLE
MANHOLE
STORMWATER PIPE INVERT
TREE TRUNK & APPROXIMATE DRIP LINE

INFORMATION ISSUE

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

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Plot Date: Feb 03, 2021 - 11:51am

ISSUE	DATE	AMENDMENT
A	03.02.21	IFI – CC9 CONSENT OPTION ISSUE

Watercare

KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CONSENT OPTION 3 – SHEET 2 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00012.DWG
REF No. CI-CIVIL
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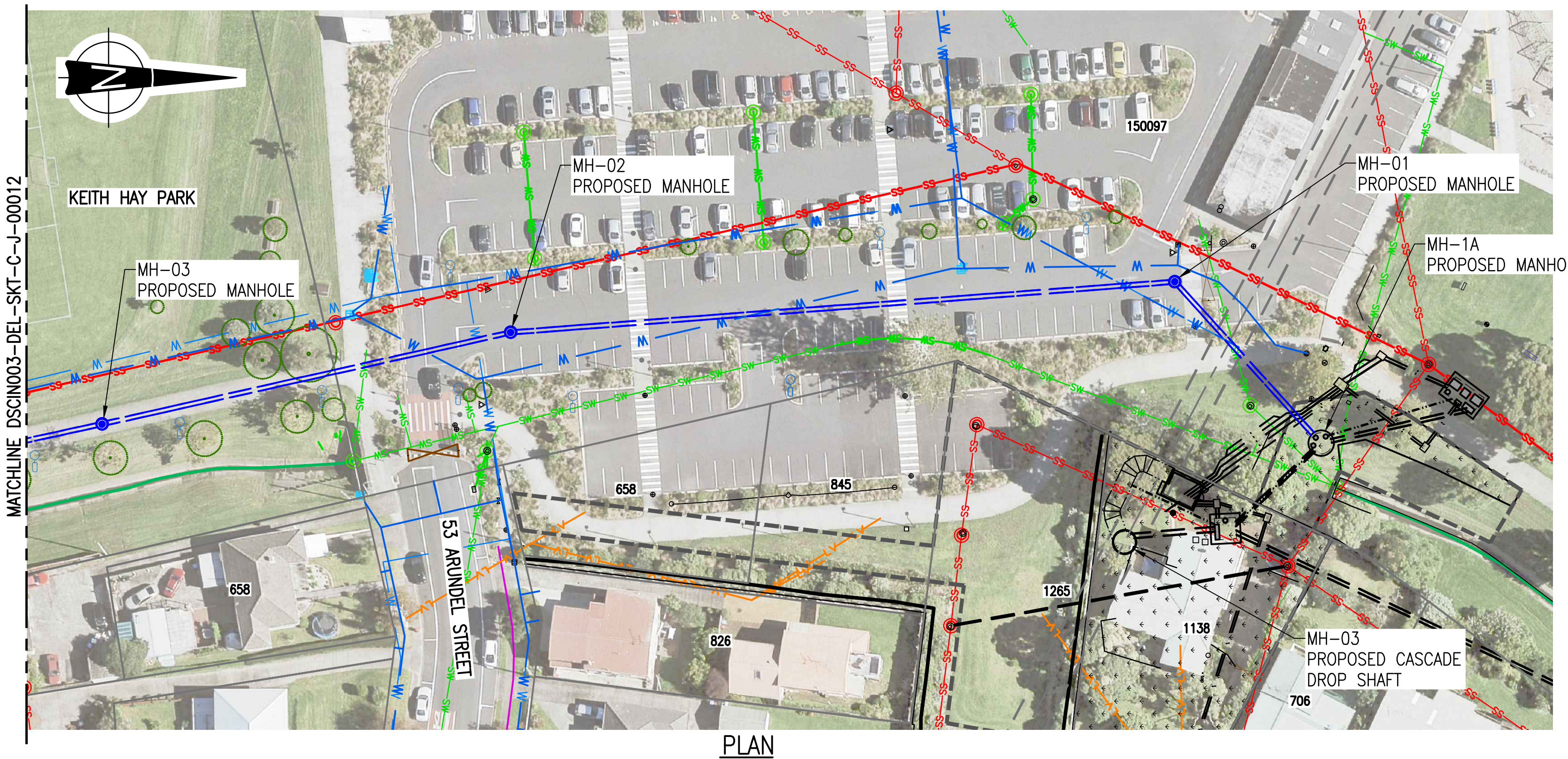
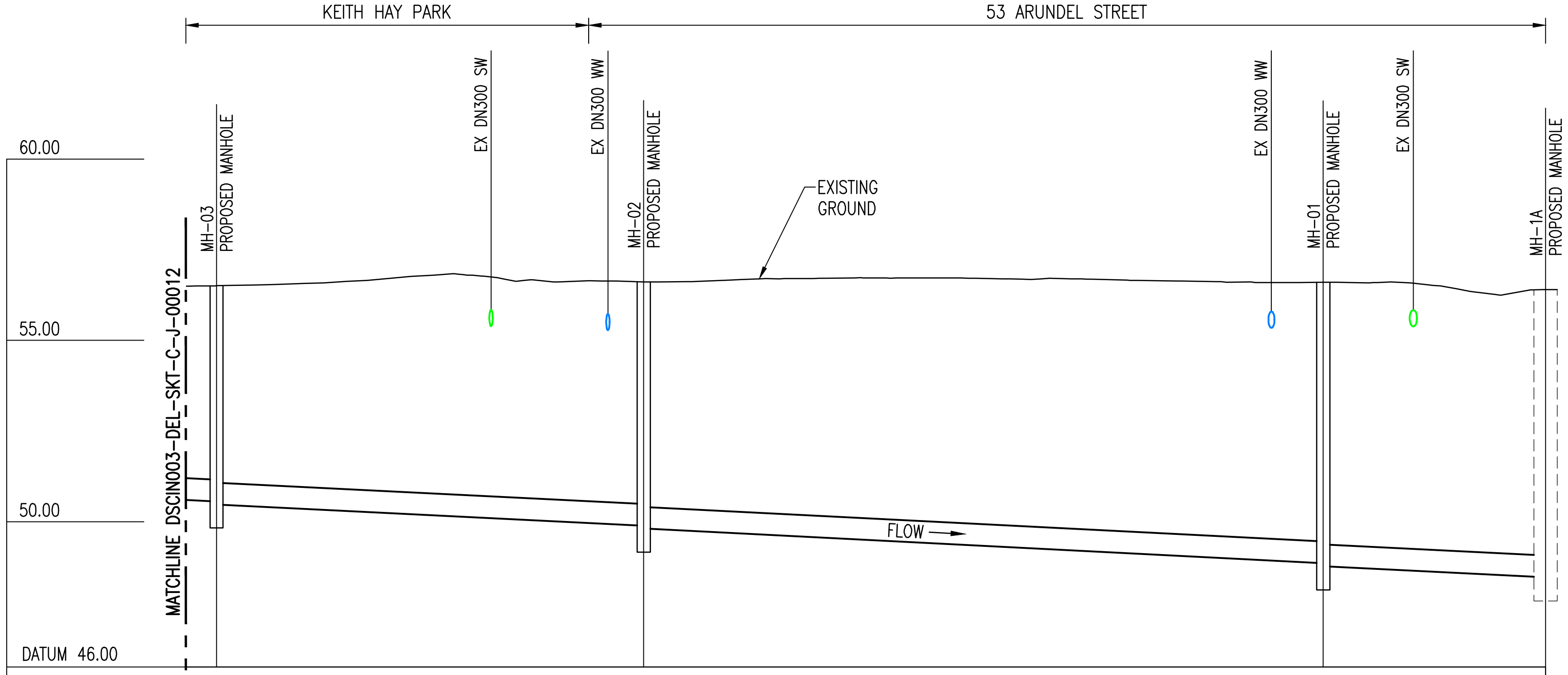
SKETCH No. DSCIN003-DEL-SKT-C-J-00012
ISSUE A



PLAN
SCALE. 1:500 (A1)



PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS			
EXISTING GROUND LEVELS (mRL)	56.51	56.61	56.60	56.40
PROPOSED INVERT LEVELS (mRL)	50.56 50.48	49.89 49.81	48.86 48.78	48.47
DEPTH TO INVERT (m)	5.95 6.03	6.72 6.80	7.74 7.82	7.93
CHAINAGE (m)	622.31	681.25	775.02	805.69

LONGITUDINAL SECTION
SCALE. 1:100 V 1:500 H (A1)

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
2. LOCATION OF EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GIS AND UTILITIES PLANS AND ARE INDICATIVE. CONTRACTOR IS RESPONSIBLE FOR ASSESSING DIAL B 4 U DIG INFORMATION PRIOR TO CONSTRUCTION. PHYSICAL LOCATION OF AFFECTED SERVICES WILL BE REQUIRED PRIOR TO CONSTRUCTION. ALL AFFECTED SERVICES SHALL BE PROTECTED DURING CONSTRUCTION.
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LEGEND

- PROPOSED MAIN TUNNEL
- PROPOSED LINK SEWER
- FUTURE CSO COLLECTOR SEWER AND MANHOLE
- PROPOSED SEWERAGE
- PROPOSED STORMWATER
- PROPOSED POWER/CONTROL DUCT
- SW — EXISTING STORMWATER
- EXISTING STORMWATER STREAM
- SS — EXISTING NETWORK WASTEWATER
- SS — EXISTING TRANSMISSION WASTEWATER
- W — EXISTING WATERMAIN
- LV — LV POWER CABLE
- HV — HV POWER CABLE
- MV — MV POWER CABLE
- TRANSPOWER LINE
- DESIGNATION BOUNDARY
- PROPOSED ALL WEATHER TRAFFICABLE ACCESS
- PROPOSED AIR DUCT
- CADASTRAL BOUNDARY
- OPEN WATER CHANNEL
- FENCE
- SURVEY MARK
- PP POWER POLE
- BOLLARD
- GATE
- CESSPIT SINGLE
- MANHOLE
- STORMWATER PIPE INVERT
- TREE TRUNK & APPROXIMATE DRIP LINE

LEGEND

- SIGN
- LIGHT POLE
- HYDRANT
- WATER METER
- TELECOM PLINTH
- GULLY TRAP
- VALVE
- SERVICE LID

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

INFORMATION ISSUE

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

ISSUE	DATE	AMENDMENT
A	03.02.21	IFI - CC9 CONSENT OPTION ISSUE

Watercare

KEITH HAY PARK - BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION - CONSENT OPTION 3 - SHEET 3 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00013.DWG
REF No. CI-CIVIL
ORIGINAL SCALE A1 AS SHOWN
SKETCH No. DSCIN003-DEL-SKT-C-J-00013
ISSUE A

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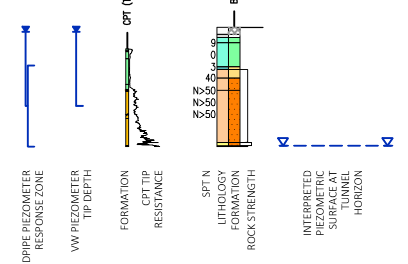
Plot Date: Feb 03, 2021 - 11:57am

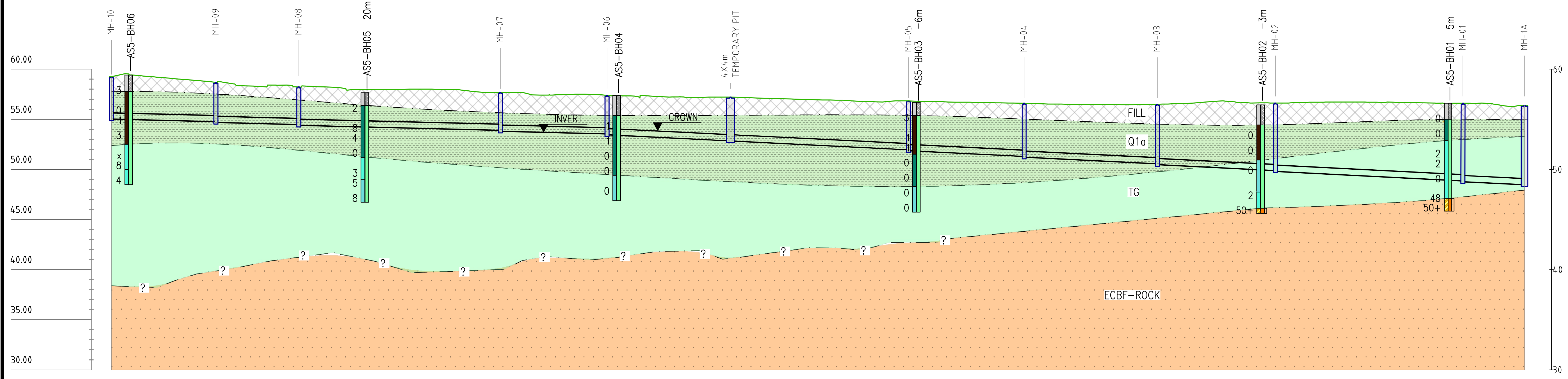
NOTES:
1. EXISTING GROUND SURFACE MODELLED FROM AUCKLAND COUNCIL GIS DATA AND LANDSURVEY DATA PROVIDED BY BECA.
2. BACKGROUND AERIAL PHOTOGRAPHY & CADASTRAL DATA FROM AUCKLAND COUNCIL GIS DATA. 21/08/2015
3. VERTICAL HEIGHT DATUM AUCKLAND 1946.
4. COORDINATE SYSTEM NZTM.
5. ALL DIMENSIONS IN METRES AND ELEVATIONS IN mRL UNLESS OTHERWISE NOTED.
6. THE GEOTECHNICAL INFORMATION SHOWN IS FOR GUIDANCE ONLY.
7. UPPER ECBF BOUNDARY UNKNOWN SOUTH OF AS5-BH02.

LEGEND

AS5-BH-03 -6m Borehole ID and offset from section. (Negative numbers are into the page.)

	BH LEFT	PLAN AND SECTION	BH RIGHT	
No core	☐	▨	▨	Made Ground (FILL)
Fill and topsoil	■	▨	▨	Recent Alluvium (Q1a)
Basalt	🟥			TAURANGA GROUP
Other volcanics	🟥	■	🟩	Undifferentiated Tauranga Group (TG)
Clay and clay dominated mixtures	🟩	■	🟦	Kaawa Formation (KAAWA)
Organic clay and organic clay dominated mixtures	🟩			
Peat	🟫			AUCKLAND VOLCANIC FIELD (PLEISTOCENE)
Silt and silt dominated mixtures	🟦	▨	🟥	Basalt (AVL)
Organic silt and organic silt dominated mixtures	🟦	▨	🟧	Tuff / Ash / Scoria (AVT)
Sand and sand dominated mixtures (clean)	🟦			WAITEMATA GROUP (MIOCENE)
Sand and sand dominated mixtures (with fines)	🟦	■	🟨	Residually to Highly Weathered - Cohesive Soils (RS)
Organic sand and organic sand dominated mixtures	🟦	▨	🟫	Residually to Highly Weathered - Granular Soils (RS)
Sandstone	🟨	▨	🟪	Parnell Volcaniclastic Conglomerate (PVC
Mudstone	🟧	▨	🟧	Moderately Weathered to Unweathered ECBF (ECBF-ROCK)
Interbedded mudstone and sandstone	▨			
Conglomerate	🟪			
Coal	■			





CHAINAGE (m)	100	200	300	400	500	600	700	800
GROUND LEVEL (mRL)	59.25	58.22	57.67	55.28	56.23	57.55	57.55	56.40
CROWN LEVEL (mRL)	55.68	49.08	49.43	49.80	50.18	50.47	50.47	49.12
INVERT LEVEL (mRL)	55.03	48.43	48.78	49.15	49.53	49.82	49.82	48.47

ISSUED FOR INFORMATION

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

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Plot Date: Mar 18, 2021 - 1:39pm

ISSUE	DATE	AMENDMENT
A	18.03.21	ISSUED FOR INFORMATION

Watercare

KEITH HAY PARK - BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
SHAFT GEOLOGY - CC9 - PLAN AND SECTION

CAD FILE DSCIN003-DEL-SKT-GT-J-30001.DWG
REF No. CI-CIVIL
ORIGINAL SCALE A1 1:1000
SKETCH No. DSCIN003-DEL-SKT-GT-J-30001
ISSUE A

Appendix C: Preliminary Site Investigation

REPORT

Tonkin+Taylor

Sewer Connection (CC9) - Keith Hay Park

Ground Contamination Assessment

Prepared for
Watercare Services Ltd
Prepared by
Tonkin & Taylor Ltd
Date
July 2021
Job Number
1015172.1400

Exceptional thinking together
www.tonkintaylor.co.nz

Document Control

Title: Sewer Connection (CC9) - Keith Hay Park– Keith Hay Park (CC9)					
Date	Version	Description	Prepared by:	Reviewed by:	Authorised by:
July 2021	1	Final Preliminary Site Investigation	Xiao Jin	Lean Phuah	Peter Roan

Distribution:

Watercare Services Ltd	1 electronic copy
Tonkin & Taylor Ltd (FILE)	1 electronic copy

Table of contents

1 Introduction 2

  1.1 Background 2

  1.2 Objective and scope of work 3

2 Site description 4

  2.1 Pipeline route 4

  2.2 Surrounding land use 5

  2.3 Geology 5

    2.3.1 Published geology 5

    2.3.2 Site specific geology 6

  2.4 Hydrology and Hydrogeology 6

3 Site history 8

  3.1 Overview 8

  3.2 Certificates of title 8

  3.3 Aerial photograph review 8

  3.4 Contamination enquiry 8

4 Potential for contamination 9

5 Implications of contamination investigation findings 11

  5.1 Proposed earthworks 11

  5.2 Consenting requirements 11

  5.3 Intrusive investigations 11

6 Conclusions 12

7 Applicability 13

Appendix A : Borehole logs

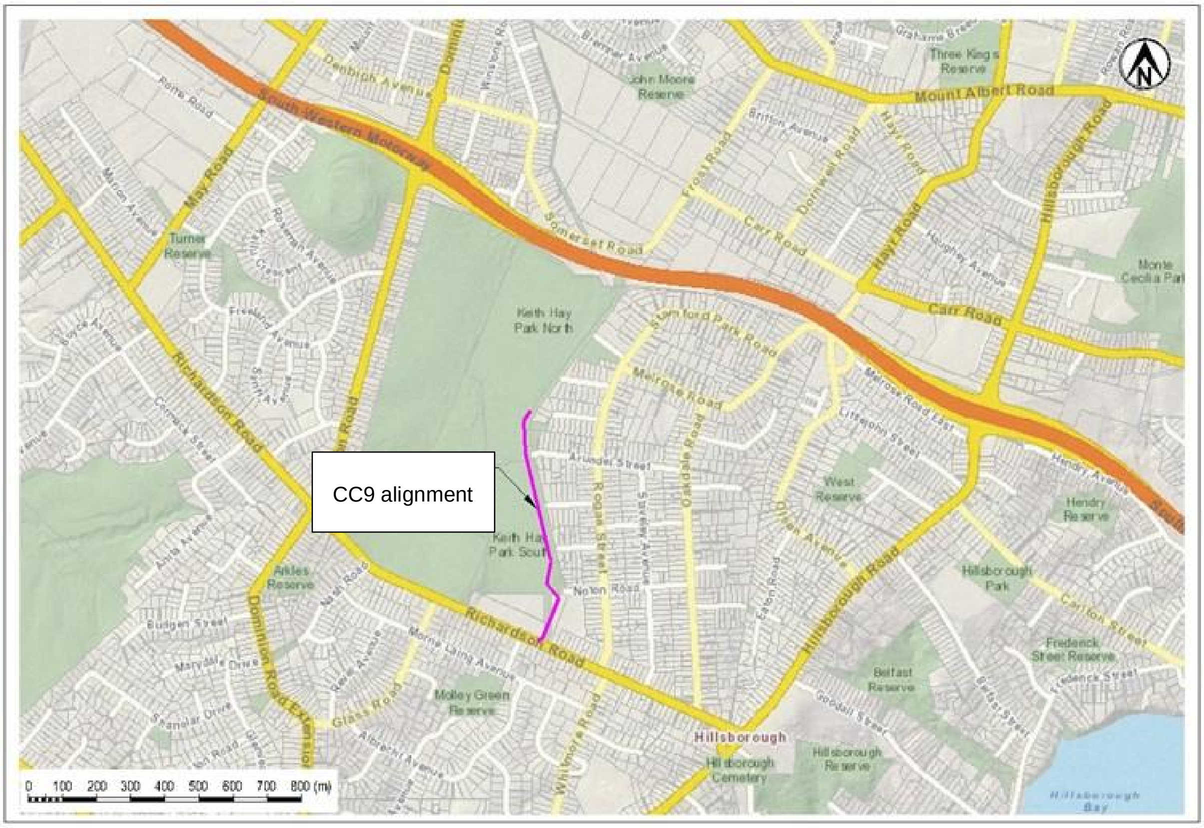
Appendix B : Aerial photographs

Appendix C : Council contamination enquiry

Appendix D : Certificates of title

1 Introduction

Tonkin & Taylor Ltd (T+T) has been commissioned by Watercare Services Ltd (Watercare) to undertake a ground contamination investigation for a proposed new connection (CC9) at Keith Hay Park. The location of the proposed CC9 (project area/site) is shown on Map 1.1. below.


CC9 alignment

Map 1.1: Project (Site) location (Source: LINZ)

1.1 Background

Watercare is proposing to install a new connection (CC9) from the CI shaft site at Keith Hay Park to Richardson Road, Mount Roskill. The latest concept drawings are presented in Error! Reference source not found. of the AEE.

The proposed works involve the installation of a sewer with an external diameter of approximately 1200 mm (900 mm ID). The new sewer is proposed to be located beneath Keith Hay Park through to an existing manhole at Richardson Road[1] and will comprise intermediate manholes at approximately 150 m apart along the route. The sewer will be located next to the existing Branch 9 trunk sewer alignment. It is proposed to be installed at a depth varying between approximately 2 and up to approximately 8 m in depth. The CC9 pipeline will be installed at a constant shallow grade (around 1:1 depending on the methodology).

At this stage, the construction methodology is expected to be trenchless (likely micro tunnelled) in the northern part of the proposed alignment through Keith Hay Park. The sewer through this section will be installed at a maximum depth of up to approximately 8 m. The southern portion of the alignment, from around manhole "M05" or "M06" near the Eden Roskill Cricket Club and through

---

[1] The proposed sewer will be physically connected to the manhole at a later stage.

Hay Park School to Richardson Road, is anticipated to be trenched to a maximum depth of 3-4 m with a trench width of approximately 1200 mm.

1.2 Objective and scope of work

T+T has undertaken this investigation to assess whether HAIL activities[2] that have the potential to cause land contamination have occurred within the proposed project area, and the potential for these activities to have resulted in ground contamination.

The scope work for this investigation comprised:

- Review of current and historical Certificates of Title;
- Review of a “Site Contamination Enquiry” provided by Auckland Council;
- Review of selected historical aerial photographs;
- Review of nearby borehole records; and
- Preparation of this report summarising the findings of the desk study.

This report documents our findings and comments on the potential for ground contamination at the site, in the context of the proposed development. This report also assesses the need for further investigation and resource consents for the proposed soil disturbance and/or land development activities with regard to ground contamination as required under the NES Soil and other relevant regulations.

---

[2] Ministry for Environment (MfE), October 2011, https://www.mfe.govt.nz/land/hazardous-activities-and-industries-list.

2 Site description

2.1 Pipeline route

The proposed pipeline extends for approximately 810 m, from the Cameron Pool and Leisure Centre carpark down to Richardson Road in the south. The pipeline alignment follows the eastern edge of Keith Hay Park (south) and intersects the carpark of the Eden Roskill Cricket Club, playground of the Hay Park School and south eastern corner of Waikowhai Intermediate School and Hillsborough Kindergarten. Further identification details are provided in Table 2.1 below.

Map 2.1: Aerial view of the proposed alignment (Source: Auckland Council Geomaps)

Table 2.1: Site identification

Location	Keith Hay Park (car park) to Richardson Road
Legal description	Keith Hay Park South and Cameron Pool and Leisure Centre: PT ALLOT 77 SEC 13 Suburbs AUCKLAND, ALLOT 78 SEC 13 Suburbs AUCKLAND, ALLOT 85 SEC 13 Suburbs AUCKLAND, ALLOT 120 SEC 13 Suburbs AUCKLAND, ALLOT 84 SEC 13 Suburbs AUCKLAND, Lot 1 DP 60415, Lot 2 DP 60415, Lot 3 DP 60415 Hay Park School: Lot 174 DP 17584, Pt Lot 1466 DP 22827, PT ALLOT 9 SEC 13 Suburbs AUCKLAND
Site owner[3]	Cameron Pool and Leisure Centre: Auckland Council

---

[3] For any works located in the road reserve (i.e. Richardson Road), Auckland Transport is the relevant authority.

	Keith Hay Park: Her Majesty The Queen Waikowhai Intermediate School and Hay Park School: Ministry of Education (Crown)
Site area	The pipeline route is approximately 810 m (total footprint conservatively estimated up to approximately 4000 m^2 if assume project footprint is up to 5 m wide).
Zoning	Mixture of Residential – Mixed Housing Suburban Zone an Open Space - Active Recreation Zone.
Designations 4732 and 4792 - Educational purposes – primary school (years 0-8), Minister of Education	These designations apply to Waikowhai Intermediate School and Hay Park School located to the south of the site.
Designation 9466 - Construction, operation and maintenance of wastewater infrastructure, Watercare	This designation applies to the Keith Hay Park CI shaft construction site to the north of the CC9 pipeline route.

2.2 Surrounding land use

The land uses in the area surrounding the site include:

- North – Keith Hay Park;
- South – Residential housing;
- East – Residential housing; and
- West – Keith Hay Park with the Akarana Golf Club beyond.

2.3 Geology

2.3.1 Published geology

The published geological map of the area[4] indicates that the site is located at the boundary of two geological units. The southern part of the project is expected to be underlain by the Tauranga Group river deposit described as sand, silt mud and clay with local gravel and peat beds. The northern part of the project is expected to comprise the Waitamata Group soils described as alternating sandstone and mudstone with variable volcanic content and interbedded volcaniclastic grits. The location of the site in the context of the regional geology is shown on Map 2.2 below.

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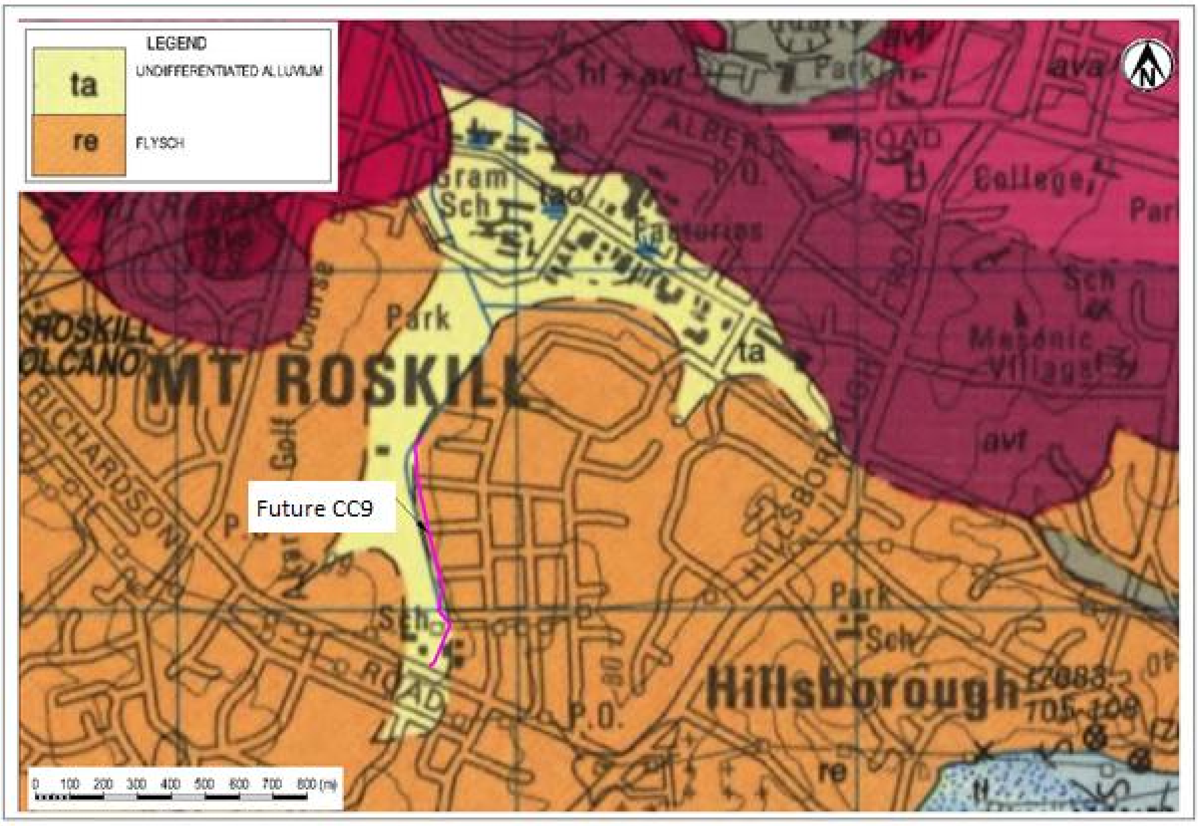
[4] Kermode, L.O. 1992. *Geology of the Auckland urban area.* Scale 1:50 000. Institute of Geological & Nuclear Sciences geological map 2. 1 sheet + 63 p. Institute of Geological & Nuclear Sciences Ltd., Lower Hutt, New Zealand.



Map 2.2: Published geology of the site (source: Kermode[4])

2.3.2 Site specific geology

Boreholes were drilled along the length of the alignment for geotechnical purposes between 8 and 15 October 2020. Borehole logs are presented in Appendix AA of this report. Borehole logs indicate that:

- Fill comprising of various layers of grey clayey silts with fine sand and fibrous inclusions was observed to depths between approximately 1.3 – 1.65 m below ground level; and
- Tauranga group sediment comprising of clayey and sandy silts with occasional organic fibrous inclusions were observed underlying the fill until the termination of the boreholes at between approximately 10.7 m – 11 m below ground level (bgl).

We also understand that peat has been identified in the borehole logs along the pipeline route.

2.4 Hydrology and Hydrogeology

A groundwater measurement taken during the drilling of a borehole recorded groundwater at 0.5 mbgl.

Based on topography, surface water is predicted to flow from the south and east towards and through Keith Hay Park (south) and northwards towards Keith Hay Park (north). Shallow groundwater flows within the Tauranga Group materials is expected to follow the surface topography and surface water flows, and flow in a generally north westerly directly towards and through Keith Hay Park from the project alignment.

Auckland Council has identified Keith Hay Park (south) as a flood prone area and flood plain. Auckland Council has also identified the western edge of Keith Hay Park (south) as a large overland flowpath which connects to the Oakley Creek.

3 Site history

Historical information relating to the site was collected from a variety of sources. The information presented documents onsite activities, except for the aerial photograph review where comments are also provided on readily observable surrounding land use. The information that has been reviewed is summarised in this section. Reviewed documents are presented in Appendix B to D.

3.1 Overview

In summary, Keith Hay Park south appears to have been developed between the 1940s and late 1950s along with the adjacent western developments and the golf course adjacent east. Prior to development the land was largely undeveloped/pastoral land with some residential developments in all directions.

Developments including the Cameron Pool and Leisure Centre, Eden Roskill Cricket Club, Hay Park School and Waikowhai Intermediate School were completed in the early 1970s with the carparks of the pool and cricket club developed between the 1970s and 1980s. These developments have stayed relatively consistent with minor renovations observed between aerials.

A review of the Auckland Council Geomaps indicates no asbestos containing underground services in the vicinity of the site.

3.2 Certificates of title

Copies of available certificates of title are provided in Appendix D. The titles are for Keith Hay Park north and south and indicate Auckland Council and The Majesty The Queen as owners of the land since 1966 and 1931, respectively. No consent notices were recorded on the titles.

3.3 Aerial photograph review

The findings of the historical aerial photograph review are summarised below:

1940: Undeveloped/pastoral land.

1959: Park with residential properties to the east of the site.

1972: Cameron Pool and Leisure Centre, Eden Roskill Cricket Club, and schools had been constructed.

1980 – 2017: No major changes. Some new buildings within the school area.

3.4 Contamination enquiry

A contamination enquiry from Auckland Council was received from council on 7 December 2020. The Council enquiry indicated that potentially unverified fill considered HAIL Item (G.5) – Waste disposal to land was identified as a potential activity at Keith Hay Park. Sampling in the northern portion of Keith Hay Park, outside the project footprint, did not identify contaminants above background concentrations.

The council enquiry further indicated that due to the age of buildings at 650 Richardson Road (the school site), there is the potential for asbestos and/or lead paint.

The council enquiry also held records of several incidents of unconsented discharge in the nearby stream that runs adjacent to Keith Hay Park between 2009 – 2013.

4 Potential for contamination

This section characterises the likely and potential contamination status of the site based on the available information as presented in Sections 2.3 and 3 of this report.

This desktop investigation has identified that potential HAIL activities were (or are likely to have been) undertaken at the site. The activities, potential contaminants and an assessment of the likelihood, potential magnitude and possible extent of contamination are presented in Table 4.1 below.

Table 4.1: Potential for contamination

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Buildings constructed (and subsequently modified or demolished) with asbestos containing materials (ACM) and use of lead based paint products	Asbestos as fibres, fines or fragments and lead.	Aerial reviews indicate that some of the buildings located close to the project footprint (e.g. school, cricket club rooms and Cameron pool) including much of the neighbouring development were completed between the 1940s to late 1950s during which lead based paint and asbestos containing material (ACM) were commonly used. Damage to or maintenance of painted surfaces (e.g. sanding or water blasting for repainting) has the potential to release lead flakes or dusts to ground. In a similar regard, if ACM was used, it is possible that asbestos was lost to ground during construction of the building include burying offcuts/waste materials, and/or by subsequent damage to or maintenance of exterior ACM cladding. If asbestos or lead contamination occurs, it is most likely to reside in the shallow soils in 'halos; immediately around the buildings in shallow soils unless mobilised by soil disturbance or water runoff or wind. Given the distance of the proposed CC9 connection development from nearby historical development (>5 m) it is unlikely for shallow soils along the proposed alignment to be affected by ACM or lead.	Assessed as not a HAIL on the basis that the proposed alignment is more than 5 m away from existing buildings (otherwise Activity H).

Land use/activity	Potential contaminants	Likelihood, magnitude and possible extent of contamination	HAIL reference
Placement of unverified fill in Keith Hay Park	Unknown but a broad range of contaminants possible depending on whether offsite material was sourced. If sourced from industrial areas then typical contaminants include metals and polycyclic aromatic hydrocarbons (PAH).	The council contamination enquiry indicated potential fill placement in Keith Hay Park. Fill may have been placed as part of the development of the park during the 1940s and 1950s. The fill as discussed in Section 2.3.2 was observed to depths of around 1.7 m and as being absent of any form of obvious contamination i.e. odours, staining, demolition material. If contamination is present in the fill material it would likely be minor and localised to the fill strata.	Not a HAIL if soils do not present a risk to human health or the environment. Otherwise, Activity H.
Potential use of pesticides for maintenance at Keith Hay Park	Arsenic, lead, copper, mercury, wide range of organic compounds including acidic herbicides, organophosphates and organochlorines (e.g., endosulfan on golf and bowling greens)	Pesticides are likely to have been used as part of the historic maintenance of Keith Hay Park. Any impacts are likely limited to shallow soils.	Activity A.10

5 Implications of contamination investigation findings

5.1 Proposed earthworks

This investigation has not identified any significant issues that would constrain proposed soil disturbance for the project from a ground contamination perspective. There are ways to manage the potential ground contamination sources identified in Table 4.1. The controls outlined in the Site Management Plan[5] (SMP) used for the wider CI project is expected to be sufficient to control any exposure to contaminated soil as part of the proposed work and is proposed to be adopted for this project.

We understand that a large part of the project pipeline will be installed using micro tunnelling at a maximum depth of up to approximately 8 m. Where trenching is required, the CC9 pipeline will be installed at a maximum depth of 3-4 m. Review of historical information and identification of HAIL on that part of the site indicates that the impacted soils are likely to be shallow confined to fill overlying the natural ground. Previous investigations indicate the maximum depth of fill to be around 1.6 m below ground surface. On that basis, the potential to encounter and become exposed to contaminated soil during micro tunnelling work is negligible.

Trenching is proposed in the southern part of the site. As the trenching works are currently proposed to be located more than 5 m from nearby buildings, the likelihood of disturbing soil impacted by asbestos and lead paint is low (noting that changes to design and alignment may result in trenching within 5 m of nearby buildings). However, the trenching works are likely to disturb near-surface fill. Historical information indicates that the fill could be slightly impacted but is unlikely to contain contaminants at levels that would be a risk to workers undertaking the trenching works. During earthworks, controls to address the possible discharge of contaminants may be necessary. Any fill that requires off-site disposal may need to be tested, depending on the location of the disposal site.

5.2 Consenting requirements

This contamination desk study fulfils the requirements of a preliminary site investigation (PSI) under the NES Soil. Given that trenching is proposed, it is unlikely that the works will be able to meet the permitted activity requirements under the NES Soil and Chapter E30 of the Auckland Unitary Plan, unless soil testing shows site soils have not been impacted by the HAIL activities.

As a detailed site investigation (DSI) report has not been completed, a discretionary activity resource consent will be required. The SMP[5] used for the wider CI project will be expanded to include this work.

5.3 Intrusive investigations

Overall, the extent and magnitude of site contamination is assessed as being low, with the only HAIL activity identified to have taken place is the use of pesticides in Keith Hay Park and potential presence of fill.

However as discussed in Sections 5.1 and 5.2 above, a DSI would be required to determine the actual risk of contamination, particularly where trenching is proposed in Keith Hay Park (or if the final alignment means that trenching occurs within 5 m of nearby buildings). The DSI can be addressed through consent conditions and should be undertaken ahead of the ground disturbance works to determine controls for managing the works, including where any excess spoil can be taken to.

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[5] Watercare Services Limited and Ghella Abergeldie Joint Venture, June 2020. *Contaminated Land Site Management Plan Central Interceptor Project – Main Project Works Version 1.1.*

6 Conclusions

T+T has carried out a ground contamination desk study on the proposed CC9 alignment located along Keith Hay Park. The objective of this report is to assess the potential for historic onsite activities to have resulted in ground contamination at the site. The conclusions of the contaminated assessments are summarised below:

- Keith Hay Park was developed between the 1940s and late 1950s. Prior to that, the land was used for pastoral purposes. The surrounding developments including the Cameron Pool and Leisure Centre, Eden Roskill Cricket Club, Hay Park School and Waikowhai Intermediate School were completed in the early 1970s with the carparks of the pool and cricket club developed between the 1970s and 1980s. The footprints of those developments stayed relatively consistent, albeit potential renovations or extensions. The use of asbestos containing material and lead based paints as building products was common in the era of development and has the potential to result in ground contamination immediately surrounding those buildings;
- Due to the distance of the works from existing buildings (i.e. more than 5 m), it is unlikely the proposed alignment will be affected by ACM or lead, and therefore for the purpose of these works we do not consider this to be a HAIL activity (noting this may change if the final alignment changes). In any case there are ways to manage the contamination, in the event it exists, during the proposed works;
- The council contamination enquiry and historical geotechnical borehole logs indicates the placement of unverified fill at Keith Hay Park (a potential HAIL activity). In addition, pesticides are likely to have been used as part of the historic maintenance of Keith Hay Park. Any impacts are likely limited to shallow soils; and
- The potential to encounter contaminated soil during micro tunnelling work in the northern part of the site is negligible.

In summary, this PSI has identified that potential HAIL activities that could impact site soils were (or are likely to have been) undertaken at the site.

Intrusive soil investigations would be required to quantify any potential ground contamination, particularly where trenching is proposed. In the absence of a DSI (or where a DSI confirms the presence of ground contamination), resource consents are required for the proposed works under the NES Soil and under Chapter E30 of the AUP. Therefore, a discretionary activity consent should be sought under the NES Soil and Chapter E30 of the AUP.

7 Applicability

This report has been prepared for the exclusive use of our client Watercare Services Ltd , with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that this report will be submitted to Auckland Council in support of an application for resource consent for the works described herein and that council will rely on this report for the purposes of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
Xiao Jin	
....	....
Xiao Jin	Peter Roan
Contaminated Land Consultant	Project Director

Report reviewed by

....

Lean Phuah

Senior Environmental Engineer

XIJI
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Appendix A: Borehole logs

Beca

ROCK LOG

Project: Central Interceptor Investigations	Site Location Central Auckland	Exposure Location: Keith Hay Park - carpark sport centre	No.: **AS5-BH01**
Job No.: 3209385	Start Date: 14/10/2020 Finish Date: 15/10/2020	Ground Level (m MSL): 56.60	Co-Ordinates (NZTM): E 1,755,277.8 N 5,912,787.1
Client: Ghella Abergeldie JV	Hole Depth: 10.76 m	Angle from Horiz.: -90°	Direction:
Sheet: 1 of 3			

Geological Description: Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.

Weathering: RS CW HW MW SW UW. Field Strength: EW VW W MS S VS ES. Defect Spacing (mm): 10 50 100 500.

Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)

Depth (m)	Method	Run / Core Recovery	Geological Description	Geological Unit	Elevation (m MSL)	Samples	Tests e.g. SPT, Packer, Permeability
0.00	VE	0.00 0%	0.00-0.40m: vacuum excavation. Refusal at 0.40m: concrete.	Fill	+56.20		
0.40	WB	0.40 0%	0.40 - 1.50m: wash drilled to complete service clearance. Note: Some fine to coarse gravel and cobbles recovered from uphole: unweathered, vesicular basalt.		+55.10		
1.50	SPT	1.50 67%	Clayey SILT, minor fine to medium sand; light grey laminated light brown, dark brown, orange. Firm, moist, high plasticity.	Tauranga Group	+55.00		SPT 1.50 m 0,0,0,0,0,0 N=0
			Organic SILT, some clay; dark brownish black. Soft, moist, high plasticity.		+54.90		
			PEAT, some clay, minor silt; dark brownish black. Fibrous, soft, moist, high plasticity. Organics: fibrous wood, plant fragments [H5 Peat].		+54.80		
			1.80 - 1.95m: no recovery.		+54.65		
1.95	TT	1.95 100%	PEAT, some clay, minor silt; dark brownish black. Fibrous, Soft, moist, high plasticity. Organics: fibrous wood, plant fragments [H5 Peat].		+54.36		
			Organic SILT, some clay; dark brownish black. Soft, moist, high plasticity. Organics: fibrous wood.		+54.24		
3.00	SPT	3.00 58%	PEAT, some clay, minor silt; dark brownish black. Fibrous, soft, moist, high plasticity. Organics: fibrous wood, plant fragments [H5 Peat].		+53.34		SPT 3.00 m 0,0,0,0,0,0 N=0
			3.26 - 3.45m: no recovery.		+53.15		
3.45	TT	3.45 62%	Organic SILT, some clay; dark brownish black. Soft, moist, high plasticity. Organics: fibrous wood. 3.55m: nodules of fine sandy SILT [Tephra].		+52.90		
			PEAT, trace clay, minor silt; dark brownish black. Fibrous, moist, low plasticity. Organics: fibrous wood, plant fragments [H5 Peat].		+52.45		
			4.15 - 4.50m: no recovery.		+52.10		
4.50	PT	4.50 64%	4.50 - 5.00m: Undisturbed tube.		+51.60	4.50	

Depth scale: 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

- ● Small Disturbed Sample
- Large Disturbed Sample
- Core Sample
- Permeability Test
- ■ Undisturbed Tube Sample
- ∨ Insitu Vane Shear Strength (kPa)
- UTP = Unable to penetrate
- Water strike (1st, 2nd...)
- ▽ Water level

Remarks

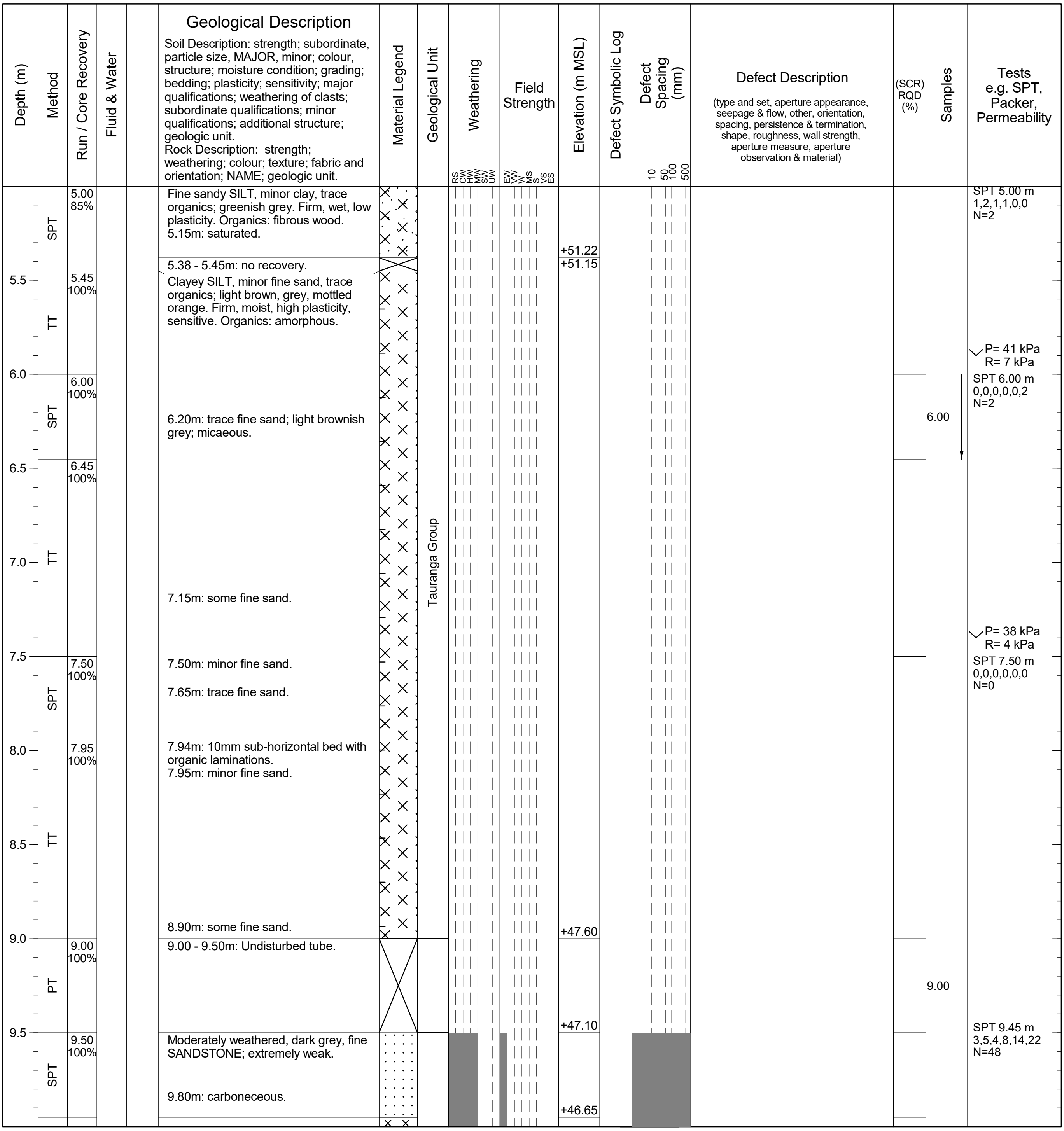
Shear vanes at 3.00m, 4.50m and 9.00m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

Beca

ROCK LOG

Project: Central Interceptor Investigations	Site Location: Central Auckland	Exposure Location: Keith Hay Park - carpark sport centre	No.: **AS5-BH01**
Job No.: 3209385	Start Date: 14/10/2020 Finish Date: 15/10/2020	Ground Level (m MSL): 56.60	Co-Ordinates (NZTM): E 1,755,277.8 N 5,912,787.1
Client: Ghella Abergeldie JV	Hole Depth: 10.76 m	Angle from Horiz.: -90°	Direction:
Sheet: 2 of 3			



Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description	Geological Unit	Elevation (m MSL)	Defect Description	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
5.00	SPT	5.00 85%		Fine sandy SILT, minor clay, trace organics; greenish grey. Firm, wet, low plasticity. Organics: fibrous wood. 5.15m: saturated.	Tauranga Group	+51.22				SPT 5.00 m 1,2,1,1,0,0 N=2
5.38				5.38 - 5.45m: no recovery.		+51.15				
5.45	TT	5.45 100%		Clayey SILT, minor fine sand, trace organics; light brown, grey, mottled orange. Firm, moist, high plasticity, sensitive. Organics: amorphous.						P= 41 kPa R= 7 kPa
6.00	SPT	6.00 100%		6.20m: trace fine sand; light brownish grey; micaeous.					6.00	SPT 6.00 m 0,0,0,0,0,2 N=2
6.45	TT	6.45 100%		7.15m: some fine sand.						P= 38 kPa R= 4 kPa
7.50	SPT	7.50 100%		7.50m: minor fine sand. 7.65m: trace fine sand.						SPT 7.50 m 0,0,0,0,0,0 N=0
7.95	TT	7.95 100%		7.94m: 10mm sub-horizontal bed with organic laminations. 7.95m: minor fine sand. 8.90m: some fine sand.		+47.60				
9.00	PT	9.00 100%		9.00 - 9.50m: Undisturbed tube.		+47.10			9.00	
9.50	SPT	9.50 100%		Moderately weathered, dark grey, fine SANDSTONE; extremely weak. 9.80m: carboneceous.		+46.65				SPT 9.45 m 3,5,4,8,14,22 N=48

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

- ● Small Disturbed Sample
- Large Disturbed Sample
- Core Sample
- Permeability Test
- ■ Undisturbed Tube Sample
- ✓ Insitu Vane Shear Strength (kPa)
- UTP = Unable to penetrate
- Water strike (1st, 2nd...)
- Water level

Remarks

Shear vanes at 3.00m, 4.50m and 9.00m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

ROCK LOG

Project: Central Interceptor Investigations	Site Location Central Auckland	Exposure Location: Keith Hay Park - carpark sport centre	No.: **AS5-BH01**
Job No.: 3209385	Start Date: 14/10/2020 Finish Date: 15/10/2020	Ground Level (m MSL): 56.60	Co-Ordinates (NZTM): E 1,755,277.8 N 5,912,787.1
Client: Ghella Abergeldie JV	Hole Depth: 10.76 m	Angle from Horiz.: -90°	Direction:
Sheet: 3 of 3			

Depth (m)	Method	Run / Core Recovery	Fluid & Water		Geological Description Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.	Material Legend	Geological Unit	Weathering RS CW HW MW SW UW	Field Strength EW VW W MS S VS ES	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm) 10 50 100 500	Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
	TT	9.95 100%			Moderately weathered, dark grey, SILTSTONE; extremely weak. *(continued)* Moderately weathered, dark grey, fine SANDSTONE; extremely weak. Moderately weathered, dark grey, SILTSTONE; extremely weak. Moderately weathered, dark grey, fine SANDSTONE; extremely weak. 10.30 - 10.40m: extremely closely spaced, 40°, carbonaceous laminations. 10.60m: 100mm bed of SILTSTONE. 10.66m: 40mm carbonaceous bed. Hole Terminated at 10.76 m		Waitemata Group			+46.57 +46.48 +46.32 +45.84						
10.5	SPT	10.40 100%														SPT 10.40 m 7,8,9,16,25/58mm N=50+
11.0																
11.5																
12.0																
12.5																
13.0																
13.5																
14.0																
14.5																

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

● Small Disturbed Sample
Large Disturbed Sample
Core Sample
Permeability Test
■ Undisturbed Tube Sample
Insitu Vane Shear Strength (kPa)
UTP = Unable to penetrate

Water strike (1st, 2nd...)
Water level

Remarks

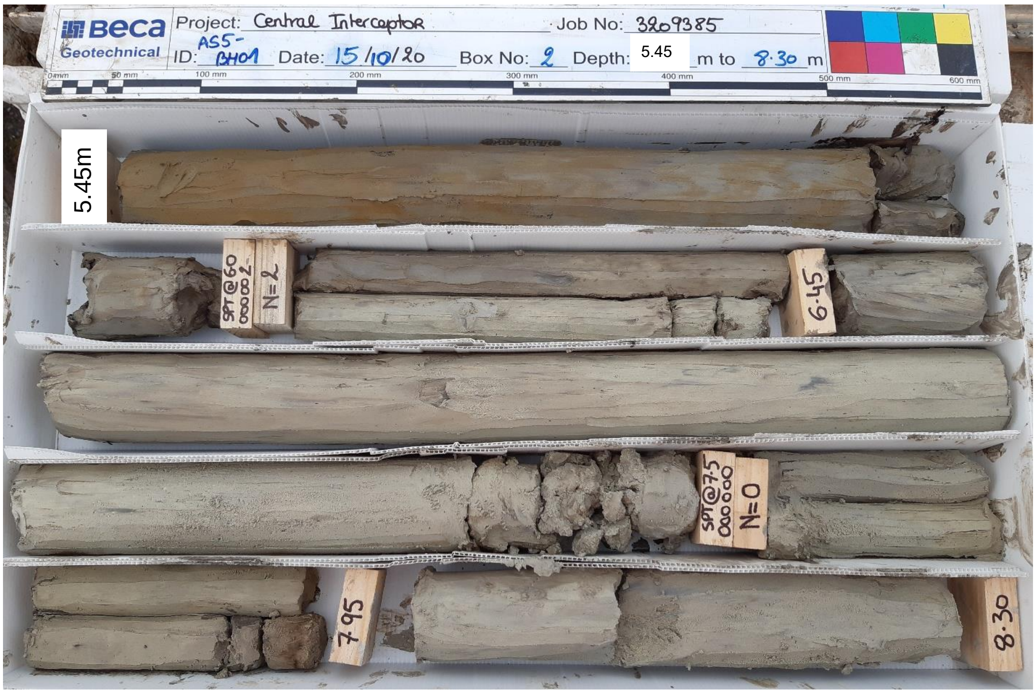
Shear vanes at 3.00m, 4.50m and 9.00m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

Central Interceptor

Beca Geotechnical
Project: Central Interceptor
Job No: 3209385
ID: AS5-BH01
Date: 14/10/20
Box No: 1
Depth: 0 m to 5.70 m

BOX: 1 **Depth:** 0.00 m to 5.45 m



Beca Geotechnical
Project: Central Interceptor
Job No: 3209385
ID: AS5-BH01
Date: 15/10/20
Box No: 2
Depth: 5.45 m to 8.30 m

BOX: 2 **Depth:** 5.45 m to 8.30 m

Central Interceptor

BOX: 3 **Depth:** 8.30 m to 10.76 m

Central Interceptor

BOX: 1 **Depth: 0.00 m to 3.60 m**

BOX: 2 **Depth: 3.60 m to 6.72 m**

Central Interceptor

BOX: 3 **Depth:** 6.72 m to 9.65 m

BOX: 4 **Depth:** 9.65 m to 10.95 m

ROCK LOG

Project: Central Interceptor Investigations	Site Location: Central Auckland	Exposure Location: Keith Hay Park - sport field	No.: **AS5-BH03**
Job No.: 3209385	Start Date: 13/10/2020 Finish Date: 14/10/2020	Ground Level (m MSL): 56.69	Co-Ordinates (NZTM): E 1,755,314.8 N 5,912,528.8
Client: Ghella Abergeldie JV	Hole Depth: 10.95 m	Angle from Horiz.: -90°	Direction:
Sheet: 1 of 3			

Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description	Geological Unit	Weathering	Field Strength	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm)	Defect Description	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
				Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.		RS CW HW MW SW UW	EW VW W MS S VS ES			10 50 100 500	(type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)			
0.00	HA	0.00 100%		Clayey SILT, minor fine sand, minor organics; brown. Stiff, dry, high plasticity. Organics: rootlets. [Topsoil]	Fill			+56.54						
				SILT, some clay, minor fine sand; light grey mottled orange. Loose, dry, non plastic (when wetted).				+56.39						
0.5				Clayey SILT; light grey mottled orange. Stiff, moist high plasticity.				+55.64						
1.0				Clayey SILT, minor fine sand, trace organics; brown mottled orange, light brown, light grey. Stiff, moist, high plasticity. Organics: amphorous. 1.30m: brown laminated dark brownish black, minor fibrous organics.				+55.37 +55.19						
1.5	SPT	1.50 55%		Organic SILT, some clay; dark brown. Firm, moist, high plasticity. Organics: fibrous wood. 1.50 - 1.70m: no recovery.	Tauranga Group			+54.99						SPT 1.50 m 0,0,0,0,1,2 N=3
2.0	TT	1.95 95%		PEAT, minor silt; dark brownish black. Fibrous, moist, non plastic. Organics: fibrous wood, plant fragments [H5 Peat]. 2.00m: some clay; high plasticity. 2.40m: 60mm fibrous wood [H3].				+54.19						
2.5				Organic SILT, some clay; dark brown. Soft, moist, high plasticity. Organics: fibrous wood [H6-H7]. 2.52m: 200mm intermixed with fine sandy SILT; orange, light grey. Loose, moist, non plastic [Tephra].				+53.69						
3.0	PT	3.00 0%		3.00 - 3:40m: Undistributed tube attempted. No recovery.				+53.19						
3.5	SPT	3.50 100%		PEAT, minor clay, minor silt; dark brownish black. Fibrous, saturated, non plastic. Organics: fibrous wood, plant fragments [H5 Peat].				+53.04 +52.89						SPT 3.50 m 0,0,0,0,0,1 N=1
				Organic SILT, some clay; dark brown. Soft, moist, high plasticity. Organics: fibrous wood.										
4.0	TT	3.95 100%		PEAT, minor clay, minor silt; dark brownish black. Fibrous, wet, non plastic. Organics: fibrous wood, plant fragments [H7 Peat].				+52.27						
				4.42 - 4.83m: no recovery.				+51.89						
4.5	SPT	4.50 27%		PEAT, minor clay, minor silt; brownish black. Fibrous, saturated, non plastic.										SPT 4.50 m 0,0,0,1,0,0 N=1

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

● Small Disturbed Sample
Large Disturbed Sample
Core Sample
Permeability Test
■ Undisturbed Tube Sample
Insitu Vane Shear Strength (kPa)
UTP = Unable to penetrate

Water strike (1st, 2nd...)
Water level

Remarks

Shear vanes at 3.00m, 4.50m, 6.0m and 7.50m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

ROCK LOG

Project: Central Interceptor Investigations	Site Location: Central Auckland	Exposure Location: Keith Hay Park - sport field	No.: **AS5-BH03**
Job No.: 3209385	Start Date: 13/10/2020 Finish Date: 14/10/2020	Ground Level (m MSL): 56.69	Co-Ordinates (NZTM): E 1,755,314.8 N 5,912,528.8
Client: Ghella Abergeldie JV	Hole Depth: 10.95 m	Angle from Horiz.: -90°	Direction:
			Sheet: 2 of 3

Geological Description

Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit.
Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.

Column headings: Depth (m) | Method | Run / Core Recovery | Fluid & Water | Geological Description | Material Legend | Geological Unit | Weathering (RS CW HW MW SW UW) | Field Strength (EW VW W MS S VS ES) | Elevation (m MSL) | Defect Symbolic Log | Defect Spacing (mm) (10 50 100 500) | Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material) | (SCR) RQD (%) | Samples | Tests e.g. SPT, Packer, Permeability

Depth (m)	Geological Description	Geological Unit	Elevation (m MSL)
4.95 – 5.20	PEAT, minor clay, minor silt; brownish black. Fibrous, saturated, non plastic. *(continued)*		+51.49
5.20 – 8.40	Organic SILT, some clay, some fine sand; dark brown. Soft, wet, high plasticity. Organics: fibrous wood, amorphous. 5.40m: trace fine sand. 5.80m: minor fine sand. 6.10m: some fine sand. 6.25m: minor fine sand. 6.40: trace fine sand. 7.80m: 150mm bed of clayey SILT; brown.	Tauranga Group	+48.29
8.40 – 9.20	Clayey SILT, trace fine sand, trace organics; brown. Soft, wet, high plasticity. 8.95m: 50mm fibrous wood. 9.05m: 50mm bed of medium GRAVEL. Gravel: angular, unweathered, siltstone. 9.10m: minor fine sand.	Tauranga Group	+47.49
9.20 – 10.00	Clayey SILT. minor organics, trace fine sand; light grey. Soft, moist, high plasticity. Organics: wood. 9.55m: 60mm fibrous wood. 9.80m: 300mm dark brown.	Tauranga Group	+46.69

Depth (m)	Method	Run / Core Recovery	Samples	Tests
4.95 – 6.00	TT	4.95 100%	5.20 ● 5.60 ●	
6.00 – 6.45	SPT	6.00 100%		SPT 6.00 m 0,0,0,0,0,0 N=0
6.45 – 7.50	TT	6.45 100%		
7.50 – 7.95	SPT	7.50 100%		SPT 7.50 m 0,0,0,0,0,0 N=0
7.95 – 9.00	TT	7.95 100%		
9.00 – 9.45	SPT	9.00 100%		SPT 9.00 m 0,0,0,0,0,0 N=0
9.45 – 10.00	TT	9.45 85%		

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

● Small Disturbed Sample
Large Disturbed Sample
Core Sample
Permeability Test
■ Undisturbed Tube Sample
Insitu Vane Shear Strength (kPa)
UTP = Unable to penetrate

Water strike (1st, 2nd...)
Water level

Remarks

Shear vanes at 3.00m, 4.50m, 6.0m and 7.50m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

Beca

ROCK LOG

Project: Central Interceptor Investigations	Site Location Central Auckland	Exposure Location: Keith Hay Park - sport field	No.: **AS5-BH03**
Job No.: 3209385	Start Date: 13/10/2020 Finish Date: 14/10/2020	Ground Level (m MSL): 56.69	Co-Ordinates (NZTM): E 1,755,314.8 N 5,912,528.8
Client: Ghella Abergeldie JV	Hole Depth: 10.95 m	Angle from Horiz.: -90°	Direction:
			Sheet: 3 of 3

Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.	Material Legend	Geological Unit	Weathering RS CW HW MW SW UW	Field Strength EW VW W MS S VS ES	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm) 10 50 100 500	Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
	TT	9.45 85%		Clayey SILT. minor organics, trace fine sand; light grey. Firm, moist, high plasticity, sensitive. Organics: fibrous wood.		Tauranga Group			+46.19						⌄ P= 46 kPa R= 11 kPa
10.5	SPT	10.50 100%		SILT, some clay, minor fine sand, trace organics; light grey. Firm, moist, high plasticity. Organics: fibrous wood.					+45.89					10.50	SPT 10.50 m 0,0,0,0,0,0 N=0
				Fine sandy SILT, minor clay; light bluish grey. Firm, moist, low plasticity.					+45.74						
11.0				Hole Terminated at 10.95 m											
11.5															
12.0															
12.5															
13.0															
13.5															
14.0															
14.5															

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

- ● Small Disturbed Sample
- ⊥ Large Disturbed Sample
- ┼ Core Sample
- ⍿ Permeability Test
- ■ Undisturbed Tube Sample
- ⌄ Insitu Vane Shear Strength (kPa)
- UTP = Unable to penetrate
- ↓ Water strike (1st, 2nd...)
- ▽ Water level

Remarks

Shear vanes at 3.00m, 4.50m, 6.0m and 7.50m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

Central Interceptor

BOX: 1 **Depth: 0.00 m to 5.15 m**

BOX: 2 **Depth: 5.15 m to 8.50 m**

Central Interceptor

BOX: **3** **Depth:** **8.50** **m to** **10.50** **m**

ROCK LOG

Project: Central Interceptor Investigations
Site Location: Central Auckland
Exposure Location: Keith Hay Park - carpark sport field
No.: **AS5-BH04**

Job No.: 3209385
Start Date: 12/10/2020
Finish Date: 12/10/2002
Ground Level (m MSL): 57.37
Co-Ordinates (NZTM): E 1,755,350.2 N 5,912,382.1

Client: Ghella Abergeldie JV
Hole Depth: 10.50 m
Angle from Horiz.: -90°
Direction:
Sheet: 1 of 3

Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.	Material Legend	Geological Unit	Weathering RS CW HW MW SW UW	Field Strength EW VW W MS S VS ES	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm) 10 50 100 500	Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
0.00	VE	0.00 0%		0.00 - 2.00m: vacuum extraction.											
0.5															
1.0															
1.5															
2.0	TT	2.00 100%		PEAT, minor silt; dark brownish black. Fibrous, wet, non plastic. Organics: fibrous wood, plant fragments [H5 Peat].		Tauranga Group			+55.37						
				Organic SILT, some clay, trace fine sand; dark brown. Soft, moist, high plasticity. Organics: fibrous wood. 2.20m: 130mm bed of silty fine SAND, trace clay [Tephra]. 2.55m: wet.					+55.22						
2.30														2.30 ●	
2.5															
				2.80m: saturated.					+54.57						
3.0	SPT	3.00 93%													SPT 3.00 m 0,0,1,0,0,0 N=1
3.5	TT	3.45 100%													
				PEAT, minor silt; dark brownish black. Fibrous, saturated, non plastic. Organics: fibrous wood, plant fragments [H5 Peat].					+53.47						
4.0															
				Organic SILT, some clay, trace fine sand; dark brown. Firm, wet, high plasticity. Organics: fibrous wood.					+52.92						⌵ P= 35 kPa R= 4 kPa
4.5	SPT	4.50 100%													SPT 4.50 m 0,0,1,0,0,0 N=1
									+52.37						

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

- ● Small Disturbed Sample
- Large Disturbed Sample
- Core Sample
- Permeability Test
- ■ Undisturbed Tube Sample
- ⌵ Insitu Vane Shear Strength (kPa)
- UTP = Unable to penetrate
- Water strike (1st, 2nd...)
- Water level

Remarks

Shear vane at 3.00m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres
Scale 1:31
Contractor: McMillan Drilling
Core Boxes:
Rig/Plant Used: Hanjin D&B
Driller:
Logged by: CJ
Checked by: SCT

Beca

ROCK LOG

Project: Central Interceptor Investigations	Site Location Central Auckland	Exposure Location: Keith Hay Park - carpark sport field	No.: **AS5-BH04**
Job No.: 3209385	Start Date: 12/10/2020 Finish Date: 12/10/2002	Ground Level (m MSL): 57.37	Co-Ordinates (NZTM): E 1,755,350.2 N 5,912,382.1
Client: Ghella Abergeldie JV	Hole Depth: 10.50 m	Angle from Horiz.: -90°	Direction:
Sheet: 2 of 3			

Geological Description: Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.

Weathering: RS CW HW MW SW UW. Field Strength: EW VW W MS S VS ES. Defect Spacing (mm): 10 50 100 500.

Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)

Depth (m)	Method	Run / Core Recovery	Geological Description	Geological Unit	Elevation (m MSL)	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
4.95	TT	4.95 100%	PEAT, minor silt; dark brownish black. Fibrous, saturated non plastic. Organics: fibrous wood, plant fragments [H5 Peat]. 5.15m: wet.	Tauranga Group				
6.0	SPT	6.00 100%	Organic SILT, minor clay, trace fine sand; dark brown. Soft, wet, low plasticity. Organics: fibrous wood.		+51.37			SPT 6.00 m 0,0,0,0,0,0 N=0
6.45	TT	6.45 100%	6.80m: moist.					
7.20			7.20 - 7:50m: fibrous wood [H3].		+50.17			
7.5	SPT	7.50 0%	7.50 - 7.95m: no recovery.		+49.87			SPT 7.50 m 0,0,0,0,0,0 N=0
7.95	TT	7.95 100%	Organic SILT, minor clay, trace fine sand; dark brown. Soft, wet, low plasticity. Organics: fibrous wood.		+49.42			
8.05			Clayey SILT, minor fine sand; light brownish grey. Firm, moist, high plasticity. 8.50m: trace fibrous organics.		+49.32			P= 21 kPa R= 11 kPa
9.0	PT	9.00 100%	9.00 - 9.50m: Undisturbed tube.		+48.37		9.00	
9.5	SPT	9.50 100%	Clayey SILT, trace fine to coarse sand, trace organics; light brownish grey. Firm, moist, high plasticity. Organics: fibrous wood.		+47.87			SPT 9.50 m 0,0,0,0,0,0 N=0

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

- ● Small Disturbed Sample
- Large Disturbed Sample
- Core Sample
- Permeability Test
- ■ Undisturbed Tube Sample
- ∨ Insitu Vane Shear Strength (kPa)
- UTP = Unable to penetrate
- Water strike (1st, 2nd...)
- Water level

Remarks

Shear vane at 3.00m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

ROCK LOG

Project: Central Interceptor Investigations	Site Location Central Auckland	Exposure Location: Keith Hay Park - carpark sport field	No.: **AS5-BH04**
Job No.: 3209385	Start Date: 12/10/2020 Finish Date: 12/10/2002	Ground Level (m MSL): 57.37	Co-Ordinates (NZTM): E 1,755,350.2 N 5,912,382.1
Client: Ghella Abergeldie JV	Hole Depth: 10.50 m	Angle from Horiz.: -90°	Direction:
Sheet: 3 of 3			

Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.	Material Legend	Geological Unit	Weathering RS CW HW MW SW UW	Field Strength EW VW W MS S VS ES	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm) 10 50 100 500	Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
	TT	9.95 100%				Tauranga Group			+47.30						
				Fine sandy SILT, minor clay; light grey. Firm, moist, low plasticity.					+47.22						
				Clayey SILT, trace fine sand, trace organics; brown. Firm, moist, high plasticity. Organics: amorphous. 10.40m: dark brown, minor amorphous organics.					+46.87						P= 26 kPa R= 11 kPa
10.5				Hole Terminated at 10.50 m											
11.0															
11.5															
12.0															
12.5															
13.0															
13.5															
14.0															
14.5															

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

- ● Small Disturbed Sample
- Large Disturbed Sample
- Core Sample
- Permeability Test
- ■ Undisturbed Tube Sample
- ∨ Insitu Vane Shear Strength (kPa)
- UTP = Unable to penetrate
- Water strike (1st, 2nd...)
- ▽ Water level

Remarks

Shear vane at 3.00m not reported due to sample disturbance in peat.
Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

Central Interceptor

Beca Geotechnical
Project: Central Interceptor
Job No: 3209385
ID: AS5 BH05
Date: 8/10/20
Box No: 1
Depth: 0 m to 2.88 m

BOX: 1 **Depth:** 0.00 m to 2.88 m

Beca Geotechnical
Project: Central Interceptor
Job No: 3209385
ID: AS5 BH05
Date: 8/10/20
Box No: 2
Depth: 2.88 m to 7.00 m

BOX: 2 **Depth:** 2.88 m to 7.00 m

Central Interceptor

BOX: 3 **Depth:** 7.00 m to 10.95 m

ROCK LOG

Project: Central Interceptor Investigations	Site Location: Central Auckland	Exposure Location: Keith Hay Park - Hay Park School	No.: **AS5-BH05**
Job No.: 3209385	Start Date: 08/10/2020 Finish Date: 08/10/2020	Ground Level (m MSL): 57.66	Co-Ordinates (NZTM): E 1,755,375.7 N 5,912,264.6
Client: Ghella Abergeldie JV	Hole Depth: 10.95 m	Angle from Horiz.: -90°	Direction:
Sheet: 1 of 3			

Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.	Material Legend	Geological Unit	Weathering RS CW HW MW SW UW	Field Strength EW VW W MS S VS ES	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm) 10 50 100 500	Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
	HA	0.00 100%		Clayey SILT, minor fine to medium sand, minor organics; dark brown. Stiff, moist, high plasticity. Organics: rootlets [Topsoil].		Fill			+57.46						
0.5				Clayey SILT, minor fine to medium sand ; light brownish orange. Very stiff, moist, high plasticity. 0.30m: light grey laminated orange.					+56.81						
1.0				Clayey SILT, minor fine sand, trace organics; dark brown. Stiff, moist, high plasticity. Organics: amorphous.					+56.39						
				Organic SILT, some clay; black. Firm, moist, high plasticity.		Tauranga Group			+56.11						P= 46 kPa R= 4 kPa
1.5	SPT	1.50 100%		Clayey SILT, minor fine to medium sand; light brown mottled orange, light grey. Firm, wet, high plasticity.					+55.94						SPT 1.50 m 0,1,0,1,0,1 N=2
2.0	TT	1.95 100%		PEAT, minor fine sand; black. Fibrous, wet, low plasticity. Organics: fibrous wood, plant fragments [H5 Peat]. 1.87m: 30mm bed of silty fine SAND; brownish orange.					+55.36						
2.5				Organic SILT, minor clay; dark brown. Soft, wet, low plasticity. Organics: fibrous.					+54.76					2.40 ● 2.60 ●	
3.0	PT	3.00 0%		PEAT, minor fine sand; black. Very soft, moist, low plasticity. Organics: fibrous wood, plant fragments [H3 Peat]. 3.00 - 3.50: Undisturbed tube attempted. No recovery.					+54.66 +54.16						
3.5	SPT	3.50 38%		PEAT, minor fine sand, minor clay; blackish brown. Wet, low plasticity. Organics: fibrous wood, plant fragments [H5 Peat]. 3.55- 3.65m: 150mm fibrous wood [H2-H3]					+53.94						SPT 3.50 m 7,7,5,1,1,1 N=8
4.0	TT	3.95 42%		3.72 - 4.27m: no recovery.					+53.39						
4.5	SPT	4.50 69%		PEAT, minor fine sand, minor clay; blackish brown. Firm, wet, low plasticity. Organics: fibrous wood, plant fragments [H3-H4 Peat].					+52.85						SPT 4.50 m 1,0,2,1,1,0 N=4
				4.81 - 4.95m: no recovery.					+52.71						

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

- ● Small Disturbed Sample
- Large Disturbed Sample
- Core Sample
- Permeability Test
- ■ Undisturbed Tube Sample
- ∨ Insitu Vane Shear Strength (kPa)
- UTP = Unable to penetrate
- Water strike (1st, 2nd...)
- Water level

Remarks

Shear vane at 3.00m, 6.00m and 9.00m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

ROCK LOG

Project: Central Interceptor Investigations	Site Location Central Auckland	Exposure Location: Keith Hay Park - Hay Park School	No.: **AS5-BH05**
Job No.: 3209385	Start Date: 08/10/2020 Finish Date: 08/10/2020	Ground Level (m MSL): 57.66	Co-Ordinates (NZTM): E 1,755,375.7 N 5,912,264.6
Client: Ghella Abergeldie JV	Hole Depth: 10.95 m	Angle from Horiz.: -90°	Direction:
Sheet: 2 of 3			

Method	Run / Core Recovery	Geological Description	Geological Unit	Elevation (m MSL)	Samples	Tests e.g. SPT, Packer, Permeability
TT	4.95 100%	PEAT, some silt, minor clay; dark brown. Soft, wet, low plasticity. Organics: fibrous wood, plant fragments [H5 Peat]. *(continued)*	Tauranga Group	+52.21		
		Organic SILT; dark brown. Soft, wet, high plasticity. Organics: fibrous wood.		+51.96		
		PEAT, some silt, minor clay; dark brown. Very soft, wet, low plasticity. Organics: fibrous wood, plant fragments [H5 Peat].		+51.81		
		Organic SILT; dark brown. Soft, moist, high plasticity. Organics: fibrous wood.		+51.66		
SPT	6.00 100%	PEAT, some silt, minor clay; dark brown. Very soft, wet, low plasticity. Organics: fibrous wood, plant fragments [H5 Peat].		+51.21		SPT 6.00 m 1,0,0,0,0,0 N=0
TT	6.45 100%	Clayey SILT, minor organics; brownish grey. Soft, wet, high plasticity, sensitive. Organics: fibrous wood. 6.90m: moist.		+50.16		P= 19 kPa R= 2 kPa
PT	7.50 100%	7.50-8.00m: Undisturbed tube.		+49.66	7.50	
SPT	8.00 100%	Clayey SILT, minor organics; light brownish grey. Firm, wet, high plasticity. Organics: fibrous wood.		+49.51		SPT 8.00 m 0,0,0,1,1,1 N=3
TT	8.45 92%	Fine sandy SILT, minor clay, trace organics; light brownish grey. Very loose, moist, low plasticity. Organics: fibrous wood.		+48.96		
SPT	9.00 100%	Silty fine to medium SAND, trace clay; bluish grey. Loose, wet, low plasticity.				SPT 9.00 m 1,1,1,1,2,1 N=5
TT	9.45 81%			+47.66		

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

● Small Disturbed Sample
Large Disturbed Sample
Core Sample
Permeability Test
■ Undisturbed Tube Sample
Insitu Vane Shear Strength (kPa)
UTP = Unable to penetrate

Water strike (1st, 2nd...)
Water level

Remarks

Shear vane at 3.00m, 6.00m and 9.00m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

ROCK LOG

Project: Central Interceptor Investigations	Site Location: Central Auckland	Exposure Location: Keith Hay Park - Hay Park School	No.: **AS5-BH05**
Job No.: 3209385	Start Date: 08/10/2020 Finish Date: 08/10/2020	Ground Level (m MSL): 57.66	Co-Ordinates (NZTM): E 1,755,375.7 N 5,912,264.6
Client: Ghella Abergeldie JV	Hole Depth: 10.95 m	Angle from Horiz.: -90°	Direction:
Sheet: 3 of 3			

Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.	Material Legend	Geological Unit	Weathering RS CW HW MW SW UW	Field Strength EW VW W MS S VS ES	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm) 10 50 100 500	Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
	TT	9.45 81%		Silty fine to medium SAND, trace clay; bluish grey. Loose, moist, low plasticity.		Tauranga Group			+47.36						
				10.30 - 10.50m: no recovery.					+47.16						
10.5	SPT	10.50 100%		Silty fine to medium SAND, trace clay; bluish grey. Loose, moist, low plasticity.					+46.71						SPT 10.50 m 1,2,1,2,2,3 N=8
11.0				Hole Terminated at 10.95 m											
11.5															
12.0															
12.5															
13.0															
13.5															
14.0															
14.5															

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

● Small Disturbed Sample
Large Disturbed Sample
Core Sample
Permeability Test
■ Undisturbed Tube Sample
Insitu Vane Shear Strength (kPa)
UTP = Unable to penetrate

Water strike (1st, 2nd...)
Water level

Remarks

Shear vane at 3.00m, 6.00m and 9.00m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

Central Interceptor

BOX: 1 **Depth:** 0.00 m to 4.50 m

BOX: 2 **Depth:** 4.50 m to 8.30 m

Central Interceptor

BOX: 3 **Depth:** 8.30 m to 10.95 m

ROCK LOG

Project: Central Interceptor Investigations	Site Location Central Auckland	Exposure Location: Keith Hay Park - carpark kindergarden	No.: **AS5-BH06**
Job No.: 3209385	Start Date: 09/10/2020 Finish Date: 09/10/2002	Ground Level (m MSL): 59.42	Co-Ordinates (NZTM): E 1,755,329.1 N 5,912,149.8
Client: Ghella Abergeldie JV	Hole Depth: 10.95 m	Angle from Horiz.: -90°	Direction:
Sheet: 1 of 3			

Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.	Material Legend	Geological Unit	Weathering RS CW HW MW SW UW	Field Strength EW VW W MS S VS ES	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm) 10 50 100 500	Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
0.5 1.0	VE	0.00 0%		0.00 - 1.50m: vacuum excavation.											
1.5	SPT	1.50 100%		1.50 - 1.65m: Bentonite - hole backfilled after vacumn excavation.		Fill			+57.92						SPT 1.50 m 0,0,1,1,0,1 N=3
2.0	TT	1.95 100%		Silty CLAY, minor organics; light grey mottled orange. Stiff, moist, high plasticity. Organics: rootlets. 1.90m: brown laminations. 2.40m: 20mm bed of organic SILT; brown. Gently inclined. 2.47m: 20mm bed of organic SILT; brown. Gently inclined.		Tauranga Group			+57.77						
2.5				Clayey SILT, trace organics; bluish grey mottled brownish orange. Stiff, moist, high plasticity.					+56.92						
				Organic CLAY; dark brown. Firm, moist, high plasticity.					+56.57						P= 87 kPa R= 29 kPa
3.0	SPT	3.00 100%		PEAT, some silt; dark brownish black. Fibrous, wet, non plastic. Organics: fibrous wood [H5 Peat].					+56.42					3.00 ●	SPT 3.00 m 0,1,0,0,0,0 N=0
				Organic SILT; dark brown. Soft, moist, high plasticity. Organics: fibrous wood.					+56.22						
3.5	TT	3.45 100%		PEAT, some silt; dark brownish black. Fibrous, wet, non plastic. Organics: fibrous wood [H5 Peat].					+55.97						
4.0				Organic SILT; dark brown. Soft, wet, high plasticity. Organics: fibrous wood.					+55.82						
4.5	SPT	4.50 100%		PEAT, some silt; dark brownish black. Fibrous, wet, non plastic. Organics: fibrous wood [H5 Peat].					+55.22						SPT 4.50 m 0,0,0,0,1,0 N=1
									+54.47						

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered

Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong

SCR - Solid Core Recovery

RQD - Rock Quality Designation

Attitude of discontinuities displayed as Dip/Dip Direction

- ● Small Disturbed Sample
- Large Disturbed Sample
- Core Sample
- Permeability Test
- ■ Undisturbed Tube Sample
- Insitu Vane Shear Strength (kPa)
- UTP = Unable to penetrate
- Water strike (1st, 2nd...)
- Water level

Remarks

Shear vane at 4.50m not reported due to sample disturbance in peat.
Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

ROCK LOG

Project: Central Interceptor Investigations	Site Location Central Auckland	Exposure Location: Keith Hay Park - carpark kindergarden	No.: **AS5-BH06**
Job No.: 3209385	Start Date: 09/10/2020 Finish Date: 09/10/2002	Ground Level (m MSL): 59.42	Co-Ordinates (NZTM): E 1,755,329.1 N 5,912,149.8
Client: Ghella Abergeldie JV	Hole Depth: 10.95 m	Angle from Horiz.: -90°	Direction:
Sheet: 2 of 3			

Geological Description: Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.

Weathering: RS CW HW MW SW UW

Field Strength: EW VW W MS S VS ES

Defect Spacing (mm): 10 50 100 500

Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)

Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description	Material Legend	Geological Unit	Weathering	Field Strength	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm)	Defect Description	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
5.5	TT	4.95 100%		Organic SILT; dark brown. Firm, wet, high plasticity. Organics: fibrous wood. *(continued)*		Tauranga Group			+53.42						P= 32 kPa R= 4 kPa
6.0	SPT	6.00 78%		6.00 - 6.10m: no recovery.					+53.32						SPT 6.00 m 1,0,1,1,1,0 N=3
				PEAT, minor silt; dark brownish black. Fibrous, wet, non plastic. Organics: fibrous wood [H5 Peat].					+53.22						
				Clayey SILT, some fine sand, trace organics; light grey. Firm, moist, high plasticity, sensitve. Organics: fibrous wood.					+52.82						
6.5	TT	6.45 100%		PEAT, minor silt; dark brownish black. Fibrous, wet, non plastic. Organics: fibrous wood [H5 Peat].					+52.52						
7.0				Fine sandy SILT, some clay, trace organics; light grey. Firm, moist, high plasticity. Organics: fibrous wood.					+52.02						
				Clayey SILT, minor fine sand; light grey. Stiff, moist, high plasticity, sensitive.					+51.92						P= 53 kPa R= 9 kPa
7.5	PT	7.50 100%		7.50 - 8.00m: Undisturbed tube.					+51.42					7.50 ●	
8.0	SPT	8.00 100%		Silty CLAY, trace fine sand, trace organics; light grey. Stiff, moist, high plasticity. Organics: fibrous wood.											SPT 8.00 m 4 blows: issue with rod length due to push tube previously sampled.
8.5	TT	8.30 100%							+50.52						P= 132 kPa R= 32 kPa
				Clayey SILT, minor fine sand, trace organics; light grey. Very stiff, high plasticity, sensitive. Organics: fibrous wood.					+50.42						
9.0	SPT	9.00 100%		Fine sandy SILT, minor clay; light grey. Very stiff, moist, low plasticity.					+50.30						SPT 9.00 m 1,3,1,2,2,3 N=8
				Clayey SILT, minor fine sand; dark grey. Very stiff, moist, high plasticity, sensitive. 9.40m: dark brown.					+49.80						
9.5	TT	9.45 11%		9.62 - 10.50m: no recovery.					+49.42						

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
RQD - Rock Quality Designation
Attitude of discontinuities displayed as Dip/Dip Direction

● Small Disturbed Sample
Large Disturbed Sample
Core Sample
Permeability Test
■ Undisturbed Tube Sample
∨ Insitu Vane Shear Strength (kPa)
UTP = Unable to penetrate

Water strike (1st, 2nd...)
Water level

Remarks

Shear vane at 4.50m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres Scale 1:31	Contractor: McMillan Drilling	Core Boxes:	Rig/Plant Used: Hanjin D&B	Driller:	Logged by: CJ	Checked by: SCT

ROCK LOG

Project:
Central Interceptor Investigations

Site Location
Central Auckland

Exposure Location:
Keith Hay Park - carpark kindergarden

No.:
AS5-BH06

Job No.:
3209385

Start Date: 09/10/2020
Finish Date: 09/10/2002

Ground Level (m MSL):
59.42

Co-Ordinates (NZTM):
E 1,755,329.1 N 5,912,149.8

Client:
Ghella Abergeldie JV

Hole Depth:
10.95 m

Angle from Horiz.:
-90°

Direction:

Sheet:
3 of 3

Depth (m)	Method	Run / Core Recovery	Fluid & Water	Geological Description Soil Description: strength; subordinate, particle size, MAJOR, minor; colour, structure; moisture condition; grading; bedding; plasticity; sensitivity; major qualifications; weathering of clasts; subordinate qualifications; minor qualifications; additional structure; geologic unit. Rock Description: strength; weathering; colour; texture; fabric and orientation; NAME; geologic unit.	Material Legend	Geological Unit	Weathering RS CW HW MW SW UW	Field Strength EW VW W MS S VS ES	Elevation (m MSL)	Defect Symbolic Log	Defect Spacing (mm) 10 50 100 500	Defect Description (type and set, aperture appearance, seepage & flow, other, orientation, spacing, persistence & termination, shape, roughness, wall strength, aperture measure, aperture observation & material)	(SCR) RQD (%)	Samples	Tests e.g. SPT, Packer, Permeability
	TT	9.45 11%		9.62 - 10.50m: no recovery.		Tauranga Group			+48.92						
10.5	SPT	10.50 100%		Clayey SILT, some fine sand; brown. Stiff, moist, high plasticity.					+48.72						SPT 10.50 m 1,1,1,1,1,1 N=4
				Fine sandy SILT, some clay; brown. Stiff, moist, high plasticity.					+48.47						
11.0				Hole Terminated at 10.95 m											
11.5															
12.0															
12.5															
13.0															
13.5															
14.0															
14.5															

Explanations:

Rock Mass Weathering - unweathered, slightly weathered, moderately weathered, highly weathered, completely weathered, residually weathered
Relative Rock Strength - extremely weak, very weak, weak, moderately strong, strong, very strong
SCR - Solid Core Recovery
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Attitude of discontinuities displayed as Dip/Dip Direction

● Small Disturbed Sample
Large Disturbed Sample
Core Sample
Permeability Test
■ Undisturbed Tube Sample
Insitu Vane Shear Strength (kPa)
UTP = Unable to penetrate

Water strike (1st, 2nd...)
Water level

Remarks

Shear vane at 4.50m not reported due to sample disturbance in peat. Groundwater not measured.

All dimensions in metres
Scale 1:31

Contractor:
McMillan Drilling

Core Boxes:

Rig/Plant Used:
Hanjin D&B

Driller:

Logged by:
CJ

Checked by:
SCT

Appendix B: Aerial photographs

B1 Historical aerial photographs

Historical aerial photographs from Auckland Council GeoMaps and Retrolens (http://retrolens.nz and licensed by LINZ CC-BY 3.0) have been reviewed. Relevant features of the site and surrounding land are summarised from each aerial photograph in Appendix B Table 1

Appendix B Table 1: Summary of aerial photograph review

1940 Auckland Council Geomaps	
Key site features	The site is undeveloped/pastoral in land use
Surrounding land features	The surrounding area is sparsely developed with some residential developments to the east and west. Patches of what appears to unvegetated area was observed adjacent west of the alignment and is potentially associated with the redevelopment of the land into the early golf club.
1959 Auckland Council geomaps	
Key site features	The site remains largely undeveloped with the exception of a small structure observed at the approximate middle of the alignment. The Keith Hay Park boundary is now better defined

	and resembles the present boundary of the park. Some potential earthworks were also observed on the northern portion of the alignment.
Surrounding land features	The surrounding area has been significantly developed with residential developments observed around the site in all directions. The golf course adjacent west of Keith Hay Park has also been developed. A sports oval/track has been developed adjacent east of the northern tip of the alignment.
1972 Retrolens [4603 – 11]	
Key site features	Structures for the Mt Roskill Cricket Club (southern part of the alignment), Cameron Pool and Leisure Centre (northern edge of the alignment), Hay Park School and Waikowhai Intermediate school (southern edge of the alignment) were observed on the aerial.
Surrounding land features	Further residential development has occurred in the surrounding area the sports oval observed in the previous aerial now developed into further residential housing

1980 Retrolens (P-12)	
Key site features	There have been some refurbishments and further redevelopment of the pool building structures. The Cricket Club to the south appears to have resurfaced the carpark, however this may be due to slight colour differences of the aerial.
Surrounding land features	No significant changes
1988 Retrolens O-5	
Key site features	There have been some refurbishments and further redevelopment of the pool building structures.
Surrounding land features	No significant changes

1996 Auckland Council Geomaps	
Key site features	No significant changes
Surrounding land features	No significant changes
2011 Auckland Council Geomaps	
Key site features	The court, along with several buildings has been redeveloped at Waikowhai Intermediate School. The Cricket Club and swimming pool structure to the south and northern end of the alignment have been redeveloped as well.
Surrounding land features	Dwellings adjacent northwest to the cricket club appears to have been redeveloped. The redevelopment remains low density residential. No other significant changes.

2017 Auckland Council Geomaps	
Key site features	A small playground has been developed between aerials at Hay Park School. No other significant differences to site.
Surrounding land features	No significant changes.

Appendix C: Council contamination enquiry

7 December 2020

Tonkin & Taylor
105 Carlton Gore Road
AUCKLAND 1023

Attention: Xiao Jin

Dear Xiao

Site Contamination Enquiry – ***650, 660 and 670 Richardson Road, Mount Roskill***

This letter is in response to your enquiry requesting available site contamination information within Auckland Council records for the above site. Please note this report does not constitute a site investigation report; such reports are required to be prepared by a (third-party) Suitably Qualified and Experienced Practitioner.

The following details are based on information available to the Contamination, Air & Noise Team in the Resource Consent Department. The details provided may be from former regional council information, as well as property information held by the former district/city councils. For completeness the relevant property file should also be requested to obtain all historical records and reports via 09 3010101 or online at:

https://www.aucklandcouncil.govt.nz/buying-property/order-property-report/Pages/order-property-file.aspx.

1. Hazardous Activities and Industries List (HAIL) Information

This list published by the Ministry for the Environment (MfE) comprises activities and industries that are considered likely to cause land contamination as a result of hazardous substance use, storage, and/or disposal.

Council's records indicate this site has possibly been subject to the following activity that fall within the HAIL:

- HAIL Item (G.5) – Waste disposal to land (excluding where biosolids have been utilised as soil conditioners).

There is no contamination information held within Council's records for the site 650 Richardson Road, Mount Roskill. However, due to the age of structures on site, the potential for asbestos and/or lead paint may need to be considered.

There is no information held within Council's records for the site 660 Richardson Road, Mount Roskill. However, the site has been identified as filled/weak ground. Sampling in the northern portion of the site did not identify contaminants at above background concentrations. However, this was not undertaken within the current area of investigation.

There is no contamination information held within Council's records for the site 670 Richardson Road, Mount Roskill. However, due to the age of structures on site, the potential for asbestos and/or lead paint may need to be considered. Additionally, the site has been identified as filled/weak ground.

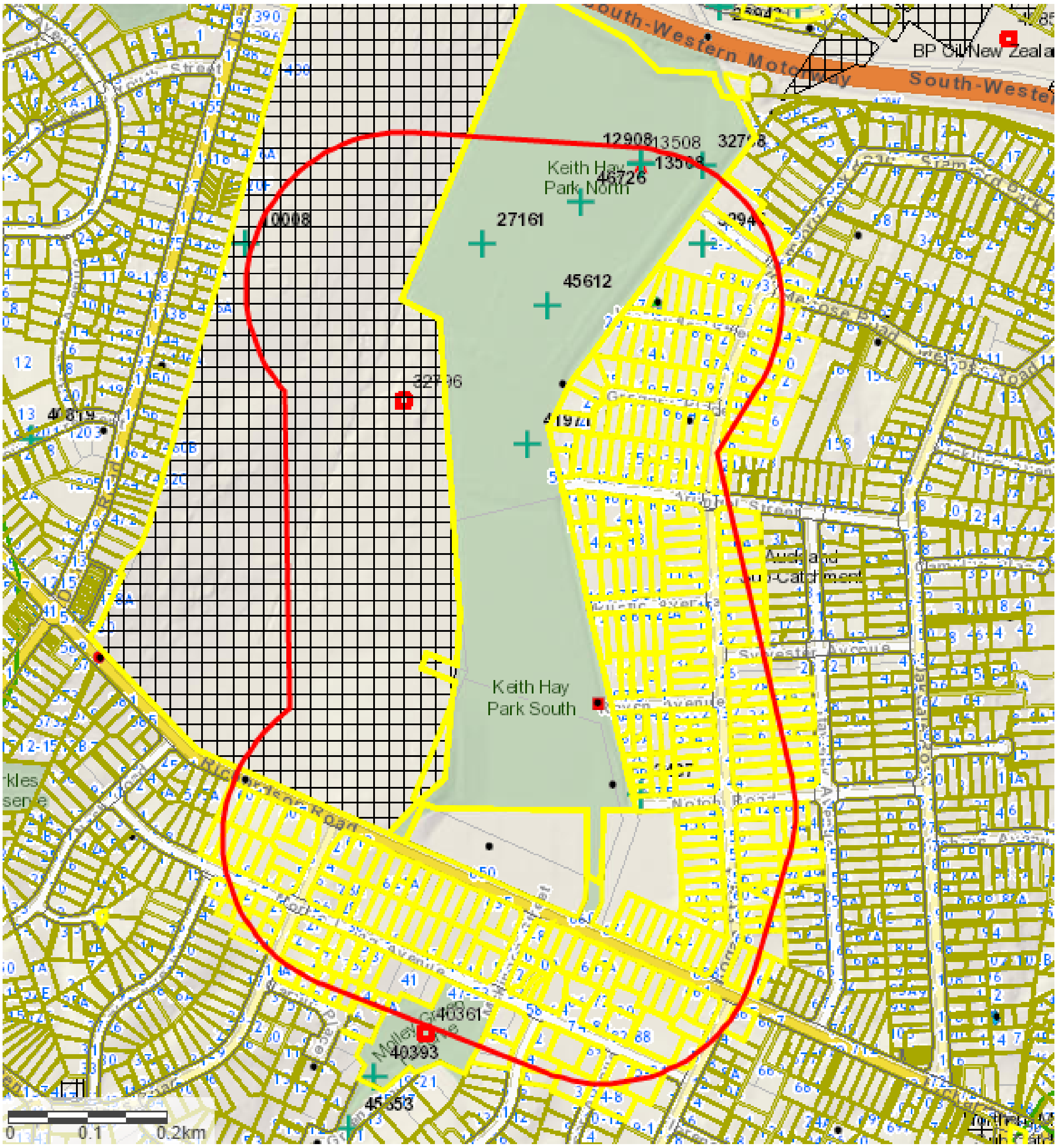
Please note:

- *If you are demolishing any building that may have asbestos containing materials (ACM) in it, you have obligations under the Health and Safety at Work (Abestos) Regulations 2016 for the management and removal of asbestos, including the need to engage a Competent Asbestos Surveyor to confirm the presence or absence of any ACM.*
- *Paints used on external parts of properties up until the mid-1970's routinely contained lead, a poison and a persistent environmental pollutant. You are advised to ensure that soils affected by old, peeling or flaking paint are assessed in relation to the proposed use of the property, including high risk use by young children.*

2. Consents and Incidents Information (200m radius of the selected site)

The Council database was searched for records of the following activities within approximately 200 metres of the site:

- Pollution Incidents (including air discharges, oil or diesel spills)
- Bores
- Contaminated site and air discharges, and industrial trade process consents
- Closed Landfills
- Air quality permitted activities



Legend:

All Consents +
All Applications 🟥
All Permitted Activities ✱
All Bores ★

Closed Landfill (Auckland Council owned) 🟪
Closed Landfill (Privately owned) 🟪

Relevant details of any pollution incidents and consents are appended to this letter (Attachment A). Please refer to the column titled ‘Property Address’ on the spreadsheet to aid in identifying corresponding data on the map.

While the Auckland Council has carried out the above search using its best practical endeavours, it does not warrant its completeness or accuracy and disclaims any responsibility or liability in respect of the information. If you or any other person wishes to act or to rely on this information, or make any financial commitment based upon it, it is recommended that you seek appropriate technical and/or professional advice.

If you wish to clarify anything in this letter that relates to this site, please contact contaminatedsites@aucklandcouncil.govt.nz. Any follow up requests for information on other sites must go through the online order process.

Should you wish to request any of the files referenced above and/or listed in the attached spreadsheet for viewing, please contact the Auckland Council Call Centre on 301 0101 and note you are requesting former Auckland Regional Council records (the records department requires three working days' notice to ensure the files will be available).

Please note Auckland Council cost recovers officer's time for all site enquiries. As such an invoice for $128 for the time involved in this enquiry will follow shortly.

Yours Sincerely,

Contamination, Air and Noise Team
Specialist Unit | Resource Consents
Auckland Council

INCIDENTN	XCOORD	YCOORD	NZTMXCOO	NZTMYCOO	LOCATION	SUBURB	CATCHMEN	POLLUTAN	RECIEVED	REPORT	INCIDENTT	ACTIONED	IMPACT	VOLUME	PROBLEMF	CULPRITTR	RECORDDATE	INVESTIGATIONDATE
10/0107	1755462	5912774	1755462	5912774	4 Gregory	Hillsboroug	546	Wastewate	Hotline	DWSO	Sewage Ov	Katie Navr	Land Only	10-200 litr	YES	YES	21/12/2009	21/12/2009
Sep-54	1755336	5912538	1755336	5912538	Arundel St	Hillsboroug	546	Dirt / Inert	Hotline	White Stre	Water / La	Glenn Ridd	Natural Wa	10-200 litr	YES	NO	31/10/2009	31/10/2009
Oct-95	1755364	5912313	1755364	5912313	660 Richar	Mt Albert	546	Dirt / Inert	Hotline	discoloure	Potential	Nora Leusc	Stormwate	<10 litres	YES	NO	17/06/2010	17/06/2010
Sep-81	1755346	5912416	1755346	5912416	Richardson	Mt Albert	546	Hydrocarb	Hotline	oil in creek	Water / La	Nora Leusc	Stormwate	10-200 litr	YES	NO	6/08/2009	6/08/2009
13/3443	1755208	5912236	1755208	5912236	650 Richar	Mt Roskill	530	Food / Bev	Hotline	Water Poll	Spill	Joe Marsha	Natural Wa	<10 litres	YES	NO	2/11/2013	2/11/2013
Dec-04	1755422	5912925	1755422	5912925	Vic Butler	Mt Roskill	530	Odour	Hotline	Odour Com	Air Polluti	Tim Butler	Potential	N/A	YES	NO	29/10/2012	29/10/2012
13/4061	1755302	5912821	1755302	5912821	53 Arundel	Hillsboroug	546	Paint / Dye	Enviroline	Culvert is d	Potential	Tim Butler	Stormwate	N/A	YES	NO	21/12/2013	21/12/2013

Appendix D: Certificates of title

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier	**NA8D/230**	**Part-Cancelled**
Land Registration District	**North Auckland**	
Date Issued	19 May 1966	

Prior References
NA1644/26

Estate	Fee Simple
Area	15.7802 hectares more or less
Legal Description	Allotment 77 Section 13 Suburbs of Auckland
Purpose	Recreation reserve

Registered Owners
Auckland Council

Interests

Subject to Section 59 Land Act 1948

SUBJECT TO THE RESERVES AND DOMAINS ACT 1953

8618489.2 Gazette Notice (2010/2913) declaring part within land now know as Section 71 SO 421535 (7705m²) to be road, which pursuant to Section 5 Land Transport Management Act 2003, forms part of State Highway 20 and vests in Her Majesty The Queen - 20.10.2010 at 4:18 pm

Subject to a right (in gross) to convey electricity over parts marked A and B on DP 479126 in favour of Vector Limited created by Easement Instrument 10853240.1 - 4.10.2017 at 9:57 am

Subject to a right (in gross) to convey electricity over part marked A on DP 459146 in favour of Vector Limited created by Easement Instrument 10853194.1 - 21.9.2018 at 8:13 am

RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy

R.W. Muir
Registrar-General
of Land

Identifier NA626/60
Land Registration District North Auckland
Date Issued 22 June 1931

Part-Cancelled

Prior References
NA122/143

Estate Fee Simple
Area 4.2674 hectares more or less
Legal Description Lot 1466 Deposited Plan 22827

Registered Owners
Her Majesty The Queen

Interests

17876 Proclamation setting apart parts for a public school - 16.11.1960 at 2.35 pm

18652 Gazette Notice declaring that the part Mount Roskill Domain over Lot 1466 DP 22827 shall cease to be subject to the provisions of Part III of the Reserves and Domains Act 1953, and shall be deemed to be a recreation reserve subject to Part II of the said Act and, further revokes the reservation for recreation purposes over the said reserve - 15.11.1961 at 9.00 am

A456124 Gazette Notice authorization of exchange of part of the within described lands for Lots 1, 2 and 3 DP 60415 (CT NA621/207) - 31.3.1970 at 9.00 am

059119.1 Gazette Notice declaring that, part of the Mount Roskill Domain shall cease to be subject to Part III of the Reserves and Domains Act 1953 and shall be deemed to be a recreation reserve, subject to Part II of the said act - 21.2.1974 at 2.10 pm

9889372.1 Certificate under section 148 of the Nga Mana Whenua o Tamaki Makaurau Collective Redress Act 2014 that the within land is RFR land as defined in section 118 and is subject to Subpart 1 of Part 4 of the Act (which restricts disposal, including leasing of the land) - 10.11.2014 at 7:00 am

4·2674 ha

REA IS

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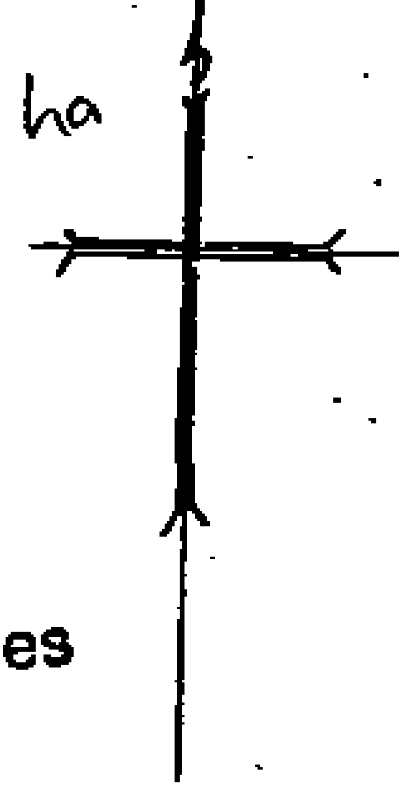

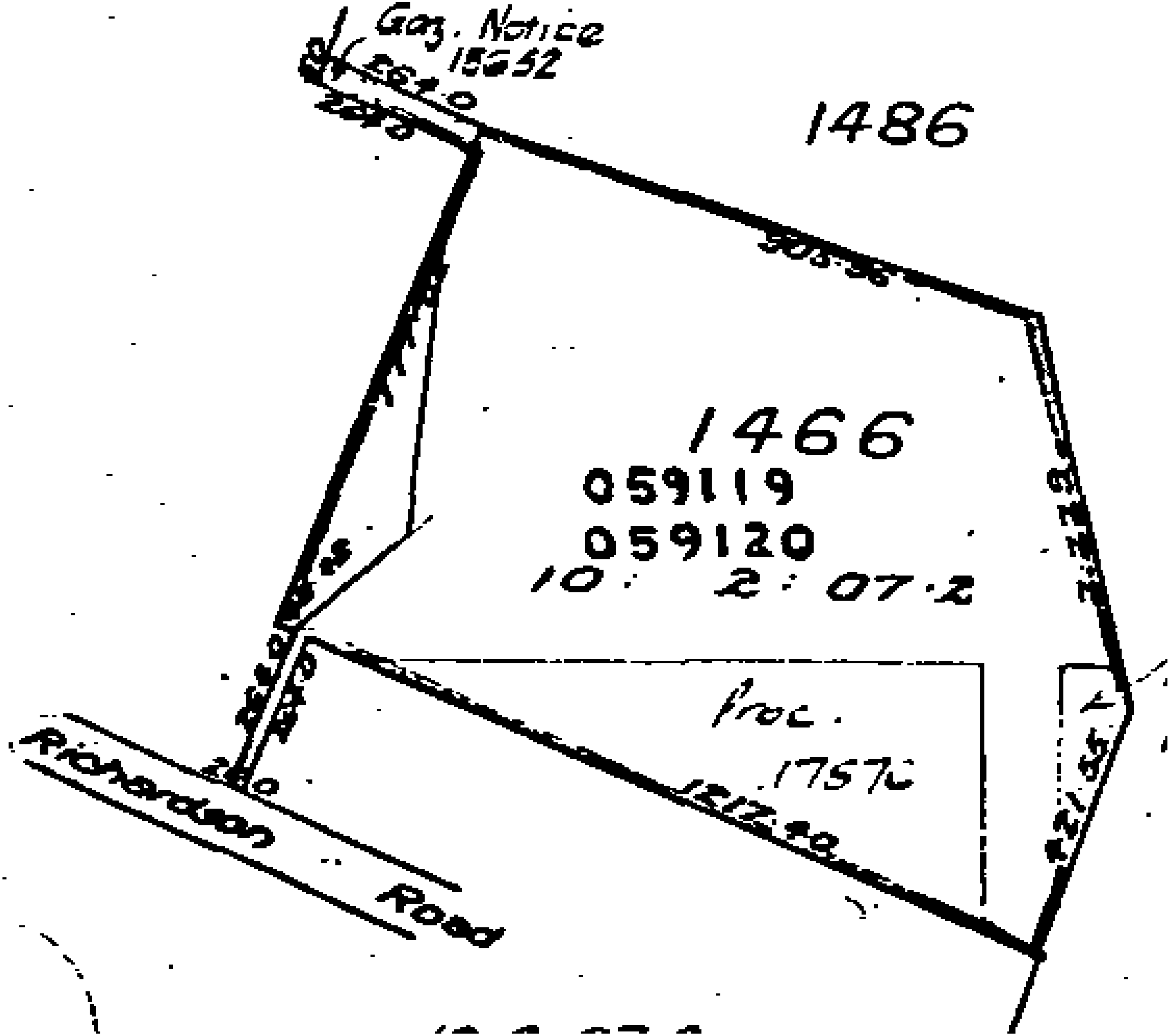

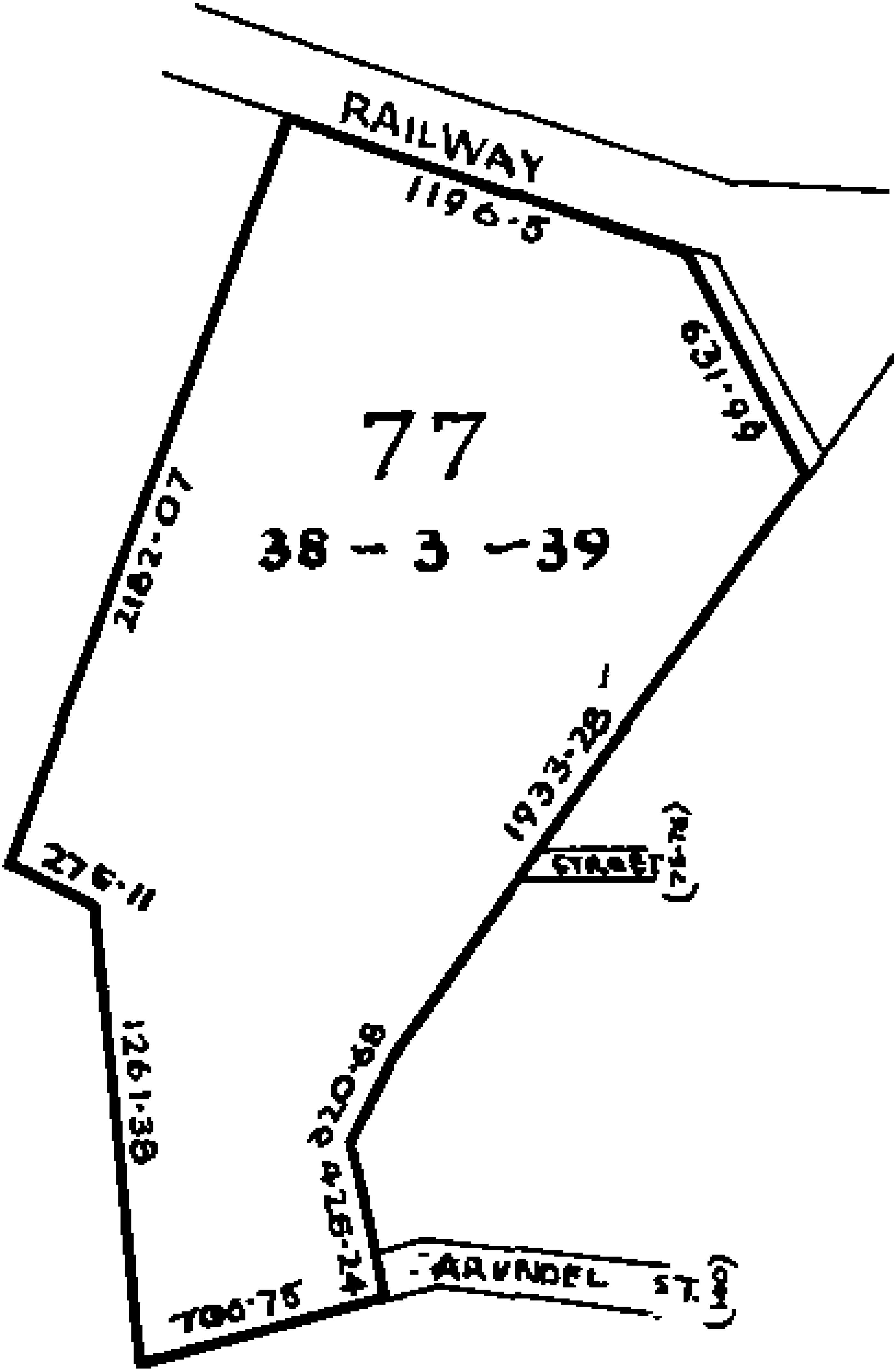
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700·75
ARUNDEL ST.

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Appendix D: Erosion and Sediment Control Plans

REPORT

Tonkin+Taylor

Sewer Connection (CC9) - Keith Hay Park

Erosion and Sediment Control Plan

Prepared for
Watercare Services Ltd
Prepared by
Tonkin & Taylor Ltd
Date
July 2021
Job Number
1015172.1400

Exceptional thinking together

www.tonkintaylor.co.nz

Document Control

Title: Sewer Connection (CC9) - Keith Hay Park					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
July 2021	1	Final Erosion & Sediment Control Plan	Stuart Airey	Steven Lopati	Peter Roan

Distribution:

Watercare Services Ltd	1 copy
Tonkin & Taylor Ltd (FILE)	1 copy

Table of contents

1 Introduction 1

1.1 Introduction 1

1.2 Background 1

2 Description of works and construction methodology 3

2.1 Overview 3

2.2 Earthworks 3

2.2.1 Extent of earthworks 3

2.2.2 Indicative earthworks methodology 5

3 Erosion and sediment control measures 7

3.1 Shaft excavations and pipe jacking 7

3.2 Open trench excavations 7

3.3 Excavation dewatering 8

3.3.1 Dewatering during winter period 8

3.4 Methods for control and management of dust emissions 8

4 Chemical aided settlement 9

4.1 Spill Contingency 9

5 Monitoring, maintenance and reporting 11

6 Rainfall response 12

7 Conclusion 13

8 Applicability 14

Appendix A : Erosion and Sediment Control Plan

Appendix B : Erosion Sediment Control: Typical details

Appendix C : Chemical Treatment Management Plan

Appendix D : Maintenance Checklist

1 Introduction

1.1 Introduction

Tonkin & Taylor Ltd (T+T) has been engaged by Watercare Services Ltd (WSL) to prepare an Erosion and Sediment Control Plan (ESCP) in support of a resource consent application for the proposed new sewer connection (CC9) from Keith Hay Park to Richardson Road, Mount Roskill. CC9 is a local sewer with a maximum outside diameter (OD) of 1200 mm (Inside diameter (ID) of 900 mm) that extends out from the Central Interceptor (CI) main works to allow connection to the existing local sewer network.

This ESCP outlines the erosion and sediment control principles, practices and procedures to be implemented to minimise the effects of sediment generation and discharge to the receiving environment associated with the construction and installation of the CC9 gravity sewer line.

The proposed works consist of open pit excavations and reception shafts to facilitate pipe jacking operations, and potentially a section of open cut trenching to install the proposed gravity sewer line. Three options have been proposed for the pipe alignment at the southern end (Option 1[1] and Options 2 and 3[2]). The Option 2 alignment is likely to be a trenchless construction methodology only. The final alignment and construction methodology will be confirmed through detailed design, however for the purpose of this assessment a worst case or conservative approach has been taken based on the southern section of pipeline being installed via open trenching (Options 1 or 3). It is noted that the Contractor will be required (as a condition of consent and contractual condition) to confirm and provide finalised erosion and sediment control plans prior to commencing construction. This report bases its recommendations on the latest proposed methodology[3].

For the purposes of this ESCP the earthwork volumes were determined assuming pipe jacking of 1200 mm diameter concrete pipes. The cross-sectional details could not be defined at this stage and are assumed to be similar to WSL's Dwg No. 2010069.001D[4] as advised by Jacobs following discussion with the Contractor[5].

Erosion and sediment control measures will be implemented throughout the project to avoid or minimise potential adverse effects by utilising measures which meet industry best practice and based on the principles outlined in the Auckland Council Guidance Document 05 (GD05)[6]. Refer to Appendix A and Appendix B for sketches illustrating the site erosion and sediment control measures.

1.2 Background

The proposed works involve the installation of an approximately 810 m length of new gravity sewer pipeline and intermediate manholes spaced approximately 65 to 150 m apart (but may be longer or shorter) with a depth to invert ranging from around 4-8 m. The pipe alignment begins at the CI shaft site and runs beneath the Cameron Leisure Pool carpark. The central section is located adjacent to the Oakley Creek channel running alongside Keith Hay Park, and it extends through Eden Roskill

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[1] Watercare (27/11/2020): *Keith Hay Park – Branch 9 Mt Roskill (DSB09) 82 Gravity Sewer including manholes: CC9 – Concept Design Issue for Review*, Issue 1.

[2] Watercare (26/02/2021): *Keith Hay Park – Branch 9 Mt. Roskill (DSB09) 82 Gravity Sewer including manholes: IRI – Revised Consent Issue, Sketch#: DSCIN003-DEL-SKT-C-J-0006: 0008 & 0009 – 00013,* Issue B

[3] Email attachment from Alex Cheesebrough (Jacobs) (02/03/2021): *FW: CC9 construction methodology*, Sent: 8:30am

[4] Watercare (28/09/2017): *Typical Trench Reinstatement and Bedding Details for Water Supply (DWG No. 2010069.001D),* Ref#: WS 2.

[5] Email from Alex Cheesebrough (Jacobs) (27/01/2021): *Consenting Questions for CC9 Update,* Sent: 3.59pm

[6] Auckland Council (06/2016): *Erosion and Sediment Control Guidelines for Land Disturbing Activities in the Auckland Region (Incorporating Amendment 2)* – Guideline Document 2016/005

Cricket Club carpark and Hay Park School, Hillsborough Kindergarten and Waikowhai Intermediate School to allow for connection into the existing network in Richardson Road.

The sewer line is an OD 1200 mm (ID 900 mm) concrete pipe (but may be larger or smaller) which will be installed using a combination of trenchless and potentially open trench construction methodologies. The trenchless method will be either pipe-jacked or Horizontal Directional Drilling (HDD) along an approximately 400 m length from the northern end southwards. Open trenching will be completed along an approximately 300 m length from near the Cricket Club through to Richardson Road to a depth of up to 5 m (noting that alternatively, the entire length of the pipeline may be completed trenchless – but this will be confirmed at the detailed design stage). See layout of Options 1 – 3, connections with the CI line and to Richardson Road shown in Figure 1.1 below.

The concrete footpath running along the eastern boundary of Keith Hay Park (south) and adjacent the Oakley Creek in the vicinity of the works will be closed for the duration of works and an alternative walkway will be provided for park users.

Figure 1.1: Approximate route of the proposed CC9 route (Option 1 in red, Option 2 in yellow, Option 3 in orange) with extents of Open Trenching (indicative only and may be subject to change) and Trenchless method. (Source: WSL[1, 2])

The Ground Contamination Assessment[7] by T+T states that surface water is predicted to flow from the south and east through Keith Hay Park (south) northwards towards Keith Hay Park (north). Shallow ground water flows (within the Tauranga Group materials, indicated to be 0.9 m below ground level) is expected to follow the surface topography and surface water flows, and flow in a generally north westerly direction towards and through Keith Hay Park from the project alignment. Auckland Council has identified Keith Hay Park (south) as a flood prone area and flood plain, and the westerly edge as a large overland flow path which connects to Oakley Creek.

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[7] Tonkin & Taylor (01/2021): *Keith Hay Park (CC9) - Ground Contamination Assessment*, Job # 1015172.1400

2 Description of works and construction methodology

2.1 Overview

The proposed works will generally be undertaken as described in Table 2.1 below. The entire time frame for activities including establishment, construction, disestablishment and remediation is anticipated to be 12-24 months[3]. Manhole identification numbers mentioned in this report are referenced from the drawings for Option 1[1], also seen in Appendix A of the AEE.

Table 2.1: Indicative scope and construction duration

Stage	Indicative Construction Duration	Indicative Scope of Works
Jacking and reception shaft excavations	Duration to be confirmed	Sheet piling and excavation of 4 shafts for construction of the trenchless pipeline, 2,200 m^3 total excavation volume (including shaft volume and jacking spoil). Construction of pipeline Connection and reinstatement
Pipe jacking operation	Duration to be confirmed	1200 mm dia. concrete pipes jacked into place*
Open trench excavations	Up to approximately four months (subject to change)[3] during the summer school holiday period as far as practicable.	Saw cutting of existing paving and footpath. Open trench excavations through grassed areas. Trench total excavation 5,300 – 5,400 m^3 and trench shoring Installation of 1200 mm dia. concrete pipe Backfilling and reinstatement Road, footpath and grass reinstatement
**This report assumes a methodology of jacking 1200 mm concrete pipes into place and the volumes calculated are based on this.*		

2.2 Earthworks

2.2.1 Extent of earthworks

The earthworks activities include shaft excavations, open trenching and pipe jacking/tunnelling operations, establishing working areas, and carting excess materials off-site.

Working areas around each excavation will be required to allow for machinery/equipment, access in and out of the work area, lay-down areas including any barriers and safety zones that may be required to facilitate the works. These areas are intended to maintain a clean working surface, to minimise the risk of silt and sediment to be tracked onto neighbouring reserve space accessed by the public, and onto the public roads. The size of the work areas for open trenching and the trenchless methodology are outlined in Table 2.2.

Lay-down areas to be constructed in grassed areas by removal of topsoil and replacement with a 300 mm thick gravel layer. It is likely that no more than two secondary lay-down areas will be in place at any one time. Each area will be reinstated to its original state once that section of the pipeline is completed.

The exact site configuration of the work areas and excavation areas will be determined by the Contractor and will vary depending on site constraints along the alignment. It is anticipated the minimum construction working width will vary based on the location plus any fencing, barriers and safety zones which may be required across Hillsborough Kindergarten, Cricket Club and Leisure Centre carparks to facilitate trenching and shaft excavation works.

Access in and out of the work areas will depend on Auckland Transport requirements. This is typical for infrastructure works of this nature and we expect Watercare has standard protocols it can rely on.

For the trenchless methodology it has been assumed there will be two 'jacking' and two 'reception' shafts excavated at each manhole location, from the CI connection end to MH-05 to facilitate pipe jacking and manhole installation. At the CI connection excavation will occur as part of the CI project so excavation volumes have not been included in this report. The depth of each shaft varies but would generally be approximately 4-8 m deep. The exact configuration of each shaft would depend on site constraints along the proposed alignment. Indicative excavation areas are detailed below in Table 2.2.

Open trenching would require a base width of 1.5 m width, and depending on its depth benching would be required, with up to approximately 3-4 m width at the surface. Benching should be completed in accordance with current occupational health and safety requirements. The pipe will be lowered into the trench and sections of the trench widened (assumed spacing at 40 m) to enable in-trench welding of pipes, if required. The estimated overall length of open trenching is approximately 300 m, although during construction the maximum length of actively open trench will be approximately 100 m (likely shorter through school grounds). Excavation shafts would be required at the location of each manhole with a corresponding working area, refer to Table 2.2. For the purposes of this report a conservative extent has been assumed for open trenching, beginning at MH05 and ending at Richardson Road.

Table 2.2: Summary of excavation areas and work areas for open trenching and trenchless methodology.

LOCATION	Excavation Area (m^2)	Work Area *excl. Excavation Area* (m^2)
	Open Trenching	
Manhole	**36*(6m *length* x 6 *width*)**	**828** (50 *length* x 20 *width*)**
	Trenchless Methodology	
Launch Shaft	**120 (6 *length* x 20 *width*)**	**880 (50 *length* x 20 *width*)**
Reception Shaft	**25 (5 *length* x 5 *width*)**	**200 (15 *length* x 15 *width*)**
**** Assumed based on minimum work area from contractor of 300 m^2*** ***** Based on maximum work area of 1000 m^2 (including excavated areas). The above value excludes the shaft excavation area and trench passing through work area***		

Pipe jacking the 1200 mm diameter concrete pipes will be completed over an estimated overall length of approximately 400 m.

Therefore, the estimated work areas for bulk earthworks for the overall jacking and reception shafts is 2,200 m^2, and overall trenching works area is 5,000 - 5,900 m^2.

The estimated earthworks volume for the overall shaft excavations is 1,900 m^3, open trenching is 5,300 – 5,400 m^3 and pipe jacking spoil removals is 300 m^3. See a summary of total work areas and earthwork volumes for Options 1-3 in Table 2.3 below.

Table 2.3: Summary of total earthwork excavation volumes and work areas for Option 1-3.

	OPEN TRENCH		TRENCHLESS METHODOLOGY		
OPTION	Work Area (m^2)*	Excavation Vol (m^3)	Work Area (m^2)*	Excavation Vol. (m^3)	Spoil Vol. (m^3)
1	5,900	5,400	2,200	1,900	300
2$^+$	5,000	5,300	2,200	1,900	300
3	5,000	5,400	2,200	1,900	300

** These areas are for construction works and the value do not include the excavation areas.*

$^+$ Option 2 alignment is trenchless.

For the purposes of this report open trenching has been assumed between MH-05 and MH-06 for Option 3; however, if this section is trenchless then allowance should be made for a 4 m x 4 m temporary pit to be excavated to retrieve a pipe jacking drill head, if required.

2.2.2 Indicative earthworks methodology

The main consideration of the programme is to undertake any open trenching or excavation works within Hay Park School, Hillsborough Kindergarten or Waikowhai Intermediate School outside of the school term as far as practicable.

Below is an indicative earthworks methodology. The exact methodology will be determined by the Contractor.

The construction works could be undertaken sequentially, or could be sequenced to allow a jacking crew and open trenching crew to work simultaneously on the project as follows:

2.2.2.1 Crew 1 - shaft excavations and pipe jacking

Prior to excavating the jacking and reception shafts, impervious retaining walls will be constructed into the ground around the perimeter of the excavations (i.e. sheet piles or soldier piles).

Water collected in the excavation will be pumped up to the surface into sediment tanks for treatment.

All excavated material from the shaft excavations will be loaded directly into tip trucks or temporarily stockpiled and carted offsite for appropriate disposal.

Once the shaft excavation is completed, the base will be concreted to provide a level platform for pipe jacking works. The 1200 mm diameter concrete pipes will be jacked into place over the design length to the next reception shaft. Spoil will be removed from pipe-jacking works, loaded onto a temporarily “stockpile” prior to offsite removal (maximum volume of stockpile to be determined). The overall length of pipe jacking is approximately 400 m.

In the case of HDD, a lay-down area immediately adjacent to the pipeline alignment will be required along the length of the route to enable pipe stringing prior to installation. Initial set-up would occur at the CI shaft with a reception shaft MH-01 likely located in the Cameron Pool carpark area with a drive from this point through to MH-03 (or alternatively from MH-03 to MH-01). Excavation shaft areas and working areas are detailed in Table 3 above.

2.2.2.2 Crew 2 - Open trenching

The existing Cricket Club asphalt and pavement carpark and concrete walkway along the pipe realignment will be saw cut, removed and the natural ground trenched through.

The trenching would be approximately 1.5 m wide at the base, and depending on the depth, benched to a surface width of 3-4 m. Benching should be undertaken in accordance with current occupational health and safety requirements. If benching is not undertaken then trench sides will need to be supported by soldier piles or steel plate shoring.

An excavator would be used to form the trench with all excavated material loaded directly into tip trucks for carting off-site to a landfill. If temporary stockpiling is needed, the stockpile will be located within the perimeter controls outlined in section 3.

Water collected in the trench will be pumped up to the surface into sediment tanks for treatment.

3 Erosion and sediment control measures

The erosion and sediment control measures to be implemented throughout the project will reflect the principles outlined in the Auckland Council's Guidance Document 05 (GD05)[6]. Specific measures are described below and in the plans attached. Refer to SK01-SK03 in Appendix A (based on Option 1) for a plan illustrating the site erosion and sediment control measures. Typical details are included in Appendix B for reference.

The majority of the CC9 sewer will be constructed using trenchless installation techniques, with little or no potential for sediment generation. However open cut trenching could also be used to install the southern section of the pipe. There will also be localised earthworks at the shaft construction sites and lay-down area(s).

Site topography is very flat which reduces the potential for erosion and sediment run-off. However, erosion and sediment control measures will be incorporated into the works methodology. The key measures to address sediment control are:

- Silt fences will be required around construction areas, and in particular any exposed areas and stockpiled excavated material and all water removed from the excavation will require treatment prior to discharge;
- Any water removed through either open trenching or trenchless processes will need to be treated and then appropriately discharged;
- Where practicable, undertaking open trenching in short (e.g. up to 100 m) sections with each section stabilised immediately on completion of the works;
- Erosion and sediment control measures will remain in place until earthworks are complete and the area of earthworks stabilised;
- Entrance ways, other areas subject to vehicle traffic and work areas will be stabilised in accordance with GD05; and
- Existing stormwater catch pits, adjacent to the site that could receive runoff from the site will be protected to GD05 standards.

3.1 Shaft excavations and pipe jacking

Clean water diversions around the excavation shaft perimeter would be provided by the sheet pile retaining/soldier piles that would extend above the ground level. Alternatively, an asphalt perimeter bund would be installed at the perimeter on pavement surfaces or a topsoil bund to be used in reserve areas. To counteract the fall in surfaces either of these options should be installed along the eastern side of the excavation shafts in the Leisure Pool Centre carpark and the west side of the shafts along the footpath.

The shaft excavation locations have been situated at the proposed manholes as it is expected that excavations will already be required to install these manholes. WSL and the Contractor to confirm or refine the shaft locations during the detailed design.

3.2 Open trench excavations

Clean water diversions would be required where carpark areas and footpaths are trenched as sections of these surfaces fall towards the trench. Sections where surfaces fall away from the trench and grassed areas would not need clean water diversion.

The west side of the trench in the Kindergarten carpark would need an asphalt diversion bund or an extension of the steel plate shoring to direct stormwater runoff around the trench and into the catchpit at the north-eastern corner of the carpark. The eastern side of the trench in the Cricket Club carpark would need an asphalt diversion bund (or steel shoring extended) to redivert stormwater runoff around the trench. The trench through the walkway between Hillsborough Kindergarten and Hay Park School would need an asphalt diversion bund (or steel shoring extended) on its western side to redivert stormwater runoff away from the trench – noting that this option (Option 2) is very likely to be trenchless.

These control measures should mitigate any adverse sediment impact on the nearby Oakley Creek.

3.3 Excavation dewatering

There are two main sources of water that will need to be collected and disposed of in the shaft and trench excavation; these are from groundwater inflows and from rainwater.

Groundwater inflow rates per excavation shaft is estimated to be 2 – 120 m^3 per day assuming permeability of soils ranging from 1 $x10^{-5}$ to $1x10^{-7}$ m/s.

Dewatering will involve pumping into a sediment tank located at existing ground level. The purpose of the tank is to allow sediment to settle out prior to discharge under gravity into the stormwater system. The sediment tank would be either a 20,000 Litre rainwater tank or a portable open top steel rectangular settlement tank (sizes vary, typically containerised).

3.3.1 Dewatering during winter period

It is expected that ground water inflow and rainfall runoff entering the excavation during the winter months will be higher than that in summer. The following contingency measures could be implemented during winter months to assist with managing the peak flowrates.

1. Additional settlement tanks may be used on the surface to increase the storage volumes required;
2. The Contractor may be required to allow the collected water in the excavation to be retained until it can be discharged via one of the dewatering methods; and
3. Last resort contingency options are to either pump excess water into a tanker to be carted to a suitable offsite disposal facility.

Which one of the above measures is to be adopted will be confirmed at detailed design and agreed between the Contractor and the consent compliance officer should construction during the winter period be required.

3.4 Methods for control and management of dust emissions

The recommended dust controls have been developed in accordance with relevant recommendations of the Ministry for the Environment Good Practice Guide for Assessing and Managing the Environmental Effects of Dust Emissions (MfE, 2016).

The following dust control measures are suggested for all general activities:

1. Sufficient water should be made available for dust control and used to wet excavation works or work areas if necessary;
2. Review daily forecast wind speed, wind direction and soil conditions before commencing activities with high dust potential;
3. The area of surfaces covered with fine materials should be minimised and exposed surfaces should be stabilized wherever practicable, excavated material can be placed in skip bins or directly into trucks where possible to minimise the need for stockpiling; and
4. If required, dust shielding (such as shelter cloth on fences) could be installed where practicable.

4 Chemical aided settlement

If chemical aided settlement is required to meet the clarity discharge requirements then bench testing will need to be undertaken and the project's Chemical Treatment Management Plan (CTMP) updated by the Contractor and be submitted to AC for certification.

To determine an appropriate flocculants and optimum-dosing rate, bench tests will need to be carried out. An example methodology is included in Appendix C of this report and is written in accordance with the following documents:

- Erosion and Sediment Control: Workshop for Chemical Treatment, Chemical Treatment Workshop Notes, August 2008, Auckland Regional Council;
- Guideline Document 2016/005 Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region; and
- Technical Publication 227 "The Use of Flocculants and Coagulants to Aid the Settlement of Suspended Sediment in Earthworks Runoff: Trials" Methodology and Design draft, June 2004, Auckland Regional Council.

In the case that flocculation is required, the following protocols will be added to those above:

- In the event that the clarity is still less than 100 mm and the pH is still within the range of 5.5 - 8.5, the optimum dose of PAC (or similar) will be added and recorded. The dose of PAC will depend on the optimum dose rate based on soil sample bench testing and will be determined when a CTMP is submitted;
- The clarity and pH will continue to be monitored to confirm whether the discharge parameters are met. Even after flocculation, the water in the tank will be slightly cloudy. If it is exceptionally clear then overdosing may have occurred. If this occurs, pH is to be measured, and if it is below 5.5, dosing will cease;
- If the discharge parameters are not met, a further 25% dose of the optimum dose of PAC is to be added and recorded. This iterative process can be undertaken a maximum of 4 times, i.e. a maximum total dose of twice the optimum PAC volume is permitted;
- The PAC is to be added to the surface of the water in the treatment device;
- In the event that after 24 hours the clarity of the treatment device is still less than 100 mm, specialist advice is to be sought; and
- In the event that 100 mm clarity is achieved but the pH is outside the limits of 5.5 – 8.5, specialist advice is to be sought regarding correction of this pH.

It is noted that the Contractor will be required (as a likely condition of consent and contractual condition) to confirm and provide further details to its own CTMP prior to commencing construction.

4.1 Spill Contingency

Any flocculant spills are to be cleaned up immediately in order to prevent adverse effects on the environment and contamination of site soils.

The flocculation chemical would be stored either off-site, or in a bunded area so that the chemical is contained in the event of the spill.

If a spill occurs, it should be immediately contained using earth bunds to prevent it entering water sources. Any PAC spilt should be recovered if possible and placed in polyethylene containers. If it cannot be recovered, it should be neutralised in accordance with Section F 2.2.2 of GD05[6]. The spill site will be assessed and any affected soil and/or water sampled by a suitably qualified person to ensure that no contamination effects remain around the spill site. If reagent is spilled into ponded water, discharge to the ocean should be prevented. Ponded water should be sampled and tested to confirm if the water is safe to discharge.

If there is a spill of reagent that enters into the stormwater network system, Auckland Council should be immediately advised and the volume of the spill recorded. Measures to remove reagent from the stormwater network system should be taken, if possible. If the reagent cannot be removed, any other nearby users including the public/neighbours should be identified and advised.

5 Monitoring, maintenance and reporting

The seven-day weather forecast will be monitored.

Monitoring of all erosion and sediment control devices will be undertaken regularly. Any maintenance will be in accordance with GD05[6]. An example site erosion and sediment control inspection checklist is included in Appendix D; however, the project is likely to use its own inspection sheets (included within the project's certified Erosion and Sediment Control Plan).

When sediment has accumulated to 20% of the storage volume, the settlement tanks would be de-silted by a sucker truck and carted off-site for appropriate disposal.

Chemical dosing rates (when required) will be undertaken before discharging into the stormwater system.

The location at the public stormwater outfalls where site discharge enters the stormwater network will be monitored daily for visible plumes and unexpected sediment discharge.

The contractor will maintain onsite monitoring records including:

- Date;
- Time of pumping;
- Clarity depth;
- Estimated volume water;
- PAC added (if required);
- pH level;
- Time of discharge; and
- Chemical dosing (if required) will be undertaken before discharge.

.

6 Rainfall response

All erosion and sediment controls will be checked before and after extreme and heavy rainfall to ensure the controls are operating correctly as per the CI project’s standard practices.

Monitoring of all erosion and sediment control devices will be undertaken regularly with elements inspected recorded and records readily accessible.

7 Conclusion

This ESCP outlines the erosion and sediment control principles, practices and procedures to be implemented to minimise the effects of sediment generation and discharge to the receiving environment associated with the construction and installation of the CC9 gravity sewer line.

The specific alignment of the pipe and construction methodology will be confirmed through detailed design. However, the proposed works consist of open pit excavations to form pipe jacking and reception shafts to facilitate pipe jacking, and potentially a section of open cut trenching to install the proposed gravity sewer line.

Estimated work areas for the jacking and reception shafts is 2,200 m^2 and bulk earthworks for shaft excavations is 1,900 m^3 and pipe jacking spoil removal is 300 m^3. The alignment of open trench works at the southern end varies and overall work areas range from 5,000 – 5,900 m^2 and overall trench excavations 5,300 – 5,400 m^3.

A lay-down area with a 300mm thick gravel layer is to be constructed on grassed areas (following removal of topsoil) within any allocated work areas.

Erosion and sediment control measures will be implemented throughout the project to avoid or minimise potential adverse effects by utilising measures which meet industry best practice and in accordance with GD05[6]. We consider that following the erosion and sediment control principles, practices and procedures outlined in this report is a best practice approach to the mitigation of the potential adverse effects of erosion and sediment discharge during earthworks for this project.

8 Applicability

This report has been prepared for the exclusive use of our client Watercare Services Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that this report will be submitted to Auckland Council in support of an application for resource consent for the works described herein and that council will rely on this report for the purposes of assessing that application.

Tonkin & Taylor Ltd

Environmental and Engineering Consultants

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Stuart Airey	Peter Roan
Civil Engineer	Project Director

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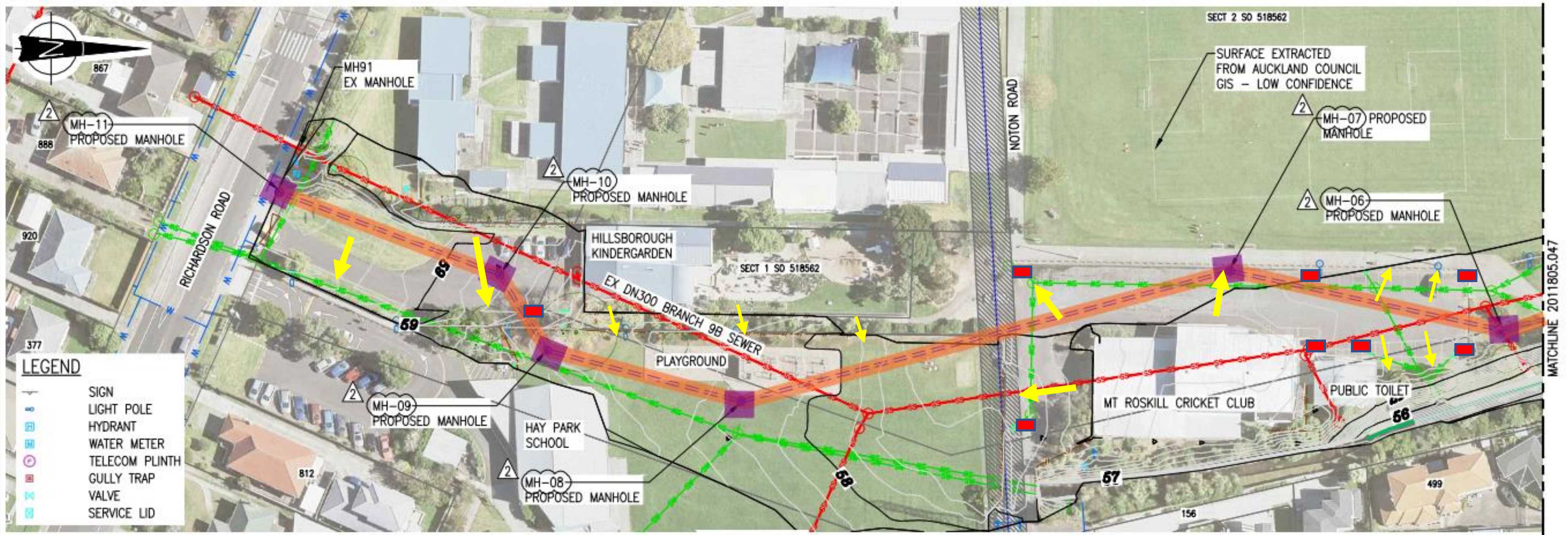
Appendix A: Erosion and Sediment Control Plan

Based on pipe alignment in Option 1



PLAN
SCALE 1:500 (A1)

🟧 INSTALLATION BY OPEN TRENCHING (Refer SK05)

🟨 INSTALLTION BY PIPE JACKING

🟪 EXCAVATION SHAFT (Refer SK04)

→ APPROXIMATE DIRECTION OF FALL ON SURFACE

🟥 CATCHPIT

NB: Location of Manholes are indicative only

LEGEND

PROPOSED MAIN TUNNEL
PROPOSED LINK SEWER
FUTURE CSO COLLECTOR SEWER AND MANHOLE
PROPOSED SEWERAGE
PROPOSED STORMWATER
PROPOSED POWER/CONTROL DUCT
SW EXISTING STORMWATER
EXISTING STORMWATER STREAM
SS EXISTING NETWORK WASTEWATER
SS EXISTING TRANSMISSION WASTEWATER
W EXISTING WATERMAIN
LV LV POWER CABLE
HV HV POWER CABLE
MV MV POWER CABLE
TRANSPOWER LINE
DESIGNATION BOUNDARY

EROSION & SEDIMENT CONTROL PLAN

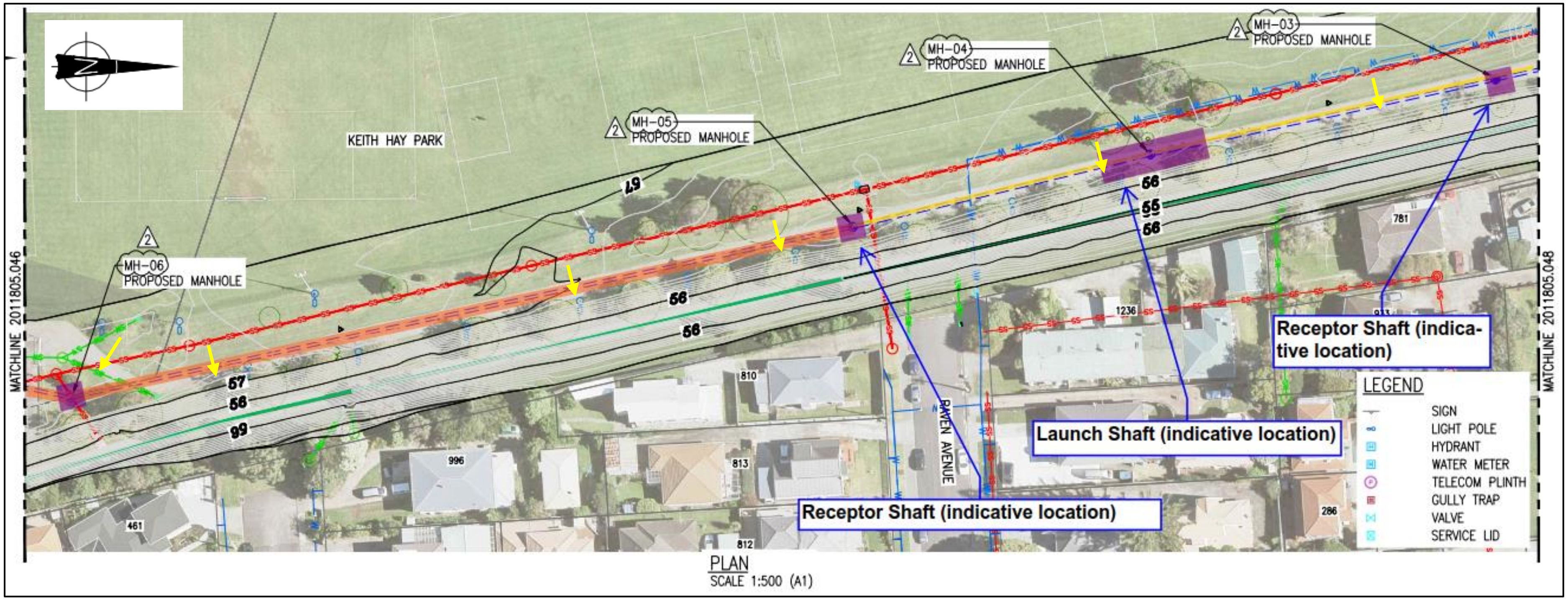
Tonkin+Taylor

Keith Hay Park – Installation of CC9 pipe

Job No: 1015172.1400 Date: 28.01.2021

CH 100.00m TO 352.67m

SK01



🟧 INSTALLATION BY OPEN TRENCHING (Refer SK05)

🟨 INSTALLTION BY PIPE JACKING

🟪 EXCAVATION SHAFT (Refer SK04)

→ APPROXIMATE DIRECTION OF FALL ON SURFACE

🟥 CATCHPIT

NB: Location of Manholes are indicative only

EROSION & SEDIMENT CONTROL PLAN

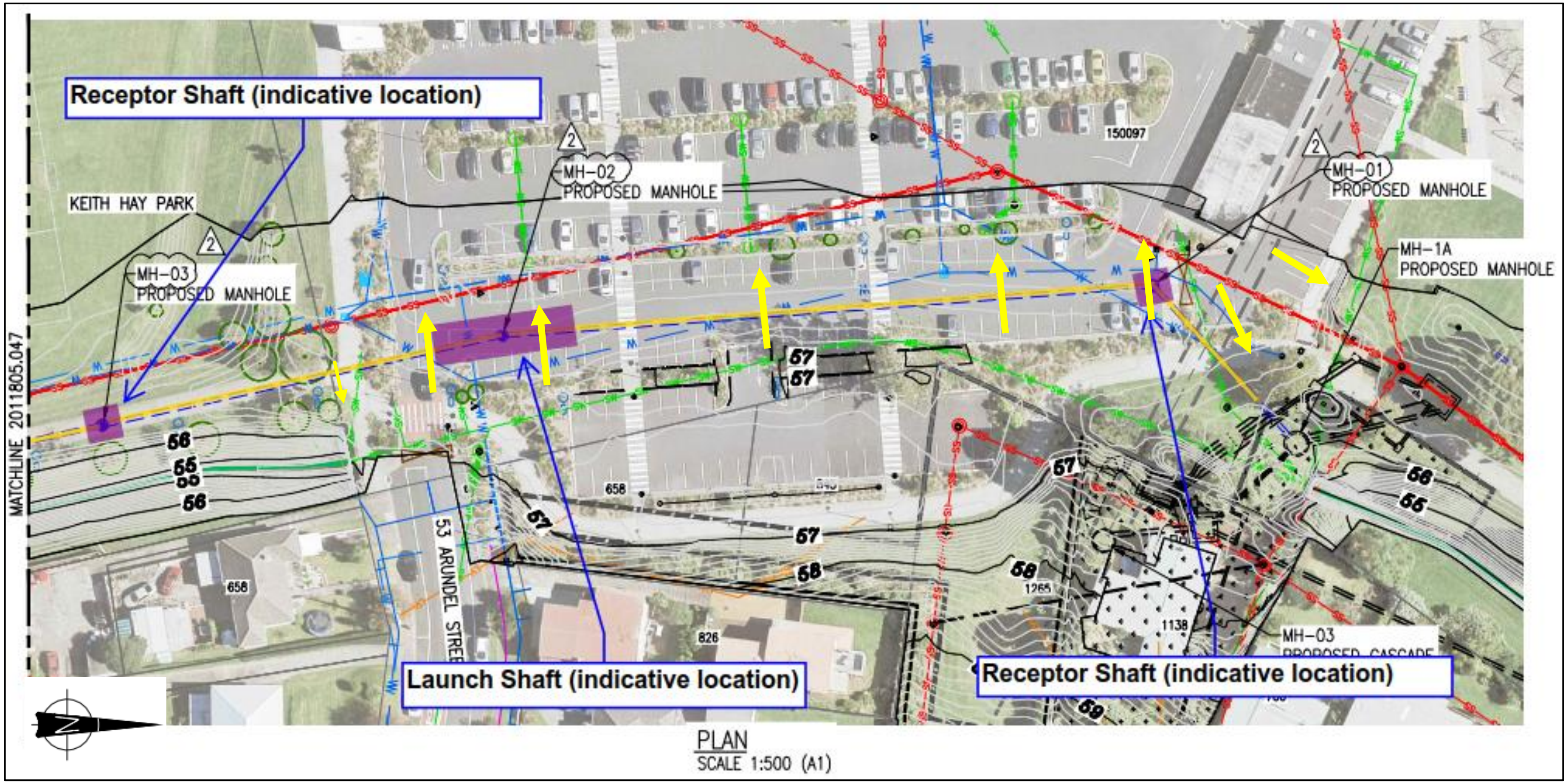
Tonkin+Taylor

Keith Hay Park – Installation of CC9 pipe

Job No: 1015172.1400 Date: 28.01.2021

CH 352.67m TO 627.47m

SK02



PLAN
SCALE 1:500 (A1)

🟧	INSTALLATION BY OPEN TRENCHING (Refer SK05)
🟨	INSTALLTION BY PIPE JACKING
🟪	EXCAVATION SHAFT (Refer SK04)
→	APPROXIMATE DIRECTION OF FALL ON SURFACE
🟥	CATCHPIT

NB: Location of Manholes are indicative only

EROSION & SEDIMENT CONTROL PLAN

Keith Hay Park – Installation of CC9 pipe

Job No: 1015172.1400 Date: 28.01.2021

CH 627.47m TO 810.85m

Tonkin+Taylor

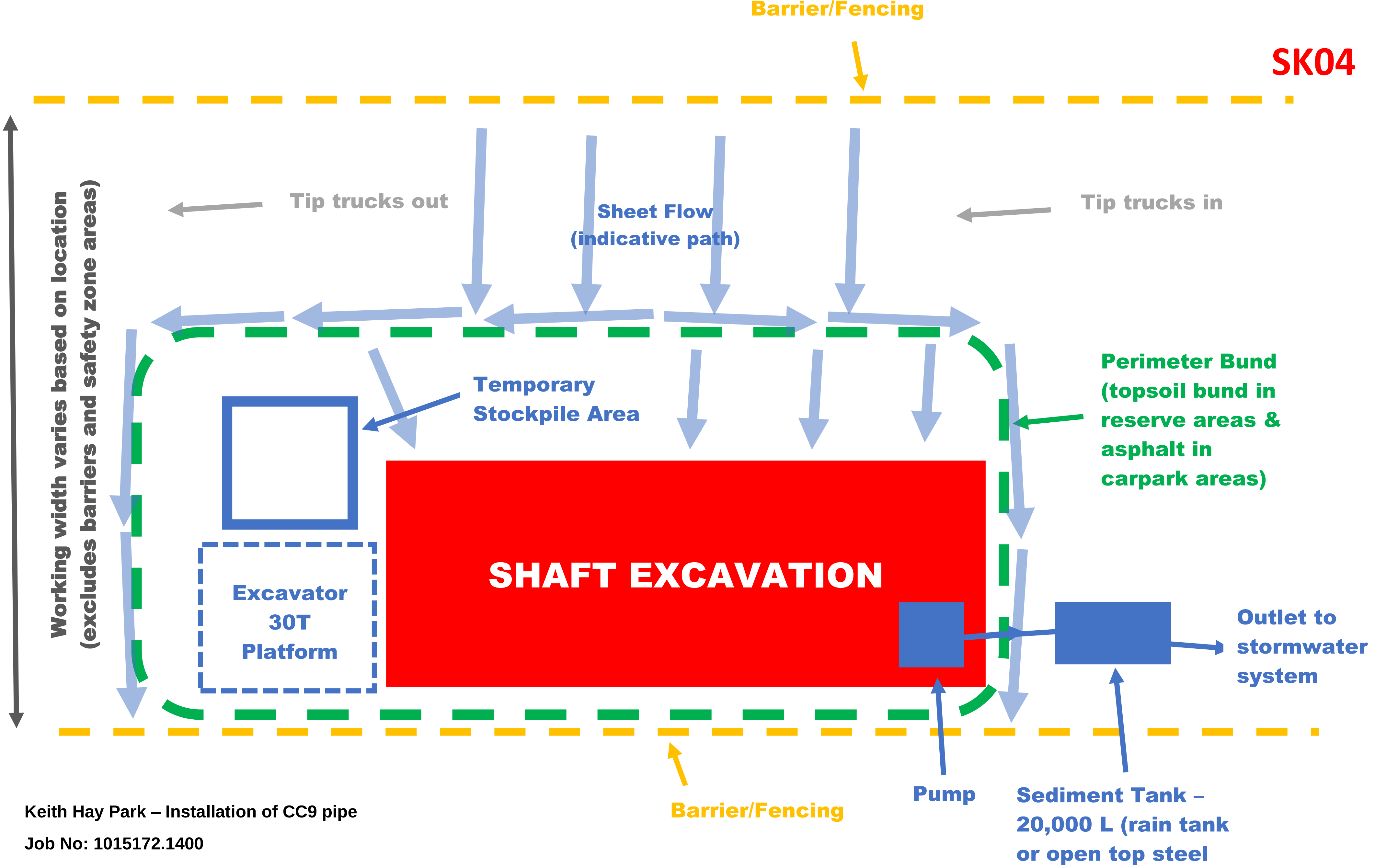
SK03

Appendix B: Erosion Sediment Control: Typical details

TYPICAL ESC for SHAFT EXCAVATIONS (NTS)

Tonkin+Taylor

SK04



Barrier/Fencing

Tip trucks out

Sheet Flow
(indicative path)

Tip trucks in

Working width varies based on location
(excludes barriers and safety zone areas)

Temporary
Stockpile Area

Perimeter Bund
(topsoil bund in
reserve areas &
asphalt in
carpark areas)

Excavator
30T
Platform

SHAFT EXCAVATION

Outlet to
stormwater
system

Barrier/Fencing

Pump

Sediment Tank –
20,000 L (rain tank
or open top steel

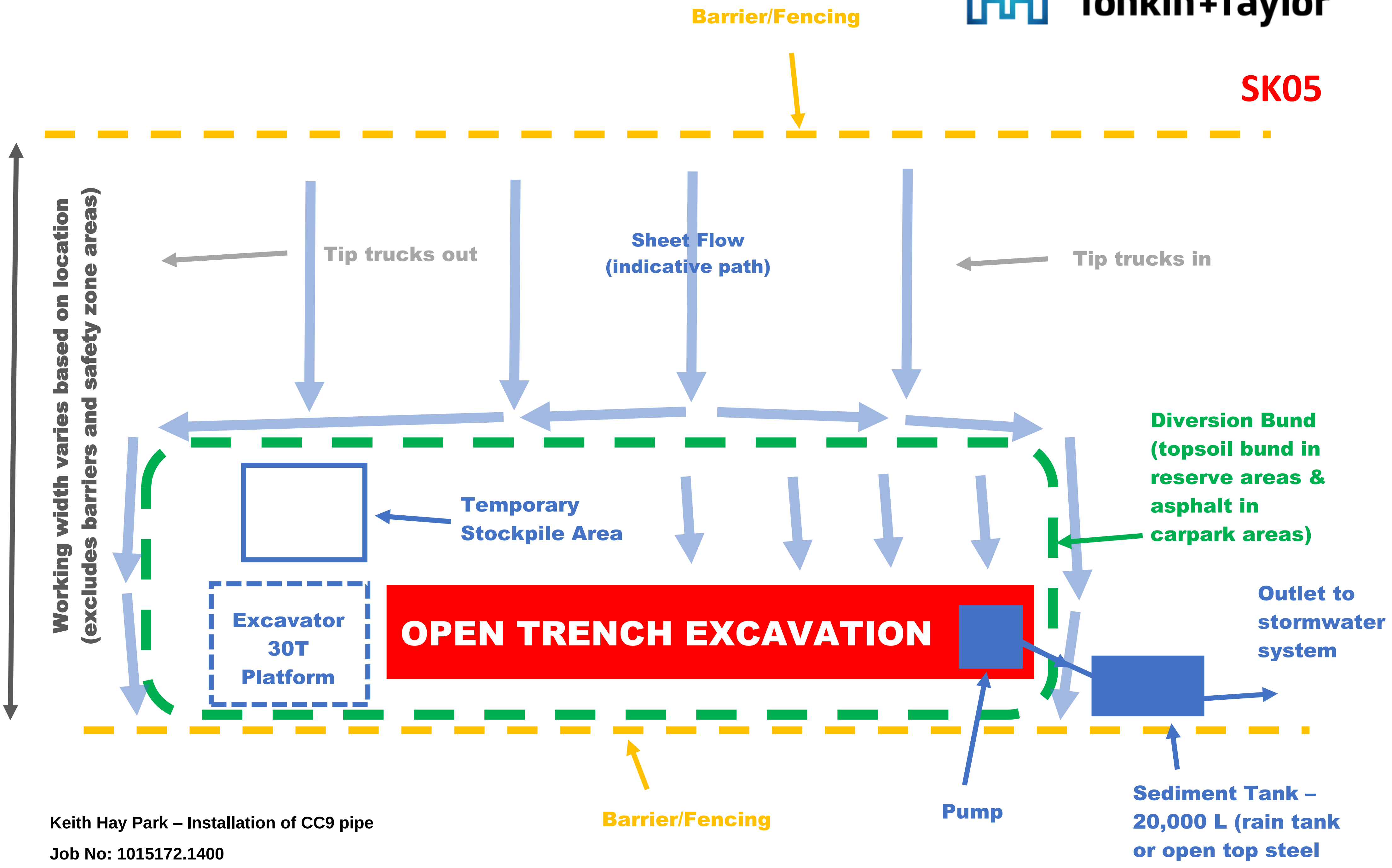
Keith Hay Park – Installation of CC9 pipe

Job No: 1015172.1400

TYPICAL ESC for OPEN TRENCH (NTS)

Tonkin+Taylor

SK05



Keith Hay Park – Installation of CC9 pipe

Job No: 1015172.1400

Appendix C: Chemical Treatment Management Plan

PAC BATCH DOSING MONITORING AND MAINTENANCE RECORD SHEET

Site: CC9 Pipe Installation – Keith Hay Park (south) **Project No.:** 1015172.1400

Completed by: ____________________________________ **Date:** _________ **Time:** _____________

Current Weather Condition: (circle)

Wind Direction / Conditions

STRONG

MODERATE

LIGHT / STILL

Location of work/stage:___________________________

ITEM/SCOPE OF INSPECTION	(CIRCLE)	COMMENTS
-Outlet of containerised unit lifted or plugged prior to pumping	Yes No N/A	
-Pumping permit approved by the Construction team	Yes No N/A	
-Outlet of containerised unit lifted or plugged prior to pumping	Yes No N/A	
-Check that the pump inlet is securely fixed	Yes No N/A	
CHEMICAL TREATMENT DOSING		
-Volume of sediment laden water pumped (stored within unit)	**m^3**	
-Time pumping started		
-Time pumping stopped		
-Volume of PAC required	**Litres**	
-Clarity of stored water is greater than 100 mm prior to discharge (record clarity depth)	**mm**	
-Measured pH is between 5.5 and 8.5 prior to discharge (record pH).		
-Time stored water discharged		

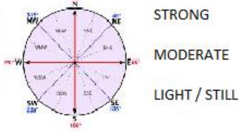
Appendix D: Maintenance Checklist

SITE EROSION & SEDIMENT CONTROL INSPECTION CHECKLIST

Site: CC9 Pipe Installation – Keith Hay Park (south) **Project No: 1015172.1400**

Inspection by: ………………………………………………… **Date:** ………………… **Time:** ………………

Current Weather Condition: (circle) **Wind Direction / Conditions**



Area Inspected (tick): ☐ Excavation ☐ Surface works area ☐ Other (please specify):

………………………………………………………………

ITEM / SCOPE OF INSPECTION	(circle)	COMMENTS
EROSION & SEDIMENT CONTROL		
Perimeter Controls		
Is the stabilised entrance needing maintenance to ensure the surface remains clean?	Y N N/A	
Is there silt tracked out onto the main road that requires sweeping?	Y N N/A	
Is there any evidence of uncontrolled dirty water discharge from the site?	Y N N/A	
Are the protection measures to existing catchpits on the main road still in place and working effectively?	Y N N/A	
Are all perimeter bunds that are in place and working effectively?	Y N N/A	
Are there any rips, tears or holes over the length of super silt fence fabric that require repairs?	Y N N/A	
Is the bottom edge of the super silt fence fabric trenched in the required depth?	Y N N/A	
Has the silt fence fabric degraded or collapsed? If so, replace immediately.	Y N N/A	
Is there dust that requires suppression? If so ensure water sprinklers are used to manage dust.	Y N N/A	
Are there areas that are not actively worked for 10 working days? If so, stabilise over with aggregate or mulch.	Y N N/A	
Pumping and rainwater storage tank		
Is the pumping activities being monitored to ensure the pump is turned off to over fill the rain water storage tank?	Y N N/A	
Check that the delivery hose and connections from the pump are secure and water tight.	Y N N/A	
Is there adequate supply of PAC for batch dosing, and is it appropriately stored.	Y N N/A	

	SITE EROSION & SEDIMENT CONTROL INSPECTION CHECKLIST	

RECOMMENDATIONS			
Priority (H/M/L)	**Action**	**By whom**	**By when**

Reviewed and Accepted by **Date:**..............................

……

Appendix E: Construction Traffic Effects Assessment

REPORT

Sewer Connection (CC9) - Keith Hay Park

Construction Traffic Effects Assessment

Prepared for
Watercare Services Ltd
Prepared by
Tonkin & Taylor Ltd
Date
July 2021
Job Number
1015172.1400

Exceptional thinking together
www.tonkintaylor.co.nz

Document Control

Title: Sewer Connection (CC9) - Keith Hay Park					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
July 2021	1	Final	MAAH	KLB	PAR

Distribution:

Watercare Services Ltd	1 copy
Tonkin & Taylor Ltd (FILE)	1 copy

Table of contents

1 **Introduction** **1**
  1.1 Overview 1
  1.2 Background 1
2 **Project Description** **2**
  2.1 Overview 2
  2.2 Hours of operation 2
  2.3 Site Layout and Access 2
    2.3.1 Trenchless construction methodology 2
    2.3.2 Trenched construction methodology 3
  2.4 Trip Generation 3
  2.5 Traffic management 4
3 **Existing Transport Environment** **5**
  3.1 Site Location 5
  3.2 Transport Network 5
  3.3 Walking and Cycling 6
  3.4 Crash Analysis 6
4 **Assessment of Effects** **8**
  4.1 Trip generation 8
  4.2 Intersection Safety 8
    4.2.1 Sight Distance 8
    4.2.2 Hillsborough Kindergarten Access 9
  4.3 Intersection Capacity 9
  4.4 Truck Routes 9
  4.5 Walking and Cycling 11
  4.6 Parking Impacts 11
5 **Summary and Recommendations** **13**
6 **Applicability** **15**

Appendix A : Concept Design Calculations
Appendix B : Crash History
Appendix C : CI Construction Traffic Management Plan

1 Introduction

1.1 Overview

Tonkin & Taylor Ltd (T+T) has been engaged by Watercare Services Ltd (Watercare) to undertake a traffic effects assessment related to the construction of a sewer connection (CC9) between the Central Interceptor (CI) shaft site at Keith Hay Park to Richardson Road, Mount Roskill. Figure 1.1 shows the location of the works.

This report assesses the construction traffic effects of the proposed CC9 sewer pipeline based on information provided by Watercare. This report has been prepared in accordance with our Letter of Engagement dated 16 November 2020.

Figure 1.1: Aerial view of the proposed alignment (Source: Auckland Council Geomaps, 2021)

1.2 Background

The CI Project has been developed to provide network capacity for growth and to mitigate wastewater overflows in the Auckland region. The Keith Hay Park CI construction site is one of the main shaft sites for CI.

CI is being undertaken in accordance with a suite of approved management plans and mitigation measures. While the CC9 works are outside of Watercare's CI designation for its Keith Hay Park shaft construction site, the CC9 works represent a connection to the local network required as part of the broader CI works to support growth within the surrounding area. The CC9 works will be implemented fully in accordance with the applicable management plans for CI which have been scrutinised and approved by Auckland Council.

Accordingly this assessment relies on the measures set out in the CI Construction Traffic Management Plan (CTMP) (Doc No. GAJV-PLN-00129 Version 0.4 Final, approved 11 Dec. 2019). This allows for an integrated and consistent approach to be taken, while also noting that the CI CTMP has been subject to review and approval by Auckland Council and is demonstrated to have worked across the course of the wider CI works.

Where this assessment identifies additional management and mitigation measures required to address potential traffic effects, the CI CTMP will be updated to include these measures.

2 Project Description

2.1 Overview

The CC9 sewer pipeline will be installed underneath Keith Hay Park, extending from the Keith Hay Park CI shaft in the Cameron Pools Carpark to a termination manhole located approximately 810 m to the south on Richardson Road. The sewer pipeline is approximately 1200 mm in diameter (900 mm in internal diameter) and will be located next to the existing Branch 9 trunk sewer alignment.

The northern section of the pipeline route is expected to be trenchless (likely pipe-jacked or possibly HDD) to a depth to invert of up to approximately 8 m. The remaining section of the CC9 route (approximately 300 m) from around the Eden Roskill Cricket Club to Richardson Road will potentially be trenched to a maximum depth of up to 5 m but may also be installed via trenchless methods. Part of this section is located in the Hay Park School and Waikowhai Intermediate School grounds and Hillsborough Kindergarten carpark, resulting in additional time constraints if this section of pipeline is trenched (i.e. as far as practicable outside of school term).

The total construction programme is expected to take up to 12 months, with works in the school grounds anticipated to take between 2 – 3 months (and possibly up to 4 months).

This report assumes the most conservative construction methodology which includes both trenching and trenchless technology.

2.2 Hours of operation

Site operational arrangements will likely occur on the following general basis:

- Trenchless (micro tunnelling) activities – This work would generally occur during normal working hours, 7 am to 6 pm, Monday to Friday and 8 am to 6 pm Saturday. However, in particular circumstances, Watercare may need to undertake the micro tunnelling works 24 hours a day 7 days a week (or alternative extended hours) to meet construction demands and to shorten the construction period.
- Trenching activities – To restrict the duration of trenching activities, Watercare proposes to undertake the trenching works 24 hours a day 7 days a week (or alternative extended hours e.g. 7 am to 8 pm summer daylight hours). This is to shorten the construction period such that as far as practicable construction activities occur outside of school term.

2.3 Site Layout and Access

The following sections outline the more conservative construction methodology which includes both trenched and trenchless construction of the CC9 sewer.

Appendix A of the AEE contains plans showing the location of the proposed CC9 sewer and corresponding manholes.

2.3.1 Trenchless construction methodology

Trenchless installation of the CC9 sewer is expected to occur between the CI shaft site and the Eden Roskill Cricket Club carpark, primarily accessed via the Noton Road entrance. This corresponds to the section between manholes MH-01 and MH05 / MH-06. When micro-tunnelling, launch pits occupying an approximately 1,000 m^2 working area will be required at every second manhole (potentially at MH-01, MH-03 and either MH-05 or MH-6). In the case of HDD, a laydown area immediately adjacent to the pipeline alignment will be required along the length of the route to enable pipe stringing prior to installation along with reception points to access the reception shaft.

As the CI shaft is next to the Cameron Pools carpark, the connection will traverse the carpark from north to south or vice versa. Throughout this time, the majority of the carpark will remain open, and public access to the Cameron Pools and Leisure Centre will be maintained. However, all construction areas within the carpark will be required to be cordoned off to restrict public access.

CC9 between MH-03 to MH-06 runs along a shared path on the eastern perimeter of Keith Hay Park; this section of the site will need to be closed to pedestrians and cyclists and an alternative temporary path provided for park users.

In the event the entire CC9 connection is installed with trenchless methods, Noton Road is likely to serve as the main site entrance. As part of this, appropriate temporary parking restrictions may be required on Noton Road adjacent to the site entrance as well as temporary traffic management measures. Should access also be required via Arundel Street this will be undertaken in accordance with the CI CTMP for Keith Hay Park, Batch 2 approved December 2019.

2.3.2 Trenched construction methodology

The site for potential trenched installation between the Eden Roskill Cricket Club and Richardson Road will be accessed from Noton Road and from the Richardson Road entrance to Hillsborough Kindergarten. This section corresponds to the southern manholes (MH-05/MH-06 to MH-10). Installation will likely begin at the Eden Roskill Cricket Club carpark (accessed from Noton Road) and continue south through the Hay Park School and Waikowhai Intermediate School grounds and the Hillsborough Kindergarten carpark.

As noted above, to reduce the construction duration and associated effects on the schools and kindergarten, Watercare proposes to undertake trenched construction up to 24 hours a day 7 days a week (or alternative extended hours). It is therefore anticipated that, as far as practicable, work within this section will occur during the summer school holiday period between mid-December and early February. However, should construction extend into the school term, construction vehicles will be required to arrive and depart outside of school peak hours.

2.4 Trip Generation

From concept design calculations, based on estimated earthworks (refer to **Appendix A**) it is expected that the trenchless section will generate approximately 1,838 truck movements, while the trenched section will generate approximately 2,570 truck movements. As each movement accounts for an arrival and departure, this corresponds to 919 trucks and 1,285 trucks respectively, resulting in 2,204 trucks in total. Over the up to 12 month construction programme, assuming construction 6 days per week, this equates to up to 25 trucks per day.

Based on information provided from the Central Interceptor main tunnel / link sewer sites, it has been assumed that five standard vehicles per day will be generated by labouring activities and two standard vehicles per day by site supervision activities as needed.

It is therefore estimated that the construction of CC9 will generate the following trips per day and per hour during the peak construction season (assume 30% of light vehicles trips occurring during the peak hour):

- 14 standard vehicle movements per day (4 vehicle movements during peak hour).
- 25 heavy vehicle movements per day (average of 2 - 3 heavy vehicles movements per hour over the course of an 11 hour day).

In total, it is estimated that the proposed CC9 sites will generate no more than 40 vehicle movements per day during the construction period, with up to 14 vehicle movements during the peak hour.

It should be noted that the assessment of traffic effects is based on the maximum number of trucks per day, however the additional vehicle demand that the site will generate will vary throughout the construction programme. This assessment therefore represents a conservative or ‘worst-case’ scenario i.e. on any particular day the number of truck movements may be less than this, and on some days significantly less. These truck movements are also spread out across the project access points (i.e. Arundel Street, Noton Road and Richardson Road) at different stages of the construction period.

2.5 Traffic management

All works will be undertaken in accordance with the approved CTMP for the CI works at Keith Hay Park[1] (refer **Appendix C**). The existing CTMP will also be updated prior to the CC9 works commencing. This update will incorporate site specific traffic management requirements that apply to CC9 including, confirming the locations of signage, construction traffic routes and how the work site will be accessed as well as any particular requirements to manage works in the vicinity of the schools and kindergarten (as agreed with those education providers).

General management and mitigation measures will be consistent with those set out in Section 8.2.1 of the CI CTMP. Additional mitigation measures that will be addressed as part of the update to the CTMP will include:

- The CC9 construction area will be contained and separated by fencing;
- Ensure appropriate access is provided to accommodate any required turning circles of site vehicles and accommodate any required truck movements;
- Ensure adequate sight distances are provided at each access point to ensure safety on the road network;
- Maintaining safe pedestrian access to and around Keith Hay Park and maintaining access to the Eden Roskill Cricket Club clubrooms;
- Minimising traffic impacts on pedestrian and vehicles accessing the schools and kindergarten, predominantly through undertaking works in the vicinity of Hay Park and Waikowhai Intermediate Schools and Hillsborough Kindergarten outside of term time as far as practicable. Should there be any construction delays and works need to extend into the term time, it is expected that this is minimised as far as practicable and that traffic is managed around school and kindergarten peak drop-off and pick-up times;
- All works in road reserve will be subject to Corridor Access Requests from Auckland Transport; and
- Any other measures that are deemed appropriate.

---

[1] Construction Traffic Management Plan - Haycock Avenue, Walmsley Park, Dundale Avenue, Keith Hay Park, Whitney Street and Miranda Reserve. Central Interceptor Doc No: GAJV-PLN-00129 V 0.4 Final. Approved 11 December 2019.

3 Existing Transport Environment

3.1 Site Location

The Keith Hay Park CI shaft site, shown indicatively in Figure 1.1, is located on the eastern side of the Cameron Pool carpark. The proposed CC9 connection runs from the shaft site, along the eastern edge of Keith Hay Park, to the Eden Roskill Cricket Club carpark. The connection then traverses the Hay Park School and Waikowhai Intermediate School grounds and Hillsborough Kindergarten, terminating once reaching the southern extent at a proposed termination manhole on Richardson Road. Key land uses in the surrounding neighbourhood are residential and recreational.

3.2 Transport Network

It is anticipated that the southern section of the works will be accessed via Richardson Road and Noton Road, as seen in Figure 3.1. According to the One Network Road Classification (ONRC), Richardson Road has an “Arterial” road classification, while Noton Road has an “Access” classification and can be reached through the “Primary Collector”, Rogan Street. All roads have a posted speed limit of 50 km/h.

Auckland Transport has recorded traffic volumes on both Richardson Road and nearby Rogan Street intermittently, at various locations over the past several years. No traffic counts for Noton Road have been found. The most recent traffic count on Richardson Road, near the site entrance was in 2018, indicating an Average Daily Traffic (ADT) of 8,565 vehicles with 2% Heavy Commercial Vehicles (HCV). This HCV proportion is consistent compared to other count locations along Richardson Road. Richardson Road is sealed and has a straight alignment near the proposed site entrance. There is one lane in each direction, with an additional parking lane each way between the Richardson Road site entrance and Rogan Street (see Figure 3.1).

The most recent traffic count for Rogan Street between Noton Road and Richardson Road was carried out in 1994, with an ADT of 2,022 vehicles and 6% HCV. Noton Road is a sealed no-exit road with one lane in each direction, ending with a driveway into the cricket club carpark. This road is mainly used by residents and Keith Hay Park visitors. The Rogan Street and Noton Road intersection is give-way priority controlled, and the Rogan Street-Richardson Road intersection is stop priority controlled.

Figure 3.1: Traffic Count Locations and Parking Lanes

3.3 Walking and Cycling

Keith Hay Park features gentle terrain and includes facilities such as a children's playground, the Cameron Pool and Leisure Centre and a shared path around the perimeter of the park. The park is generally well used by the public.

Richardson Road, Noton Road, and Rogan Street have pedestrian footpaths adjacent to both sides of the carriageway.

Due to the proximity with Hay Park School and Waikowhai Intermediate School, there is a pedestrian crossing on Richardson Road and widened footpath catering for cyclists 35m west of the proposed site entrance. A high volume of pedestrians and cyclists are expected during weekday peak hours near the school during the school term (e.g. around 8:15 – 9:15 am and 2:45 – 3:15 pm).

The footpaths on Noton Road are separated from vehicle traffic by grass berms.

3.4 Crash Analysis

A search was undertaken of the NZ Transport Agency's Crash Analysis System (CAS) for all reported crashes in a full five-year period from 2016 to 2020 (inclusive), on roads adjacent to the proposed site accesses. From this search a total of 16 crashes were recorded. A breakdown of the crash severities and factors can be found in Table 3.1 and Table 3.2. The full site detail crash report and collision diagram is attached in **Appendix B**.

Table 3.1: Crash severity study

Year	Fatal	Serious	Minor	Non-injury	Total
2016	0	0	0	4	4
2017	0	0	1	2	3
2018	0	0	0	2	2
2019	0	0	0	2	2
2020	0	2	0	3	5
Total	**0**	**2**	**1**	**13**	**16**

Table 3.2: Crash factor summary

Crash Type	Crash numbers
Lost control – straight	2
Cornering – lost control	2
Pedestrians crossing road	2
Parked vehicle	3
Crossing/Turning	4
Manoeuvring	1
Head on	1
Intentional	1
Total	**16**

Observations from the crash review include the following:

- The majority of crashes were either minor or non-injury.
- Two serious crashes occurred at the intersection of Richardson Road and Rogan Street; these were both crossing/turning type crashes.

It should be noted that with the increase of HCVs at both site entrances and surrounding intersections, crossing and turning may increase. This may be reduced by addressing on-street parking adjacent to the proposed site entrance on Richardson Rd as well as around the intersection of Rogan Street / Richardson Road. Appropriate temporary traffic management measures should also be incorporated to advise other road users of the construction traffic.

4 Assessment of Effects

4.1 Trip generation

Section 2.4 outlines that the maximum number of vehicles generated by the proposed CC9 sewer pipeline works is as follows:

- 14 standard vehicle movements per day (4 vehicle movements during peak hour).
- 25 heavy vehicle movements per day (average of 2 - 3 heavy vehicles movements per hour over the course of an 11 hour day).

This equates to a maximum of 39 construction vehicles generated per day. This is considered negligible (0.5%) compared to current traffic volumes on Richardson Road (8,565 vehicles in 2018).

Considering the low overall volumes of construction vehicles, and that construction traffic is spread across multiple access points with access for CC9 typically located on Noton Road, Richardson Road and potentially Arundel Street, the cumulative construction traffic effects of the CC9 works are considered to be negligible[2].

4.2 Intersection Safety

As the site is adjacent to schools, recreational, and residential areas, safety is a key consideration for access. The entrance on Richardson Road and the intersections leading to the Noton Road entrance are of particular interest during construction. As mentioned in Section 2.3.2, trenched installation will predominantly occur during the summer school holiday period, or otherwise outside of school peak hours to avoid impacting pedestrians and other vulnerable road users.

4.2.1 Sight Distance

Available sight distance plays an important role in drivers' decisions and whether it is safe for vehicles to enter or exit access roads. A desktop assessment has been conducted to estimate the available sight distance and compare it to Safe Intersection Sight Distance (SISD) requirements. SISD is referenced in the 'Austroads' guidance as the minimum distance that should be provided on the major road of any intersection from a point 5 m back from the stop line on the side road.[3] Austroads indicated that for roads with posted speed limits of 50 km/h the minimum sight distance requirement is 123 m for major roads. This sight distance is a minimum and where practicable, designers should provide a larger sight distance. Table 4.1 shows the approximate sight distances estimated from the current site access.

Table 4.1: Sight Distance Summary

Intersection	Approach	Austroads recommendation	Current
Richardson Rd / Site Entrance	**West of site entrance**	**123 m**	**150+ m**
	East of site entrance		**250+ m**
Richardson Rd / Rogan St	**West of Rogan St**		**150+ m**
	East of Rogan St		**150+ m**
Noton Rd / Rogan St	**North of Noton Rd**		**150+ m**

---

[2] The approved CTMP for the CI works at Keith Hay Park estimates low heavy vehicle movements per day as follows: Arundel Street: 8 – 12 per day; Rainford Street: 5 – 10 per day; Frost Road: 4-8 per day.

[3] Austroads. (2009). Guide to Road Design Part 4A: Unsignalised and Signalised Intersections. Sydney.

Intersection	Approach	Austroads recommendation	Current
	South of Noton Rd		**150+ m**

The sight distances in all directions of the proposed site entrances are considered to be adequate and satisfy the above minimum requirements.

The sight distances in Table 4.1 consider property boundaries and permanent obstacles to sight distance. They do not account for parked cars using on-street parking lanes. Parked cars would reduce the intersection site distance and increase chances for collision for normal passenger cars with an eye height of 1.1 m. However, trucks have an elevated driver eye height (2.4 m) compared to passenger vehicles according to Austroads, allowing visibility above parked cars. It can thus be assumed that parked cars will not impact the construction vehicles' SISD.

4.2.2 Hillsborough Kindergarten Access

Trenched installation will occur as far as practicable during the summer school holiday period outside of term time; however it is understood that Hillsborough Kindergarten operates slightly outside of the school holiday period[4]. If construction extends into this period or more broadly into the school term time, temporary traffic management would be required to ensure access can be maintained to the kindergarten carpark via Richardson Road. Should construction not allow for this access to be maintained, an alternative access may be available via Noton Road and the Eden Roskill Cricket Club carpark.

During the construction phase HCVs will be turning in and out of the Hillsborough Kindergarten carpark to access the site. Currently there are NSAAT line markings to the west of the Hay Park School carpark access. In order to ensure the safe turning of HCVs in and out of the site, several on-street parking spaces may need to be temporarily removed to the east of the Hay Park School carpark access during part of the construction period.

Due to Richardson Road being an arterial road and the tracking requirements of HCVs, manual traffic controllers may be required to manage vehicle movements when required. HCV movements will also be required to co-ordinate to ensure that two trucks do not meet at the Hay Park School carpark access at the same time. Radio contact when HCVs are arriving and departing the site will need to be maintained.

4.3 Intersection Capacity

As outlined in Section 3.2, Richardson Road has an ADT of 8,565 vehicles. Using first principles this equates to roughly 856 vehicles in the commuter peak hours. Assuming an even directional split, this equates to 428 vehicles in each direction or roughly an 8 second gap between vehicles. Given that vehicles are likely to bunch and arrive in waves, it is considered that trucks will have ample opportunities to turn into and out of the site entrance on Richardson Rd and Rogan Street.

4.4 Truck Routes

Figure 4.1 outlines the potential HCV routes to the worksite, with different routes depending on the origin of trucks. These routes are considered appropriate to access the site as trucks are routed through arterial roads and State Highway 20 (SH20) to avoid excess HCVs on the local road network and residential areas. The two routes are detailed below.

---

[4] https://www.aka.org.nz/2021-term-dates/

From the north:

- Dominion Road offramp on SH20
- Dominion Road
- Richardson Road

From the south:

- Hillsborough Road offramp on SH20
- Hillsborough Road
- Richardson Road
- Rogan Street
- Noton Road

The return journey is the reverse, using the corresponding onramps onto SH20.

The general hours of operation are 7 am to 6 pm Monday to Friday and 8 am to 6 pm on Saturday (see Section 2.2). This will include truck movements and general site activities. The proposed works involve relatively low number of truck movements (25 heavy vehicle movements per day) and in relation to the trenched methodology will be programmed to take place predominantly during the school holidays in order to minimise disruption. However, should works need to be undertaken during the school (including kindergarten) terms, heavy vehicle movements in proximity to the schools (i.e. Richardson and Noton Roads) will be restricted to outside of peak drop-off and pickup times.

Based on the assumptions in **Appendix A**, it is anticipated that the maximum truck size is a 6-wheel 8 m^3 capacity truck. It is unlikely that any larger vehicle will be able to traverse the Rogan Street and Noton Road. However, it may be necessary for some deliveries made to site that exceed this. These may be for specialised machinery or large components. If these are required then specific evidence that these vehicles can turn into, out of and travel along Rogan Street and Noton Road will be required. Agreement with Auckland Transport will be required and over-dimension rules will need to be complied with. Controllers may also be required to manage vehicle movements on Rogan Street and Noton Road when required. This will be addressed through the update to the CTMP as required.

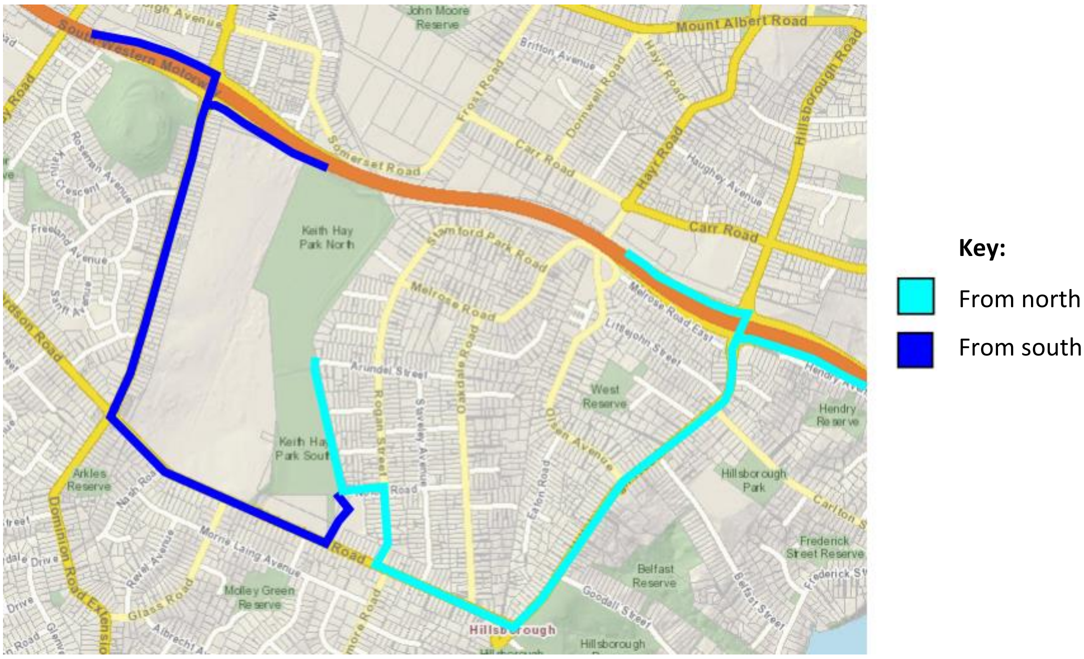


Figure 4.1: Proposed HCV routes

4.5 Walking and Cycling

Introducing temporary increased truck movements during construction can impact on walking and cycling amenity, particularly for the three school communities and park users. Therefore, as outlined in Section 4.4, the proposed trenching works are programmed to take place predominantly during the summer school holidays to minimise disruption. For works that are required during the school and kindergarten terms, heavy vehicle movements in proximity to the schools (i.e. Richardson and Noton Roads) will be restricted outside of peak school drop-off and pick-up times.

Where footpaths are impacted during the construction phase, temporary traffic management will also be required to ensure a safe alternative is provided.

As outlined in Section 2.3.1, works may also impede on the general amenity of the area. This includes closures along sections of the shared path through Keith Hay Park. It is recommended that suitable surfaced temporary shared path diversions are provided during the construction phase.

4.6 Parking Impacts

Currently, there is a parking lane between the Richardson Road site entrance and Rogan Street. In order to ensure the safe turning of HCVs in and out of the site, several on-street parking spaces may need to be temporarily removed to the east of the Hay Park School carpark access during part of the construction period.

It is proposed that if construction is trenchless, then construction staff access to site will be via the Eden Roskill Cricket Club carpark, as shown in Figure 4.2. This will be for light vehicles only. Parking for staff vehicles should be provided within the Eden Roskill Cricket Club carpark wherever practicable.

Should the section between MH-05/MH-06 to MH-10 require a trenched installation, the Eden Roskill Cricket Club carpark will be restricted to the public. As works in this section are anticipated to take 2 – 3 months (and possibly up to 4 months), the impacts to the public will be kept to a minimum. Alternative public parking locations include the Cameron Pools Carpark, Keith Hay Car Park (located on Rainford St) and nearby on-street parking. The update to the CI CTMP will include a detailed parking plan which addresses the cumulative parking impact of CI and CC9.

Figure 4.2: Site access and parking arrangements

5 Summary and Recommendations

Construction of the new sewer connection (CC9) between the Central Interceptor (CI) shaft site at Keith Hay Park to Richardson Road may rely on both trenched and trenchless technology, requiring site access through entrances on Richardson Road and Noton Road (and potentially Arundel Street). General management and mitigation measures will be consistent with those set out in Section 8.2.1 of the CI CTMP with additional mitigation measures to be addressed through the update to the CTMP to specifically address CC9 works.

A review of crash records indicates serious injury crashes have been low in these locations, however appropriate temporary traffic management measures should be designed to safely integrate the temporary increase in construction vehicles within the existing traffic environment. Routing construction vehicles on SH20 and arterials will also reduce disturbances to residential neighbourhoods. Safe intersection sight distances have been assessed to be adequate based on truck driver eye height.

The following transport recommendations have been identified:

- For trenchless installation of CC9, the site entrance on Noton Road, through the Eden Roskill Cricket Club carpark, should be used.
- While the trenchless construction methodology is expected to rely on Noton Road as the primary access, should access also be required via Arundel Street then this shall be in accordance with the approved CTMP for Keith Hay Park (Batch 2 – approved December 2019).
- For trenched installation, a site entrance on Richardson Road through the Hillsborough Kindergarten will be required. These works should be programmed outside of school (and kindergarten) terms wherever practicable. Alternatively, if the kindergarten is operational temporary traffic management will be required to maintain access to the kindergarten carpark. Should construction not allow for this access to be maintained, an alternative access should be provided via Noton Road and the Eden Roskill Cricket Club carpark.
- Construction of the trenched section is scheduled to occur as far as practicable during the school holidays. Where there is a delay to construction activities which mean works occur during the school term, then works in proximity to the schools should occur outside of school peak hours generally as follows:
  - Monday – Friday (excluding school and public holidays)
    - 8:15 am – 9:15 am
    - 2:45 pm - 3:15 pm
- Communication campaigns should be undertaken in relation to traffic management activities throughout construction activities (including letter drops to affected residents, flier drops, project signage, web based resources, etc) as per the CI communication and complaints protocols.
- Appropriate temporary traffic management measures should be incorporated to advise other road users of the construction traffic.
- Trucks to be routed predominantly on SH20 and arterial roads to avoid excess HCV's on the local road network and residential areas.
- A maximum truck size of 6-wheel 8 m^3 capacity truck. Should it be necessary for larger trucks to be used for deliveries then specific evidence that these vehicles can turn into, out of and travel along Rogan Street, Noton Road and the Eden Roskill Cricket Club carpark will be required. Agreement with Auckland Transport will be required and over-dimension rules will need to be complied with. Controllers may also be required to manage vehicle movements on

Rogan Street and Noton Road when required. This will be addressed through the update to the CTMP as required.

- A suitable surfaced temporary shared path diversion adjacent to the shared path on the eastern boundary of Keith Hay Park shall be provided during the construction period to maintain the amenity of the park.
- The update to the CTMP shall identify measures to maintain access to the Eden Roskill Cricket Club clubrooms.
- All construction areas within Keith Hay Park, Hay Park School, Waikowhai Intermediate School and Hillsborough Kindergarten grounds will be required to be cordoned off to ensure public safety.
- All construction staff should park within the Eden Roskill Cricket Club carpark, or otherwise off the surrounding road network, wherever practicable.
- All works shall be undertaken in accordance with the update to the CI CTMP. Any updates are required to be approved by Auckland Transport / Auckland Council prior to construction.

The low additional traffic volumes are within the capacity of the surrounding roads and are within the typical hourly fluctuations of the nearby roads. Taking this into account together with the management and mitigation measures proposed, minimal effects on the surrounding road network are expected.

6 Applicability

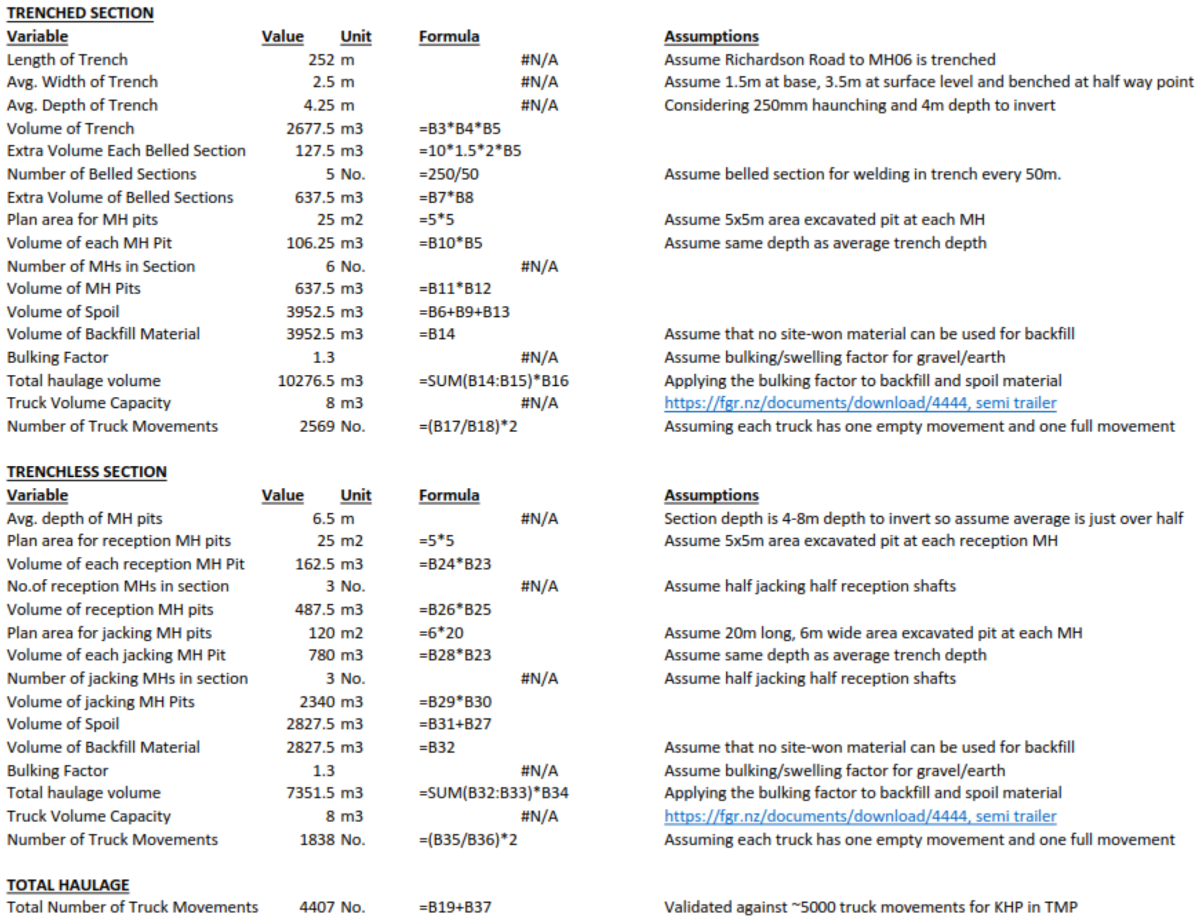
This report has been prepared for the exclusive use of our client Watercare Services Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Auckland Council will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Matan Aharon	Peter Roan
Transportation Engineer	Project Director

Appendix A: Concept Design Calculations



TRENCHED SECTION

Variable	Value	Unit	Formula	Assumptions
Length of Trench	252	m	#N/A	Assume Richardson Road to MH06 is trenched
Avg. Width of Trench	2.5	m	#N/A	Assume 1.5m at base, 3.5m at surface level and benched at half way point
Avg. Depth of Trench	4.25	m	#N/A	Considering 250mm haunching and 4m depth to invert
Volume of Trench	2677.5	m3	=B3*B4*B5	
Extra Volume Each Belled Section	127.5	m3	=10*1.5*2*B5	
Number of Belled Sections	5	No.	=250/50	Assume belled section for welding in trench every 50m.
Extra Volume of Belled Sections	637.5	m3	=B7*B8	
Plan area for MH pits	25	m2	=5*5	Assume 5x5m area excavated pit at each MH
Volume of each MH Pit	106.25	m3	=B10*B5	Assume same depth as average trench depth
Number of MHs in Section	6	No.	#N/A	
Volume of MH Pits	637.5	m3	=B11*B12	
Volume of Spoil	3952.5	m3	=B6+B9+B13	
Volume of Backfill Material	3952.5	m3	=B14	Assume that no site-won material can be used for backfill
Bulking Factor	1.3		#N/A	Assume bulking/swelling factor for gravel/earth
Total haulage volume	10276.5	m3	=SUM(B14:B15)*B16	Applying the bulking factor to backfill and spoil material
Truck Volume Capacity	8	m3	#N/A	https://fgr.nz/documents/download/4444, semi trailer
Number of Truck Movements	2569	No.	=(B17/B18)*2	Assuming each truck has one empty movement and one full movement

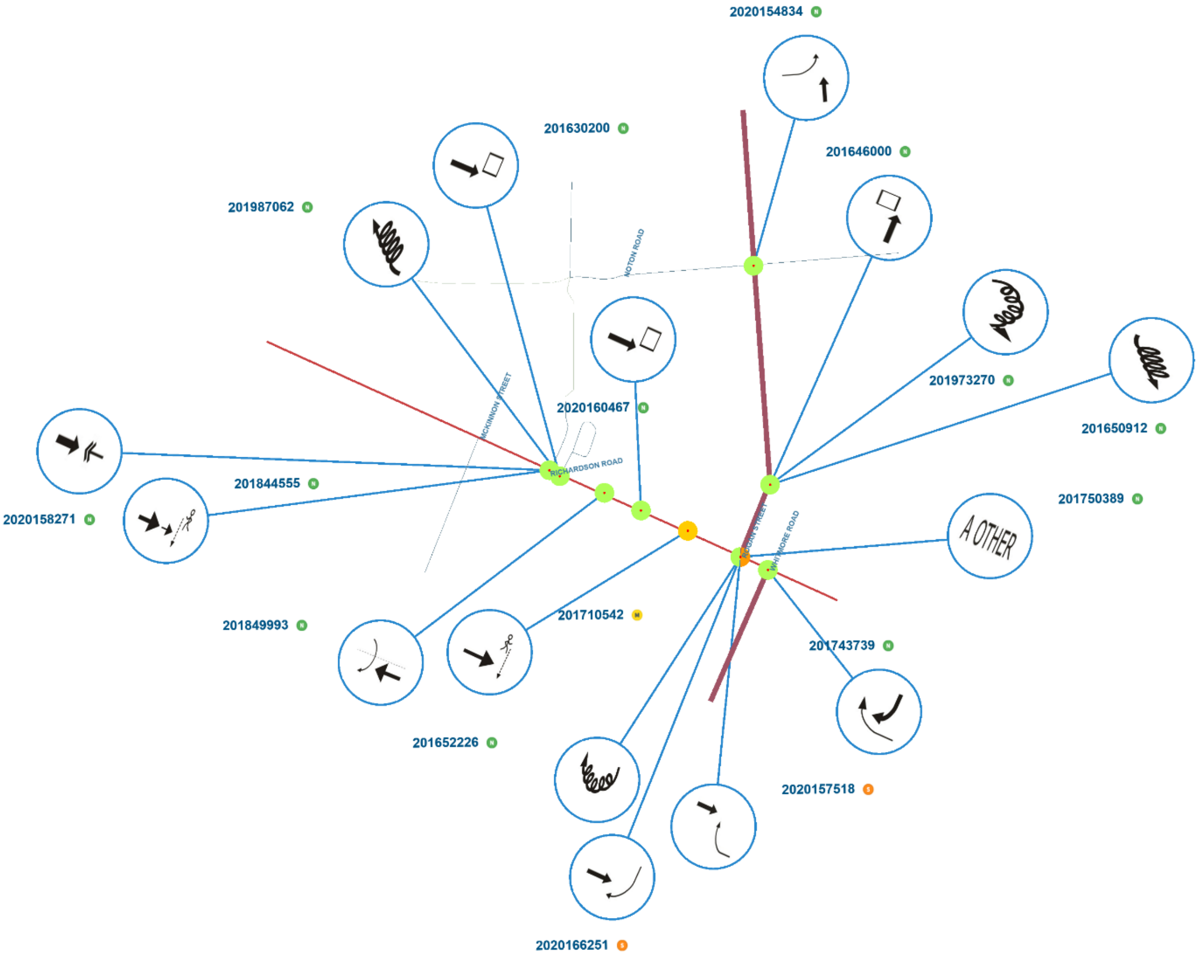
TRENCHLESS SECTION

Variable	Value	Unit	Formula	Assumptions
Avg. depth of MH pits	6.5	m	#N/A	Section depth is 4-8m depth to invert so assume average is just over half
Plan area for reception MH pits	25	m2	=5*5	Assume 5x5m area excavated pit at each reception MH
Volume of each reception MH Pit	162.5	m3	=B24*B23	
No.of reception MHs in section	3	No.	#N/A	Assume half jacking half reception shafts
Volume of reception MH pits	487.5	m3	=B26*B25	
Plan area for jacking MH pits	120	m2	=6*20	Assume 20m long, 6m wide area excavated pit at each MH
Volume of each jacking MH Pit	780	m3	=B28*B23	Assume same depth as average trench depth
Number of jacking MHs in section	3	No.	#N/A	Assume half jacking half reception shafts
Volume of jacking MH Pits	2340	m3	=B29*B30	
Volume of Spoil	2827.5	m3	=B31+B27	
Volume of Backfill Material	2827.5	m3	=B32	Assume that no site-won material can be used for backfill
Bulking Factor	1.3		#N/A	Assume bulking/swelling factor for gravel/earth
Total haulage volume	7351.5	m3	=SUM(B32:B33)*B34	Applying the bulking factor to backfill and spoil material
Truck Volume Capacity	8	m3	#N/A	https://fgr.nz/documents/download/4444, semi trailer
Number of Truck Movements	1838	No.	=(B35/B36)*2	Assuming each truck has one empty movement and one full movement

TOTAL HAULAGE

Total Number of Truck Movements	4407	No.	=B19+B37	Validated against ~5000 truck movements for KHP in TMP

Appendix B: Crash History



NZ TRANSPORT AGENCY WAKA KOTAHI CAS

Keith Hay Park CC9

Crash severity

Non-Injury Crash, Minor Crash, Serious Crash, Fatal Crash

Crash year

2016 — 2020

Saved sites

Keith Hay Park CC9

Site details report

Fatal crashes: 0 | **Injury crashes:** 3 | **Non-injury crashes:** 13 | **Total crashes:** 16

Overall crash statistics

Crash severity

Crash severity	Number	%	Social cost $(m)
Fatal	0	0	0
Serious	2	12.50	0.00
Minor-injury	1	6.25	0.10
Non-injury	13	81.25	0.24
TOTAL	16	100	0.34

Crash numbers

Year	Fatal	Serious	Minor	Non-injury
2016	0	0	0	4
2017	0	0	1	2
2018	0	0	0	2
2019	0	0	0	2
2020	0	2	0	3
TOTAL	0	2	1	13
Percent	0	12.5	6.25	81.25

Crash type and cause statistics

Overall casualty statistics

Injury severity

Injury severity	Number	% all casualties
Fatal	0	0.00
Serious Injured	3	75.00
Minor Injured	1	25.00
TOTAL	4	100.00

Casualty numbers

Year	Fatal	Serious Injured	Minor Injured
2016	0	0	0
2017	0	0	1
2018	0	0	0
2019	0	0	0
2020	0	3	0
TOTAL	0	3	1
Percent	0.00	75.00	25.00

Note: Last 5 years of crashes shown (unless query includes specific date range).

Casualty types

Casualty types	Fatalities	Serious injuries	Minor injuries
Cyclists	0	0	0
Drivers	0	2	0
Motorcycle pillions	0	0	0
Motorcycle riders	0	1	0
Passengers	0	0	0
Pedestrians	0	0	1
Other	0	0	0
TOTAL	0	3	1

Note: Motorcycle stats include Mopeds.

Crash type

Crash type	Crash numbers	% All crashes
Overtaking crashes	1	6.25
Straight road lost control/head on	2	12.5
Bend - lost control/Head on	2	12.5
Rear end/obstruction	6	37.5
Crossing/turning	4	25
Pedestrian crashes	1	6.25
Miscellaneous crashes	0	0
TOTAL	16	100

Driver and vehicle statistics

Drivers at fault or part fault in injury crashes - by age

Age	Male	Female	Unknown	Total	Percentage (%)
0-4	0	0	0	0	0.00
5-9	0	0	0	0	0.00
10-14	0	0	0	0	0.00
15-19	0	0	0	0	0.00
20-24	1	0	0	1	33.33
25-29	0	0	0	0	0.00
30-34	0	0	0	0	0.00
35-39	0	0	0	0	0.00
40-44	0	1	0	1	33.33
45-49	0	0	0	0	0.00
50-54	1	0	0	1	33.33
55-59	0	0	0	0	0.00
60-64	0	0	0	0	0.00
65-69	0	0	0	0	0.00
70-74	0	0	0	0	0.00
75-79	0	0	0	0	0.00
80-84	0	0	0	0	0.00
85-89	0	0	0	0	0.00
90-94	0	0	0	0	0.00
95-99	0	0	0	0	0.00
100+	0	0	0	0	0.00
Unknown	0	0	0	0	0.00
TOTAL	2	1	0	3	-
Percent	66.67	33.33	0.00	100.00	-

Note: Driver information is not calculated for non-injury crashes.

Drivers at fault or part fault in injury crashes - by licence

Licence	Male	Female	Unknown	Total	Percentage (%)
Full	1	0	0	1	33.33
Learner	0	1	0	1	33.33
Restricted	1	0	0	1	33.33
Overseas	0	0	0	0	0.00
Wrong class	0	0	0	0	0.00
Never Licensed	0	0	0	0	0.00
Unknown	0	0	0	0	0.00
Forbidden	0	0	0	0	0.00
TOTAL	2	1	0	3	-
Percent	66.67	33.33	0.00	100.00	-

Note: Driver information is not calculated for non-injury crashes.

Crash factors

Crash factors	Crash numbers	% All crashes
#N/A	4	25.00
Alcohol	2	12.50
Disabled, old age or illness	0	0.00
Failed to give way or stop	5	31.25
Fatigue	2	12.50
Incorrect lanes or position	5	31.25
Miscellaneous factors	1	6.25
Overtaking	0	0.00
Pedestrian factors	1	6.25
Poor handling	2	12.50
Poor judgement	2	12.50
Poor observation	4	25.00
Position on Road	1	6.25
Road factors	1	6.25
Travel Speed	1	6.25
Unknown	0	0.00
Vehicle factors	1	6.25
Weather	0	0.00
TOTAL	32	200.00

Crashes with:

Factor groups	Crash numbers	% All crashes
All road user factors	6	37.50
Driver only factors	15	93.75
Pedestrian factors	1	6.25
Vehicle factors	1	6.25
Road factors	1	6.25
Environment factors	0	0.00
No identifiable factors	0	0.00
Retired codes - no future use	0	0.00
TOTAL	24	150.00

Notes: Factors are counted once against a crash - i.e. two fatigued drivers count as one fatigue crash factor.

Driver/vehicle factors are not available for non-injury crashes for Northland, Auckland, Waikato and Bay of Plenty before 2007. This will influence numbers and percentages.

% represents the % of crashes in which the cause factor appears.

Number of parties in crash

Party type	All crashes	% All crashes
Single party	1	6.25
Multiple party, including pedestrian	1	6.25
Multiple party, excluding pedestrian	14	87.50
TOTAL	16	100

Vehicles involved in injury crashes (vehicle count)

Vehicle type	No. of vehicles	% of vehicles in injury crashes
Unknown	0	0.00
Car/Wagon	4	80.00
SUV	0	0.00
Van	0	0.00
Ute	0	0.00
Truck	0	0.00
Truck HPMV	0	0.00
Bus	0	0.00
Motorcycle	1	20.00
Moped	0	0.00
Train	0	0.00
Cycle	0	0.00
Other	0	0.00
Unknown	0	0.00
50 Max	0	0.00
Left scene	0	0.00
Uncoupled towed vehicle	0	0.00
TOTAL	5	100.00

Vehicles involved in injury crashes (crash count)

Vehicle type	Injury crashes	% of injury crashes
Unknown	0	0.00
Car/Wagon	3	100.00
SUV	0	0.00
Van	0	0.00
Ute	0	0.00
Truck	0	0.00
Truck HPMV	0	0.00
Bus	0	0.00
Motorcycle	1	33.33
Moped	0	0.00
Train	0	0.00
Cycle	0	0.00
Other	0	0.00
Unknown	0	0.00
50 Max	0	0.00
Left scene	0	0.00
Uncoupled towed vehicle	0	0.00
TOTAL	4	133.33

Vulnerable road users

Crash types	Number	Percentage (%)
Cyclist crashes	0	0.00
Pedestrian crashes	1	6.25
Motorcycle crashes	1	6.25
All other crashes	14	87.50

Note: Some crashes involve more than one vulnerable road user type.

Note: Motorcycle stats include Mopeds.

Road environment statistics

Road type

Road type	State highway	Local road	Unknown	N/A	Total	Percentage (%)
Urban	0	16	0	0	16	100.00
Open	0	0	0	0	0	0.00
Unknown	0	0	0	0	0	0.00
TOTAL	0	16	0	0	16	–
Percent	0.00	100.00	0.00	0.00	100.00	–

Natural light conditions

Conditions	Injury	Non-injury	Total	%
Light/overcast	3	6	9	56.25
Dark/twilight	0	7	7	43.75
Unknown	0	0	0	0.00
TOTAL	3	13	16	100

Conditions

Conditions	Injury	Non-injury	Total	%
Dry	2	11	13	81.25
Ice or Snow	0	0	0	0.00
Wet	1	2	3	18.75
Null	0	0	0	0.00
TOTAL	3	13	16	100

Intersection/midblock

Intersection/mid-block	Total	%
Intersection	8	50.00
Midblock	8	50.00
TOTAL	16	100

Vehicle usage in injury crashes

Vehicle usage	Fatal Crash	Serious Crash	Minor Crash	Total	Percentage (%)
Private	0	4	0	4	80.00
Attenuator Truck	0	0	0	0	0.00
Agricultural	0	0	0	0	0.00
Ambulance	0	0	0	0	0.00
Campervan	0	0	0	0	0.00
Concrete mixer	0	0	0	0	0.00
Fire	0	0	0	0	0.00
Logging truck	0	0	0	0	0.00
Mobile crane	0	0	0	0	0.00
Police	0	0	0	0	0.00
Rental	0	0	0	0	0.00
Road Working	0	0	0	0	0.00
Scheduled service Bus	0	0	0	0	0.00
School bus	0	0	0	0	0.00
Tanker	0	0	0	0	0.00
Taxi	0	0	0	0	0.00
Tour Bus	0	0	0	0	0.00
Trade person	0	0	0	0	0.00
Work travel	0	0	0	0	0.00
Work vehicle	0	0	0	0	0.00
Other	0	0	0	0	0.00
Null	0	0	1	1	20.00
TOTAL	0	4	1	5	–
Percent	0.00	80.00	20.00	100.00	–

Time period statistics

Objects struck

Objects struck	Injury crashes	%	Non-injury crashes	%
Crashes w/obj struck	1	6.25	7	43.75

Object struck	Injury crashes	%	Non-injury crashes	%
Animals	0	0.00	0	0.00
Bridges/Tunnels	0	0.00	0	0.00
Cliffs	0	0.00	0	0.00
Debris	0	0.00	0	0.00
Embankments	0	0.00	0	0.00
Fences	0	0.00	1	6.25
Guide/Guard rails	0	0.00	0	0.00
Houses	0	0.00	0	0.00
Traffic Islands	0	0.00	0	0.00
Street Furniture	0	0.00	0	0.00
Kerbing	0	0.00	0	0.00
Landslips	0	0.00	0	0.00
Parked vehicle	0	0.00	6	37.50
Trains	0	0.00	0	0.00
Sight Rails	0	0.00	0	0.00
Poles	1	6.25	0	0.00
Stationary Vehicle	0	0.00	0	0.00
Roadwork	0	0.00	0	0.00
Traffic Sign	0	0.00	0	0.00
Trees	0	0.00	0	0.00
Drainage Structures	0	0.00	0	0.00
Ditches	0	0.00	0	0.00
Other	0	0.00	0	0.00
Thrown or dropped objects	0	0.00	0	0.00
Water	0	0.00	0	0.00
TOTAL	1	-	7	-

Note: % represents the % of crashes in which the object is struck.

Month by injury/ non-injury crashes

Month	Injury crashes	%	Non-injury crashes	%	Total	%
Jan	1	33.33	1	7.69	2	12.5
Feb	0	0	1	7.69	1	6.25
Mar	0	0	0	0	0	0
Apr	0	0	0	0	0	0
May	0	0	0	0	0	0
Jun	0	0	2	15.38	2	12.5
Jul	1	33.33	2	15.38	3	18.75
Aug	0	0	3	23	3	18.75
Sep	0	0	1	7.69	1	6.25
Oct	1	33.33	2	15.38	3	18.75
Nov	0	0	0	0	0	0
Dec	0	0	1	7.69	1	6.25
TOTAL	3	100	13	100	16	100

Day/period

Day/Period	All crashes	% All crashes
Weekday	12	75
Weekend	4	25
TOTAL	16	100

Day/period by hour

Day/Period	00:00 - 02:59	03:00 - 05:59	06:00 - 08:59	09:00 - 11:59	12:00 - 14:59	15:00 - 17:59	18:00 - 20:59	21:00 - 23:59	Total
Weekday	2	2	1	1	3	2	1	0	12
Weekend	1	1	0	0	1	0	1	0	4
TOTAL	3	3	1	1	4	2	2	0	16

Day/period by hour DOW

Day/Period	00:00 - 02:59	03:00 - 05:59	06:00 - 08:59	09:00 - 11:59	12:00 - 14:59	15:00 - 17:59	18:00 - 20:59	21:00 - 23:59	Total
Mon	0	1	1	0	1	0	0	0	3
Tue	0	1	0	1	0	0	0	0	2
Wed	1	0	0	0	0	0	1	0	2
Thu	0	1	0	0	2	2	0	0	5
Fri	1	0	0	0	0	0	0	0	1
Sat	0	0	0	0	1	0	1	0	2
Sun	1	0	0	0	0	0	0	0	1
TOTAL	3	3	1	1	4	2	2	0	16

Appendix C: CI Construction Traffic Management Plan

www.tonkintaylor.co.nz

Appendix F: Construction Noise and Vibration Assessment

REPORT

Tonkin+Taylor

Sewer Connection (CC9) - Keith Hay Park

Construction Noise and Vibration Assessment

Prepared for
Watercare Services Ltd
Prepared by
Tonkin & Taylor Ltd
Date
July 2021
Job Number
1015172.1400

Exceptional thinking together
www.tonkintaylor.co.nz

Document Control

Title: Sewer Connection (CC9) - Keith Hay Park					
Date	**Version**	**Description**	**Prepared by:**	**Reviewed by:**	**Authorised by:**
June 2021	1.0	Final	L. Leitch	D. Humpheson	P. Roan

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Watercare Services Ltd	1 PDF copy
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Table of contents

1 Introduction 1

2 Background and approach 1

3 Project overview 2

- 3.1 Proposed works 2
- 3.2 Site location and description 2
- 3.3 Construction methodology 3
- 3.4 Duration of works 3
- 3.5 Hours of operation 3

4 Noise sensitive receivers 5

5 Regulatory assessment criteria and standards 7

- 5.1 Noise limits 7
  - 5.1.1 RMA 7
  - 5.1.2 AUP 7
  - 5.1.3 New Zealand Standards 7
  - 5.1.4 CI Requirements 9
- 5.2 Vibration limits 9
  - 5.2.1 AUP 9
  - 5.2.2 DIN 4150-3 9
  - 5.2.3 CI Requirements 11

6 Construction noise and vibration assessment 11

- 6.1 Plant list 11
- 6.2 Predicted noise levels 12
- 6.3 Predicted vibration levels 15

7 Assessment of effects 16

- 7.1 Noise 16
  - 7.1.1 Potential effects 16
  - 7.1.2 Activity assessment 16
- 7.2 Vibration 18
- 7.3 Specific noise mitigation measures 18

8 Conclusion 19

9 Applicability 19

1 Introduction

Tonkin & Taylor Ltd (T+T) has been engaged by Watercare Services Ltd (Watercare) to prepare a construction noise and vibration assessment for works associated with a new sewer pipeline (CC9) at Keith Hay Park, Mt Roskill.

This assessment sets out the likely acoustic effects of these works. It relies on information provided in the Marshall Day Acoustics assessment[1] for works associated with the wider collector sewers project undertaken as part of the Central Interceptor (CI) works, of which CC9 is a part.

This report has been prepared in accordance with T+T's letter of engagement dated 16 November 2020.

2 Background and approach

The CI Project has been developed to provide network capacity for growth and to mitigate wastewater overflows in the Auckland region. The Keith Hay Park CI construction site is one of the main shaft sites for CI.

CI is being undertaken in accordance with a suite of approved management plans and mitigation measures. While the CC9 works are outside of Watercare's CI designation for its Keith Hay Park shaft construction site, the CC9 works represent a connection to the local network required as part of the broader CI works to support growth within the surrounding area. The CC9 works will be implemented fully in accordance with the applicable management plans for CI which have been scrutinised and approved by Auckland Council.

Accordingly, this assessment relies on the measures set out in the CI Construction Noise and Vibration Management Plan (CNVMP) developed to manage construction noise and vibration from the Keith Hay Park shaft site, along with the Activity Specific Construction Noise Management Plan – Keith Hay Park Sheet Piling (ASCNMP)[2] where relevant. This allows for an integrated and consistent approach to be taken, while also noting that the CI CNVMP and ASCNMP represent a best-practice approach which have been subject to review and approval by Auckland Council and are demonstrated to have worked across the course of the wider CI works.

Where this assessment identifies additional management and mitigation measures required to address potential noise and vibration effects, the CI CNVMP and ASCNMP will be updated to include these measures.

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[1] Marshall Day Acoustics report *Central interceptor project, CSO collector sewers, Noise impact assessment*. Ref Rp003 2011153A dated 23 July 2012.

[2] CNVMP: Doc No: GAJV-PLN-00043 Version 0.4 Final, approved 18 December 2019; and ASCNMP: Doc No. GAJV-PLN-0079, Version 0.3 Final, approved 18 March 2020.

3 Project overview

3.1 Proposed works

The CC9 sewer pipeline will be installed underneath Keith Hay Park, extending from the Keith Hay Park CI shaft in the Cameron Pools Carpark to a termination manhole located approximately 810 m to the south on Richardson Road. The sewer pipeline is approximately 1200 mm in diameter (900 mm in internal diameter) and will be located next to the existing Branch 9 trunk sewer alignment.

The northern section of the pipeline route is expected to be trenchless (likely pipe-jacked or possibly HDD) to a depth to invert of up to approximately 8 m. The remaining section of the CC9 route (approximately 300 m) from around the Eden Roskill Cricket Club to Richardson Road will potentially be trenched to a maximum depth of up to 5 m but may also be installed via trenchless methods (or a combination of trenchless and trenched construction methodologies). Part of this section is located in the Hay Park School and Waikowhai Intermediate School grounds and Hillsborough Kindergarten carpark, resulting in additional time constraints if this section of pipeline is trenched (i.e. as far as practicable outside of school term).

The total construction programme is expected to take up to 12 months, with works in the school grounds anticipated to take between 2 – 3 months (and possibly up to 4 months).

This report assumes the most conservative construction methodology which includes both trenching and trenchless technology.

3.2 Site location and description

The site is next to and within the surface catchment area of Oakley Creek which is an urban stream that flows from Mt Roskill through the western suburbs of Central Auckland before entering the Motu Manawa Marine Reserve in the Waitemata Harbour.

Key land uses in the immediate area include Keith Hay Park and associated facilities including playing fields and cricket pitches, and two schools (Waikowhai Intermediate School and Hay Park School) at the southern extent of the alignment near Richardson Road. To the east of the proposed CC9 route, the immediate land use is primarily residential.

Figure 3.1: Aerial view of the proposed alignment (Source: Auckland Council Geomaps, 2021).

3.3 Construction methodology

The construction methodology is expected to be primarily trenchless, likely pipe-jacked or possibly via HDD methods, from the CI Keith Hay construction site through to the Eden Roskill Cricket Club carpark (at or about MH05 or MH06) and will be installed at a depth to invert of up to approximately 8 m.

The trenchless methodology will require intermediate manholes located at an average of 65 m apart, and a maximum of 150 m apart along the CC9 route at a depth to invert of between 4-8 m.

Launch pits will be required at every second manhole location along the trenchless section of the alignment. In the case of HDD, a laydown area immediately adjacent to the pipeline alignment will be required along the length of the route to enable pipe stringing prior to installation. Initial set-up would occur at the CI shaft with a reception shaft likely to be located at the existing manhole in the Cameron Pool car park (MH01) with a drive from this point through to MH03 (or alternatively from MH03 to MH01).

The remaining section of the CC9 route will be installed via a trenchless construction methodology outlined above, or by open trenching.

In the case of open trenching, this would occur from around manhole MH05 or MH06 to Richardson Road (approximately 300 m in length) at a maximum depth to invert of up to 5 m. Depending on the depth of the trench it may be benched. Pipes will be lowered into the trench, with sections of the trench widened to enable in-trench welding of pipes to occur should this be required. Trenching is likely to require a construction area at each manhole location.

Construction lay-down areas will be required for the storage of machinery and construction materials during the works. These areas are intended to maintain a clean working surface and to minimise the risk of silt and sediment to be tracked onto the public roads. The exact site configuration will be determined by the Contractor and will vary depending on site constraints along the proposed alignment. However a main construction lay-down area is proposed within the Cameron Leisure Pool carpark with secondary smaller construction lay-down areas required around each manhole while that section of the pipeline is laid.

Excavation in basalt is not anticipated for CC9.

In addition to construction works, there are several trees close to the alignment which need to be removed by chainsaw and chipped. The number of trees to be removed will be minimised as far as possible.

3.4 Duration of works

The total construction programme is expected to take up to up to 12 months, with trenching works including works in the school grounds anticipated to take between 2–3 months (and possibly up to a maximum of 4 months).

3.5 Hours of operation

Site operational arrangements will likely occur on the following general basis:

- Micro tunnelling/HDD and trenching activities – this work would generally occur during normal working hours, 7 am to 6 pm, Monday to Friday and 8 am to 6 pm Saturday. However, in particular circumstances, Watercare may need to undertake micro tunnelling/HDD 24 hours a day 7 days a week (or alternative extended hours) to meet construction demands, provided that construction work can be managed to meet construction noise and vibration (along with construction traffic requirements).

- Trenching activities – To restrict the duration of trenching activities, Watercare proposes to undertake the trenching works 24 hours a day 7 days a week (or alternative extended hours) provided that construction work can be managed to meet construction traffic requirements (along with noise and vibration requirements). This is to shorten the construction period such that as far as practicable construction activities occur outside of school term.
- General site activities – normal working hours, 7 am to 6 pm, Monday to Friday, 8 am to 6 pm Saturday, with provision to extend hours during summer daylight savings periods as required.
- Sheet piling and tree chipping will not need to take place outside normal daytime working hours.

For works outside of normal hours, appropriate measures will be implemented to ensure that the relevant construction noise, vibration and traffic management standards are met where practicable. These measures will reflect those set out in the CNVMP as updated to specifically address CC9 works (see **Appendix A**) and will also reflect the CI ASCNMP measures where relevant (e.g. for sheet piling and tree removal).

4 Noise sensitive receivers

Figure 4.1 to Figure 4.3 show the alignment of CC9 in relation to the nearest noise sensitive receivers. Most of these receivers towards the northern end are residential, and there are two schools, a kindergarten and a cricket club towards the south of the alignment, as well as residential properties along the south side of Richardson Road.

These receivers are listed in Table 4.1, together with the type of receiver and approximate distance to the alignment (note that this may not be representative of the closest distance to works).

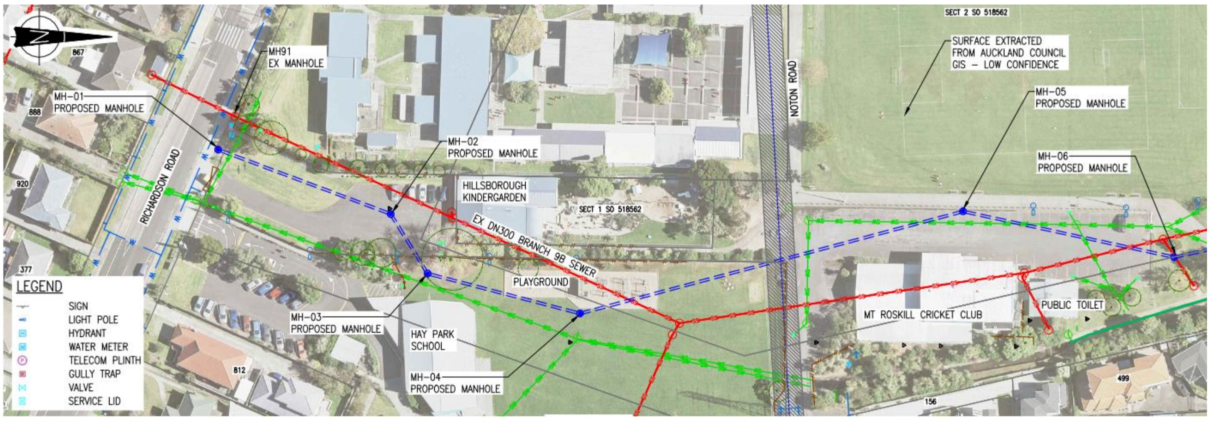


Figure 4.1: Approximate layout of alignment (blue line), southern end.

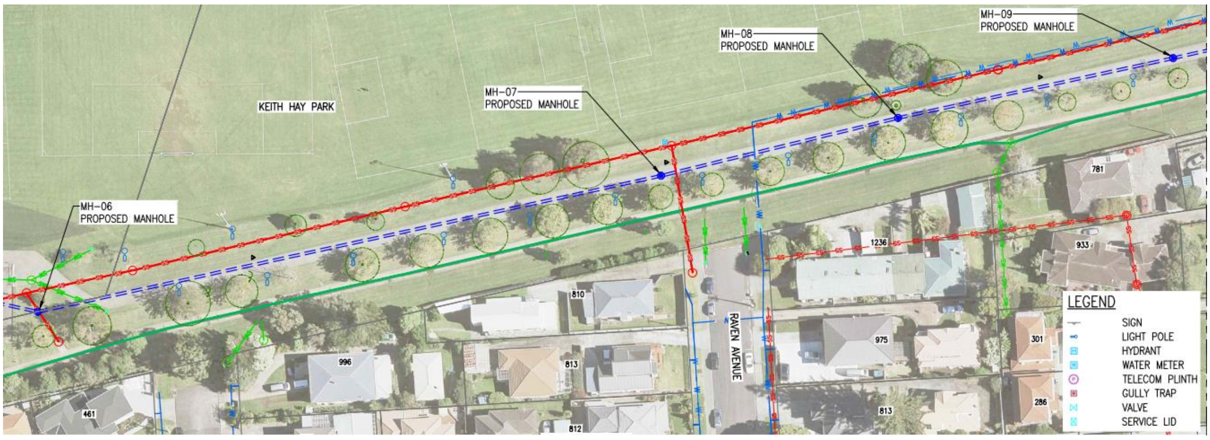


Figure 4.2: Approximate layout of alignment (blue line), central section.

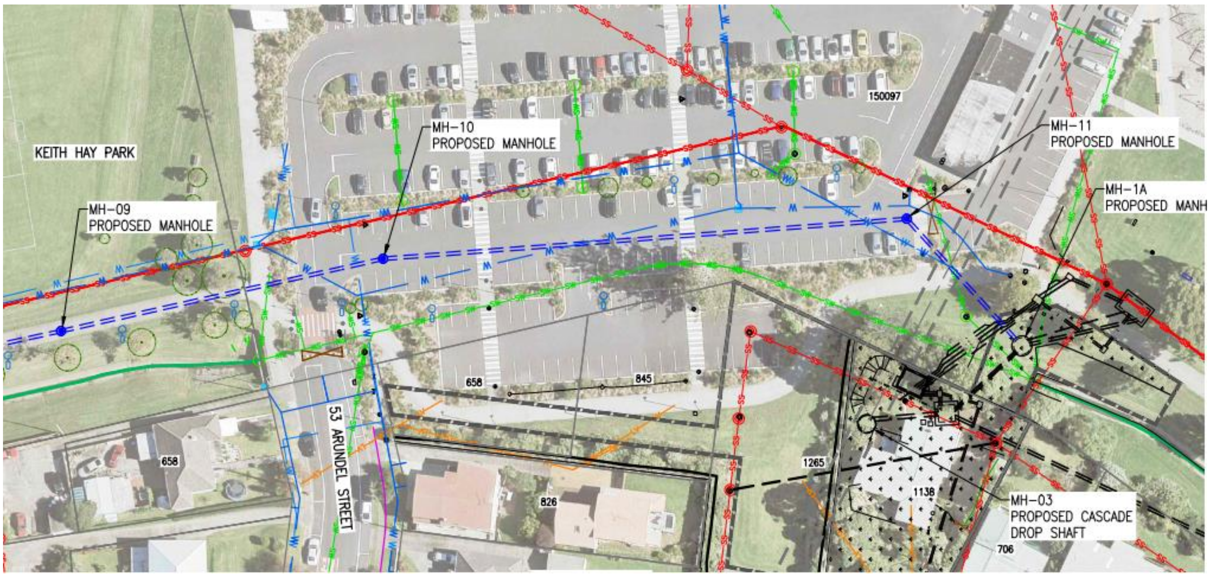


Figure 4.3: Approximate layout of alignment (blue line), northern end.

Table 4.1: Noise sensitive receivers

Receiver	Type	Distance from works	Comments
639-645, 672, 672A Richardson Road	Residential	20 m+	
Waikowhai Intermediate School	School	10-15 m	Trenching through school grounds programmed to be outside school term as far as practicable.
Hillsborough Kindergarten	Kindergarten	10-15 m to building, adjacent to play area	As above.
Hay Park School	School	5-10 m from building, on edge of playing fields	As above.
Eden Roskill Cricket Club	Cricket club	5-10 m	Likely to be lower sensitivity except when events are on.
Properties facing park, at ends of Raven Ave, Rustic Ave and the south side of Arundel Street (before the carpark entrance)	Residential	20-25 m	Some properties are 2-storey therefore barriers may have limited effect.
Properties facing park immediately to north of Arundel Street carpark entrance	Residential	35-45+m	Located immediately to south of CI shaft site.
Keith Hay gymnasium and pool complex	Sports complex	50 m	Low sensitivity, daytime/evening only.
Public changing rooms		10 m	Low sensitivity.
19 Gregory Place	Residential	30 m	To north of (behind) CI shaft site. Noise effects addressed through CI ASCNMP.

5 Regulatory assessment criteria and standards

The following standards and criteria are applicable for assessing noise and vibration from construction activities associated with CC9:

- Resource Management Act 1991 (RMA).
- Auckland Unitary Plan (AUP).
- NZS 6801:2008 – Acoustics – Measurement of environmental noise (NZS 6801).
- NZS 6802:2008 – Acoustics – Environmental noise (NZS 6802).
- NZS 6803:1999 – Acoustics – Construction noise (NZS 6803).

There is no New Zealand standard for vibration, however the following German Industrial Standard is typically referenced:

- DIN 4150-3:1999 Effects of vibration on structures.

The following sections detail the requirements/recommendations of these documents as well as the existing CI resource consent and designation noise and vibration conditions.

5.1 Noise limits

5.1.1 RMA

District plan noise limits (see below) serve to establish whether the noise experienced from another site is likely to result in annoyance or unreasonable noise. However, non-compliance with a noise limit does not necessarily result in the noise being considered excessive as defined in Section 326 of the Resource Management Act 1991:

> "*any noise that is under human control and unreasonably interferes with the peace, comfort and convenience of any person*."

In situations where there is the potential for excessive noise, there is a duty to avoid unreasonable noise. Section 16(1) of the RMA requires:

"*Every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level."*

Section 17 of the RMA imposes duties to avoid, remedy, or mitigate any adverse effects whether or not the activity is in accordance with a rule in a plan.

5.1.2 AUP

Chapter 25 of the AUP sets out the policy direction and associated rules in relation to noise (and vibration). The AUP refers to NZS 6803 for construction noise limits (refer below).

5.1.3 New Zealand Standards

In general, noise sources should be measured in accordance with NZS 6801 and assessed in accordance with NZS 6802.

NZS 6802 sets out a procedure for the assessment of environmental noise for compliance with noise limits and provides guidance for the setting of noise limits for consent conditions, rules or national environmental standards.

The Foreword goes on to state that '*this Standard should be used in conjunction with NZS 6801:1999* [current version 2008]*, which contains detailed requirements for the measurement of environmental sound. The standard is intended for the guidance of those involved in managing noise in the construction industry and the local authorities with responsibility for control of noise within their districts and regions under the Resource Management Act 1991*'.

The recommended construction noise limits of NZS 6803:1999 are detailed in Table 5.1. These values are for works of long duration, i.e. over 20 weeks duration. Noise is assessed over a typical 15-minute period which should be indicative of typical activity for the majority of the time.

Table 5.1: Construction noise limits for residential dwellings taken from NZS 6803

Time of week	**Time period**	**Noise limit dB**	
		L_{Aeq}	**L_{Amax}**
Weekdays	6:30 am – 7:30 am	55	75
	7:30 am – 6:00 pm	70	85
	6:00 pm – 8:00 pm	65	80
	8:00 pm – 6:30 am	45	75
Saturdays	6:30 am – 7:30 am	45	75
	7:30 am – 6:00 pm	70	85
	6:00 pm – 8:00 pm	45	75
	8:00 pm – 6:30 am	45	75

These limits apply to construction noise levels measured at 1 m from the façade of residential dwellings.

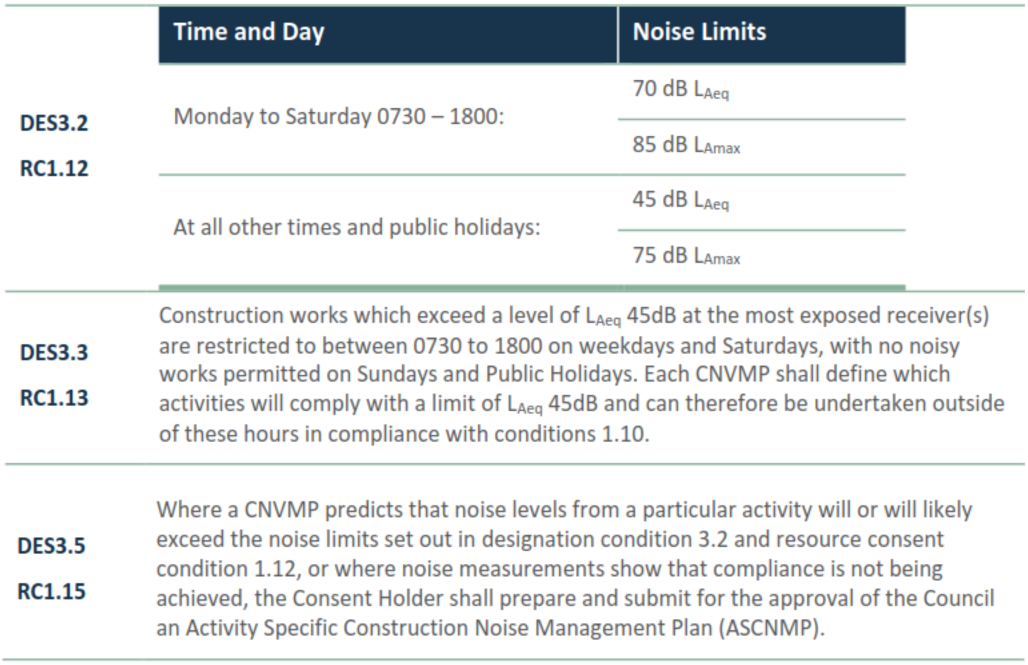
Limits for commercial and industrial buildings are presented in Table 5.2. These night time limits may be appropriate for the schools and cricket club as they will have less sensitivity to noise at night.

Table 5.2: Construction noise limits for commercial and industrial buildings taken from NZS 6803

Time period	**Typical duration of work dB L_{Aeq}**
7:30 am – 6:00 pm	70
6:00 pm – 7:30 am	75

5.1.4 CI Requirements

The excerpt below identifies the noise limits set out in the relevant CI resource consent (Condition RC1.12) and Designation condition DES3.2.



	Time and Day	Noise Limits
DES3.2 **RC1.12**	Monday to Saturday 0730 – 1800:	70 dB L_{Aeq}
		85 dB L_{Amax}
	At all other times and public holidays:	45 dB L_{Aeq}
		75 dB L_{Amax}
DES3.3 **RC1.13**	Construction works which exceed a level of L_{Aeq} 45dB at the most exposed receiver(s) are restricted to between 0730 to 1800 on weekdays and Saturdays, with no noisy works permitted on Sundays and Public Holidays. Each CNVMP shall define which activities will comply with a limit of L_{Aeq} 45dB and can therefore be undertaken outside of these hours in compliance with conditions 1.10.	
DES3.5 **RC1.15**	Where a CNVMP predicts that noise levels from a particular activity will or will likely exceed the noise limits set out in designation condition 3.2 and resource consent condition 1.12, or where noise measurements show that compliance is not being achieved, the Consent Holder shall prepare and submit for the approval of the Council an Activity Specific Construction Noise Management Plan (ASCNMP).	

5.2 Vibration limits

5.2.1 AUP

The AUP (E25.6.30) requires construction activities to not exceed the vibration limits set out in DIN 4150-3 (1999) when measured in accordance with that Standard on any structure not on the same site. The applicable vibration limit for a residential receiver is 5 mm/s Peak Particle Velocity (PPV) at the lowest frequencies.

Table E25.6.30.1 provides amenity vibration limits in buildings in any axis when measured in the corner of the floor of the storey of interest for multi-storey buildings, or within 500 mm of ground level at the foundation of a single storey building. The applicable amenity vibration criterion is 2 mm/s PPV between 7 am and 10 pm, or 0.3 mm/s PPV between 10 pm and 7 am. Exceedance of this criterion should result in management and mitigation measures being implemented such as communication and consultation.

The AUP includes an allowance for up to 5 mm/s PPV being received between 7 am and 6 pm for no more than three days provided that occupants within 50 m are advised at least three days prior to works commencing. Vibration up to 2 mm/s PPV is permissible.

5.2.2 DIN 4150-3

The criteria from DIN 4150-3 are shown in Table 5.3 and summarised in Figure 5.1 below.

These show the recommended vibration limits in terms of PPV as this is directly related to strain, and hence potential for damage to structures. They are lowest in the frequency range of 1-10 Hz which is the normal range of natural frequency of most structures. The limits increase at higher frequencies where the potential harmonic effects are reduced.

Table 5.3: DIN 4150:1999 standard guidelines for evaluating the effects of short-term vibration on structures

Line	Type of structure	Vibration at the foundation at a frequency of			Vibration at horizontal plane of the highest floor
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz	All frequencies
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20 mm/s	20 to 40 mm/s	40 to 50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or occupancy.	5 mm/s	5 to 15 mm/s	15 to 20 mm/s	15 mm/s
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value.	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

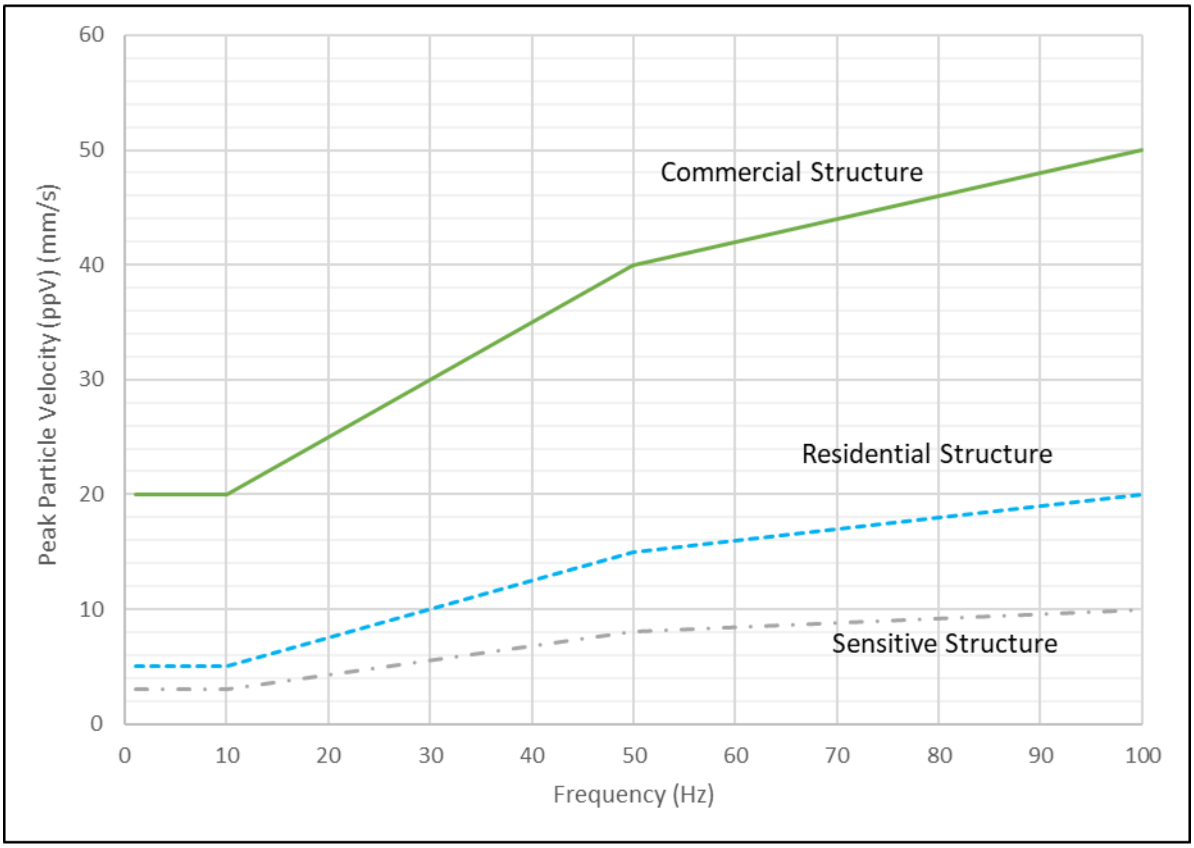
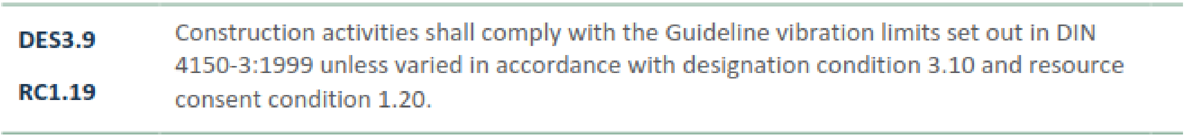


Figure 5.1: DIN 4150-3: 1999 Short-term standard baseline curves.

DIN 4150 recommends that vibration levels in buildings used for residential purposes should be limited to less than 5 mm/s at low frequencies, increasing up to 20 mm/s and higher frequencies, and for intermittent or short term vibrations are less than 5 mm/s for continuous activities. The limits recommended in the DIN 4150 standard provides a low probability of cosmetic damage while structural damage is unlikely to occur in both residential and commercial structures at less than 50 mm/s, and for in-ground structures and infrastructure services at less than 100 mm/s. The application of this standard using a statistically based criteria for the DIN 4150 limits has been regularly applied in New Zealand [Structural damage] to encourage use of best practice.

5.2.3 CI Requirements

The excerpt below identifies the vibration limits set out in the relevant CI resource consent (Condition RC1.19) and Designation condition DES3.9.



DES3.9 **RC1.19**	Construction activities shall comply with the Guideline vibration limits set out in DIN 4150-3:1999 unless varied in accordance with designation condition 3.10 and resource consent condition 1.20.

6 Construction noise and vibration assessment

The likely equipment for each stage of works has been assessed below (noting the methodology for works is not finalised and a certain amount of flexibility is required).

6.1 Plant list

The following sound power levels for likely equipment and activities are taken from the MDA report. Tree removal noise levels are taken from T+T's library of measured levels. The table provides noise level data at different distances from the noise source.

Table 6.1: Construction equipment noise levels without mitigation (from MDA report)

Activity	Equipment	Sound power level dB LWA	Noise level dB LAeq				
			5 m	10 m	20 m	30 m	50 m
Tunnelling	Air supply pump	93	71	65	59	55	51
	Muck out	99	77	71	65	61	57
	Crawler crane	99	77	71	65	61	57
	Slurry separation	103	81	75	69	65	61
General	Generator	102	80	74	68	64	60
	Hydraulic control pump	90	68	62	56	52	48
	Truck deliveries	105	83	77	71	67	63
	Standby generator	88	66	60	54	50	46
Trenching	Sheet piling	115	93	87	81	79	73
	Crawler crane	99	77	71	65	61	57
	Excavation	102	80	74	68	64	60
	Muck out	99	77	71	65	61	57
	Trenching	105	83	77	71	67	63

Activity	Equipment	Sound power level dB LWA	Noise level dB LAeq				
			5 m	10 m	20 m	30 m	50 m
	Truck carting debris	105	83	77	71	67	63
Tree removal	Chainsaw	96	74	68	62	58	54
	Woodchipper	118	96	90	84	80	76

6.2 Predicted noise levels

Table 6.2 lists the noise sensitive receivers, their distance, likely noise levels for anticipated activities, and indication of possible mitigation. Predicted levels with mitigation (where likely to be practicable) are included.

The table also identifies those activities considered low risk (green), medium risk (orange) and high risk (red). The risk rating has been used to inform the level of mitigation required. Where medium and high risk works are to be undertaken, as shown as orange and red in Table 6.2, the Contractor shall adopt the best practicable option to ensure that noise and vibration levels do not exceed a reasonable level.

A hierarchy of mitigation measures is set out in Table 6.3 below. The risk rating and colours correspond to those in Table 6.2.

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Table 6.2: Predicted noise levels at sensitive receivers

Receiver	Approx. min distance to works m	Activity	Predicted noise level dB LAeq		Night working required?	Mitigation/limitations
			Without mitigation	With mitigation		
639-647, 672, 672A Richardson Road	20	Sheet piling	81	81	No	Restrict to daytime
		Trenching	71	61	May extend during summer daylight savings (including night time work)	Screening, timing of works
		General	68	58	May extend during summer daylight savings (including night time work)	Screen generator
		Truck deliveries	71	71	Some deliveries outside normal hours	Discreet events, relatively short duration and low traffic vols
Waikowhai Intermediate School, Hillsborough Kindergarten[3]	10-15	Sheet piling	87	87	N/A – not sensitive at night	Only when unoccupied
		Trenching	77	67		Screening, timing of works
		General	74	64		Screen generator
		Truck deliveries	77	77		Discreet events, relatively short duration and low traffic vols
Hay Park School, Eden Roskill Cricket Club	5-10	Sheet piling	93	93	N/A – not sensitive at night	Only when unoccupied
		Trenching	83	73		Ideally only when unoccupied
		General	80	70		Ideally only when unoccupied
		Truck deliveries	83	83		Discreet events, relatively short duration and low traffic vols
Properties facing park	20	Tunnelling	69	59	24/7 at times	Screening, timing of works
		General	68	58	May extend during summer daylight savings	Screening, timing of works

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[3] And potentially two properties at south western end of Raven Avenue (8 and 8A Raven Avenue) if trenching commences from MH06 rather than MH05.

Receiver	Approx. min distance to works m	Activity	Predicted noise level dB LAeq		Night working required?	Mitigation/limitations
			Without mitigation	With mitigation		
		Truck deliveries	71	71	Some deliveries outside normal hours	Discreet events, relatively short duration and low traffic vols
Properties near Cameron Leisure Pools carpark	30	Tunnelling	65	55	24/7 at times	Screening, timing of works
		General	64	54	May extend during summer daylight savings	Screening, timing of works
		Truck deliveries	67	67	Some deliveries outside normal hours	Discreet events, relatively short duration and low traffic vols

Table 6.3: Hierarchy of mitigation

Risk	Hierarchy of mitigation
Low	General measures: • Staff training and awareness. • Stakeholder/community engagement. • General equipment measures.
Medium	Mitigation measures: • Stakeholder/community engagement and confirmation of occupancy and times of greatest sensitivity to noise exposure. • Where practicable utilise acoustic screens/barriers. • Use of low vibration equipment or alternative construction methodology.
High	Enhanced mitigation measures: • Where practicable place additional acoustic screens including at the source of the noise. • Engagement with affected parties to arrange working times around sensitive hours. • Consideration of temporary accommodation or other options such as offering vouchers (shopping/entertainment) to encourage residents to temporarily leave their home on a particular morning or afternoon while works are completed.

The predicted noise levels in Table 6.2 are for the single noisiest piece of equipment used for the activity. When multiple items of equipment are used simultaneously it may result in higher noise levels, however it is unlikely that multiple items of equipment will be operating at the closest point to any single receiver so overall the levels presented are likely to represent a reasonable worst-case.

Where screening is practicable to implement and line of sight can be blocked between source and receiver, these levels are likely to decrease by 10 dB. Levels with and without mitigation are shown in Table 6.2. Screening is not expected to be practicable for sheet piling or for truck deliveries. Where properties are two-storey, screening is not likely to be effective for the upper storey.

Noise levels from tree chipping are predicted to exceed daytime noise limits even at 50 m (76 dB LAeq). As there will be some discretion as to where the chipper is located, this has not been included in the above table. It should be possible to site it at least 30 m from noise sensitive properties; predicted noise level would be 80 dB LAeq. The chipper will be used in relatively short bursts as branches are fed into it. It may also be practicable to screen the chipper.

6.3 Predicted vibration levels

From the listed equipment on site, significant vibration is only likely to be caused by sheet piling. This is expected to be compliant with a limit of 2 mm/s at a distance of 20 m or less, depending on local ground conditions. Tunnel boring and heavy equipment movement may cause low levels of vibration, but this is unlikely to be significant at receivers.

7 Assessment of effects

All works will be undertaken in accordance with the approved CNVMP for the CI works at Keith Hay Park (refer **Appendix A**) and any ASCMP as relevant. The existing CNVMP will be updated prior to the CC9 works commencing to include any additional mitigation measures described below, as required.

7.1 Noise

7.1.1 Potential effects

The degree of the noise effects will depend upon the magnitude, frequency of occurrence and duration of the noise exposure. As residents will experience noise inside and outside their dwellings if they are at home, an indication of the potential effects both indoors and outside is provided in Table 7.1 below.

Table 7.1: Subjective response to environmental noise levels

External Noise Level (LAeq)	Potential Daytime Effects Outdoors	Corresponding Internal Noise Level (LAeq)	Potential Daytime Effects Indoors
Up to 65 dB	Conversation becomes strained, particularly over longer distances.	Up to 45 dB	Noise levels would be noticeable but unlikely to interfere with residential activities.
65 to 70 dB	People would not want to spend any length of time outside.	45 to 50 dB	Concentration would start to be affected. TV and telephone conversations would begin to be affected.
70 to 75 dB	Outdoor users would experience considerable disruption.	50 to 55 dB	Phone conversations would become difficult. Personal conversations would need slightly raised voices. For residential activity, TV and radio sound levels would need to be raised.
75 to 80 dB	Some people may choose hearing protection for long periods of exposure. Conversation would be very difficult, even with raised voices.	55 to 60 dB	People would actively seek respite when exposed for a long duration.
80 to 90 dB	Hearing protection would be required for prolonged exposure (8 hours at 85 dB) to prevent hearing loss.	60 to 70 dB	Untenable for residential environments. Unlikely to be tolerated for any extent of time.

Note: The adjustment factor between the external noise level and the internal noise level is based on a 20 decibel reduction as allowed for in NZS 6803.

7.1.2 Activity assessment

Where screening can be implemented effectively (i.e. placed so that line of sight is lost between source and receiver) then up to 10 dB attenuation may be expected.

For residential receivers, noise levels are predicted to be within the allowable daytime limits for much of the time or with only negligible exceedance, i.e approximately 1 dB. The exception is sheet piling, which is anticipated to exceed the daytime noise limits at receivers up to 50 m away.

Mitigation such as screening is generally not practical to implement for piling due to the elevated noise source. There are only a few residential properties within 50 m of possible sheet piling; these are 639, 641, 643, 645, 672 and 672A Richardson Road and potentially 8 and 8A Raven Avenue if trenching commences at MH06 towards the northern end of the cricket club carpark. For the closest receivers (incl. 641, 643 Richardson Road), the highest levels of noise from sheet piling (if required) will only occur when works are underway at the very southern end of the alignment (i.e. when works are in close proximity to those receivers). When works are further from these properties, noise levels will be lower. Adverse effects of noise from sheet piling will be reduced through effective communication with these properties consistent with the current approach set out in the CI ASCMP for Keith Hay Park. It is also noted that ambient noise levels at the Richardson Road properties will be affected by traffic along Richardson Road which is a main arterial route.

Wood chipping is also likely to exceed daytime noise levels at distances of up to 100 m if unscreened. If the wood chipper can be effectively screened, noise levels may be compliant with daytime limits at a distance of around 30 m. The wood chipper should be oriented so that it is facing away from noise sensitive receivers and sited as far from noise sensitive receivers as practical. Noise from a wood chipper is typically in short bursts and there is unlikely to be sustained high levels of noise from chipping.

The schools, kindergarten and cricket club are predicted to receive higher noise levels at times when works are in close proximity to the buildings, and in particular when sheet piling (if required) is taking place. Waikowhai School and Hillsborough Kindergarten are predicted to receive maximum noise levels of 77 dB LAeq during trenching works at the closest location, and 87 dB LAeq from sheet piling. It is recommended that the schools and kindergarten are consulted to agree the best approach to undertaking these works. It may be possible to undertake works during school holidays or otherwise outside of school hours.

Hay Park School and Mount Roskill Cricket Club are predicted to receive maximum noise levels of 83 dB LAeq from trenching and general works, and 93 dB LAeq from sheet piling if this occurs at the closest location to the buildings. Some screening may be possible, but this will be less effective where buildings are two-storey, such as the cricket club. As above, noisy activities within the vicinity of the school should be undertaken wherever practicable outside of term time. Where possible, particularly noisy activities within the vicinity of the cricket club should be scheduled for times when the club is not in use.

Works will on occasion be required during the evening/night-time when lower noise limits apply. Sheet piling and wood chipping will not take place outside normal daytime hours. Other noisy works should be avoided outside normal working hours as far as practicable, although it is noted that this may not always be possible particularly in relation to trenching in the school grounds. Watercare proposes to potentially undertake this activity 24/7 to limit the duration of works within the school (and ideally to limit works to the school holiday period/outside of term time as far as practicable). Noise levels will be managed via the measures set out in the CI CNVMP along with the ASCNMP whenever exceedances are considered possible, with specific CC9-related mitigation methodologies set out in an update to the CI management plans (through an addendum or similar to those plans).

It should be noted that the period 7-7.30 am during standard working hours falls within the morning ‘shoulder’ period when a lower noise limit applies. Noisy works including deliveries should be restricted during this time. However consistent with CI, non-noisy activities such as toolbox meetings, administration tasks and setup may be conducted during this time.

Evening and night-time works are less likely to affect the schools, kindergarten and cricket club as these may be unoccupied. Works are likely to be least disruptive to the schools and kindergarten during the school holidays. This can be assessed through consultation with these parties and the works programmed to reflect any direction or feedback provided.

It should be noted that this assessment represents a conservative or 'worst-case' scenario (i.e. trenching rather than micro-tunnelling along with southern section of pipeline). Also construction activities and therefore noise effects will be spread out across the 810 m length of the pipeline over a duration of up to 12 months, with construction activities relatively limited at most locations along the alignment particularly for the northern tunnelled section.

7.2 Vibration

It is considered unlikely that the vibration limits in the AUP for cosmetic damage or for amenity will be exceeded. Residents may be able to detect some vibration from works, for example loose fixtures or items on shelving may rattle. With prior notice and consultation, vibration levels are likely to be considered reasonable.

Vibration levels during sheet piling should be monitored when this occurs within 10 m of a building. It may be desirable to monitor at greater distances depending on the particular sensitivities of specific receivers. Feedback can be provided in real time to the construction manager/equipment operator and appropriate controls can be implemented during the works immediately.

7.3 Specific noise mitigation measures

The following specific noise mitigation measures for this project include the following:

- Sheet piling should be minimised whenever possible.
- Timing of piling should work around any particular sensitivities of receivers as far as practicable (e.g. middle of the day rather than after school times).
- Sheet piling and wood chipping should be timetabled during the day as far as practicable.
- Activities which exceed the relevant limits should be restricted to Monday to Friday during the day, not Saturdays when more people are likely to be at home.
- Normal working hours include the period 7 – 7:30 am when lower noise limits apply. Noisy works on site should be avoided before 7:30 am, such as trucks queuing up for deliveries and cranes lifting heavy items.
- Noisy works which may exceed limits specified in Section 5.1 should be managed in a manner which is consistent with the approved CI CNVMP and ASCNMP, updated as required to specifically address CC9 works.
- Tunnel ventilation fan should be fitted with an attenuator or plenum/louvre arrangement.
- Fit silencer to diesel engines for muck-out noise during tunnelling activities (crane, excavator lift of debris, impact noise). Prevent bucket from hitting ground or muck storage bin.
- Wood chipping should be oriented away from noise sensitive receivers and sited as far away as practicable. The chipper should be screened if possible.
- Ensure fixed plant which is operating continuously (e.g. generators) is fitted with acoustic enclosures or noise barriers. Keep doors of acoustic enclosures closed. If an opening is required for ventilation this should face away from noise sensitive receivers.
- Laydown areas located at the edge of Keith Hay park should have acoustic barriers facing the residential properties. This should be an 1.8-2 m high acoustically effective barrier, such as 20 mm plywood with no gaps.
- Consultation will be required with all noise sensitive receivers in close proximity to works, particularly around the potential for works to be undertaken outside normal daytime hours.
- Following consultation with the schools and kindergarten, works in this area are likely to need to be undertaken at times when these establishments are unoccupied, e.g. during the school holidays.

- Consultation with the cricket club can establish the sensitivity this receiver has, e.g. it may only be sensitive during occasional events or regular weekend activities.

8 Conclusion

Noise levels have been predicted from likely equipment/activities for the project at nearby noise sensitive receivers.

Most general construction activities and equipment are predicted to comply (or only negligibly exceed) the daytime noise limits at residential properties. Sheet piling and wood chipping is likely to exceed daytime noise limits by 11-14 dB at a distance of 20 m. The effects of these activities can be managed through an ASCNMP consistent with the existing approved CI ASCNMP, including for tree removal and for sheet piling at Keith Hay Park.

Greater levels of exceedance are expected at the schools, kindergarten and cricket club. This can best be managed through consultation and timing of works via the CNVMP (and an ASCNMP where required).

Most construction activities are predicted to exceed night-time levels. There are limited circumstances in which works will need to take place outside normal daytime hours and the effects of this on surrounding residential properties can best be managed via the CNVMP and ASCNMP. Where this assessment identifies additional management and mitigation measures required to address potential noise and vibration effects, the CI CNVMP and ASCNMP will be updated to include these measures.

9 Applicability

This report has been prepared for the exclusive use of our client Watercare Services Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that our client will submit this report as part of an application for resource consent and that Auckland Council as the consenting authority will use this report for the purpose of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Lindsay Leitch	Peter Roan
Senior Acoustic Consultant	Project Director

Appendix A: CI Construction Noise and Vibration Management Plan

This document is an exact copy of the Council approved plan (with approval documentation inserted) and has been issued For Information only.

Drawings embedded in this document are from the tender package and are not to be used for construction.

Construction Noise and Vibration Management Plan

Keith Hay Park shaft site, 49 Arundel Street and 20 and 22 Gregory Place, Mount Roskill

Central Interceptor

Doc No: GAJV-PLN-00043 (previously CI-EN-2030)

Version: [0.4 Final]

Watercare
An Auckland Council Organisation

Ghella
5 Generations of Tunnelers

ABERGELDIE
COMPLEX INFRASTRUCTURE

Sarah Blair

From: Randy Leung <Randy.Leung@aucklandcouncil.govt.nz>
Sent: Wednesday, 18 December 2019 1:27 PM
To: Tommy Ma <tma@ga-jv.com>
Cc: Lesley Hopkins <lhopkins@ga-jv.com>; Sandra Edwards <sedwards@ga-jv.com>; XMeier (Xenia) <Xenia.Meier@water.co.nz>
Subject: RE: Central Interceptor - Batch Two Management Plans

Thanks Tommy,

I can confirm CNVMP for Batch 2 is now approved.

Ngā mihi | Kind Regards

Randy Leung | Senior Compliance Monitoring Officer | Licensing & Regulatory Compliance
Auckland Council | T: +64 (09) 353 9101 | M: 027 272 0302
Location: Level 1 | 35 Graham Street | CBD Auckland
Postal: Private Bag 92300 | Wellesley Street | Auckland | 1036
mailto: randy.leung@aucklandcouncil.govt.nz |

From: Tommy Ma <tma@ga-jv.com>
Sent: Wednesday, 18 December 2019 12:01 PM
To: Randy Leung <Randy.Leung@aucklandcouncil.govt.nz>
Cc: Lesley Hopkins <lhopkins@ga-jv.com>; Sandra Edwards <sedwards@ga-jv.com>; XMeier (Xenia) <Xenia.Meier@water.co.nz>; J. Exeter <Jamie@stylesgroup.co.nz>
Subject: RE: Central Interceptor - Batch Two Management Plans

Sensitivity: General

Hi Randy
Please find attached the updated CNVMP for Dundale Avenue, Whitney Street, Miranda Reserve and Keith Hay Park.

Tommy Ma
Consenting Manager – Central Interceptor
M +64 21 196 5370

Ghella Abergeldie JV
360 Dominion Road,
Mt Eden 1024, New Zealand

Table of Contents

1. Information ____ 1

1.1 Definitions and Abbreviations ____ 1

2. Introduction ____ 2

2.1 Project Background ____ 2

2.2 Purpose ____ 2

2.3 Relationship to other Plans ____ 2

2.4 Sustainability ____ 4

2.5 Consent Requirements ____ 4

3. Roles and Responsibilities ____ 9

3.1 Environmental roles and responsibilities ____ 9

3.1.1 Specific roles and responsibilities ____ 9

3.1.2 Contact details ____ 9

4. Project Description ____ 11

4.1 Project background ____ 11

4.2 Keith Hay Park shaft site ____ 12

4.3 Works and sequencing ____ 13

4.4 Hours of operation (DES8.1 and RC1.10) ____ 13

5. Noise and Vibration Limits ____ 14

5.1 Noise limits (DES3.2 and RC1.12) ____ 14

5.2 Vibration limits (DES3.8, DES3.9, RC1.18 and RC1.19) ____ 14

6. Construction Equipment ____ 16

6.1 Noise sources (DES3.4(a), DES3.4(b), RC1.14(a) and RC1.14(b)) ____ 16

6.2 Vibration sources (DES3.6(a), DES3.6(c), RC1.16(a) and RC1.16(e)) ____ 17

6.3 Receiver specific noise and vibration limits ____ 18

7. Noise and Vibration Levels ____ 19

7.1 Noise receivers and levels (DES3.5 and RC1.15) ____ 19

7.1.1 Tree Removal (DES3.5 and RC1.15) ____ 19

7.1.2 Sheet piling (DES3.5 and RC1.15) ____ 19

7.1.3 Shaft Drilling (DES3.5 and RC1.15) ____ 20

7.2 Vibration receivers and levels (DES3.9, DES3.10, RC1.19 and RC1.20) ____ 20

8. Construction Noise and Vibration Mitigation and Management ____ 21

8.1 Consultation (DES3.4(g)and RC1.14(g)) ____ 21

8.2 Specific noise mitigation measures (DES3.4(d) and RC1.14(d)) ____ 22

8.2.1 Site Boundary Noise Barrier ____ 22

8.3 Specific vibration mitigation measures (DES3.6(e) and RC1.16(e)) 23
8.3.1 Vibratory roller 23
8.4 General noise and vibration mitigation and management 23
8.4.1 General mitigation measures (DES3.4(e) and RC1.14(e)) 23
8.4.2 Training (DES3.4(j) and RC1.14(j)) 24
8.4.3 Noise barriers (DES3.4(d) and RC1.14(d)) 24
8.4.4 Enclosures (DES3.4(d) and RC1.14(d)) 25
8.4.5 Building condition surveys (DES3.6(d) and RC1.16(d)) 25
9. ASCNMPs (DES3.5 and RC1.15) 26
10. Communication and Complaints 27
10.1 Communication 27
10.2 Complaints (DES3.4(i), DES3.6(h), RC1.14(i) and RC1.16(h)) 27
11. General Noise and Vibration Monitoring and Review 29
11.1 General noise and vibration review (DES3.4(h), DES3.6(g), RC1.14(h) and RC1.16(g)) 29
11.2 Noise and vibration monitoring (DES3.4(h), DES3.6(g), RC1.14(h) and RC1.16(g)) 29
11.2.1 Noise monitoring 29
11.2.2 Vibration monitoring 29
11.2.3 General review of the CNVMP (DES3.11 and RC1.21) 30

Appendices

APPENDIX A - Activity Specific Construction Noise and Vibration Management Plans
APPENDIX B - Review Records
APPENDIX C - Noise Monitoring Records
APPENDIX D - Vibration Monitoring Records
APPENDIX E - Sustainability Aspects

Revision History

Review and Approval

FUNCTION	POSITION	NAME	SIGNATURE	DATE
Prepared by	Acoustic Consultant, Marshall Day Acoustics	Shaun King		7/11/2019
Reviewed by	Key Relationship Manager, Ghella Abergeldie JV	Lesley Hopkins		8/11/2019
Approved by	Project Director, Ghella Abergeldie JV	Francesco Saibene		11/11/2019

Each page of this document bears a document number and revision date. When revisions to the document are issued, the following table will be updated to show the most recent revision level. The revised document will be forwarded to the holders of controlled copies. Recipients are responsible for destroying or marking “superseded” on the previous revision.

Revision Status

VERSION	DATE	STATUS	AMENDMENT DESCRIPTION
0.1	3/09/2019	Draft	Draft for internal review
0.2	11/10/2019	Revised draft	Draft for Watercare review
0.3	11/11/2019	Final	For submission to Auckland Council for approval
0.4	4/12/2019	Final	Incorporating Auckland Council feedback

Where review and revision is deemed warranted, i.e. such as comments received from the Client, or where necessary to reflect changes in contractual or Project requirements, or as a result of an incident then these revisions shall be reviewed by the respective Project Manager and approved by the Construction Manager.

Distribution (Controlled Copies)

COPY #	ISSUED TO	COMPANY / POSITION
01	Project File	Ghella Abergeldie Joint Venture
02	Client Rep	Engineer to Contract

1. Information

1.1 Definitions and Abbreviations

Noise	A sound that is unwanted by, or distracting to, the receiver.
dB	Decibel (dB) is the unit of sound level. Expressed as a logarithmic ratio of sound pressure (P) relative to a reference pressure (Pr), where dB = 20 x log(P/Pr).
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) to more closely approximate the frequency bias of the human ear. A-weighting is used in airborne acoustics.
$L_{Aeq\ (t)}$	The equivalent continuous (time-averaged) A-weighted sound level commonly referred to as the average level. The suffix (t) represents the period, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{AFmax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
L_{peak}	The peak instantaneous pressure level recorded during the measurement period (normally not A-weighted).
AS 2187-2: 1993	Australian Standard AS 2187-2: 1993 *“Explosives - Storage, transport and use. Part 2: Use of explosives”*
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 *“Acoustics - Construction Noise”*
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into vertical (up and down vibration), horizontal transverse (side to side) and horizontal longitudinal direction (front to back) components.
PPV	Peak Particle Velocity (PPV) is the measure of the vibration amplitude, zero to maximum, measured in mm/s.
DIN 4150-3:1999	German Standard DIN 4150-3:1999 *“Structural Vibration - Effects of Vibration on Structures”*

2. Introduction

2.1 Project Background

Watercare Services Limited (‘**Watercare**’) has Designations (Designation 9466 – Central Interceptor Main Works) and Resource Consents for the construction of a new wastewater tunnel to collect wastewater flows from the Auckland isthmus area and transfer them across the Manukau Harbour to the Māngere Wastewater Treatment Plant (‘**WWTP’**). Referred to as the Central Interceptor (or ‘**the Project**’), the Project arose from the Three Waters Plan which identified the need to provide trunk sewer capacity to central Auckland to provide capacity for growth, increase resilience and reduce wet weather wastewater overflows.

This Construction Noise and Vibration Management Plan (‘**CNVMP**’) has been prepared in accordance with Designation Conditions DES3.1 and Resource Consent Conditions RC1.11.

This CNVMP addresses the works at the Keith Hay Park shaft site located at **49 Arundel Street, Mount Roskill**.

2.2 Purpose

The purpose of this CNVMP is to outline the management of construction noise and vibration for the Keith Hay Park shaft site. This plan predicts noise and vibration levels resulting from activities in the Construction Management Plan (‘**CMP**’) and outlines mitigation measures to ensure best-practice is adopted.

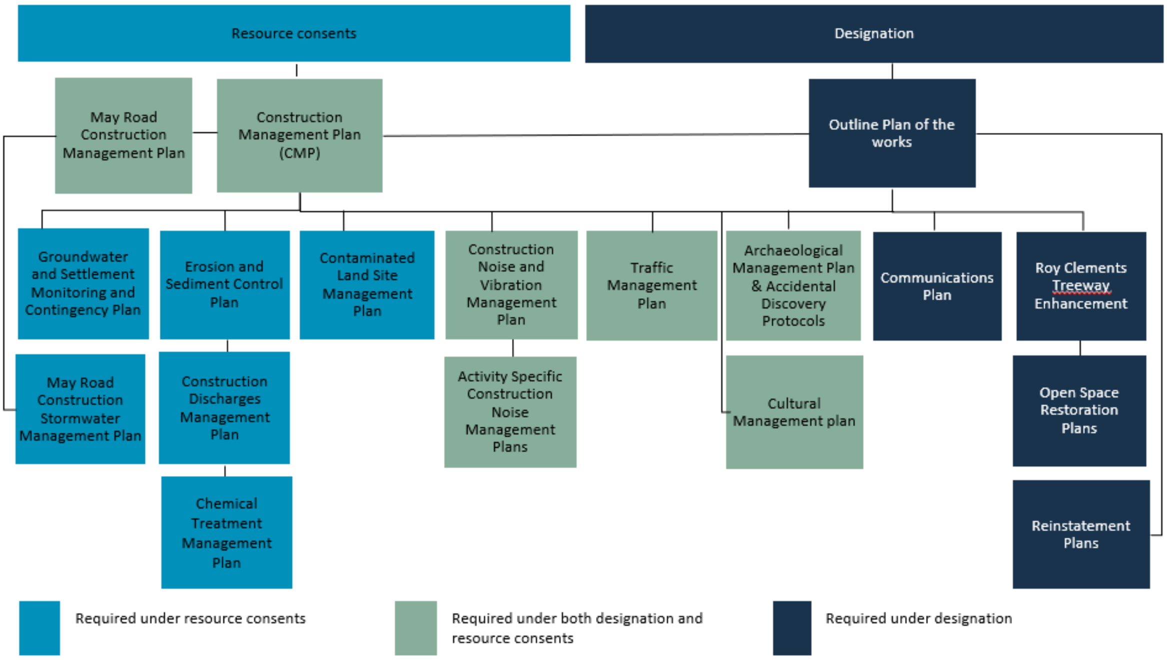
In cases where certain activities will exceed the specified noise limits, an Activity Specific Construction Noise Management Plan (‘**ASCNMP**’) will be prepared in accordance with conditions DES3.5 and RC1.15.

2.3 Relationship to other Plans

In accordance with DES1.8, the CNVMP is to be submitted with the Outline Plan of the work for the Project or for each Project stage. The CNVMP is also required by the resource consent conditions. The Project is being delivered in stages, and this CNVMP specifically addresses the site works at the Keith Hay Park shaft site, being one of the 16 surface works sites for the Project.

Figure 1 shows the construction management plans required by the designation and resource consents and their relationship to each other.

Figure 1: Construction management plan structure



2.4 Sustainability

Watercare is seeking an Infrastructure Sustainability Council of Australia (‘**ISCA**’) Infrastructure Sustainability rating for the Project. Full details about the rating scheme and methods to achieve the accreditation are included in the Project’s Sustainability Management Plan. The sustainability management plan is not a designation/resource consent compliance requirement, however, this CNVMP does include Project sustainability aspects, and they are included in **Appendix E**.

2.5 Consent Requirements

A full set of the designation and resource consent conditions for the Project are appended to the CMP. Table 1 identifies the conditions that are relevant to this CNVMP and are referred to throughout this plan.

Table 1: Resource consent and designation conditions relevant to the CNVMP

Condition number	Condition	CNVMP section
RC1.8(l)	A Construction Noise and Vibration Management Plan (‘CNVMP’) for each site containing measures to address the management of construction noise and vibration as identified in Condition 1.10;	This Plan – Keith Hay Park shaft site
DES1.8(d)	The OPW shall include the following Management Plans for the relevant stage(s) of the Project: Site Specific Construction Noise and Vibration Management Plan (CNVMP).	CNVMP
DES8.1 **RC1.10**	Construction hours shall be as described below (1.10 a to i) except where work is necessary outside the specified days or hours for the purposes specified below:	4.4
DES8.1(a) **RC1.10(a)**	Tunnelling activities – 24 hours a day, 7 days a week operation for all tunnelling activities, including the main tunnel works and the link tunnels;	

<table>
<tr><th>Condition number</th><th>Condition</th><th>CNVMP section</th></tr>
<tr><td>DES8.1(b)
RC1.10(b)</td><td>General site activities – 7 am to 6pm, Monday to Friday, 8am to 6pm Saturday; and</td><td></td></tr>
<tr><td>DES8.1(c)
RC1.10(c)</td><td>Truck movements – 7am to 6pm, Monday to Friday, 8am to 6pm Saturday, except that Truck movements are restricted from entering and exiting sites in proximity to schools and colleges between 8:15 am and 9:15 am and 2:45pm and 3:15 pm Monday to Friday during school and college term times. This includes, although is not limited to the following sites: Mt Albert War Memorial Reserve (Car Park site), Walmsley Road (AS4), Motions Road (L1S1), Pump Station 25 (L3S1), Lyon Avenue (AS2), and Miranda Reserve (L3S2).</td><td>4.4</td></tr>
<tr><td>DES8.2(a)
RC1.10(d)</td><td>Purposes for which work may occur outside of the specified days or hours are: where, due to unforeseen circumstances, it is necessary to complete an activity that has commenced;</td><td>Noted</td></tr>
<tr><td>DES8.2(b)
RC1.10(e)</td><td>where work is specifically required to be planned to be carried out at certain times e.g. to tie into the existing network during periods of low flow, or to tie into tidal cycles for works in the CMA;</td><td></td></tr>
<tr><td>DES8.2(c)
RC1.10(f)</td><td>for delivery of large equipment or special deliveries required outside of normal hours due to traffic management requirements;</td><td></td></tr>
<tr><td>DES8.2(d)
RC1.10(g)</td><td>in cases of emergency; and</td><td></td></tr>
<tr><td>DES8.2(e)
RC1.10(h)</td><td>for the securing of the site or the removal of a traffic hazard; and/or</td><td></td></tr>
<tr><td>DES8.2(f)
RC1.10(i)</td><td>for any other reason specified in the CMP or a Traffic Management Plan required under Condition 1.22.</td><td></td></tr>
<tr><td>DES3.1
RC1.11</td><td>A Construction Noise and Vibration Management Plan shall be prepared for each site for Council approval as part of the CMP and shall be prepared by a suitably qualified person. These documents shall be submitted to Council with the OPW to which it relates.</td><td>This Plan – Keith Hay Park shaft site</td></tr>
<tr><td>DES3.2
RC1.12</td><td><table>
<tr><th>Time and Day</th><th>Noise Limits</th></tr>
<tr><td>Monday to Saturday 0730 – 1800:</td><td>70 dB L_{Aeq}
85 dB L_{Amax}</td></tr>
<tr><td>At all other times and public holidays:</td><td>45 dB L_{Aeq}
75 dB L_{Amax}</td></tr>
</table></td><td>5.1</td></tr>
<tr><td>DES3.3
RC1.13</td><td>Construction works which exceed a level of L_{Aeq} 45dB at the most exposed receiver(s) are restricted to between 0730 to 1800 on weekdays and Saturdays, with no noisy works permitted on Sundays and Public Holidays. Each CNVMP shall define which activities will comply with a limit of L_{Aeq} 45dB and can therefore be undertaken outside of these hours in compliance with conditions 1.10.</td><td>4.4</td></tr>
<tr><td>DES3.4
RC1.14</td><td>Each CNVMP shall, in demonstrating compliance with Designation Condition 3.2 and Resource Condition 1.12, as a minimum, address the below aspects (DES3.2(a) to (j) and RC1.14(a) to (j)), with regard to construction noise:</td><td>6.1</td></tr>
<tr><td>DES3.4(a)
RC1.14(a)</td><td>a description of noise sources, including machinery, equipment and construction techniques to be used;</td><td></td></tr>
</table>

Condition number	Condition	CNVMP section
DES3.4(b) **RC1.14(b)**	predicted construction noise levels;	6.1
DES3.4(c) **RC1.14(c)**	hours of operation, including times and days when noisy construction work and blasting would not occur in compliance with designation condition 3.2 and resource condition 1.12;	4.4
DES3.4(d) **RC1.14(d)**	physical noise mitigation measures, including prohibiting the use of tonal reverse alarms, maintenance of access roads (to ensure they are smooth), acoustic screening around the site, plant selection and maintenance procedures, and site layout;	8.2 8.4.3
DES3.4(e) **RC1.14(e)**	construction noise criteria for any specific areas and sensitive receivers such as schools, child care centres, medical or aged care facilities;	N/A
DES3.4(f) **RC1.14(f)**	the identification of activities and locations that will require the design of specific noise mitigation measures;	6.3
DES3.4(g) **RC1.14(g)**	the measures that will be taken by the Consent Holder to communicate and obtain feedback from affected stakeholders on noise management measures	8.1
DES3.4(h) **RC1.14(h)**	methods for monitoring and reporting on construction noise;	11.1 11.2
DES3.4(i) **RC1.14(i)**	methods for receiving and responding to complaints about construction noise; and	10.2
DES3.4(j) **RC1.14(j)**	construction operator training procedures.	8.4.2
DES3.5 **RC1.15**	Where a CNVMP predicts that noise levels from a particular activity will or will likely exceed the noise limits set out in designation condition 3.2 and resource consent condition 1.12, or where noise measurements show that compliance is not being achieved, the Consent Holder shall prepare and submit for the approval of the Council an Activity Specific Construction Noise Management Plan (ASCNMP).	7.1 9
DES3.6 **RC1.16**	Each CNVMP shall also describe measures adopted to meet the requirements of German Standard DIN4150-3:1999, and as a minimum shall address the following aspects with regard to construction vibration:	6.2
DES3.6(a) **RC1.16(a)**	vibration sources, including machinery, equipment and construction techniques to be used;	
DES3.6(b) **RC1.16(b)**	preparation of building condition reports on 'at risk' buildings prior to, during and after completion of works, where for the purposes of this condition an 'at risk' building is one at which the levels in the German Standard DIN4150-3: 1999 are likely to be approached or exceeded; Note: For the May Road site, internal and external building condition reports shall be prepared for the buildings identified on the diagram titled “Foodstuffs Pre-Condition Survey Recommendation” dated 11 August 2014, and submitted to the Environment Court on 22 September 2014, and any other building(s) identified as ‘at risk’ to identify and quantify any adverse effects in respect of vibration, dewatering, ground settlement and consequential damage to structures.	8.4.5
DES3.6(c) **RC1.16(c)**	use of building condition surveys to determine the sensitivity of the building(s) on the adjacent sites to ground movement in terms of the Line 1-3 criteria of the DIN standard;	6.2

Condition number	Condition	CNVMP section
DES3.6(d) RC1.16(d)	provision for the determination of buildings that require post-condition surveys to be undertaken following the commencement of blasting;	N/A
DES3.6(e) RC1.16(e)	identification of any particularly sensitive activities in the vicinity of the proposed works (e.g. commercial activity using sensitive equipment such as radiography or mass-spectrometry) including the NZ Institute for Plant and Food Research (at 118-120 Mt Albert Road, Mt Albert), the Institute of Environmental Science and Research (Hampstead Road, Sandringham) and Caltex Western Springs (at 778-802 Great North Road, Grey Lynn), along with the details of consultation with the land owners of the sites where the sensitive activities are located and any management measures that will be adopted based on this consultation;	N/A
DES3.6(f) **RC1.16(f)**	the measures that will be taken by the Consent Holder to communicate and obtain feedback from affected stakeholders on vibration management measures;	10.1
DES3.6(g) **RC1.16(g)**	methods for monitoring and reporting on construction vibration; and	11.2
DES3.6(h) **RC1.16(h)**	methods for receiving and responding to complaints about construction vibration.	10.2
DES3.7 **RC1.17**	Air overpressure levels from blasting shall comply with the following limits, measured and assessed in accordance with AS2187.2-2006 Explosives – Storage and Use Part 2: Use of Explosives:	N/A
DES3.7(a) **RC1.17(a)**	For buildings that are not occupied for any blast event, the air overpressure limit shall be 133 dBZ L_{peak} unless prior agreement is reached in writing with the owner(s) (in conjunction with a building pre-condition survey) that a higher limit may apply; and	
DES3.7(b) **RC1.17(b)**	For buildings that are occupied for any blast event, and where there are less than 20 blast events to be undertaken on the site over the entire project, the air overpressure limit shall be 128 dBZ L_{peak}; and	
DES3.7(c) **RC1.17(c)**	For buildings that are occupied for any blast event, and where there are more than 20 blast events to be undertaken on the site over the entire project, the air overpressure limit shall be 120 dBZ L_{peak}. Note: A blast event may comprise the detonation of one or more charges in a period not exceeding three seconds.	
DES3.8 **RC1.18**	The Guideline vibration limits set out in DIN 4150-3:1999 must be complied with for all blast events at all neighbouring buildings and infrastructure unless varied in accordance with designation condition 3.10 and resource consent condition 1.20.	5.2
DES3.9 **RC1.19**	Construction activities shall comply with the Guideline vibration limits set out in DIN 4150-3:1999 unless varied in accordance with designation condition 3.10 and resource consent condition 1.20.	5.2
DES3.10 **RC1.20**	The Guideline vibration limits set out in DIN4150 must not be exceeded except where the Consent Holder can demonstrate to the prior satisfaction of the Council:	7.2
DES3.10(a) **RC1.20(a)**	that the receiving building(s) are capable of withstanding higher levels of vibration and what the new vibration limit is. The investigation required to demonstrate this must include an assessment of the building(s) by a suitably experienced and qualified structural engineer and a full pre-condition survey; and	
DES3.10(b) **RC1.20(b)**	that the Consent Holder has obtained the written agreement of the building owner(s), that a higher limit may be applied.	

Condition number	Condition	CNVMP section
DES3.11 **RC1.21**	Each CNVMP shall be implemented and maintained throughout the entire construction period. Each CNVMP shall be updated when necessary and any updated CNVMP shall be submitted to the Council in accordance with designation condition 3.1 and resource consent condition 1.8.	11.2.3

3. Roles and Responsibilities

3.1 Environmental roles and responsibilities

Each person involved in the Project has equal responsibility to avoid, remedy or mitigate adverse environmental effects. There are three key groups with responsibility for environmental management of the Project:

- Watercare as the Project owner, requiring authority, and holder of the resource consents;
- Ghella Abergeldie Joint Venture ('Ghella-Abergeldie JV') undertaking the works; and
- Auckland Council to audit the works and monitor compliance with Designation and Resource Consent Conditions, the CMP and sub-plans.

3.1.1 Specific roles and responsibilities

The key management roles for each organisation in relation to this CNVMP during the construction of the Project are outlined in Table 2. Further responsibilities are set out in the CMP.

Table 2: CNVMP responsibilities

Organisation	Role	Role Responsibilities
Watercare Services Limited	Requiring Authority, Consent Holder and Project Manager	• Overall responsibility for project compliance and performance in relation to environment, quality assurance and incident management. •
Ghella Abergeldie Joint Venture	Project Director	• Overall responsibility for site environmental management. • Review and approve all relevant management plans.
	Stakeholder and Communications Manager	• Responsible for notifying residents of works occurring within the near vicinity and managing mitigation as required. • Disseminates information to the public as approved by Watercare.
	Environmental Manager	• Monitoring day to day construction noise and vibration levels as required • Monitoring noise and vibration levels following complaints
	Project & Site Engineers	• Development, management, and monitoring of construction procedures, including incorporating environmental and sustainability requirements. • Overseeing subcontractors.
Subcontractors	Site Managers	• Adherence to the CNVMP and any ASCNMPs
	Acoustic Specialist	• Monitoring noise and vibration levels generated from construction activity. • Updating mitigation and management measures based on new information.

3.1.2 Contact details

Contact details for those with key responsibilities in the implementation of this CNVMP including the Communication Manager are provided in the Table 3 below.

A Project representative will be contactable during works and contact details provided in communication to adjacent residents.

Table 3: Key contacts

Role	Name	Contact Details
Watercare Services Limited, Private Bag 92 521 Wellesley Street, Auckland, 1141		
Engineer to Contact	Tony Parsons	P: +64 27 447 3737 E: *Tony.Parson@water.co.nz*
Compliance Advisor	Xenia Meier	P: 021 574 585 E: *Xenia.Meier@water.co.nz*
Ghella Abergeldie Joint Venture, PO Box 10354, Dominion Road, Auckland, 1024		
Project Director	Francesco Saibene	P: 021 0882 7237 E: *APupi@ghella.com*
Construction Manager	Stefano Vittor	P: 021 630 355 E: *SVittor@ghella.com*
Key Relationships Manager	Lesley Hopkins	P: +64 27 414 351 E: *LHopkins@ga-jv.com*
Environmental Manager	Sandra Edwards	P: +64 27 366 3884 E: *sedwards@ga-jv.com*
Communications Manager	Carol Moffatt	P: +64 27 703 0672 E: *CMoffatt@ga-jv.com*

4. Project Description

This section provides a summary of the proposed works at Keith Hay Park construction site that are relevant to this CNVMP. A detailed description of the construction works is provided in the CMP.

4.1 Project background

The Central Interceptor main project works involve the construction and commissioning of a bulk wastewater interceptor and associated activities. This CNVMP relates to effects during the construction phase.

The Project involves constructing a 13 km gravity sewer tunnel with two link sewer tunnels extending from the main tunnel westward, a series of connections to the existing trunk sewer network to pick up wastewater flow, and a new pump station at the Māngere WWTP. Figure 2 provides a general location plan.

Figure 2: Central Interceptor location plan

4.2 Keith Hay Park shaft site

The Keith Hay Park site is located in close proximity to the Keith Hay Park sports facilities complex, parks, recreational areas and the playground of the Waikowhai Intermediate School.

The shaft location directly borders a number of neighbouring residential properties and also has a popular cycle path transecting the site footprint. The site will have a single access and egress point which will be marshalled during attended periods.

Enabling and construction works will take place over a period of 14 months, commencing in January 2020 and finishing in March 2021. As the works are independent of the TBM tunnelling until the final connection is made, there is no break in construction activities at this site. The final connection will be made from within the tunnel. The overall period of site establishment has been minimised.

Figure 3: Keith Hay Park site location

4.3 Works and sequencing

Details of the construction work and the staging for Keith Hay Park are provided in the CMP. The proposed construction programme for each phase of the project and the anticipated dates are provided in Table 4.

Table 4: Construction Programme

Construction works	Indicative start date	Indicative finish date
Main site setup	Mid-Jan-2020	Late-Feb-2020
Piling platform	Early-Apr-2020	Early-Apr-2020
Drill shaft	Late-Apr-2020	Late-May-2020
Install GRP liner and finish shaft top	Late-May-2020	Early-Jul-2020
Control chamber and manhole	Early-Jul-2020	Early-Aug-2020
Short pipejacks at shaft	Early-Aug-2020	Late-Jan-2020
Construct bifurcation chamber (MH2A)	Early-Aug-2020	Late-Sep-2020
Plant room construction	Early-Aug-2020	Late-Sep-2020
Construct Branch 9B chambers	Early-Oct-2020	Late-Oct-2020
Construct bifurcation chamber (MH84B)	Early-Dec-2020	Mid-Jan-2021
Pipe installation for Branch 9	Mid-Jan-2021	Late-Jan-2021
Temporary site reinstatement	Mid-Feb-2021	Mid-Mar-2021
TBM arrival at shaft	Late-Oct-2022	-
Shaft/tunnel connection (from main tunnel)	Late-Mar-2023	Late-Apr-2023
Commissioning	Late-Nov-2023	-

4.4 Hours of operation (DES8.1 and RC1.10)

The allowable hours of construction are defined as per conditions RC1.10 and DES8.1.

5. Noise and Vibration Limits

5.1 Noise limits (DES3.2 and RC1.12)

The construction noise limits for the Project are defined in DES3.2 and RC1.12.

Construction noise shall be measured and assessed in accordance with NZS6803:1999 Acoustics – Construction Noise and shall comply with the noise limits in Table 5 at occupied buildings, unless otherwise allowed through an ASCNMP.

Table 5: Construction Noise Limits

Time and Day	Noise Limits
Monday to Saturday 0730 – 1800	70 dB L_{Aeq}
	85 dB L_{AFmax}
At All Other Times and Public Holidays	45 dB L_{Aeq}
	75 dB L_{AFmax}

Construction activities will not commence until 0730, however toolbox meetings, administration tasks and setup may be conducted between 0700 and 0730.

5.2 Vibration limits (DES3.8, DES3.9, RC1.18 and RC1.19)

The construction and blasting vibration limits for the Project are defined in DES3.8, DES3.9, RC1.18 and RC1.19.

Construction activities shall comply with the Guideline vibration limits set out in German Standard DIN 4150-3:1999 "*Structural vibration – Part 3: Effects of vibration on structures*", unless varied in accordance with RC1.20. The short-term (transient)[1] vibration limits in Figure 4 apply at building foundations in any axis. The vibration limits in all other cases are summarised in Table 6.

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[1] Short-term (transient) vibration is "*vibration which does not occur often enough to cause structural fatigue and which does not produce resonance in the structure being evaluated*"

Figure 4: Short-term (transient)[1] vibration at building foundations (DIN 4150-3 1999: Figure 1)

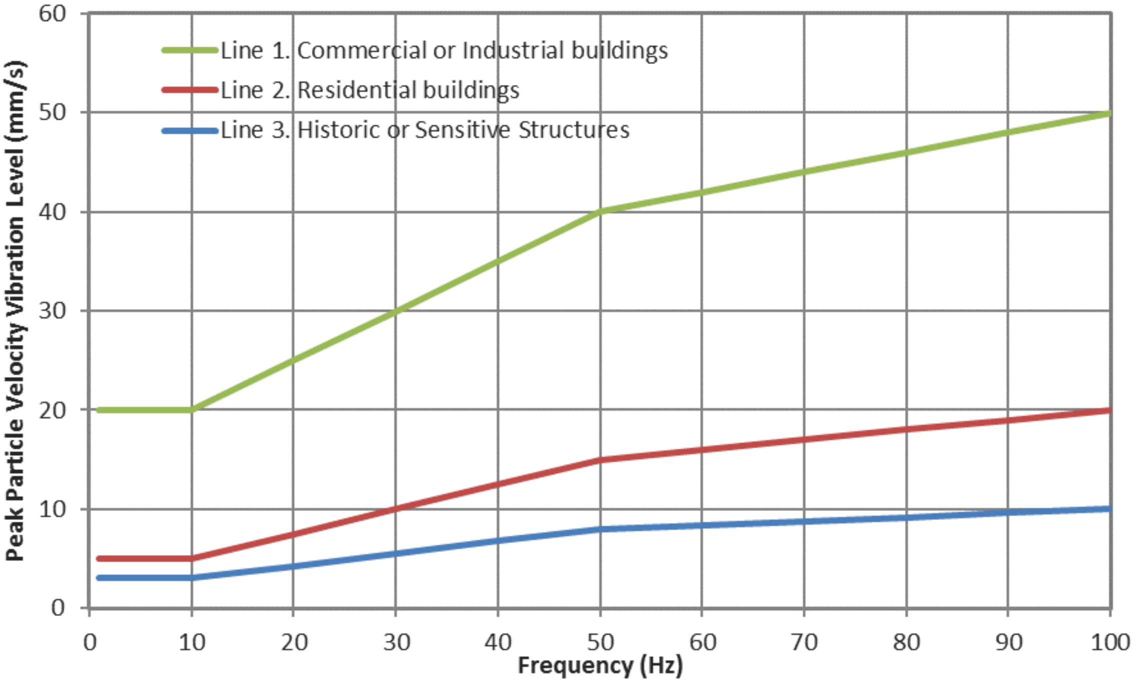

Table 6: Vibration at horizontal plane of highest floor (DIN 4150-3 1999: Tables 1 and 3)

Structure Type		Peak Particle Velocity Vibration Level (mm/s)	
		Short-term (transient)[1]	Long-term (continuous)[2, 3]
Line 1.	Commercial or Industrial buildings	40	10
Line 2.	Residential buildings	15	5
Line 3.	Historic or Sensitive Structures	8	2.5

The criteria relate to the avoidance of cosmetic building damage, such as cracking in paint or plasterwork. Cosmetic building damage effects are deemed 'minor damage' in the Standard and can generally be easily repaired. The cosmetic building damage thresholds are much lower than those that would result in structural damage. The Standard states: "*Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur*."

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[2] Long-term (continuous) vibration includes types not covered by the short-term vibration definition

[3] The long-term (continuous) criteria can apply at all floor levels, but levels are normally highest at the top floor

6. Construction Equipment

6.1 Noise sources (DES3.4(a), DES3.4(b), RC1.14(a) and RC1.14(b))

Table 7 and Table 8 provide indicative construction noise levels for proposed activities with and without noise barriers. It will be used by the Construction Manager (or nominated person) prior to construction to inform what equipment will require mitigation and/or management and when. It will be kept up to date by the Acoustic Specialist when new information becomes apparent through noise monitoring or other means.

Table 7: Indicative noise levels at 1m from a building façade[4] without noise barriers

Equipment	Sound Power Level (dB L_{Aeq})	Noise Level (dB L_{Aeq})			Setback (m)
		10 m	20 m	50 m	70 dB L_{Aeq}
Dingo with auger attachment	98	73	67	58	14
Chainsaw	114	89	83	74	69
Wood chipper	124	99	93	84	174
Franna	103	78	72	63	25
Roller	103	78	72	63	25
14t rock breaker	121	96	90	81	132
30t rock breaker	121	96	90	81	132
14t excavator	103	78	72	63	25
30t excavator	103	78	72	63	25
30t sheet piling	116	91	85	76	83
Drilling rig	114	89	83	74	69
50t crawler crane	98	73	67	58	14
100t mobile crane	98	73	67	58	14
8-wheel tip truck	91	66	60	51	6
Concrete pump	103	78	72	63	25
Concrete saw	115	90	84	75	76
Desander	110	85	79	70	48

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[4] In accordance with the requirements of NZS 6803: 1999 (Section 5.1), inclusive of 3 decibels façade reflection

Table 8: Indicative noise levels at 1m from a building façade[5] with effective noise barriers[6]

Equipment	Sound Power Level (dB L_{Aeq})	Noise Level (dB L_{Aeq})			Setback (m)
		10 m	20 m	50 m	70 dB L_{Aeq}
Dingo with auger attachment	98	63	57	48	4
Chainsaw	114	79	73	64	28
Wood chipper	124	89	83	74	69
Franna	103	68	62	53	8
Roller	103	68	62	53	8
14t rock breaker	121	86	80	71	52
30t rock breaker	121	86	80	71	52
14t excavator	103	68	62	53	8
30t excavator	103	68	62	53	8
30t sheet piling	116	81	75	66	33
Drilling rig	114	79	73	64	28
50t crawler crane	98	63	57	48	4
60t mobile crane	98	63	57	48	4
8-wheel tip truck	91	56	50	41	2
Concrete pump	103	68	62	53	8
Concrete saw	115	80	74	65	30
Desander	110	75	69	60	18

6.2 Vibration sources (DES3.6(a), DES3.6(c), RC1.16(a) and RC1.16(e))

Table 9 provides indicative construction vibration levels for proposed activities that have the potential to result in vibration in building structures. It will be used by the Construction Manager (or nominated person) prior to construction to inform what equipment will require mitigation and/or management and when. It will be kept up to date when new information becomes apparent through vibration monitoring or other means.

Table 9: Indicative distances to comply with vibration limits at building foundations

Equipment	Cosmetic Building Damage Setback (m) [7]		
	Heritage 2.5 mm/s PPV	Residential 5 mm/s PPV	Commercial 10 mm/s PPV
Vibratory Roller	30	14	6
Rock Breaker	16	10	7

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[5] In accordance with the requirements of NZS 6803: 1999 (Section 5.1), inclusive of 3 decibels façade reflection

[6] Assuming 10 decibels shielding from effective noise barriers (Section 8.4.3)

[7] Based on regression analysis of available vibration measurements, plus a 100% safety factor

Equipment	Cosmetic Building Damage Setback (m) [7]		
Sheet Piling	30	11	4
Drilling	2	1	1
Excavator	15	4	1

6.3 Receiver specific noise and vibration limits

There are no receiver specific noise and vibration limits for the work at Keith Hay Park.

7. Noise and Vibration Levels

This section provides details of the noise and vibration receivers for the Project which are predicted to be non-compliant with the noise and vibration limits set up by the consent conditions. Details of addresses, building classification and locations are provided below.

7.1 Noise receivers and levels (DES3.5 and RC1.15)

7.1.1 Tree Removal (DES3.5 and RC1.15)

During site establishment several trees are to be removed. This requires the use of chainsaws and a woodchipper. These activities are predicted to exceed the noise limits at the adjacent buildings.

An ASCNMP is considered necessary for these activities and will be submitted to Auckland Council for approval 7 working days prior to the proposed work commencing in accordance with condition DES3.5 and RC1.15. Consultation will be undertaken with adjacent landowners affected by the exceedance and their written endorsement included. A template of an ASCNMP has been included in **Appendix A**.

The table below presents the buildings where exceedances are predicted and the worst-case noise levels including 3.0m high temporary noise barriers near the equipment. Additional mitigation and management measures will be implemented as part of the ASCNMP.

Table 10: Tree removal noise levels

Location	Occupancy	Noise Level
47 Arundel Place	Dwelling	75 dB L_{Aeq}
47A Arundel Place	Dwelling	71 dB L_{Aeq}
63C Arundel Place	YMCA Cameron Pool	77 dB L_{Aeq}
63B Arundel Place	Tristar Gym	78 dB L_{Aeq}
18 Gregory Place	Dwelling	71 dB L_{Aeq}
19 Gregory Place	Dwelling	73 dB L_{Aeq}

7.1.2 Sheet piling (DES3.5 and RC1.15)

Sheet piling might be required for the shaft, chamber and manhole construction. It is predicted to exceed the noise limits at the adjacent buildings.

If this activity is required, an ASCNMP is considered necessary and will be submitted to Auckland Council for approval 7 working days prior to the proposed work commencing in accordance with condition DES3.5 and RC1.15. Consultation will be undertaken with adjacent landowners affected by the exceedance and their written endorsement included. A template of an ASCNMP has been included in **Appendix A**.

The table below presents the buildings where exceedances are predicted and the worst-case noise levels without mitigation. Management measures will be implemented as part of the ASCNMP.

Table 11: Sheet piling noise levels

Location	Occupancy	Noise Level
47 Arundel Place	Dwelling	72 dB L_{Aeq}

47A Arundel Place	Dwelling	78 dB L_{Aeq}
56 Frost Road	Commercial	74 dB L_{Aeq}
58 Frost Road	Commercial	81 dB L_{Aeq}
16 Gregory Place	Dwelling	75 dB L_{Aeq}
17 Gregory Place	Dwelling	78 dB L_{Aeq}
18 Gregory Place	Dwelling	78 dB L_{Aeq}
19 Gregory Place	Dwelling	84 dB L_{Aeq}
Mount Roskill Grammar School	School	73 dB L_{Aeq}
59B Stamford Park Road	Dwelling	73 dB L_{Aeq}
61 Stamford Park Road	Dwelling	74 dB L_{Aeq}
73 Stamford Park Road	Various Dwellings	74-76 dB L_{Aeq}
13 Vic Butler Street	Dwelling	71 dB L_{Aeq}
15 Vic Butler Street	Dwelling	73 dB L_{Aeq}
17 Vic Butler Street	Dwelling	73 dB L_{Aeq}

7.1.3 Shaft Drilling (DES3.5 and RC1.15)

Shaft drilling is predicted to exceed the noise limits at the adjacent buildings. An ASCNMP is considered necessary for this activity and will be submitted to Auckland Council for approval 7 working days prior to the proposed work commencing in accordance with condition DES3.5 and RC1.15. Consultation will be undertaken with adjacent landowners affected by the exceedance and their written endorsement included. A template of an ASCNMP has been included in **Appendix A**.

The table below presents the buildings where exceedances are predicted and the worst-case noise levels without mitigation. Mitigation and management measures will be implemented as part of the ASCNMP.

Table 12: Shaft noise levels

Location	Occupancy	Noise Level
47A Arundel Place	Dwelling	75 dB L_{Aeq}
18 Gregory Place	Dwelling	76 dB L_{Aeq}
19 Gregory Place	Dwelling	75 dB L_{Aeq}

7.2 Vibration receivers and levels (DES3.9, DES3.10, RC1.19 and RC1.20)

No exceedances of the vibration limits are anticipated.

8. Construction Noise and Vibration Mitigation and Management

This section summarises noise and vibration mitigation and management measures. Where an exceedance of the noise limits is predicted activity specific noise management measures will be detailed in the relevant ASCNMP.

8.1 Consultation (DES3.4(g)and RC1.14(g))

General communication measures are detailed in 10.1 of this plan. Specific communication in relation to exceedances will be described in each ASCNMP (refer to **Appendix A** for the template).

As part of the ASCNMP, consultation with affected parties to understand their sensitivities, including times, activities and locations will be undertaken. Consultation will focus on a collaborative approach to managing the adverse effects from construction noise and vibration.

A project representative will be contactable during works.

Table 13 identifies sensitive receivers where noise is predicted to exceed the performance standards.

Table 13: Sensitive receivers

Address	Occupancy
43 Arundel Place, Mount Roskill	Dwelling
47 Arundel Place, Mount Roskill	Dwelling
47A Arundel Place, Mount Roskill	Dwelling
63C Arundel Place, Mount Roskill	YMCA Cameron Pool
63B Arundel Place, Mount Roskill	Tristar Gym
56 Frost Road, Mount Roskill	Commercial
58 Frost Road, Mount Roskill	Commercial
16 Gregory Place, Mount Roskill	Dwelling
17 Gregory Place, Mount Roskill	Dwelling
18 Gregory Place, Mount Roskill	Dwelling
19 Gregory Place, Mount Roskill	Dwelling
Mount Roskill Grammar School, Mount Roskill	School
59B Stamford Park Road, Mount Roskill	Dwelling
61 Stamford Park Road, Mount Roskill	Dwelling
73 Stamford Park Road, Mount Roskill	Various Dwellings
13 Vic Butler Street, Mount Roskill	Dwelling
15 Vic Butler Street, Mount Roskill	Dwelling
17 Vic Butler Street, Mount Roskill	Dwelling

8.2 Specific noise mitigation measures (DES3.4(d) and RC1.14(d))

8.2.1 Site Boundary Noise Barrier

A 4.0m high noise barrier will be installed along the southern boundary of the site and a 2.4m high noise barrier will be installed along the northern boundary of the site as shown in Figure 5. The smaller pipe jacking sites along Keith Hay Park will have 2.4m high noise barriers facing the dwellings to the south as shown in Figure 6 and Figure 7. These barriers will enable general site activities to comply with the noise limits.

Figure 5: Main site noise barriers

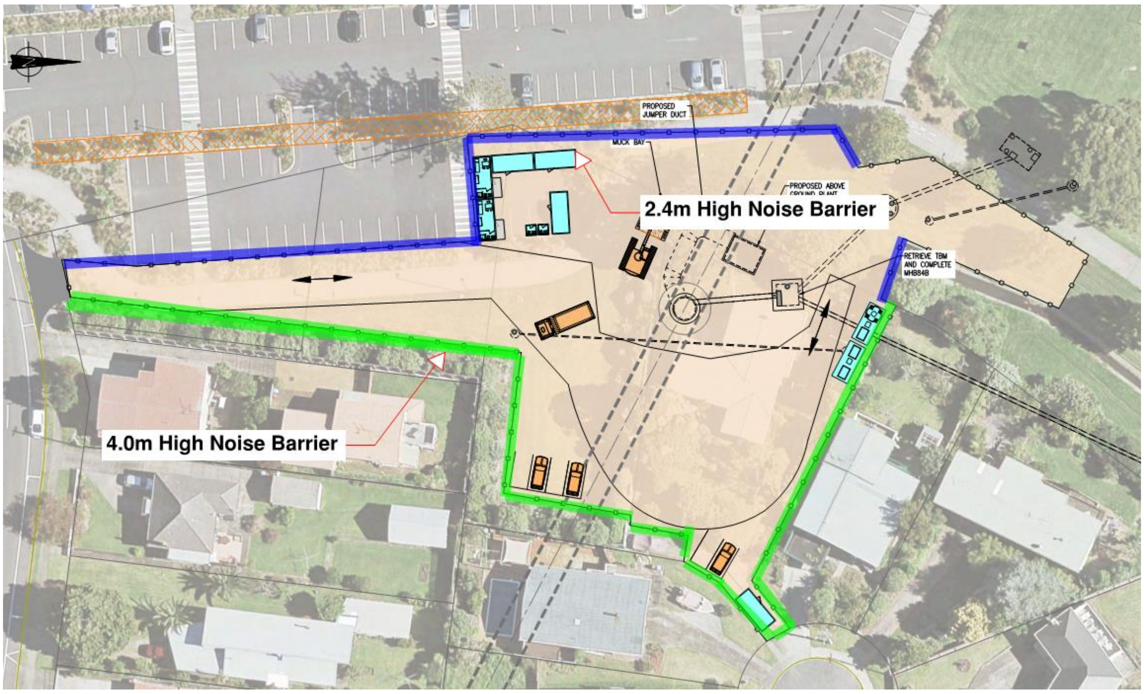


Figure 6: Pipe Jacking Noise Barriers

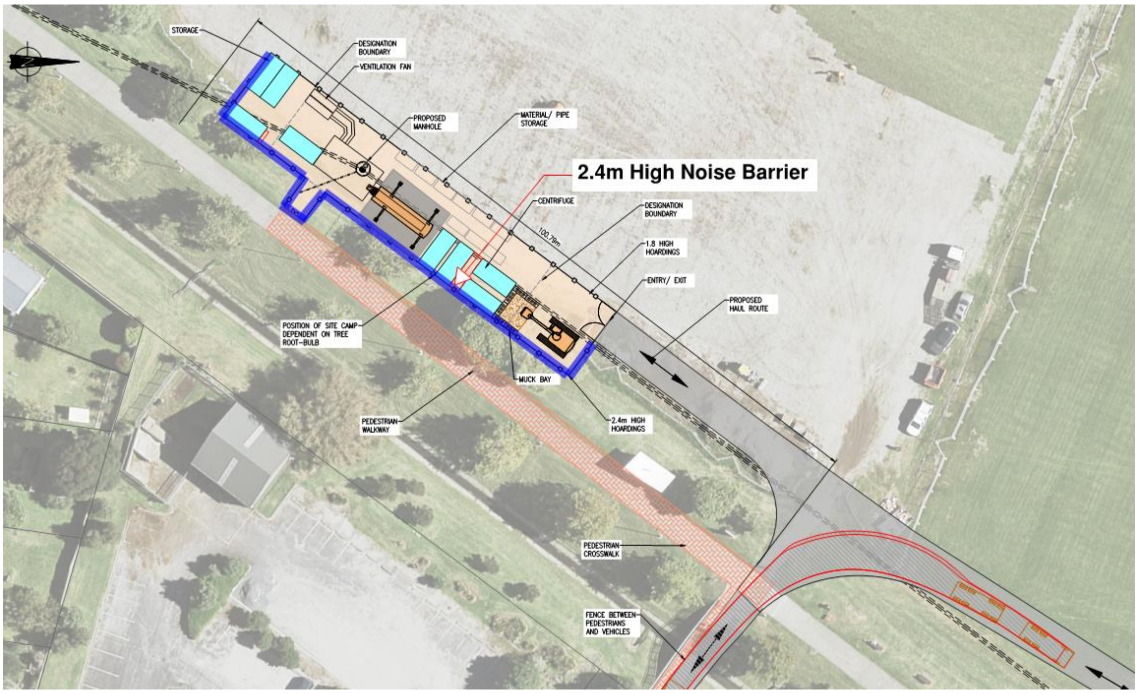
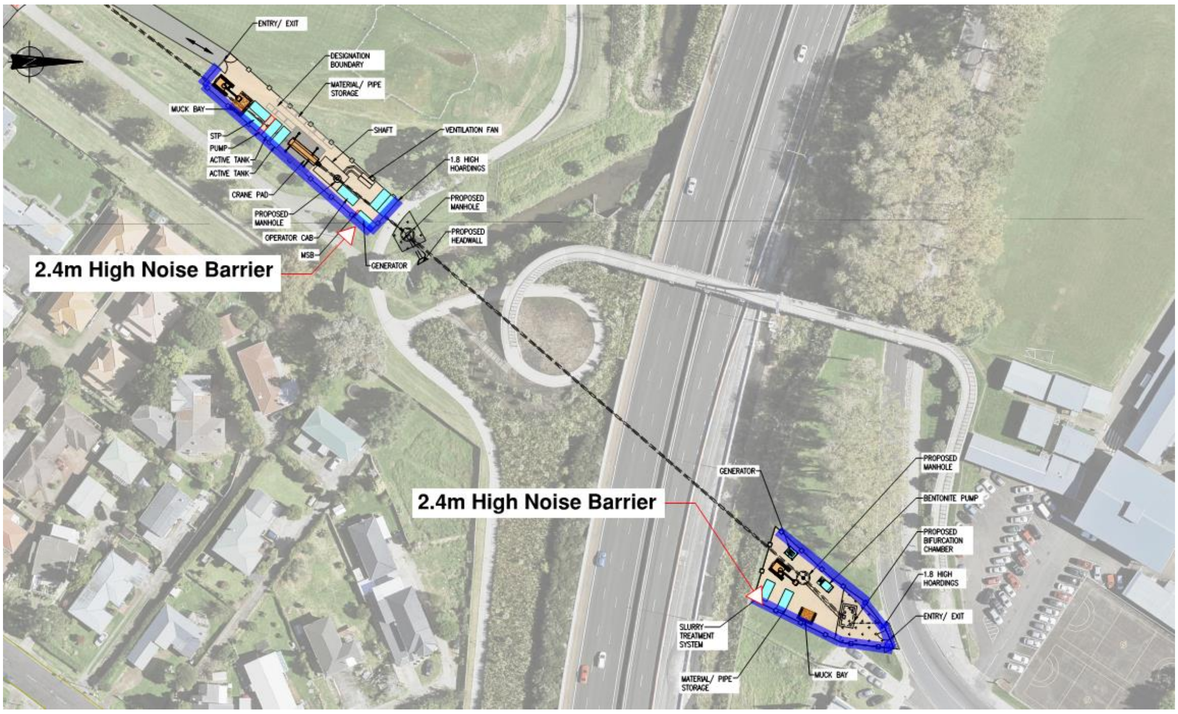


Figure 7: Pipe Jacking Noise Barriers



8.3 Specific vibration mitigation measures (DES3.6(e) and RC1.16(e))

8.3.1 Vibratory roller

For vibratory roller activities the following measures shall apply:

- Prioritise the use of static rollers over vibratory rollers or switch off the vibration function within predicted safe setback distances (Section 6.2);
- Match the size of roller to the scale of the works (i.e. large enough to undertake the works efficiently, but avoiding oversized units); and
- Match the vibration output to the scale of the works (i.e. combination of minimising the amplitude of the drum vibration and/or maximising the vibration frequency of operation).

8.4 General noise and vibration mitigation and management

8.4.1 General mitigation measures (DES3.4(e) and RC1.14(e))

Complaints can arise whether or not noise and vibration levels comply with the limits. To avoid complaints, general mitigation and management measures include, but are not be limited to, the following:

- Avoid unnecessary noise, such as shouting, the use of horns, loud site radios, rough handling of material and equipment, and banging or shaking excavator buckets;
- Avoid steel on steel contact such as during the loading of scaffolding on trucks;
- Avoid high engine revs through appropriate equipment selection and turning engines off when idle;
- Maintain site accessways to avoid pot holes and corrugations;
- Mitigate track squeal from tracked equipment, such as excavators (may include tensioning and watering or lubricating the tracks regularly);

- Minimise construction duration near sensitive receivers;
- Stationary equipment (e.g. generators) will be located away from noise sensitive receivers and site buildings and material stores used to screen them;
- Orient mobile machinery to maximise the distance between the engine exhaust and the nearest sensitive building façade (e.g. excavators);
- Utilise noise barriers and enclosures where appropriate (Section 8.4.3); and
- Ensure advanced communication is complete (Section 10.1) prior to commencing construction.

8.4.2 Training (DES3.4(j) and RC1.14(j))

All staff will participate in an induction training session prior to the start of construction, with attention given to the following matters:

- Construction noise and vibration limits (Section 5);
- Activities with the potential to generate high levels of noise and/or vibration (Section 6);
- Noise and vibration mitigation and management procedures (Section 8);
- The sensitivity of receivers and any operational requirements and constraints identified through communication and consultation (Section 6.3); and
- Best practice for night works including;
  - Keeping doors to the shed closed
  - Taking care when handling materials; and
  - No shouting or making other unnecessary noise.

Awareness of current noise and vibration matters on, or near active worksites, will be addressed during regular site meetings and/or ‘toolbox’ training sessions.

8.4.3 Noise barriers (DES3.4(d) and RC1.14(d))

Temporary noise barriers will be used where a construction noise limit is predicted to be exceeded (Section 6) and the barriers would noticeably reduce the construction noise level. They will be installed prior to works commencing and maintained throughout the works. Effective noise barriers typically reduce the received noise level by 10 decibels.

Where practicable, the following guidelines will be incorporated in the design and utilisation of temporary noise barriers:

- The panels will be constructed from materials with a minimum surface mass of 6.5 kg/m^2. Suitable panels include 12 mm plywood or the following proprietary ‘noise curtains’:
  - Duraflex ‘Noise Control Barrier - Performance Series’ (www.duraflex.co.nz);
  - Soundex ‘Acoustic Curtain - Performance Series' (www.ultimate-solutions.co.nz);
  - Flexshield ‘Sonic Curtain with 4 kg/m^2 mass loaded vinyl backing’ (www.flexshield.co.nz*);*
- Alternatives will be approved by a suitably qualified acoustic specialist because some proprietary noise curtains have insufficient surface mass for general use;
- The panels will be a minimum height of 2 m, and higher if practicable to block line-of-sight;
- The panels will be abutted or overlapped to provide a continuous screen without gaps at the bottom or sides of the panels;
- The panels will be positioned as close as practicable to the noisy construction activity to block line-of-sight between the activity and noise sensitive receivers; and
- Where positioned on the site boundary, additional local barriers will be considered near the activity to ensure effective mitigation for sensitive receivers on upper floor levels.

8.4.4 Enclosures (DES3.4(d) and RC1.14(d))

Enclosures differ from barriers in that they surround the sound source on more than one side, and usually include a 'roof'. The effectiveness of noise enclosures depends on the extent that the noise source can be enclosed without constraining the operation of the equipment and resulting in an unacceptable occupational health and safety environment (e.g. noise exposure, heat, dust, poor lighting etc). Enclosures can also result in traffic management issues and increase construction duration, particularly for short term or transient activities.

The following guidelines will be incorporated in the design and utilisation of noise enclosures where practicable and effective:

- Enclosures will be used where a noise barrier is not sufficient to achieve compliance with the noise limits and it is practicable to do so (e.g. stationary plant such as compressors, pumps, generators, air tools and concrete cutting activities)
- A suitably qualified and experienced acoustic specialist (such as MASNZ) will be involved in the enclosure design (an example is included as Figure B.3 in NZS 6803: 1999).

8.4.5 Building condition surveys (DES3.6(d) and RC1.16(d))

At this stage, no building condition surveys are required for vibration.

The Construction Manager will request in writing the approval of the property owner to undertake a building condition survey at the following times:

- Where vibration is predicted to exceed the cosmetic building damage limits (Section 5.2)
- Where vibration is measured to exceed the cosmetic building damage limits in (Section 5.2) and/or in response to a reasonable claim of damage from construction vibration (Section 10.2)
- Post construction to avoid subsequent claims of damage from construction vibration

Each building condition survey will:

- Be undertaken by a suitably qualified person;
- Provide a description of the building;
- Determine the appropriate structure type classification[8] with respect to DIN 4150-3:1999 *"Structural Vibration - Effects of Vibration on Structures"* (i.e. historic/sensitive, residential or commercial/industrial); and
- Document and photograph the condition of the building, including any cosmetic and/or structural damage.

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[8] Classifications with respect to Tables 1 and 3 of DIN 4150-3:1999 *"Structural Vibration - Effects of Vibration on Structures"* (i.e. historic/sensitive, residential or commercial/industrial)

9. ASCNMPs (DES3.5 and RC1.15)

The ASCNMPs need to be compliant with condition DES3.5 and RC1.15 the following needs to apply:

Where a CNVMP predicts that noise levels from a particular activity will or will likely exceed the noise limits set out in condition DE3.2 and RC1.12, or where noise measurements show that compliance is not being achieved, the Consent Holder shall prepare and submit for the approval of the Auckland Council an ASCNMP.

Three ASCNMPs will be prepared to cover the following non-compliant activities:

- ASCNMP 1 – Tree removal
- ASCNMP 2 – Shaft drilling
- ASCNMP 3 – Sheet piling

The ASCNMPs will be submitted to Auckland Council for approval at least 7 working days prior to the proposed work commencing. Consultation will be undertaken with adjacent landowners affected by the exceedance and their written endorsement included.

10. Communication and Complaints

This section details the communication procedures relating to noise and vibration for the Keith Hay Park shaft site as well as the complaints process. The CMP and Communications Plan contain a more detailed discussion of communication activities for the Project.

10.1 Communication

Written communication (e.g. newsletter) shall be provided to occupiers of buildings within 100 m of the site at least 1 week prior to the Project works commencing. It will acknowledge that some activities are predicted to generate high noise and/or vibration levels that may result in disturbance for short periods. It will include details of the overall works, its timing, duration and contact details for where complaints and enquiries should be directed.

Written communication during the works:

- Public site signage will include contact details;
- Regular project updates will include details of impending activities that may result in disturbance, including tree removal, sheet piling and drilling. It will include scheduled timing and duration of these activities and contact details where complaints and enquiries should be directed; and
- Occupants of buildings within 100m of night works will be advised at least 5 days prior to the works commencing.

10.2 Complaints (DES3.4(i), DES3.6(h), RC1.14(i) and RC1.16(h))

All construction noise and/or vibration complaints will be recorded in a complaints file that is available to Auckland Council on request. For each complaint, an investigation will be undertaken involving the following steps as soon as practicable:

- Acknowledge receipt of the concern or complaint and record:
  - Time and date the complaint was received and who received it;
  - Time and date of the activity subject to the complaint (estimated where not known);
  - The name, address and contact details of the complainant (unless they elect not to provide);
  - The complainant’s description of the activity and its resulting effects; and
  - Any relief sought by the complainant (e.g. scheduling of the activity)
- Identify the relevant activity and the nature of the works at the time of the complaint;
- If a reasonable complaint relates to building damage, inform the on-duty site manager as soon as practicable and cease associated works pending an investigation;
- Review the activity noise and/or vibration levels (Section 7) to determine if the activity is predicted to comply with the relevant performance standards (Section 5) at the complainant’s building. Consider attended monitoring to verify the underlying reference level assumptions;
- If the activity is measured to be non-compliant with the noise and/or vibration limits (Section 5) the following shall be undertaken;
- Implement mitigation measures (Section 8) and undertake additional monitoring to determine compliance (Section 11.2);
- If compliance cannot be achieved, halt works and prepare an ASCNMP (if not already prepared);
- Report the findings and recommendations to the Construction Manager, implement changes and update this CNVMP or the relevant ASCNMP as appropriate; and
- Report the outcomes of the investigation to the complainant, identifying where the relief sought by the complainant has been adopted or the reason(s) otherwise.

In most cases, ceasing the activity would provide immediate relief. In some cases, this may not be practicable for safety or other reasons. The complainant shall be kept updated regularly during the time it takes to resolve the matter.

11. General Noise and Vibration Monitoring and Review

This section provides details of the methodology for noise and vibration monitoring as well as review of the CNVMP.

11.1 General noise and vibration review (DES3.4(h), DES3.6(g), RC1.14(h) and RC1.16(g))

This CNVMP shall be implemented and maintained throughout the entire construction period and updated when necessary. The CNVMP shall be updated as follows:

- When working conditions become clearer;
- Alternative construction methodologies are adopted;
- Following noise and/or vibration monitoring; and
- Yearly to ensure best practicable option is still being adopted.

Following any material updates, the CNVMP shall be issued to Auckland Council in accordance with the project conditions.

11.2 Noise and vibration monitoring (DES3.4(h), DES3.6(g), RC1.14(h) and RC1.16(g))

11.2.1 Noise monitoring

Construction noise levels will be monitored as follows:

- In accordance with the relevant ASCNMP;
- In response to a reasonable noise complaint;
- At 1m from the most affected building façade, or proxy position and adjusted for distance and façade reflections where appropriate for a representative duration when required;
- By a suitably qualified and experienced specialist (e.g. Member of the Acoustical Society of New Zealand) in accordance with the requirements of New Zealand Standard NZS 6803: 1999 “Acoustics - Construction Noise”;
- For a representative duration, reported with the measured level (e.g. 65 dB L_{Aeq} (30min)); and
- The results will be used to update Section 6.1 if appropriate.

11.2.2 Vibration monitoring

Construction vibration will be monitored:

- In response to a reasonable vibration complaint (Section 10.2);
- At the closest building foundations and/or the top floor level as appropriate where consent to access the building of interest has been requested and granted for a representative duration when required;
- By a suitably qualified and experienced specialist (e.g. Member of the Acoustical Society of New Zealand) in accordance the requirements of German Standard DIN 4150-3:1999 “Structural vibration – Part 3: Effects of vibration on structures”;
- For a representative construction duration, measured in 2-second intervals; and

- The results will be used to update Section 6.2 if appropriate.

11.2.3General review of the CNVMP (DES3.11 and RC1.21)

This CNVMP should be considered as a live document. It will be updated, with the necessary approvals, throughout the course of the project to reflect material changes to construction methods, site conditions or the natural environment.

APPENDIX A - ACTIVITY SPECIFIC CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLANS

APPENDIX B - REVIEW RECORDS

Review records

The table below is a register of all construction related communication with Stakeholders, including complaints that have been received during the construction period.

Date/Time	Nature of Communicator (e.g. complaint)	Name and address of stakeholder	Details of communications	Action taken	Resolved (date)

APPENDIX C - NOISE MONITORING RECORDS

NOISE MONITORING FIELD SHEET

Monitoring Information

Site:		**Date:**			
Address/ Location:		**Meter:**			
Reason for Monitoring	Routine	SSCNVMP Requirement	Complaint	Attenuation	Background

Site Information

Description of Works: **(Include source on noise and location of source)**			
Description of Receiver:			
Background Sound (s):			
Distance Between Measurement and Source:		**Distance between Measurement and Receiver:**	

Weather

Temperature:		**Cloud Cover (%):**	
Wind Direction:		**Rainfall:**	

Wind speed: (tick the box)

- ☐ Calm. Smoke rises vertically (1 Km/h).
- ☐ Smoke drift indicates wind direction. Leaves and wind vanes are stationary (1-5 Km/h).
- ☐ Wind felt on exposed skin. Leaves rustle. Wind vanes begin to move (6-11 Km/h).
- ☐ Leaves and small twigs constantly moving, light flags extended (12-19 Km/h).

If wind speeds are greater than those indicated above, do not carry out monitoring.

Location Consideration

Proximity to unrelated noise sources (e.g. road traffic)	
Height of noise sampling location (as close to 1.2m above ground surface as possible)	
Location of any reflective surfaces (e.g. walls / buildings)	

NOISE MONITORING FIELD SHEET

Monitoring Results					
Location	**Distance to Noise Source**	**Duration (Default 15min)**	**L_{Amax}**	**L_{Aeq}**	**Comments**
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	
		_ _ min	_ _ . _ dB	_ _ . _ dB	

The measurement sample should not exceed one hour. For constant sound measurement of 15 minutes will often be adequate.

Refer to Construction Noise and Vibration Management Plan and NZS 6803:1999 Acoustics - Construction Noise

Comments:

Completed By:			
Name		**Signature**	

APPENDIX D - VIBRATION MONITORING RECORDS

VIBRATION MONITORING FIELD SHEET

Monitoring Information				
Site:		**Date:**		
Address/ Location:		**Meter:**		
Reason for Monitoring	Routine	CNVMP Requirement	Complaint	Attenuation Background

Site Information			
Description of Works			
Source of Vibration (Include details of plant)			
Description of Receiver (I.e. structure of property, foundation type)			
Ground Conditions (If Known)			
Distance between measurement and source:		**Distance between measurement and receiver:**	

Meter Positioning			
Position of Meter	Foundations	Ground	Floor
Secured to surface	Clamped	Sand bagged	Other
Other Notes			

	Monitoring Results					
ID	Start Time	Duration	Vibration Source/Activity	Distance to Source	V-SUM	Dominant Frequency
1						
2						
3						
4						
5						
6						

Comments:

Completed By:			
Name		**Signature**	

APPENDIX E - SUSTAINABILITY ASPECTS

Sustainability Aspects

Table A below Identifies the ISCA Credit Requirements relevant to this CNVMP and where they are addressed in the documents.

Table A: ISCA Requirements

Credit	Requirement *	Relevant section	Other relevant information / comments
Noise			
DIS-2 Level 1	DIS2.1.1 Baseline studies of existing noise environment have been carried out for the project.	-	Pages 14 and 42 of Environmental Investigations Programme – Noise Impact Assessment, prepared Marshall Day Acoustic and dated 23 July 2012
DIS-2 Level 1	DIS2.1.2 Predictions for noise developed for construction	Sections 7.1	-
DIS-2 Level 1	DIS2.1.3 Measures to mitigate noise during construction have been identified and implemented	Sections 8.2 and 8.4	-
DIS-2 Level 1	DIS2.1.4 Monitoring of noise is undertaken at appropriate intervals and in response to complaints	Section 11.2.1	Refer also to the Communications Plan
Vibration			
DIS-3 Level 1	DIS3.1.1 Building condition surveys have been undertaken for properties potentially impacted by vibration	Section 8.4.5	Refer also to the Construction Management Plan
DIS-3 Level 1	DIS3.1.2 Predictions for vibration have been enveloped	Section 7.2	-
DIS-3 Level 1	DIS3.1.3 Measures to mitigate vibration during construction have been identified and implemented	Sections 8.3.1	-
DIS-3 Level 1	DIS3.1.3 Monitoring of vibration is undertaken at appropriate intervals and in response to complaints	Section 11.2.2	-

* Refer to ISCA Rating Tool for full details of the requirement.

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Appendix G: Groundwater and Settlement Assessment

Tonkin+Taylor

Memo

To:	**Xenia Meier and Shalini Sanjeshni** **Watercare (CI)**	**Job No:**	**1015172.1400**
From:	**Troy McAlister, Tonkin & Taylor Ltd**	**Date:**	**24 June 2021**
Subject:	**CC9 Keith Hay Park - groundwater and settlement overview**		

1 Introduction

Watercare Services Ltd (Watercare) proposes to construct a sewer connection (CC9) at Keith Hay Park, Mt Roskill. The proposed works involve the installation of a 810 m long sewer pipeline from the Central Interceptor (CI) shaft construction site at Keith Hay Park to Richardson Road to allow connection to the existing network.

The construction methodology for the northern extent of the pipeline route will be trenchless (likely micro-tunnelled or otherwise HDD) and the sewer will be installed at a depth to invert of up to approximately 8 m. The construction methodology for the southern section of the CC9 route from the Mt Roskill Cricket Club onwards to Richardson Road will be confirmed at the detailed design stage. While this section may also rely on trenchless methodologies, there is the potential that this section of pipeline will be installed via open cut trenching.

This memorandum sets out a review of potential groundwater drawdown effects along the CC9 alignment through Keith Hay Park to Richardson Road, based on a conservative assessment which considers the credible scenario as well as a worst case scenario for three alignment options.

2 Geology

Previous ground investigations include six boreholes located along the CC9 pipe alignment, as shown in Appendix A and Table 2.1. These boreholes identify a 9.5 to 11+ m cap of Tauranga Group sediments underlain by East Coast Bays Formation (ECBF). The Tauranga Group sediments, which were present in all boreholes drilled along the alignment, are composed of very soft to firm organic silt and peat deposits. Organic silt and peat material was found at depths ranging from 1.30 mbgl to 9.20 mbgl, with an average thickness of 5.8 m. A ground profile is provided in Table 2.1.

Additional to the previous investigations, T+T completed a single borehole, BH01, to a depth of 9.0 m. This was undertaken to install a piezometer for groundwater monitoring. The geological profile identified from this borehole has also been used to inform the geological profile. The borehole identified organic clay, organic silt and peat from a depth of 2.1 to 7.5 mbgl. No ECBF material was identified within this borehole. The information obtained from the drilling of this hole is included in the ground profile in Table 2.1 and displayed on the borehole log in Appendix B.

Table 2.1: Borehole and geology summary

BH ID	Associated manhole ID (Drawings 2011805.046-.048)	Likely installation methodology	Tauranga Group sediments depth range (m)	Weathered ECBF depth range (m)	Organic silt and peat depth range (m)
AS5-BH01	MH-01	Trenchless	0.0-9.50	9.5-10.75+	1.7-4.5
AS5-BH02	MH-02	Trenchless	0.0-10.30	10.30-10.82+	2.0-5.5
AS5-BH03	MH-05	Trenchless	0.0-10.95	Not encountered	1.7-9.2
AS5-BH04	MH-06	Trenched	0.0-10.50	Not encountered	2.0-8.1
BH01 (T+T)	MH-07	Trenched	0.0-9.00	Not encountered	2.1-7.5
AS5-BH05	MH-08	Trenched	0.0-10.95	Not encountered	1.3-6.5
AS5-BH06	MH-11	Trenched	0.0-10.95	Not encountered	2.7-6.8

3 Groundwater

In the previous ground investigations, one groundwater measurement was taken during the drilling of AS5-BH02. However, this measurement was taken during the drilling process (which used water as the drilling medium); therefore, this single groundwater level observation was not considered an accurate representation of the groundwater conditions of the area for the purposes of modelling.

To obtain an accurate groundwater level, BH01 was installed with a piezometer. The details of this piezometer are given on the borehole log in Appendix B. Groundwater has been continually monitored for 2 months from the 9th March 2021 using a Solinist Level logger. The maximum depth recorded was 1.07 mbgl and the minimum reading was 0.83 mbgl, giving an average water level of 0.93 mbgl. The average water level has been adopted for assessment in this report. The graphed groundwater data is available in Appendix D.

3.1 Permeability testing

Permeability testing in the form of a slug test was conducted on BH01 on the 9th March 2021. This testing was conducted on the organic units between 3.5 and 8.5 mbgl. The slug used for the test was a bailer filled with sand of approximate dimensions of 1 m in height and 0.04 m in width. The test comprised:

- Falling head test, which commenced when the slug was fully submerged into the well to displace water. Duration of 30 minutes, data recorded on a pressure transducer logger.
- Rising head test, which commenced immediately after the slug was removed from the well. Duration of 30 minutes, data recorded on a pressure transducer logger.

The falling head and rising head tests were analysed using the Hvorslev and Bouwer & Rice methods using AquiferTestPro software. The hydraulic conductivities obtained from the analysis are shown in Table 3.1. Based on this testing, the average permeability for organic units between 3.5 and 8.5 mbgl is 5.2×10^{-7} m/s.

Table 3.1: Slug test permeability results

Field Method - Analysis Method	Falling Head - m/s	Rising Head - m/s
Bouwer & Rice	4.4×10^{-7}	5.2×10^{-7}
Hvorslev	5.7×10^{-7}	5.6×10^{-7}
Average hydraulic conductivity	5.2×10^{-7}	

3.2 Groundwater drawdown

3.3 Trenchless section (northern end of alignment, MH01-MH06)

Based on the trenchless methodologies proposed for all three of the alignment options, groundwater inflow/settlement is expected to occur throughout the construction. However, to ensure a conservative assessment, a series of potential scenarios for the trenchless construction methodology have been considered as follows:

1. Minor drawdown of the groundwater through general working and minor water flow though material with a high organic content (modelled for 20 days of continuous drawdown – assuming a machine progression of 10 m/day for a maximum distance of 200 m). This scenario assumes that groundwater inflow occurs at both the sides and face of the excavation, permeability is homogenous across the alignment, hydraulic head is homogenous across the alignment, and the cone of depression extends out from a point location at 10 m intervals.
2. Machine failure for a period of >100 days. This is very much a worst-case scenario and is considered unlikely. This scenario assumes that groundwater inflow occurs at both the sides and face of the excavation, permeability is homogenous across the alignment, hydraulic head is homogenous across the alignment, and the cone of depression extends out from a point location being the machine face.

Scenarios 1 and 2 are shown on Figure 3.1 below.

Under Scenario 1, drawdown of 2.38 m is estimated to occur. If complete drawdown is to develop during a worst case scenario (i.e. prolonged machine breakdown), there is likely to be 7.1 m of drawdown at the tunnel face. In both cases groundwater drawdown will extend approximately 10 m from the tunnel face.

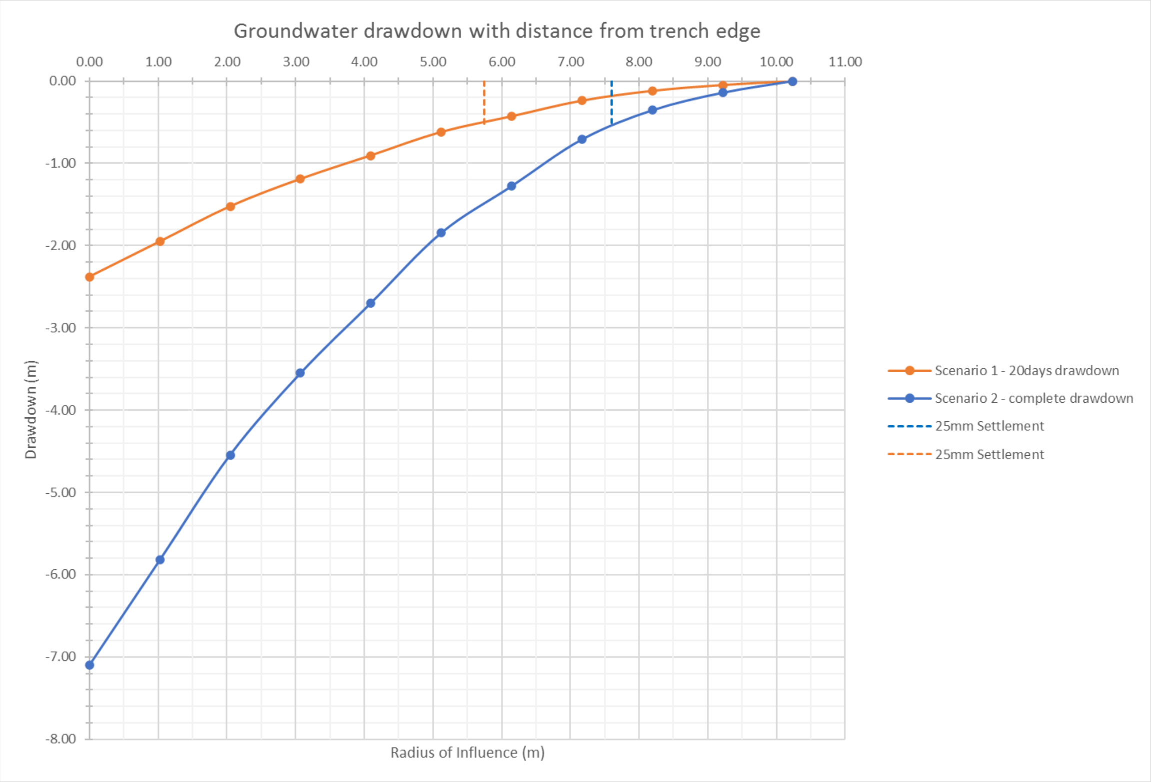

Figure 3.1: Groundwater drawdown for the trenchless methodology from MH01-MH06.

3.4 Trenched section (southern end of alignment, MH06-Richardson Rd)

For the proposed open trench construction methodology for alignment options 1 and 3, groundwater will flow freely and dewatering will be required for the installation of the pipe, for which the following scenarios have been assessed:

1. Limited construction time for any one section of the trench to be open (10 days open). This will limit the groundwater flow into the trench and the radius of influence. At any one time the trench wall area is assumed to be approximately 80 m^2, permeability is homogenous across the alignment and hydraulic head is homogenous across the alignment.
2. Prolonged construction period with full drawdown (which occurs at 32 days of an open trenched section). At any one time the trench wall area is assumed to be approximately 80 m^2, permeability is homogenous across the alignment and hydraulic head is homogenous across the alignment.

These scenarios are shown on 3.2 below.

After 10 days of the trench being open, approximately 2.1 m of drawdown has been estimated to occur. On complete drawdown after approximately 32 days, 3.1 m of drawdown has been estimated to occur. If the trench was to be open for more than 32days, no further settlement is expected to occur as drawdown has reached its maximum.

Both scenarios are estimated to extend to a radius of influence of 4.5 m from the trench edge.

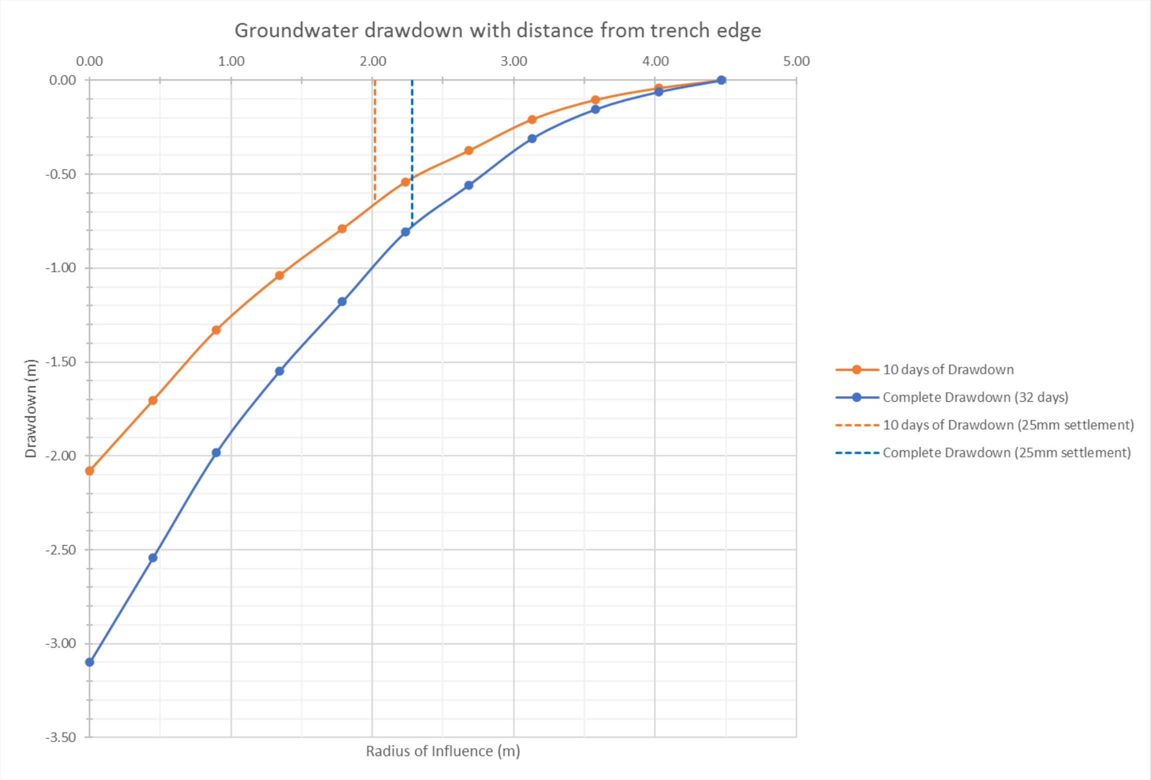

Figure 3.2: Groundwater drawdown for the trenched methodology.

3.5 Trenchless section (southern end of alignment, MH06-Richardson Rd)

Based on the trenchless methodologies proposed for alignment option 2 (i.e. generally following the walkway alignment between Hay Park School and the Hillsborough Kindergarten), groundwater inflow/settlement is expected to occur throughout the construction. However, to ensure a conservative assessment, a series of potential scenarios for the trenchless construction methodology have been considered as follows:

3 Minor drawdown of the groundwater through general working and minor water flow though material with a high organic content (modelled for 20 days of continuous drawdown – assuming a machine progression of 10 m/day for a maximum distance of 200 m). This scenario assumes that groundwater inflow occurs at both the sides and face of the excavation, permeability is homogenous across the alignment, hydraulic head is homogenous across the alignment, and the cone of depression extends out from a point location at 10 m intervals.

4 Machine failure for a period of >50 days. This is very much a worst-case scenario and is considered unlikely. This scenario assumes that groundwater inflow occurs at both the sides and face of the excavation, permeability is homogenous across the alignment, hydraulic head is homogenous across the alignment, and the cone of depression extends out from a point location being the machine face.

Scenarios 1 and 2 are shown on Figure 3.3 below.

Under Scenario 1, drawdown of 2.38 m is estimated to occur. If complete drawdown is to develop during a worst case scenario (i.e. prolonged machine breakdown >50 days), there is likely to be 3.1 m of drawdown at the tunnel face. In both cases groundwater drawdown will extend approximately 4.5 m from the tunnel face.

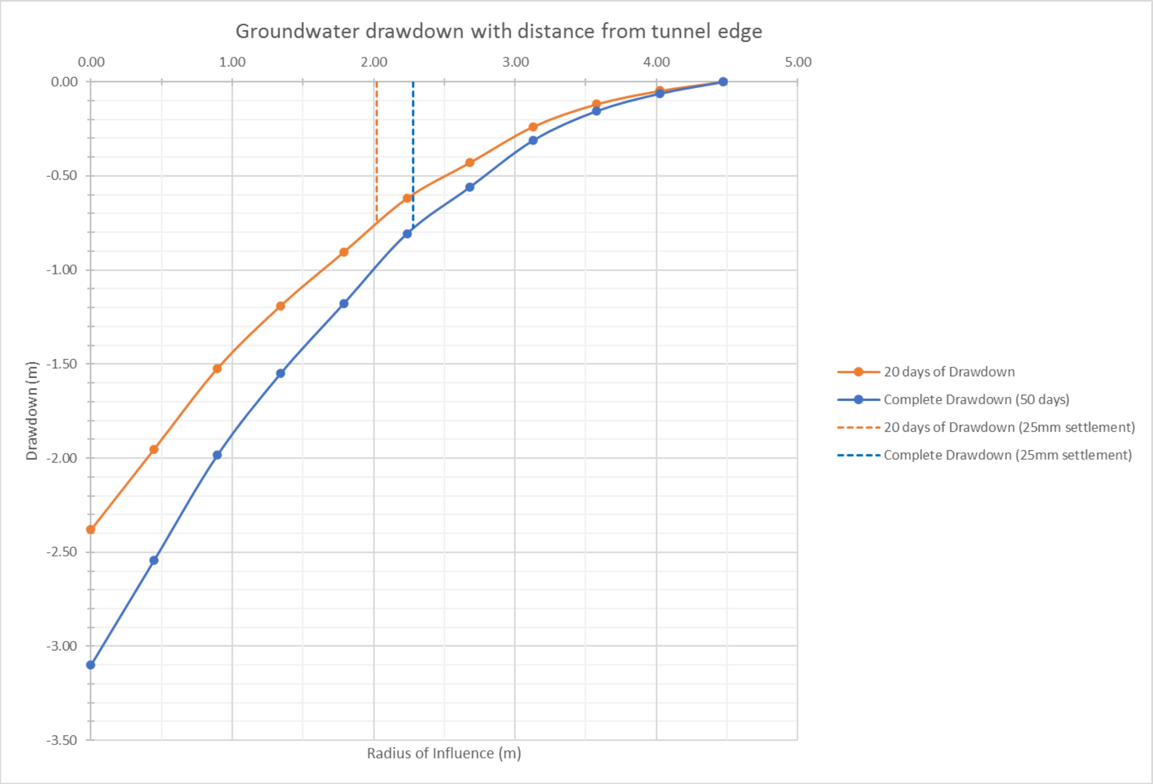

Figure 3.3: Groundwater drawdown for the trenchless methodology from MH06-Richardson Rd.

4 Groundwater drawdown induced settlement

Table 4.1 outlines the compression properties adopted for the estimates of settlement for both trenchless and trenched methodologies, based on Look:2007[2]. Utilising the values in Table 4.1, there are two scenarios adopted in deriving the settlement estimates:

- Worst case (complete groundwater drawdown); and
- Credible case for the trenched methodology and for the trenchless methodology[1] (10-20 days of groundwater drawdown).

The settlement estimates for these scenarios are provided in Table 4.2.

Table 4.1: Settlement Assumptions[2]

Description of settlement	Unit	Value
Coefficient of Volume Compressibility (mv) for alluvial clay/silt	m/kN	0.0008
Coefficient of Volume Compressibility (mv) for organic silt and peat	m/kN	0.0015
Static groundwater level	m bgl	0.93
Settlement calculation where s is settlement, h is thickness		$s = m_v \times \Delta\sigma \times h$
Dewatering period	days	10 to >100 (worst case)
Depth to Invert (m)	m	7.8 North 4.1 South
Organic silt/Peat thickness dewatered	m	5.8 North 3.0 South
Alluvial clay/silt thickness dewatered	m	1.2 North 0 South

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[1] Noting the expected probable case for the trenched methodology is no drawdown i.e. Scenario 1.

[2] Handbook of Geotechnical Investigation and Design Tables, Burk Look, 2007

Table 4.2: Settlement estimates along the CC9 alignment

	Trenchless (MH01-MH06)		Trenched (MH06-Richardson Rd)		Trenchless (MH06-Richardson Rd)	
	Scenario 2: Worst Case (>100 days)	Scenario 1: Credible (20 days)	Worst Case (32 days)	Credible (10 days)	Scenario 2: Worst Case (>50 days)	Scenario 1: Credible (20 days)
	7.1 m (trenchless - northern end)	2.38 m (trenchless - northern end)	3.1 m (trenched - southern end)	2.1 m (trenched - southern end)	3.1 m (trenchless - southern end)	2.38 m (trenchless - southern end)
Settlement immediately above pipe alignment (mm)	350	120	100	70	100	80
Differential settlement (as per groundwater settlement curves)	@10 m radius of influence – 1:30	@10 m radius of influence - <1:80	@4.5 m radius of influence – 1:45	@4.5 m radius of influence – 1:65	@4.5 m radius of influence – 1:45	@4.5 m radius of influence – 1:55

In the scenario where groundwater inflow occurs and complete drawdown is induced (i.e. (continuously during trenched sections and during a prolonged machinery breakdown in trenchless sections), there is the potential for structures and utilities nearby to the pipeline alignment to be affected. The estimated radius of influence of the drawdown induced settlement, as well as potential structures and utilities affected, is shown on Appendix C for each alignment option.

Some structures and utilities can tolerate a certain quantity of settlement. The tolerable settlement for infrastructure is considered to be approximately 25 mm (this can vary depending on the structure). For the trenched construction methodology, at least 25 mm of settlement is expected to occur within 2.0 m of the trench edge after 10 days of groundwater drawdown, and within 2.3 m of the trench edge for complete drawdown (i.e. >30 days).

When considering the trenchless methodology between MH01-MH06 for the northern section of the alignment, at least 25 mm of settlement is expected to occur within 5.8 m from the tunnel machine after 20 days of groundwater drawdown, and within 7.6 m from the tunnel machine face in the worst case scenario (i.e. very unlikely scenario of a prolonged machine breakdown >100 days).

When considering the trenchless methodology between MH06-Richardson Rd for the southern section of the alignment, at least 25 mm of settlement is expected to occur within 2.0 m from the tunnel machine after 20 days of groundwater drawdown, and within 2.3 m from the tunnel machine face in the worst case scenario (i.e. very unlikely scenario of a prolonged machine breakdown >50 days).

The maximum zone of influence from the pipe edge at the southern end of the alignment is 4.5 m (i.e. at which point settlement is expected to be zero (0)), and at the northern end of the alignment the maximum zone of influence is 10.2 m. It is expected that infrastructure and buildings will be affected by settlement for southern alignment option 2, as two buildings are located within this zone of influence. These are the Hillsborough Kindergarten at 668 Richardson Rd and Mt Roskill Cricket Club at 13 Noton Rd.

The radius of influence with potential settlement of 25 mm or greater and maximum influence zone (0 mm settlement) is shown on Figure 4.1, Figure 4.2, Figure 4.3 and Appendix C.

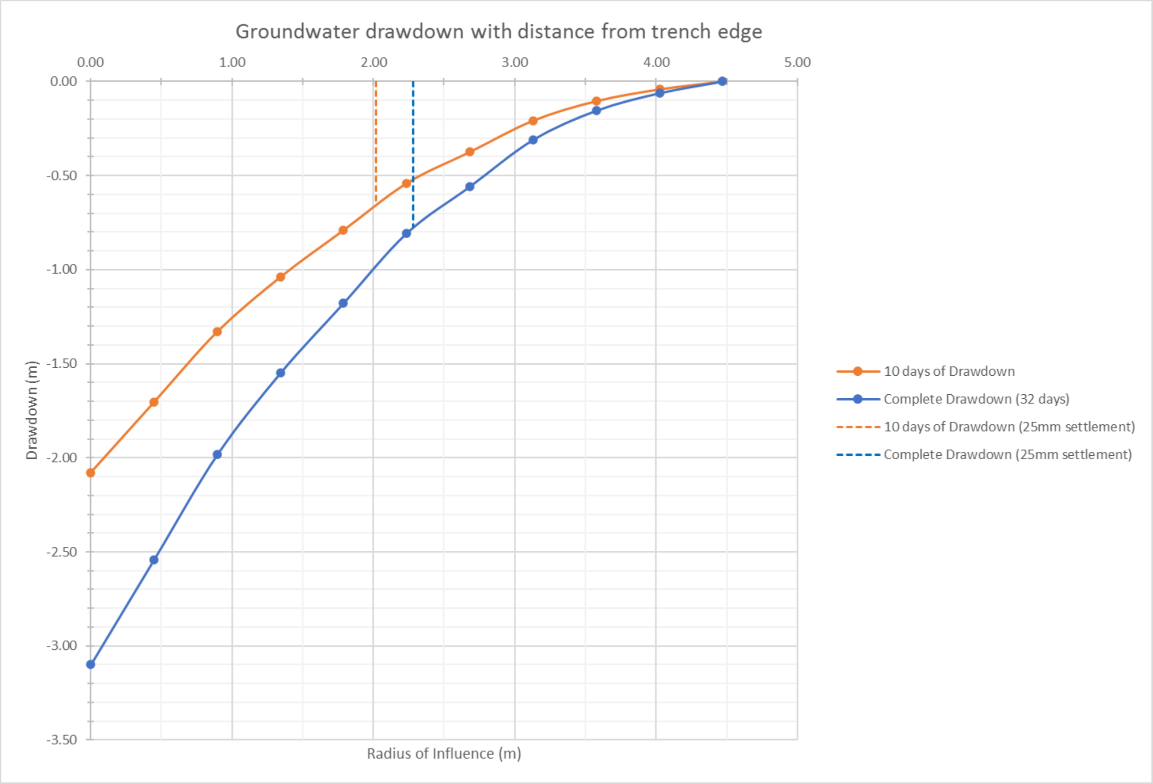


Figure 4.1: Distance from the trench edge at which 25mm settlement occurs.

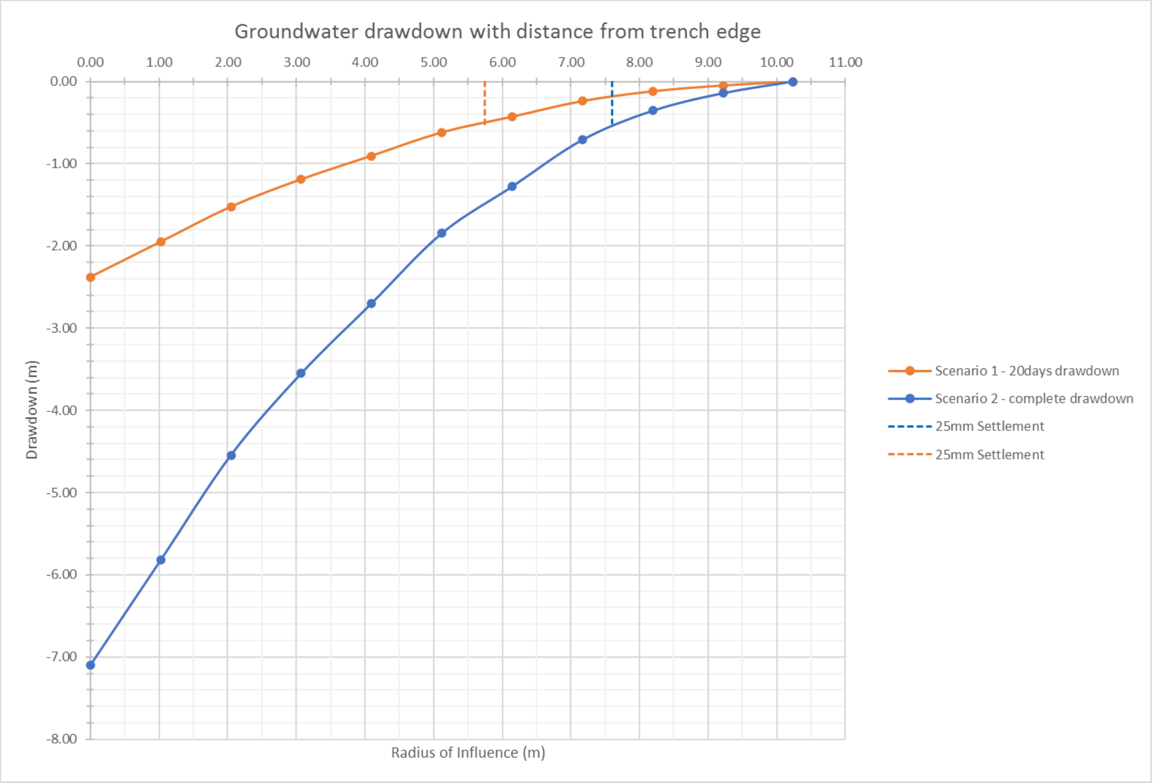


Figure 4.2: Distance from the trenchless methodology between MH01-MH06 along the northern section at which 25 mm settlement occurs.

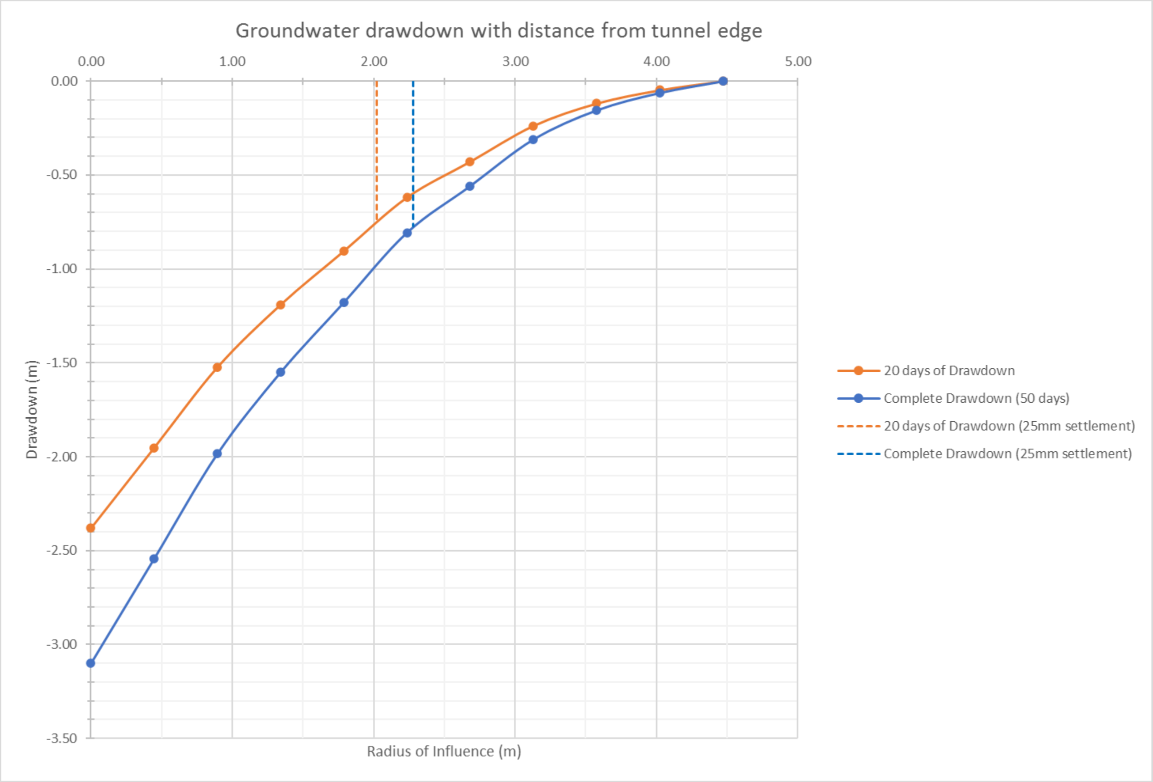


Figure 4.3: Distance from the trenchless methodology between MH06-Richardson Rd along the southern section at which 25mm settlement occurs.

5 Summary

5.1 Groundwater

Groundwater has been measured to be 0.93 mbgl on average (and ranges between 0.83 mbgl and 1.07 mbgl). A best estimate evaluation of the permeability of the soils within the organic units is estimated to be 5.2 x 10^{-7} m/s. Using these estimates, drawdown curves indicate that radius of influence could potentially extend to a distance of 10 m from the pipe alignment in the north, to 4.5 m in the south. The best estimate settlement values and radii of influence is shown in Table 4.2. It should be noted that at the northern end this represents a very conservative and unlikely scenario (i.e. prolonged breakdown of the machine).

5.2 Groundwater drawdown induced settlement

Worst case (complete groundwater drawdown):

- Settlement calculations at the location of maximum drawdown indicate up to 350 mm settlement at the northern end and 100 mm at the southern end immediately above the pipe alignment. These settlement magnitudes are considered to be significant and if they occurred would likely result in building and utility damage. Furthermore, resulting differential settlements are estimated to be between 1:30 and 1:45 which pose a risk of damage to buildings and utilities.
- An infrastructure tolerance of 25 mm settlement was considered and the radius of influence for this point was 2.3 m at the southern end (trenched and trenchless methodology) and 7.6 m at the northern end (trenchless methodology). **Settlement is not expected to affect buildings along alignment options 1 or 3.**

- The maximum zone of influence of settlement is 4.5 m for the southern portion of the alignment (MH-06-Richardson Rd) and 10.2 m for the northern portion of the alignment (MH-01 – MH-06). **Settlement is expected to affect two buildings along the alignment for alignment option 2** (being the Hillsborough Kindergarten and Mt Roskill Cricket Club).
- Underground services will be affected on all alignment options.
- For the northern section which will be installed via a trenchless methodology, this represents a very conservative and unlikely scenario (i.e. prolonged breakdown of the machine for a period of >100 days).
- For the southern trenched sections, this represents a conservative estimate with the trench open for >30 days.
- For the southern trenchless sections, this represents a very conservative and unlikely scenario (i.e. prolonged breakdown of the machine for a period of >50 days).

Groundwater drawdown for a period of 10 days (trenched):

- Settlement calculations indicate that up to 70 mm settlement could occur at the southern end.
- The settlement magnitude at the southern end (trenched methodology) is considered to be potentially significant and would likely result in building and utility damage. However an infrastructure tolerance of 25 mm settlement was considered and the radius of influence is likely to be 2.0 m from the edge of the trench. **No buildings are within the radius of influence, however underground services do cross the alignment and will be affected by this settlement.**

Groundwater drawdown for a period of 20 days (credible – trenchless):

- Settlement calculations indicate that up to 120 mm settlement could occur at the northern end.
- The settlement magnitude at the northern end (trenchless methodology) is considered to be significant and would likely result in building and utility damage. However an infrastructure tolerance of 25 mm settlement was considered and the radius of influence is likely to be 5.8 m from the edge of the trench. **No buildings are within the radius of influence, however underground services do cross the alignment and will be affected by this settlement.**
- Settlement calculations indicate that up to 80mm settlement could occur at the southern end.
- The settlement magnitude at the southern end (trenchless methodology) is considered to be significant and would likely result in building and utility damage. However an infrastructure tolerance of 25 mm settlement was considered and the radius of influence is likely to be 2.0 m from the edge of the trench. **In the credible event of a maximum 20 day drawdown, no buildings are within the radius of influence, however underground services do cross the alignment and will be affected by this settlement.**

5.2.1 Assumptions and limitations

For groundwater drawdown effects of the trenchless methodology we have assumed:

- Groundwater inflow occurs across the entire tunnel alignment. For drawdown calculations, 10 m sections of pipe excavation have been assessed and assumed a pipe diameter of 1.0 m;
- Permeability is homogenous across the alignment;
- Hydraulic head is homogenous across the alignment; and
- The cone of depression extends out from a point location.

For groundwater drawdown effects of the trenched methodology we have assumed:

- At any one time the trench wall area is approximately 80 m2;
- Permeability is homogenous across the alignment: and
- Hydraulic head is homogenous across the alignment.

Recognising the many assumptions considered in the groundwater effect calculation, the report gives best estimates of settlement outcomes. It is likely that the stated figures will differ from those that will eventuate, which could be lesser or greater.

6 Considerations and recommendations

6.1 Considerations

The following considerations should be made for the CC9 alignment:

1. Trenches are open and closed as soon as practical to avoid extended drawdown of the groundwater, and therefore increases in the magnitude of settlement.
2. Dewatering of the excavation should only be undertaken to the base of the excavation.
3. The works contractor/designer for the trenched sections should consider trench supports such as face shields or similar to prevent mechanical settlement of the ground and ensure that the combined effects of groundwater drawdown induced settlement and mechanical settlement do not affect nearby infrastructure, buildings and assets.
4. Groundwater drawdown induced settlement estimates are affected by several independent parameters and model assumptions. Uncertainties in the accuracy of the groundwater and geotechnical characteristics used in the reported settlement estimates are a significant factor in the confidence levels for the estimated settlements.
5. Based on the above assessments of worst case scenarios, it is considered that groundwater drawdown induced settlement is unlikely to affect structures or buildings near the alignment for alignment options 1 and 3 (the nearest building being 4.8 m from the alignment). However, groundwater drawdown induced settlement is likely to affect structures and buildings near alignment option 2.
6. Based on the above assessments of credible scenarios, it is considered that groundwater drawdown induced settlement is unlikely to affect structures or buildings near the alignment for alignment options 1, 2 and 3.
7. Several utilities cross both the trenched and trenchless sections of the alignment and are expected to be damaged if settlement occurs (both in credible and worst case scenarios). Settlement is likely to occur in trenched sections and therefore potentially damage utilities. However, settlement caused by a longer tunnelling machine breakdown in the trenchless sections is considered a rare event and therefore each utility should be considered on a risk-based analysis. This should be considered by the construction contractor and an appropriate management plan created.

6.2 Recommendations

The following recommendations are therefore made for the CC9 alignment:

1. The works contractor/designer should ensure that utilities exposed during the trenched installation are supported.
2. For the trenchless alignment, a risk-based analysis should be undertaken for all utilities within the radius of influence identified in this report, before construction is started. Utilities considered high risk (such as critical services) should be realigned to avoid the CC9 trenchless alignment. Utilities of lesser risk may remain in place during the tunnelling operation, however a contingency

plan to protect and potentially repair them should be in place if monitoring indicates potential for damage.

3 A settlement monitoring and control plan should be developed for the alignment.

4 Pre-works condition surveys should be undertaken on all buildings within 15 m of the pipeline route alignment.

7 Applicability

This report has been prepared for the exclusive use of our client, Watercare Service Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

We understand and agree that this report will be submitted to Auckland Council in support of an application for resource consent for the works described herein and that council will rely on this report for the purposes of assessing that application.

Tonkin & Taylor Ltd

Report prepared by:	Authorised for Tonkin & Taylor Ltd by:
....	....
Troy McAlister	Peter Roan
Engineering Geologist	Project Director

28-Jun-21
\\ttgroup.local\files\aklprojects\1015172\1015172.1400 cso cc9 keith hay park\issueddocuments\1015172.1400 cc9 settlement and groundwater_final.docx

Appendix A: Ground investigation locations

LEGEND:

◐ AS5-BH01	MACHINE BOREHOLE LOCATIONS
●	FUTURE CSO COLLECTOR SEWER AND MANHOLE
SS—SS—SS	EXISTING TRANSMISSION WASTEWATER
SS	EXISTING WASTEWATER
⊕	Tonkin & Taylor Machine Borehole Location

SCALE 1:200

4 3 2 1 0 4 8 12 16 20m

FOR INFORMATION
CONTRACTOR'S DESIGN

Plot Date: Dec 09, 2020 - 12:48pm X:\CAD\6661_DRAWINGS\DSCIN003 (Keith Hay Park)\SKETCHES\ DSCIN003-DEL-SKT-C-G-00086.dwg

ISSUE	DATE	AMENDMENT
A	25.11.20	FOR INFORMATION

KEITH HAY PARK – BRANCH 9B CARR RD (DSB9B)
00 SITE GENERAL
GEOTECHNICAL INVESTIGATIONS – TEMP

CAD FILE DSCIN003-DEL-SKT-C-G-00086.DWG
REF No.
ORIGINAL SCALE A1
1:400
SKETCH No.
DSCIN003-DEL-SKT-C-G-00086
ISSUE
A

Appendix B: Tonkin & Taylor machine borehole

Tonkin+Taylor

BOREHOLE LOG

BOREHOLE No.:
BH01
SHEET: 1 OF 1

DRILLED BY: Lei and Craig
LOGGED BY: ANZH
CHECKED: TRMC
START DATE: 25/02/2021
FINISH DATE: 25/02/2021
CONTRACTOR: McMillan Drilling

PROJECT: Keith Hay Park CC9 Consenting
JOB No.: 1015172.1400
LOCATION: Keith Hay Park

CO-ORDINATES: (NZTM2000) 5912320.00 mN 1755342.00 mE
DIRECTION:
ANGLE FROM HORIZ.: -90°

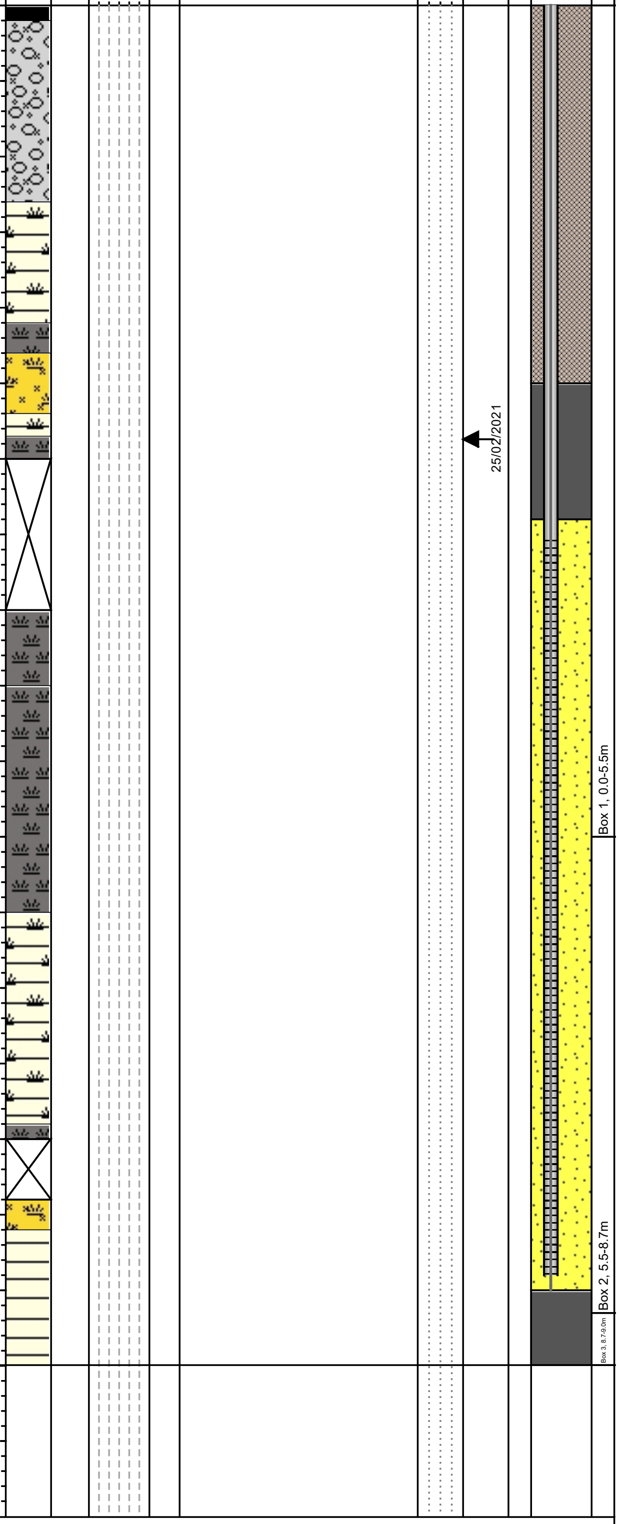
R.L. GROUND: 57.80m
R.L. COLLAR: 57.80m
DATUM: NZVD2016
SURVEY: GIS\Web map viewer

GEOLOGICAL UNIT	DESCRIPTION OF CORE SOIL: Classification, colour, consistency / density, moisture, plasticity ROCK: Weathering, colour, fabric, name, strength, cementation
	Vacuum excavation.
	GRAVEL, minor silt; grey brown. Dense, moist, gap graded; gravel, fine to coarse, subangular, unweathered.
Tauranga Group	Organic CLAY, some silt; dark brownish black. Soft, wet, high plasticity; Organics: fibrous wood. *1.90m:* Rootlets.
	PEAT, trace silt; dark brownish black. Fibrous, moist, non-plastic. Organics: fibrous wood.
	Organic SILT, some clay; dark brownish black. Soft, moist, low plasticity; Organics: fibrous wood.
	Organic CLAY, trace silt; brown. Soft, moist, high plasticity; Organics: fibrous wood.
	PEAT, trace silt; dark brownish black. Fibrous, moist, non-plastic. Grey inclusions. Organics: fibrous wood.
	Core loss; soft core fell from barrel.
	PEAT; dark brownish black. Fibrous, moist, non-plastic. Organics: fibrous wood.
	PEAT, some clay; dark brownish black. Soft, wet, low plasticity. Organics: fibrous wood.
	Organic CLAY, some silt; brown. Soft, moist, low plasticity; Organics: fibrous wood.
	PEAT; black. Fibrous, moist, non-plastic. Organics: fibrous wood.
	Core loss; soft core fell from barrel.
	Organic SILT, some clay; dark brownish black. Soft, wet, low plasticity; Organics: fibrous wood.
	CLAY, trace peat (fibrous) and silt; brownish grey. Soft to firm, moist, high plasticity; Organics: fibrous wood.
	9m: Target depth

Rock Weathering: UW SW MW HW CW
Rock Strength: ES VS S MS W VW EW

Sampling Method	Core Recovery (%)	Testing
HVAC	0	
HQTT	100	● 8/0 kPa
HQTT	33	
HQTT	100	● 8/0 kPa
HQTT	100	● 47/0 kPa
HQTT	73	● 28/12 kPa

RL (m)	Depth (m)
57	1
56	2
55	3
54	4
53	5
52	6
51	7
50	8
49	9
48	



Core Box No:
Box 1, 0.0-5.5m
Box 2, 5.5-8.7m
Box 3, 8.7-9.0m

COMMENTS:

Hole Depth
9m

Scale 1:50

Rev.: A

CORE PHOTOS

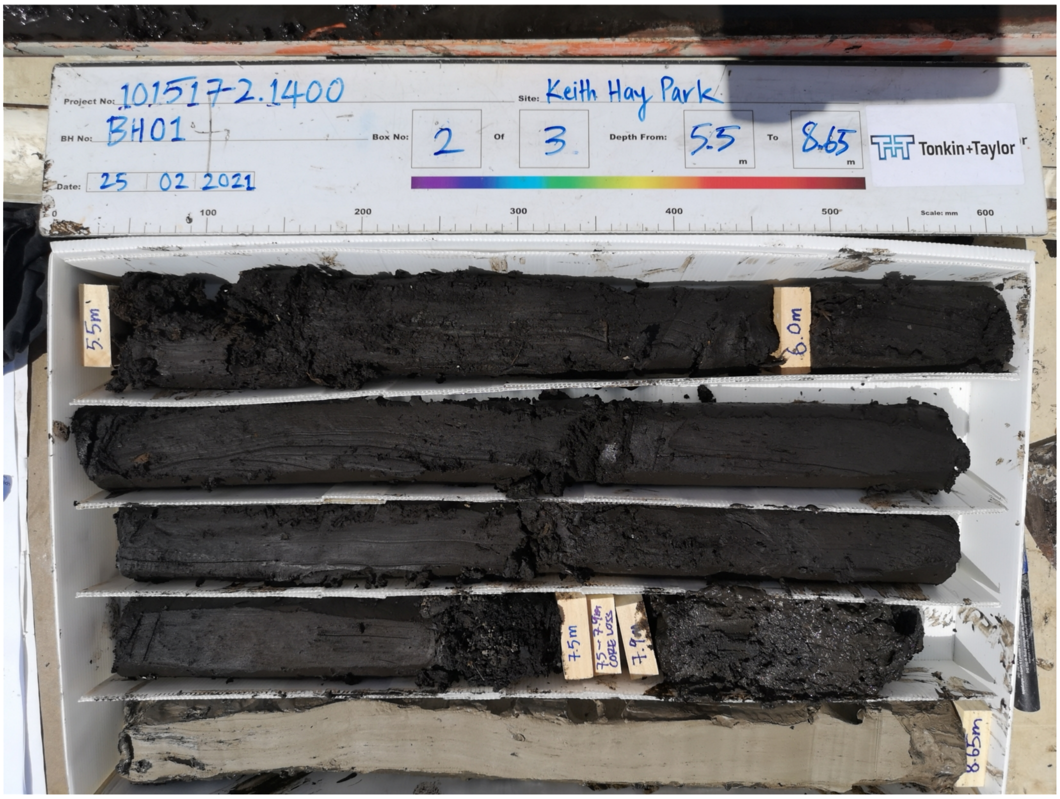
BOREHOLE No.: **BH01**

Hole Location: Keith Hay Park

SHEET: 1 OF 2

PROJECT: Keith Hay Park CC9 Consenting	LOCATION:	JOB No.: 1015172.1400
CO-ORDINATES: (NZTM2000) 5912320.00 mN 1755342.00 mE	DRILL TYPE: Massenza MM3 HQ	HOLE STARTED: 25/02/2021
		HOLE FINISHED: 25/02/2021
R.L.: 57.80m	DRILL METHOD: RC	DRILLED BY: McMillan Drilling
DATUM: NZVD2016		LOGGED BY: ANZH CHECKED: TRMC

0.00-5.50m



5.50-8.65m

CORE PHOTOS

BOREHOLE No.: **BH01**

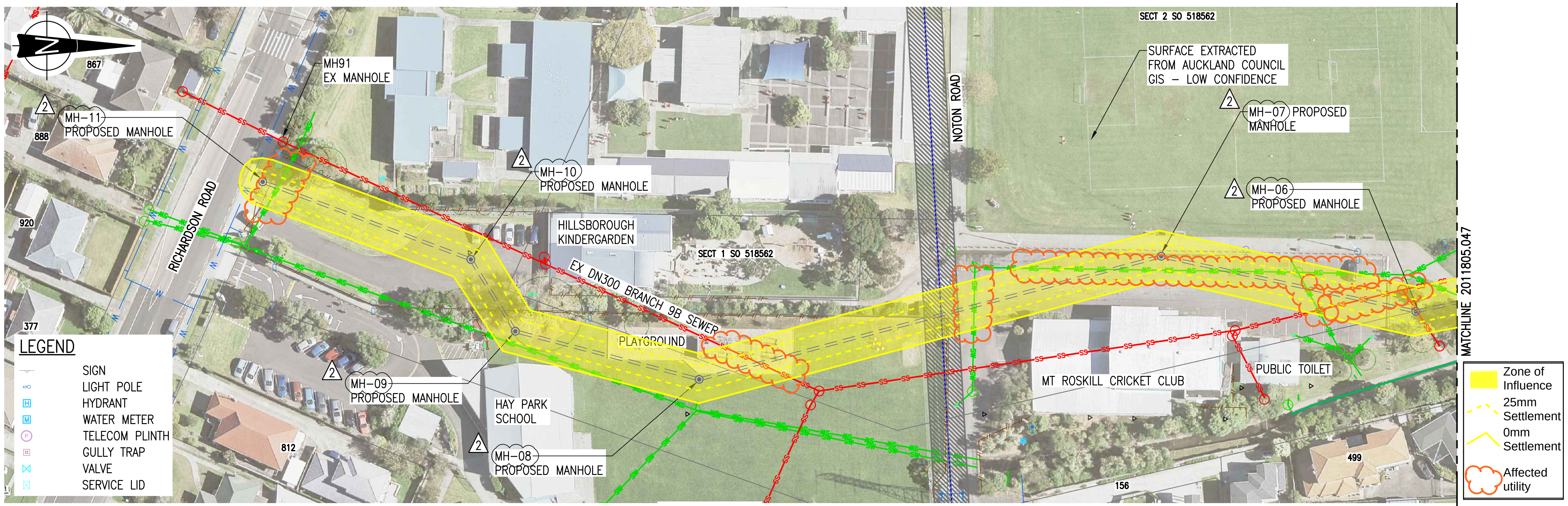
Hole Location: Keith Hay Park

SHEET: 2 OF 2

PROJECT: Keith Hay Park CC9 Consenting	LOCATION:	JOB No.: 1015172.1400
CO-ORDINATES: (NZTM2000) 5912320.00 mN 1755342.00 mE R.L.: 57.80m DATUM: NZVD2016	DRILL TYPE: Massenza MM3 HQ DRILL METHOD: RC	HOLE STARTED: 25/02/2021 HOLE FINISHED: 25/02/2021 DRILLED BY: McMillan Drilling LOGGED BY: ANZH CHECKED: TRMC

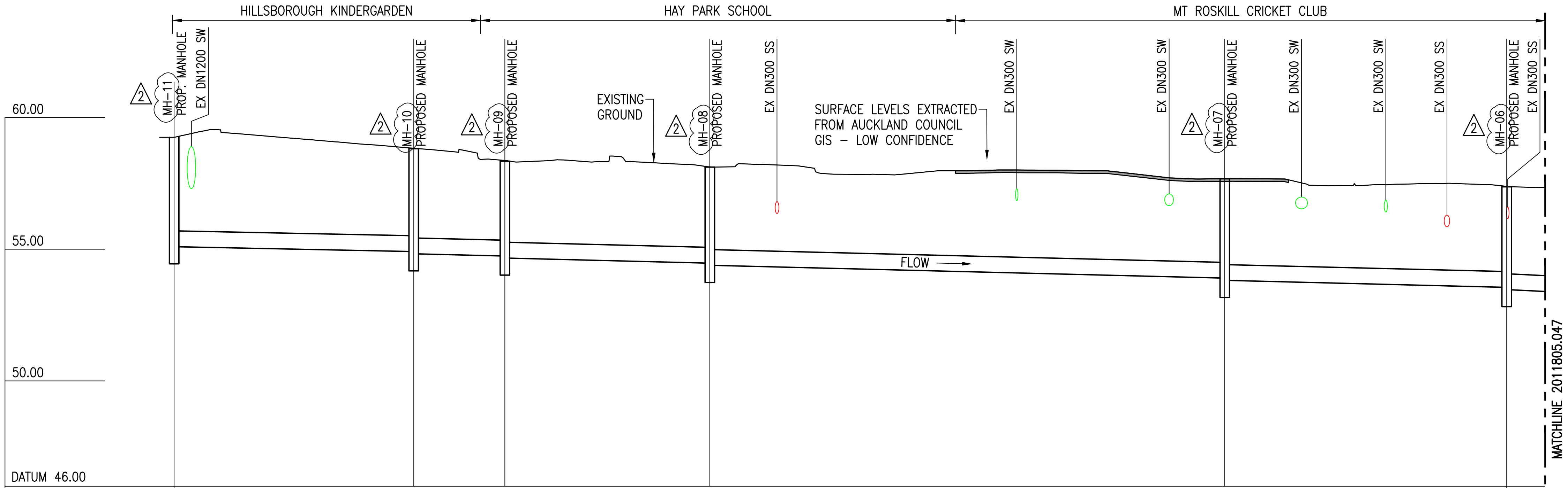
8.65-9.00m

Appendix C: Radius of Influence plans



PLAN

SCALE 1:500 (A1)



PIPE DIAMETER AND GRADE	600 ID (1:200) PIPE					
EXISTING GROUND LEVELS (mRL)	59.21	58.83	58.37	58.13	57.67	57.38
PROPOSED INVERT LEVELS (mRL)	55.09	54.91 54.83	54.74 54.66	54.47 54.39	53.90 53.82	53.55 53.47
DEPTH TO INVERT (m)	4.12	3.92 4.00	3.63 3.71	3.66 3.74	3.77 3.85	3.83 3.91
CHAINAGE (m)	100.00	145.43	162.71	201.57	299.21	352.67

LONGITUDINAL SECTION

SCALE 1:100 V 1:500 H (A1)

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
2. LOCATION OF EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GIS AND UTILITIES PLANS AND ARE INDICATIVE. CONTRACTOR IS RESPONSIBLE FOR ASSESSING DIAL B 4 U DIG INFORMATION PRIOR TO CONSTRUCTION. PHYSICAL LOCATION OF AFFECTED SERVICES WILL BE REQUIRED PRIOR TO CONSTRUCTION. ALL AFFECTED SERVICES SHALL BE PROTECTED DURING CONSTRUCTION.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN OF PIPE STRUCTURE CLASS AND PRESSURE RATING TO BOTH LONG-TERM PERMANENT-CASE AND TEMPORARY LOADS.

LEGEND

- PROPOSED MAIN TUNNEL
- PROPOSED LINK SEWER
- FUTURE CSO COLLECTOR SEWER AND MANHOLE
- PROPOSED SEWERAGE
- PROPOSED STORMWATER
- PROPOSED POWER/CONTROL DUCT
- EXISTING STORMWATER (SW)
- EXISTING STORMWATER STREAM
- EXISTING NETWORK WASTEWATER (SS)
- EXISTING TRANSMISSION WASTEWATER (SS)
- EXISTING WATERMAIN (W)
- LV POWER CABLE (LV)
- HV POWER CABLE (HV)
- MV POWER CABLE (MV)
- TRANSPOWER LINE
- DESIGNATION BOUNDARY
- PROPOSED ALL WEATHER TRAFFICABLE ACCESS
- PROPOSED AIR DUCT
- CADASTRAL BOUNDARY
- OPEN WATER CHANNEL
- FENCE
- SURVEY MARK
- POWER POLE (PP)
- BOLLARD
- GATE
- CESSPIT SINGLE
- MANHOLE
- STORMWATER PIPE INVERT
- TREE TRUNK & APPROXIMATE DRIP LINE

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

INFORMATION ISSUE

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

ISSUE	DATE	AMENDMENT	BY	APPD.
2	08.01.21	CC9 - CONCEPT DESIGN ISSUE FOR INFORMATION	SS	DJK
1	27.11.20	CC9 - CONCEPT DESIGN ISSUE FOR REVIEW	SS	DJK

	BY	DATE
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DES. CHECKED	DK	10.20
DRAWN	SS	10.20
DWG. CHECKED	PMF	10.20
PROJECT LEADER	EB	10.20
INFRAST'R APP'D	SG	10.20

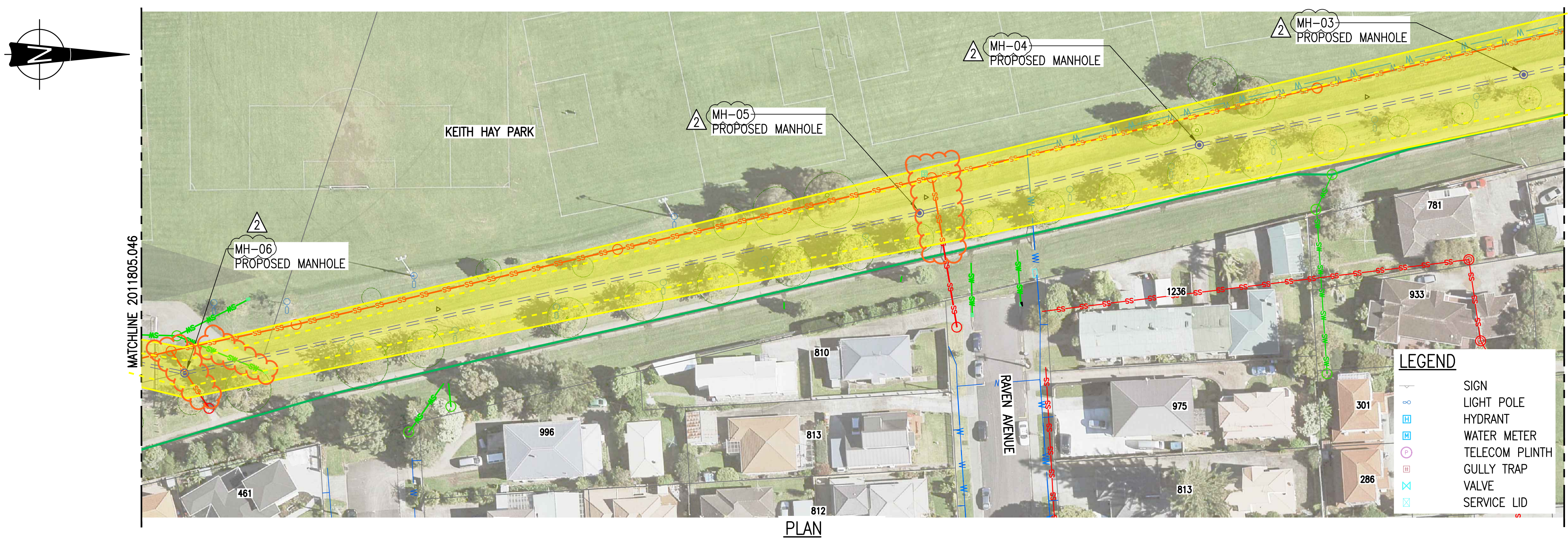
OPERATIONS

INFRASTRUCTURE

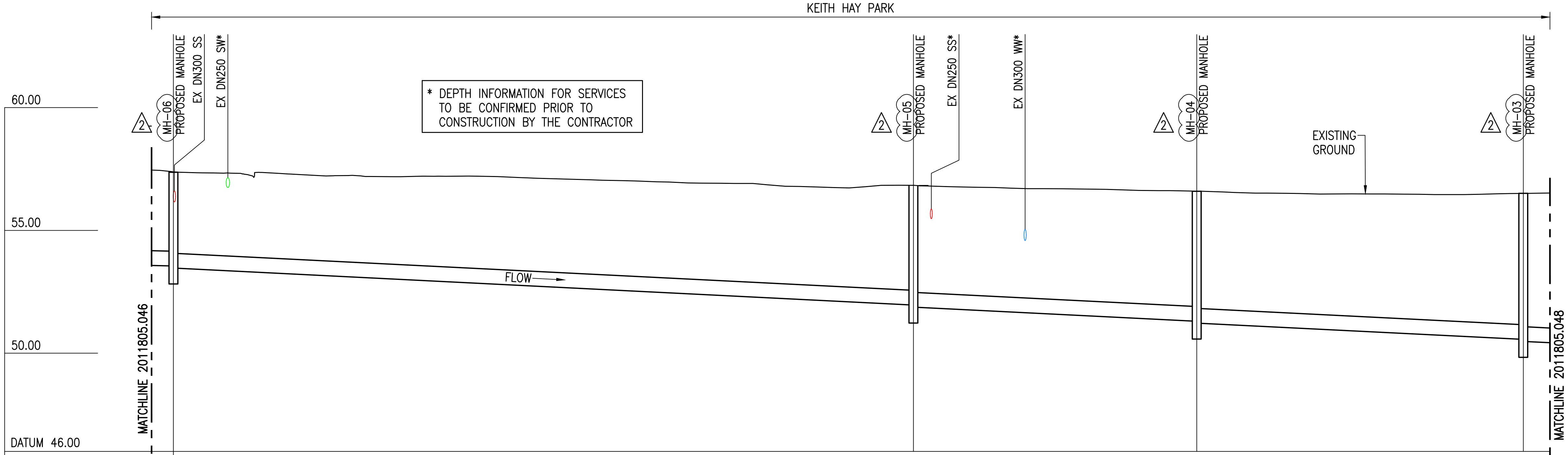
Watercare

KEITH HAY PARK - BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION - CC9 - SHEET 1 OF 3

CAD FILE 2011805.046
DATE 08.01.21
ORIGINAL SCALE A1 AS SHOWN
CONTRACT No. 6661
REF. No. CI-CIVIL
ISSUE 2
DWG. No. 2011805 .046



PLAN
SCALE 1:500 (A1)



* DEPTH INFORMATION FOR SERVICES TO BE CONFIRMED PRIOR TO CONSTRUCTION BY THE CONTRACTOR

DATUM 46.00

PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS			
EXISTING GROUND LEVELS (mRL)	57.38	56.83	56.60	56.51
PROPOSED INVERT LEVELS (mRL)	53.55 53.47	51.96 51.88	51.30 51.22	50.56 50.48
DEPTH TO INVERT (m)	3.83 3.91	4.87 4.95	5.30 5.38	5.95 6.03
CHAINAGE (m)	352.67	503.32	560.99	627.47

LONGITUDINAL SECTION
SCALE 1:100 V 1:500 H (A1)

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
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3. CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN OF PIPE STRUCTURE CLASS AND PRESSURE RATING TO BOTH LONG-TERM PERMANENT-CASE AND TEMPORARY LOADS.

LEGEND

- PROPOSED MAIN TUNNEL
- PROPOSED LINK SEWER
- FUTURE CSO COLLECTOR SEWER AND MANHOLE
- PROPOSED SEWERAGE
- PROPOSED STORMWATER
- PROPOSED POWER/CONTROL DUCT
- SW EXISTING STORMWATER
- EXISTING STORMWATER STREAM
- SS EXISTING NETWORK WASTEWATER
- SS SS SS EXISTING TRANSMISSION WASTEWATER
- W EXISTING WATERMAIN
- LV LV POWER CABLE
- HV HV POWER CABLE
- MV MV POWER CABLE
- TRANSPOWER LINE
- DESIGNATION BOUNDARY
- PROPOSED ALL WEATHER TRAFFICABLE ACCESS
- PROPOSED AIR DUCT
- CADASTRAL BOUNDARY
- OPEN WATER CHANNEL
- FENCE
- SURVEY MARK
- PP POWER POLE
- BOLLARD
- GATE
- CESSPIT SINGLE
- MANHOLE
- STORMWATER PIPE INVERT
- TREE TRUNK & APPROXIMATE DRIP LINE

- 🟨 Zone of Influence
- 25mm Settlement
- 0mm Settlement
- Affected utility

INFORMATION ISSUE

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

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PROJECT LEADER	EB	10.20
INFRAST'R APP'D	SG	10.20

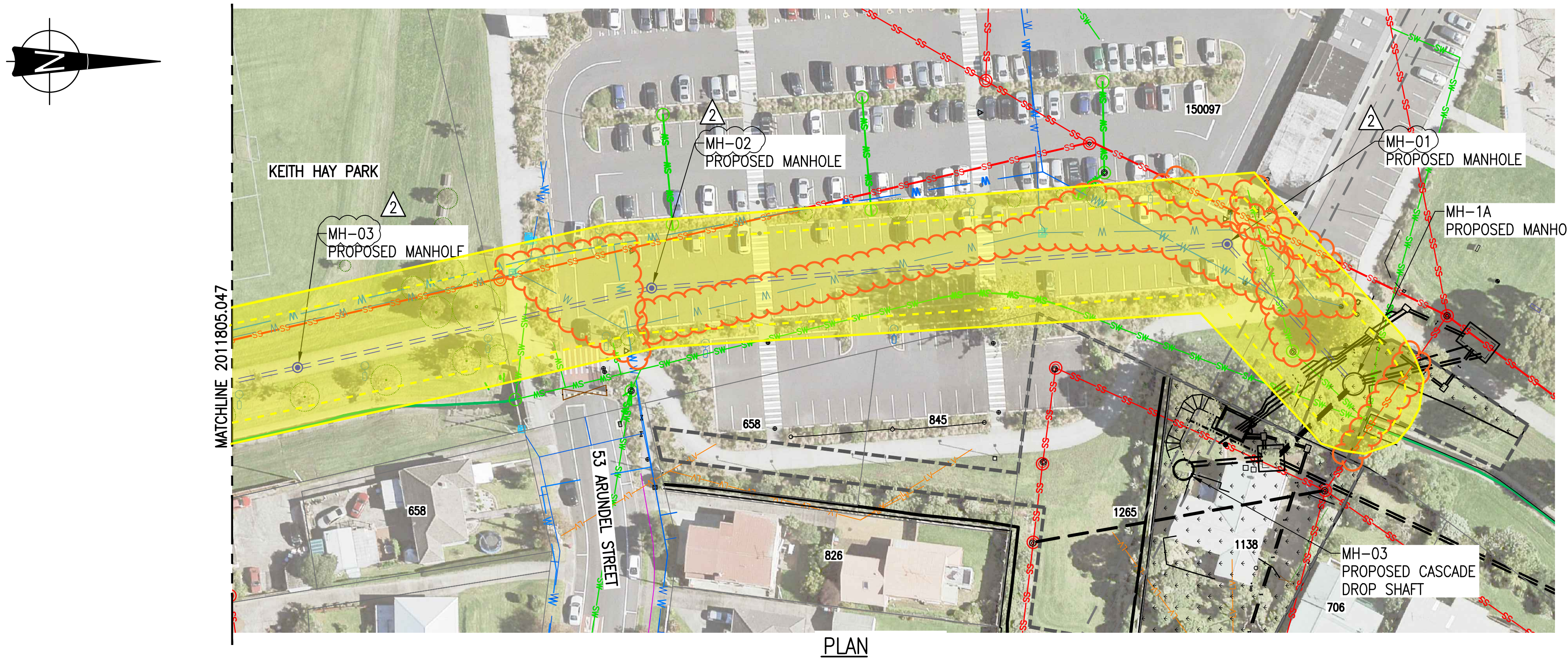
OPERATIONS

INFRASTRUCTURE

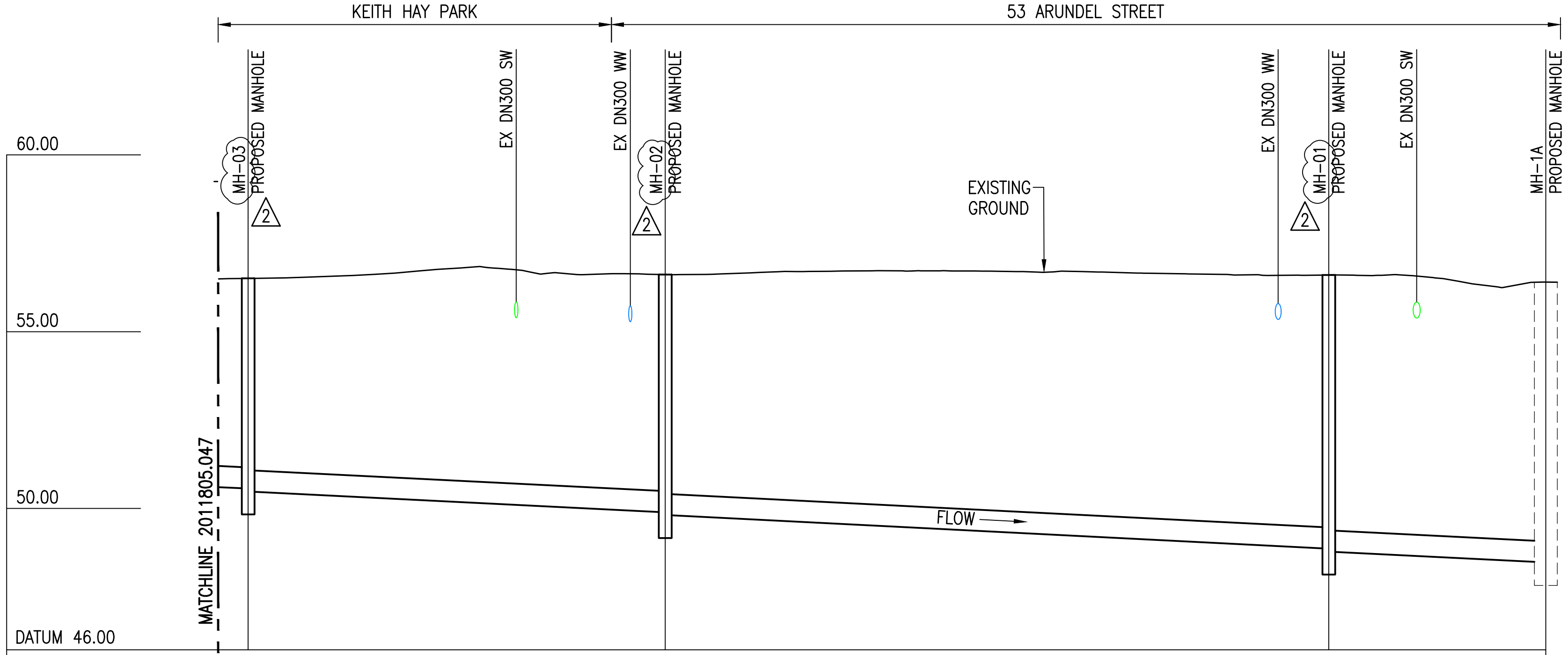
Watercare

KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CC9 – SHEET 2 OF 3

CAD FILE 2011805.047
DATE 08.01.21
ORIGINAL SCALE A1 AS SHOWN
CONTRACT No. 6661
REF. No. CI–CIVIL
ISSUE 2
DWG. No. 2011805 .047



PLAN
SCALE 1:500 (A1)



PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS			
EXISTING GROUND LEVELS (mRL)	56.51	56.61	56.60	56.40
PROPOSED INVERT LEVELS (mRL)	50.56 50.48	49.89 49.81	48.86 48.78	48.47
DEPTH TO INVERT (m)	5.95 6.03	6.72 6.80	7.74 7.82	7.93
CHAINAGE (m)	627.47	686.42	780.18	810.85

LONGITUDINAL SECTION
SCALE 1:100 V 1:500 H (A1)

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

NOTES:

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LEGEND

PROPOSED MAIN TUNNEL
PROPOSED LINK SEWER
FUTURE CSO COLLECTOR SEWER AND MANHOLE
PROPOSED SEWERAGE
PROPOSED STORMWATER
PROPOSED POWER/CONTROL DUCT
SW — EXISTING STORMWATER
EXISTING STORMWATER STREAM
SS — EXISTING NETWORK WASTEWATER
SS — EXISTING TRANSMISSION WASTEWATER
W — EXISTING WATERMAIN
LV — LV POWER CABLE
HV — HV POWER CABLE
MV — MV POWER CABLE
TRANSPOWER LINE
DESIGNATION BOUNDARY
PROPOSED ALL WEATHER TRAFFICABLE ACCESS
PROPOSED AIR DUCT
CADASTRAL BOUNDARY
OPEN WATER CHANNEL
FENCE

LEGEND

SIGN
LIGHT POLE
H HYDRANT
M WATER METER
P TELECOM PLINTH
GULLY TRAP
VALVE
SERVICE LID
SURVEY MARK
PP POWER POLE
BOLLARD
GATE
CESSPIT SINGLE
MANHOLE
STORMWATER PIPE INVERT
TREE TRUNK & APPROXIMATE DRIP LINE

Zone of Influence
25mm Settlement
0mm Settlement
Affected utility

INFORMATION ISSUE

JACOBS AECOM McMILLEN JACOBS ASSOCIATES

Plot Date: Dec 19, 2020 - 12:05am C:\pw work\ssolanki\watercare\dms52389\2011805.048.dwg

ISSUE	DATE	AMENDMENT	BY	APPD.
2	08.01.21	CC9 – CONCEPT DESIGN ISSUE FOR INFORMATION	SS	DJK
1	27.11.20	CC9 – CONCEPT DESIGN ISSUE FOR REVIEW	SS	DJK

	BY	DATE
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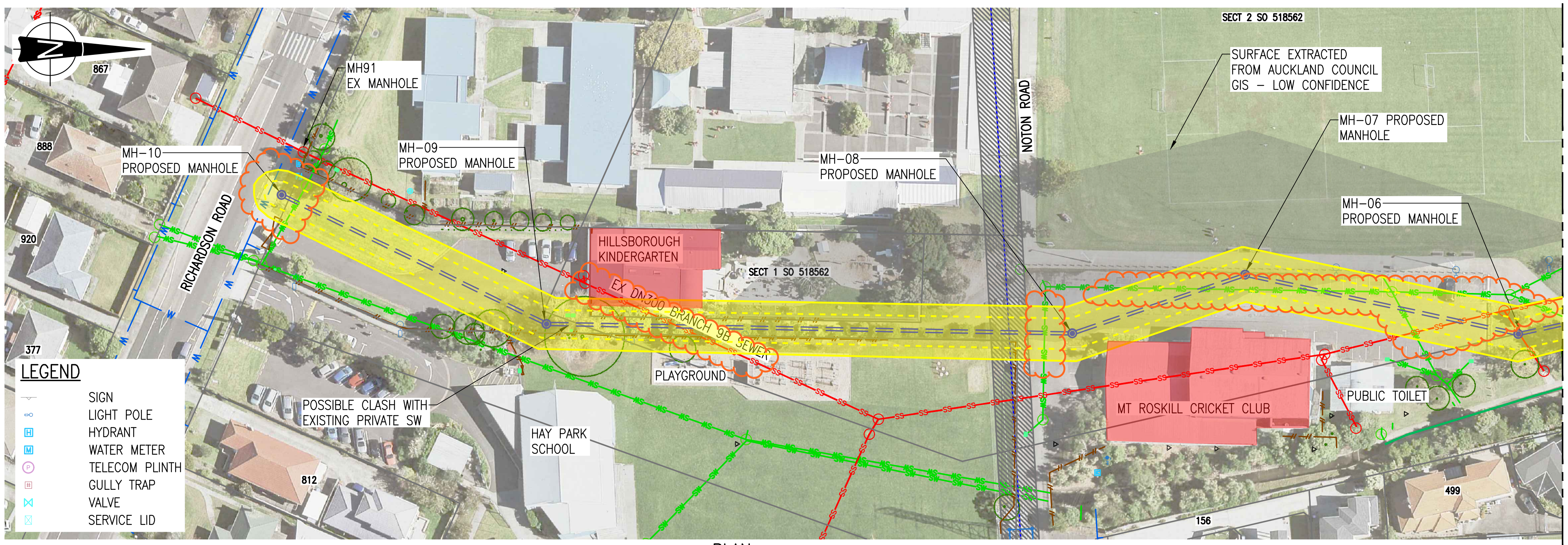
DES. CHECKED	DK	10.20
DRAWN	SS	10.20
DWG. CHECKED	PMF	10.20
PROJECT LEADER	EB	10.20
INFRAST'R APP'D	SG	10.20

OPERATIONS
INFRASTRUCTURE

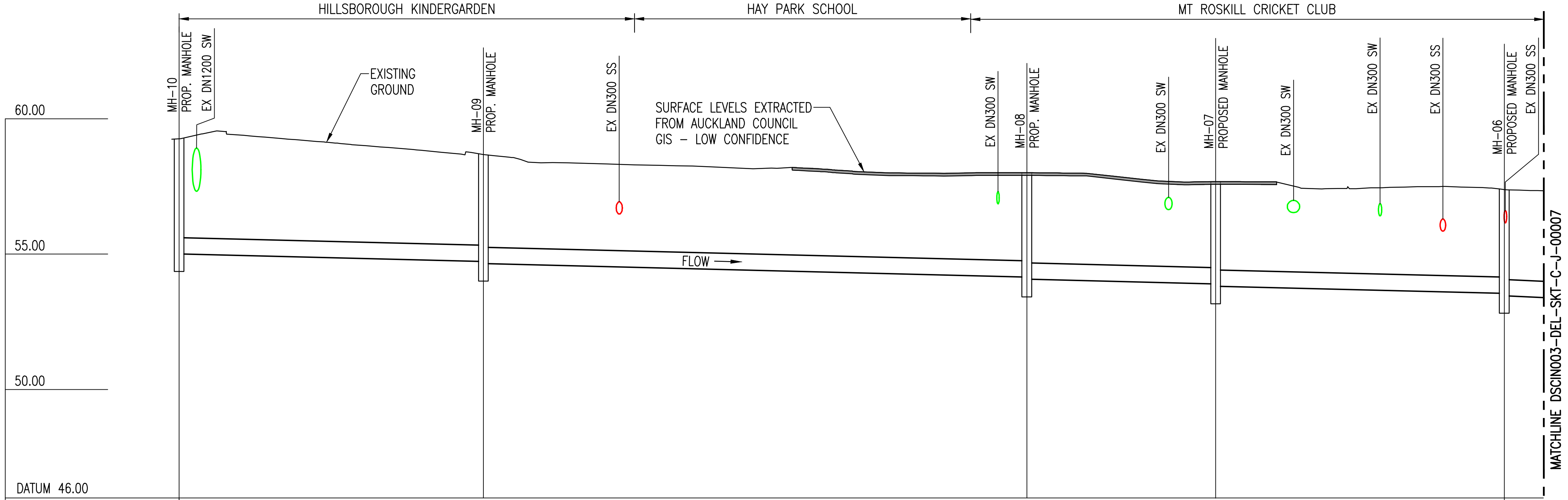
Watercare

KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CC9 – SHEET 3 OF 3

CAD FILE 2011805.048
DATE 08.01.21
ORIGINAL SCALE A1 AS SHOWN
CONTRACT No. 6661
REF. No. CI-CIVIL
ISSUE 2
DWG. No. 2011805 .048



PLAN
SCALE 1:500 (A1)



PIPE DIAMETER AND GRADE	600 ID (1:200) PIPE				
EXISTING GROUND LEVELS (mRL)	59.25	58.67	58.00	57.67	57.38
PROPOSED INVERT LEVELS (mRL)	55.01	54.73 54.65	54.15 54.07	53.90 53.82	53.55 53.47
DEPTH TO INVERT (m)	4.24	3.94 4.02	3.85 3.93	3.77 3.85	3.83 3.91
CHAINAGE (m)	100.00	156.18	256.47	291.33	344.61

LONGITUDINAL SECTION
SCALE 1:100 V 1:500 H (A1)

NOTES:

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LEGEND

- PROPOSED MAIN TUNNEL
- PROPOSED LINK SEWER
- FUTURE CSO COLLECTOR SEWER AND MANHOLE
- PROPOSED SEWERAGE
- PROPOSED STORMWATER
- PROPOSED POWER/CONTROL DUCT
- SW EXISTING STORMWATER
- EXISTING STORMWATER STREAM
- SS EXISTING NETWORK WASTEWATER
- SS SS SS EXISTING TRANSMISSION WASTEWATER
- W EXISTING WATERMAIN
- LV LV POWER CABLE
- HV HV POWER CABLE
- MV MV POWER CABLE
- TRANSPOWER LINE
- DESIGNATION BOUNDARY
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- PP POWER POLE
- BOLLARD
- GATE
- CESSPIT SINGLE
- MANHOLE
- STORMWATER PIPE INVERT
- TREE TRUNK & APPROXIMATE DRIP LINE

- Zone of Influence
- 25mm Settlement
- 0mm Settlement
- Affected utility
- Affected building

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m
SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

INFORMATION ISSUE

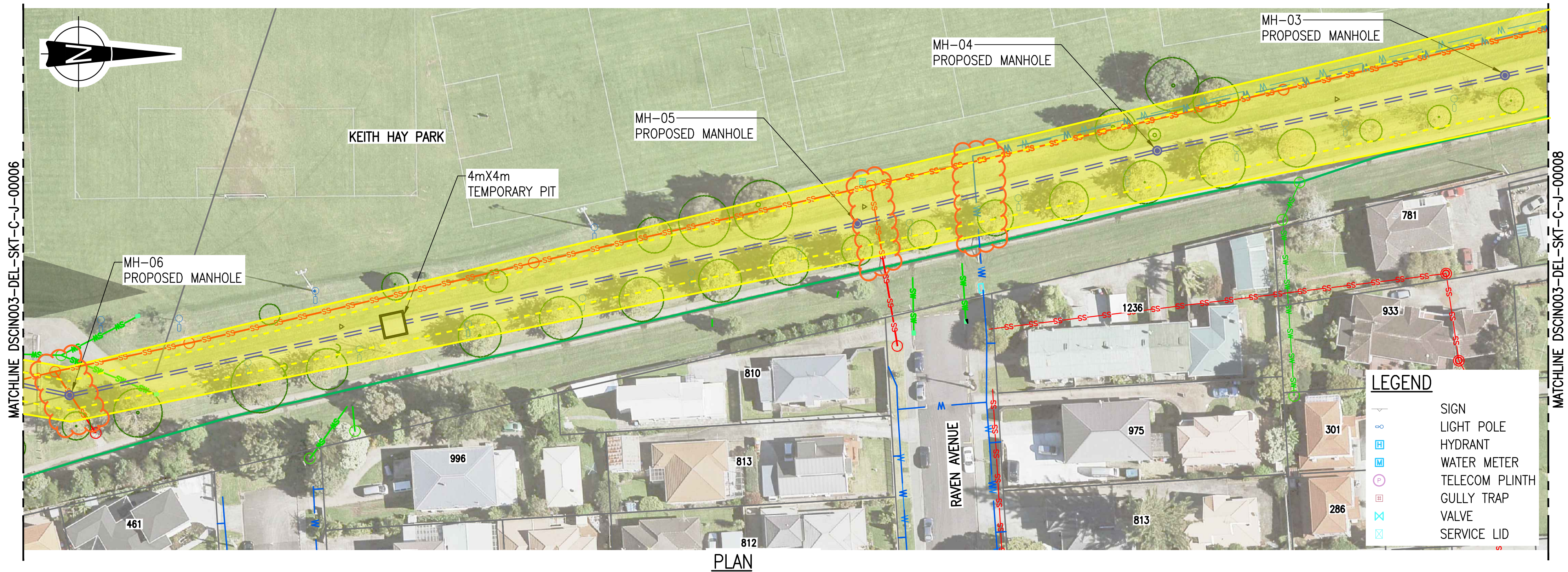
JACOBS AECOM McMILLEN JACOBS ASSOCIATES

ISSUE	DATE	AMENDMENT
A	03.02.21	IFI – CC9 CONSENT OPTION ISSUE

Watercare

KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CONSENT OPTION 2 – SHEET 1 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00006.DWG
REF No. CI-CIVIL
ORIGINAL SCALE A1 AS SHOWN
SKETCH No. DSCIN003-DEL-SKT-C-J-00006
ISSUE A



PLAN
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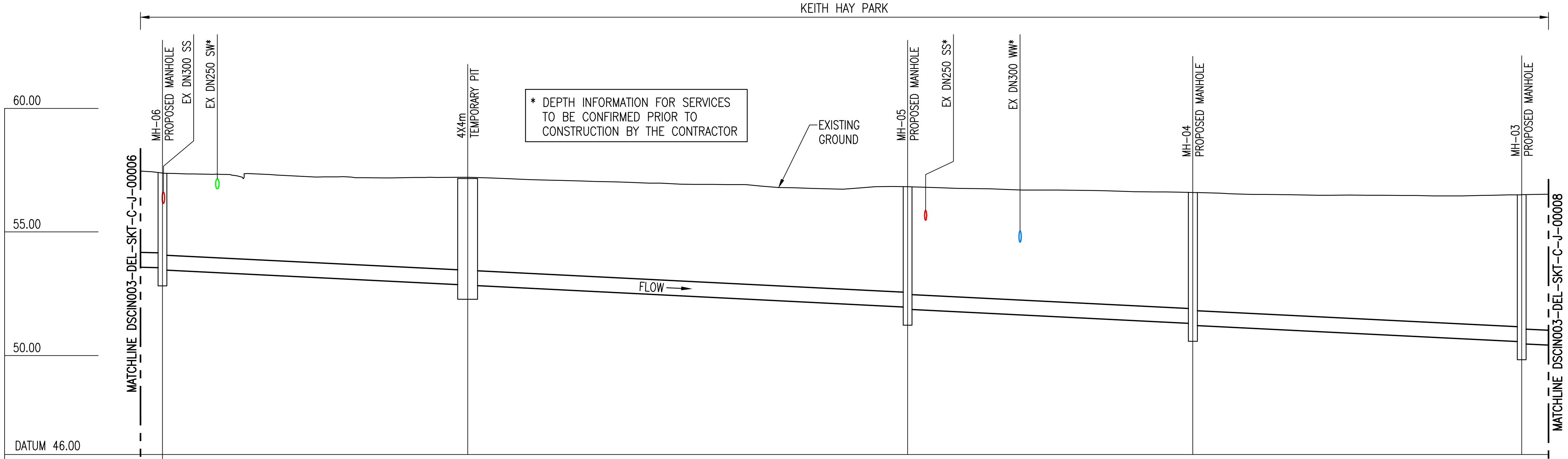

* DEPTH INFORMATION FOR SERVICES TO BE CONFIRMED PRIOR TO CONSTRUCTION BY THE CONTRACTOR

PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS				
EXISTING GROUND LEVELS (mRL)	57.38	56.80	56.83	56.60	56.51
PROPOSED INVERT LEVELS (mRL)	53.55 53.47	52.86 52.83	51.96 51.88	51.30 51.22	50.56 50.48
DEPTH TO INVERT (m)	3.83 3.91	3.94 3.97	4.87 4.95	5.30 5.38	5.95 6.03
CHAINAGE (m)	344.61	406.31	495.26	552.93	619.42

LONGITUDINAL SECTION
SCALE 1:100 V 1:500 H (A1)

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
2. LOCATION OF EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GIS AND UTILITIES PLANS AND ARE INDICATIVE. CONTRACTOR IS RESPONSIBLE FOR ASSESSING DIAL B 4 U DIG INFORMATION PRIOR TO CONSTRUCTION. PHYSICAL LOCATION OF AFFECTED SERVICES WILL BE REQUIRED PRIOR TO CONSTRUCTION. ALL AFFECTED SERVICES SHALL BE PROTECTED DURING CONSTRUCTION.
3. CONTRACTOR SHALL BE RESPONSIBLE FOR DESIGN OF PIPE STRUCTURE CLASS AND PRESSURE RATING TO BOTH LONG-TERM PERMANENT-CASE AND TEMPORARY LOADS.

LEGEND

- PROPOSED MAIN TUNNEL
- PROPOSED LINK SEWER
- FUTURE CSO COLLECTOR SEWER AND MANHOLE
- PROPOSED SEWERAGE
- PROPOSED STORMWATER
- PROPOSED POWER/CONTROL DUCT
- SW EXISTING STORMWATER
- EXISTING STORMWATER STREAM
- SS EXISTING NETWORK WASTEWATER
- SS SS SS EXISTING TRANSMISSION WASTEWATER
- W EXISTING WATERMAIN
- LV LV POWER CABLE
- HV HV POWER CABLE
- MV MV POWER CABLE
- TRANSPOWER LINE
- DESIGNATION BOUNDARY
- PROPOSED ALL WEATHER TRAFFICABLE ACCESS
- PROPOSED AIR DUCT
- CADASTRAL BOUNDARY
- OPEN WATER CHANNEL
- FENCE
- SURVEY MARK
- PP POWER POLE
- BOLLARD
- GATE
- CESSPIT SINGLE
- MANHOLE
- STORMWATER PIPE INVERT
- TREE TRUNK & APPROXIMATE DRIP LINE

- Zone of Influence
- 25mm Settlement
- 0mm Settlement
- Affected utility

INFORMATION ISSUE

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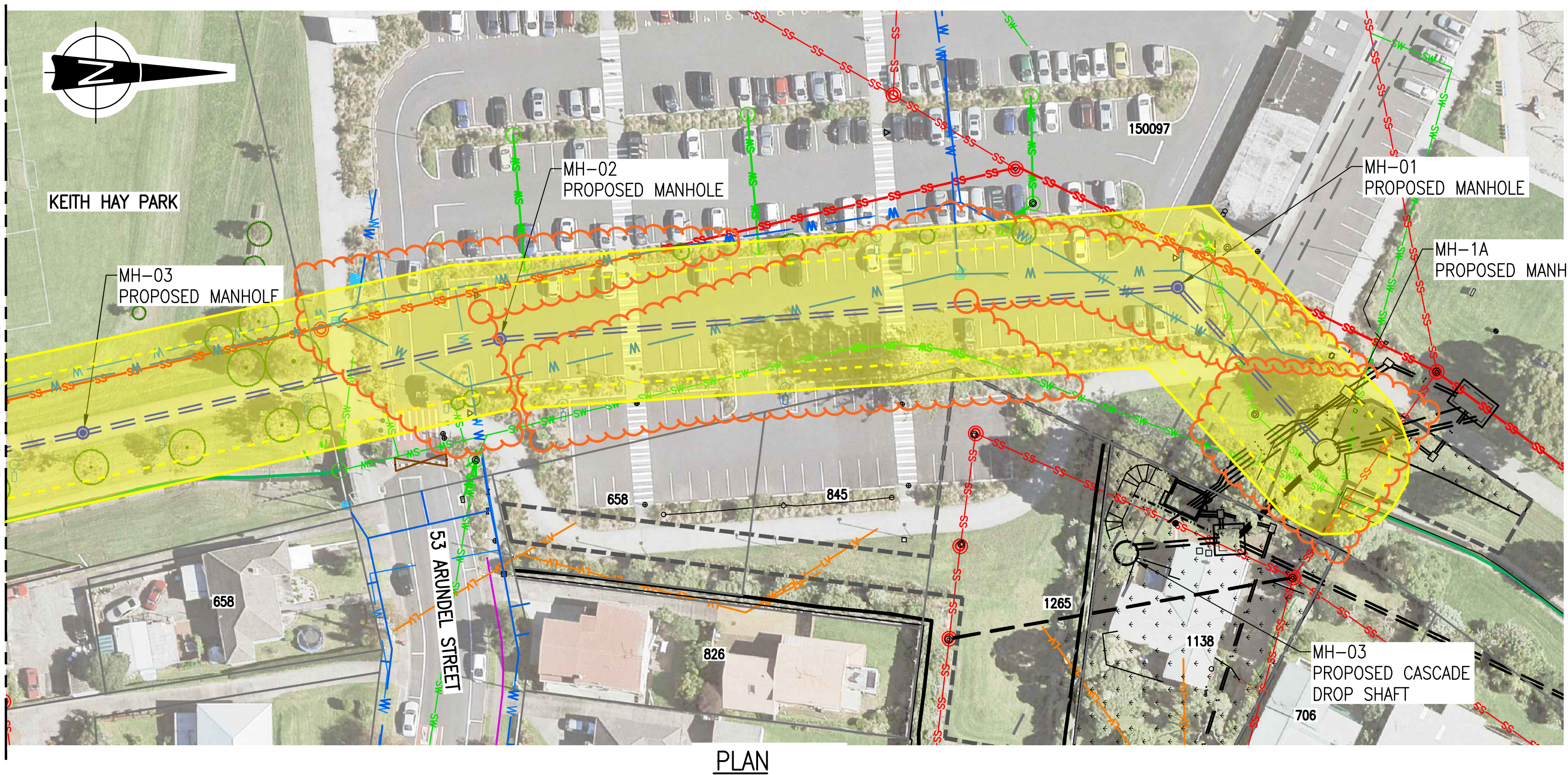
ISSUE	DATE	AMENDMENT
A	03.02.21	IFI – CC9 CONSENT OPTION ISSUE

Watercare

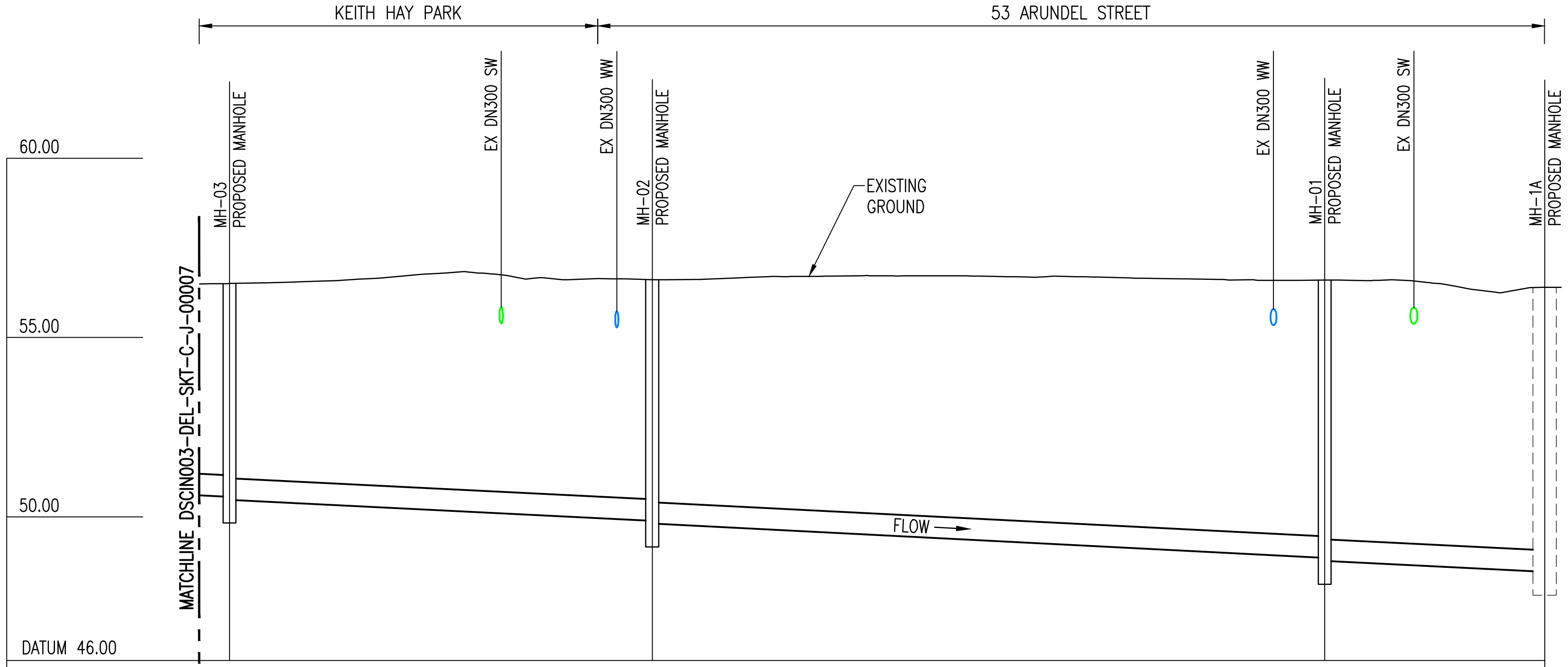
KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CONSENT OPTION 2 – SHEET 2 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00007.DWG
REF No. CI-CIVIL
ORIGINAL SCALE A1 AS SHOWN
SKETCH No. DSCIN003-DEL-SKT-C-J-00007
ISSUE A

Plot Date: Feb 03, 2021 – 11:05 c:\users\pfar\appdata\local\projectwise\watercare_ltd_projects\dms51944\ DSCIN003-DEL-SKT-C-J-00007.dwg



PLAN
SCALE 1:500 (A1)



	MH-03	MH-02	MH-01	MH-1A
PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS			
EXISTING GROUND LEVELS (mRL)	56.51	56.61	56.60	56.40
PROPOSED INVERT LEVELS (mRL)	50.56 50.48	49.89 49.81	48.86 48.78	48.47
DEPTH TO INVERT (m)	5.95 6.03	6.72 6.80	7.74 7.82	7.93
CHAINAGE (m)	619.42	678.36	772.12	802.79

LONGITUDINAL SECTION
SCALE 1:100 V 1:500 H (A1)

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
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LEGEND

═ ═ ═	PROPOSED MAIN TUNNEL
— — —	PROPOSED LINK SEWER
═●═	FUTURE CSO COLLECTOR SEWER AND MANHOLE
═ ═ ═	PROPOSED SEWERAGE
═ ═ ═	PROPOSED STORMWATER
═ : ═	PROPOSED POWER/CONTROL DUCT
— SW —	EXISTING STORMWATER
〜	EXISTING STORMWATER STREAM
— SS —	EXISTING NETWORK WASTEWATER
—SS—SS—SS—	EXISTING TRANSMISSION WASTEWATER
— W —	EXISTING WATERMAIN
— LV —	LV POWER CABLE
— HV —	HV POWER CABLE
— MV —	MV POWER CABLE
▨	TRANSPOWER LINE
■ ■ ■	DESIGNATION BOUNDARY
▨	PROPOSED ALL WEATHER TRAFFICABLE ACCESS
═ ═ ═	PROPOSED AIR DUCT
——	CADASTRAL BOUNDARY
——	OPEN WATER CHANNEL
—//—	FENCE
△	SURVEY MARK
● PP	POWER POLE
●	BOLLARD
⋈	GATE
▤	CESSPIT SINGLE
◎	MANHOLE
×	STORMWATER PIPE INVERT
⊙	TREE TRUNK & APPROXIMATE DRIP LINE

LEGEND

⌐	SIGN
∞	LIGHT POLE
⊞	HYDRANT
Ⓜ	WATER METER
Ⓣ	TELECOM PLINTH
⊞	GULLY TRAP
⋈	VALVE
⊠	SERVICE LID

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

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ISSUE	DATE	AMENDMENT
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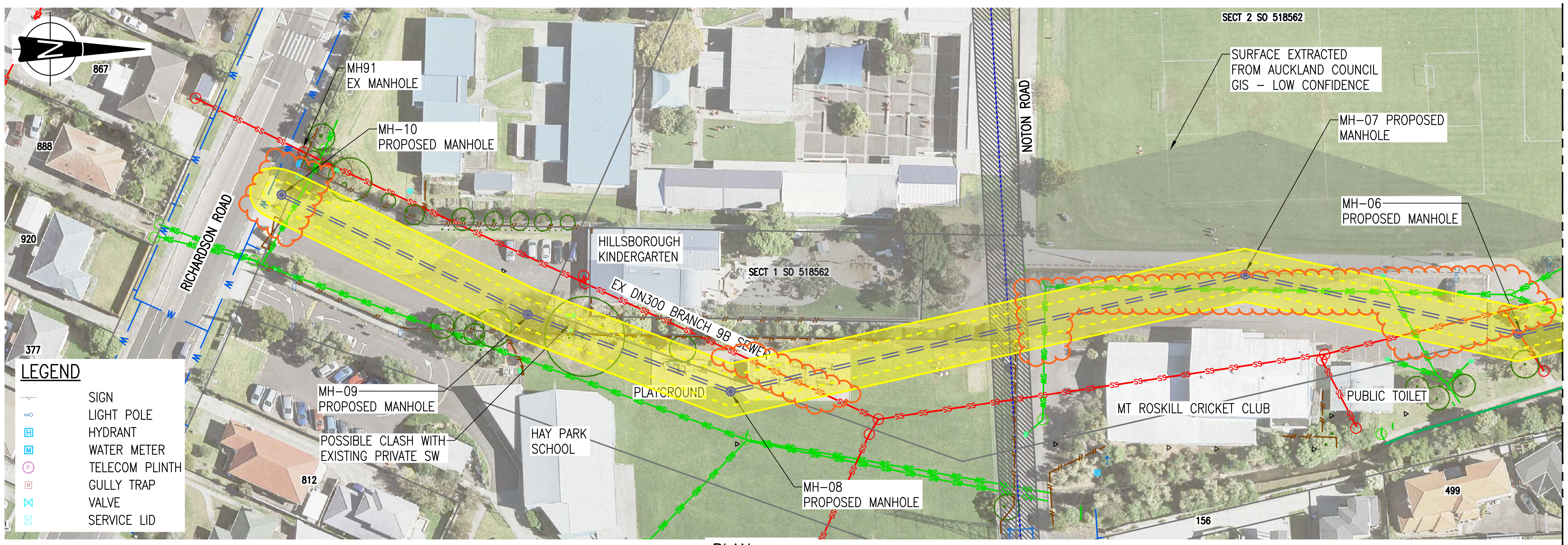
Watercare

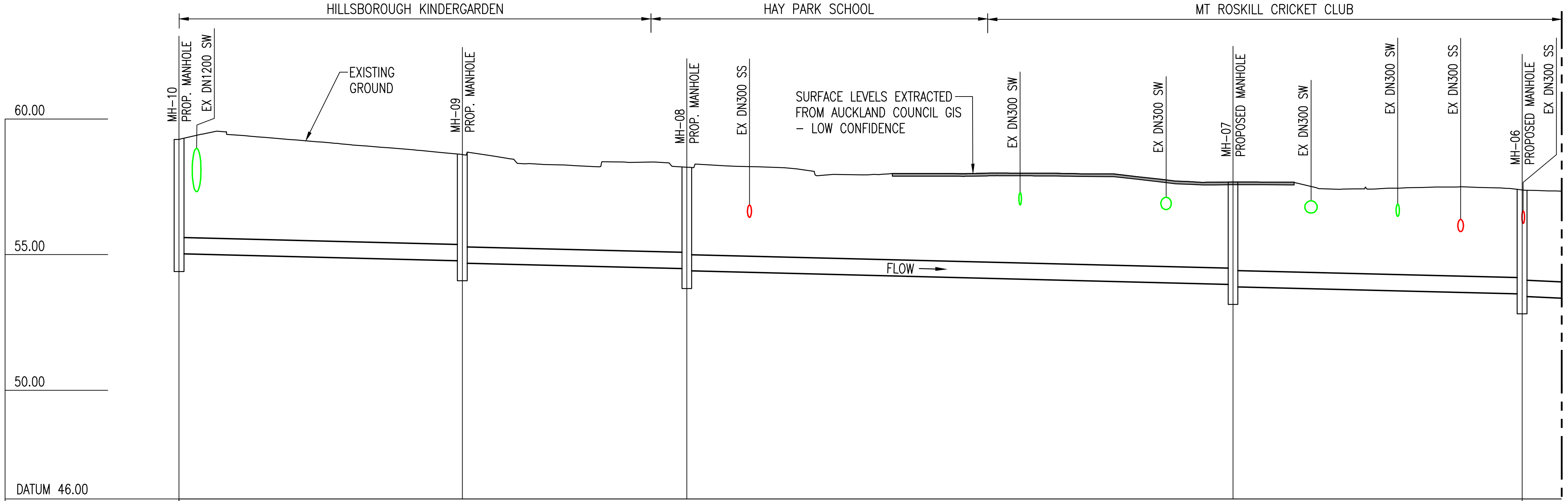
KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CONSENT OPTION 2 – SHEET 3 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00008.DWG
REF No. CI-CIVIL
ORIGINAL SCALE A1 AS SHOWN
SKETCH No. DSCIN003-DEL-SKT-C-J-00008
ISSUE A



PLAN

SCALE 1:500 (A1)



DATUM 46.00					
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EXISTING GROUND LEVELS (mRL)	59.25	58.69	58.22	57.67	57.38
PROPOSED INVERT LEVELS (mRL)	55.03	54.77 54.69	54.48 54.40	53.90 53.82	53.55 53.47
DEPTH TO INVERT (m)	4.22	3.92 4.00	3.74 3.82	3.77 3.85	3.83 3.91
CHAINAGE (m)	100.00	152.20	193.57	294.23	347.50

LONGITUDINAL SECTION

SCALE 1:100 V 1:500 H (A1)

NOTES:

1. CO-ORDINATES ARE IN NZTM AND LEVELS ARE TO AUCKLAND L&S 1946 DATUM.
2. LOCATION OF EXISTING SERVICES HAVE BEEN EXTRACTED FROM AUCKLAND COUNCIL GIS AND UTILITIES PLANS AND ARE INDICATIVE. CONTRACTOR IS RESPONSIBLE FOR ASSESSING DIAL B 4 U DIG INFORMATION PRIOR TO CONSTRUCTION. PHYSICAL LOCATION OF AFFECTED SERVICES WILL BE REQUIRED PRIOR TO CONSTRUCTION. ALL AFFECTED SERVICES SHALL BE PROTECTED DURING CONSTRUCTION.
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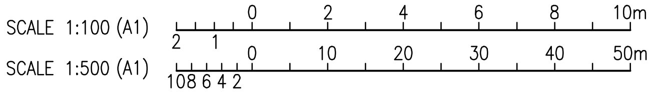
LEGEND

▬ ▬ ▬	PROPOSED MAIN TUNNEL
— — —	PROPOSED LINK SEWER
═◉═	FUTURE CSO COLLECTOR SEWER AND MANHOLE
▬ ▬ ▬	PROPOSED SEWERAGE
═ ═ ═	PROPOSED STORMWATER
═ : ═	PROPOSED POWER/CONTROL DUCT
— SW —	EXISTING STORMWATER
〰	EXISTING STORMWATER STREAM
— SS —	EXISTING NETWORK WASTEWATER
—SS—SS—SS—	EXISTING TRANSMISSION WASTEWATER
— W —	EXISTING WATERMAIN
— LV —	LV POWER CABLE
— HV —	HV POWER CABLE
— MV —	MV POWER CABLE
▨	TRANSPOWER LINE
■ ■ ■ ■	DESIGNATION BOUNDARY
▭	PROPOSED ALL WEATHER TRAFFICABLE ACCESS
═:═:═	PROPOSED AIR DUCT
——	CADASTRAL BOUNDARY
——	OPEN WATER CHANNEL
–//– //– //–	FENCE
△	SURVEY MARK
PP	POWER POLE
●	BOLLARD
⋈	GATE
▤	CESSPIT SINGLE
◎	MANHOLE
×	STORMWATER PIPE INVERT
◎	TREE TRUNK & APPROXIMATE DRIP LINE

🟨	Zone of Influence
- - -	25mm Settlement
——	0mm Settlement
☁	Affected utility



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KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES

PLAN AND LONGITUDINAL SECTION – CONSENT OPTION 3 – SHEET 1 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00011.DWG

REF No. CI-CIVIL

ORIGINAL SCALE A1 AS SHOWN

SKETCH No. DSCIN003-DEL-SKT-C-J-00011

ISSUE A

Plot Date: Feb 03, 2021 – 11:54am c:\users\pfar\appdata\local\projectwise\watercare_ltd_projects\dms51944\ DSCIN003-DEL-SKT-C-J-00011.dwg

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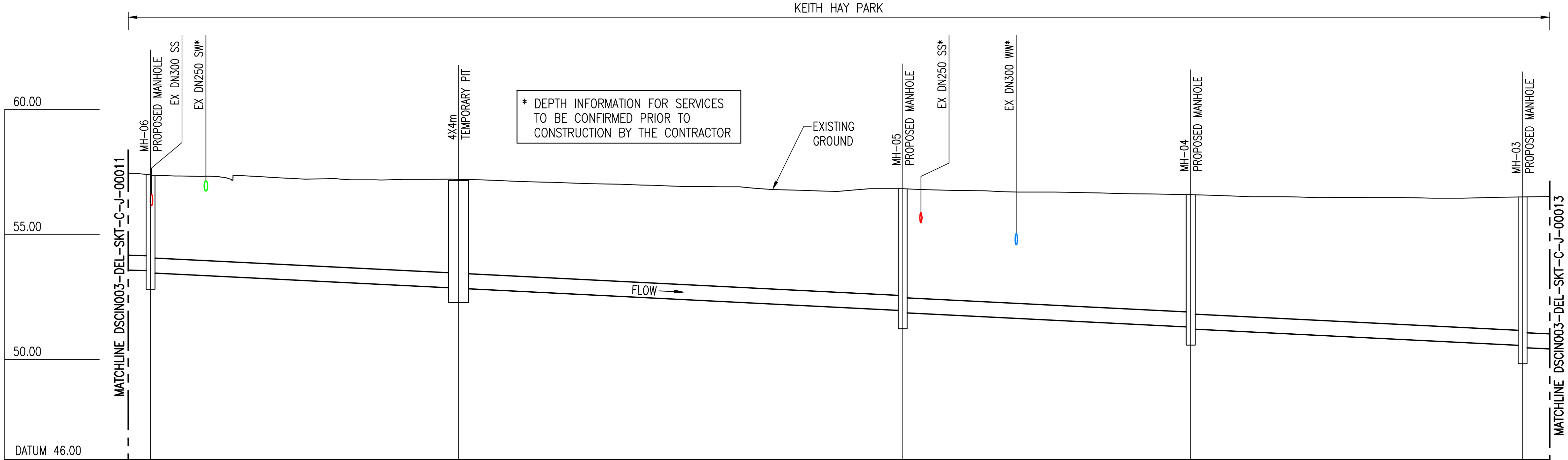

PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS				
EXISTING GROUND LEVELS (mRL)	57.38	56.80	56.83	56.60	56.51
PROPOSED INVERT LEVELS (mRL)	53.55 53.47	52.86 52.83	51.96 51.88	51.30 51.22	50.56 50.48
DEPTH TO INVERT (m)	3.83 3.91	3.94 3.97	4.87 4.95	5.30 5.38	5.95 6.03
CHAINAGE (m)	347.50	406.31	498.15	555.83	622.31

LONGITUDINAL SECTION
SCALE. 1:100 V 1:500 H (A1)

SCALE 1:100 (A1) 2 1 0 2 4 6 8 10m

SCALE 1:500 (A1) 10 8 6 4 2 0 10 20 30 40 50m

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- SW EXISTING STORMWATER
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- SS EXISTING NETWORK WASTEWATER
- SS SS SS EXISTING TRANSMISSION WASTEWATER
- W EXISTING WATERMAIN
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- Zone of Influence
- 25mm Settlement
- 0mm Settlement
- Affected utility

INFORMATION ISSUE

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82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION - CONSENT OPTION 3 - SHEET 2 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00012.DWG
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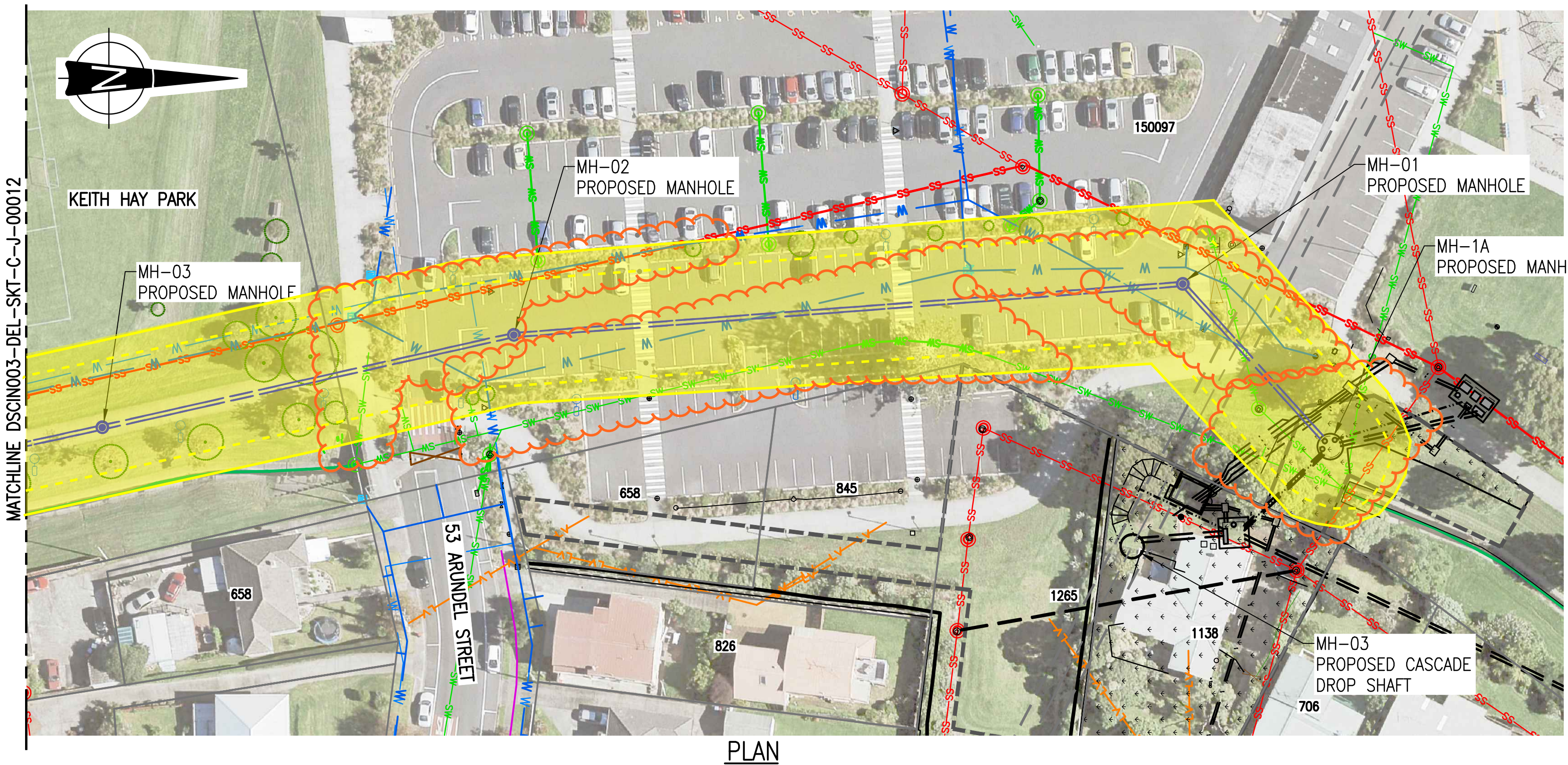
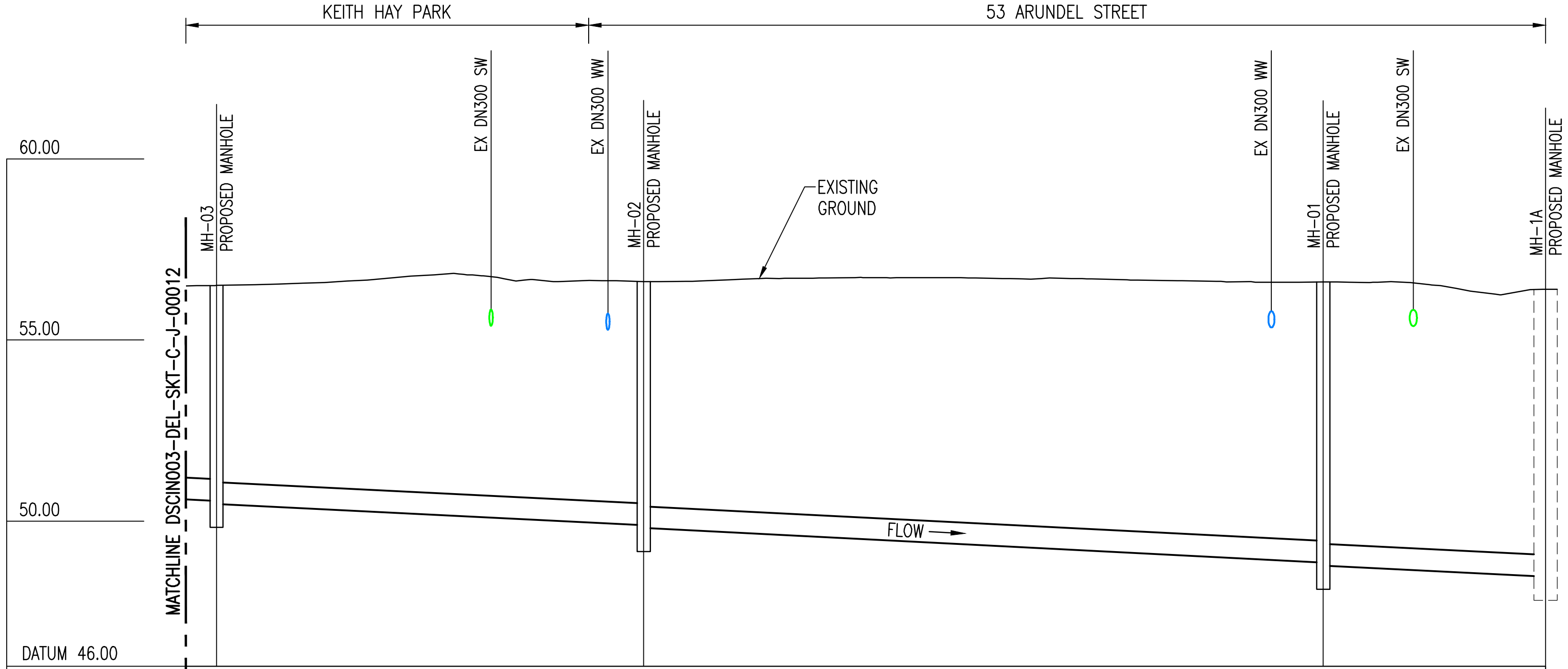
ISSUE A



PLAN
SCALE. 1:500 (A1)



DATUM 46.00				
PIPE DIAMETER AND GRADE	600 ID (1:100) TRENCHLESS			
EXISTING GROUND LEVELS (mRL)	56.51	56.61	56.60	56.40
PROPOSED INVERT LEVELS (mRL)	50.56 50.48	49.89 49.81	48.86 48.78	48.47
DEPTH TO INVERT (m)	5.95 6.03	6.72 6.80	7.74 7.82	7.93
CHAINAGE (m)	622.31	681.25	775.02	805.69

LONGITUDINAL SECTION
SCALE. 1:100 V 1:500 H (A1)

NOTES:

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- SS SS SS EXISTING TRANSMISSION WASTEWATER
- W EXISTING WATERMAIN
- LV LV POWER CABLE
- HV HV POWER CABLE
- MV MV POWER CABLE
- TRANSPOWER LINE
- DESIGNATION BOUNDARY
- PROPOSED ALL WEATHER TRAFFICABLE ACCESS
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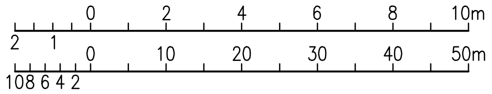
- 🟨 Zone of Influence
- 25mm Settlement
- 0mm Settlement
- Affected utility

LEGEND

- SIGN
- LIGHT POLE
- H HYDRANT
- M WATER METER
- T TELECOM PLINTH
- GULLY TRAP
- ⋈ VALVE
- SERVICE LID



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ISSUE	DATE	AMENDMENT
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Watercare

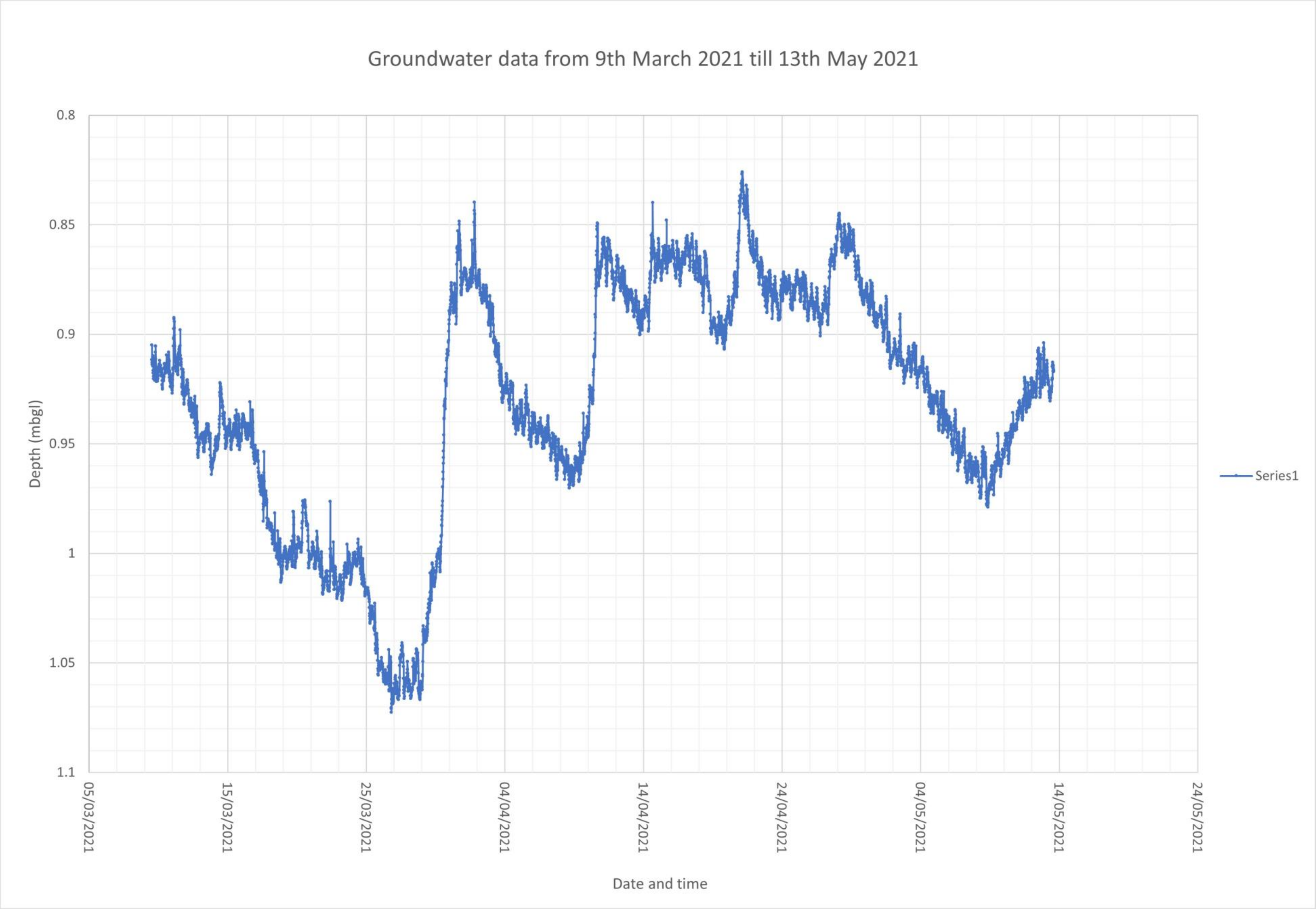
KEITH HAY PARK – BRANCH 9 MT. ROSKILL (DSB09)
82 GRAVITY SEWER INCLUDING MANHOLES
PLAN AND LONGITUDINAL SECTION – CONSENT OPTION 3 – SHEET 3 OF 3

CAD FILE DSCIN003-DEL-SKT-C-J-00013.DWG
REF No. CI-CIVIL
ORIGINAL SCALE A1 AS SHOWN
SKETCH No. DSCIN003-DEL-SKT-C-J-00013
ISSUE A

Plot Date: Feb 03, 2021 - 11:57am C:\users\pfar\appdata\local\projectwise\watercare__ltd__projects\dms51944\ DSCIN003-DEL-SKT-C-J-00013.dwg

Appendix D: Groundwater levels

- **Groundwater graph**


Groundwater data from 9th March 2021 till 13th May 2021
Depth (mbgl)
0.8
0.85
0.9
0.95
1
1.05
1.1
05/03/2021
15/03/2021
25/03/2021
04/04/2021
14/04/2021
24/04/2021
04/05/2021
14/05/2021
24/05/2021
Date and time
Series1

Appendix H: Archaeological Assessment

CENTRAL INTERCEPTOR –SEWER (CC9) IN KEITH HAY PARK, MT ROSKILL, AUCKLAND: ARCHAEOLOGICAL APPRAISAL

Prepared for Watercare Services Ltd

February 2021

By

Kim Tatton (MA Hons)

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Waiatarua, Auckland 0612
Telephone: (09) 8141946
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TABLE OF CONTENTS

Introduction 1
  Project Background 1
  Proposed Works 1
  Methodology 1
Historical Background 4
  Maori Settlement 4
  European Settlement 4
Archaeological Background 7
  Previous Archaeological Work 7
Historical Survey 10
  Information from Early Aerials 10
Field Assessment 12
  Field Survey Results 12
Discussion and Conclusions 15
  Summary of Results 15
  Maori Cultural Values 15
  Survey Limitations 15
  Archaeological Value and Significance 15
  Effects of the Proposal 16
  Resource Management Act 1991 Requirements 16
  Heritage New Zealand Pouhere Taonga Act 2014 Requirements 17
  Conclusions 17
Recommendations 19
Bibliography 20
Appendix 1: Site Record Forms 21

INTRODUCTION

Project Background

Watercare Services Ltd (Watercare) is the water and wastewater service provider for Auckland. Watercare is planning to construct a new sewer (CC9) to the Central Interceptor (CI) shaft site at Keith Hay Park in Mt Roskill (the Project area) (Figure 1 and Figure 2).

In 2011 and 2012 archaeological assessments were completed at Keith Hay Park as part of the main Central Interceptor works. The site was assessed to identify the potential effects on archaeology arising from the construction, operation and maintenance of the then proposed CI (Shakles et al. Dec 2011; Shakles et al. Aug 2012). The CC9 project is an additional proposed sewer which connects to the CI shaft at Keith Hay Park, which is currently under construction.

An archaeological appraisal was commissioned by Tonkin and Taylor Ltd on behalf of Watercare to establish whether the proposed work is likely to impact on archaeological and other historic heritage values. This report has been prepared as part of the required assessment of effects accompanying a resource consent application under the Resource Management Act 1991 (RMA) and to identify any requirements under the Heritage New Zealand Pouhere Taonga Act 2014 (HNZPTA). Recommendations are made in accordance with statutory requirements.

Proposed Works

The proposed works involve the installation of a sewer beneath Keith Hay Park in Mt Roskill. The CC9 sewer extends from the Keith Hay Park Central Interceptor (CI) shaft construction site located at the Cameron Leisure Pool carpark off Arundel Street, beneath Keith Hay Park and through Hay Park School and Hillsborough Kindergarten to a termination manhole at Richardson Road.

The total pipeline length is approximately 810 m with an external diameter of up to 1200 mm (ID 900 mm). The northern section of the CC9 route through Keith Hay Park will be trenchless (likely pipe-jacked or possibly via HDD methods). The remaining section of the CC9 route from the Eden Roskill Cricket Club to Richardson Road will potentially be trenched to a depth of 4-8 m but may also be installed via trenchless methods.

The CC9 pipeline will be located next to the existing Branch 9 trunk sewer alignment.

Methodology

The New Zealand Archaeological Association's (NZAA) site record database (ArchSite), Auckland Council's Cultural Heritage Inventory (CHI), Auckland Unitary Plan Operative in Part (AUP OP) schedules and the Heritage New Zealand Pouhere Taonga (Heritage NZ) New Zealand Heritage List/Rārangi Kōrero were searched to determine whether any archaeological or other historic heritage sites sites had been recorded on or in the immediate vicinity of the project area. Literature and archaeological reports relevant to the area were consulted (see Bibliography). Early survey plans and aerial photographs were checked for information relating to past use of the area.

A visual inspection of the property was conducted on 11 February 2021. The ground surface was examined for evidence of former occupation. Photographs were taken to record the area and its immediate surrounds. Archaeological sites beneath modern buildings and sealed surfaces in urban environments (as in much of the project area) can rarely be identified prior to being exposed in the course of redevelopment work, and the approach to archaeological assessment is therefore to identify historically recorded activities and assess the potential for archaeological evidence to have survived on the basis of later modifications to the site.

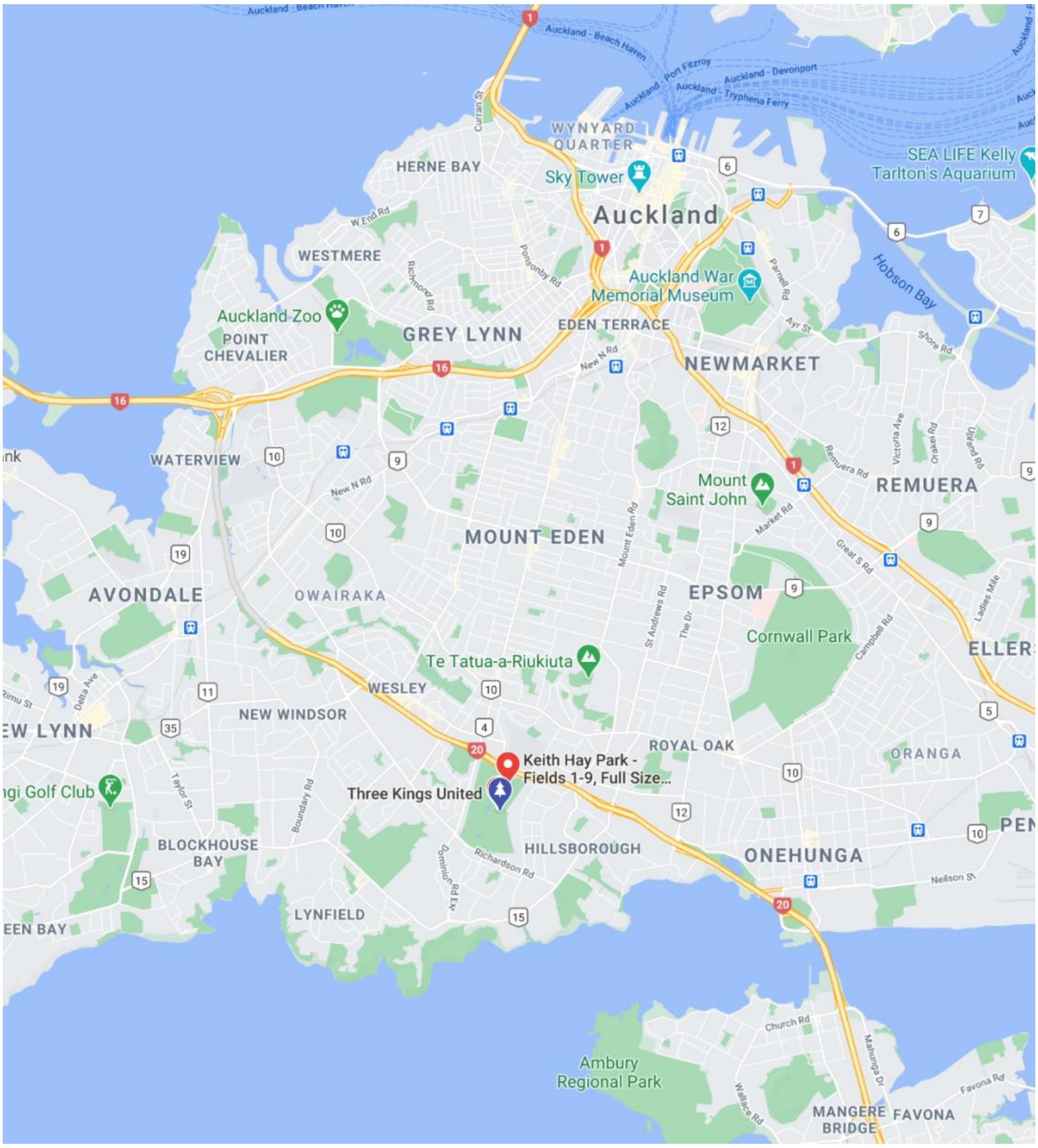

Figure 1. The location of Keith Hay Park in Mt Roskill (source: Google Maps)

Figure 2. Watercare proposed future CC9 sewer and manholes (source: Watercare)

HISTORICAL BACKGROUND

Maori Settlement[1]

The Mt Roskill area has been the site of human habitation from pre-European times. The volcanic cone pa (Figure 3) of Mt Roskill, known to Maori as Puketapapa, meaning flat-topped hill, and Pukewiwi, was occupied from around 1450 AD and is recorded on the NZAA ArchSite database as R11/19. It has extensive evidence of settlement with numerous terraces and pits covering the mountain. Prior to the mid-18th century this pa and many others on the isthmus were occupied by the Waiohua of Tamaki. Around the middle of the 18th century the Waiohua under Kiwi Tamaki were defeated by Ngati Whatua and the pa of the area were subsequently abandoned. However, archaeological investigations carried out in the 1960s (Shawcross 1962) provided no evidence to suggest that Puketapapa was occupied at this time, or much beyond 1700AD. In the traditional evidence set down by Fenton, Puketapapa is not mentioned as one of the pa belonging to Kiwi Tamaki in the mid-18th century (Fox 1979:59). The archaeological features visible in the early aerials and excavated by Shawcross (1962) are typical of the volcanic cone pa on the Auckland isthmus. They include evidence of habitation and food storage and consumption within a defendable location. Gardening is likely to have taken place on the slopes and areas below, although there is now little direct evidence of this (see Sullivan 1972).

European Settlement

In 1841, the Crown purchased land including Mt Roskill from Ngati Whatua. The County of Eden was established in 1842 and included Mt. Roskill. In 1844, the Crown sold land at Mt Roskill to Alexander Kennedy (SO 1358C, Figure 4), New Zealand Manager of the Union Bank of Australia. At this time, the mountain was known as Mt Kennedy (McConnell 1983:1; Figure 3). In 1849, Kennedy sold his land holding of 429 acres to Joseph May (LINZ CT Vol. 38, Folio 295). May built a substantial dwelling on his estate, just east of the mountain. In 1868, May became the founding chairman of the Mt Roskill Highway Board and later entered parliament where he represented the Franklin electorate (McConnell 1983:1). By 1891, May had died, and his heirs sold 420 acres of land at Mt Roskill, including the homestead, to George Winstone (McConnell 1983:1). This block of land was bounded by May Road, Richardson Road and Mt Albert Road and extended east to enclose the present Akarana Golf Course (LINZ CT Vol.122, Folio 143; Figure 5).

The population of the area remained small until the late 1920s/1930s, when many of the larger estates were subdivided. Most of the local reserves came about as a result of subdivisions from the 1920s. These include Winstone Park (Mt Roskill) which was donated as a public reserve by George Winstone and tennis courts and croquet lawns were subsequently built at the foot of the mountain. The Akarana Golf Club was established in the 1920s on Winstone's land. Keith Hay Park was set up as the Metropolitan Playing Area in 1956 and renamed in 1959 (Matthews and Matthews Feb 2014:45). Much of the

---

[1] While based on reliable documentary sources, this information should not be viewed as complete or without other context. There are a large number of iwi historically associated with the Auckland region and many other histories known to tangata whenua.

rest of the Winstone estate was purchased by the Labour Government for state housing in the 1930s. More land was purchased in the 1940s and 1950s and state houses were built on it. The former Winstone homestead became the clubhouse of the Akarana Golf Course but was demolished in the 1990s. (McConnell 1983:16, 29).

Figure 3. Mt Kennedy (Puketapapa/Mt Roskill), from Hochstetter (1859)

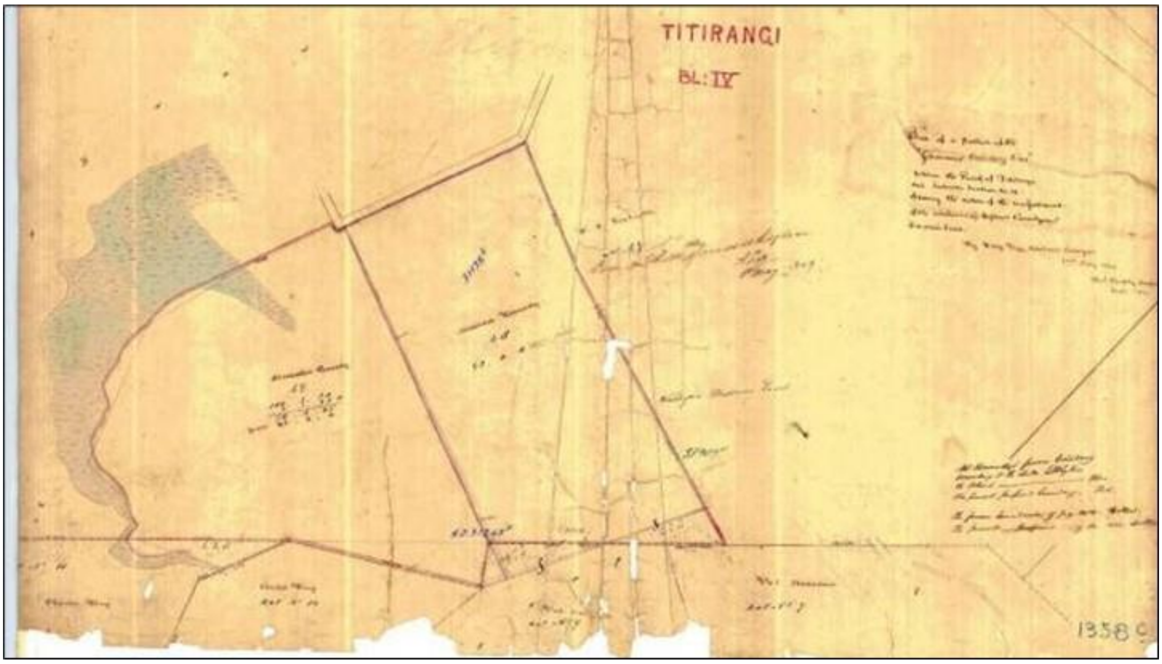

Figure 4. SO 1358C (LINZ) dated 1849 and signed by Charles Heaphy, sale of land to Alexander Kennedy

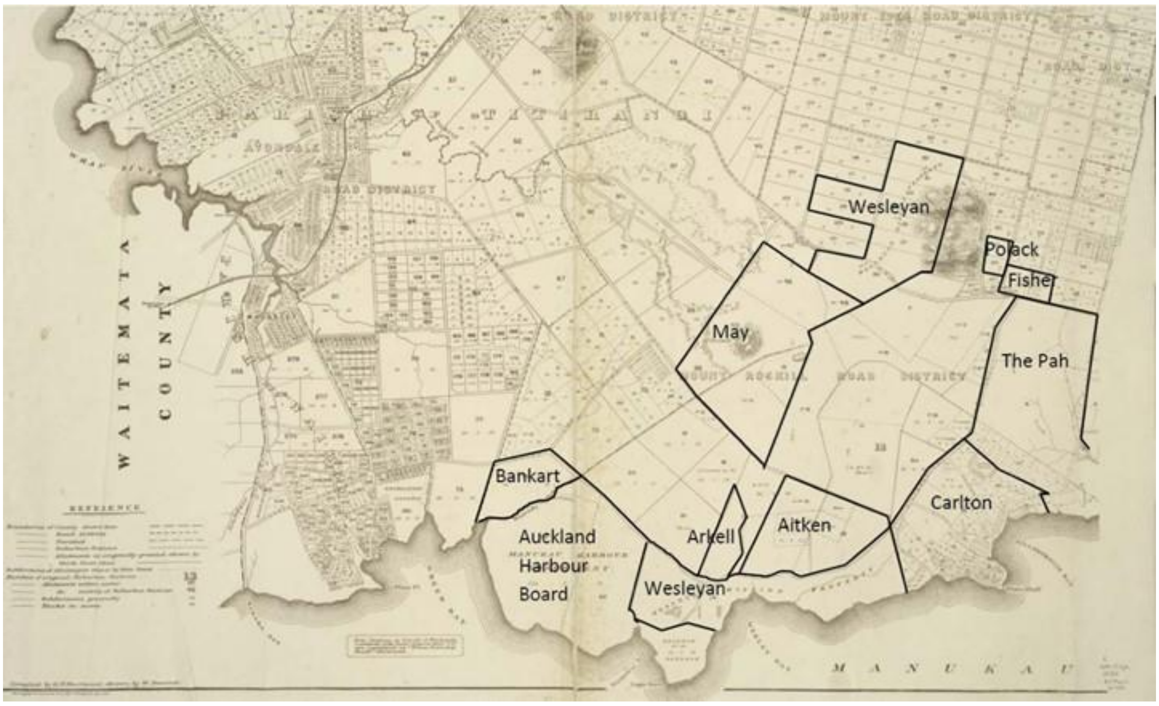

Figure 5. Map of locations of some of the large early land owners in the Mt Roskill area, overlaid on Map of Eden County, Sheet 2 Auckland City Libraries, Special Collections NZ Map 4786, dated 1892 (source: Matthews and Matthews Feb 2014)

ARCHAEOLOGICAL BACKGROUND

Previous Archaeological Work

In 2011, an archaeological assessment of the alignment of the Watercare main CI tunnel and shaft sites was carried out (Shakles et al. Dec 2011). This included the Project area as the pipeline passes through the Mt Roskill area between Hillsborough Bay on the Manukau Harbour to May Road and a shaft for the CI is located adjacent to Keith Hay Park, beside the Cameron Leisure Pool carpark (Figure 6). This part of Mt Roskill and the area surrounding Keith Hay Park is predominantly residential houses and roads.

The main CI pipeline passes close to recorded midden site R11/354, south of Mt Roskill, and just to the south of the pa site Mt Roskill (Puketapapa) itself (R11/19). R11/354 is described as a scatter of shell midden located in the garden of a residential property at 92 Stamford Park Road to the east of Keith Hay Park (Figure 6 and Figure 7; see Appendix 1).

Mt Roskill, or Puketapapa, R11/19, has undergone various modifications in the past through the development and expansion of Auckland. However, it is a significant pa site within the Auckland Isthmus, and pits and terraces are still present on the southern and western faces of the pa. Surrounding the pa would have been rich volcanic soils that would have been cultivated by Maori prior to European settlement, but intensive development around Mt Roskill has destroyed any such evidence. A midden site R11/3182 has been recorded separately on Mt Roskill that was exposed during recent works to upgrade the tihi on the mountain.

The site of the original Mt Roskill Homestead, occupied by the May family and later by the Winstones, is recorded as R11/2819. Before its demolition in the 1990s the homestead was used by the Akarana Golf Club as its clubrooms. A surface scatter of historic midden was observed in 2012 at its previous location.

In the May Road area, wooden artefacts (R11/57) were recovered in an area of former swampland, although the site is now recorded as destroyed. The artefacts recovered were described as wooden implements for maize grinding from the ‘mission swamp’. Much of this area is former swampland unsuitable for human habitation in the past. The only archaeological evidence that might be present in areas of former swamp would be isolated artefacts, although the likelihood of any being discovered is considered ‘low to remote’ (Clough, Macready and Bickler 2010: 78).

While there is a low density of known archaeological sites in the Mt Roskill area generally, the close proximity of R11/354 and Mt Roskill (Puketapapa) R11/19 suggests that the possibility of subsurface archaeological remains cannot be ruled out. However, it is considered unlikely within the Project area given the level of overall development and the presence of existing services along the proposed CC9 alignment.

Figure 6. Location of the main CI tunnel from Hillsborough Bay through to Mt Roskill/May Road (arrowed) with recorded archaeological sites in the vicinity. The proposed CC9 sewer has been added in blue (source: Shakles et al Dec 2011)

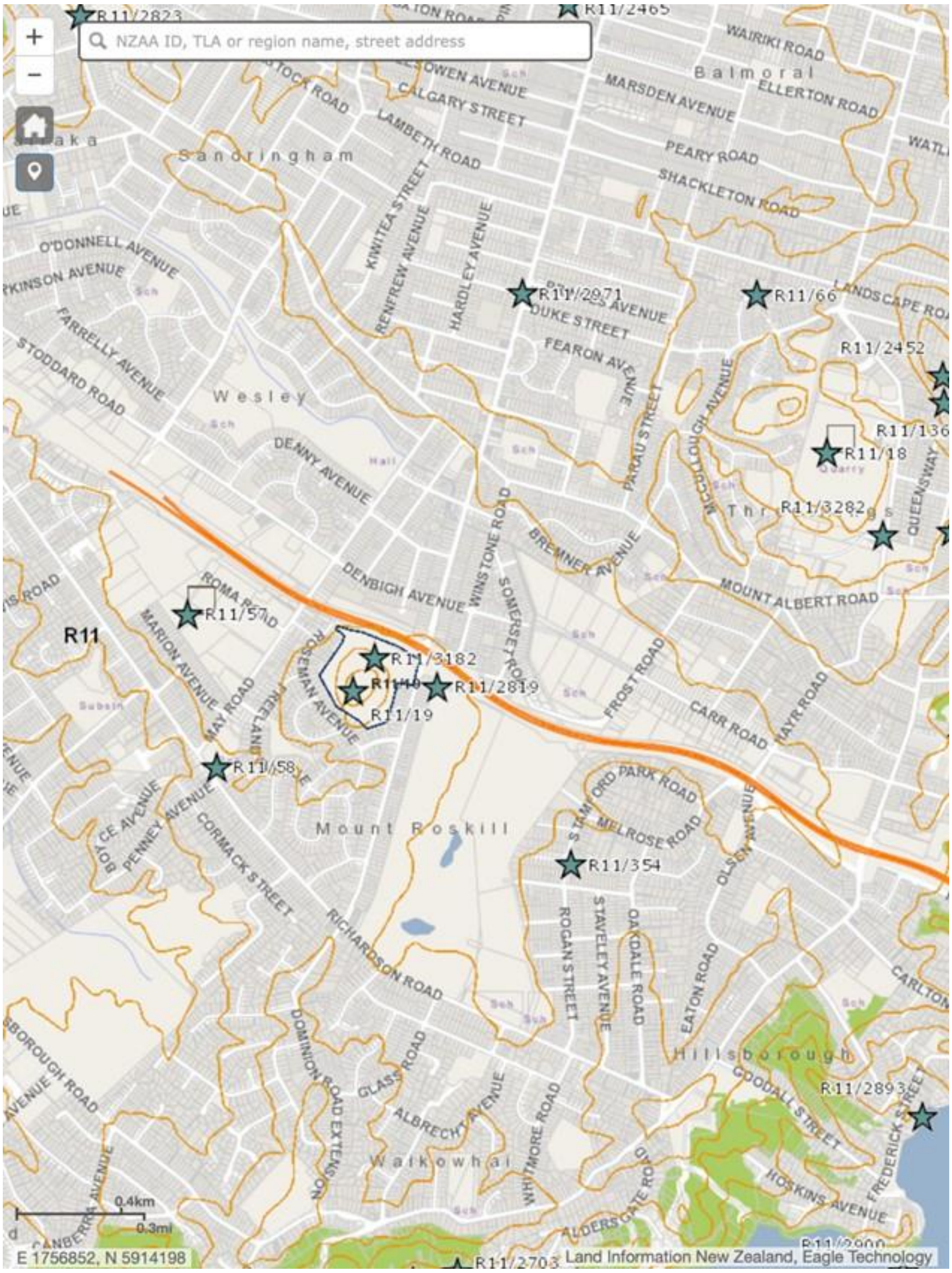

Figure 7. The location of recorded archaeological sites within the wider vicinity of the project area (source: NZAA ArchSite)

HISTORICAL SURVEY

Information from Early Aerials

Examination of early aerial photographs shows the transition of the Mt Roskill area from predominantly farm land in the 1940s (Figure 8) to the development of a residential and state housing suburb by the late 1950s (Figure 9). Winstone Park containing Mt Roskill/Puketapapa and the Akarana Golf Club are also clearly established within the residential development at this time. The area covered by what is now Keith Hay Park is also visible but as yet undeveloped as a recreation area.

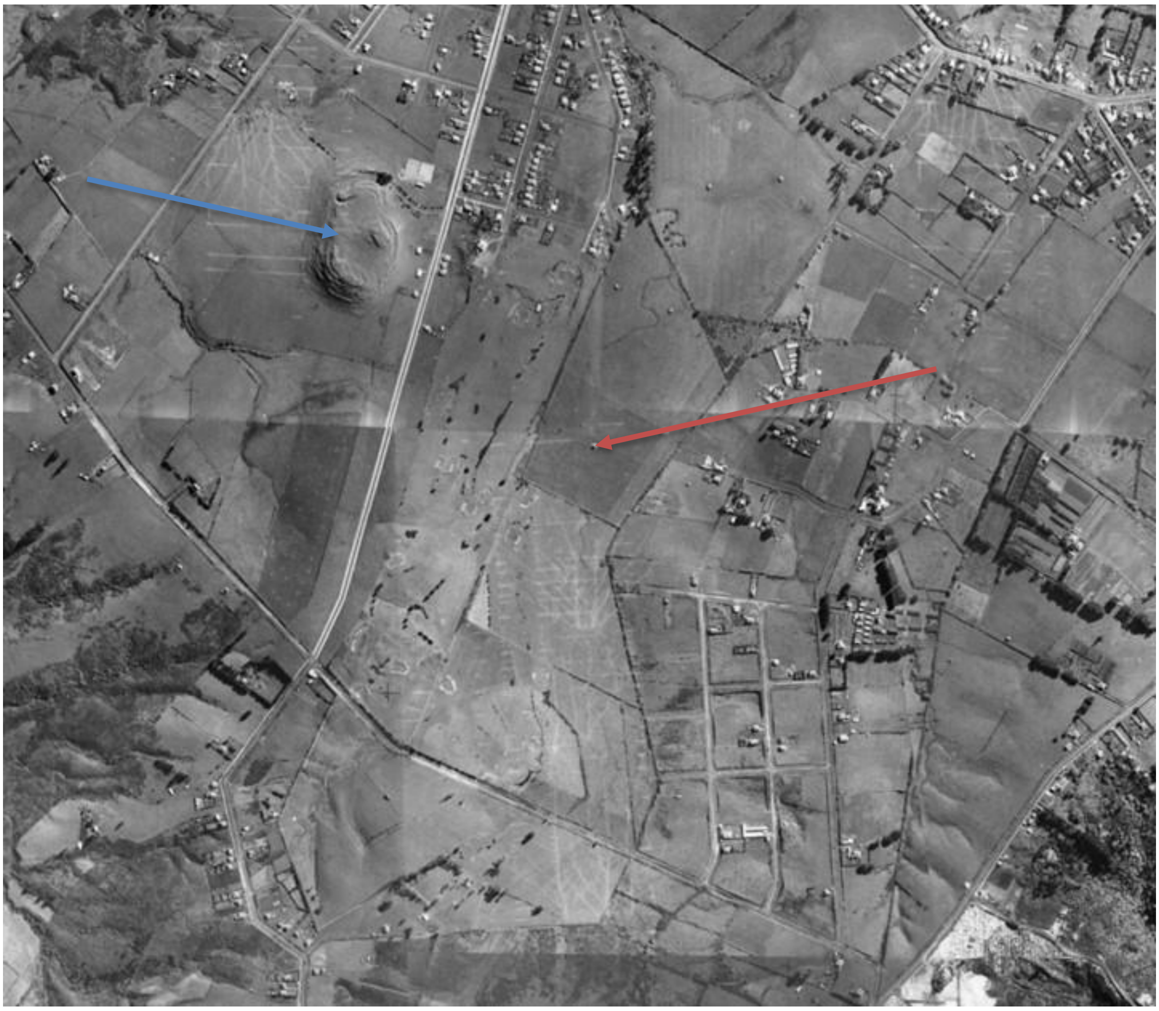

Figure 8. 1940 aerial photograph of the surrounding area of Mt Roskill/Puketapapa (blue arrow) and Keith Hay Park (red arrow) (source: Auckland Council Geomaps)

Figure 9. 1959 aerial photograph of the surrounding area of Mt Roskill/Puketapapa (blue arrow) and the Akarana Golf Club and Keith Hay Park (red arrows) (source: Auckland Council Geomaps) (source: Auckland Council Geomaps)

FIELD ASSESSMENT

Field Survey Results

An archaeological site inspection was carried out of the proposed CC9 route through Keith Hay Park on 11 February 2021. The CC9 sewer pipeline begins at the CI main works, currently under construction at 22 Gregory Place, Mt Roskill (Figure 10). It will then run for approximately 810 m through the eastern side of Keith Hay Park parallel to the walking path and open concrete-lined drain that runs the length of the park to the Eden Roskill Cricket Club (Figure 12 and Figure 12). The proposed pipeline will then run through the playing field and the carpark of Hay Park School through to Richardson Road in the south (Figure 14 and Figure 14). An existing branch sewer runs along this route for the majority of this alignment (see Figure 2).

No archaeological deposits or features were identified within the proposed CC9 route. The area of proposed works is primarily on the school playing field and sealed surfaces, making the identification of archaeological remains difficult prior to being exposed in the course of redevelopment work. However, it is considered unlikely that intact subsurface archaeological remains survive in the project area given the level of overall development and the presence of existing services along the proposed alignment.

Figure 10. Looking north across the Cameron Leisure Pool carpark to the CI main works (left)

Figure 11. Looking north along the proposed CC9 alignment along the eastern side of Keith Hay Park

Figure 12. Looking north across the Eden Roskill Cricket Club building and carpark

Figure 13. Looking south from the Eden Roskill Cricket Club carpark to the Hay Park School playing field and buildings

Figure 14. Looking south across the Waikowhai Intermediate School carpark towards Richardson Road

DISCUSSION AND CONCLUSIONS

Summary of Results

Watercare Services Ltd is planning to construct a new sewer (CC9) which connects to the Central Interceptor (CI) shaft site at Keith Hay Park in Mt Roskill.

The area of proposed works is primarily within an urban environment on school playing fields and beneath sealed surfaces, making the identification of archaeological remains difficult prior to being exposed in the course of redevelopment work. No archaeological deposits or features were identified within the proposed CC9 route and it is considered unlikely that intact subsurface archaeological remains survive in the project area given the level of overall development and the presence of existing services along the proposed alignment.

Maori Cultural Values

This is an assessment of effects on archaeological values and does not include an assessment of effects on Maori cultural values. Such assessments should only be made by the tangata whenua. Maori cultural concerns may encompass a wider range of values than those associated with archaeological sites.

The historical association of the general area with the tangata whenua is evident from the recorded sites, traditional histories and known Maori place names.

Survey Limitations

It should be noted that archaeological survey techniques (based on visual inspection and minor sub-surface testing) cannot necessarily identify all sub-surface archaeological features, or detect wahi tapu and other sites of traditional significance to Maori, especially where these have no physical remains.

Archaeological sites beneath modern buildings and sealed surfaces in urban environments can rarely be identified prior to being exposed in the course of redevelopment work.

Archaeological Value and Significance

The archaeological value of sites relates mainly to their information potential, that is, the extent to which they can provide evidence relating to local, regional and national history using archaeological investigation techniques, and the research questions to which the site could contribute. The surviving extent, complexity and condition of sites are the main factors in their ability to provide information through archaeological investigation. For example, generally pa are more complex sites and have higher information potential than small midden (unless of early date). Archaeological value also includes contextual (heritage landscape) value. Archaeological sites may also have other historic heritage values including historical, architectural, technological, cultural, aesthetic, scientific, social, spiritual and traditional values.

No archaeological sites and associated values have been recorded within the Project area.

Effects of the Proposal

There are no known effects on known archaeological or other historic heritage sites from the proposed activity.

In any area where archaeological sites have been recorded in the general vicinity it is possible that unrecorded subsurface remains may be exposed during development. While it is considered unlikely in this situation given, the level of overall development in the area and the presence of existing services along the proposed CC9 alignment; - The possibility is provided for under the AUP OP Accidental Discovery Rule (E12.6.1). In addition to this, the existing approved CI Construction Management Plan (CMP) includes accidental discovery protocols which will be applied to the proposed CC9 works if required. The existing CMP will be updated to include the proposed CC9 works.

Archaeological features and remains can take the form of burnt and fire cracked stones, charcoal, rubbish heaps including shell, bone and/or 19th century glass and crockery, ditches, banks, pits, old building foundations, artefacts of Maori and early European origin or human burials.

Resource Management Act 1991 Requirements

Section 6 of the RMA recognises as matters of national importance: 'the relationship of Maori and their culture and traditions with their ancestral lands, water, sites, waahi tapu, and other taonga' (S6(e)); and 'the protection of historic heritage from inappropriate subdivision, use, and development' (S6(f)).

All persons exercising functions and powers under the RMA are required under Section 6 to recognise and provide for these matters of national importance when 'managing the use, development and protection of natural and physical resources'. There is a duty to avoid, remedy, or mitigate any adverse effects on the environment arising from an activity (S17), including historic heritage.

Historic heritage is defined (S2) as 'those natural and physical resources that contribute to an understanding and appreciation of New Zealand's history and cultures, deriving from any of the following qualities: (i) archaeological; (ii) architectural; (iii) cultural; (iv) historic; (v) scientific; (vi) technological'. Historic heritage includes: '(i) historic sites, structures, places, and areas; (ii) archaeological sites; (iii) sites of significance to Maori, including wahi tapu; (iv) surroundings associated with the natural and physical resources'.

Regional, district and local plans contain sections that help to identify, protect and manage archaeological and other heritage sites. The plans are prepared under the provisions of the RMA. The Auckland Unitary Plan Operative in Part 2016 (AUP OP) is relevant to the proposed activity.

There are no scheduled historic heritage sites located in the project area. This appraisal has established that the proposed activity will have no effect on any known archaeological or other historic heritage sites, and has little potential to affect unrecorded subsurface archaeological remains. If resource consent is granted, consent conditions relating to archaeological monitoring or protection would therefore not be required. However, if suspected archaeological remains are exposed during development works, the Accidental Discovery Rule (E12.6.1) set out in the AUP OP must be complied with. Under the Accidental Discovery Rule works must cease within 20m of the discovery and the Council, Heritage NZ, Mana Whenua and (in the case of human remains) NZ Police must be informed. The Rule would no longer apply in respect to archaeological sites if an Authority from Heritage NZ was in place.

Heritage New Zealand Pouhere Taonga Act 2014 Requirements

In addition to any requirements under the RMA, the HNZPTA protects all archaeological sites whether recorded or not, and they may not be damaged or destroyed unless an Authority to modify an archaeological site has been issued by Heritage NZ (Section 42).

An archaeological site is defined by the HNZPTA Section 6 as follows:

> ‘**archaeological site** means, subject to section 42(3), –
>
> (a) any place in New Zealand, including any building or structure (or part of a building or structure) that –
>
> (i) was associated with human activity that occurred before 1900 or is the site of the wreck of any vessel where the wreck occurred before 1900; and
>
> (ii) provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand; and
>
> (b) includes a site for which a declaration is made under section 43(1).’ [2]

Authorities to modify archaeological sites can be applied for either in respect to archaeological sites within a specified area of land (Section 44(a)), or to modify a specific archaeological site where the effects will be no more than minor (Section 44(b)), or for the purpose of conducting a scientific investigation (Section 44(c)). Applications that relate to sites of Maori interest require consultation with (and in the case of scientific investigations the consent of) the appropriate iwi or hapu and are subject to the recommendations of the Maori Heritage Council of Heritage NZ. In addition, an application may be made to carry out an exploratory investigation of any site or locality under Section 56, to confirm the presence, extent and nature of a site or suspected site.

An archaeological Authority will not be required for the proposed Watercare CC9 connection to the CI shaft site at Keith Hay Park as no known archaeological sites will be affected, and it is unlikely that any undetected sites are present. However, should any sites be exposed during development the provisions of the HNZPTA must be complied with.

Conclusions

This appraisal has established that the proposed Watercare CC9 sewer pipeline which connects to the CI shaft site at Keith Hay Park will have no effect on any known archaeological or other historic heritage sites, and has little potential to affect unrecorded subsurface archaeological remains. However, if suspected archaeological remains are

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[2] Under Section 42(3) an Authority is not required to permit work on a pre-1900 building unless the building is to be demolished. Under Section 43(1) a place post-dating 1900 (including the site of a wreck that occurred after 1900) that could provide ‘significant evidence relating to the historical and cultural heritage of New Zealand’ can be declared by Heritage NZ to be an archaeological site.

exposed during development works, the Accidental Discovery Rule (E12.6.1) set out in the AUP OP and the provisions of the HNZPTA must be complied with. The existing CI CMP will be updated to include the proposed CC9 works.

RECOMMENDATIONS

- There should be no constraints on the proposed Watercare CC9 connection to the Central Interceptor shaft site at Keith Hay Park on archaeological grounds, since no archaeological sites are known to be present and it is considered unlikely that any will be exposed during development.
- If subsurface archaeological evidence should be unearthed during construction (e.g. intact shell midden, hangi, storage pits relating to Maori occupation, or cobbled floors, brick or stone foundation, and rubbish pits relating to 19th century European occupation), or if human remains should be discovered, the Accidental Discovery Rule (section E.12.6.1 of the AUP OP) must be followed. This requires that work ceases within 20m of the discovery and that the Auckland Council, Heritage NZ, Mana Whenua and (in the case of human remains) the NZ Police are notified. The relevant authorities will then determine the actions required.
- If modification of an archaeological site does become necessary, an Authority must be applied for under Section 44(a) of the HNZPTA and granted prior to any further work being carried out that will affect the site. (*Note that this is a legal requirement*).
- Since archaeological survey cannot always detect sites of traditional significance to Maori, such as wahi tapu, tangata whenua should be consulted regarding the possible existence of such sites in the project area.

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APPENDIX 1: SITE RECORD FORMS

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHSITE archaeological site recording scheme

Site Record Form

NZAA SITE NUMBER: R11/19

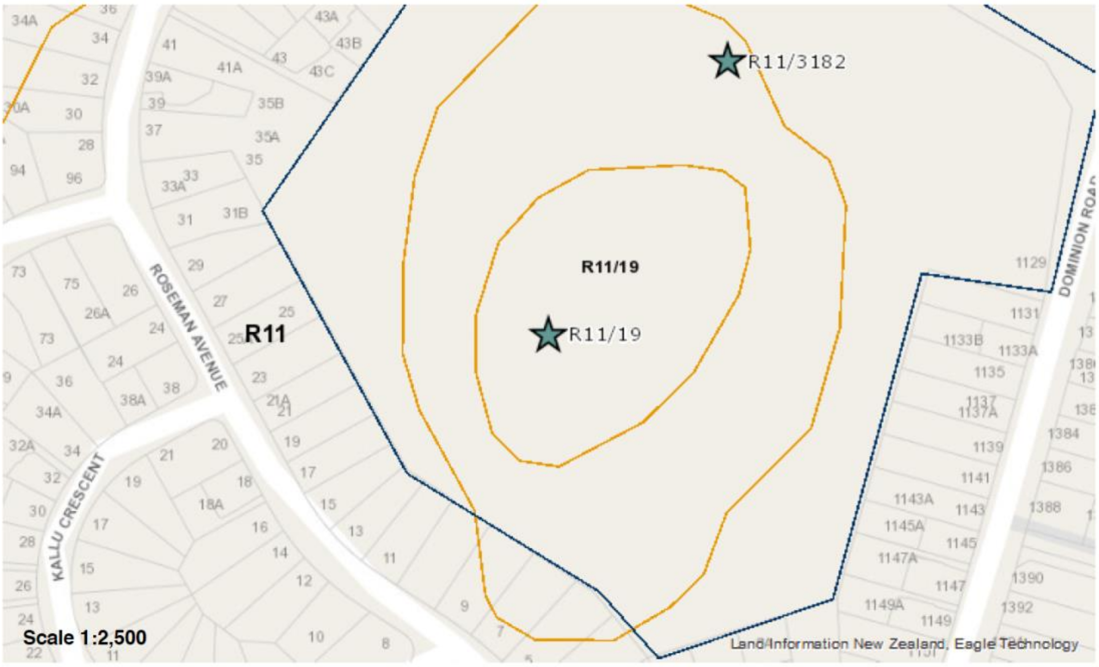
SITE TYPE: Pa

SITE NAME(s): Puketapapa
Mt Roskill

DATE RECORDED:

SITE COORDINATES (NZTM) Easting: 1754699 **Northing:** 5913410 **Source:** On Screen

IMPERIAL SITE NUMBER: N42/11 **METRIC SITE NUMBER:** R11/19



Finding aids to the location of the site

Winstone Park, Mt Roskill.

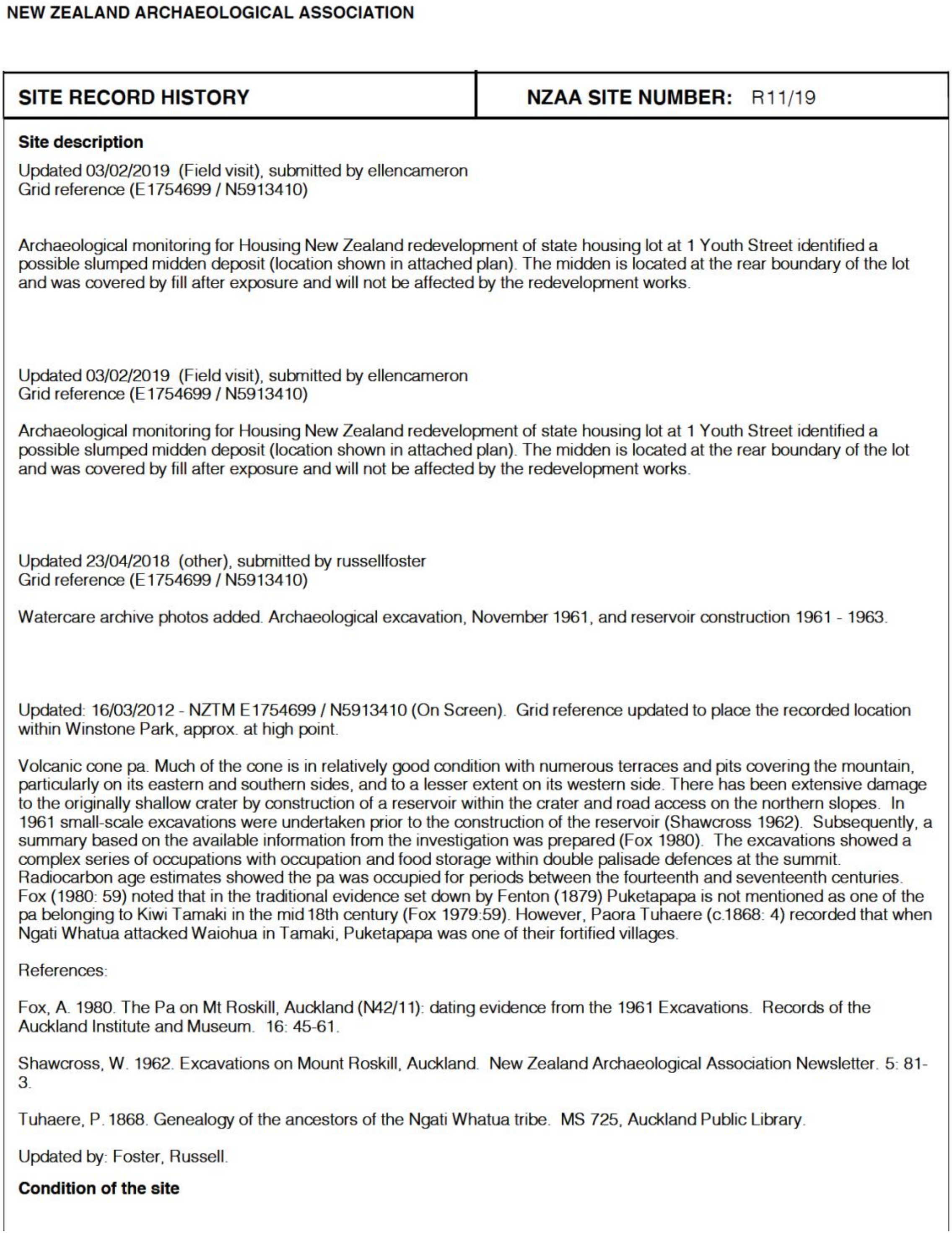
Brief description

Pa

Recorded features

Artefact, Midden, Pit, Terrace

Other sites associated with this site



NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD HISTORY	**NZAA SITE NUMBER:** R11/19

Site description

Updated 03/02/2019 (Field visit), submitted by ellencameron
Grid reference (E1754699 / N5913410)

Archaeological monitoring for Housing New Zealand redevelopment of state housing lot at 1 Youth Street identified a possible slumped midden deposit (location shown in attached plan). The midden is located at the rear boundary of the lot and was covered by fill after exposure and will not be affected by the redevelopment works.

Updated 03/02/2019 (Field visit), submitted by ellencameron
Grid reference (E1754699 / N5913410)

Archaeological monitoring for Housing New Zealand redevelopment of state housing lot at 1 Youth Street identified a possible slumped midden deposit (location shown in attached plan). The midden is located at the rear boundary of the lot and was covered by fill after exposure and will not be affected by the redevelopment works.

Updated 23/04/2018 (other), submitted by russellfoster
Grid reference (E1754699 / N5913410)

Watercare archive photos added. Archaeological excavation, November 1961, and reservoir construction 1961 - 1963.

Updated: 16/03/2012 - NZTM E1754699 / N5913410 (On Screen). Grid reference updated to place the recorded location within Winstone Park, approx. at high point.

Volcanic cone pa. Much of the cone is in relatively good condition with numerous terraces and pits covering the mountain, particularly on its eastern and southern sides, and to a lesser extent on its western side. There has been extensive damage to the originally shallow crater by construction of a reservoir within the crater and road access on the northern slopes. In 1961 small-scale excavations were undertaken prior to the construction of the reservoir (Shawcross 1962). Subsequently, a summary based on the available information from the investigation was prepared (Fox 1980). The excavations showed a complex series of occupations with occupation and food storage within double palisade defences at the summit. Radiocarbon age estimates showed the pa was occupied for periods between the fourteenth and seventeenth centuries. Fox (1980: 59) noted that in the traditional evidence set down by Fenton (1879) Puketapapa is not mentioned as one of the pa belonging to Kiwi Tamaki in the mid 18th century (Fox 1979:59). However, Paora Tuhaere (c.1868: 4) recorded that when Ngati Whatua attacked Waiohua in Tamaki, Puketapapa was one of their fortified villages.

References:

Fox, A. 1980. The Pa on Mt Roskill, Auckland (N42/11): dating evidence from the 1961 Excavations. Records of the Auckland Institute and Museum. 16: 45-61.

Shawcross, W. 1962. Excavations on Mount Roskill, Auckland. New Zealand Archaeological Association Newsletter. 5: 81-3.

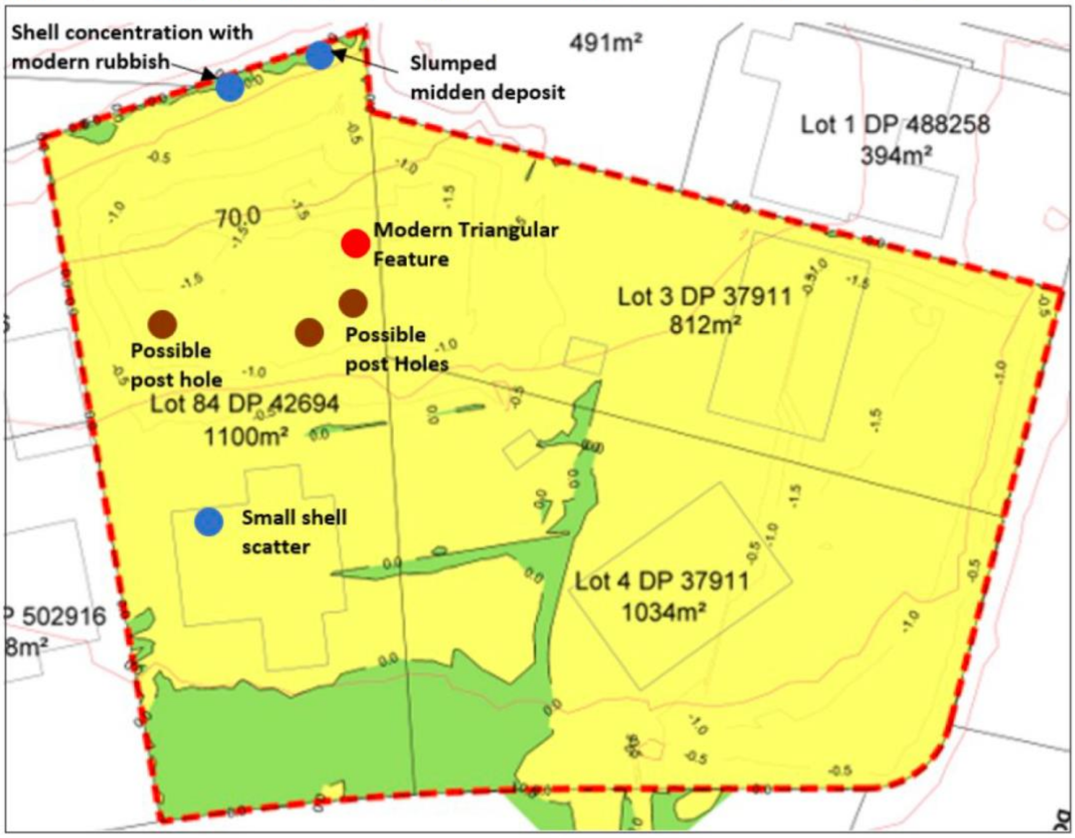
Tuhaere, P. 1868. Genealogy of the ancestors of the Ngati Whatua tribe. MS 725, Auckland Public Library.

Updated by: Foster, Russell.

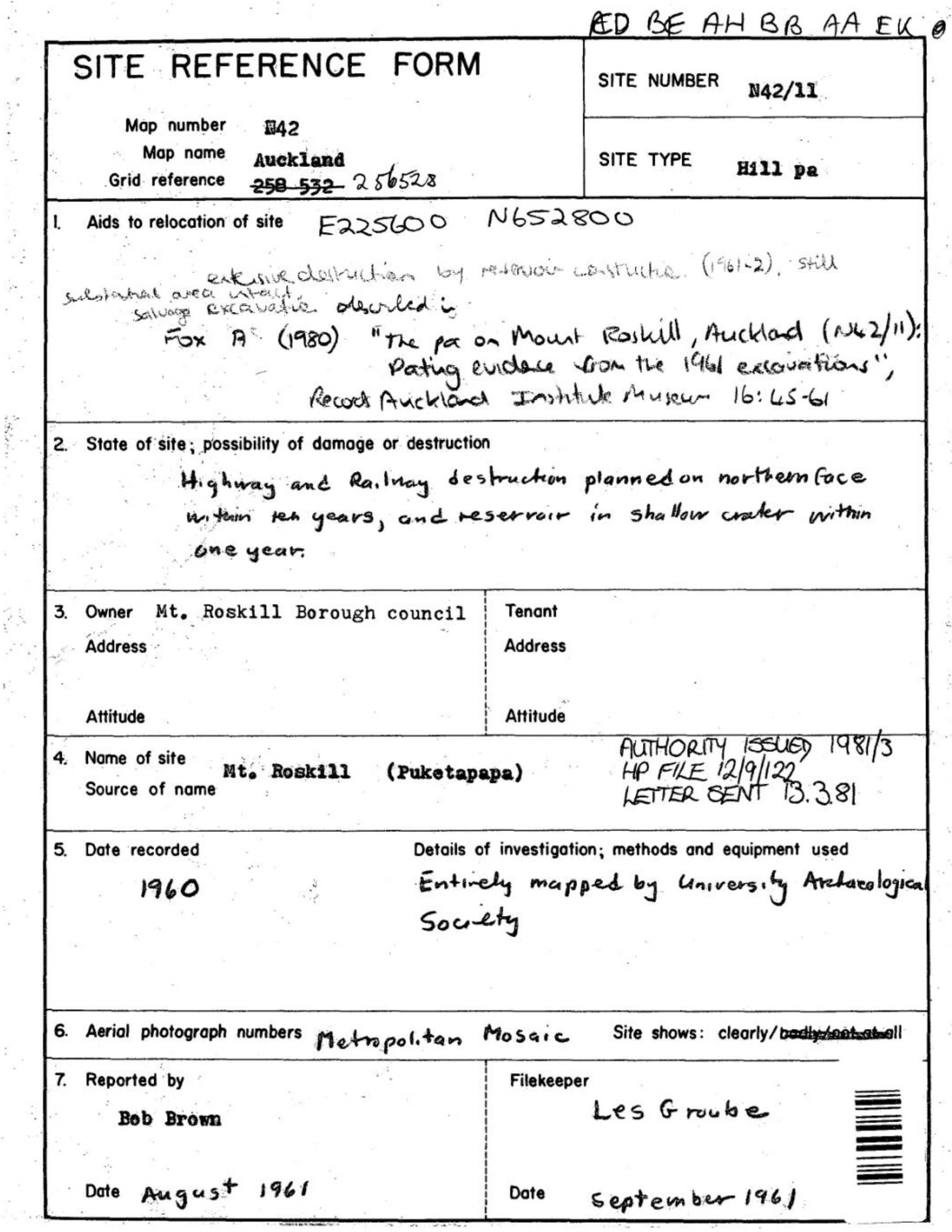
Condition of the site

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

Location of slumped midden from (Cameron E. and S. Phear. February 2018. Roskill South Proposed Housing development (Stage 1A): Archaeological Monitoring Report, Prepared in Fulfillment of NZHPT Authority No. 2018/483)



NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION



AED BE AH BB AA EK

SITE REFERENCE FORM

SITE NUMBER N42/11

Map number N42
Map name Auckland
Grid reference ~~258 532~~ 256528

SITE TYPE Hill pa

1. Aids to relocation of site E225600 N652800

extensive destruction by reservoir construction (1961-2), still substantial area intact.
salvage excavation described in
Fox A. (1980) "The pa on Mount Roskill, Auckland (N42/11): Dating evidence from the 1961 excavations", Record Auckland Institute Museum 16: 45-61

2. State of site; possibility of damage or destruction

Highway and Railway destruction planned on northern face within ten years, and reservoir in shallow crater within one year.

3. Owner Mt. Roskill Borough council
Address
Attitude

Tenant
Address
Attitude

4. Name of site Mt. Roskill (Puketapapa)
Source of name

AUTHORITY ISSUED 1981/3
HP FILE 12/9/122
LETTER SENT 13.3.81

5. Date recorded 1960

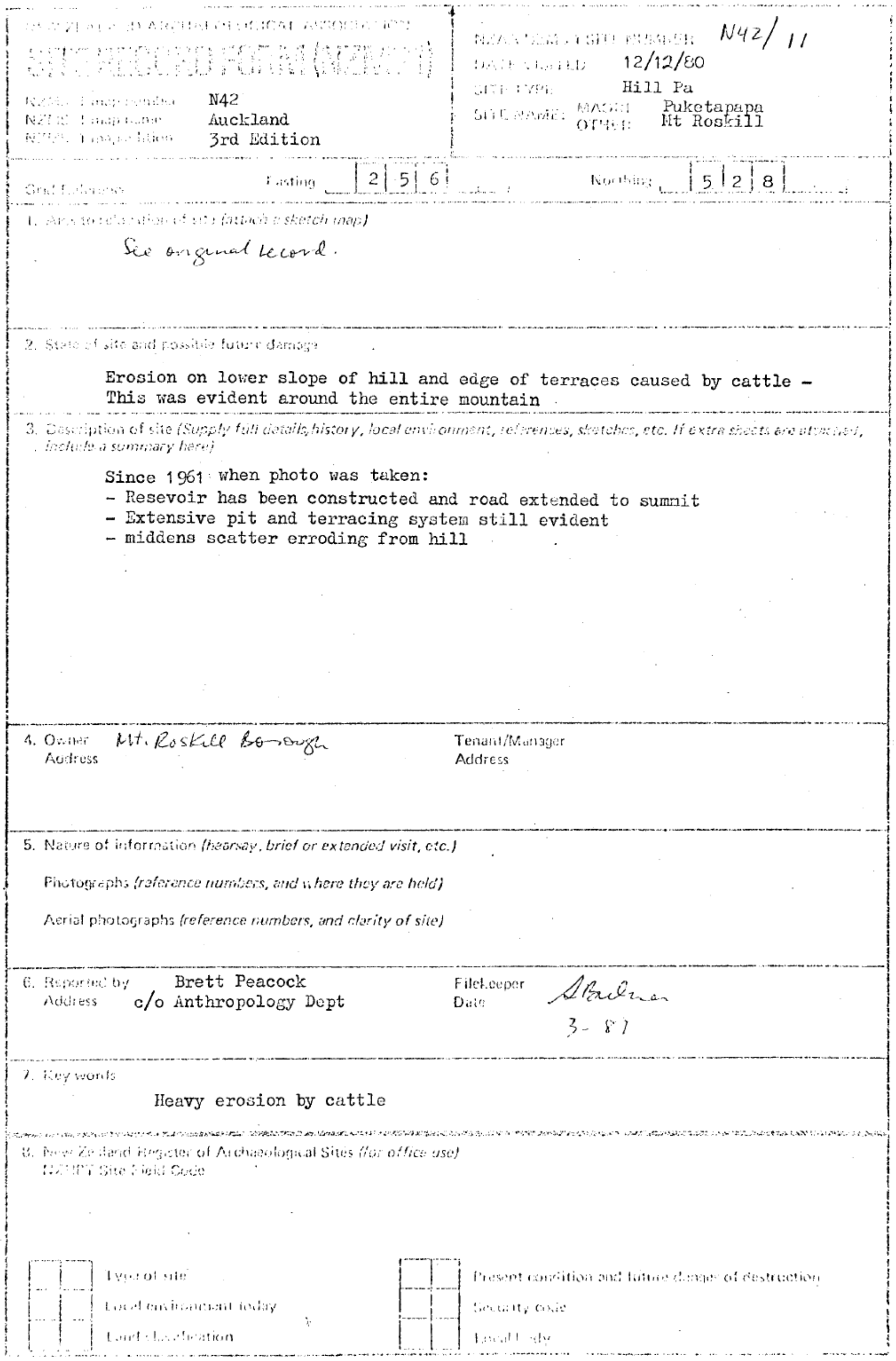
Details of investigation; methods and equipment used
Entirely mapped by University Archaeologica
Society

6. Aerial photograph numbers Metropolitan Mosaic
Site shows: clearly/~~badly/not at all~~

7. Reported by Bob Brown
Date August 1961

Filekeeper Les Groube
Date September 1961

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION



NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM (NZMS1)

NZMS1 map number N42
NZMS1 map name Auckland
NZMS1 map edition 3rd Edition

NZAA NZMS1 SITE NUMBER N42/11
DATE VISITED 12/12/80
SITE TYPE Hill Pa
SITE NAME: MAORI Puketapapa
OTHER Mt Roskill

Grid Reference Easting 2 5 6 Northing 5 2 8

1. Aids to relocation of site (attach a sketch map)

See original record.

2. State of site and possible future damage

Erosion on lower slope of hill and edge of terraces caused by cattle - This was evident around the entire mountain

3. Description of site *(Supply full details, history, local environment, references, sketches, etc. If extra sheets are attached, include a summary here)*

Since 1961 when photo was taken:
- Resevoir has been constructed and road extended to summit
- Extensive pit and terracing system still evident
- middens scatter erroding from hill

4. Owner Mt. Roskill Borough
Address

Tenant/Manager
Address

5. Nature of information *(hearsay, brief or extended visit, etc.)*

Photographs *(reference numbers, and where they are held)*

Aerial photographs *(reference numbers, and clarity of site)*

6. Reported by Brett Peacock
Address c/o Anthropology Dept

Filekeeper A Bulmer
Date 3-81

7. Key words

Heavy erosion by cattle

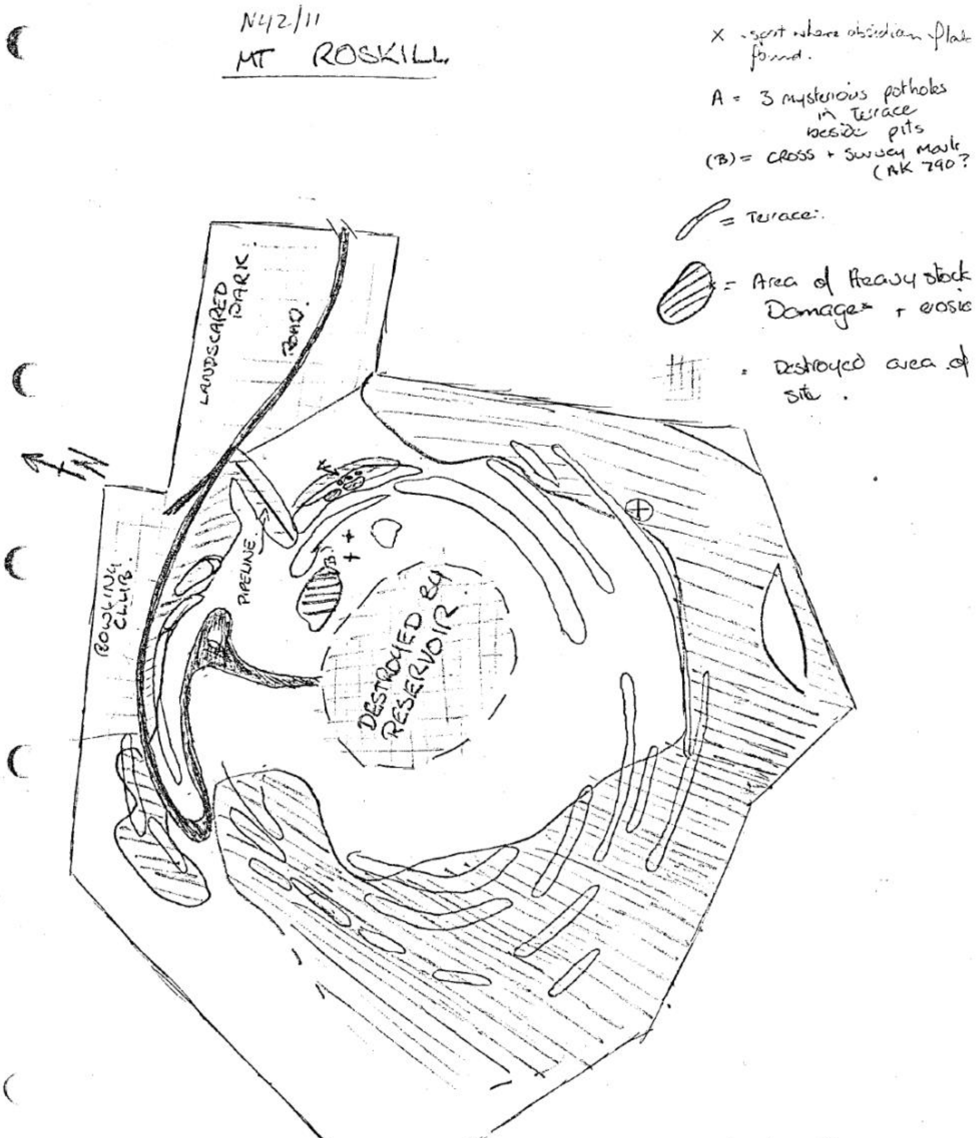
8. New Zealand Register of Archaeological Sites *(for office use)*
NZHPT Site Field Code

☐☐ Type of site
☐☐ Local environment today
☐☐ Land classification

☐☐ Present condition and future danger of destruction
☐☐ Security code
☐☐ Local body

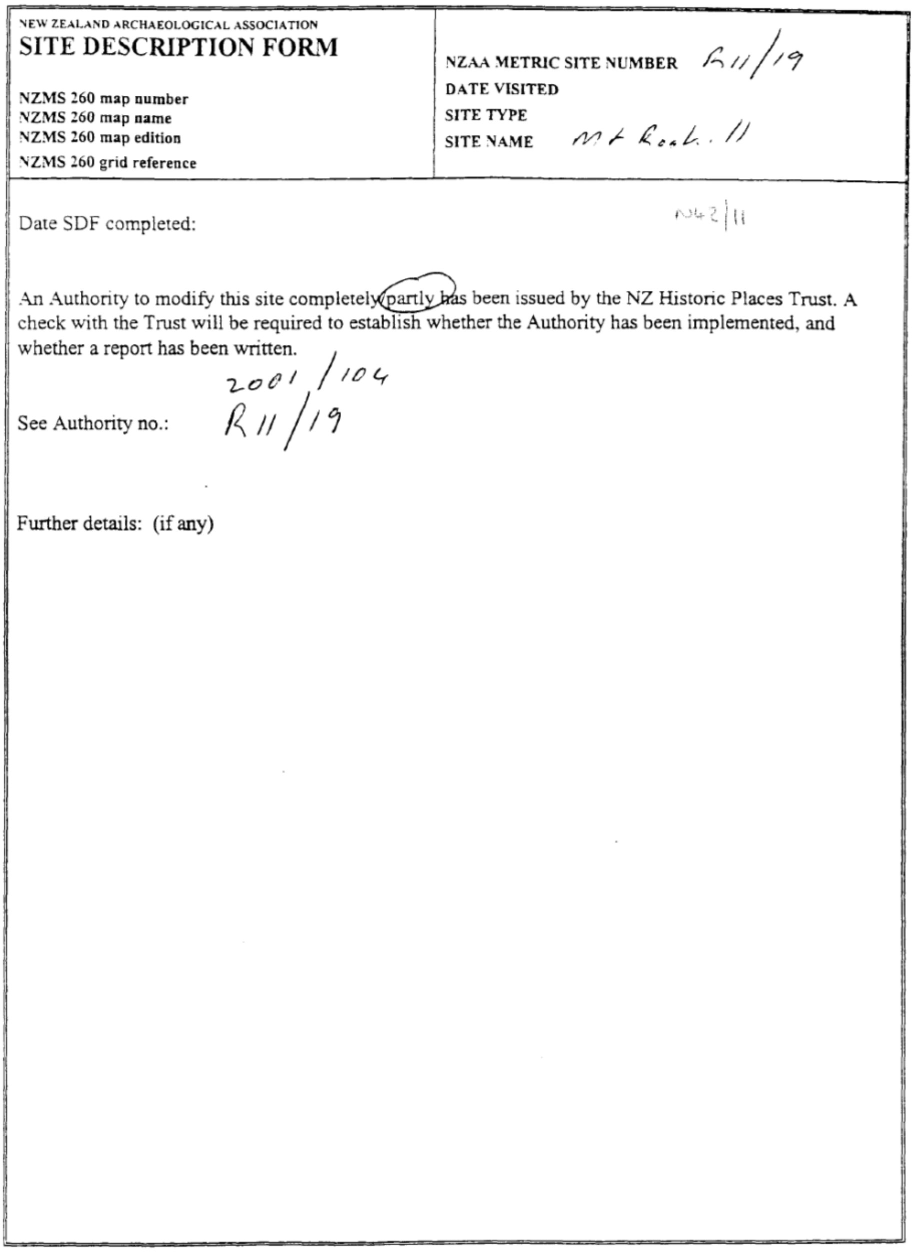
NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

N42/11
MT ROSKILL



Sketch Map by
Peacock. 12-80

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION



NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE DESCRIPTION FORM

NZMS 260 map number
NZMS 260 map name
NZMS 260 map edition
NZMS 260 grid reference

NZAA METRIC SITE NUMBER R11/19
DATE VISITED
SITE TYPE
SITE NAME Mt Roskill

Date SDF completed:

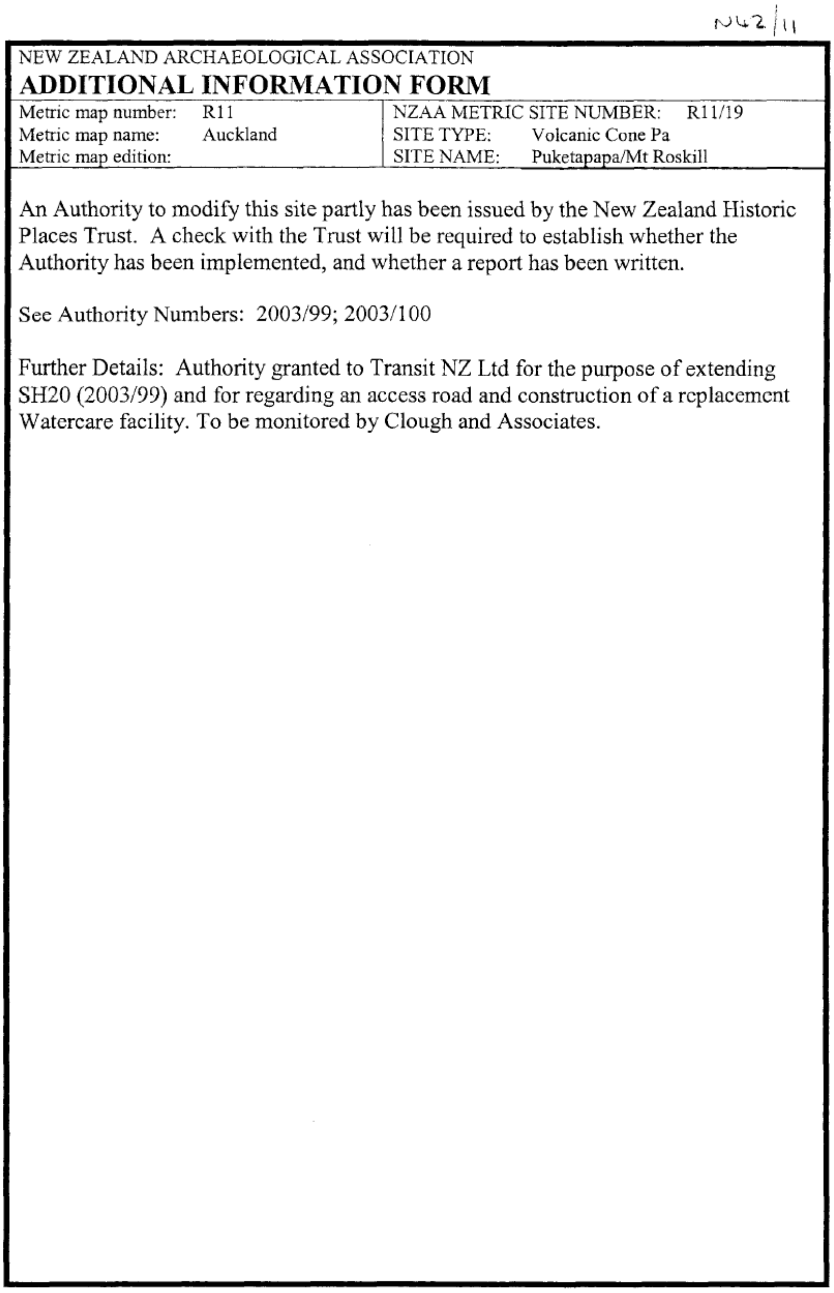
N42/11

An Authority to modify this site completely/[✓ partly] has been issued by the NZ Historic Places Trust. A check with the Trust will be required to establish whether the Authority has been implemented, and whether a report has been written.

See Authority no.: 2001/104
R11/19

Further details: (if any)

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION



N42/11

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ADDITIONAL INFORMATION FORM

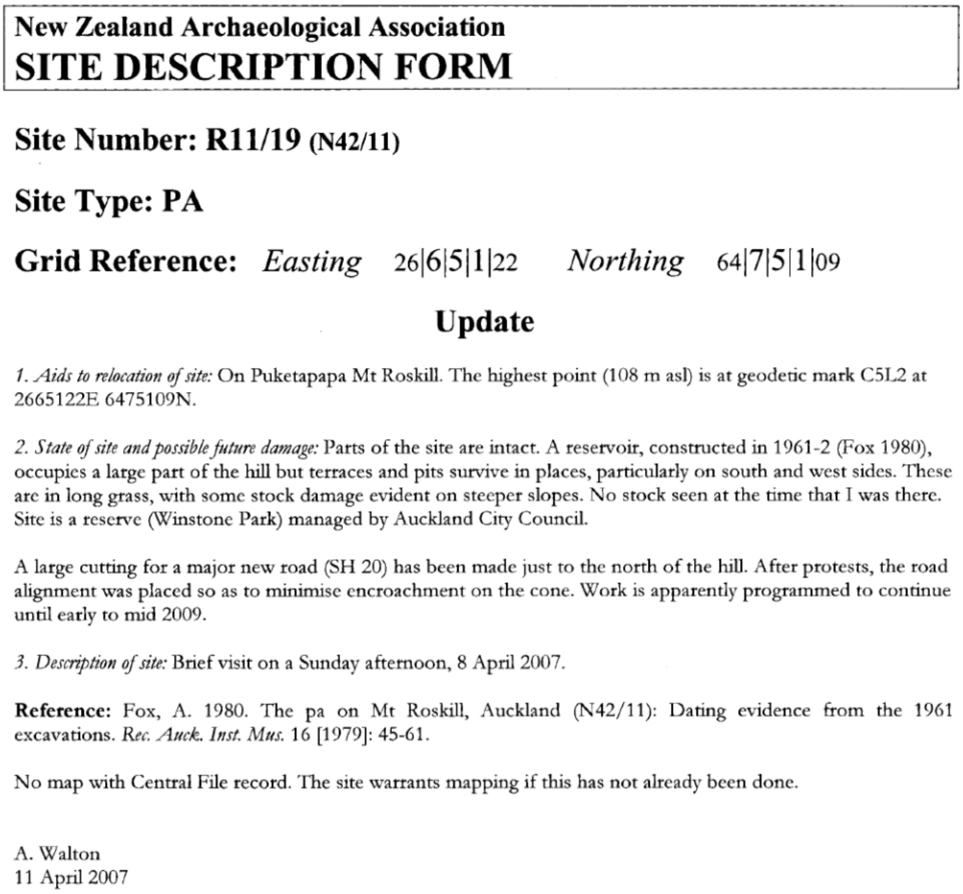
Metric map number:	R11	NZAA METRIC SITE NUMBER:	R11/19
Metric map name:	Auckland	SITE TYPE:	Volcanic Cone Pa
Metric map edition:		SITE NAME:	Puketapapa/Mt Roskill

An Authority to modify this site partly has been issued by the New Zealand Historic Places Trust. A check with the Trust will be required to establish whether the Authority has been implemented, and whether a report has been written.

See Authority Numbers: 2003/99; 2003/100

Further Details: Authority granted to Transit NZ Ltd for the purpose of extending SH20 (2003/99) and for regarding an access road and construction of a replacement Watercare facility. To be monitored by Clough and Associates.

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION



New Zealand Archaeological Association

SITE DESCRIPTION FORM

Site Number: R11/19 (N42/11)

Site Type: PA

Grid Reference: *Easting* 26|6|5|1|22 *Northing* 64|7|5|1|09

Update

1. *Aids to relocation of site:* On Puketapapa Mt Roskill. The highest point (108 m asl) is at geodetic mark C5L2 at 2665122E 6475109N.

2. *State of site and possible future damage:* Parts of the site are intact. A reservoir, constructed in 1961-2 (Fox 1980), occupies a large part of the hill but terraces and pits survive in places, particularly on south and west sides. These are in long grass, with some stock damage evident on steeper slopes. No stock seen at the time that I was there. Site is a reserve (Winstone Park) managed by Auckland City Council.

A large cutting for a major new road (SH 20) has been made just to the north of the hill. After protests, the road alignment was placed so as to minimise encroachment on the cone. Work is apparently programmed to continue until early to mid 2009.

3. *Description of site:* Brief visit on a Sunday afternoon, 8 April 2007.

Reference: Fox, A. 1980. The pa on Mt Roskill, Auckland (N42/11): Dating evidence from the 1961 excavations. *Rec. Auck. Inst. Mus.* 16 [1979]: 45-61.

No map with Central File record. The site warrants mapping if this has not already been done.

A. Walton
11 April 2007

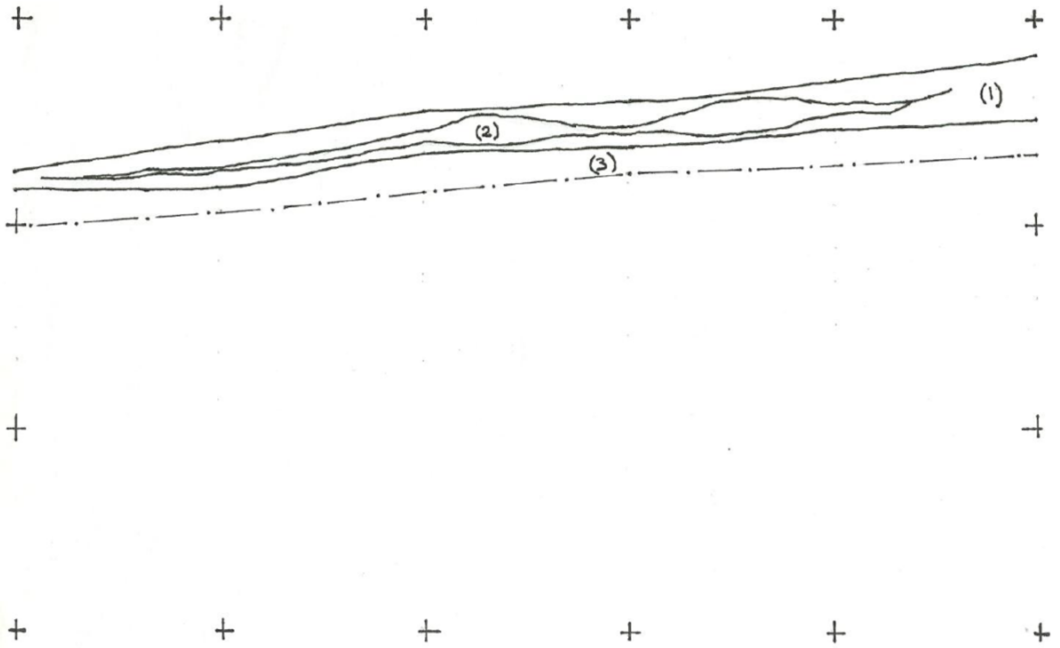
NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHSITE
archaeological site
recording scheme

Update of NZAA Site Number: R11/19

SITE TYPE Pa
SITE NAME(S) Puketapapa

DATE RECORDED (*if new site*)
DATE OF THIS UPDATE 09/09/2010



Section drawing showing the east facing section exposed on the eastern side of Mt Roskill/Puketapapa.
Grid = 1m.

1. Topsoil: Firm, dark blackish brown, clayey silt with occasional gravel/scoria
2. Midden: Moderately compacted, dark brownish black, silt with some dense shell patches and moderate rocks and charcoal.
3. Subsoil: Firm, dark reddish brown, silty clayey subsoil with moderate rocks.

GPS point taken at midden location with a handheld Garmin GPS unit: E:2665267 N:6475047 +/-7m

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHSITE
archaeological site recording scheme

Site Record Form

NZAA SITE NUMBER: R11/354

SITE TYPE: Midden/Oven

SITE NAME(s):

DATE RECORDED:

SITE COORDINATES (NZTM) Easting: 1755516 **Northing:** 5912758 **Source:** On Screen

IMPERIAL SITE NUMBER: N42/362 **METRIC SITE NUMBER:** R11/354

Finding aids to the location of the site

92 Stamford Park Road.

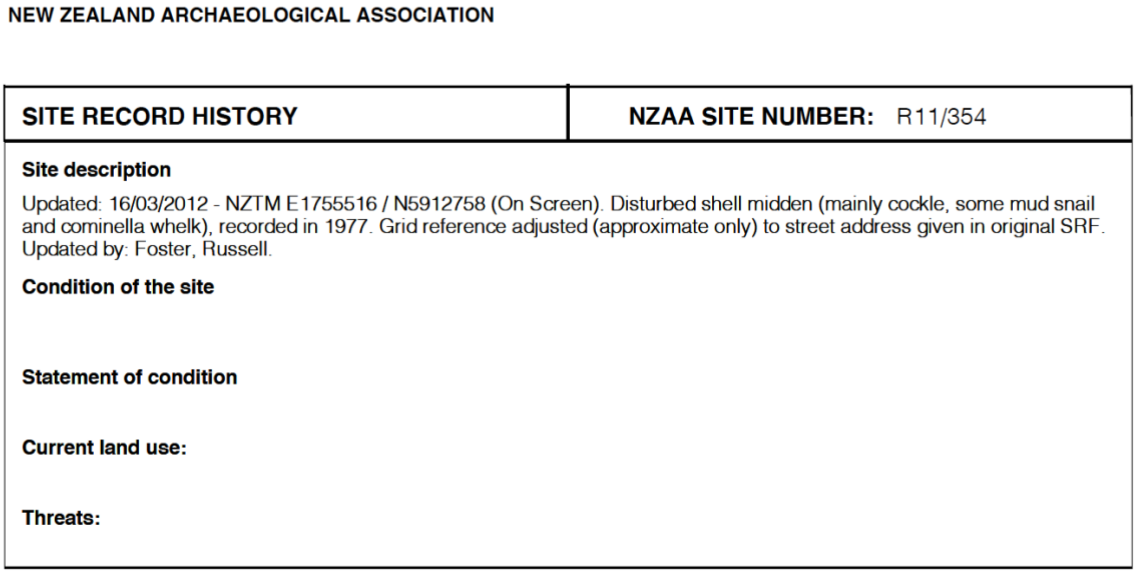
Brief description

Midden.

Recorded features

Midden

Other sites associated with this site



NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD HISTORY **NZAA SITE NUMBER:** R11/354

Site description

Updated: 16/03/2012 - NZTM E1755516 / N5912758 (On Screen). Disturbed shell midden (mainly cockle, some mud snail and cominella whelk), recorded in 1977. Grid reference adjusted (approximate only) to street address given in original SRF. Updated by: Foster, Russell.

Condition of the site

Statement of condition

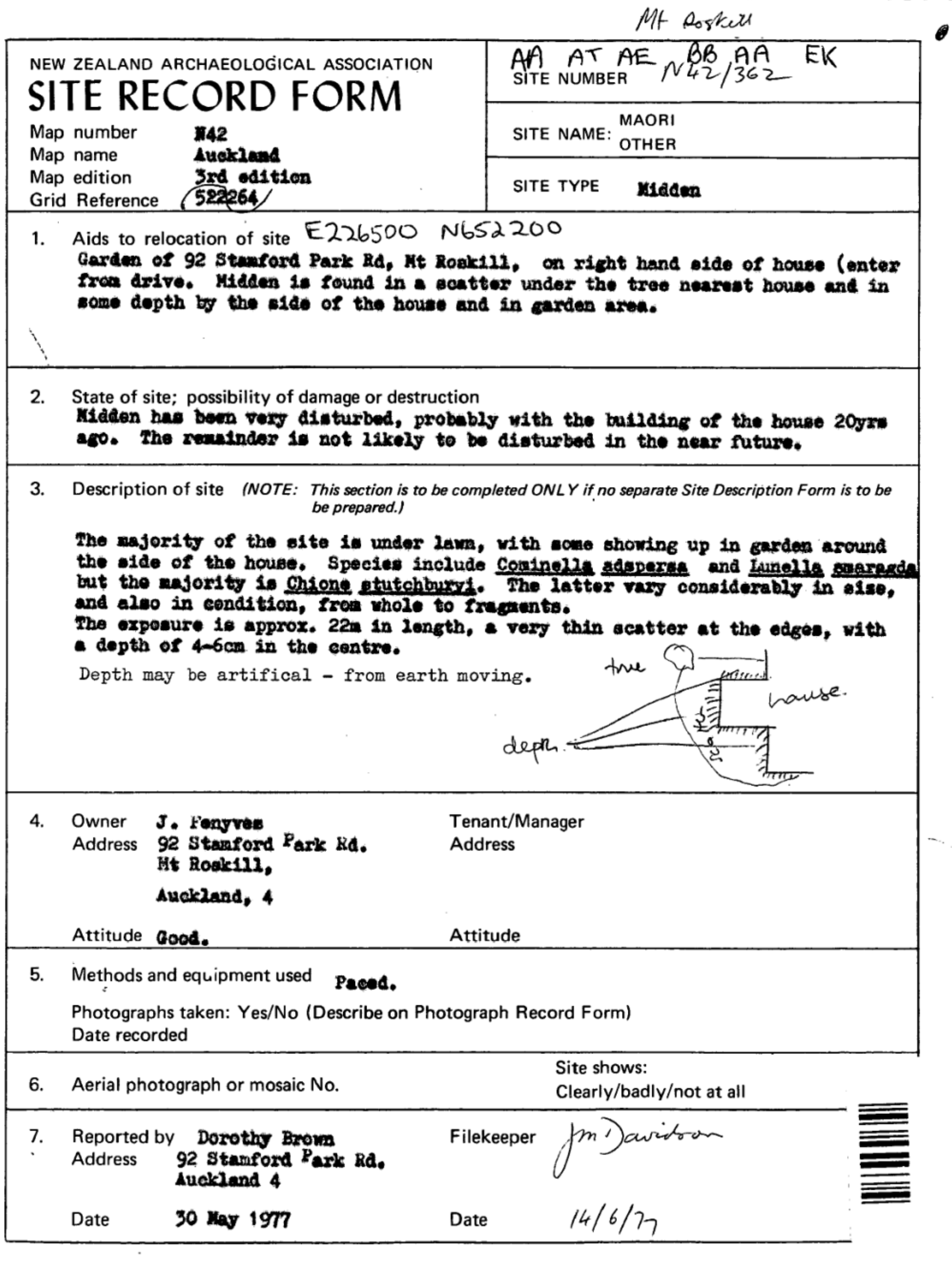
Current land use:

Threats:

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD INVENTORY	**NZAA SITE NUMBER:** R11/354

Supporting documentation held in ArchSite



Mt Roskill

NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD FORM

Map number N42
Map name Auckland
Map edition 3rd edition
Grid Reference 522264

AA AT AE BB AA EK
SITE NUMBER N42/362

SITE NAME: MAORI
OTHER

SITE TYPE Midden

1. Aids to relocation of site E226500 N652200
Garden of 92 Stamford Park Rd, Mt Roskill, on right hand side of house (enter from drive. Midden is found in a scatter under the tree nearest house and in some depth by the side of the house and in garden area.

2. State of site; possibility of damage or destruction
Midden has been very disturbed, probably with the building of the house 20yrs ago. The remainder is not likely to be disturbed in the near future.

3. Description of site *(NOTE: This section is to be completed ONLY if no separate Site Description Form is to be prepared.)*

The majority of the site is under lawn, with some showing up in garden around the side of the house. Species include <u>Cominella adspersa</u> and <u>Lunella smaragda</u> but the majority is <u>Chione stutchburyi</u>. The latter vary considerably in size, and also in condition, from whole to fragments.
The exposure is approx. 22m in length, a very thin scatter at the edges, with a depth of 4-6cm in the centre.
Depth may be artifical - from earth moving.

4. Owner J. Fenyves
Address 92 Stamford Park Rd.
Mt Roskill,
Auckland, 4

Attitude Good.

Tenant/Manager
Address

Attitude

5. Methods and equipment used Paced.

Photographs taken: Yes/No (Describe on Photograph Record Form)
Date recorded

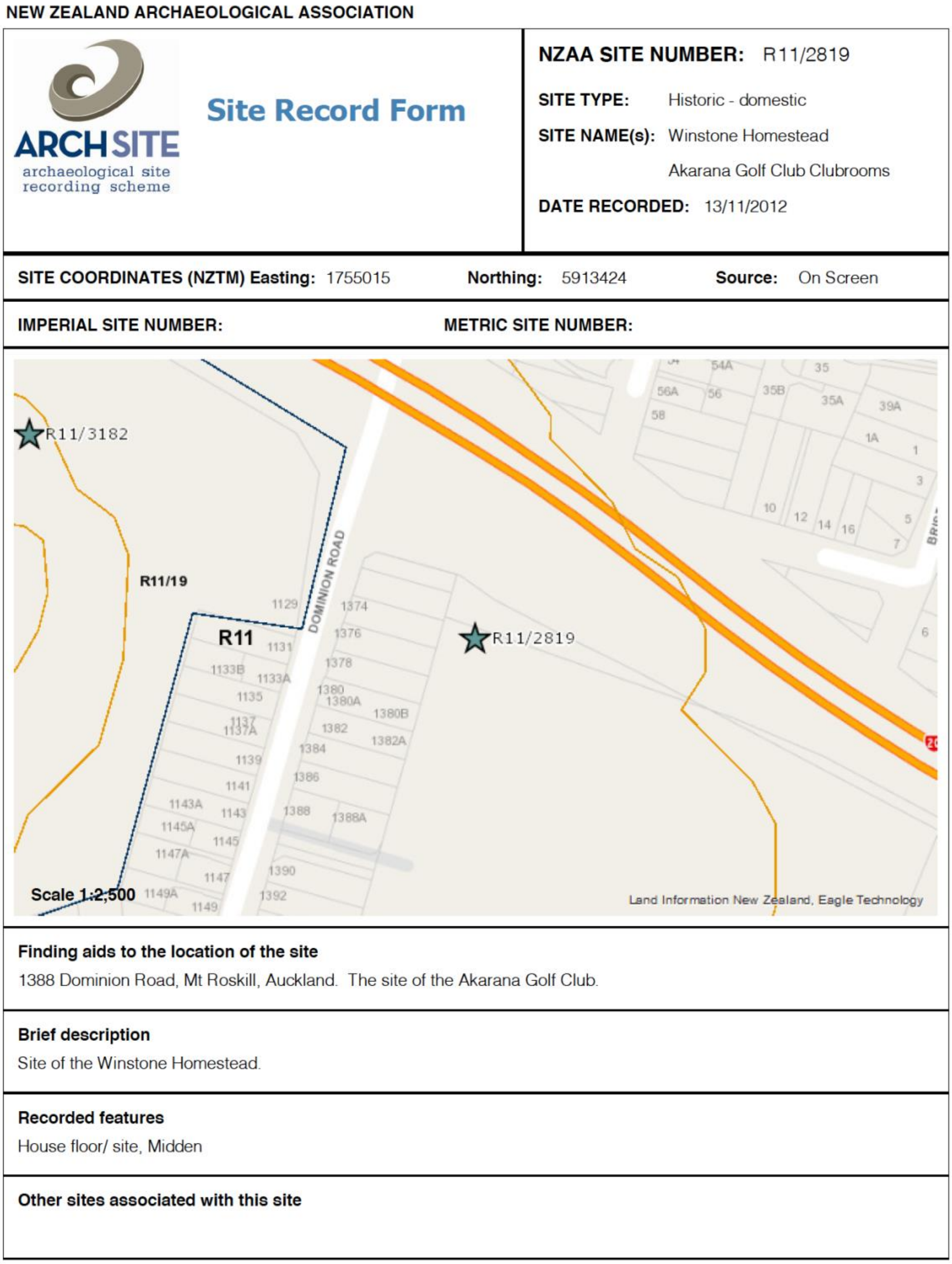
6. Aerial photograph or mosaic No.
Site shows:
Clearly/badly/not at all

7. Reported by Dorothy Brown
Address 92 Stamford Park Rd.
Auckland 4

Date 30 May 1977

Filekeeper JM Davidson

Date 14/6/77



NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

ARCHSITE archaeological site recording scheme

Site Record Form

NZAA SITE NUMBER: R11/2819

SITE TYPE: Historic - domestic

SITE NAME(s): Winstone Homestead

Akarana Golf Club Clubrooms

DATE RECORDED: 13/11/2012

SITE COORDINATES (NZTM) Easting: 1755015 **Northing:** 5913424 **Source:** On Screen

IMPERIAL SITE NUMBER: **METRIC SITE NUMBER:**

Finding aids to the location of the site

1388 Dominion Road, Mt Roskill, Auckland. The site of the Akarana Golf Club.

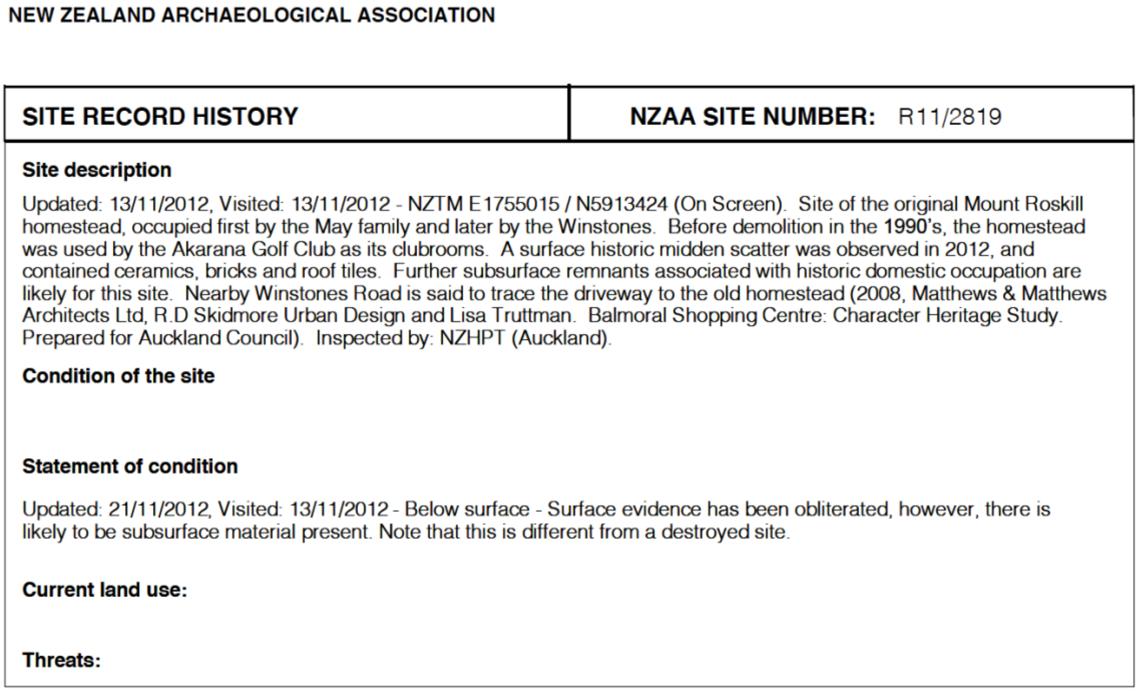
Brief description

Site of the Winstone Homestead.

Recorded features

House floor/ site, Midden

Other sites associated with this site



NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION

SITE RECORD HISTORY	**NZAA SITE NUMBER:** R11/2819

Site description

Updated: 13/11/2012, Visited: 13/11/2012 - NZTM E1755015 / N5913424 (On Screen). Site of the original Mount Roskill homestead, occupied first by the May family and later by the Winstones. Before demolition in the **1990's**, the homestead was used by the Akarana Golf Club as its clubrooms. A surface historic midden scatter was observed in 2012, and contained ceramics, bricks and roof tiles. Further subsurface remnants associated with historic domestic occupation are likely for this site. Nearby Winstones Road is said to trace the driveway to the old homestead (2008, Matthews & Matthews Architects Ltd, R.D Skidmore Urban Design and Lisa Truttman. Balmoral Shopping Centre: Character Heritage Study. Prepared for Auckland Council). Inspected by: NZHPT (Auckland).

Condition of the site

Statement of condition

Updated: 21/11/2012, Visited: 13/11/2012 - Below surface - Surface evidence has been obliterated, however, there is likely to be subsurface material present. Note that this is different from a destroyed site.

Current land use:

Threats:

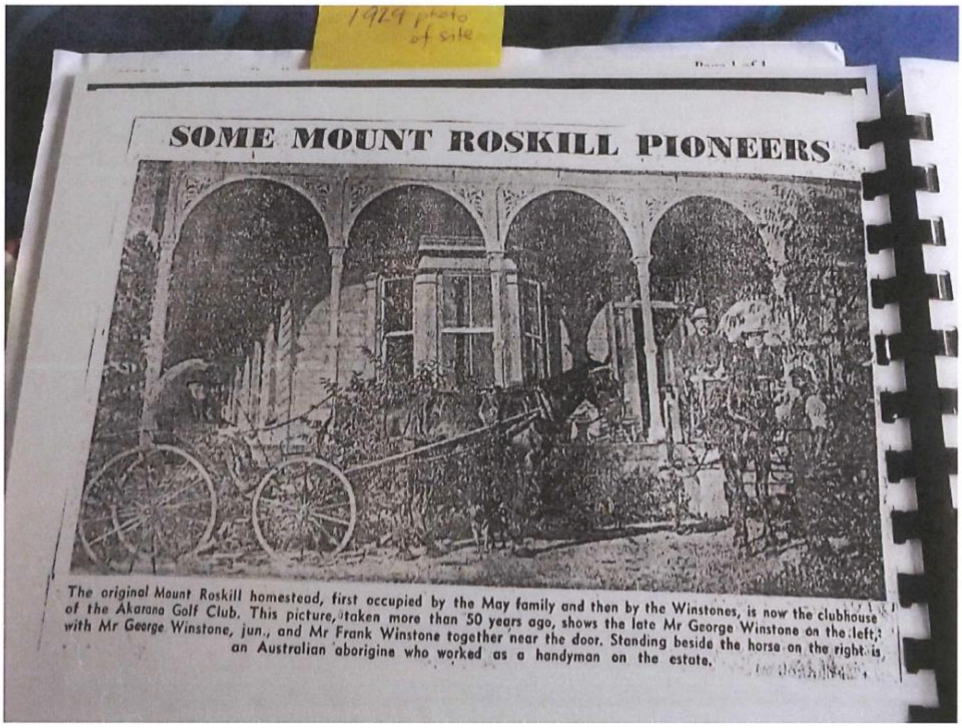
1

Mt Roskill

JOSEPH MAY AND WINSTONE FAMILY BOUNDARY FENCE FINDINGS

5 OCTOBER 2012

By JOHN P ADAM



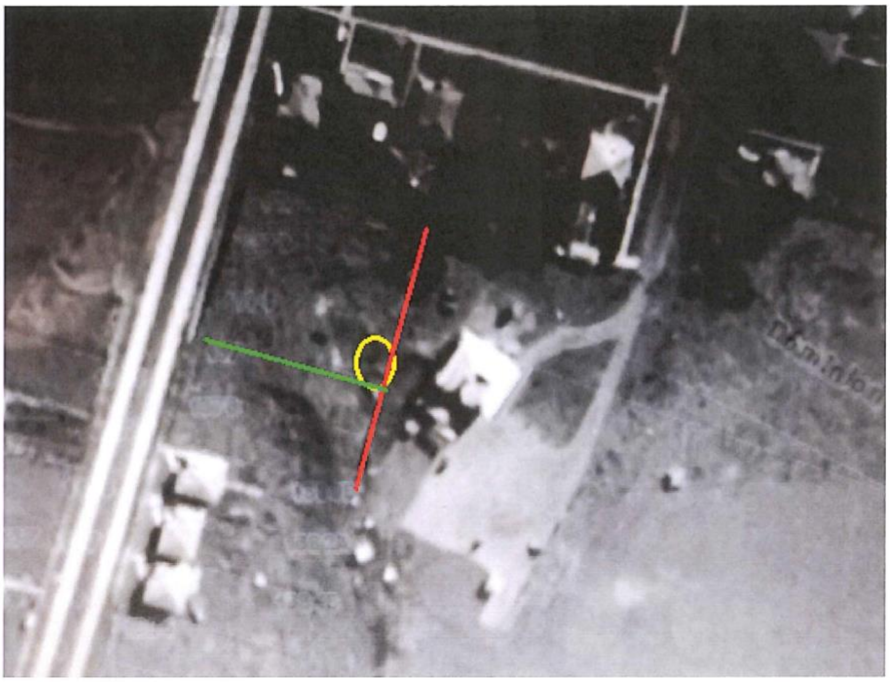
1929 photo of site

SOME MOUNT ROSKILL PIONEERS

The original Mount Roskill homestead, first occupied by the May family and then by the Winstones, is now the clubhouse of the Akarana Golf Club. This picture, taken more than 50 years ago, shows the late Mr George Winstone on the left, with Mr George Winstone, jun., and Mr Frank Winstone together near the door. Standing beside the horse on the right is an Australian aborigine who worked as a handyman on the estate.

This image was recently found bound in an undated newspaper clipping scrap book created by Eddie Tell. Titled "Historical Record for Mount Roskill".

Location of scatter.



Red –Boundary fence between golf club and road reserve

Yellow – Scattered crockery, pottery, slate roof tile etc.

Green – New boundary fence between houses and road reserve

3

GIS images from Auckland City web site – records house in situ

GIS image from 1990s with house removed

4

GIS aerial from 2000's marking location of scatter (yellow) and house site (red).

Appendix I: Arboricultural Impact Assessment

The Tree Consultancy Company
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Browns Bay
Auckland, 0753

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0508 TREE CO (873 326)
TreeConsultancy.co.nz

Arboricultural Report

Keith Hay Park
on
CC9 Sewer

Prepared for	**Watercare Services Ltd**	Prepared by	**Ian Lawson** Urban Forest and Tree Consultant
		DATE	26 May 2021
		Job ref #	1821
		Reviewed by	Sean McBride

1 Introduction

1.1 Watercare Services Ltd proposes to construct a new sewer from Richardson Road, north to the Cameron Pool and Leisure Centre car park, through Keith Hay Park, Mt Roskill. The Tree Consultancy Company has been engaged to provide an arboricultural assessment of effects relating to protected and non-protected trees. It is based on a site visit on 19th January 2021 with the project team, a second site visit on 27th January with Natalie Marsden, Urban Forest Specialist for Auckland Council, and concept drawings from Watercare.

1.2 The Tree Consultancy Company provided arboricultural supervision for the footpath and car park renewals from Richardson Rd – Noton Road that were carried out in the park in 2018. Therefore, we are familiar with historical works around these trees and have considered this aspect when assessing potential cumulative effects.

2 Key points

- From Richardson Road to the Eden Roskill Cricket Club car park (MH05 or MH06), the sewer may be trenched (or otherwise will be trenchless)
- The remainder through to Cameron Pool and Leisure Centre car park will be trenchless
- Manhole chambers/reception pits are required along the pipeline
- Launching areas are needed for the trenchless sections
- Higher value amenity trees are marked for mandatory retention
- Pruning and work within the root zones of protected trees are required
- 34 trees are proposed for removal and replacement, of which 22 are protected. Of these 22 trees, I note that:
  - Five trees will require removal
  - A further seventeen trees potentially could be retained. However, consent is sought for removal, where is it not reasonable to retain
- Two trees are in poor condition
- Tree retention is the primary focus, and worst-case numbers are given for removal if needed
- Many of the trees can be retained with arborist supervision
- Replanting numbers of individual specimen trees are provided for each tree
- Protected trees will be replaced in similar positions with additional mixed planting to make up the deficit
- If trenchless methods install the entire pipeline, the need for tree removal is significantly reduced
- Watercare wishes to use the tree protection methodologies associated with the Central Interceptor project

3 Appendices

- Appendix A – Tree location plans 1821_001-4_A
- Appendix B – Tree inventory
- Appendix C – 2019 Arborlab Tree Protection Methodology, for Keith Hay Park

4 Statutory context

4.1 Relevant zones applicable:

- Open Space - Sport and Active Recreation Zone

4.2 Relevant Auckland Unitary Plan sections that apply:

- E26 Infrastructure

Table E26.4.3.1 Activity table

(A83) Tree trimming or alteration as a Permitted Activity

(A87) Works within the protected root zone that comply with Standard E26.4.5.2 as a Permitted Activity

(A88) Works within the protected root zone not otherwise provided for as a Restricted Discretionary Activity

(A91) Tree alteration or removal of any tree less than 4m in height and/or less than 400mm in girth as a Permitted Activity
(A92) Tree alteration or removal of any tree greater than 4m in height and/or greater than 400mm in girth as a Restricted Discretionary Activity

Tree owner approval (TOA) is a prerequisite for all activities affecting Council-owned trees and vegetation.

5 Arboricultural comments

Richardson Road – Eden Roskill Cricket Club car park

5.1 The pipeline will potentially be open trenched and benched or shored, depending on the depth. There are several trees west of the start point, within Waikōwhai Intermediate School, close to the alignment (two early mature kahikatea and one monkey apple). The two kahikatea are far enough away that no effects are expected. The monkey apple is in decline and was noted as such in 2018 during the car park works. The tree is in a mortality spiral and will not recover.

5.2 Trees along the eastern edge of the car park are within Hay Park school grounds. If the works area is limited to the footpath edge, then effects can be avoided. Some pruning may be needed to reduce the overhang.

5.3 Also, on the school grounds are two ash trees (5 and 6) that grow close together to form a shared crown. They are generally slender, overextended in their branch forms, and lean out over the Hillsborough Kindergarten car park and entrance. Tree 5 was particularly sparse, and this was also noted during the 2018 works where the tree defoliated during summer. The root zone beneath was previously used for storing green waste for some time. At the recent site visit, the area had been levelled and re-seeded with grass. If the soil was scraped away before levelling, there might have been some root disturbance. The only area of permeable root zone for these trees is within the school. As tree 6 is the larger, healthier tree, natural competition for water resources may play some part in tree 5's ongoing poor vitality.

5.4 The first option proposed was to have a manhole in the car park and direct the pipeline around trees 5 and 6. The depth and extent of earthworks cannot adequately avoid the root zone and nearby building. Given that the trench would sever and fragment the only permeable root zone area, the cumulative effects are too great to retain these trees. Therefore, both trees are proposed for removal, and replacement, which will be managed as part of the landowner approval process.

5.5 Two small taupata (tree 8) at the cricket club car park's southern edge will be removed for the last part of the open cut section. The small triangle of berm is ideal for replanting as part of the project mitigation.

Eden Roskill Cricket Club car park – Cameron Leisure Pools car park

5.6 This section will be constructed using trenchless methods at depths between 5-8 m, with manhole chambers and reception pits needing to be installed along the line. The cricket club car park was extended as part of the works previously supervised, and I have knowledge of the underlying root architecture of some trees present. The current aerial photos do not represent the extended car parking to the north of the cricket club building. The alignment north from here follows the line of the concrete footpath, the manholes will be within the path surface. The path will be used as machinery and vehicle access between the two car parks for construction.

5.7 Given the depths of the manholes, the working area needed to install them will be proportionally larger than the chamber diameters. For the most part, these can be positioned between trees rather than adjacent to them. A worst-case approach has been used, and trees are proposed for removal to prevent hold-ups during construction. Some trees may be able to be retained with supervision during works.

5.8 The manhole near tree 15 will need to be in line with the footpath. The area to the west of this tree is now a car park, with a kerb and drain along the eastern edge, closest to the tree. This area was excavated to approximately 600 mm depth during previous works, with little root activity encountered. Therefore, provided that any excavation for the manhole installation is within the car park, the root zone disturbance is expected to be within tolerable levels. The small tree showing west of tree 16 was transplanted to the cricket field edge further north (tree 60).

5.9 Trees on the western sports field side are considered of higher amenity value for park users[1] and have all been identified for mandatory retention. Tree removal has been generally limited to the row of London planes on the eastern side of the footpath. Many of these are affected by seasonal anthracnose and canker. This was noted in other plane trees around the park.

5.10 The trees along the eastern edge of the footpath are all early mature plane trees. The species is known to tolerate root zone disturbance, and provided that excavation does not infringe past the concrete surface, these trees will be minimally affected. Many of these will need some minor pruning to provide clearance over the path as a precaution to avoid damage from vehicle movements. This will all be within permitted standards, and no greater than 5% of live foliage from any tree will be removed.

5.11 Tree 29 has been identified for removal as connections to tie into existing infrastructure will be needed in this area. The tree is of poor vitality. There is fissuring of the trunk bark to 3 m, typical of canker, and the tree has been unable to react to the damage. There is some browning of the leaves, likely from seasonal anthracnose, compounding the effects. Overall, the tree is in fair condition and is not expected to improve. Removal was supported in principle by the urban forest specialist.

5.12 There is an early mature willow myrtle at the northern end of the path, where it meets the Cameron Pool and Leisure Centre car park (tree 45). It overhangs the footpath and will affect the access needed. There are several areas of damage, decay and dieback in the crown, and this species does not readily occlude such wounds. Removal and replacement are proposed for these reasons.

Cameron Pool and Leisure Centre car park

5.13 The car park has several planted islands demarking the parking areas, containing juvenile-early mature trees planted when it was last renewed. Directly adjacent to the footpath are two juvenile rimu (48 and 49). Tree 49 has an irregular form and a pronounced lean. Both trees' root plates move when pushed by hand. This is probably a result of poor nursery stock and planting practices and is not something that trees can correct. These and several other juvenile trees nearby are proposed for removal and replacement to allow access to the path and a drill launching area.

5.14 Tree 54 is a mature Norfolk Island pine. The pipeline passes through the root zone of the tree at a depth of approximately 8 m. At that depth, there are no effects expected.

5.15 At the northern end of the car park, another working and yard area is needed for the drilling operation. Several small trees are establishing in the islands (trees 55-58) that will require removal. No assessment of underlying services, drainage etc., has been made in consideration of transplanting, so removal and replacement are applied for in the first instance. If they can be easily transplanted nearby at the time of works, this may be attempted under the direction of the works arborist.

6 Mitigation

6.1 We used the tree DBH measurements and modelling from i-Tree to make some inferences about ecosystem services (The i-Tree Development Team, 2020, Nowak & Crane, 2000). The i-Tree software quantifies ecosystem services provided by trees based on input dimensions, known species characteristics and growth rates. Using this tool, it is possible to forecast how a tree will perform over time and specifically how much carbon it is expected to sequester. With reference to the removal of trees, the remedial planting needs to account for lost future benefits since all benefits up to the date of removal have already been received (Nowak & Aevermann, 2019). That is, the replanting needs to account for the future carbon sequestration of the trees being removed.

6.2 We used the dimensions of the trees proposed for removal and forecast the carbon sequestration values for 29 years. A value of 29 years was chosen because a goal has been set for carbon neutrality by the Climate Change Response (Zero-Carbon) Amendment Act (2019) by 2050.

---

[1] Due to the shading they can cast for spectators during sported events, etc.

Therefore, the remedial planting needs to account for this carbon ‘footprint’ if carbon neutrality is to be achieved.

6.3 Using the same tool and with known dimensions of 45-L grade nursery trees, the benefits of these nursery trees are forecast in the same way. Therefore, the remedial planting needs to match or exceed the value of total stored carbon, which would have been achieved by the existing asset at the end of the forecast period, e.g., sequestered carbon. These trees need to be planted in such a way as to achieve optimum final dimensions over time, e.g., as part of a formal park or street tree asset. If space limits this, then larger numbers of smaller trees or revegetation planting can be used to offset this in a similar way.

6.4 In Keith Hay Park, there are limited spaces for replanting. It will not be possible to plant all the replacements in 45-litre grades within the park. Therefore, for each tree removed, a single 45-litre replacement will be replanted close to the same spot wherever possible, with an additional 10 m² of mixed native planting added elsewhere. This mixed area will be smaller grade plant sizes and will include one 8 litre specimen tree. Replacement numbers for each tree are included in the tree inventory (Appendix B). The final planting plan will be subject to landowner approval and approval of the urban forest specialist within Community Facilities, within the budget set in line with Appendix B.

6.5 An area at the north of Keith Hay park has been identified where similar mixed planting is establishing and can be added to, subject to landowner approval and approval of the urban forest specialist within Auckland Council’s Community Facilities. The car park islands at Cameron Pool and Leisure Centre and Eden Roskill Cricket Club should be replanted like for like where vegetation is removed for the project. A minimum three-year aftercare period is recommended to ensure establishment, including watering during summer months and periods of drought.

7 Conclusions and recommendations

7.1 Watercare Services proposes to construct a new sewer from Richardson Rd to Cameron Pool and Leisure Centre car park through Keith Hay Park. The pipeline is likely to be installed using a combination of open-cut trenching and trenchless methods with manholes along the alignment. A worst-case approach has been taken to trees in that open-cut trenching has been considered for the southern section of the works, and removal is applied wherever possible conflict is expected. It is understood that the proposed construction methodology will prioritise tree retention as far as practicable. I anticipate that many trees can be retained and worked around with supervision. If trenchless methods are used to install the entire pipeline, the need for tree removal is significantly reduced.

7.2 In most cases, there are no arboricultural reasons that alone warrant tree removal. However, the need for infrastructure improvements is the primary rationale for removal. Trees considered of the highest amenity value in the setting are marked for mandatory retention. As a result, the worst-case approach is taken to the remaining trees to allow work to proceed without hold-ups.

7.3 The mitigation suggested is calculated to ensure there is no deficit in ecosystems service benefits the trees have the capability to provide. The replanting will be a mixture of specimen trees and group plantings. The works arborist will document all tree removal and provide final planting numbers and areas.

7.4 Given the size of the project and the number of staff involved, it is vital that tree protection is at the forefront of staff training and induction for the site. A site-specific tree protection fence layout is provided in Appendix A. This should be set up in active work areas and signed off by the works arborist before any other site establishment. These will then clearly demarcate areas where works arborist input or supervision is needed. As the required fencing length is substantial, a simple mesh and steel post option is suggested; however, this may need to be upgraded at pinch points. Fencing repositioning and type will be at the discretion of the works arborist.

7.5 Watercare will use an existing tree protection document for the adjacent central interceptor project for this project to avoid duplication. I have reviewed the document (Arborist Tree Protection Management Plan - Keith Hay Park Appendix L3 to the CMP (GAJV-PLN-00017)) – written by Leon Saxon. The tree protection methodology contained is appropriate. It should be noted that the term dripline and references to 35 mm roots are no longer appropriate measures for tree protection areas or unsupervised root pruning. The root zones shown in Appendix A are the protected areas to be used. All root severance must be assessed dynamically by a suitably experienced works arborist considering the cumulative effects on each tree.

7.6 Tree protection is often forgotten over the course of long projects. I recommend that all existing staff have a training update given the age of this document, and new personnel are given the proper induction training around tree protection.

7.7 It is recommended that tree protection measures prescribed in the management plan in Appendix C are adhered to at all times, in conjunction with this report, and that these form a part of the tender documents. Following the recommendations in this report will allow works to proceed with minimal effects to all retained trees.

Please contact the author for further information.

Ian Lawson
Urban Forest and Tree Consultant
The Tree Consultancy Company
I.S.A Certified Arborist® NZ-0221A

Bibliography

Nowak DJ, Aevermann T, 2019. Tree compensation rates: Compensating for the loss of future tree values. *Urban Forestry & Urban Greening* **41**, 93-103.

Nowak DJ, Crane DE, 2000. The Urban Forest Effects (UFORE) model: quantifying urban forest structure and functions. In: Hansen M, Burk T, eds. St. Paul, MN, USA: U.S. Dept. of Agriculture, Forest Service, North Central Forest Experiment Station, 714-20. (Integrated tools for natural resources inventories in the 21st century.)

The I-Tree Development Team, 2020. *i-Tree Eco V. V.6.35* USA: USDA Forest Service.

Watercare

Keith Hay Park - CC9 Sewer
Appendix A
Tree Location Plan

The TREE CONSULTANCY COMPANY

Project No. 1821

Drawing: 1821_001

Rev: A

Watercare

Keith Hay Park - CC9 Sewer
Appendix A
Tree Location Plan

The TREE CONSULTANCY COMPANY

Project No. 1821

Drawing: 1821_002	Rev: A

Watercare

Keith Hay Park - CC9 Sewer
Appendix A
Tree Location Plan

The TREE CONSULTANCY COMPANY

Project No. 1821

Drawing: 1821_003

Rev: A

Keith Hay Park - CC9 Sewer
Appendix A
Tree Location Plan

Project No. 1821

Drawing: 1821_004

Rev: A

Tree number	No. of trees	Species	Common name	Height (m)	DBH (cm)	Structural root zone radius (m) (Coder, 1996)	Root zone radius (m)	Overall vitality	Branch structure	Form	Age class	Ownership	Protection	Proposed activity	Replacement specimen tree numbers (45 litre) One column only.		Arboricultural comments
															Exotic	Native	
1	2	*Dacrycarpus dacrydioides*	Kahikatea	8	23.9	1.5	4.7	Good	Good	Good	Early-mature	Waikōwhai School	Non-protected	Retain and protect			
2	1	*Syzygium smithii*	Monkey apple	10	76.4	2.9	n/a	Poor	Fair	Fair	Over-mature	Waikōwhai School	Non-protected	Retain and protect			Tree in decline. Approximately 10 % Live foliage remaining. Hard up against the chain link fence. 4.2 m from the car park edge. This tree was noted as being in decline when we previously worked at this site two years ago.
3	3	*Pittosporum crassifolium*	Karo	5	19.1	1.4	4.4	Good	Fair	Fair	Early-mature	Hay Park School	Non-protected	Retain and protect			Group of three trees along fence. Overhangs path by 2 m.
4	1	*Acacia* sp.	Wattle	5	47.7	2.3	5.2	Good	Fair	Fair	Early-mature	Hay Park School	Non-protected	Prune - Retain and protect			1 m inside school fence. Multi stemmed. Estimated girth at 300 mm. Two stems leaning on fence with most overhang into car park. Prune two branches. Footpath is the tree protection fence line.
5	1	*Fraxinus sp.*	Ash	12	41.7	2.1	5.2	Fair	Fair	Fair	Early-mature	Hay Park School	Non-protected	Remove	3*	4*	Lead tip scorch. Tree defoliating and was noted to have been almost completely defoliated during previous works here. The area around the trunk has been used for green waste storage and is amended, raised, and compacted in places. Re grassed since previous assessment. The entire western root zone is impermeable 50% coverage.
6	1	*Fraxinus sp.*	Ash	12	57.7	2.5	5.2	Good	Fair	Fair	Early-mature	Hay Park School	Non-protected	Remove	3*	4*	The area around the trunk has been used for green waste storage and is amended, raised, and compacted in places. Re grassed since previous assessment. The entire western root zone is impermeable 50% coverage. Western stem resting on fence. Cavity forming in ne stem at 2 m at the point of an old pruning wound. Two similar sized wounds above, also showing decay.
7	1	*Acer buergerianum*	Trident maple	6	15.3	1.2	4.1	Good	Fair	Good	Mature	Hay Park School	Non-protected	WWRZ – remove if needed	4	5	Significant ongoing mower damage to the root collar. One structural root has been damaged and died back to the trunk. The roots have replaced this but are still being damaged by the mower.
8	2	*Coprosma repens*	Taupata	3	9.5	0.9	1	Good	Good	Good	Mature	Council	Non-protected	Remove	2*	2*	Remove and replace. Replant this island after works.
9	1	*Metrosideros excelsa*	Pōhutukawa	7	57.9	2.5	4	Good	Good	Good	Early-mature	Council	Protected	Retain and protect			
10	1	*Metrosideros excelsa*	Pōhutukawa	5	21.3	1.5	2.5	Poor	Fair	Fair	Early-mature	Council	Protected	Retain and protect			Structural root and root collar damage and decay. 50 % live crown. Tree moves at root collar when pushed. Recommend removal.
11	1	*Lagunaria patersonii*	Norfolk Island hibiscus	6	27.7	1.7	4	Good	Good	Good	Early-mature	Council	Protected	Retain and protect			
12	1	*Metrosideros excelsa*	Pōhutukawa	4.5	19.1	1.4	2.9	Poor	Fair	Fair	Early-mature	Council	Protected	Retain and protect			Mower damage to structural Roots resulting in decay. Damage compounded by weed spraying. Space crown approximately 50% live foliage.
13	1	*Platanus x acerifolia*	London plane	8	30.2	1.8	5.9	Good	Fair	Good	Early-mature	Council	Protected	Retain and protect			Canker at base of trunk. Failed branch. Incomplete unions. Mower damage compounded by weed spraying.
14	1	*Metrosideros excelsa*	Pōhutukawa	4.5	20.7	1.4	2.3	Good	Good	Good	Early-mature	Council	Protected	Retain and protect			
15	1	*Metrosideros excelsa*	Pōhutukawa	5	25.1	1.6	2.9	Good	Good	Good	Early-mature	Council	Protected	Retain and protect			
16	1	*Platanus x acerifolia*	London plane	8	27.7	1.7	5.3	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	2.15 from car park and pruned back to this line by previous works. WWRZ for chamber construction. Some leaf browning, typical of anthracnose.

17	1	*Platanus x acerifolia*	London plane	10	39.5	2.0	5.6	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	4	4	2.3 m from car park and pruned back to this line by previous works. WWRZ for chamber construction. Some leaf browning, typical of anthracnose.
18	1	*Platanus x acerifolia*	London plane	10	35.0	1.9	4	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	4	4	
19	1	*Platanus x acerifolia*	London plane	9	24.5	1.6	5.1	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
21	1	*Platanus x acerifolia*	London plane	10	36.6	2.0	6.7	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	4	4	
22	1	*Platanus x acerifolia*	London plane	9	27.4	1.7	5.9	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
23	1	*Platanus x acerifolia*	London plane	10	28.3	1.7	5.4	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
24	1	*Cryptomeria japonica*	Japanese red cedar	10	38.2	2.0	5	Good	Good	Good	Early-mature	Council	Protected	WWRZ – Retain and protect			
25	1	*Casuarina cunninghamiana*	River oak	12	54.4	2.4	6.7	Fair	Poor	Poor	Mature	Council	Protected	WWRZ – Retain and protect			Codominant central eastern stem has snapped out. Remaining diameter of trunk proximately 40 to 50%. Sparce foliage, considerable epicormic growth at the base, significant mower damage of all surface routes within the spray circle.
26	1	*Platanus x acerifolia*	London plane	10	32.1	1.8	5.5	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ – Retain and protect			
27	1	*Casuarina cunninghamiana*	River oak	18	72.6	2.9	8.7	Good	Good	Good	Mature	Council	Protected	WWRZ – Retain and protect			
28	1	*Platanus x acerifolia*	London plane	10	31.2	1.8	6.6	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ – Retain and protect			
29	1	*Platanus x acerifolia*	London plane	10	28.6	1.7	3.5	Poor	Fair	Fair	Early-mature	Council	Protected	Remove	3	4	Central upper Stem is dead. Very sparse foliage throughout approximately 10 to 20% the life of the Live foliage remaining. Dense flush of epicormic growth. Browning leaf tips throughout typical of anthracnose. Bark fissuring on the trunk typical of canker to 3 m. Apply for removal of this tree to construct the manhole chamber and tie in with the existing services across the channel.
30	1	*Platanus x acerifolia*	London plane	9	26.1	1.6	5.2	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
31	1	*Platanus x acerifolia*	London plane	9	30.9	1.8	7.3	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
32	1	*Platanus x acerifolia*	London plane	9	27.7	1.7	6.8	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
33	1	*Platanus x acerifolia*	London plane	10	26.1	1.6	4.7	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ – Retain and protect			Minor pruning for machinery access within permitted standards.
34	1	*Cordyline australis*	Cabbage tree	6	26.1	1.6	3	Good	Fair	Good	Mature	Council	Protected	WWRZ – Retain and protect			Some damage at base from mowing operations no signs of wound wood.
35	1	*Cryptomeria japonica*	Japanese red cedar	14	43.0	2.1	7	Good	Good	Good	Early-mature	Council	Protected	WWRZ – Retain and protect			
36	1	*Banksia integrifolia*	Coast banksia	12	59.8	2.6	7.2	Good	Good	Good	Mature	Council	Protected	WWRZ – Retain and protect			
37	1	*Cryptomeria japonica*	Japanese red cedar	15	50.9	2.4	7.5	Good	Good	Good	Mature	Council	Protected	WWRZ – Retain and protect			
38	1	*Platanus x acerifolia*	London plane	8	25.5	1.6	5.1	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ – Retain and protect			
39	1	*Platanus x acerifolia*	London plane	12	24.5	1.6	6	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	

40	1	*Platanus x acerifolia*	London plane	7	18.1	1.3	5.1	Fair	Fair	Fair	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
41	1	*Platanus x acerifolia*	London plane	10	22.6	1.5	4.9	Fair	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
42	1	*Platanus x acerifolia*	London plane	10	18.8	1.4	4.4	Fair	Fair	Fair	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	Space foliage in upper crown. Some die back in upper crown. Notably less developed than the other trees in the row.
43	1	*Platanus x acerifolia*	London plane	7	20.1	1.4	5.1	Good	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
44	1	*Platanus x acerifolia*	London plane	7	20.7	1.4	5.2	Fair	Good	Good	Early-mature	Council	Protected	Prune/WWRZ - Remove if needed	3	4	
45	1	*Agonis flexuosa*	Willow myrtle	6	37.6	2.0	4.8	Fair	Poor	Poor	Early-mature	Council	Protected	Remove	5	7	Crown lift pruning over the footpath currently 1.8 m. Clearance will be needed for vehicle access along the footpath. Two previous failures and resulting tears, showing decay. Poor branch structure.
46	1	*Cordyline australis*	Tī kōuka	7	36.1	1.9	3.5	Good	Good	Good	Mature	Council	Protected	WWRZ - Remove if needed	2	2	
47	1	*Dysoxylum spectabile*	Kohekohe	2	6.4	0.7	2	Good	Good	Good	Juvenile	Council	Non-protected	Remove	4*	5*	
48	1	*Dacrydium cupressinum*	Rimu	3	6.7	0.8	2	Fair	Poor	Poor	Juvenile	Council	Non-protected	Remove	3*	3*	Pronounced lean and drooping apical tip. Root ball moves with ease when rocked. Likely poor stock and planting.
49	1	*Dacrydium cupressinum*	Rimu	3	9.5	0.9	2	Fair	Poor	Poor	Juvenile	Council	Non-protected	Remove	3*	3*	Root ball moves with ease when rocked. Likely poor stock and planting.
50	1	*Cordyline australis*	Tī kōuka	3	11.8	1.0	1.5	Good	Good	Good	Early-mature	Council	Non-protected	Remove if needed	2*	2*	
51	1	*Beilschmiedia tarairi*	Taraire	4	10.5	1.0	1	Fair	Good	Fair	Juvenile	Council	Protected	Remove	3	4	Root plates moves when rocked. Suspect root bound stock.
52	1	*Cinnamomum camphora*	Camphor laurel	2	9.5	0.9	1.5	Good	Fair	Fair	Juvenile	Council	Non-protected	Remove	4*	5*	Possibly self-seeded or root sucker from adjacent dead stem.
53	3	*Alectryon excelsus*	Tītoki	4	11.1	1.0	1.5	Good	Good	Good	Early-mature	Council	Protected	Retain and protect			
54	1	*Araucaria heterophylla*	Norfolk Island pine	25	99.3	3.4	13	Good	Good	Good	Mature	Council	Protected	WWRZ – Retain and protect			Apical tip lost and reshooting.
55	1	*Knightia excelsa*	Rewarewa	4	7.3	0.8	2	Good	Good	Good	Juvenile	Council	Protected	Transplant or remove	3	3	
56	1	*Dysoxylum spectabile*	Kohekohe	3.5	6.4	0.7	2	Good	Good	Good	Juvenile	Council	Non-protected	Transplant or remove	4*	5*	
57	1	*Dysoxylum spectabile*	Kohekohe	2	6.4	0.7	1	Good	Good	Good	Juvenile	Council	Non-protected	Transplant or remove	4*	5*	
58	1	*Beilschmiedia tarairi*	Taraire	4	7.0	0.8	1	Fair	Good	Fair	Juvenile	Council	Protected	Remove	3	4	Remove. Root plate moves when rocked. Suspect root bound stock. Noted during second site assessment: Branch snapped by footpath contractors, concrete spoil poured onto root zone.
59	1	*Platanus x acerifolia*	London plane	12	39.8	2.1	8.3	Good	Good	Good	Early-mature	Council	Protected	Retain and protect			1.9 m from path, directly opposite spur. Noted during second site assessment: roots severed by footpath contractors. Not pruned, concrete on torn roots, spoil against trunk, root zone compacted. No arb supervision used.
60	1	*Metrosideros excelsa*	Pōhutukawa	4		2		Good	Good	Good	Early-mature	Council	Protected	Retain and protect			Estimated dimensions.
61	1	*Vitex lucens*	Pūriri	5		2.5		Good	Good	Good	Early-mature	Council	Protected	Retain and protect			Estimated dimensions
62	1	*Metrosideros excelsa*	Pōhutukawa	5		2		Good	Good	Good	Early-mature	Council	Protected	Retain and protect			Estimated dimensions.
63	Mixed group	*Metrosideros excelsa*	Pōhutukawa	4-6		2.5		Good	Good	Good	Early-mature	Council	Protected	Retain and protect			Group of trees. Estimated dimensions.

DBH – Trunk diameter at 1.4 m – or at a height noted

WWRZ – Works within the root zone

Tree 20 omitted from table as it has died and been removed

Replacement tree numbers based on one column (exotic or native), not a total of both.

* Replacement numbers recommended to mitigate the loss of non-protected trees

TREE PROTECTION METHODOLOGY

1. Summary

- Site pre-commencement meeting held and documented.
- Temporary hard surfaces to be available where required whilst working in the vicinity of trees.
- Adherence to control methods as specified in the conditions of Resource Consents /Asset Owner Approvals (AOA).
- Works arborist to assist GAJV in the planning and execution of the works in the vicinity of the root zone of any of the retained trees.
- Arboricultural end of project report compiled and submitted if required or requested by GA-JV

2. Tree protection methodology

Pre-works

2.1 A suitably qualified and experienced arborist (works arborist) shall be engaged by the AOA/consent holder at the start of the project to assist GAJV in the planning and execution of the works in the vicinity of the trees. The appointed works arborist must be experienced in tree protection systems and construction methodologies, and will need to be capable of coordinating site works ensuring that the tree protection methodology is correctly implemented.

2.2 Identification of procedures for trees on site will be undertaken as set out in Table 2 below:

Table 2. Tree identification procedures

Action	How	Responsibility	To be documented/ confirmed by:
Identify trees for removal	Tree marked with a red X with dazzle 5 days prior to removal, in accordance with this plan. Checked by Approved Contractor before starting work each day. Approved contractor to contact GAJV if any discrepancies. Record that checks have been completed on daily 'tool box' pre start sheet.	GAJV Approved Contractor	GAJV
Identify trees for retention	Marked with pink ribbon, tied to tree 2 metres above ground level.	GAJV	GAJV
Identify scheduled trees	Attach 'scheduled tree' sign with tape/straps.	GAJV in consultation with the works arborist	GAJV
Identify retained trees; works in root zone / biosecurity	Identify exclusion area, attach 'protected tree' signs.	GAJV in consultation with the works arborist	GAJV

2.3 Prior to any works commencing, a meeting will be held at the site to discuss all the tree protection measures proposed and to gain clarification of any conditions of relevant consents imposed by Council. Present at the meeting should be:

- the consent holder
- the site's project manager (or other contractor representative)
- the works/supervisory arborist appointed by consent holder

The following Council officers must also be invited to attend this meeting:

- Team Leader Isthmus Monitoring (or representative);
- In the case of trees on Parks or road reserve land – the Senior Arboriculture and Eco Specialist (or equivalent), Operational Management and Maintenance, Auckland Council Community Services.

Supervision

2.4 A suitably qualified and experienced Arborist shall assist GAJV in the planning and execution of the tree protection measures, in accordance with the attached Tree Protection Methodology. The appointed works arborist will be experienced in tree protection systems and construction methodologies. Records will be kept digitally by the monitoring arborist which will be utilised to provide the required reporting.

Pre/Post Work Administration Procedures

2.5 Prior to works in the vicinity of protected trees to be retained commencing, the Environmental Manager will arrange a pre-start meeting. At the meeting, the following will be confirmed:

- The methodology and timing of the works
- Site access and areas for manoeuvring vehicles and machinery
- Areas for storing and/or stockpiling materials, spoil and equipment
- The care needed when working around trees
- The conditions of the resource consent.

It is the responsibility of the Construction Manager to ensure that all persons engaged or otherwise to work on the site are made aware of the conditions of consent, and that those conditions are adhered to at all times.

2.6 At the completion of works, the works arborist will provide a report to the contractor, if requested by GA-JV, provide a brief account of the project to the council arborist (if necessary with photos). The account of works shall include, but not be limited to:

- The effects of the works to the subject trees
- Any remedial work which may be necessary

Inspections

2.7 Weekly environmental inspections will be undertaken by the GAJV which includes tree protection aspects.

Reporting

2.8 If required by GA-JV, a report of arboricultural monitoring can be compiled and provided. This report will include at a minimum the Supervising Arborist Records or approved similar method.

Protective Barrier Fencing

2.9 Prior to physical works commencing in the vicinity of protected trees, and where practicable to do so, a suitable protective fence shall be erected around the tree. The exact location and nature of the protective fence shall first be agreed and minuted upon with the works arborist. For the duration of time the protective fence is in place, the area enclosed by the fence shall be regarded as an exclusion zone, and no material is to be stored, emptied or disposed of within the area enclosed by the protective fence. No person, vehicle or machinery may enter the area enclosed by the protective fence unless otherwise authorised to do so by the works arborist.

2.10 If for any reason it becomes necessary to move the protective fencing, then for the duration of time that the protective fence is not in place, the area which was previously enclosed by the fence shall be regarded in the same manner as if the protective fence were still in place.

2.11 Protective barrier fencing shall consist of temporary barriers at least 1.25 metres in height anchored securely to the ground (or an accepted alternative approved by the Council arborist, or representative). The fencing should be erected so as to enclose as greater portion of the trees root zone as possible whilst allowing safe work areas and to exclude access or the storage of any materials from within the fenced areas. The fencing should be of sufficient durability to ensure the tree is protected from damage.

2.12 Signage shall be affixed to the fencing to identify the enclosed area as a Tree Protection Zone. An example of the signage that will be used is provided as an Appendix.

Works within the root zone or drip line

2.13 Works within the root zone and/or drip line of the trees will be undertaken in accordance with this plan. Where additional works are required or any amendments to the tree protection methodology, these will be undertaken in consultation with the works arborist.

2.14 No material is to be stored, emptied or disposed of within the root zone of any of the trees unless otherwise authorised to do so by the works arborist. Any material which is to be stored or temporarily placed within the root zone of the trees shall be stored carefully on an existing or temporary hard surface such as asphalt or plywood sheets respectively.

2.15 If during the course of the works, machinery or vehicle access/manoeuvring is required within the root zone of the trees, then depending on the nature of the loading of the machinery or vehicle, it may be necessary to cover those areas with a protective overlay sufficient to protect the ground from being muddied, compacted, churned up or otherwise disturbed (for example “Track Mats”, or a layer of mulch or sand/SAP7 overlaid if necessary with a raft of wire planks, plywood or similar).

2.16 If machinery/vehicles are to be operated or stored within the root zone area on an existing or temporary load bearing surface, then the machinery/vehicle shall not cause any detrimental effect to the tree(s) through compaction, physical damage, spillage of lubricants and fuels or discharge of waste emissions.

2.17 All excavations which are to take place within the root zone of the tree shall be done so in conjunction with the works arborist.

2.18 Any roots of retained protected trees which are encountered during any part of the process are to be retained where possible. Every effort shall be made to retain all roots 35mm in diameter or greater. The severance of any tree roots greater than 35mm in diameter shall be done at the discretion and under the direction of the works arborist. Where roots are to be severed, they shall be cut cleanly by, or under the direction of, the works arborist with a sharp hand saw or loppers, and the area around the root shall be backfilled with the original material.

2.19 Where roots to be retained are encountered and there is need for these roots to remain exposed in order that works are not impeded, then those roots shall be covered with a suitable protective material (such as moist Hessian, or a wool mulch) in order to protect them from desiccation and/or mechanical damage, until such a time as the area around the root can be back filled with the original material. The method of wrapping or covering of any roots and the relevant materials used shall be specified by the works arborist.

2.20 If during the works, there are large areas of root zones exposed, then it may be necessary to protect the exposed root zone with a protective overlay sufficient enough to protect the ground and roots from being disturbed, for example a layer of geotextile fabric laid over a 150mm thick layer of wood mulch.

2.21 Where concrete is to be poured into excavations containing exposed roots, then all exposed roots shall first be covered in a layer of polythene to prevent the concrete from contacting the exposed root.

2.22 If during the works, it becomes necessary to pour concrete and/or lay asphalt directly over exposed roots (for example during reinstatement, or footpath construction), then all exposed roots shall first be covered with a layer of fine sand not less than 75mm thick and a layer geotextile fabric shall be placed over the roots prior to pouring the concrete/asphalt.

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