Watercare Services Limited

Motions Catchment Improvement

Detailed Site Investigation (DSI) Report

July 2025

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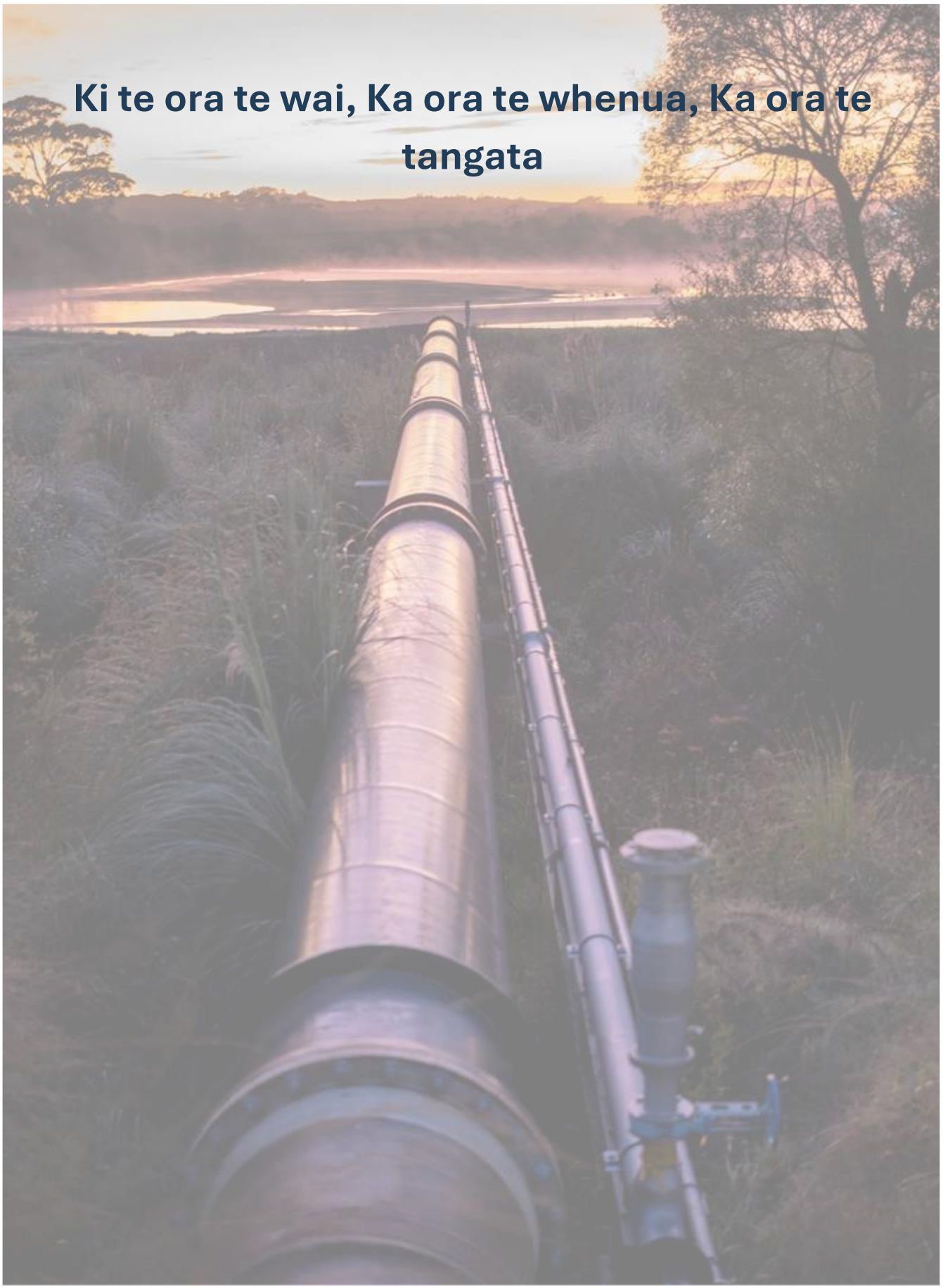
Watercare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Executive Summary

Watercare Services Limited (Watercare) is a lifeline utility providing water and wastewater services to 1.7 million Aucklanders every day and the future growth of 2.3 million people. Its services are vital for life, keeping people safe and helping communities to flourish. Watercare is responsible for municipal wastewater within Auckland, and the provider of bulk services to Pōkeno and Tuakau in the Waikato District.

Our activities and programmes are funded through user charges and borrowings. We are required by the Local Government (Auckland Council) Act 2010 to be a minimum-cost, cost-efficient service provider.

A Detailed Site Investigation (DSI) has been completed to provide a preliminary appraisal of ground conditions for the Western Isthmus water quality improvement programme (WIWQIP) – Motions catchment improvements Project (the Project). The DSI was completed based on the findings of the Preliminary Site Investigation (PSI) report (*Aurecon report reference: 521290-W00064-REP-EC-0001*) completed for the Project.

Ground investigation (GI) programme was completed between 13 May 2024 and 10 October 2024. To inform this DSI, a total of 69 soil samples (SS) and 11 groundwater (GW) samples from 19 borehole (BH) locations were collected to target contaminants of concern (CoC) associated with identified hazardous activity and industries list (HAIL) activities potentially impacting the Project. The GI for this DSI focused primarily on the shaft locations (SH01 -SH15), where the greatest exposure to potential soil and groundwater contamination (if present) during construction and excavation is anticipated.

The GI confirmed no CoC exceedances above the adopted human health criteria. Some exceedances above the adopted environmental and ecological criteria (for soil and groundwater) and Auckland background soil concentrations were identified for the Project.

Based on the findings of the GI, the following source-pathway- receptor (SPR) linkages were confirmed for the Project:

- '*Incomplete SPR linkages*' at SH03, SH05, SH06, SH07 (associated with HAIL I), SH04 (associated with HAIL G3) and SH09, SH10 and SH11 (associated with HAIL H).
- '*Potentially complete SPR linkages*' at SH01 (associated with HAIL I and no GI), SH12 and SH12A (associated with HAIL G3) and SH08 (HAIL I and limited GI).
- '*Complete SRP linkages*' at SH02 (associated with HAIL I) and SH13, SH14 and SH15 (associated with HAIL G3).

The following design/construction and resource consent considerations are required for the Project:

- A robust and practical Contaminated Land Management Plan (CLMP) to manage soil and groundwater as part of the Construction Management Plan (CMP) for the Project;
- Groundwater for the Project was measured between 0.5 m to 8.52 m at the shaft locations and will be intercepted during shaft construction. Dewatering will be required to facilitate construction;
- A controlled activity resource consent (Rule E30.6.2.1) for the discharges of contaminants into air, or into water, or onto or into land not meeting permitted activity standards from Auckland Council;
- A controlled activity (Regulation 9) National Environmental Standard for Assessing and Managing Contaminants in Soil (NES-CS) resource consent is required for the Project; and

- An Asset owner application (AOA) from Auckland Council for the construction of SH12 and SH12A within Basque Park will be required.

Should the Project's alignment and shaft locations investigated as part of this DSI change as the Project design progresses, further GI and assessment of any associated HAIL activities may be required to further inform detailed design, construction and/or the Project's resource consent application. The findings of this DSI can also be utilised as part of the stakeholder engagement process for the Project.

List of abbreviations

Abbreviation	Definition
AC	Auckland Council
ACM	Asbestos containing material
AOA	Asset owner approval
AUP	Auckland Unitary Plan (Operative in Part)
ANZG	Australian & New Zealand Guidelines for fresh & marine water quality
AVF	Auckland volcanic field
Aurecon	Aurecon New Zealand Limited
BH	Borehole
CBD	Central business district
CI	Central interceptor
CLMG	Contaminated land management guidelines
CMJ	Central Motorway Junction
CSM	Conceptual site model
CSMP	Contaminated site management plan
CMP	Construction management plan
CRL	City Rail Link
CSM	Conceptual site model
CSOs	Combined sewer overflows
DO	Dissolved oxygen
DGV	Default guideline values
DSI	Detailed site investigation
EC	Electrical conductivity
ECBF	East coast bays formation
EOPs	Engineered overflow points
GI	Ground investigation

Abbreviation	Definition
GFIR	Geotechnical factual interpretative report
GW	Groundwater
HAIL	Hazardous activities and industries list
HDD	Horizontal directional drilling
km	Kilometre
m	Metre
mg/L	Milligram per litre
mm	Millimetre
m bgl	Metres below ground level
MfE	Ministry for the Environment
m RL	Metres relative level
NES-CS	National environmental standard for assessing and managing contaminants in soil to protect human health
NWM	North-Western Motorway
NZGD	New Zealand geotechnical database
OCP	Organochlorine pesticides
PAH	Polycyclic aromatic hydrocarbons
PSI	Preliminary site investigation
RPD	Relative percentage difference
SH	Shaft
SH01-SH15	Shaft locations
SQEP	Suitably qualified and experienced practitioner
SS	Soil sample
SVOC	Semi-volatile organic contaminants
TPH	Total petroleum hydrocarbon
WIWQIP	Western Isthmus Water Quality Improvement Program
WW	Wastewater

Abbreviation	Definition
Watercare	Watercare Services Limited

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1 Introduction

1.1 Watercare

Watercare Services Limited (Watercare) is a lifeline utility responsible for the planning, maintenance, and operation of wastewater services to communities in Auckland. Its activities and programmes are funded through user charges and borrowings. Watercare is required by the local authority by the Local Government (Auckland Council) Act 2009 to be a minimum-cost, cost-efficient service provider.

Watercare collects wastewater from 1.7 million people's homes including trade waste from industry, through approximately 8,700 Km of pipelines. It pumps through 534 pump stations, treats approximately 410 million litres of wastewater daily through 18 treatment plants and disposes in environmentally responsible ways to protect the public health, the local environment and coasts and harbours.

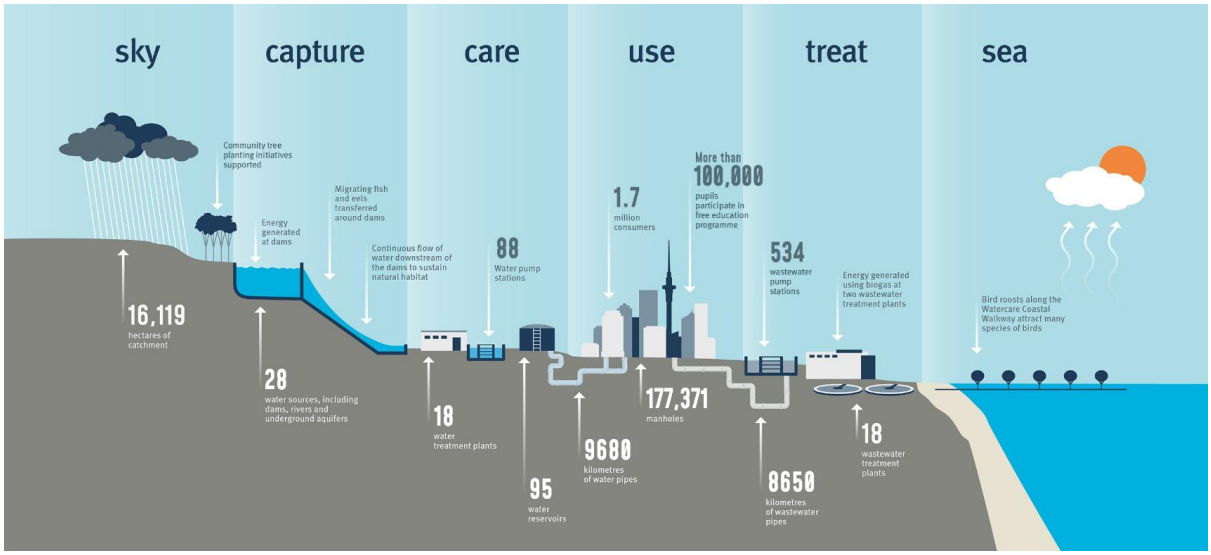

Figure 1: Overview of our assets and operations.

Watercare's activities are intrinsically linked to the health of people and the natural environment. Auckland's wastewater sources must be sufficient volume and reliability to improve the quality of beaches and waterways.

Watercare carries out significant work to upgrade and build infrastructure, to maintain levels of service and provide capacity for a fast-growing population. Watercare ensures Auckland and its people continue to enjoy dependable services by upgrading its assets, planning, building, and delivering new infrastructure in cost-efficient ways.

1.1 Project background and description

The Western Isthmus Water Quality Improvement Programme (WIWQIP) Motions Catchment Improvements Project (the Project) involves the construction of a new collector sewer approximately 3.2 kilometres in length from Canada Street in Auckland's Central Business District (CBD) to Western Springs Park in Western Springs. The collector sewer is proposed to be a diameter ranging from 2.4m up to 4.5m and will have three branch connections. Two branch connections will go under State Highway 16 connecting the Newton Catchment to Suffolk Reserve and connecting Arch Hill Scenic Reserve and southern parts of Grey Lynn to Nixon Park. The third branch connection will connect

Suffolk Reserve to Basque Park. There will also be 16 Engineered Overflow Points (EOPs) and 16 local network connections. The Project will tie into the Central Interceptor at Western Springs Park.

The Project is part of the WIWQIP which aims to significantly reduce wastewater overflows into the Waitematā Harbour in order to improve stream and beach water quality across the City's Central Western Isthmus. The aim of the Project is to build a new pipeline to collect combined wastewater, and stormwater flows from the Motions Catchment and convey these to the Central Interceptor at Point Erin Park, where they can then be safely conveyed to the Māngere Wastewater Treatment Plant. The WIWQIP is a joint initiative between Watercare and Auckland Council's Healthy Waters that was established in 2017 and has been identified in Watercare's Asset Management Plan 2021 – 2041 as a key programme to further protect the environment and provide clean harbours and waterways.[1] At a high level, the three main goals of the WIWQIP are:

- To reduce risks to public health by alleviating uncontrolled discharges into local catchments;
- To remove the permanent health warning status of both Meola Reef and Cox's Bay; and
- To reduce intermittent beach closures in the area over the next 10 years.

The Project is a critical component of the wider WIWQIP which will enable Watercare to bring about considerable environmental benefits, reduce risks to public health and improve the amenity of the Motions catchment. For further detail regarding the proposed works and the Project's objectives, please refer to Section 4 of the Assessment of Effects on the Environment.

1.2 Purpose of this report

Watercare Services Limited (Watercare) has engaged Aurecon New Zealand Limited (Aurecon) to undertake a Detailed Site Investigation (DSI) for the Motions Catchment Improvements Project (the Motions Project). The Motions Project is required as part of the Western Isthmus Water Quality improvement programme (WIWQIP) (referred to herein as 'the Project').

The purpose of this report is to support the resource consent application for the construction of a new collector sewer approximately 3.2 kilometres in length from Canada Street in Auckland's Central Business District (CBD) to Western Springs Park in Western Springs where the Project ties into the Central Interceptor. The Project also involves the construction of three branch connections and 16 Engineered Overflow Points (EOPs). The following reasons for consent pertaining to contaminated land have been identified:

- Rule E4.4.1 (A11): Groundwater will be encountered at some shaft locations, particularly at closed landfill sites. Groundwater contamination was identified at Shaft SH02 (Suffolk Reserve), where concentrations of copper, nickel, and zinc exceeded the ANZG DGVs for 80% protection criteria. However, these concentrations were below the 80% protection criteria when applying dilution and reasonable mixing. One of the options to dispose contaminated groundwater is to store and seal contaminated groundwater in containers and transport it to a licensed facility for treatment or disposal. This requires a **controlled activity** resource consent.
- Rule E30.4.1 (A6): The project cannot comply with Standard E30.6.1.4(1) as lead and arsenic concentrations exceeded permitted activity criteria at SH12A and SH13. At SH12A pyrene concentrations exceeded the MfE petroleum guideline-soil acceptance criteria. Arsenic concentration (at SH09 and SH11) and lead concentration (at SH02, SH04, SH12, SH13, SH14)

[1] Evidence of Stephen Webster for the Herne Bay Tunnell at [1.4].

exceeded the Auckland background soil concentration limits. This requires a **controlled activity** resource consent.

- Regulation 9: A Detailed Site Investigation (DSI) currently exists for the Project alignment. The DSI has established contaminant concentrations are above background soil concentrations but below any applicable human health standard for the project. As the permitted standards of Regulation 8(3) cannot be met, a **controlled activity** resource consent is needed in accordance with Regulation 9 of the NES-CS for this project.

For all resource consent triggers, please refer to the Assessment of Environmental Effects (AEE) for further details.

1.3 Preliminary site investigation report

A Preliminary Site Investigation (PSI) report has been prepared for the Project entitled: WIWQIP Motions Catchment Improvements, Preliminary Site Investigations, dated 13 June 2025, Rev B01 (Aurecon report reference: 521290-W00064-REP-EC-0001).

The PSI assessed current and/or historical activities with the potential to have caused soil and/or groundwater contamination which could potentially impact the Motions Collector Sewer alignment and constrain construction. A preliminary conceptual site model (PCSM) prepared as part of the PSI identified the following hazardous activity and industrial sites (HAIL) with 'potentially complete' and 'complete' source- pathway-receptor (SPR) linkages with the potential to impact the Motions Collector Sewer alignment:

- HAIL G3 (closed landfills);
- HAIL H (migration of contaminants from adjacent activities);
- HAIL I (contamination present in sufficient quantity); and
- Road corridors (not considered HAIL but subject to HAIL activities such as significant fill material).

The PSI report should be read in conjunction with this DSI report to provide context for the Project.

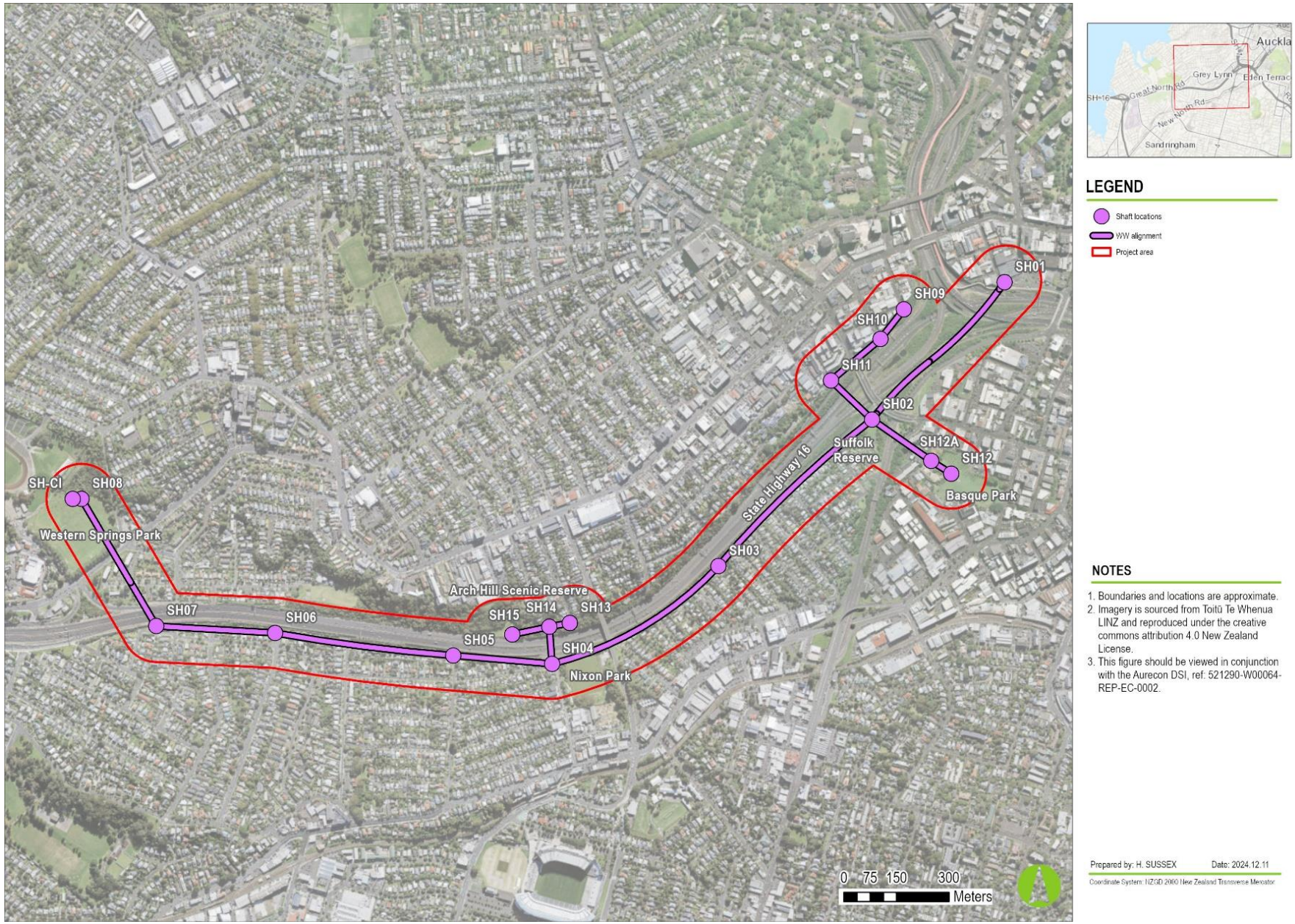

Figure 2: Motions Collector Sewer alignment and shaft locations

1.4 Objective and scope

The objectives of this DSI are to:

1. Provide an appraisal of ground conditions associated with the identified HAIL activities through intrusive soil and groundwater investigations (referred to herein as 'ground investigations' (GI));
2. Provide advice on contaminated land resource consents requirements; and
3. Provide advice on contaminated soil and groundwater management requirements to inform design and construction.

To achieve the above objectives, the following scope was undertaken:

- Review and update (due to design adjustments) of the PSCM prepared as part of the PSI to establish GI programme;
- Mobilisation, planning and coordination of the GI with Aurecon's wider GI programme team, including sub-contractor engagement and fulfilment of health, safety and environmental requirements;
- Obtaining necessary landowner approvals for GI, including Asset Owner Approval (AOA) from Auckland Council (AC) for areas of the Motions Collector Sewer alignment which encroach confirmed closed landfill sites (HAIL G3);
- Completion of intrusive soil and groundwater investigations and sampling as part of the GI programme;
- Laboratory analysis of selected soil and groundwater samples for a range of contaminants of concern (CoC) associated with the identified HAIL; and
- Preparation of this DSI report in accordance with the MfE CLMG No.1[2].

1.5 Explanatory statement

The following Project limitations applies to this DSI:

- GI has been undertaken to inform concept design and provides an appraisal of ground risk along the Motions Collector Sewer and shaft locations as shown in Figure 2: Motions Collector Sewer alignment and shaft locations
- . Should the Motions Collector Sewer and shaft location change as the Project progresses to that presented in Figure 2: Motions Collector Sewer alignment and shaft locations
- , further GI and assessment of HAIL activities may be required to inform detail design, construction and/or the Project resource consent application
- Soil and groundwater sampling was not undertaken for SH08 (for the connection into the Central Interceptor-CI shaft at Western Springs Park) as existing GI data associated with the CI shaft development will be utilised by Watercare to inform detail design and resource consent application, as required. As such, SH08 has not been investigated as part of the GI programme, however included for risk assessment purpose to inform the CSM (refer Section 6).
- Soil and groundwater sampling was not undertaken for SH01 due to access restrictions into the City Rail Link (CRL) Project yard during the GI programme. As such, SH01 has been excluded from the GI

[2] MfE, 2021. Ministry for the Environment (MfE) Contaminated Land Management Guideline No. 1: Reporting on Contaminated Sites in New Zealand (Revised June 2021).

programme, however included for risk assessment purposes only to inform the CSM (refer Section 6).

- Soil and rock formations are often variable, and this along with the use, storage or disposal of hazardous substances on a site can result in a heterogeneous distribution of contaminants across it. Contaminant concentrations may be evaluated at chosen sample locations - however, conditions between sample sites can only be inferred based on geological and hydrological conditions and the nature and the extent of identified contamination. Boundaries between zones of contamination are often indistinct, and therefore interpretation is based on available information and the application of professional judgement.
- Only a finite amount of information has been collected to meet the specific technical requirements of Watercare's change note and this report does not purport to completely describe the entire Motions Collector Sewer characteristics. The nature and continuity of the ground between test locations have been inferred using experience and judgement and it must be appreciated that actual conditions could vary.
- This DSI does not provide a complete assessment of the environmental status of the entire Motions Collector Sewer alignment, and it is limited to the scope defined in Section 1.4. Should further information become available regarding the conditions for the Motions Collector Sewer, including previously unknown likely sources of contamination, Aurecon reserves the right to review this DSI report in the context of the additional information; and
- This DSI report has been prepared for Watercare for its use and is based on the information provided. Aurecon takes no responsibility and disclaims all liability whatsoever for any loss or damage that the Watercare may suffer as a result of using or relying on any such information or recommendations contained in this DSI report, except to the extent Aurecon expressly indicates in this DSI report that it has verified the information to its satisfaction. This DSI report is not to be reproduced either wholly or in part without our prior written permission.

2 Risk assessment methodology

Table 1 presents the source – pathway – receptor (SPR) assessment methodology which was applied to the HAIL identification within a 200 m radius of the Motions Collector Sewer as part of the preliminary conceptual site model (PCSM), presented in the PSI report. Since the preparation of the PSI report (refer Section 1.3), parts of the Motions Collector Sewer and shaft locations have been modified/updated to accommodate concept design. As such, the PCSM presented in the PSI has been updated to reflect the design modifications (refer to Table 2). In addition, 521290-W00064-SKT-EC-0001 to 521290-W00064-SKT-EC-0006,Attachment A provides an updated visual of the identified HAILs and Motions Collector Sewer, including shaft positioning used to inform this DSI.

Table 1 SPR linkage assessment criteria

SPR linkage	SPR linkage assessment criteria
Incomplete	The identified HAIL/ potentially contaminating activity or land use presents little or no risk to human health or the environment given: ■ It is located greater than 50 m from the Motions Collector Sewer. ■ Will not be subject to any construction works associated with the Motions Collector Sewer; and ■ Is unlikely that contaminants will migrate to the Motions Collector Sewer or shaft works area (i.e. no direct connectivity to natural soil or and/or hydraulic connectivity). or ■ Is located less than 50 m from the Motions Collector Sewer, however potential CoC (PCoC) or HAIL activity is likely confined to a given site; and/ or ■ Sufficient information has been provided indicating the HAIL/ potentially contaminating activity or land use has been remediated and/or managed.
Potentially complete	The identified HAIL/ potentially contaminating activity or land use is located within 50 m of the Motions Collector Sewer alignment and: ■ Is located hydraulically upgradient, and is more likely than not, to have hydraulic connectivity; and ■ Information reviewed confirming HAIL/ potentially contaminating activity is too limited to characterise the contamination risk i.e., confirm contaminants or remediation status.
Complete	The identified HAIL/potentially contaminating activity or land use has been identified along the Motions Collector Sewer alignment and: ■ Contaminated material has been identified; and ■ Will more likely than not be encountered during the construction phase (subject to construction methodology for the Project).

Table 2 Preliminary conceptual site model linkages

In vicinity of shaft	Source (PSI report)	HAIL	PCoC	Pathway	Receptor	SPR linkages
SH01	▪ The following two contamination sources were identified: ▪ Canada Street: Potential groundwater contamination based on anecdotal evidence. No further information relating to the source and/or contaminant concentration was available at time of writing this DSI. ▪ Central Motorway Junction (CMJ). There is an ongoing contaminant discharge to land consent for the CMJ. No further information pertaining to the discharge consent was available at the time of writing this DSI.	Road corridors and road berms are not technically classified HAIL but may be subject to potentially contaminating activities list on the HAIL (i.e., fill material used for road construction and low-level contamination associated with the long-term vehicle use).	Soil: Heavy metals, asbestos, PAH. Groundwater - contaminants unknown.	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	Potentially complete Fill material generally up to 3.4 m bgl was noted in geotechnical logs reviewed, with insufficient soil and groundwater data available to confirm risk to human health or environment for the Project.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
SH02	Suffolk Reserve at 9 Suffolk Street: This site has been subject to significant historic 'uncontrolled fill material' as part of the reserve development.	Due to confirmed uncontrolled fill, meets threshold for consideration as HAIL G3 (landfilling)[3] .	Heavy metals, asbestos, PAH.	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Potentially complete** Insufficient data available, relating to 'HAIL G3' to confirm human health or environment risks for the Project.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
SH03	NWM and the Bond Street bridge	Road corridors and road berms are not technically classified HAIL but may be subject to potentially contaminating activities list on the HAIL (i.e., fill material used for road construction and low-level contamination associated with the long-term vehicle use).	Heavy metals, PAH, asbestos	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Potentially complete** Insufficient data available to confirm risk to human health or environment for the Project.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
SH04	Nixon Park, 11 Central Road: Nixon Park is listed as a 'medium risk closed landfill' by AC with 'uncontrolled fill material' which comprises topsoil, silts, and clays abundant with gravel, brick, concrete, and tree roots to a depth of 6 m bgl. Soil contamination and groundwater seepage have also been previously recorded.	Confirmed HAIL G3 closed landfill site. As such meets threshold for consideration as HAIL G3 based on the SPR assessment criteria applied.	Heavy metals, PAH, asbestos, organic acids, landfill gas, ammonia.	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Complete** Subject to confirmed shaft locations and depth of Motions Collector Sewer alignment within this area, further ground assessment works may be required to assess the risk posed to human health and environment for the Project.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	

[3] This HAIL was listed as HAIL I in the PSI report. Given the recent updates to the MfE HAIL publication (updated March 2023), uncontrolled filling is considered HAIL G3. The PCSM has been updated to reflect this change.

In vicinity of shaft	Source (PSI report)	HAIL	PCoC	Pathway	Receptor	SPR linkages
SH05, SH06 and SH07	NWM and Myrtle Street: Current use as road corridor.	Road corridors and road berms are not technically classified HAIL but may be subject to potentially contaminating activities list on the HAIL (i.e., fill material used for road construction and low-level contamination associated with the long-term vehicle use).	Heavy metals, PAH and asbestos	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Potentially Complete** Insufficient data available to confirm risk to human health or environment.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, ecosystems (flora/fauna), buried services and infrastructure.	
SH08	Western Springs outer fields, 731 Great North Road: This site has been used as a sports field (both currently and historically) and subject to fill placement as part of the park development. Previous investigations completed as part of the Central Interceptor Project also included some investigation at this location. A review of the borelogs indicate the presence of fill material approximately to 1.2 m bgl comprising ceramic fragments, scoria, gravel wood fragments, including asbestos detected in one soil sample collected.	The identified site within the Project area has been subject to significant 'uncontrolled fill material', as such meet threshold for consideration as HAIL G3 (present in sufficient quantity to pose a risk to human health and environment).	Heavy metals, PAH, asbestos.	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Complete** Based on previous investigation completed at this location. Limited soil samples were collected, and the previous investigation carried out as part of the Central Interceptor Project did not cover the full extent of the current proposed Motions Collector Sewer alignment. As such, further information is required to sufficiently inform the current proposed Motions Collector Sewer.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, ecosystems (flora/fauna), buried services and infrastructure.	
SH09, SH10, SH11	▪ The following sources were identified: ▪ 15 Gundry Street: Used for motor vehicle panel and paint activities (HAIL F4). ▪ 19 Gundry Street. Former use as a factory including storage of 140L flammable liquids and wash solvents (HAIL A17). Current use for automotive servicing (potential HAIL F4). ▪ 20 - 22 Gundry Street. Used for automotive servicing (potential HAIL F4). ▪ 18 Newton Street. Occupied by 'Eastern automatics' and contained hazardous substances (HAIL F4). ▪ 21 Newton Road: The site is listed on the AC closed landfill database as a 'low risk closed landfill site' (HAIL G3). Records indicate 'uncontrolled fill material' approximately 1 m thick likely comprising non-household refuse. ▪ Ian McKinnon Drive Reserve, 22A Randolph Street: The site is listed on the AC closed landfill database as a 'low risk closed landfill site' (HAIL G3). Records indicate fill is likely cleanfill however asbestos containing material (ACCM) in soil has been previously identified.	The identified HAIL and potentially contaminating activities are considered to meet the threshold of consideration as HAIL H (migration of contaminants of adjacent properties) based on the SPR assessment criteria applied.	Heavy metals, PAH, organic acids and solvents.	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Potentially Complete** Insufficient data available to confirm risk to human health or environment.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	

In vicinity of shaft	Source (PSI report)	HAIL	PCoC	Pathway	Receptor	SPR linkages
SAH12 and SH12A	Basque Park, 17-23 Exmouth Street This site is listed on the AC closed landfill database as a 'high risk closed landfill site'. Previous environmental investigations carried out indicates the landfill comprises 'uncontrolled fill material' which consists of topsoil, silts, and clays abundant with gravel, brick, concrete, and tree roots to a depth of 6 m bgl.	Confirmed HAIL G3 closed landfill site. As such meets threshold for consideration as HAIL G3 based on the SPR criteria applied.	Heavy metals, PAH, asbestos, organic acids, landfill gas and ammonia,	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Complete** Subject to confirmed shaft locations and depth of Motions Collector Sewer alignment within this area, further ground assessment works may be required to assess the risk posed to human health and environment for the Project.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
SH13, SH14, SH15	Arch Hill Reserve The site has been subject to significant historic 'uncontrolled fill material' as part of the reserve development.	The site within the Project area has been subject to significant 'uncontrolled fill material', as such meet threshold for consideration as HAIL G3 (present in sufficient quantity to pose a risk to human health and environment).	Heavy metals, PAH, asbestos.	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Potentially Complete** Insufficient data available to confirm risk to human health or environment.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	

3 Ground investigations

3.1 Ground investigation rationale

The ground (soil and groundwater) investigation rationale is based in general accordance with the National Environmental Standards (NES)[4] and MfE CLMG No.5 Guideline[5].

As described in Section 1 above, the Motions Collector Sewer is proposed to be installed using a Pipejack TBM at depths up to 25 m bgl, with shafts to provide launch and retrieval access for the TBM and future access into the Motions Collector Sewer for maintenance purposes. Typically for tunnel construction Projects, the greatest exposure to potential soil contamination (as established and referenced in Table 2), if present, is associated with excavated/removed materials (both soil and/or groundwater) predominately at shaft locations where direct excavations are required and spoil is removed from drilling activity. As such, the GI for the Project focuses on areas required for the construction of shafts and parts of the Motions Collector Sewer alignment which transverses known uncontrolled fill areas and/or closed landfill sites such as Basque Park and Westerns Springs Park.

Whilst the construction phase has been factored, the actual management of any contamination, if identified as part of this DSI will be addressed in more detail as part of the resource consent application process for the Project. As mentioned in Section 1, shaft locations (SH01 and SH08) have been excluded from the GI programme, with an additional shaft (SH12A) included at Basque Park.

3.2 GI drilling programme

Table 3 presents the GI programme details.

Table 3 Ground investigation drilling programme

GI programme	Description
Programme date	Ground investigations were completed as part of the overall GI programme for the Project6 between 13 May 2024 and 10 October 2024.
Landowner approval/ Asset owner approval for closed landfill	Landowner approval (LOA) was sought by Aurecon from the affected owners where drilling was required, as part of the GI programme procurement. In addition, an asset owner approval (AOA) was sought for Basque Park. A copy of the application and AC approval is provided in Attachment B. In general, all drilling works has been completed in accordance with the consent conditions stipulated in the AOA 680, dated 6 June 2024.

[4] MfE, 2012. Users' Guide. National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health),ME number: 1092, Ministry for the Environment, Wellington.
[5] MfE, 2021. MfE's Contaminated Land Management Guideline No. 5: Site Investigation and Analysis of Soils (Revised June 2021).
[6] Aurecon, 2024. Geological and Geotechnical Appraisal Report. 521290-W00064-REP-GG-0003.

GI programme	Description
Drilling contractors	Drilling works was conducted by McMillan Drilling Limited or Drill Force NZ Limited under the full-time supervision of Aurecon GI programme supervisors.
Drilling type	All boreholes (BH) were drilled using HQ drilling equipment with a rotary cored wireline drilling system.
Predrilling requirement/ allow for soil sampling	Pre-drilling activities were completed by the drilling contractor to facilitate utility avoidance and protection, which comprised hydro-excavation to 1.5 m bgl to check for the presence of utilities at each proposed drilling location and allow for soil sample collection (as described in Section 3 below).
Installation of piezometers and data loggers	Standpipe groundwater piezometers installations were completed immediately following the termination of each BH at the specified shaft location. At each location, dual standpipe installations were constructed consisting of 50 mm diameter PVC pipe with a slotted section dependent on encountered groundwater levels during drilling and for geotechnical data collection (e.g vibrating wires).
Groundwater monitoring well development	Groundwater monitoring well development was undertaken by the drilling contractor post installation.

3.3 Soil and groundwater sampling plan

A total of 40 BH were advanced to inform the Motions Collector Sewer alignment and shaft locations to between 5 m bgl to 25 m bgl, as part of the overall GI programme.

A total of 11 groundwater piezometers (for groundwater monitoring purposes) were installed at shaft locations to depths <10 m bgl, including 24 standpipes at varying depths up to 25 m bgl (for geology and geotechnical purposes).

An intermediatory shaft was added to the GI programme at Basque Park (SH12A), as additional information relating to a 'future designation associated with a high-rise apartment development was identified, resulting in an additional shaft being added to accommodate and avoid the potential deep foundation pilings for this residential development.

A GI investigation plan showing BH and GW monitoring well locations investigated as part of this DSI, including BH identification numbering is presented in *521290-W00064-SKT-EC-0007*, Attachment A

3.4 Soil and groundwater sampling methodology

3.4.1 Soil sampling (heavy metals and organics)

Soil sampling was completed by Aurecon contaminated land team[7] in general accordance with the MfE CLMG No. 5[8]. Soil samples were collected at varying depths of the borehole (BH) to target fill material and/or change in soil lithology until either basalt or natural soil profile were encountered.

General methodology used for soil sample collection included using a clean pair of nitrile gloves to place soil into sample containers supplied by an IANZ-accredited laboratory. Surface soil sample (SS) was collected prior to the hydrovac clearance to target the upper 0 - 0.3 m bgl, where practical. For subsurface SS, the hydrovac was paused by the drilling contractor to allow SS to be collected, either by a trowel or with a hand auger immediately within the hydrovac hole to a depth 1.5 m bgl. SS deeper than 1.5 m bgl were collected from the core drilled.

Immediately before and prior to soil sampling, and between BH locations, any equipment used (i.e. hand auger) were cleaned by washing with potable water, followed by a decontamination solution (Decon 90), and rinsing with potable water. Each sample was given a unique sample identification number, with the location and depth were recorded at the time of sampling.

Following collection, all SS were placed directly into chilled storage prior to transportation to the laboratory. Collected SS were screened in the field for visual and/or olfactory evidence of contamination and observations photographed (refer Section 4.1.2) and logged in general accordance with the New Zealand Geotechnical Society (NZGS) field description of soil and rock[9].

Following completion of sampling at each BH location, SS were placed directly into chilled storage and transported, accompanied with a chain of custody (COC) form, to an International Accreditation New Zealand (IANZ accredited) laboratory in accordance with Aurecon standard procedures (refer to Section 3.4.4 below).

3.4.2 Soil sampling (asbestos containing material)

Soil sampling and field assessment for asbestos containing material (ACM) in soils was conducted using the procedure described in the 'New Zealand Guidelines for assessing and managing asbestos in soil' (NZ GAMAS)[10]. This involves the collection of a 500 ml soil sample plus visual observation for potential ACM. Any bulk sample identified as potential ACM was double bagged for laboratory analysis.

Transport and storage process for ACM SS and bulk sample is as described in Section 3.4.1 above.

3.4.3 Groundwater sampling

Groundwater (GW) well development was completed by the drilling contractor as described in Table 3. GW depth was measure in each GW monitoring well at the time of GW sampling.

In order to collect a representative GW sample, groundwater was decanted into a bucket using a bailer system, with continuous observation of field parameters until field parameter stabilisation was achieved over three consecutive readings to within the established limits: electrical conductivity (EC, 3%), pH (0.05 pH units), temperature (0.2 ºC), redox (10 mV) and dissolved oxygen (DO, 10%). Once

[7] Suitably qualified environmental practitioner as defined in the NES,2012 Users Guide.ME number: 1092, Ministry for the Environment, Wellington.
[8] Ministry for the Environment, 2021. Contaminated Land Guideline No.5. Site investigation and analysis of soils.
[9] New Zealand Geotechnical Society, 2005. Field description of soil and rock. NZDS Guidelines.
[10] BRANZ, 2017. New Zealand Guidelines for assessing and managing asbestos in soil.

field parameters were stabilised, groundwater was decanted from the bailer directly into appropriately preserved bottles supplied by the laboratory. To minimise the potential for cross contamination of groundwater samples, each sample was collected using disposable gloves which were replaced between the collection of each sample. All GW samples were labelled with unique identifiers including groundwater monitoring well location and date, placed onto ice in cool boxes and delivered to the laboratory immediately following sampling in accordance with Aurecon chain of custody procedures.

3.4.4 Laboratory selection

R.J. Hills Laboratories (Hills Laboratory) was selected to perform analysis of all SS and GW samples. This laboratory is IANZ accredited and each of the test methods used are also IANZ accredited.

3.4.5 QA/QC

Quality assurance / quality control (QA/QC) procedures were implemented during field investigation works. All samples were collected under Aurecon chain of custody (COC) documentation procedures. Duplicated soil and groundwater samples were also collected and analysed. For groundwater a trip blank and field blank analysis was also completed.

4 Ground investigation observations

4.1 Soil

4.1.1 Geology

GI programme supervisors logged ground conditions for the duration of the GI drilling programme. Ground lithology varied, depending on section of the Motions Collector Sewer alignment and shaft locations. In general, the geology along the Motions Collector Sewer alignment can been broken down into four basic geological units:

- Fill material;
- Tauranga Group Alluvium;
- Auckland Volcanic Field (AVF) deposits; and
- Waitemata Group (East Coast Bays Formation (ECBF) soils.

The extent of these geological units varied across the Motions Collector Sewer alignment. The eastern and central extent of the alignment was dominated by ECBF. The central to western parts of the alignment appeared to traverse alluvial deposits of the Tauranga Group Alluvium group, with AVF deposits prominent in the western extent part of the alignment. The Motions Collector Sewer also crosses closed historic landfill sites (Basque Park) with its own complex localised geology. For a detailed interpretation of the alignment geology established during the GI, refer to the Project Geotechnical Interpretative Report (GIR)[11].

Borelogs for the shaft locations, and applicable to this DSI, is provided in Attachment C. Where applicable, the findings from these borelogs have been referenced herein.

4.1.2 Visual and olfactory observations

GI programme supervisors performed constant visual and odour monitoring while drilling occurred. The following key observations were noted:

- At SH15 (at Arch Hill Reserve), a bulk piece of fibrous board (approximate size: 20 mm by 30 mm) was noted within shallow soils (0.35 m bgl) during drilling, with no other bulk material was identified. The fibrous board material was laboratory tested and was positively identified as ACM comprising Amosite (brown) and Chrysotile (white) asbestos. Refer to Photographs 1 and 2, Attachment D for details;
- Uncontrolled fill material (as confirmed by the PSI report and AOA, refer Section 3.2.1) was also noted within BH43, BH44, BH45 and BH46 advanced at Basque Park (associated with SH12 and SH12A). In general, plastic pieces, glass and ceramic fragments, a metal peg, a piece of fabric, including trace brick fragments was intermixed within the predominately silt and clay fill layer at depths between 0.15 and 3.7 m bgl, respectively. Black discolouration/staining with no odour was also encountered at BH46 at a depth of 1.25 m bgl to 1.35 m bgl, including a 5 mm black discolouration/staining, with a burnt like odour at 2.4 m bgl. Refer to Photographs 3 and 4, Attachment D for details. No visual leachate or landfill gas (LFG) was encountered during the GI drilling;
- Brick fragments and glass shards were encountered at SH02 (BH07) advanced in the vicinity of Suffolk Reserve. The brick and glass shard fragments were noted at depths of 0.05 and 0.85 m bgl,

[11] Aurecon, 2024. Geotechnical Interpretative Factual Report. 521290-W00064-REP-GG-0002

respectively. At the base of the fill layer, East Coast Bay Formation (ECBF) soil (natural soil) comprising silts were encountered at 2.3 m bgl. Refer to Photograph 5, Attachment D for details;

- Brick fragments were encountered in BH30 advanced within Western Springs Park between 0.2 m bgl to 2.5 m bgl and asphalt millings at BH32 within the gravel fill layer between 0 m bgl to 0.75 m bgl. Refer to Photograph 6, Attachment D for details;
- Fragments of plastic, wood, concrete, and glass were encountered within the fill material at a depth of 0.5 m bgl at SH06 (BH21). In addition, concrete (approximately 200 mm thick with a 100 mm gap) was noted on the side of the BH between 2 m to 2.5 m bgl and between 5.2 -5.4 m bgl. Refer to Photograph 7, Attachment D for details; and
- A geotextile mat was encountered within the fill material at a depth of 0.6 m bgl at SH09 (BH36). Natural soils comprising silts and sands were encountered at 3.5 m bgl.
- With the exception of the above observations, no other refuse material, uncontrolled fill material or offensive odours were noted at any other BH advanced during the GI. Refer to Attachment C for the shaft borelogs and the GIFR[12] for the full extent of GI borelogs.

4.2 Groundwater

4.2.1 Groundwater model

There are two complex hydrogeological aquifers, namely the Auckland Isthmus Waitemata Aquifer (for the Motions Collector Sewer) and the Three Kings Volcanic Aquifer (between SH07 and SH08). According to the AC overlay maps[15], the Three Kings Volcanic Aquifer is classified as a 'quality-sensitive aquifer management area', inferring that the aquifer underlying the west alignment is shallow and unconfined, thus requiring management to prevent the discharge of contaminants from surface sources[13].

As part of the overall GI, two groundwater piezometers were installed at each shaft location based on the borehole log information and groundwater encountered during drilling. One piezometer was installed (a 50 mm diameter unslotted PVC pipe, with vibrating wires) to target the deep aquifers and associated groundwater pressure for the tunnel construction, and a shallow groundwater monitoring well (50 mm diameter slotted PVC pipe) was installed to target shallow groundwater to assess the identified HAIL (as shown in Table 4 above). The groundwater piezometers were designed to ensure no cross contamination of the deeper aquifers. For more details relating to the groundwater data monitoring that will be undertaken over the next two years for the Project, refer to the Project Geotechnical Interpretative Report (GIR)[14] .

4.2.2 Groundwater purging and parameters

Stabilised groundwater field parameters are presented in Attachment E Groundwater levels

Groundwater depths were recorded during GW sampling. Table 4 presents the summary of measured GW and groundwater levels converted to ground level.

[12] Aurecon, 2024. Geotechnical Interpretative Factual Report. 521290-W00064-REP-GG-0002
[13] Aurecon, 2024. Preliminary Site Investigation Report. 521290-064-0000-REP-EC-0001
[14] Aurecon, 2024. Geotechnical Interpretative Factual Report. 521290-W00064-REP-GG-0002

Table 4 Measured groundwater levels

Shaft ID	Location	Ground level (mRL)	Groundwater depth measured (m bgl)	Actual Groundwater Level (m RL)	Observation/comments
SH01	East Street/Canada Street	52.24	-	-	Not advanced – refer to limitation section
SH02	Suffolk Reserve	43.38	0.56	42.82	-
SH03	Mostyn Street	26.17	0.52	25.65	-
SH04	Nixon Park Carpark	22.5	2.96	19.64	-
SH05	Kingsland Avenue	19.38	0.65	18.73	-
SH06	Finch Street	16.58	-	-	GW sampling not undertaken, as vibrating wires for geotechnical purposes installed instead.
SH07	Myrtle Street	12.96	1.92	11.04	-
SH08	Western Spring Park	12.26	-	-	Not advanced – refer to limitation section
SH09	Edinburgh Street	60.25	8.57	51.68	-
SH10	Gundry Street	52.26	3.74	48.52	-
SH11	Burgoyne St	51.75	6.98	44.77	-
SH12 SH12A	Basque Park	51.92 44.35	7.85 0.87	44.07 43.48	-
SH13	Cooper Street	34.34	-	-	GW sampling not undertaken, as vibrating wires for geotechnical purposes installed instead.

Shaft ID	Location	Ground level (mRL)	Groundwater depth measured (m bgl)	Actual Groundwater Level (m RL)	Observation/comments
SH14	Within Arch Hill Reserve	31.3	-	-	GW sampling not undertaken, as vibrating wires for geotechnical purposes installed instead.
SH15	Within Arch Hill Reserve	22.99	1.32	21.67	-

4.3 Sampling laboratory tracking

Soil and groundwater samples sent to the Hills Laboratory were tracked and analysed in accordance with the methodology described in Section 3.3. All soil and groundwater samples were received by Hills packaged appropriately and at the acceptable temperature for laboratory analysis. Copies of the COC and confirmation of receipt is provided in Attachment F.

5 Sample analysis

Table 5 and Table 6 provide a high-level summary of the CoC analysed at the shaft locations. Visual observations made during the GI have also been factored into the soil sample analysis regime. A full soil sample analysis regime for each BH, including depth where the sample was collected and analysis undertaken is presented in Attachment G.

5.1 Soil

A total of 69 soil samples (SS) were collected and analysed from 19 BH locations.

Table 5 Contaminant of concern for each shaft location

Shaft	Boreholes	CoC	Comments and GI observations
SH01	No BH advanced	Heavy metals (HM), Total Petroleum hydrocarbons (TPH), Polyaromatic hydrocarbons (PAH), Bezene, Toluene, Ethylbenzene and Xylene (BTEX) and asbestos	No GI completed
SH02	BH06 BH07	Heavy metals (HM), Total Petroleum hydrocarbons (TPH), Polyaromatic hydrocarbons (PAH), Bezene, Toluene, Ethylbenzene and Xylene (BTEX) and asbestos	-
SH03	BH10	HM, PAH, TPH and asbestos	-
SH04	BH14 BH13 (Motions Collector Sewer alignment has been included as downgradient from HAIL G3)	HM, PAH, TPH and asbestos	-

Shaft	Boreholes	CoC	Comments and GI observations
SH05, SH06, SH07	BH17 BH21 BH22 BH25	HM, PAH, TPH and asbestos	-
SH08	BH30 (Motions Collector Sewer alignment BH, SS collected) BH32 (Motions Collector Sewer alignment bore logs)	HM, PAH, TPH, organochlorine pesticides (OCPs) and asbestos	No GI completed for SH08.
SH09, SH10, SH11	BH36 BH35 BH38 BH39	HM, PAH, TPH, SVOCs, BTEX and asbestos	-
SH12, SH12A	BH43 BH44 BH45 BH46	HM, PAH, TPH, BTEX and asbestos	-
SH13, SH14, SH15	BH48 B49 BH51	HM, PAH, TPH, SVOCs, BTEX and asbestos	Bulk ACM testing was also included as per the visual observations noted (refer Section 4.1.2.
Note: (-) denotes no GI observations			

5.2 Groundwater

A total of 11 GW samples were collected to target CoC as described in Table 2.

Table 6 Groundwater COC

Shaft	BH	CoC	Comments
SH01 and SH08	-	No GI was completed	-
SH02	BH06	Dissolved HM, Total suspended solids (TSS), PAH	-
SH03	BH10	Dissolved HM, TSS	-

Shaft	BH	CoC	Comments
SH04, SH05, SH06, SH07	BH14, BH17, BH25	Dissolved HM, TSS, PAH, TPH and SVOCs	It should be noted that analysis for leachate at SH04, associated with HAIL G3 was not undertaken as no leachate encountered during drilling.
SH09, SH10, SH11	BH36, BH38, BH39	Dissolved HM, TSS, TPH, PAH, SVOCs	-
SH12, SH12A	BH44, BH46	Dissolved HM, TSS, TPH, PAH, SVOCs	It should be noted that analysis for leachate associated with HAIL G3 was not undertaken as no leachate encountered during drilling.
SH13, SH14 and SH15	BH51	Dissolved HM, TSS	-
Note: (-) denotes no GI observations			

5.3 Quality assurance/quality control

- Eight duplicate SS were collected for qa/qc purposes; and
- One round of GW trip blank, field blank and duplicate sample were collected for QA/QC purposes.

Tabulated laboratory analytical results for SS and GW samples analysed are provided in Attachment H, with copies of Hills Laboratory analytical summary and certifications provided in Attachment I.

Review of the Hills Laboratory reports did not identify any laboratory QA/QC anomalies or outliers during laboratory analysis performed on the samples.

5.3.1 Soil

Eight duplicate samples were collected during the GI and analysed for heavy metals. Relative percentage difference (RPD) calculation was performed to establish the mean concentration of each analyte to determine the precision and reproducibility of the results. The RPD values for all samples and analytes were within the acceptable limits of less than 50% RPD for all samples except for QAQC_02 for lead. The RPD for this analyte was 51.9% however this sample was collected close to transition zone between the fill and natural soils where the fill was known to contain elevated levels of lead. As such, due to the heterogeneity in the fill material, this RPD result is considered to be within the acceptable limits. Refer to Table 7.

Table 7 RPD calculations for soils

ID	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Nickel	Zinc
QAQC_01	5	< 0.10	28	30	12.6	8	35
BH06_1.4-1.5	3	< 0.10	23	35	8.9	5	30
RPD (%)	50.0	0	19.6	15.4	34.4	46.2	15.4
QAQC_02	2	< 0.10	15	10	20	11	41
BH10_1.8-1.9	3	< 0.10	18	14	34	15	58
RPD (%)	40.0	0	18.2	33.3	51.9	30.8	34.3
QAQC_03	3	< 0.10	22	9	6.4	4	16
BH13_1.4-1.5	3	< 0.10	24	9	6.8	5	14
RPD (%)	0.0	0	-8.7	0.0	6.1	22.2	13.3
QAQC_04	<2	< 0.10	7	3	12.8	2	12
BH25_1.5-1.6	3	< 0.10	11	5	12.4	3	16
RPD (%)	NA	0	44.4	50.0	3.2	40.0	28.6
QAQC_05	<2	< 0.10	14.0	4.0	7.4	3.0	9.0
BH17_1.5-1.95	<2	<0.10	9	3	7.3	2	7
RPD (%)	0.0	0.0	35.7	25.0	1.4	33.3	22.2
QAQC_06	9.0	< 0.10	9.0	3.0	14.5	5.0	6.0
BH22_0.6	7	<0.10	9	3	11.6	6	6
RPD (%)	22.2	0.0	0.0	0.0	20.0	20.0	0.0
QAQC_07	4.0	< 0.10	21.0	20.0	9.2	< 2	9.0
BH39_1.5-1.6	4	<0.10	22	21	10.3	<2	10

ID	Arsenic	Cadmium	Chromium (III+VI)	Copper	Lead	Nickel	Zinc
RPD (%)	0.0	0.0	4.8	5.0	12.0	0.0	11.1
QAQC_08	< 2	< 0.10	27.0	21.0	13.6	13.0	55.0
BH43_2.3	<2	<0.10	35.0	23.0	17.2	14.0	64.0
RPD (%)	0.0	0.0	25.8	9.1	23.4	7.4	15.1

5.3.2 Groundwater

For quality control purposes, a trip blank, field blank and duplicate sample were collected at one BH location. Both the trip blank and field blank samples returned results below the limit of detection for PAH and heavy metals.

Table 8 presents the RPD for the duplicate samples. For the duplicate GW sample, the results were within the acceptable limits.

Table 8 Groundwater RPD calculations

ID	Arsenic (filtered)	Cadmium (filtered)	Copper (filtered)	Chromium (III+VI) (filtered)	Lead (filtered)	Nickel (filtered)	Zinc (filtered)
BH14A-02	<1.0	<0.05	1.9	<0.5	<0.10	1.0	4.3
BH14-01	<1.0	<0.05	2.1	<0.5	<0.10	0.7	3.4
RPD (%)	0.0	0.0	10.0	0.0	0.0	35.3	23.4

6 Tier 1 Screening Assessment

6.1 Screening Criteria and Guidelines

The laboratory analytical results for the Project have been assessed against three categories of Tier 1 acceptance criteria/ guideline values for soil and groundwater, as summarised in Table 9. The criteria referenced in this DSI report have been selected taking into consideration the identified potential receptors and guided by CLMG No.2[15] and the NES[16] methodology for deriving standards for contaminants in soils and groundwater to protect human health and environment.

Table 9 Tier 1 soil and groundwater assessment criteria/guidelines

Criteria	Guideline values
Human health	The following human health guideline values have been adopted for the Project: ▪ NES-CS, 2012. National environmental standard for assessing and managing contaminants in soil to protect human health (NES-CS) for arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), the OCPs dieldrin and DDT and Benzo(a)pyrene. The commercial/industrial outworker (unpaved) land use scenario has been applied given Project requires excavation for shaft construction. ▪ NEPC, 2013[17]. NEPM Guidelines for nickel (Ni) and zinc (Zn). ▪ MfE,1999. Guidelines for assessing and managing petroleum hydrocarbon contaminated sites in New Zealand, referred to herein as the 'MfE Petroleum Guidelines'. The Tier 1 soil acceptance criteria for maintenance/excavation workers have been applied given the Project requires excavation for shaft construction; and ▪ BRANZ, 2017. Guidelines for assessing and managing asbestos in soil. The commercial/industrial land use scenario has been applied for shaft construction.

[15] MfE Contaminated Land Management Guidelines No. 2: Hierarchy and Application in New Zealand of Environmental Guideline Values (Revised 2011).
[16] National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, 2012.
[17] National Environmental Protection Council (NEPC), 2013. National Environmental Protection (Assessment of Site Contamination) Measure.

Criteria	Guideline values
Environmental / ecological	The following environmental/ecological guideline values have been adopted for the Project: ▪ AUP, 2021.E30 – Table E30.6.1.4.1 Permitted activity (PA) soil acceptance criteria. ▪ MfE, 1999. MfE petroleum guideline-soil acceptance criteria for protection of groundwater quality – for clay and/or sandy silt soil type typically encountered within the fill material at each BH location; and ▪ Mfe, 1999. MfE Petroleum Guidelines. Module 5: Tier 1 groundwater acceptance criteria. ▪ Australia and New Zealand Guidelines (ANZG), 2023. ANZG Freshwater toxicant default guideline values (DGVs) for 80% species protection (given urban environmental setting) across the Motions Collector Sewer alignment.
Background soil concentrations	▪ The Auckland background soil concentration values presented in Table E30.6.1.4.2 (background ranges of trace elements in Auckland soils) has been adopted for the Project.
Waste disposal	▪ To inform construction disposal, the WasteMINZ, 2022, Class 1 to 4 criteria has been used to assess material disposal for the Project.

6.2 Soil results

6.2.1 Human health

All SS analysed for heavy metals, poly aromatic hydrocarbons (PAH), total petroleum hydrocarbon (TPH), organochlorine pesticides (OCPs) and semi volatile organic compounds (SVOCs) were at or below the adopted human health criteria.

All asbestos soil analysis completed were below the adopted BRANZ human health criteria.

6.2.2 Environmental / ecological

With the exception of lead and pyrene exceedance at the following two shaft locations, all other SS analysed for heavy metals, PAH, TPH, OCPs and SVOCs were at or below the adopted environmental/ecological criteria:

SH13 (BH48_0.05-0.2) exceeded the AUP PA criteria (250 mg/kg) for lead with a value of 900 mg/kg; and

One sample collected at SH12A (BH43_0.5-0.6) exceeded the MfE petroleum guideline-soil acceptance criteria for protection of groundwater within 2 m bgl (1.2 mg/kg for clay soil type) for pyrene with a value of 7.8 mg/kg. This is also the location where black discolouration/staining including burnt odour was noted during the GI (as discussed in Section 4.1.2 above).

6.2.3 Auckland background soil concentration

With the exception of arsenic and lead detected above Auckland background soil concentration at the following shaft locations, all other heavy metal concentrations were within the Auckland background soil concentrations limits:

For arsenic (adopted criteria 12 mg/kg): exceedances were recorded at SH09 (BH35_3.4-3.5, 24 mg/kg) and SH11 (BH39_0.5-0.6, 70 mg/kg) within the fill layer.

For lead (adopted criteria 65 mg/kg): exceedances were recorded in 10 SS collected from the following locations:

- SH02 (BH06_0.4-0.5, 89 mg/kg)
- SH04 (BH14_0.6-0.7, 114 mg/kg)
- SH12 (BH46_3.5-3.6, 75 mg/kg)
- SH12A (BH43_0.5-0.6, 92 mg/kg)
- SH13 (BH48_0.05-0.2, 900 mg.kg)
- SH14 (BH49_0.05-0.2, 99 mg/kg and BH49_0.3-0.4, 98 mg/kg)
- BH22_0.2-0.3 199 mg/kg (Motions Collector Sewer alignment, located approximately 20 m south of SH06)
- BH29_0.05-0.2 69 mg/kg (Motions Collector Sewer alignment, located at 736 Great North Road approximately 205 to the southeast of SH08)
- BH13_0.4-0.5, 187 mg/kg (Motions Collector Sewer alignment, located on New Bond Street approximately 215 m to the east of SH04).

With the exception the priority contaminants, including Benzo(a)pyrene and Total DDT, there are no other Auckland background soil concentrations provided in the AUP. For other contaminant concentrations above limit of detection (LOD), these have been addressed as part of the soil disposal criteria, refer Section 6.2.4.

6.2.4 Soil reuse/disposal

With the exception of one SS collected at SH13 (BH48_0.05-0.2, 900 mg/kg) which exceeded the Class 3 managed fill criteria (320 mg/kg) for lead, all other SS met the Class 3 managed fill criteria.

Toxicity characteristic leaching potential (TCLP) testing was undertaken for this sample which yielded a concentration of 0.55 mg/L, which is within the Class 1 and Class 2 C & D landfill waste acceptance criteria.

With the exception on one piece of bulk ACM (actual size approximately 2 -3 cm) was confirmed to contain Amosite brown fibres and Chrysotile white fibres, no other ACM detected in any of the SS analysed.

6.3 Groundwater

6.3.1 Results

All groundwater results were below the adopted criteria with the exception of BH06 (Shaft SH02) in vicinity of Suffolk Reserve. Concentrations of copper (0.0026 milligram per litre (mg/L)), nickel (0.034 mg/L), and zinc (0.0031 mg/L) were recorded above the ANZG DGVs for 80% protection (copper: 0.0025 mg/L, nickel: 0.017 mg/L and zinc 0.031 mg/L), confirming copper, nickel and zinc mobility. However, utilising a Dilution Attenuation Factor (DAF) of 20, the following dilution values are calculated, indicating not exceeding the 80% freshwater protection:

- Copper: 00091 mg/L;

- Nickel: 0017 mg/L; and
- Zinc: 0.0031 mg/L.
- TPH, PAH, OCPs, and SVOCs were below the limit of detection in all samples.

7 Updated CSM to inform Project

The Conceptual Site Model (CSM) outlines the potential source-pathway-receptor linkages during development works and Project area use that may be present. A risk is only present if there is a complete SPR linkage. Table 10 presents an updated CSM developed based on the findings of the GI. For ease of interpretation and way forward for the Project, the source (HAIL), pathway and receptor has been categorised for each shaft location. It should be noted that although no GI was undertaken at shafts SH01 and SH08, however these have been captured in establish risks for the Project. For to 521290-W00064-SKT-EC-0008, Attachment A for a visual of SPR linkages for the Project.

Table 10 Conceptual Site Model

Identifier		Source (HAIL)	CoC	Pathway	Receptor	SPR linkages and discussion
Shaft location	**BH and GW**					
SH01	No GI completed as part of this DSI for Concept Design	HAIL I (uncontrolled fill material)	Soil: Heavy metals (HM), asbestos, PAH. Groundwater: Heavy metals (HM), PAH.	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Potentially complete** Although no intrusive GI was completed at SH01, there is existing ground contamination data available from the City Rail Link (CRL) project that can be utilised to inform SH01. As detailed in the Aurecon PSI report (Ref: 521290-W00064-REP-EC-0001), a Tier 2 ground investigation was undertaken for a 3.4 km underground railway system which included investigations at Karangahape Road Station (approximately 50 m north of SH01). The closest bore to the WW alignment drilled as part of this investigation was identified as BH134 (located approximately 250 m north from SH01). A review of the soil and groundwater investigation data for this borehole revealed no CoC above the NES-CS (human health criteria for commercial/ industrial land use) and AUP PA criteria (Auckland background soils concentrations).
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
SH02	BH06 + GW BH07	HAIL G3 (Suffolks Reserve – confirmed significant historic 'uncontrolled fill material' as part of the reserve development).	Soils: HM, TPH, PAH, BTEX, asbestos GW: dissolved metals, Total suspended solids (TSS), PAH	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Complete** Soil analytical results from the two SS collected from the fill layer (which comprised silts with trace gravels between 0.4 -0.5 m bgl), were below the adopted human health and environmental criteria. Glass shards and brick fragments were also observed during GI in BH07 (Motions Collector Sewer alignment BH, not sampled). Fill material was encountered to depth 1.6 m bgl, beyond which was ECBF soils. Groundwater sample analysed exceeded the ANZG DGVs for 80% protection criteria for copper, nickel, and zinc. However, were below the 80% protection criteria when applying dilution and reasonable mixing (refer Section 6.2). It should be noted that SH02 is located in the vicinity of CMJ which has an ongoing groundwater discharge consent.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
SH03	BH10 + GW	Road corridor *Northwestern Motorway*	Soils: HM, TPH, PAH, BTEX, asbestos GW: dissolved metals, Total suspended solids (TSS), PAH	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Incomplete** Soil and GW analytical results were below the adopted human health and environmental criteria.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	

Identifier		Source (HAIL)	CoC	Pathway	Receptor	SPR linkages and discussion
Shaft location	**BH and GW**					
SH04	BH14 + GW BH13 (Motions Collector Sewer alignment has been included as downgradient from HAIL G3)	HAIL G3 (in vicinity of HAIL G3 – Nixon Park which is classified 'medium risk closed landfill').	Soil: HM, PAH and asbestos GW: Dissolved HM, TSS, PAH, TPH and SVOCs	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Incomplete** Soil and GW analytical results were below the adopted human health and environmental criteria. One sample (BH14_0.6-0.7) exceeded the regional background soil concentration for lead. Fill material comprising gravel and clay was encountered to a depth of 2.2 m bgl, followed by Tauranga Group Alluvium comprising silts and clays and ECBF silty soils from 5.8 m bgl to 7 m bgl. There was no evidence of uncontrolled fill (topsoil, silts, and clays abundant with gravel, brick, concrete, and tree roots to a depth of 6 m bgl, including potential GW seepages associated with Nixon Park (closed landfill site) as identified in the PSI at the shaft location.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
SH05, SH06 and SH07	BH17 + GW BH21 BH22 BH25	Potential HAIL I (fill material along Northwestern motorway)	Soil: HM, PAH and asbestos GW: Dissolved metals, TSS, PAH, TPH and SVOCs	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Incomplete** Soil and GW analytical results were below the adopted human health and environmental criteria. One sample (BH22_0.2-0.3) exceeded the regional background soil concentration for lead.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake	Groundwater, surface water, buried services and infrastructure.	
SH08	BH30 (Motions Collector Sewer alignment BH, SS collected) BH32 (Motions Collector Sewer alignment borelogs)	HAIL G3 (Western Springs outer field has historically being subject to uncontrolled filling.	Soil: HM, PAH, TPH, organochlorine pesticides (OCPs) and asbestos GW: Dissolved metals, TSS, PAH, TPH and SVOCs	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Potentially complete** Soil analytical results from BH30 and BH32 (collected from the Motions Collector Sewer BH) were below the adopted human health, environmental and Auckland background concentration criteria. Previous investigations completed as part of the Central Interceptor tunnel project (refer PSI report Ref: 521290-W00064-REP-EC-0001) included investigations within the Western Springs outer fields (731 Great North Road) in close proximity to SH08. The soil results from this investigation also noted heavy metals, TPH and PAH below the PA and NES-CS criteria, however, did encounter contaminant concentration above the Auckland background soil concentrations and cleanfill criteria. This included one soil sample with heavy metal and TPH concentrations below cleanfill criteria but detected PAHs just above the laboratory detection limit (LOD) and one asbestos sample with chrysotile fibres at 0.5 m depth but below the human health assessment criteria of 0.001% weigh for weight (w/w).
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake	Groundwater, surface water, ecosystems (flora/fauna), buried services and infrastructure.	
SH09, SH10 and SH11	BH36 + GW BH35 BH38 + GW BH39 + GW	HAIL H (migration of contaminants, associated with HAIL F4 (motor vehicle), HAIL A17	Soil: HM, PAH, and asbestos	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Incomplete** Soil and GW analytical results were below the adopted human health and environmental criteria. Two samples (SH09 (BH35_3.4-3.5) and SH11 (BH39_0.5-0.6)) exceeded the regional background soil concentration for arsenic.

Identifier		Source (HAIL)	CoC	Pathway	Receptor	SPR linkages and discussion
Shaft location	**BH and GW**					
		(chemical storage) and HAIL G3 (low risk closed landfill site).	GW: TSS, TPH, PAH, SVOCs	Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
SH12 and SH12A	BH43 (SH12A) BH44 + GW BH45 (SH12) BH46 + GW	HAIL G3 (confirmed closed landfill at Basque Park)	Soil: HM, PAH, TPH, SVOCs, BTEX and asbestos GW: Dissolved metals, TSS, TPH, PAH, SVOCs	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Potentially Complete** Lead concentration exceeded the Auckland background soil concentrations at SH12 (BH46_3.5-3.6, 75 mg/kg) and SH12A (BH43_0.5-0.6, 92 mg/kg). One SS collected at SH12A (BH43_0.5-0.6, 7.8 mg/kg, adopted criteria 1.2 mg/kg) analysed for analyte pyrene also exceeded the MfE petroleum guideline-soil acceptance criteria for protection of groundwater to the depth of 2 m bgl (for clay soil type). However, GW samples collected from SH12A identified pyrene concentrations to be within the ANZG DGVs for 80% protection criteria.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
SH13, SH14 and SH15	BH48 B49 BH51 + GW	HAIL G3 (uncontrolled fill material -Arch Hill Reserve)	Soil: HM, PAH, TPH, BTEX and asbestos GW: Dissolved HM, TSS	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Complete** All SS results were below the adopted human health criteria. At SH13, lead concentrations (BH48_0.05-0.2, 900 mg/kg, adopted criteria 250 mg/kg) exceeded the Permitted Activity criteria. Three samples (SH13 (BH48_0.05-0.2) and SH14 (BH49_0.05-0.2, BH49_0.3-0.4)) also exceeded the regional background soil concentration for lead. In addition, at SH15, a bulk piece of fibrous board (actual size approximately 2 - 3 cm) was noted at surface (0 -0.35 m bgl). Analytical testing confirmed asbestos containing material (ACM) comprising Amosite brown fibres and Chrysotile white fibres. No ACM was detected within any of the SS analysed collected at depth from the boreholes advanced in the Arch Hill area. GW analytical results were below the adopted human health and environmental criteria.
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	
Motions Collector Sewer alignment	Overall GI programme	All HAIL identified for SH01- SH15	Soil + GW (as indicated for the shaft locations)	Dermal contact, Ingestion, Inhalation.	Current and future site users, adjacent site users, construction and excavation workers, maintenance workers.	**Incomplete** Construction of the Motions Collector Sewer is anticipated to be at depth > 20 m bgl within natural soils using TBM and HDD construction methodology, with no human contact at depth along the tunnel construction. Additionally at this depth, groundwater encountered is anticipated to be within the deeper confined aquifer and unlikely to be impacted by the shallow contaminated groundwater identified at SH01 and S02. However, no GW testing of the deeper aquifer has been undertaken to date. Refer to Section 4.2.1 for information pertaining to how the groundwater wells were installed and ongoing groundwater monitoring for the Project. Contamination concentration encountered at all shaft locations appear to be confined to shallow fill material (< 5 m bgl) with no exceedance noted in any SS collected at depth (> 5 m bgl).
				Permeation through soil profile, groundwater flow and runoff, leaching and uptake.	Groundwater, surface water, buried services and infrastructure.	

8 Motions Collector Sewer and shaft design/construction

Table 11 provides a summary of soil and groundwater management requirements for consideration as part of the design and construction phase of the Project. Refer to 521290-W00064-SKT-EC-0009, Attachment A for a visual display of construction management requirements.

Table 11 Design/construction management for soil and groundwater

Shaft or Motions Collector Sewer alignment	Design/construction management for soil and groundwater
SH01	▪ Applying a precautionary and conservative approach (based on previous investigation data, refer Table 10) shallow soil/fill management (< 2 m bgl) potentially required. Further soil testing to inform soil disposal maybe required, subject to confirmation with disposal facility. ▪ Applying a precautionary and conservative approach, groundwater management may be required. Supporting groundwater data from the City Rail Link (CRL) project, if available will be beneficial to inform construction management for SH01.
SH02	▪ Shallow soil/fill management (< 2 m bgl) required. ▪ Groundwater management required. Dewatering of shallow groundwater during shaft construction likely required based on measured groundwater levels (0.56 m). Groundwater sample collected exceeded the ANZG DGVs for 80% protection criteria for copper, nickel, and zinc but was below the 80% protection criteria when applying dilution and reasonable mixing (refer Section 6.2).
SH03, SH04, SH05, SH07, SH09, SH10 and SH11, SH13, SH14 and SH15	▪ Shallow soil/fill management (< 2 m bgl) required. ▪ Groundwater dewatering will be required. Based on the data as identified in this DSI groundwater is not impacted by concentrations of contaminants that require additional management.
SH06	▪ Shallow soil/fill management (< 2 m bgl) required. ▪ Groundwater dewatering will be required. Based on the data as identified in this DSI groundwater is not impacted by concentrations of contaminants that require additional management.

Shaft or Motions Collector Sewer alignment	Design/construction management for soil and groundwater
SH08	▪ Applying a precautionary and conservative approach (although no contamination identified for the WW pipe alignment BHs drilled, previous investigations completed did encounter shallow contamination, refer Table 10). As such, shallow soil/fill management (< 2 m bgl) will be required. Additional soil testing maybe required to inform soil disposal, subject to confirmation with disposal facility. ▪ Applying a conservative and precautionary approach, groundwater management may be required. Supporting groundwater data from the CI project, if available will be beneficial to inform construction management for SH08.
SH12 and SH12A	▪ Given the location of SH12 and SH12A within a closed landfill, design and construction management is required for soil management and groundwater during construction in accordance with the AOA for construction. ▪ No refuse or leachate was encountered in any of the boreholes advanced at Basque Park which could potentially impact tunnel integrity. Only construction type uncontrolled fill was identified in the boreholes advanced. ▪ An AOA for construction of shafts SH12 and SH12A will be required from Auckland Council. Refer to Section 8.2.3 for further details.

8.1.1 Contaminated land management plan

Based on the outcome of this DSI, a Contaminated land Management Plan (CLMP) will be required as part of the Project resource consent application (refer Section 8) and/or to support construction, which shall address the items presented in Table 11, including procedures and standards to be followed during the course of earthworks and construction.

A CLMP has been prepared (Aurecon report reference: 521290-W0064-EC-REP-0003) to support the Project AEE application.

8.1.2 Sustainability

In addition, it is recommended soil and groundwater management be addressed through a lens of sustainability including, where possible, diverting spoil from landfill sites, , and undertake sustainable practises (i.e., consider mitigation of negative environmental, economic and social impacts). Sustainable soil management can be leveraged to support Watercare's carbon reduction targets of 40 percent.

8.1.3 Groundwater dewatering

Groundwater for the Project was measured between 0.5 m to 8.52 m and anticipated in deeper soils from SH09, SH11 and SH12 (refer to Table 4) and will be intercepted during shaft construction. As such, dewatering will be required to facilitate construction.

8.2 Resource consents

The following section discusses the contaminated land regulatory implications for the Project. The Project's AEE should be referred to for detailed explanations of consent triggers, policy framework and related statutory tests.

8.2.1 NES-CS

The NES-CS Regulations 2011 came into effect on the 1st of January 2012 and supersedes any District Plan rules related to contaminated land. Any regional plan contaminated land rules still apply, and as such the AUP (E30 Contaminated Land) has been considered in Section 8.2.2 below.

The DSI has established contaminant concentration above background soil concentrations but below any applicable human health standard for the Project. As the permitted standards of Regulation 8(3) cannot be met, a '**controlled activity**' NES resource consent will be required in accordance with Regulation 9 for the Project.

8.2.2 AUP Chapter E30

The earthworks for the shaft (pending confirmation of extent and depth of excavations required for each) will likely exceed the soil disturbance volume of 200 m3 stated within the permitted activity (PA) rule E30.6.1.2. As such, the requirements of Standard E30.6.1.4 (assessment of contaminants against natural background ranges) has been applied relating to in-situ soil and fill material to determine AUP (Contaminated land) resource consent requirement for the Project.

Table 12 discusses the findings of the DSI against this standard.

Table 12 AUP Standard E30 6.1.4

Excerpt of Standard E30.6.1.4	Discussion
(1) For in-situ soil and fill material, the concentrations of contaminants (relevant to the site's history) in soil or fill material, or the 95 per cent upper confidence limit of the mean, determined in accordance with the Ministry for the Environment Contaminated Land Management Guidelines No.5 – Site Investigation and Analysis of Soils (Revised 2011), must not exceed: (a) the criteria specified in Table E30.6.1.4.1 Permitted activity soil acceptance criteria; or (b) for contaminants not included in Table E30.6.1.4.1: (i) the tier 1 soil acceptance criteria for the protection of groundwater quality in sensitive aquifers specified in Table 4.20 Soil acceptance criteria for protection of groundwater quality in the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand, Ministry for the Environment (Revised 2011); or (ii) for contaminants not included in Table 4.20 Soil acceptance criteria for protection of groundwater quality in the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand by the Ministry for the Environment (Revised 2011) (c) the natural background levels for that soil or fill material or the relevant background levels specified in Table E30.6.1.4.2 Background ranges of trace elements in Auckland soils sources from Table 3 of TP153.	**Does not comply** The findings from this DSI confirms that all shaft locations encountered fill material < 2 m bgl (and < 5 m bgl at SH12A, within Basque Park). Fragments of plastic, wood, concrete, and glass were also encountered within the fill material at some (six out of sixteen) shaft locations (refer Section 4.1.2). The following non-compliances with Rule E30.6.1.4 were noted: ■ PA criteria (Table 30.6.1.4). Lead (at SH13) and arsenic (SH12A, Basque Park) concentration exceeded the PA limit. Refer to Section 5.3.2 for further details. ■ PA criteria exceedances for contaminants not included in Table 30.6.1.4.1. At SH12A (BH43_0.5-0.6, 7.8 mg/kg, adopted criteria 1.2 mg/kg) pyrene concentration exceeded the MfE petroleum guideline-soil acceptance criteria for protection of groundwater within 2 m bgl (for clay soil type). ■ Exceedances of the Auckland background soil concentration limits: Arsenic concentration (at SH09 and SH11) and lead concentration (at SH02, SH04, SH12, SH13, SH14) exceeded the Auckland background soil concentration limits.
2) Any discharge from land containing elevated levels of contaminants must not contain separate phase liquid contaminants including separate phase hydrocarbons.	**Complies** The DSI confirmed no separate phase liquid contaminants, including separate phase hydrocarbons were noted during drilling works or during GW monitoring.

*As established at the time of writing this DSI.

Based on the above E30.6.1.4 assessment (Table 12), the Project will require a **Controlled Activity** consent from Auckland Council, subject to meeting the requirements stipulated in Table 13. If for any

reason, compliance with Table 8 cannot be demonstrated for the Project at the time of resource consent application, a Discretionary Activity consent may be required.

Table 13 Excerpt of E30.6.2.1

Excerpt from E30.6.2.1	Compliance and Requirements*
(1) A detailed site investigation (contaminated land) must be prepared and submitted to Council for consideration.	**Complies** This DSI can be submitted with the Project resource consent application. Once submitted, compliance with this requirement can be demonstrated for the Project.
(2) A site management plan (contaminated land) must be prepared and submitted to Council for consideration.	**Complies** A Contaminated Land Management Plan (CLMP) as part of the Project Construction Management Plan (CMP) is required to inform shallow soil/fill management at the shaft locations, including how the fill material exceeding the PA criteria will be managed either as part of Project design or construction phase. A CLMP has been prepared, separate to this DSI report (*Aurecon report reference: 52190-W00064-REP-EC-0003*). Once submitted, compliance with this requirement can be demonstrated for the Project.
(3) A remedial action plan (contaminated land), relevant to the site and the proposed disturbance or remediation must be prepared and submitted to Council for consideration.	**Complies** No remediation action plan is required for the Project given: All SS analysed for heavy metals, poly aromatic hydrocarbons (PAH), total petroleum hydrocarbon (TPH), organochlorine pesticides (OCPs) and semi volatile organic compounds (SVOCs) were at or below the adopted human health criteria. All asbestos soil analysis completed were below the adopted BRANZ human health criteria; and

Excerpt from E30.6.2.1	Compliance and Requirements*
	All groundwater results were below the adopted criteria
(4) The report on the detailed site investigation (contaminated land) must state either that: (a) the concentrations of soluble contaminants in any of the following: (i) overland stormwater at the site boundary, (ii) surface water within the site, or (iii) groundwater at the site boundary must not exceed the guideline values specified in Table 3.4.1 Trigger values for toxicants at alternative levels of protection in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000 Guidelines) for marine or freshwater, where relevant, at the level of protection for 80 per cent of species, except for benzene where 95 per cent of species shall apply; or (b) discharges from the land are highly unlikely to cause significant adverse effects on the environment; or (c) the contamination associated with the land must be contained beneath a continuous impervious layer and must be located above the highest seasonal groundwater level beneath the site.	**Complies** An assessment of effects on the environment (AEE) report for the Project has been prepared, separate to this DSI report, to demonstrate effects at the site boundary in accordance with 4(a-c). The findings from this DSI, support the Project AEE, including the associated application for dewatering. With regard to 4 (iii), GW samples collected at SH02 recorded concentrations of copper, nickel, and zinc above the ANZG DGVs for 80% protection criteria. However, were below the 80% protection criteria when applying dilution and reasonable mixing (refer Section 6.2). Once the AEE resource consent application is submitted, compliance with this requirement can be demonstrated for the Project.

8.2.3 AOA for construction

An Asset owner approval (AOA) from Auckland Council, similar to that obtained for the GI programme (refer Section 3.2), will be required for the construction of Shaft 12 and Shaft 12A at Basque Park. The findings of this DSI will be required to be submitted to inform the AOA application. Discussion of any affected parties is addressed by the AEE.

9 Conclusion and recommendations

This DSI has been completed to provide a preliminary appraisal of ground conditions for the HAIL activities identified and to inform any implication on design/construction and resource consent requirements for the Project. The DSI was completed based on the findings of the PSI report (*Aurecon report reference: 521290-W00064-REP-EC-0001*) completed for the Project.

A total of 69 SS from 19 BH locations and 11 GW samples, including additional quality control/quality assurance (QA/QC) samples were collected to target COC associated with HAIL for the Project. The GI for this DSI primarily focused on the shaft locations (SH01 -SH15), where the greatest exposure to potential soil and groundwater during construction and excavation is anticipated.

The following summarises the key findings and recommendations for the Project:

- The GI confirmed no contaminant exceedances in soil or groundwater above the adopted human health criteria. Some exceedances above the adopted environmental and ecological criteria and Auckland background soil concentration were established for the Project;
- Groundwater for the Project was measured between 0.5 m to 8.52 m at the shaft locations and will be intercepted during shaft construction. Dewatering will be required to facilitate construction;
- The soil and groundwater analytical results from the GI has been utilised to produce an updated CSM to establish the following SPR linkages for the Project:
- '*Incomplete SPR linkages*' at SH03, SH05, SH06, SH07 (associated with HAIL I), SH04 (associated with HAIL G3) and SH09, SH10 and SH11 (associated with HAIL H).
- '*Potentially complete SPR linkages*' at SH01 (associated with HAIL I and no GI) SH12 and SH12A (associated with HAIL G3) and SH08 (HAIL I and limited GI).
- '*Complete SRP linkages*' at SH02 (associated with HAIL I) SH13, SH14 and SH15 (associated with HAIL G3);
- Design and construction consideration is required at shaft locations based on the findings of this DSI;
- A controlled activity resource consent for the *discharges of contaminants into air, or into water, or onto or into land not meeting permitted activity standards* in accordance with AUP Standard E30.6.1.4 will be required from Auckland Council;
- A controlled activity consent under Regulation 9 of the NES-CS will be required for the Project;
- An Asset owner application (AOA) from Auckland Council will be required for the construction of SH12 and SH12A within Basque Park;
- A Contaminated Land Management Plan (CLMP) addressing soil and groundwater management has been prepared as a separate document (*Aurecon report reference: 521290-W0064-EC-REP-0003*) to support the Project resource consent application;
- If the Motions Collector Sewer alignment and/or shaft location change as the Project design progresses, further GI and assessment of HAIL activities may be required to inform detail design, construction and/or the Project resource consent application; and
- The findings of this DSI can also be positively utilised as part of the stakeholder engagement process for the Project.

Aurecon reserves the right to review our conclusions and recommendations in the event further information becomes available regarding the history along the Motions Collector Sewer alignment, or changes to design are subject to change.