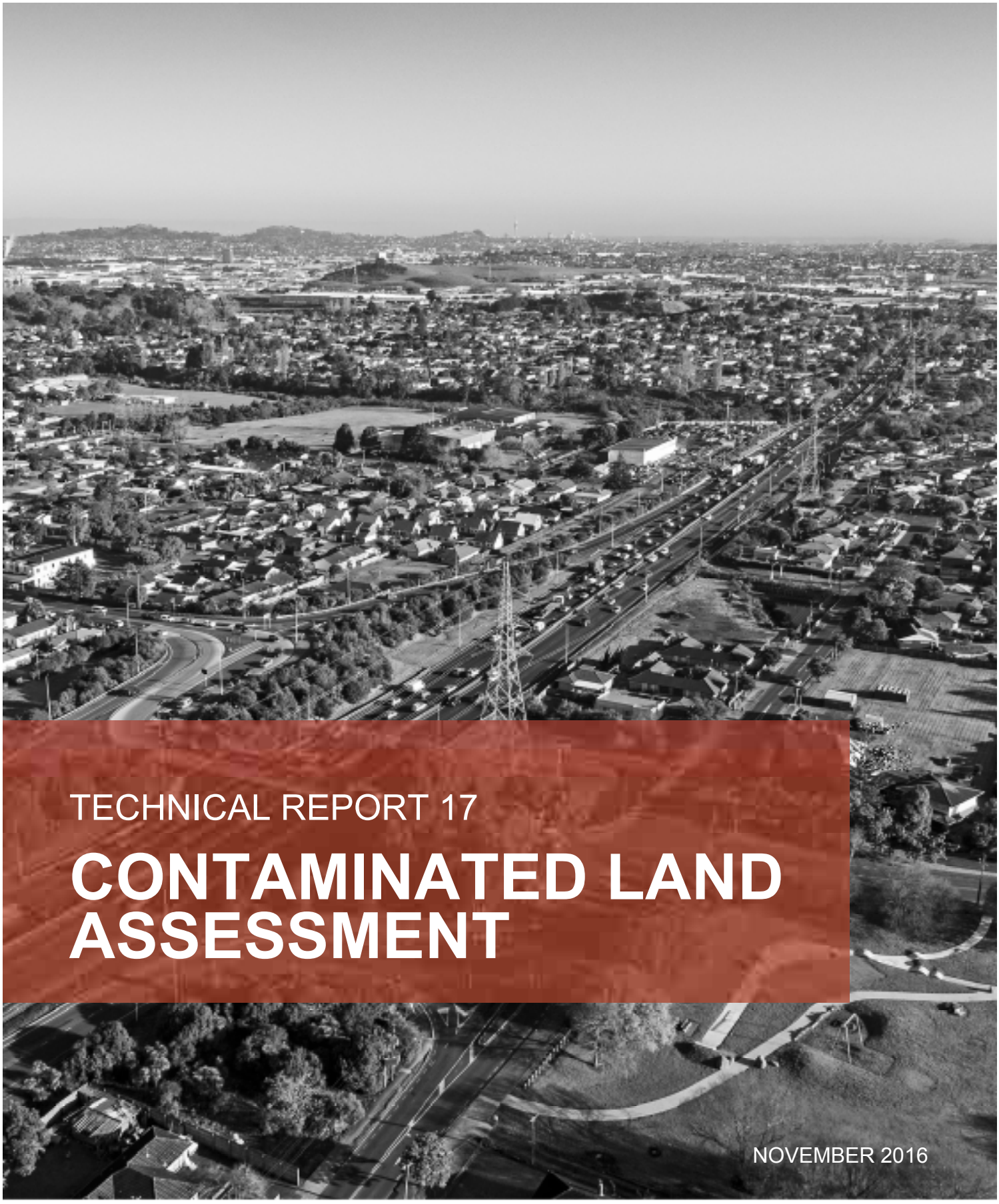

TECHNICAL REPORT 17

CONTAMINATED LAND ASSESSMENT

NOVEMBER 2016

NZ TRANSPORT AGENCY
WAKA KOTAHI

East West Link

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Revision schedule					
Rev. N°	Date	Description	Prepared by	Reviewed by	Approved by
0	November 2016	Final for Lodgement	Wijnand Udema Dr Murray Wallis	Ian Fraser	Patrick Kelly

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EXECUTIVE SUMMARY

Purpose and scope

1. This report presents the findings of the assessment of the potential effects of the Project related to disturbance of contaminated land.

2. The purpose of this report is to:
   - Describe land contamination in the existing environment;
   - Assess the effects of the Project arising from disturbance of contaminated land;
   - Identify measures to avoid, remedy or mitigate adverse effects on the environment resulting from land disturbance.

3. The scope of this report is limited to land contamination effects (including discharges of contaminants to ground and groundwater). The report refers to the assessments of contaminants in groundwater, stormwater, the marine environment and air in the respective Technical Reports for those aspects of the receiving environment.

Assessment undertaken

4. To characterise the existing environment, an assessment of terrestrial contamination was undertaken including:
   - A Preliminary Site Investigation (PSI) for the Project area, in accordance with the NES (Soil);
   - The PSI was used to support development of a Conceptual Site Model for the Project area;
   - Walkover surveys, field investigations and soil testing were undertaken to support the Contaminated Land Assessment;
   - The Conceptual Site Model was refined following completion of the investigations;
   - Potential risks to human health and the environment were identified for the construction of the Project and operation of the Project;
   - The effects of the EWL Project on contaminated land resulting from land disturbance were assessed; and
   - Mitigation measures were identified, and the effects of the EWL Project with mitigation were assessed.

5. The assessment included a review of the comprehensive detailed site investigations that have been completed at sites in the Project area, which were obtained from Auckland Council when the PSI was undertaken. It also relied on the three-dimensional Ground Model completed for the Project (*Volume 3: Technical Report 13 - Groundwater*). The Ground Model was developed and calibrated for the Project area using multiple lines of evidence, including groundwater geochemistry and water quality data.

6. Measures to avoid, remedy or mitigate adverse effects arising from disturbance of existing contamination in the area have been developed by a multi-disciplinary team of experts. Design responses, monitoring and control measures were also derived following consultation with Auckland Council closed landfill and contaminated land specialists and their expert advisors.

Existing environment

7. The Project area has a large number of known (and potentially unknown) contaminated areas, arising from a wide range of historic and current “hazardous activities and industries” (HAIL) including extensive modification of the historic Māngere Inlet. Some filling may have also

occurred at Ōtāhuhu Creek. Activities that are relevant to our assessment of effects for the EWL Project include:

a) Areas where landfills received municipal solid waste continuing until the 1980s;

b) Areas with uncontrolled fill;

c) A range of historic hazardous activities and industries list (HAIL1) land use activities including horticulture, industrial and commercial land uses, and

d) Ongoing (current) HAIL industrial and commercial land uses.

8. The soil investigations supported the findings of the PSI. The contaminants identified in the Project area included asbestos, hydrocarbons, and heavy metals present at concentrations above the naturally occurring background levels.

9. A conceptual model for the Project was developed based upon the PSI, and the model was refined following the site investigations. The conceptual site model identified the sources, human and ecological receptors and exposure pathways for contaminants.

10. The investigations identified two particularly sensitive areas for construction activities from a contaminated land perspective:

a) Works in the asbestos fill area on 141-199 Hugo Johnston Drive, where a stormwater treatment wetland is proposed, and potential discharges to air of respirable asbestos fibres could pose a risk to human health; and

b) Works in the closed landfill areas at Pikes Point and Galway Street, which require special health and safety controls and have particular ecological sensitivity due to the proximity of the coastal receiving environment.

Assessment of potential contamination effects

11. The actual and potential construction effects of the Project on contaminated land are:

a) Disturbance of contaminants and associated discharges of contaminants to air, land and water (surface and groundwater) where there may be an effect on the environment; and

b) Discharge of contaminants where there may be an effect on human health – including site workers and/or the public.

12. The actual and potential operational effects of the Project on contaminated land have been identified as:

a) Discharge of landfill gas into subsurface utilities, posing potential health risks for subsurface maintenance workers;

b) Discharge of contaminants due to disturbance of contaminated soil during periodic maintenance works for subsurface utilities; and

c) Discharge of contaminants in stormwater runoff from the road surface, which will be treated in the stormwater treatment system.

[1] Ministry for the Environment HAIL List: http://www.mfe.govt.nz/land/hazardous-activities-and-industries-list-hail

13. There are also existing resource consents held by Auckland Council for diffuse discharge of leachate, and to take and divert groundwater containing leachate from within the closed landfills. The Project works include the relocation of an existing leachate interception system at Pikes Point Landfill. The Transport Agency will manage the relocation of this system as part of the construction phase, whilst Council will retain it as an asset for the ongoing management of landfill discharges.

14. For this assessment of effects, we adopted an assessment framework based upon effects ascribed as minor, moderate or significant.

15. Prior to mitigation, potential effects on the environment from construction and operation of the Project include discharges to air, ground, groundwater and surface water. The significance of these potential effects is summarised in Table 0-1. Potential effects related to air and surface water discharges have been assessed in the Technical Reports related to those subject areas. Refer *Volume 3: Technical Report 9 – Air Quality* and *Volume 3: Technical Report 12 – Surface Water.*

Table 0-1: Assessment of potential effects on the environment before mitigation measures

Effect	Scale of Effect
During Construction of the Project	
Discharge of contaminants to ground and groundwater	• Moderate for general areas (based on probability of encountering unknown contamination) • Potentially significant for landfills
Discharge of contaminants to air	• Refer to Air Quality Assessment
Discharge of contaminants to surface water	• Refer to Surface Water Assessment
During Operation of the Project	
Discharge of contaminants to ground and groundwater	• Minor for general area and sensitive areas
Discharge of contaminants to air	• Refer to Air Quality Assessment
Discharge of contaminants to surface water	• Refer to Surface Water Assessment

Measures to avoid, remedy or mitigate adverse effects

16. The potential construction effects associated with disturbance of contaminated land can primarily be mitigated through design measures to avoid or minimise the disturbance of contaminated land. Where disturbance cannot be avoided, the effects of disturbance can be managed through controls.

17. The EWL Project design has been informed by contaminated land considerations, in particular:

    a) There are specific design requirements for those locations where the Project crosses historic landfills

    b) Auckland Council's existing leachate collection trench adjacent to the Pikes Point East and Pikes Point West landfills will be reconstructed and enhanced.

18. Construction management measures have been recommended to minimise effects during construction as set out in a bespoke Contaminated Land Management Plan (CLMP) and specific controls for sensitive areas. Further soil and landfill gas (including LFG flows) investigations should be undertaken prior to construction to assess risk and establish

management options in the CLMP. Implementation of the CLMP should be overseen by a Suitably Qualified Experienced Practitioner (SQEP).

19. Following mitigation, the potential scale of effects on the environment from construction and operation of the Project are summarised in Table 0-2. Potential effects related to air and surface water discharges have been assessed in the Technical Reports related to those subject areas. Refer *Volume 3: Technical Report 9 – Air Quality* and *Volume 3: Technical Report 12 – Surface Water.*

Table 0-2: Assessment of effects on the environment after mitigation

Effect	Scale of effects
During Construction of the Project	
Discharge of contaminants to air	• Refer to Air Quality Assessment
Discharge of contaminants to ground and groundwater	• Minor for general areas subject to CLMP • Minor for sensitive areas including landfills subject to controls
Discharge of contaminants to surface water	• Refer to Surface Water Assessment
During Operation of the Project	
Discharge of contaminants to air	• Refer to Air Quality Assessment
Discharge of contaminants to ground and groundwater	• Minor for general area • Minor for sensitive areas
Discharge of contaminants to surface water	• Refer to Surface Water Assessment

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Glossary of Technical Terms/Abbreviations

Abbreviation	Term
AEE	Assessment of Effects on the Environment
ALWP	Auckland Council Regional Plan: Air, Land and Water
BoI	Board of Inquiry
Class 1 Landfill	A site that accepts municipal solid waste as defined in Technical Guidelines for Disposal to Land WasteMINZ April 2016. A Class 1 landfill generally also accepts construction and demolition waste, some industrial wastes and contaminated soils. These landfills are sited in areas that reduce the potential for adverse environmental effects, have engineered systems of cap, liner and leachate collection system designed to provide a high level of containment, appropriate redundancy to collect landfill leachate and landfill gas.
Cleanfill Material	Material that when buried will have no adverse effect on people or the environment. Cleanfill Material includes virgin natural materials such as clay, soil and rock and free of: (i) combustible, putrescible, degradable or leachable components; (ii) hazardous substances; (iii) products or materials derived from hazardous waste treatment, hazardous waste stabilisation or hazardous waste disposal practices; (iv) materials that may present a risk to human or animal health such as medical and veterinary waste, asbestos or radioactive substances; and (v) liquid waste[2]
CLMP	Contaminated Land Management Plan
CMA	Coastal Marine Area
DoC	Department of Conservation
DBC	Detailed Business Case
EPA	Environmental Protection Authority
EWL	East West Link
HAIL	Ministry for the Environment's hazardous activities and industries list (MfE)
Landfill	A waste disposal site used for the controlled deposit of solid wastes onto or into land.[3]
Main Alignment	The components of the Project comprising the new four lane arterial road between SH20 at the Neilson Street Interchange in Onehunga, and State SH1 at Mt Wellington.
MfE	Ministry for the Environment
Municipal Solid Waste	Commonly known as refuse or rubbish; any non-hazardous, solid waste from household, commercial and/or industrial sources.[4]
NES	National Environmental Standard
NoR	Notice of Requirement
NZ Transport Agency	New Zealand Transport Agency
PAUP	Proposed Auckland Unitary Plan
RMA	Resource Management Act 1991

[2] https://www.mfe.govt.nz/sites/default/files/cleanfills-guide-jan02.pdf

[3] Technical Guidelines for Disposal to Land WasteMINZ April 2016

[4] Technical Guidelines for Disposal to Land WasteMINZ April 2016

Abbreviation	Term
Soil NES	Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 as it relates to assessment and management of contaminated soil
SH(x)	State Highway (number)
SQEP	Suitably Qualified and Experienced Practitioner (refer to the MfE Contaminated Land Guidelines)
ULDF	Urban and Landscape Design Framework
Uncontrolled Fill	A site that has been filled primarily with Cleanfill Material but the fill operations were not controlled to prevent the deposition of Municipal Solid Waste or other waste materials (building debris, rubble, industrial waste and scrap).
WES	Workplace Exposure Standard

1. Introduction

1.1 Purpose and scope of this report

This report forms part of a suite of technical reports prepared for the NZ Transport Agency's East West Link Project (the EWL or Project). Its purpose is to inform the Assessment of Effects on the Environment Report (AEE) and to support the resource consent applications, a new Notice of Requirement and an alteration to existing designations required for the EWL.

This report assesses the contaminated land effects of the Project as shown on the Project Drawings in *Volume 2: Drawing Set*. This assessment report covers only land contamination including discharges of contaminants to ground and groundwater. The contaminant discharge matters pertaining to Air, Surface Water and the Marine environment are addressed in the relevant assessment reports for those subjects.

The Project has been developed through a series of multidisciplinary multi-criteria analyses at both the Detailed Business Case phase and the Assessment phase of the Project. Design changes have been adopted throughout the AEE assessment process for the Project in response to a range of construction and environmental considerations.

The purpose of this report is to:

1. Describe land contamination in the existing environment;
2. Assess the effects of the Project arising from disturbance of contaminated land;
3. Identify measures to avoid, remedy or mitigate adverse effects on the environment resulting from land disturbance.

1.2 Project description

The EWL Project involves the construction, operation and maintenance of a new four lane arterial road from State Highway 20 (SH20) at the Neilson Street Interchange in Onehunga, connecting to State Highway 1 (SH1) at Mt Wellington as well as an upgrade to SH1 between the Mt Wellington Interchange and the Princes Street Interchange at Ōtāhuhu. New local road connections are provided at Galway Street, Captain Springs Road, the ports link road and Hugo Johnston Drive. Cycle and pedestrian facilities are also provided.

The primary objective of the Project is to address the current traffic congestion problems in the Onehunga, Penrose and Mt Wellington commercial areas which will improve freight efficiency and travel reliability for all road users. Improvements to public transport, cycling and walking facilities are also proposed.

For description purposes in this Report, the Project has been divided into six sectors. These are:

Sector 1. Neilson Street Interchange and Galway Street connections;

Sector 2. The main alignment along the Māngere Inlet foreshore;

Sector 3. Anns Creek to Great South Road;

Sector 4. Great South Road to SH1 at Mt Wellington;

Sector 5. SH1 at Mt Wellington to the Princes Street Interchange;

Sector 6. Onehunga local road works.

A full description of the Project including its design, construction and operation is provided in Part C: Description of the Project in the Assessment of Effects on the Environment Report contained in *Volume 1: AEE* and shown on the Drawings in *Volume 2: Drawing Set*.

1.3 Experience

Wijnand Udema is a Principal Environmental Scientist and Environment Team Leader at GHD Limited, based in Auckland. He has over 16 years' consulting experience in contaminated land assessment and remediation. He has a Bachelor of Science degree (Earth Sciences) from the University of Waikato (1998) and a Master of Science Degree in Environmental Technology from Saxion University of Applied Sciences (formerly Saxion Hogeschool Ijesslland), in the Netherlands (2000).

Wijnand has acted as an expert witness on contaminated land issues for both the Environment and High Court. Most notably for NZ Transport Agency Roads of National Significance projects including Christchurch Southern Motorway and Pūhoi to Warkworth Motorway. For the High Court, Wijnand delivered expert evidence on incremental remediation costs in the Auckland Waterfront Development Agency Limited v Mobil Oil New Zealand Limited case. Wijnand was involved in completion of the Indicative Business case and Detailed Business Case for the EWL Project for the Transport Agency.

Dr Murray Wallis holds a PhD in soil science and a Bachelor of Horticultural Science (1st class Hons). Through the majority of his career spanning 24 years in New Zealand, Australia and the USA, Murray has specialised in contaminated land investigation, assessment and management.

His work in Auckland from the mid-1990s included the NZ Farmers Fertiliser site in Onehunga, which led to a multidisciplinary characterisation of a contaminant plume and the interconnection between the tuff, basalt aquifer and stormwater/marine receiving environment ('the Green stream study" for Auckland Council funded by MfE). Murray completed a multi-year investigation, risk assessment and remediation project for chlorinated solvents in the Mt Wellington area and studies to assess asbestos contamination at sites along the Main Alignment. His work at other industrial sites in the Onehunga area has included a battery manufacturer, oil recycling facility and the detailed assessment of oxidation pond sediment contamination for the decommissioning of the Watercare wastewater treatment ponds at Māngere. Murray gave evidence at the Council Hearing for Watercare, and he has also provided expert evidence on a range of cases at the Environment Court.

Over the last four years he has led the Environment team for the approvals and procurement of the Ara Tūhono Pūhoi to Warkworth Road of National Significance which was subject to an EPA Board of Inquiry. Murray was also involved in completion of the Indicative Business Case and Detailed Business Case for the EWL Project for the Transport Agency.

1.4 Assessment methodology

This Contaminated Land Assessment is based broadly upon the guidelines presented in the Ministry for the Environment Contaminated Land Management Guidelines No. 1 Reporting on Contaminated Sites in New Zealand (MfE, 2011). The MfE reporting guidelines address reporting for investigation and remediation of contaminated sites rather than the requirements to support an Assessment of Environmental Effects under the RMA. As such, our approach has been adapted to suit that assessment.

This assessment relies on and refers to information presented in the following technical reports:

- The Geotechnical Factual Report, which presents the results of the ground investigations, including the monitoring results for soil samples analysed for contaminants;
- The Groundwater Modelling Report (*Volume 3: Technical Report 13-Groundwater Assessment, Appendix A*) which presents the three dimensional Ground Model; and
- The Preliminary Site Investigation (PSI) (Appendix A) which presents the findings of a desk-based study of contaminated land in the Project area and contaminants in the receiving environment. The PSI is presented in Appendix A to this report.

In addition to the soil contamination sampling, testing and interpretation, the EWL contaminated land team was responsible for the monitoring of contaminants in soil gas, groundwater, stormwater and sediments. Each assessment covers the relevant data as follows:

- The soil gas data are presented and assessed in the Air Quality Assessment (*Volume 3: Technical Report 9 – Air Quality*);
- The groundwater quality data are presented in the Geotechnical Factual Report and assessed in the Groundwater Assessment (*Volume 3: Technical Report 13*);
- The stormwater quality data are presented and assessed in the Surface Water Assessment (*Volume 3: Technical Report 12*); and
- The sediment quality data and the ecological significance of the sediment quality data is assessed in the Ecological Impact Assessment (*Volume 3: Technical Report 16*).

1.5 Other specialist teams

To undertake this Assessment we engaged with the following specialists from the Project team regularly during the investigation and assessment phases:

- Statutory Planning;
- Surface water;
- Civil engineering and geometrics;
- Geotechnical;
- Groundwater;
- Coastal processes; and
- Marine ecology

1.6 Related reports reviewed

Project related reports and documents that were reviewed for this assessment included:

- The Detailed Business Case;
- Geotechnical Factual Report;
- Geotechnical Interpretative Report;
- Groundwater Modelling Report (*Volume 3: Technical Report 13-Groundwater Assessment, Appendix A*);
- Air Quality Assessment (*Volume 3: Technical Report 9*);
- Ecological Impact Assessment (*Volume 3:* Technical Report 16);
- Surface Water Assessment (*Volume 3:* Technical Report 12);
- Groundwater Assessment (*Volume 3:* Technical Report 13);
- Coastal Processes Assessment (*Volume 3:* Technical Report 15); and
- Description of the Project (Section 9 of the AEE, *Volume 1: AEE*).

1.7 Scope of assessment

The scope of the contaminated land assessment included:

- Walkover field surveys of the proposed Main Alignment and local road connections;
- Completion of a PSI, including review of available Council information, historical photographs and results from previous contaminated site investigations;
- Preparation of a conceptual site model;
- Investigations to assess soil contamination in the existing environment;

- Identification of Sensitive Areas where there are elevated risks to human health and/or the environment due to the presence of contaminated land;
- Assessment of the potential effects of the EWL Project construction and operation in terms of discharges of contaminants to ground and groundwater resulting from disturbance of contaminated land;
- Development of mitigation measures for works involving contaminated land, including control measures appropriate for the management of construction works in the Sensitive Areas;
- Assessment of the effects of the EWL Project construction and operation following mitigation.

The investigation philosophy for this report was to develop a conceptual model of the potential sources of contamination in the existing environment that may be disturbed or affected by construction and operation of the EWL Project. We considered the potential exposure pathways relevant to human health and the environment, and the effects on potential receptors that may be impacted. The results of site investigations and the related assessments such as the groundwater modelling were used to update and refine the conceptual model and inform this assessment of effects.

The methodology applied for the assessment of contaminated land is set out below.

Contaminants in soil represent a potential source for contaminants in other media (groundwater, stormwater, and air). Project earthworks in the terrestrial environment have the potential to disturb contaminated soil. Soil contamination was investigated by firstly reviewing existing information on contaminated sites (summarised in the PSI report), and secondly undertaking targeted environmental investigations along or adjacent to the Main Alignment and local road connections for the Project.

1.8 Preliminary site investigation

We completed a PSI to identify the potential sources of contaminants in the existing environment that may be affected by construction and operation of the EWL Project. The PSI is provided in Appendix A and the methodology adopted is described in the PSI.

Since the detailed business case (DBC) was prepared for the Project, the EWL contaminated land team has met regularly with Auckland Council's contaminated land regulatory officers and closed landfill team. Their assistance in providing information needed to prepare the PSI is gratefully acknowledged.

1.9 Conceptual site model

Based upon our knowledge of contaminated sites in the Project area and the findings of the PSI, we developed a conceptual site model (CSM). A CSM is used in the practice of contaminated land assessment to visualise and help understand the interactions between contamination sources, pathways through which the contaminants could move or effect receptors, and receptors that may be impacted by contamination.

For the purposes of this assessment, we adopted the following approach to the development and subsequent refinement of the CSM:

- Development of the preliminary CSM based upon information gathered and interpreted during the Preliminary Site Investigation (Appendix A);
- Development and execution of a field investigation programme to validate assumptions in the preliminary CSM;
- Refinement of the CSM based upon the findings of the field investigations and the three dimensional ground model prepared by the groundwater assessment team; and
- Consideration of the CSM to assess the environmental effects of the EWL Project.

1.10 Site Investigations

Soil investigations undertaken were intended as a screening exercise to support this assessment of contaminated land effects. The soil investigations do not comprise a Detailed Site Investigation as defined by the Ministry for the Environment publications Contaminated land management guidelines No. 1: Reporting on contaminated sites in New Zealand (revised 2011) and Contaminated land management guidelines No. 5: Site investigation and analysis of soils (revised 2011). The assessment of requirements under the Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (Soil NES) is covered in the PSI (Appendix A).

To the extent possible based on health and safety considerations (including live State Highway traffic operations on SH20 and SH1), walkovers of the entire Main Alignment and local road connections were conducted by members of the contaminated land team, in order to assess the ground conditions and select locations for the drilling programme. During the walkovers we made observations including the visible appearance of any contamination on the ground surface (staining, waste etc) and evidence of fill or made ground.

Soil contamination investigations were generally undertaken in conjunction with the geotechnical investigations. The exception to this was for three transects of investigation boreholes that were located perpendicular to the Onehunga foreshore. These locations were selected primarily for the purposes of assessing contaminated soil and groundwater, targeting landfills.

The contaminated land team participated in planning meetings with the geotechnical and groundwater teams, to develop an investigation programme. Drilling and test pit sites were added to the locations adopted by the geotechnical and groundwater teams, particularly in order to assess the coastal margin of the Māngere Inlet which has been reclaimed with “Uncontrolled Fill” and “Landfill” (refer to these defined terms).

This section provides a summary of the field assessment methodology. A more detailed description of field assessment methodologies and sampling locations is provided in the Geotechnical Factual Report.

Soil sampling was undertaken in selected boreholes and test pits. The Figures that illustrate the soil investigation locations are presented in Appendix B.

Grab samples were collected from selected depths during drilling or test pitting. Indicators of contamination or signs of asbestos were noted on bore logs. Samples were kept cold and dispatched under a standard chain of custody to Eurofins Laboratories for analysis.

Analytical testing of selected soil samples was undertaken by Eurofins | mgt in Australia. All tests were accredited by the National Association of Testing Authorities (NATA accreditation number 1261). In New Zealand the International Accreditation New Zealand (IANZ) body also accredits laboratories to ISO/IEC 17025. NATA and IANZ are Signatories under Mutual Recognition Arrangement with the International Laboratory Accreditation Corporation (ILAC) and Asia Pacific Laboratory Accreditation Cooperation (APLAC). ILAC and APAC recognise accreditations by IANZ and NATA as being equivalent.

The analytical testing programme for the EWL Project soil investigation was developed based upon review of the applicable environmental guidelines and the contaminants of potential concern (COPC). The COPC were assessed from the findings of the PSI.

The tests undertaken covered a wide range of potential contaminants, and included:

- Asbestos;
- Inorganic constituents including heavy metals, arsenic;
- Total petroleum hydrocarbons (TPH);

- Semi volatile organic compounds (SVOC);
- Volatile organic compounds (VOC);
- Benzene, toluene, ethylbenzene, and xylenes (BTEX);
- Polycyclic aromatic hydrocarbons (PAH);
- Organochlorine pesticides (OCP); and
- Phenols.

Eighty two primary soil samples were analysed. Results were tabulated and compared with the adopted tier 1 risk based acceptance criteria for contaminated land. Results tables and laboratory reports are provided in the Geotechnical Factual Report.

The assessment of requirements under the *Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011* is covered in the Preliminary Site Investigation (Appendix A) which recommends that further investigations be undertaken prior to construction.

1.11 Assessment of contamination effects methodology

We have adopted the following levels of significance to assess the environmental effects of the Project in relation to the disturbance of contaminated land:

Table 1-1: Levels of significance

Minor	Where the extent of the impact is barely noticeable in scale or magnitude as a result of low sensitivity to change or a low intrinsic value. The impact will be of medium or short term nature or unlikely to occur
Moderate	Where the extent of the impact is small in scale or magnitude as a result of low sensitivity to change or a low intrinsic value. The impact will be of medium or short term nature and likely to occur.
Significant	Where the extent of the impact is large in scale or magnitude as a result of high sensitivity to change or a high intrinsic value. The impact will be of long term nature (or very severe short term), irreversible and certain or likely to occur

2. Existing Environment

2.1 Preliminary site investigation

The PSI (Appendix A) found that there is a high number and density of actual and potential Hazardous Activities and Industries (HAIL) sites in the Project area. Figure 1 in Appendix B shows the identified HAIL sites. The activities and industries represented in the area include most of the MfE HAIL categories, thereby resulting in a wide range of potential contaminant types and sources.

The Urban and Landscape Design Framework (ULDF) for the Project provides a useful description of the history of the Project area. In the early period of European settlement, the fertile, free draining volcanic soils that are extensive in the area were favoured for horticulture (as they were in pre-European times). Horticultural land uses continued into the mid to late 1900's with market gardens and glasshouses. As a result, pesticide residues associated with these land uses are likely to be present in topsoil.

Since the 19th century, the Onehunga port facilitated the development of the Onehunga borough which became an industrial hub of Auckland with improved road and rail connections (refer to *Volume 3: Technical Report 2 - Built Heritage Assessment*).

Major abattoirs ("freezing works") were developed at Southdown and Westfield. A fertiliser works was located on Church street (the former New Zealand farmers Fertiliser, NZFF site), and other industrial activities included chemical plants, oil recycling, battery manufacture, timber processing and treatment and a wide range of commercial and industrial activities. The James Hardie plant located near Mt Smart produced asbestos containing materials (ACM) and the waste material from the plant is known to have been used extensively as fill in the area.

Industrial growth following the Second World War and continuing through to the late 1970s was coupled with extensive land reclamation and landfilling along the Māngere Inlet and Onehunga Bay foreshore.

The reclamations and landfills that are directly affected by the EWL Project are as follows (from west to east):

1. Gloucester Park (North and South) reclamation within the crater of Te Hōpua, hereafter referred to as Gloucester Park;
2. Galway Street closed Landfill (includes "75 Acre Reclamation");
3. Pikes Point West reclamation and closed Landfill (includes Waikaraka landfill); and
4. Pikes Point East reclamation and closed Landfill.

In addition, there were also numerous other closed Landfills in the wider Project area (Earthtech, 1993)[5]:

1. Mount Smart landfill;
2. Former One Tree Hill Borough Council Tip Site (landfill);
3. Former New Zealand Rail landfill; and

[5] Earthtech, 1993: Groundwater Investigation Scoping Report Pikes Point Aftercare, Auckland Regional Council. June, 1993 (Earthtech Consulting Ltd. Ref 2112).

4. Church Street Closed landfill.

Gloucester Reserve reclamation

The Gloucester Park reclamation within the crater of Te Hōpua is located within the area of disturbance for the EWL Project. The Gloucester Park reclamation was filled prior to 1940, and is regarded as an Uncontrolled Fill site rather than a Landfill[6]. This means that the site is expected to contain some incidental waste material that was disposed at the site when the area was reclaimed, however the site is not expected to have the full characteristics of a Landfill that was used for disposal of Municipal Solid Waste.

Galway Street and Pikes Point Landfills

Available information regarding the construction and environmental status of these landfills is generally limited. However we were able to obtain some information for the closed municipal landfills at Galway Street and Pikes Point East, for which Auckland Council holds consents for the discharge of contaminants to ground and groundwater[7] Geotechnical investigations[8] reviewed for the PSI have shown that these landfills do not incorporate modern engineered landfill design elements such as a low permeability "liner" beneath the refuse or a low permeability "cap" to restrict rainfall infiltration into the landfill surface. It is understood that the landfills along the Māngere Inlet foreshore were founded directly on the recent marine sediments and the lava outcrops within the historic inlet area.

An oblique aerial photograph from 1975 showing reclamation and filling at the Pikes Point West reclamation and closed landfill is provided in Figure 2-1. The photograph is taken from the west towards the area between Waikaraka and Miami Stream (Miami Parade). This photograph illustrates the earth bunds that were built to progressively form the margins of the filled area with fill placement occurring within the bunded area during construction. A line of trucks can be observed tipping what appears to be refuse or waste material into the Pikes Point West landfill area, with a bulldozer nearby. Dumped soil/material is also evident across the reclamation area. Pikes Point East landfill can be observed in the background, with filling activities evident and a large remaining area yet to be reclaimed.

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[6] M Crooks, pers comm. Auckland Council Closed Landfill ad Contaminated Land Response Team

[7] Consent for Galway landfill:

- Discharge to ground # 34282.

Consents for Pikes Point:

- Divert and take groundwater containing leachate from within a closed landfill. Permit No. 22100 (expiry date 31 December 2023) – Pikes Point East - Superseded;
- Divert and take groundwater containing leachate from within a closed landfill. Permit No. 22101 (expiry date 31 December 2023) - Pikes Point East - Superseded;
- Divert and take groundwater containing leachate from within a closed landfill. Permit No. 928155 (expiry date 31 December, 2023) - Pikes Point East - Current;
- Divert and take groundwater containing leachate from within a closed landfill. Permit No. 928156 (expiry date 31 December, 2023) - Pikes Point East - Current;
- Divert and take groundwater containing leachate from within a closed landfill. Permit No. 928103 (expiry date 31 December, 2023) - Pikes Point West - Current;
- Divert and take groundwater containing leachate from within a closed landfill. Permit No. 928104 (expiry date 31 December, 2023) - Pikes Point West - Current;
- Diffuse leachate discharge through the base of the landfill into ground. Permit No. 928157 (expiry date 31 December, 2023) - Pikes Point East - Current;
- Diffuse leachate discharge through the base of the landfill into ground. Permit No. 928105 (expiry date 31 December, 2023) - Pikes Point West - Current.

[8] Tonkin & Taylor June 2007: *Report* – Visy Recycling – Martials Recycling Facility Onehunga, Auckland. Contamination Assessment.

A leachate interception system was installed in the early 1990s along the edge of the Māngere Inlet (beneath the walkway) at Pikes Point West and Pikes Point East Landfills. The system installed at Pikes Point West consists of a perforated polyethylene pipe in a scoria filled trench up to 4m deep with three pump stations that discharge to the wastewater sewer from Pump 3 at Miami Parade opposite Pukemiro Street. Details for the system at Pikes Point East are unknown but there is a section of perforated leachate collection pipe 50m either side of pump station 4. Pikes Point East Pump Station 4 is connected to Pump Station 3.

Figure 2-1: Photograph of Pikes Point 1975

The Galway Street and Pikes Point landfills ceased operation in the late 1970s and early 1980s respectively. Pikes Point east landfill closed in 1984. Based upon these dates and the evidence from the 1975 photograph, the Pikes Point reclamations and landfills were filled rapidly in the 10 years or so after 1975.

Asbestos Containing Materials, Southdown area

Asbestos fill in the vicinity of the former Southdown Freezing Works and Hugo Johnston Drive is known to be widespread, and has been a feature of the development of these sites in the area known as Southpark. The authors have completed investigations for Auckland City Council at the Southdown Reserve and the foreshore walkway in the late 1990s and more recent (2016) investigations for Utility companies in Hugo Johnston Drive that confirmed the presence of asbestos containing materials (ACM) in the area. It is considered likely that the landfills in the area also contain ACM.

Uncontrolled Fill and Reclamation at Anns Creek

Anns Creek in Sector 3 has been subject to filling activities, and soil, construction debris and other inorganic material was observed during walkover surveys of the area. The reclamation activity in the area includes the reclamations completed for the railway corridors and a consented reclamation within the past decade by TR Group in Anns Creek east. Our review of aerial photographs showed that significant earthworks have occurred on the site between 1996 and 2006. No significant earthworks have occurred after 2006, however the site has been developed.

Uncontrolled Fill and Reclamation at Ōtāhuhu Creek

Ōtāhuhu Creek in Sector 5 may have been subject to filling activities to facilitate construction of SH1 based upon the review of the historical aerial photos from 1959. Any filling in this area is considered relatively minor when compared to the Māngere Inlet reclamations in the western sectors of the Project.

HAIL Activities and Industries

The identified key HAIL activities for each terrestrial sector of the EWL Project are summarised in Table 2-1.

Table 2-1: HAIL Activities and Industries

HAIL Activity (HAIL Number)	Sector 1	Sector 2	Sector 3	Sector 4	Sector 5	Sector 6
Chemical Manufacture (A2)		✓				✓
Dry-Cleaning (A5)	✓					
Landfill (G3)	✓	✓				✓
Waste Disposal to land (G5)	✓	✓	✓	✓	✓	✓
Asbestos (E1)	✓	✓	✓	✓		✓
Rail Siding (F6)	✓		✓			
Wood Treatment (A18)	✓					
Metal Manufacturing (D2)	✓					
Tannery / Wool Scourer (A16)	✓				✓	✓
Automotive Dismantlers / Scrap Metal (G4)	✓	✓				✓
Waste Recycling (G6)	✓	✓				✓
Chemical storage or liquid wastes (A17)	✓	✓		✓		✓
Paint Manufacturing (A9)	✓	✓		✓		
Cemetery (G1)		✓				
Transport Yard (F8)			✓			
Abrasive Blasting (D1)			✓			✓
Service station / Commercial Refueling (F7)				✓		
Automotive Workshops (F4)				✓		✓
Intentional or Accidental Release of Hazardous Substances (I)	✓	✓	✓	✓		✓
Persistent Pesticide Use (A10)					✓	
Petroleum or petrochemical industry (A13)						✓
Metal Treatment (D3)						✓
Port Activities	✓					

Summary of PSI Findings

In summary, there are many historic and current HAIL sites in the wider Project area. In addition, many of the current commercial and industrial land uses are potential or actual HAIL sites. Closed municipal landfills and reclamations with uncontrolled fill are prevalent around the Māngere Inlet and filling is also evident at Ōtāhuhu Creek. As such, construction of the Project is expected to encounter contaminated land.

From west to east, the EWL Project directly affects the Gloucester Park (uncontrolled fill), Galway Landfill (local road connection), Pikes Point West and East landfills (Main Alignment), asbestos fill at Hugo Johnston Drive (local road connection and stormwater pond), and uncontrolled fill at Anns Creek and Ōtāhuhu Creek.

2.2 Preliminary conceptual site model

As explained above, a conceptual site model (CSM) was developed on the basis of the PSI. A CSM identifies contaminant sources, receptors and exposure pathways.

The essential elements of an initial CSM are:

- Known and potential sources of contamination;
- Potentially affected environmental media;
- Human and ecological receptors; and
- Potential and complete exposure pathways.

The following section provides a summary of the preliminary conceptual site model which was developed based on the information reviewed for the PSI, prior to the field investigations.

2.2.1 Contamination sources

There are numerous known and potential sources of contamination in the Project area. Historical industrial site uses have caused localised contamination of soils and groundwater. Contaminants could have been initially present in soil from the activities on the land or spills, and could have percolated into deeper soils and groundwater. If heavily impacted, soil can continue to be a source of groundwater and stormwater contamination for decades, as is noted for the NZFF site. [9]

The landfills are also sources of ongoing contamination, produced in the form of leachate from rainfall and / or groundwater infiltration and degradation of landfill material over time.

The industrial history of the area and past practices of waste disposal was such that prior to the installation of the Māngere treatment plant in 1960, wastes were generally discharged directly to stormwater. Discharges to the harbour at this time included untreated waste along the northern coast and untreated urban wastewater effluent at several points and additional effluent from process operations.[10]

There are documented accounts of liquid waste being disposed to stormwater (and ultimately the Manukau Harbour) such as the Green Stream (Miami Stream).[11] URS noted that management practices were a concern, and "in particular, the discharge of effluent to on-site soakage pits and discharges to stormwater/trade waste were noted to have caused significant off-site contamination issues." It can be inferred that other industries in the area at the time (1950s) had similar practices of disposal of waste and effluent directly into stormwater or to ground.

In the present context, surface runoff from rainwater over industrial land use can result in contaminants entering stormwater. It can also be assumed that in an industrialised area, the potential exists for accidental releases of contaminants into the stormwater system, as has been the case of the 2013 "purple dye" discharge to the Oruarangi stream[12] located south of the Māngere Inlet and other similar cases known to the authors that have not received media coverage but have been managed through abatement notice procedures by the Auckland Council pollution control officers.

[9] URS, 2010, Green Stream Groundwater Plume Characterisation and Risk Assessment
[10] The history of wastewater treatment in Auckland, 1878-2005, Wastewater information sheet 1, Watercare
[11] URS, 2010, Green Stream Groundwater Plume Characterisation and Risk Assessment
[12] http://www.stuff.co.nz/national/8868412/Dye-spill-stains-Auckland-harbour

In summary, based upon the review of existing information, the main contaminant sources are considered to be:

- Pesticide contaminants in soil from historic horticultural land uses;
- Contaminants in soil from current and historic industrial land uses including metals, nutrients, petroleum hydrocarbons, PAHs, solvents;
- Contaminants in groundwater from current and historic land uses including metals, nutrients, petroleum hydrocarbons, PAHs, solvents;
- Landfills and uncontrolled fill – contaminants in soil including ACM, metals, hydrocarbons, solvents, pesticides;
- Landfills – contaminants in groundwater including metals, hydrocarbons, solvents, nutrients;
- Landfills – contaminants in soil gas including the landfill gas (LFG) methane, sulphides and odiferous products of anaerobic waste decomposition; and
- Stormwater – the primary contaminants in runoff including metals and PAHs. Unauthorised spills that may comprise a wide range of contaminants from products stored and used in the area.

Potentially Affected Media

The following media are potentially affected by contaminants in the Project area:

- Soil;
- Groundwater;
- Stormwater;
- Air; and
- Marine receiving environment in the Māngere Inlet and Tāmaki River (sediment/water).

2.2.2 Human and ecological receptors

Human Receptors

The existing human receptors that are potentially exposed to contamination in the existing environment include:

- Public using the area
- Maintenance workers on properties with contaminated land/over landfill

Human receptors for contaminants that may discharge to the marine environment (i.e. through consumption of shellfish, fish and contact recreation) are not considered here. The body burden of contaminants in shellfish is considered in the marine assessment of the Ecological Impact Assessment (*Volume 3: Technical Report 16*). Contact recreation is considered in the water quality assessment, which forms an appendix to the Surface Water Assessment (*Volume 3: Technical Report 12*).

Ecological

The ecological receptors in the context of the existing area that could be receptors of contamination include:

- On-site terrestrial flora and fauna;
- Off-site biota in freshwater bodies; and
- Off-site biota in marine water environments.

The terrestrial, freshwater and marine ecological habitats are described in the Ecological Impact Assessment (*Volume 3: Technical Report 16*). Although the ecological effects of the Project area are assessed in this report, the nature and location of these receptors informs the sensitivity of the receiving environment for this contaminated land assessment.

Terrestrial ecological receptors

The terrestrial ecological receptors are described in *Volume 3: Technical Report 16 – Ecological Impact Assessment* . The terrestrial and herpetofauna ecology report describes the land, wetland and estuarine ecological values of the Project area.

Surface water ecological receptors

The fresh surface water bodies in the Project area are described in the Surface Water Assessment (*Volume 3: Technical Report 12*). The number of freshwater bodies in the Project area and their extent are limited.

Captain Springs and Bycroft Stream are located up-hydraulic gradient from the Project and as such are not expected to be affected (*Volume 3: Technical Report 13 - Groundwater Assessment*,).

The zone of freshwater at Miami Stream is limited as the majority of the stream is tidal. As such there are no freshwater biota of any significance that may be affected by contamination derived from the Project construction or operation.

In the eastern area of the Project (Sectors 4 and 5), the only receiving body of fresh water that may be affected by the Project construction and operation is the Clemow Drain that drains the Sylvia Park area and flows to the Tāmaki River. There are no freshwater biota of any significance that may be affected by contamination derived from the Project construction or operation.

Marine ecological receptors

In the Onehunga/Te Papapa area of the Project (Sectors 1, 2, 3 and 6), stormwater and groundwater ultimately discharge into the Māngere Inlet. The inlet is considered to be the environmental receptor for contaminants that could potentially migrate from contaminated land existing in the Project area via groundwater, stormwater and surface water. The landfills are immediately adjacent to the Māngere Inlet.

In the eastern area of the Project (Sectors 4 and 5) stormwater and groundwater ultimately discharge into the Tāmaki River (including the Ōtāhuhu Creek). The Tāmaki River is considered to be the environmental receptor for contaminants that migrate in groundwater, stormwater and surface water.

As a general rule for contaminants from urban areas, and from Auckland in particular, most contaminants from these discharges are expected to attach (or “sorb”) to particulate material which settles out of the water column and accumulates in depositional zones that can affect benthic organisms in the sediment[13]. Taking account of the food web, birds foraging in the intertidal zone of the Māngere Inlet and Tāmaki River may take up contaminants through consumption of benthic biota.

2.2.3 Existing pathways for contaminant migration to receptors

Surface spills, discharges to ground or run off from contaminated soil (surface or stockpiles) can cause contaminants to enter stormwater, or contaminants can move through the soil and rock into deeper soils and into shallow or deep groundwater. The geological units and hydrogeology of the Project area are

[13] Marine Water Quality Annual Report 2013, Auckland Council Technical report, TR2014/030, 2014

described in *Technical Report 13*. Stormwater and surface water are described in *Technical Report 12*. Air Quality is addressed in *Technical Report 9.*

In summary, the key mechanisms for contaminant transport in the Project area include:

- Percolation (flow downward through soil) of contaminants into groundwater;
- Overland flow of contaminants across the surface in stormwater during rain events;
- Movement of groundwater contaminants into the stormwater drainage network, which may ultimately discharge to the marine environment;
- Discharges of groundwater into the marine environment;
- Contaminated dust that may be mobilised during dry windy conditions and/or during earthworks;
- Discharges of LFG and other volatile organic compounds from the landfills and any other area impacted by volatile organic compounds; and
- Exposure pathways to human receptors are: inhalation, ingestion and dermal contact.

These pathways are explained in more detail below.

Our interpretation for existing contaminant transport in the current context of the Project area is that:

- The volcanic soils have relatively high permeability and drain freely, thereby allowing contaminants to move through the soil;
- Regionally, groundwater in the underlying tuff and basalt flows south toward the Māngere Inlet (for Sectors 1, 2, 3 and 6), and east toward the Tāmaki River (for Sectors 4 and 5) and as such generally follows the topography;
- Groundwater in the shallow tuff and basalt is hydraulically connected and acts as one aquifer;
- On a local scale, the actual groundwater flow paths may be influenced by:
  - The natural heterogeneity (anisotropy) in hydraulic characteristics of the basalt lava flows, and
  - The paleosurface of the underlying Tauranga Group and Waitematā series bedrock.
- The basalt rock permeability (hydraulic conductivity) is typically high, in the order of 10-4 to 10-5 m/s. Contaminants that reach groundwater in the basalt can move freely, and attenuation of contaminants in the basalt rock will be limited because the rock surfaces offer a low specific surface and a low organic matter content for sorption for contaminants within the aquifer;
- The Tauranga Group alluvium and Waitematā Group rock beneath the basalt acts as a confining layer because it has low hydraulic conductivity (10-7 to 10-8 m/s);
- The hydraulic conductivity of the fill (both uncontrolled fill and landfill) is expected to vary over a wide range (K = 10-5 to 10-9 m/s) but is generally assumed to have a relatively low permeability (when compared to that of the basalt);
- Leachate from the landfills (i.e. shallow groundwater impacted by landfill contaminants) may migrate to the Māngere Inlet through:
  - Migration into deeper groundwater;
  - Seepage through the rip rap rock revetment along the foreshore;
  - Migration through stormwater pipes and surrounding base course; and
  - Tidal flushing of shallow groundwater via stormwater lines and the interface with shallow groundwater.

- Stormwater pipes and their surrounding backfill act more generally as preferential flow pathways for contaminants where they intersect groundwater and the integrity of the stormwater pipes is compromised. For example, the Patrick Street stormwater line has been identified as a receptor of groundwater flow.14 The stormwater lines can provide a short circuit route for contaminant migration to the marine environment of the Māngere Inlet;
- In Sectors 1, 2, 3 and 6, more than half of stormwater in the catchment area drains to soakage. In the eastern area of the Project (Sectors 4 and 5) a proportion of stormwater drains to soakage, although the proportion is not defined in the Auckland Council model. Stormwater therefore has potential to carry contaminants from surface or underlying soils by percolating into groundwater. The remainder is serviced by the stormwater network, which drains through 12 outfalls into the inlet;
- Volatile contaminants may migrate from the landfills and any other soil/groundwater impacted by volatile organic compounds into the air;
- Contaminants may migrate into the air in dust; and
- Common for the entire Project area, even if industrial discharges are properly disposed of to trade waste (for treatment at the Māngere wastewater treatment plant) is that, overflows of the wastewater network still have the potential to contribute contaminants to the receiving environment.15 .

2.3 Site investigation

2.3.1 Walkover surveys

Site walkovers and drive by inspections to assess current land use were undertaken along sections of the Project area prior to developing the methodology for the intrusive works.

The site inspections identified the following features of the site that could be indicative of potentially contaminated areas:

- Rail corridor;
- Known landfills;
- Evidence of uncontrolled fill (e.g. exposed rubble and waste, irregular ground and soil stockpiles); and
- The current industrial land uses.

The walkover surveys were also complemented by the information reviewed for the PSI.

After completing the PSI we developed a soil investigation programme. The data quality objectives for soil testing were informed by the soil guidelines adopted, as discussed below.

2.3.2 Statutory context and soil quality guidelines

The following statutory considerations and environmental guidelines were adopted for the soil investigation.

[14] URS, 2010, Green Stream Groundwater Plume Characterisation and Risk Assessment

[15] Griffiths, G. and Timperley, M., 2005. Auckland City Stormwater–a summary of NIWA and other relevant studies. NIWA, Auckland

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

The Soil NES provides human health risk based criteria for the assessment of risks to human health. The Soil NES does not include criteria for an environmental risk assessment, however by reference the Soil NES incorporates relevant Ministry for the Environment (MfE) guidelines for site assessment. These include the New Zealand Contaminated Land Management Guidelines which are based upon a tiered approach to assess the risks to human health and the environment.

MfE Contaminated land management guidelines

The MfE has prepared a series of guideline documents on contaminated land management. These guides are intended to ensure consistency of reporting on the investigation, assessment and remediation of contaminated sites in New Zealand. The Soil NES incorporates the Contaminated Land Management Guidelines (CLMG) by reference.

Auckland Regional Plan: Air, Land, and Water

The Auckland Council Regional Plan: Air, Land and Water (ALWP) specifies rules that relate to the discharge of contaminants from soils with elevated levels of contaminants. The ALWP includes the Schedule 10 contaminant level assessment criteria as an indicator of historic land uses indicative of a permitted activity. The contaminant levels specified in the Schedule 10 table apply to historical land uses only. They are not to be construed as levels to which land can be polluted up to as a result of ongoing discharges or as levels to which land must be remediated.

The ALWP will be superseded by the Auckland Unitary Plan when it is made or deemed operative.

Proposed Auckland Unitary Plan (PAUP)

The PAUP is currently being developed and will replace various Auckland Council District and Regional Plans. Portions of the PAUP currently have legal effect and must be considered when developing proposals. Like the ALWP, the PAUP requires management of both the use of land containing elevated levels of contaminants and the discharge of contaminants from land containing elevated levels of contaminants. The PAUP outlines permitted activity soil acceptance criteria in Chapter E30.6.1.4.1. The schedule 10 criteria from the ALWP have been included in the PAUP and are referred to hereafter in this report as the Table 2 – Permitted Activity Criteria.

2.3.3 Assessment criteria

This section provides details of the guidelines adopted for the soil investigation and the manner in which they were applied.

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

The Soil NES contains a national set of Soil Contaminant Standards (SCS(health)) consisting of 12 priority contaminants for five standard land use scenarios, including significant excavation works. SCS(health) criteria are prescribed for the 12 contaminants in the Soil NES.

For other contaminants, the Ministry for the Environment (MfE) Contaminated Land Management Guidelines No. 216 provides a hierarchy for the application of other acceptance criteria.

[16] Contaminated Land Management Guidelines No. 2. *Hierarchy and Application in New Zealand of Environmental Guideline Values.* 2001 (revised 2011). Prepared by the Ministry for the Environment.

The criteria for commercial industrial land use have been adopted for this investigation, because the exposure scenario reflected in the commercial industrial land use best fits the use of land for roading purposes.

Technical Publication No. 153

Auckland Regional Council Technical Publication No. 153 (October 2001) Background Concentrations of Inorganic Elements in Soils from the Auckland Region (TP153) provides guideline values for total recoverable levels of a number of trace elements in naturally occurring Auckland soils.

TP153 provides the assessment criteria for background concentrations of trace elements in the soil samples and is referenced in both the PAUP and ALWP. The PAUP states that for in situ soil and material imported or deposited onto land, the concentrations of target contaminants must not exceed the greater of the Table 2 – Permitted Activity Criteria or the background ranges of trace elements in Auckland soils (TP153).

The TP153 criteria for non-volcanic soil were adopted for this assessment even though the natural soils in the Project area are predominately volcanic. The reason for this approach was because much of the soil fill used for reclamations and land filling in the Project area is non-volcanic. This approach was adopted as a conservative comparison for the soils, because the background levels for non-volcanic soils are lower than for volcanic soils.

National Environmental Protection Measure

In the absence of New Zealand risk based human health criteria for nickel and zinc, the Australian National Environment Protection Measure 2013 (NEPM) guidelines[17] have been adopted for this investigation, in accordance with the MfE CLMG No. 2[18].

For the purposes of this assessment, the soil results were compared with the following NEPM health based investigation levels (HILs):

- HIL C for public open space areas (exposure scenario includes footpaths); and
- HIL D for Commercial/Industrial.

Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand

The Soil NES requires that petroleum hydrocarbon contamination be assessed in accordance with the Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand (commonly referred to as Oil Industry Guidelines (OIG))[19].

The OIG in New Zealand has been prepared in the context of two objectives. These are establishing the detailed procedure for developing soil acceptance criteria, and to develop generic (Tier 1) soil acceptance criteria. The guideline focuses on sites that have stored, handled, or distributed petroleum products.

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[17] National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended 2013) Schedule B(1); Guideline on the Investigation Levels for Soil and Groundwater.

[18] Contaminated Land Management Guidelines No. 2. *Hierarchy and Application in New Zealand of Environmental Guideline Values.* 2001 (revised 2011). Prepared by the Ministry for the Environment.

[19] Guidelines for Assessing and Managing Petroleum Hydrocarbon Contaminated Sites in New Zealand. *Module 4: Tier 1 soil acceptance criteria.* August 1999 (revised 2011). Prepared by the Ministry for the Environment.

For this assessment, the soil results were compared to the OIG for sandy silt in the following settings:

- Residential;
- Commercial/Industrial; and
- Excavation.

The excavation exposure scenario and commercial/industrial land use are applicable to the Project construction and operational phases, respectively.

2.3.4 Field observations

Field observations are provided in bore logs in the Geotechnical Factual Report, and the key observations relating to indicators of contamination are summarised in Appendix C. The table lists boreholes (BH) and testpits (TP) and the depth interval (meters below ground level; mbgl) where asbestos landfill refuse and odours were observed.

Asbestos

During intrusive works, asbestos fragments were observed at the following locations:

- Borehole BH2001 in Southdown Reserve;
- Boreholes BH2002, BH2039 and test pits TP2001, TP2001A located at 141-199 Hugo Johnston Drive. Significant amounts of asbestos were observed in the test pits. The test pits were terminated before the full depth of ACM was established; and
- Test pit TP2015 adjacent to SH1 (together with refuse in fill material near the surface).

Analytical results are included in the Geotechnical Factual Report. Laboratory analysis of samples of ACM confirmed the presence of asbestos. The asbestos found included chrysotile, amosite and crocidolite in the form of loose fibres and asbestos cement product.

The property at 141-199 Hugo Johnston Drive was identified as an area of asbestos dumping in the PSI, and the finding of the field investigations confirmed that asbestos contamination in this location is extensive.

It is considered likely that there will be other sites affected by the Project that have not been investigated and that may also have ACM in soil associated with prior building demolition or localised uncontrolled fill.

Based on investigations, ACM in the area is predominately in the form of fragments of cement fibre board (traded as products such as “Fibrolite,” “Super 6” corrugated roofing product and asbestos cement pipes). The asbestos fibre in these materials occurs in a cement matrix. However, ACM waste characterised at other sites and sourced from the James Hardie Penrose plant has been found to contain fibrous asbestos as well as asbestos cement material (remediation of the Manukau Heights asbestos fill site for Manukau City Council).

The Hugo Johnston Drive site is known to contain large quantities of failed batches of “Fibrolite” manufactured by a local manufacturer. The ACM is likely to be several metres deep and overlaid with soil mixed with demolition waste and scrap machinery. It is believed that the fill does not include municipal solid waste. Unconfirmed reports suggest that waste oil “bottoms” (settled sludge from waste oil recovery) was mixed with the asbestos at the time of placement as a dust suppressant. This is supported though groundwater analysis that has detected hydrocarbons.

Refuse

Refuse was observed at many investigation locations. In most cases, samples from the refuse were not collected for laboratory analysis because landfill refuse material that will be disturbed by the Project is heterogeneous and will be treated as contaminated.

Refuse was expected to be encountered in areas of known landfills. Refuse was also encountered in some areas that are not identified landfills. These observations outside the recorded landfill footprints of Pikes Point and Galway Street were generally limited to a shallow fill layer near the ground surface, and as such have been deemed to represent evidence of "uncontrolled fill" rather than landfill.

Odours

Hydrocarbon odours were noted in several boreholes and test pits during investigations. The locations and depths odours were observed are summarised in Appendix C. Test pits in landfills where refuse was excavated released landfill odours. These observations indicate an effect that will be produced by construction works for the Project in the landfill areas.

2.3.5 Soil chemical test results

The analytical results for chemical soil testing and a discussion of the results are summarised below. The tabulated analytical results compared with the environmental guideline criteria are presented in the Geotechnical Factual Report. The sampling locations are shown in the Figures presented in Appendix B of this report.

Inorganic Contaminants

All of the inorganic elements analysed (arsenic, cadmium, chromium, copper, mercury, nickel, lead, zinc) exceeded the background levels for non-volcanic soil throughout the Project area.

The only locations where the measured metals concentrations were less than the background levels at all of the depths sampled were BH2004, BH2006, BH2028 and BH2031.

This means that the majority of soil across the Project area has metal concentrations above background levels and would need to be managed as contaminated soil as per the NES.

Zinc was elevated at TP2010 located north of the Turners and Growers site in Sector 4. However, the concentration of zinc measured did not exceed the NEPM criterion for commercial industrial land use.

Lead was found at elevated concentrations in the locations where hydrocarbons were also elevated (BH2002 at 141-199 Hugo Johnston Drive; BH5009 in the footprint of Pikes Point East landfill). BH5009 is located in the vicinity of the proposed ports link road. Concentrations of lead at BH5009 also exceeded the NES (Soil) criteria for the protection of human health. Lead was also elevated generally in samples from the landfills.

Soils in the vicinity of the proposed ports link road also contained hydrocarbons as discussed below.

Organic Contaminants

Hydrocarbons

Total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzenes and xylene (BTEX) and polycyclic aromatic hydrocarbons (PAH) concentrations were generally below detection limits or at low levels except for samples taken from the following locations:

- Borehole BH2002 located at 141-199 Hugo Johnston Drive had elevated TPH concentrations in samples collected at 2, 3 and 3.5m bgl;
- Test pit TP2022 located within the footprint of the Pikes Point East landfill (not to be confused with Borehole BH2022); and
- Borehole BH5009 (0.5 – 1.0 m) in the footprint of Pikes Point East landfill, north of TP2022.

Hydrocarbons were detected in the deeper soil samples from the asbestos fill at 141-199 Hugo Johnston Drive. There is anecdotal information that refinery bottoms (i.e. oil sludge) were mixed with asbestos material for disposal purposes, which may have been undertaken to bind the asbestos

material. This area is proposed to be used for a stormwater pond and disturbance of soils in this area will need to be managed to prevent exposure to hydrocarbons (as well as asbestos).

A soil sample from TP2022 exceeded the NES criterion for carcinogenic PAHs (BaP TEQ), with a concentration of 84.63 mg/kg. This test pit was located within the footprint of the Pikes Point East landfill in a swale east of Pukemiro Street near the former Dominion Oil Recycling (DOR) site (23 Pukemiro Street). During the test pitting, refuse was also noted and separate phase hydrocarbon was observed in shallow water entering the test pit. Elevated TPH concentrations were found in samples collected at 2, 3 and 3.5m bgl. The DOR site was used for refining used oil and was subject to environmental investigations and remediation including a groundwater interception trench on Pukemiro Street after it closed (overseen by the author Dr Wallis).

BH5009 is located slightly north of TP2022 and the sample from 0.5 – 1.0m bgl also had elevated TPH concentrations indicative of the presence of separate phase product (80,000 mg/kg).

Both BH5009 and TP2022 are within the area of the proposed ports link road. Disturbance of soils in this area will require specific controls given the concentrations of hydrocarbons, BaP and inorganic contaminants to mitigate any potential exposure and human health risks.

PAHs were detected at relatively low concentrations at many of the investigation locations across the Project. However, other than at TP2022 the measured concentrations did not exceed the guidelines for protection of human health.

The soil investigation undertaken did not find any concentrations of benzene, toluene, ethylbenzene, and xylenes (BTEX) that exceeded the environmental guidelines adopted for the assessment.

Pesticides

The soil investigation undertaken did not find any concentrations of organochlorine pesticides that exceeded the environmental guidelines adopted for the assessment. However, the number of near-surface samples analysed was limited (due to service clearance), and pesticide residues may be detected in those areas where the topsoil remains from historic market gardening activities.

SVOC

The soil investigation undertaken did not find any concentrations of semi-volatile organic compounds (SVOC) that exceeded the environmental guidelines adopted for the assessment.

VOC

The soil investigation undertaken did not find any concentrations of volatile organic compounds (VOC) that exceeded the environmental guidelines adopted for the assessment.

Phenols

The soil investigation undertaken did not find any concentrations of phenols that exceeded the environmental guidelines adopted for the assessment.

2.3.6 Summary of soil chemical testing results

In summary, the soil analytical results are considered to be representative of industrial land uses and fill material, with relatively low to moderate concentrations of inorganic and organic contaminants detected in most of the soil samples analysed across the Project area. There were some locations where elevated metals and hydrocarbons were observed and disturbance of soil at these locations should be managed with specific controls as discussed further in this report.

It is noted that for the most part, samples were not collected from the refuse in the landfills for laboratory analysis, because for the purposes of the Project the refuse will be assumed as contaminated material for management and off-site disposal (Mitigation, Section 9.3).

Due to the inherently variable nature of fill materials in landfills, it should be recognised that higher concentrations of soil contaminants may be present at the closed landfills affected by the Project.

2.3.7 Landfill Gas

To provide a screening level assessment for landfill gas (LFG), thirteen groundwater wells were monitored for gases at locations where evidence of municipal solid waste was encountered in the borehole during drilling. Gas sampling ports were installed in the well caps to allow for the analysis of gases in the headspace of the wells using a portable LFG monitor. The full methodology for the LFG investigation and the LFG monitoring results are provided in an appendix to the Air Quality Assessment (Technical Report 9).

Ambient landfill gas was also detected during drilling of BH5007 (Pikes Point east landfill) which resulted in drilling works being suspended. The drilling works were resumed after a period of further monitoring and implementation of specific controls.

The assessment of effects for LFG is also presented in the Air Quality Assessment (Technical Report 9), however a summary of the findings is also presented here for ease of reference and because the controls recommended for managing the potential construction effects through landfill areas (Section 9.3) include measures for LFG.

In summary, all 13 locations were observed to have relatively low gas flow (less than 10 L/hour) and low relative pressure (less than 1 mB). These observations indicate that the subsurface gases produced in the tested areas are likely to be discharging from the subsurface to atmosphere via diffuse discharge through the soil surface. The one possible exception was at BH4002 located north of the footprint of the Galway landfill, west of the Victoria Street / Neilson Street intersection. At BH4002 a positive pressure of 4.54 millibar (mB) was observed suggesting some confinement of the subsurface gas at this location. It should be noted that groundwater fluctuations may also influence pressure gradients within monitoring wells.

The concentrations of carbon dioxide measured in the well headspace were relatively low except at:

- Borehole BH2001 located at the Southdown Reserve;
- Borehole BH5001 located west of Waikaraka park, near the Māngere Inlet foreshore within Galway landfill footprint, and
- Boreholes BH5007 and BH5008 located at the Pikes Point East landfill.

The measured carbon dioxide concentrations at the four locations listed above ranged up to 34.7% by volume. Reduced oxygen is associated with elevated carbon dioxide (and other landfill gases), which can present risks for human health due to asphyxiation in excavations and subsurface infrastructure if inadequately managed. Oxygen was recorded at 0% by volume in the well headspace at boreholes BH2001, BH5007 and BH5008; and oxygen levels were also depressed in the headspace of other wells.

Methane at boreholes BH2001, BH2023, BH5007 and BH5008 was elevated, up to 70.9% by volume. These levels are above the Upper Explosive Limit for methane, and therefore present a potential explosion risk.

The headspace of the well at BH5007 had a measured hydrogen sulphide concentration of 18 to 23 parts per million (ppm), which exceeds criteria for human health protection Workplace Exposure Standards (WES)[20].

These results are indicative only and further monitoring of LFG will need to be undertaken prior to construction. In summary, the presence of LFG needs to be considered and managed appropriately to avoid adverse effects as further discussed in Section 3.5.

2.4 Refined conceptual site model

The CSM was revisited and revised following the contaminated land investigation programme undertaken for the Project, and also in the light of the investigations and assessments undertaken by other disciplines that have examined the relevant receptors and contaminant pathways.

Although the fundamental structure and attributes of the CSM have not changed, our perceptions of the environment have changed, in terms of contaminant sources and pathways. The changes to our model cover the following key areas:

- Leachate in the landfills is a source of contaminants, however the leachate at Pikes Point and Galway landfills has been found to be much more dilute than we expected. The concentrations of landfill derived contaminants in the shallow groundwater at these landfills are relatively low, with the exception of ammoniacal nitrogen;
- Stormwater is a source of contaminants, but the stormwater monitoring has shown lower concentrations of contaminants than expected given the land use. Biological contaminants from wastewater are evident in the stormwater, however. These attributes, their relevance to stormwater treatment and the assessment of effects for surface water are covered in the Surface Water Assessment (Technical Report 12);
- The concentrations of contaminants in sediment in the Māngere Inlet receiving marine environment are lower than expected, which appears to be due to the great quantity of (relatively uncontaminated) sediment that is deposited in the inlet on each incoming tide from the wider Harbour. These attributes, their relevance to the marine ecosystem and the assessment of effects for biota in sediments and foraging birds are covered in the Ecological Impact Assessment (Technical Report 16).

A schematic Conceptual Site Model is provided as Figure 3 of Appendix B.

The CSM illustrates the Project, sources of contaminants and the relevant receptors and exposure pathways for people and the environment. These are described below.

2.4.1 Contamination sources

From our investigations of existing contaminated land that will be affected by the Project, the primary sources of contaminants and the associated contaminants of potential concern are:

- Landfill leachate – ammoniacal nitrogen;
- Landfill gas – LFG components including methane, sulphide and odorous organics; and
- Asbestos fill – Asbestos containing materials (ACM).

2.4.2 Toxicity of contaminants of potential concern

The contaminants of potential concern for the Project are discussed below.

[20] http://www.epa.govt.nz/search-databases/pages/substance-exposure-limit-register.aspx

Ammoniacal nitrogen

The processes of nitrogen transformation are well understood as the "nitrogen cycle." These processes are relevant to the fate of ammoniacal nitrogen in the terrestrial and marine environment.

Ammoniacal nitrogen is the measure of nitrogen from ammonia (NH_3) and ammonium (NH_4^+). Ammonia is a common break down product of nitrogen from organic matter and it is toxic to aquatic organisms. In the ammonium form, the cation sorbs to the cation exchange complexes of soils and sediments, which reduces its bioavailability and hence toxicity. Ammonium nitrogen also reacts readily with anions in solution to form less toxic compounds.

Through the process of nitrification, nitrifying bacteria convert ammonia under oxidising conditions first to nitrite (which is also toxic), and then to nitrate which is used by plants and other organisms for growth. Nitrite is a very reactive ion and is almost immediately converted to nitrate. Volatile losses of nitrate as nitrogen gas can occur under anaerobic conditions when sufficient mineralisable carbon is available, in a process called denitrification. Ammoniacal nitrogen is very water soluble. In summary, ammoniacal nitrogen in soil exhibits low toxicity and also transforms to less toxic forms. In fresh and marine water ammoniacal nitrogen can be toxic.

Ammoniacal nitrogen is not toxic to humans at the concentrations found in environmental media during our investigations.

Landfill gas

The toxicity of landfill gas is variable, depending on composition. The primary constituents of landfill gas, in varying proportions are summarised in Table 2-2:

Table 2-2: Typical landfill gas composition[21]

Landfill Gas Component	Typical % by volume
Methane	45–60
Carbon dioxide	40–60
Nitrogen	2–5
Oxygen	0.1–1
Ammonia	0.1–1
Volatile and semi-volatile organics	0.01–0.6
Sulphides (includes hydrogen sulphide)	0–1
Hydrogen	0–0.2
Carbon monoxide	0–0.2

The composition of landfill gas changes over time, depending on the stage of landfill degradation. Landfill gas composition may also vary across a landfill due to the heterogeneity of the material placed within the landfill (for example, the proportion of putrescible organic waste).

Landfill gas has been linked to both acute and chronic toxicity to human health. For the purposes of this assessment we consider that acute toxicity is most relevant, as it applies to construction workers. There are no foreseeable scenarios where chronic exposure would manifest for the EWL Project. The following discussion summarises the potential health effects of the major components of landfill gas.

[21] Tchobanoglous, George, Hilary Theisen, and Samuel Vigil. *Integrated solid waste management: engineering principles and management issues*. McGraw-Hill, Inc., 1993.

Methane

Methane is an odourless gas that is not directly toxic to human health. The main concern that arises from methane is that it is explosive/flammable between 5% and 15% by volume. Above 15% b/v oxygen is displaced and therefore combustion cannot occur. However methane will readily dilute in the atmosphere to combustible levels.

At high concentrations, methane will displace other gases in the atmosphere, including oxygen. This can lead to oxygen depleted environments, which poses an asphyxiation risk. This may be more prevalent in confined spaces such as trench, excavations and underground infrastructure. It should be noted that other landfill gases such as carbon dioxide and carbon monoxide may also cause unfavourable breathing environments.

Concentrations of methane are likely to be variable across the landfills depending on the waste composition, the stage of the landfill degradation, and the containment of the landfill (particularly the nature of the cover material).

Hydrogen sulphide

Hydrogen sulphide is extremely toxic to humans and is often associated with a "rotten egg" odour.[22] Hydrogen sulphide is heavier than air and therefore can accumulate in trenches, excavations and subsurface utilities. Acute exposure to hydrogen sulphide can result in nausea, headaches, delirium, disturbed equilibrium, poor memory, neurobehavioral changes, olfactory paralysis, loss of consciousness, tremors, and convulsions[23]. Exposure to hydrogen sulphide concentrations of 600 ppm can be fatal within 30 minutes through respiratory failure[24].

The New Zealand Workplace Exposure Standard (WES) for hydrogen sulphide is 10 ppm or 0.001% b/v. Based upon the "typical" landfill gas composition (Table 5) it may be possible that dangerous levels (above the Workplace Exposure Standard; WES) may be encountered during disturbance of landfill material. Investigations undertaken for the Project have detected hydrogen sulphide at levels above the WES.

As for methane, concentrations of hydrogen sulphide are likely to be variable across the landfills depending on the waste composition, the stage of the landfill degradation, and the containment of the landfill.

Volatile and semi-volatile organic compounds

Volatile and semi-volatile organic compounds (VOC and SVOC) cover a wide range of organic compounds that have varying degrees of toxicity and flammability. Whist the environmental investigations to date have not identified any significant concentrations of volatile of semi-volatile organic compounds, sampling did not focus on the refuse contained in the landfills and it is possible that such compounds are encountered during the construction works through the landfill areas. Given the age of the landfills, the risk is considered relatively low as VOCs and SVOCs would typically degrade relatively quickly[25] in a landfill environment.

In the event that gross contamination is detected during the construction works for the Project in landfills (such as free product or chemical vapours), specialist advice should be sought on addressing risks associated with these compounds. For this reason (among others), a SQEP is recommended to supervise the implementation of the CLMP.

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[22] Although quickly leads to olfactory desensitising

23 DHHS/ATSDR, July 2006: Toxicological Profile for Hydrogen Sulfide p.62 - http://www.atsdr.cdc.gov/toxprofiles/index.asp

[24] Matheson, 1983: Guide to Safe Handling of Compressed Gases 2nd ED p.15

[25] SVOCs will tend to degrade less rapidly that VOC.

Odour

Whilst odour generally does not pose a risk to human health (exception is some volatile vapours), it does pose a nuisance to workers and the public. Odours are likely to be generated from disturbance of land fill. Strong, pungent odours can be generated from mercaptans, a naturally synthesised organo-sulphur compound. At higher concentrations, mercaptans can exhibit comparable human health effects of hydrogen sulphides and also irritate eyes, skin, and respiratory tract.

Odour is discussed further in Technical Report 9 Air Quality Assessment.

Asbestos

Asbestos only poses a risk to human health, not to ecological receptors. Asbestos fibres must be inhaled in order to be toxic to humans, and as such the asbestos fibres must become airborne. The main toxicological effects of asbestos are asbestosis and mesothelioma. There is no known safe level[26] of asbestos fibres in air, and as such acute exposure (from short term exposure) needs to be carefully considered.

Asbestos is a group of natural rock minerals found in certain geological formations, and the minerals were mined for use. The most common minerals of asbestos found in New Zealand are chroysitile, amosite and crocidolite, with secondary minerals including anthophyllite, and actinolite. The health effects of the minerals vary (amosite and crocidolite are the most hazardous). However, for the purposes of this assessment, the group of minerals is addressed collectively.

Asbestos products come in various forms and was used extensively in the in the building industry and in industrial applications until the 1990s in New Zealand. The asbestos materials identified during the investigation works comprised asbestos in a cement matrix including cladding and roofing (Fibrolite, Coverline and Supersix corrugated roofing), asbestos pipe fragments and asbestos cement slurry (found at Hugo Johnston Drive).

When present in a cement matrix the asbestos fibres are bound in the cement and therefore present a lower risk of respirable fibres. Likewise, the asbestos fibres bound in soil (particularly moist, fine textured soils such as silts and clay) are less prone to release into the air. There have been several remediation projects undertaken in New Zealand by the authors that have involved the removal of “bulk” ACM material from fill sites, where asbestos monitoring at the remediation site boundary and monitoring of workers has not measured any detectable concentrations of asbestos in air. These findings have been supported by remediation projects undertaken by others in New Zealand and Australia.

2.4.3 Receptors

The receptors that may be impacted by the contaminants of potential concern are unchanged from the Preliminary CSM in Section 2.2 of this report.

2.4.4 Contaminant exposure pathways

The complete contaminant exposure pathways for human and ecological receptors in the existing context of the Project area are:

- Percolation (flow downward through soil) of contaminants into groundwater;
- Overland flow of contaminants across the surface in stormwater during rain events;

[26] Skammeritz, E; Omland, L. H.; Johansen, J. P.; Omland, O (2011). "Asbestos exposure and survival in malignant mesothelioma: A description of 122 consecutive cases at an occupational clinic". The international journal of occupational and environmental medicine. 2

- Movement of groundwater contaminants into and around the stormwater drainage network, which may ultimately discharge to the marine environment;
- Discharges of groundwater into the marine environment;
- Discharges of leachate into the marine environment; and
- Discharges of LFG and other volatile organic compounds from the landfills and any other area impacted by volatile organic compounds.

3. Assessment of Contamination Effects

This assessment considers both potential effects of the construction and operation of the project. Although most of the considerations for contaminated land apply to the construction phase of the project, the risks represented by contaminants in the closed landfill footprint will prevail beyond the period of construction and as such there is a need for proper management and control during future maintenance and operation.

3.1 Conceptual site model for the Project

3.1.1 Sources

From our investigations of contaminated land that will be affected by the Project, the primary sources of contaminants and the associated contaminants of potential concern are as follows:

- Landfill leachate – ammoniacal nitrogen;
- Landfill gas – LFG components including methane, sulphide and odorous organics; and
- Asbestos fill – asbestos containing materials (ACM).

The investigations identified two particularly sensitive areas for construction activities from a contaminated land perspective:

- The asbestos fill area on 141-199 Hugo Johnston Drive; and
- Closed landfill areas at Pikes Point and Galway Street.

It is noted that there are other sources of contaminants (such as a wide range of potential contaminants in uncontrolled fill or at industrial sites) in the Project area, however the management controls that will be adopted for the general areas of the Project through the Contaminated Land Management Plan will be appropriate to address these.

3.1.2 Pathways

To assess the effects of contaminated land disturbance during construction of the Project, the complete contaminant exposure pathways for human and ecological receptors during construction and/or operation of the Project are considered to be:

- Disturbance of soils that leads to percolation (flow downward through soil) of contaminants into groundwater;
- Overland flow (runoff) of contaminants from exposed surfaces (cut faces or stockpiles) into stormwater during rain events;
- Movement of groundwater contaminants into the stormwater drainage network, which may ultimately discharge to the marine environment;
- Discharges of groundwater into the marine environment;
- Contaminated dust that may be mobilised during dry windy conditions and/or during earthworks; and
- Discharges of LFG and other volatile organic compounds from the landfills (and any other area impacted by volatile organic compounds) to air.

The exposure pathways to human receptors include:

- Inhalation (of dust, LFG or volatiles or asbestos);
- Ingestion (of contaminated soil or water); and
- Dermal contact with contaminated soil or groundwater.

3.1.3 Receptors

Human Receptors

During construction, the following people could be affected by the Project works:

- Construction workers building the EWL Project who may be exposed to contaminated soil, groundwater, dust and vapours;
- Off-site public, including workers at nearby commercial and industrial sites who may be exposed to contaminated dust and vapours.

During operation, the following people could be affected by the Project:

- Maintenance workers, including those workers who maintain subsurface utilities for the EWL Project may be exposed to contaminated soil, groundwater, dust and vapours;
- Off-site public, including workers at nearby commercial and industrial sites may be exposed to contaminated dust and vapours during maintenance works.

Ecological

During construction and operation of the EWL Project, the potential ecological receptors for contaminants in land that may be disturbed by the Project works are:

- On-site terrestrial flora and fauna;
- Off-site biota in freshwater bodies; and
- Off-site biota in marine water environments

The assessment of effects on terrestrial, freshwater and marine ecology is provided in Technical Report 16 - Ecological Impact Assessment.

3.2 Potential construction effects

The actual and potential construction effects of the Project on contaminated land have been identified as:

- Disturbance of contaminants in soil and groundwater and consequential discharges of contaminants to air, land and water (surface and groundwater) where there may be an effect on the environment; and
- Discharge of such contaminants where there may be an effect on human health – including site workers and the public.

There are two areas affected by the Project that are particularly sensitive in terms of existing contamination risk as described below.

3.2.1 Asbestos area (141-199 Hugo Johnston Drive)

In the asbestos fill area on 141-199 Hugo Johnston Drive, a stormwater treatment wetland is proposed. In addition to ACM, hydrocarbons were detected in high concentrations.

Potential effects from disturbance of soil in this area are:

- Human health risks associated with direct contact with contaminated soil;
- Dust – if conditions are dry during excavation of soils dust may be generated which may contain contamination and have the potential to be inhaled by site workers or general public. Deposition of contaminated dust could also spread contaminants to the environment;
- Disturbance of asbestos mobilising asbestos fibres into the air causing a potential public health risk;

- Contaminated run-off of hydrocarbons from construction areas or stockpiles – impact to environment (receiving waters of Anns Creek, recognised in parts as a significant ecological area) from contaminated sediment can impact water quality and ecosystems;
- Odours or volatile vapours – if odorous or volatile material (from hydrocarbons) is encountered it could be inhaled by site workers or public causing impacts on human health;
- Cross contamination of the environment if contaminated soils are placed or re-used in previously uncontaminated areas or not disposed of appropriately leading to degradation of receiving environment, lack of amenity value or impact to human health, particularly if asbestos containing soil not handled correctly; and
- A positive effect of the Project will be capping of ACM following construction of the wetland, limiting access and resulting in a controlled area.

3.2.2 Landfills

The Galway and Pikes Point landfills have been found to contain refuse up to 8m deep below ground surface. Monitoring completed for the Project has identified landfill gas in the headspace of wells installed at and near the landfills.

The direct effects of the Project on contaminated land increase in that part of the alignment over the Pikes Point Landfills where Auckland Council operates a leachate interception system. The interception system needs to be replaced as part of the Project, involving construction of a trench in the landfill. Disturbance of the refuse may mobilise contaminants from the material and result in a discharge to ground and groundwater.

Works in the closed landfill areas at Pikes Point and Galway Street, require special health and safety controls and have particular ecological sensitivity due to the proximity of the coastal receiving environment.

Potential effects from disturbance of soil in the landfills are:

- Human health risks associated with direct contact with contaminated soil;
- Dust – if conditions are dry during excavation of soils, dust may be generated which may contain contamination and have the potential to be inhaled by site workers or general public. Deposition of contaminated dust could also spread contaminants to the environment;
- Contaminated run-off from construction areas or stockpiles may impact the environment (such as the receiving waters of Māngere Inlet) in terms of water quality and its ecosystems;
- Odours or volatile vapours from landfill gas – if odorous or volatile gases are encountered they may be inhaled by site workers or the pubic, causing impacts on human health;
- Cross contamination of the environment if contaminated soils are placed or re-used in previously uncontaminated areas or not disposed of appropriately leading to degradation of receiving environment, lack of amenity value or impact to human health; and
- A positive effect of the Project will be the construction of the road pavement surface over part of the landfills, reducing rainfall infiltration to the refuse. The State highway road corridor will also entail restricted public access, thereby reducing potential exposure of people to contaminants in the landfill areas.
- Auckland Council's existing leachate collection trench adjacent to the Pikes Point East and Pikes Point West landfills will be reconstructed and enhanced.

These sensitive areas will require specific control measures to address the increased risks related to disturbance of these areas. In the absence of controls, disturbance of contaminated soil at the sensitive areas would cause temporary effects that may be moderate to significant.

Outside these "sensitive areas" the remainder of the Project area (which we refer to as the "general area") includes industrial sites and areas that have been subject to the deposition of uncontrolled fill. As such, both the general area and sensitive areas will require a level of contaminated land management. Our mitigation measures are structured to reflect the distinct areas.

3.3 Operational effects

The actual and potential operational effects of the Project arising from the disturbance of contaminated land have been identified as:

- Discharge of landfill gas into subsurface utilities, posing potential health risks for future subsurface maintenance workers and/or the public;
- The future disturbance of contaminated soil for periodic maintenance work involving the Project subsurface utilities (e.g. repair and replacement of stormwater lines) and
- Discharge of contaminants in stormwater runoff from the road surface, which will be treated in the stormwater treatment system (refer to Technical report 12 Surface Water Assessment).

3.4 Assessment of effects before mitigation

Prior to mitigation, the scale of potential effects on the environment from construction and operation of the Project is summarised in Table 3-1.

Table 3-1: Assessment of potential effects on the environment before mitigation measures

Effect	Scale of effect
During Construction of the Project	
Discharge of contaminants to ground and groundwater	• Moderate for general areas (based on probability of encountering unknown contamination) • Potentially significant for landfills
Discharge of contaminants to air	• Refer to Air Quality Assessment Report
Discharge of contaminants to surface water	• Refer to Surface Water Assessment Report
During Operation of the Project	
Discharge of contaminants to ground and groundwater	• Minor for general area and sensitive areas
Discharge of contaminants to air	• Refer to Air Quality Assessment Report
Discharge of contaminants to surface water	• Refer to Surface Water Assessment Report

3.5 Measures to avoid, remedy or mitigate adverse effects

The construction effects associated with contaminated land can primarily be mitigated through design measures to avoid or minimise the disturbance of contaminated land. Where soil disturbance cannot be avoided altogether, management measures are described in a contaminated land management plan (CLMP).

The EWL Project design has been informed by contaminated land considerations, in particular:

- There are specific design requirements for those locations where the Project crosses historic landfills;

- Auckland Council's existing leachate interception system[27] along the southern margin of the Pikes Point East and Pikes Point West landfills will be replaced.

Construction management measures have been recommended to minimise effects during construction as set out in a bespoke CLMP. This plan also provides specific controls for sensitive areas. Implementation of the CLMP should be overseen by a Suitably Qualified Experienced Practitioner (SQEP).

3.5.1 Project areas requiring general management

Much of the land that will be affected by the Project is potentially contaminated (PSI, Appendix A). As such, contaminated soil could be encountered at many of the sites directly affected by the Project.

However, the extent of soil disturbance required for the Project is relatively limited because:

- Existing motorways and rail corridors need to be crossed using grade separation with the Project on structure;
- Structures (as opposed to on grade) need to be adopted at ecologically sensitive sites such as Anns Creek west and Anns Creek east;
- The local road connections dictate an alignment at or close to existing grade;
- An embankment in the CMA is adopted for the Main Alignment in Sector 1 and the western part of Sector 2; and
- In the eastern part of the Project, particularly within Sector 5, the area is predominantly residential.

These design features mean that where possible, the Project minimises soil disturbance as a primary mitigation measure to avoid adverse effects of disturbing contaminated land.

Where soil disturbance cannot be avoided, a CLMP will be adopted. A draft CLMP has been prepared and is provided in Appendix D.

As noted previously, potential effects include exposure of workers, the potential discharge of contaminants in runoff from the open earthworks, and contaminant release in dust/vapours.

The potential risks to workers can be effectively mitigated through appropriate health and safety management on site such as the use of PPE to manage inhalation and dermal contact.

The CLMP also includes contamination discovery protocols that address the discovery of unexpected contamination that may occur during the Project works.

Standard erosion and sediment control (ESC) practices designed to manage sediment at a construction site will also provide effective control of contaminants in soil for the Project, because the contaminants identified at the site are sorbed (attached) strongly to soil particles. If hydrocarbons (including separate phase hydrocarbons) are encountered, additional measures will be adopted such as sorbent booms and mats, as described in the draft CLMP. Normal ESC measures in uncontaminated soil would allow for sediments to be de-watered and distributed back into the earthworks site. However, if these areas are found to be contaminated, depending on the level of contamination, sediment removed from the sediment retention ponds may need to be disposed of to an appropriately licensed landfill facility. A management approach may be adopted where water and sediments collected are tested prior to disposal to determine appropriate disposal or discharge. On the basis that these measures are adopted

[27] The approximate location of the existing leachate interception system is shown in Section 12 of the AEE. The existing system has not been illustrated in the scaled Drawings for the Project because there are no surveyed as-built plans available for the system.

for the Project, the effects of contaminated soil in relation to potential suspended sediment discharges are assessed as less than minor.

Dust can be generated from the open earthworks area. Standard dust suppression measures will be effective for the control of contaminants in soil, and as such with the adoption of proper dust suppression measures it is assessed that the effects on the environment related to contaminants in dust are minor or less than minor.

On the basis that the provisions of the CLMP are adhered to, the risks to human health and the environment represented by contaminated soil are assessed as minor.

3.5.2 Contaminated Land Management Plan

A draft CLMP has been prepared to cover all the Project construction works, in order to manage risks associated with land contamination.

The draft CLMP should include the following:

- Roles and responsibilities for management and implementation of the CLMP;
- Health and safety precautions including PPE to manage inhalation and dermal contact with contaminated material;
- Unexpected contamination discovery protocols;
- Risk mitigations or management measures to address human health and environmental risks associated with the contaminants of potential concern identified in this report;
- Management of risks related to exposure to LFG such as confined space entry requirements;
- Dewatering and disposal of liquid wastes;
- Contaminated soil management, reuse, and offsite disposal;
- Management and tracking of soil movements and appropriate disposal – this may involve sampling of stockpiled material to establish whether it is suitable for re-use as fill for the Project or depending on the level of contaminants, which class of landfill for disposal would be required. Note that soil containing asbestos will need to be managed and disposed of appropriately;
- Management of stockpiling, including cover to stop dust and runoff;
- Secure fencing and signage to minimise exposure to members of the public;
- Dust suppression;
- Wheel wash bays to prevent spread of contaminants and covering of trucks transporting soil off site and decontamination for equipment and personnel;
- Stormwater and erosion and sediment controls; and
- Contingency plans for spillages of contaminated media.

It is recommended that further soil investigations be undertaken prior to construction to assess risk and establish management options for the purposes of developing and finalising the CLMP (e.g. disposal or reuse of soil).

For the general area, implementation of the CLMP needs to be managed under the supervision of a Suitably Qualified and Experienced Practitioner (SQEP; refer to the MfE guide to the Soil NES)[28].

[28] http://www.mfe.govt.nz/publications/rma-land-hazards/users-guide-national-environmental-standard-assessing-and-managing

3.5.3 Sensitive Project areas

In addition the proposed CLMP should include specific measures are proposed to manage the works in the sensitive areas. Each of these areas is discussed below.

Landfills

Mitigation is required for Project works in the landfills both during construction and operation. As a general principle, construction through the landfill waste requires installation of controls, minimisation of the excavation zone, and isolation from influences that could compromise the environmental and human health controls.

The Project works in the closed landfills will include:

- construction of the Galway link local road extension at the western margin of the Galway Landfill
- construction of the Main Alignment across the distal (southern) extent of Pikes Point West Landfill (including Waikaraka Landfill) and the Pikes Point East Landfill.
- construction of the ports link road and Captain Springs road connections (partly over the Pikes Point East Landfill footprint)
- construction of a replacement leachate interception system in the Pikes Point Landfills, comprising a drainage trench and two alternate discharge systems - one to the stormwater treatment wetlands and a contingency pumped system connected to a Watercare trade waste sump at Miami Parade.

Although construction methods may vary following detailed design, we anticipate raft type construction (where the road sits on top of the landfill) in the closed landfill areas, with the “raft” supported on steel beams to minimise settlement. The area of Galway Landfill expected to be affected directly by the new Galway Road is approximately 2.3 hectares. The area of the Pikes Point landfills expected to be affected directly by the new Main Alignment is approximately 8.4 hectares.

By assuming an average depth of excavation between 1 and 2m for the new road corridors, the volume of excavation needed in the landfill footprints is approximately 150,000 - 300,000 cubic meters. In addition, deeper excavation will be required to construct the replacement leachate interception system. Allowing a trench 1500m long and up to 5.5m bgl with 1:1 batters yields a cut volume of approximately 50,000 to 70,000 cubic metres. The overall cut volume in the closed landfills therefore represents a range of 200,000 to 370,000 cubic meters. This material is expected to be contaminated and contain Municipal Solid Waste, and will need to be disposed of and managed appropriately.

Some excavation works in the closed landfills (such as for the replacement leachate collection system) needs to extend below the groundwater table. Disturbance of the landfill waste below the groundwater table will result in a localised, short term increase in the contaminant concentrations in the groundwater. Dewatering for these works will create an inward hydraulic gradient, allowing the water collected to be discharged to trade waste. Over time following construction, the groundwater quality is expected to return to pre-construction levels.

The recommended controls to manage potential effects associated with works in these landfill areas are provided in Appendix E of this document, and should be implemented by the Contractor for the design and construction of the Project. These controls will form part of the CLMP for the Project.

Controls required during construction in landfill areas are more comprehensive than those in general areas and should include:

- Construction management of earthworks associated with landfill waste;
- Landfill waste management and disposal;

- Landfill Gas management and odour - we recommend that a landfill gas investigation, including flows, is undertaken to assess potential risks associated with landfill gas prior to construction
- Leachate management and disposal;
- Landfill reinstatement;
- Construction in confined spaces; and
- Minimisation of human health contact with chemical and biologically contaminated materials.

To mitigate operational effects, in particular due to the future disturbance of contaminated soil for periodic maintenance work it is recommended that the following measures are considered during detailed design:

- Marker or warning layers placed over any buried refuse;
- As-built plans relating to the closed landfills including:
  - Utilities;
  - Topographical plans of any areas of landfill altered by the Project works;
  - Details of the construction and extent of engineered landfill cap installed;
  - Surface water management devices related to the landfills;
  - Extents of retained landfill waste;
  - Extent and construction of the leachate/landfill gas interception trench;
  - Location of leachate and landfill gas management structures and services; and
  - Location of monitoring wells.
- The report information may also be used to support a geospatial hazard register maintained by the Transport Agency.

Asbestos site

No known environmental risk is posed by the presence of asbestos.

The human health risk associated with asbestos in soil is the release of respirable asbestos fibres into air, which may then be inhaled by construction workers or the public. ACM that remains undisturbed and is not exposed does not pose an environmental or health risk. Exposed ACM may release asbestos fibres if the material is dry, and particularly if it is disturbed. However, site remediation projects undertaken for ACM dump sites in New Zealand by the authors have measured very low to non-detectable concentrations of fibre in air, and these findings are supported by the findings of overseas practitioners.

We recommend that for any works undertaken in the asbestos site at 141-199 Hugo Johnston Drive, the controls provided in Appendix F are adopted and implemented by the Contractor for the design and construction of the Project.

The management controls for ACM address the following:

i. Construction management of earthworks;
ii. Excavation and handling;
iii. Offsite transportation and disposal;
iv. Onsite disposal;
v. Human health; and
vi. Post construction activities.

Capping of the ACM within the Project works area in accordance with the controls will have a moderate positive effect on the environment because the ACM will be controlled and contained.

The reuse of the ACM contaminated soil in other areas of the Project is not recommended due to the long term potential for disturbance of the ACM. However, ACM may be able to be redistributed within the 141-199 Hugo Johnston Drive site, since it is anticipated that ACM will remain on the site and require control irrespective of the Project works.

To mitigate operational effects, in particular due to the future disturbance of contaminated soil for periodic maintenance work it is recommended that the following measures are considered during detailed design:

- Marker or warning layers placed over any buried ACM;
- As-built drawings indicating the dimensions and locations of areas that were contaminated with ACM and are now free of ACM, together with any areas where ACM remains in situ;
- Details of encapsulation or capping installed for retained ACM; and
- The report information may also be used to support a geospatial hazard register maintained by the Transport Agency.

3.6 Assessment of effects with mitigation

Following mitigation, the scale of potential effects on the environment from construction and operation of the Project are summarised in Table 3-2.

Table 3-2: Assessment of effects on the environment after mitigation

Effect	Scale of Effect
During Construction of the Project	
Discharge of contaminants to surface water	• Refer to Surface Water Assessment Report • Erosion and sediment controls will minimise the risk of discharging contaminants via surface water. With proposed measures in place the effects on the environment would be minor.
Discharge of contaminants to air	• Refer to Air Quality Assessment Report
Discharge of contaminants to ground and groundwater	• Minor for general area • Minor for sensitive areas
During Operation of the Project	
Discharge of contaminants to ground	• Minor for general area • Minor for sensitive areas
Discharge of contaminants to air	• Refer to Air Quality Assessment Report
Discharge of contaminants to groundwater	• Refer to Groundwater Assessment Report
Discharge of contaminants to surface water	• Refer to Surface Water Assessment Report

The Project will also generate a range of positive effects in terms of contaminated land affected by the Project works. Relocation of the Council leachate interception system affords the opportunity to reinstate a system with improved leachate capture performance. Public access and potential exposure to the landfill and asbestos sites will be permanently controlled through the operational requirements of the EWL as part of the State highway network. Capping of the asbestos site within the Project works area and sealing of the road carriageway where it passes over the landfills will reduce rainfall infiltration and generation of contaminated dust.

4. Conclusions and Recommendations

The Project area crosses a number of existing contaminated sites. Although the Project design minimises land disturbance, there is still potential to disturb areas of contaminated land and as such, soil disturbance will require careful management during construction to prevent unacceptable discharges of any contaminants to the environment and to protect the health and safety of workers and the local community.

Provided suitable controls are adopted, the effects of the Project from contaminated land disturbance on the environment will be minor. The necessary controls have been identified and articulated in this assessment, and should be reflected in the designation and resource consent conditions for the Project.

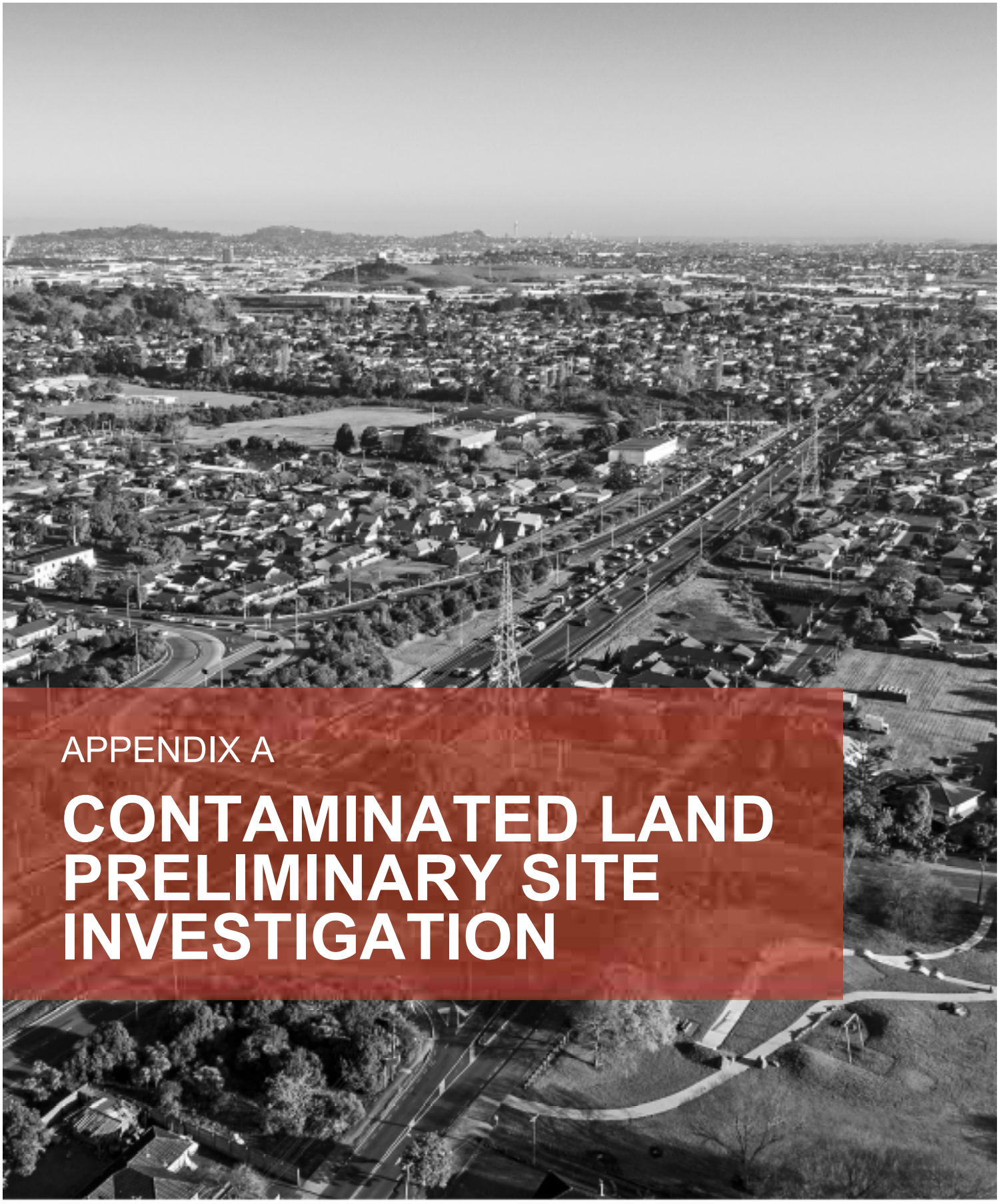
A condition is proposed to provide for appropriate engineering and environmental controls through a CLMP during construction of the Project. Implementation of the CLMP needs to be supervised by a Suitably Qualified and Experienced Practitioner (SQEP).

Further investigations (including landfill gas) are recommended to be undertaken prior to construction to assess risk and establish management options (e.g. disposal or reuse of soil) and to inform the controls of the CLMP.

Where Project works affect sensitive areas such as the landfills and asbestos sites specialised controls should be adopted and provided for in the CLMP as identified in Appendix E and F of this Assessment Report.

Appendix A

Preliminary Site Investigation



APPENDIX A

CONTAMINATED LAND PRELIMINARY SITE INVESTIGATION

NZ TRANSPORT AGENCY WAKA KOTAHI

East West Link

Quality Assurance Statement	
Prepared by	Wijnand Udema
	Laura Bell
Reviewed by	Wijnand Udema
	Ian Fraser
Approved for release	Patrick Kelly (EWL Alliance Manager)

Revision schedule					
Rev. N°	Date	Description	Prepared by	Reviewed by	Approved by
0	November 2016	Final for Lodgement	Laura Bell	Wijnand Udema	Patrick Kelly

Disclaimer

This report has been prepared by East West Link Alliance on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which East West Link Alliance has not given its prior written consent, is at that person's own risk.

Executive Summary

Purpose and Scope

1. The purpose of this Preliminary Site Investigation is to:
    - Inform consent requirements under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, 2011.
    - Assess whether any wider environmental investigations should be undertaken as part of this project.

2. The scope of this report includes:
    - Identify the likelihood of activities listed on the hazardous activities and industries list (HAIL) occurring along or adjacent to the project area. Sites along, or adjacent to the alignment were considered.
    - Identify the primary contaminants of concern
    - Identify likely contamination risk profiles for sites along or adjacent to the alignment
    - Recommend whether further investigations are required.

Assessment undertaken

3. This Preliminary Site Investigation Report (PSI) has been prepared in general accordance the Ministry for the Environment, *Contaminated Land Guidelines No. 1, Reporting on Contaminated Sites in New Zealand (revised 2011*). The main deviation from the guidance includes:
    - Limitations in available information for private land holdings. For the purposes of this assessment, only publicly available information was reviewed.
    - Limited access to privately held land for site inspections.

4. The approach undertaken involved a screening process where aerial photos were initially reviewed to identify potential HAIL activities. More in depth reviews were then undertaken for the individual sites, where the information was publicly available. The information was typically sourced from:
    - Auckland Council contaminated sites register;
    - Property files;
    - Auckland Council spillages and pollution response records;
    - Discussions with the Onehunga Fencible & Historical Society Inc;
    - Historical aerial photo review
    - National Library lateral oblique photos (various dates)
    - Site boundary inspections, where possible.

5. A risk ranking exercise was undertaken for each of the sites, based upon the hazard posed by potential contamination, likelihood of disturbance during the construction and operation phase of the Project.

6. The ratings included:
    - Low Risk – Limited risk posed by contamination (hazard and/or likelihood of contamination being encountered) and no special controls are likely to be required during construction or operation of the EWL project.

- Moderate Risk – Some potential risk posed by contamination (hazard and/or likelihood of contamination being encountered) and special controls may be required during construction or operation of the EWL project.
- High risk – Likely risk posed by contamination (hazard and/or likelihood of contamination being encountered) and special controls are likely be required during construction or operation of the EWL project.

Results of assessment

7. Numerous hazardous activities and industries were identified along or adjacent to the alignment. The following sector summaries provide a summary of the HAIL activities identified:

   Sector 1: Landfill, uncontrolled fill, various industrial land uses. Low to high risk.

   Sector 2: Dominated with landfill, adjacent to various industrial land uses. High risk. Includes the marine environment which is not considered in this investigation.

   Sector 3: Landfill, rail sidings, filling, power station and asbestos dump. Moderate to high risk.

   Sector 4: Commercial vehicle refuelling facility, former Mazda assembly plant (now Turners and Growers). Low to moderate risk.

   Sector 5: Industrial and residential land use, former glass houses. Low risk.

   Sector 6: Landfills, heavily industrialised. Moderate risk

Conclusion and Recommendations

8. Numerous HAIL activities have been identified along, and adjacent to the project, and as such the *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, Regulations 2011,* are considered to apply.

9. Further investigations prior to construction are recommended.

Table of Contents

Appendices

Appendix A1 - Contaminated Sites Inventory

Appendix A2 - HAIL / Site location Map

List of Tables

Glossary of Technical Terms/Abbreviations

Abbreviation	Term
AEE	Assessment of Effects on the Environment
ALW Plan	Auckland Council Regional Plan: Air, Land and Water
ARP:C	Auckland Council Regional Plan: Coastal ARP:C
CLMP	Contaminated Land Management Plan
CMA	Coastal Marine Area
DSI	Detailed Site Investigation
EPA	Environmental Protection Authority
EWL	East West Link
EWLA	East West Link Alliance
HAIL	Ministry for the Environment's hazardous activities and industries list
NES	National Environmental Standard
NESCS	National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health
NoR	Notice of Requirement
The NZ Transport Agency	New Zealand Transport Agency
PAUP	Proposed Auckland Unitary Plan
PSI	Preliminary site investigation
RMA	Resource Management Act 1991

1 Introduction

1.1 Purpose and scope of this report

This report forms an appendix to *Technical Report 21 –Contaminated Land Assessment* prepared for the Transport Agency's EWL project (the Project). It's purpose is to inform the AEE and to support the resource consent applications, new Notices of Requirement and alterations to existing designations required for the EWL.

The purpose of this Preliminary Site Investigation is to:

- Inform consent requirements under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, 2011.
- Assess whether any wider environmental investigations should be undertaken as part of this project.

The scope of this report includes:

- Identify the likelihood of activities listed on the hazardous activities and industries list (HAIL) occurring along or adjacent to the project area. Sites along, or adjacent to the alignment were considered.
- Identify the primary contaminants of concern
- Identify likely contamination risk profiles for sites along or adjacent to the alignment
- Identify and review the existing site specific contaminated land investigations that have been undertaken throughout the study area.
- Recommend whether further investigations are required.

1.2 Project description

The EWL Project involves the construction, operation and maintenance of a new four lane arterial road from State Highway 20 (SH20) at the Neilson Street Interchange in Onehunga, connecting to State Highway 1 (SH1) at Mt Wellington as well as an upgrade to SH1 between the Mt Wellington Interchange and the Princes Street Interchange at Otahuhu. New local road connections are provided at Galway Street, Captain Springs Road, the port link road and Hugo Johnston Drive. Cycle and pedestrian facilities are provided along the alignment.

The primary objective of the Project is to address the current traffic congestion problems in the Onehunga, Penrose and Mt Wellington commercial areas which will improve freight efficiency and travel reliability for all road users. Improvements to public transport, cycling and walking facilities are also proposed.

For description purposes in this report, the Project has been divided into six sectors. These are:

Sector 1. Neilson Street Interchange and Galway Street connections

Sector 2. Foreshore works along the Māngere Inlet foreshore including dredging

Sector 3. Anns Creek from the end of the reclamation to Great South Road

Sector 4. Great South Road to SH1 at Mt Wellington

Sector 5. SH1 at Mt Wellington to the Princes Street Interchange

Sector 6. Onehunga local road works

A full description of the Project including its design, construction and operation is provided in Part C: Description of the Project in the Assessment of Effects on the Environment Report contained in *Volume 1: AEE* and shown on the Drawings in *Volume 2: Drawing Set*.

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2 Preparation for this Report

2.1 Consideration of Guideline Documents

This Preliminary Site Investigation Report (PSI) has been prepared in general accordance the Ministry for the Environment, *Contaminated Land Guidelines No. 1, Reporting on Contaminated Sites in New Zealand (revised 2011*). These guidelines are designed for reporting on discrete parcels of land where contamination issues may be present, and therefore, have limitations for large linear infrastructure projects, such as EWL, that incorporate numerous contaminated land parcels. The main deviation from the guidance includes:

- Limitations in available information for private land holdings. For the purposes of this assessment, only publicly available information was reviewed.
- Limited access to privately held land for site inspections.

The investigation methodology and geographical extent for this PSI is described further in section 4 of this report.

2.2 Authors and Experience

This report was prepared by Wijnand Udema and contributing contaminated land practitioners including Matt James, BSc (Geological Science), MSc (Engineering Geology), and Laura Bell BSc (Chemistry). It was reviewed by Dr Murray Wallis.

Wijnand is a Principal Environmental Scientist, and the Environment Team Leader at GHD Limited, based in Auckland. He has over 16 years' consulting experience in contaminated land assessment and remediation. He has a Bachelor of Science degree (Earth Sciences) from the University of Waikato (1998) and a Master of Science Degree in Environmental Technology from Saxion University of Applied Sciences, Deventer, Netherlands (2000).

Wijnand has acted as an expert witness on contaminated land issues in both the Environment and High Court. Most notably for NZ Transport Agency Roads of National Significance projects including Christchurch Southern Motorway and Pūhoi to Warkworth motorway. For the High Court, Wijnand delivered expert evidence on incremental remediation costs in the Auckland Waterfront Development Agency Limited v Mobil Oil New Zealand Limited case.

Dr Murray Wallis holds a PhD in soil science and a Bachelor of Horticultural Science (1st class Hons). Throughout the majority of his career spanning 24 years in New Zealand, Australia and the USA, Murray has specialised in contaminated land investigation, assessment and management. His work in Auckland from the mid 1990's started with projects in Onehunga, including the NZ Farmers Fertiliser site which led to a multidisciplinary characterisation of a contaminant plume that examined the interconnection between the tuff, basalt aquifer and stormwater/ marine receiving environment ('the Green stream study" for Auckland Council funded by MfE). Another multi-year investigation, risk assessment and remediation project for chlorinated solvents in Mt Wellington was completed for a commercial client at a site on the EWL Project alignment. Further studies for Auckland Council were completed to assess asbestos contamination at sites along the EWL alignment. Other industrial sites in the Onehunga area included a battery manufacturer, oil recycling facility and the detailed assessment of oxidation pond sediment contamination for the decommissioning of the Watercare wastewater treatment ponds at Māngere. Murray gave evidence at the Council Hearing for Watercare, and he has also provided expert evidence on a range of cases at the Environment Court. Over the last 4 years he has led the Environment team for the approvals and procurement of the Ara Tūhono Pūhoi to Warkworth Road of National Significance which was subject to an EPA Board of Inquiry. Murray was also involved in completion of the Indicative and Detailed Business Case for the EWL Project for the Transport Agency.

This report was peer reviewed by Ian Fraser BSc (Geology), MSc (Hons. Geology), Post Graduate Diploma in Business (DipBus). Ian Fraser has over 25 years' experience with project management of environmental and civil engineering projects, environmental site assessments and water resource investigations. This work has included numerous appraisals and remediation of sites impacted by a range of contaminants associated with the operating and closed landfill operations, mining, oil and gas and manufacturing sectors in New Zealand, the United States and throughout Asia.

3 Assessment Methodology

This PSI has been prepared in general accordance the Ministry for the Environment, Contaminated Land Guidelines No. 1, Reporting on Contaminated Sites in New Zealand (revised 2011). These Guidelines are designed for reporting on discrete parcels of land where contamination issues may be present and therefore have limitations for large linear infrastructure projects, such as EWL, that incorporate numerous contaminated land parcels.

3.1 Desktop Review

As the project covers a large area comprising numerous individual sites, the approach undertaken has involved a screening process where aerial photos were initially reviewed to identify potential HAIL activities. More in-depth reviews were then undertaken for individual sites, where the information was publically available. The information was typically sourced from:

- Auckland Council contaminated sites register;
- Property files;
- Auckland Council spillages and pollution response records;
- Discussions with the Onehunga Fencible & Historical Society Inc;
- Historical aerial photo review (summarised in Table 1)
- National Library lateral oblique photos (various dates)
- Site boundary inspections, where possible.

Table 3-1: Summary of aerial photo dates reviewed

Auckland Council GIS viewer	Google Earth Pro	Opus International Consultants Limited
1940	2002	1972
1959	2005	1980
1996	2007	1988
2006	2009	
2008	2010	
2010	2013	
	2016	

In addition to the desktop assessments, visual inspections of selected “high risk” sites were undertaken from site boundaries to assess current land use.

3.2 Contaminated Site Inventory and Risk Rating

A contaminated site inventory (provided in Appendix A1) has been prepared that summarises relevant information from specific sites that have been investigated as part of this assessment.

The site specific assessments incorporated a corridor approximately 600 m wide, which includes the proposed Project alignment. The rationale for this extent is to capture sites that may be contributing to contaminant loading (e.g. contaminated groundwater, leachate or landfill gas) into the local environment

and may extend into the Project area through flow pathways such as groundwater, storm water / sewer infrastructure, or other preferential flow pathways.

It is considered unlikely that any significant contamination source areas beyond this threshold would cause any observable effects in the Project area.

In some instances, sites outside of the 600 m wide corridor were included, where offsite effects (such as groundwater contaminant plumes) are known.

The focus of the contaminated site inventory was to identify as many as possible of the HAIL activities adjacent to the Project alignment and to identify the contamination risk profile for each site.

The inventory should not be considered an exhaustive list, nor a comprehensive investigation of each individual site. The assessments were relatively "high level" with the purpose of identifying the potential risks associated with contaminated sites within or adjacent to the alignment.

Individual site details including property descriptions or titles are not shown in the table in Appendix A1 but can be provided if required. The locations are shown in Appendix A2.

3.3 Site Contamination Risk Assessment

The risk assessments that were undertaken as part of the contaminated sites inventory followed the risk ranking principles set out in the Ministry for the Environment guideline document entitled Risk Screening System - Contaminated Land Management Guideline No. 3[1].

The risk assessment followed a conceptual site model approach where by the contamination sources, the migration and exposure pathway, and receptor impact are considered.

The risk assessment was qualitative in nature due to relatively limited information being available for most of the sites identified through the PSI assessment work, and for the purposes of this investigation it was not considered appropriate that any form of quantitative risk assessment be undertaken.

The approach utilised professional judgement in review of the contaminant risk elements (contamination hazard, pathways, and receptors) in the context of the EWL project. Drawing upon the review of information collected as part of the PSI. The criteria considered included:

- Duration of site activities (where determined);
- When the activities occurred;
- Likely contaminants of concern (CoCs);
- Mobility of the CoCs;
- Potential risk to human health and environment; and
- Likelihood of disturbing contaminants in soil or groundwater during construction or operation of the Project.

Each site was assigned a rating of low, medium or high relating to contamination risk in the context of the EWL project, based upon the potential risks (to human health and / or environment).

[1] Ministry for the Environment, 2004: Risk Screening System - Contaminated Land Management Guideline No. 3.

The rating was based on the likelihood to impact the project, and as such, distance from the project alignment was also considered. Consequently, any sites that may have been considered high risk due to contamination alone, but are located a significant distance from the EWL Project area were assigned a low risk where off site discharges were considered unlikely to extend into the project area.

The ratings included:

- Low Risk – Limited risk posed by contamination (hazard and/or likelihood of contamination being encountered) and no special controls are likely to be required during construction or operation of the EWL project.
- Moderate Risk – Some potential risk posed by contamination (hazard and/or likelihood of contamination being encountered) and special controls may be required during construction or operation of the EWL project.
- High risk – Likely risk posed by contamination (hazard and/or likelihood of contamination being encountered) and special controls are likely be required during construction or operation of the EWL project.

4 Statutory Framework

4.1 Introduction

The purpose of the Resource Management Act 1991 (RMA) is to promote the sustainable use of New Zealand's natural resources. This purpose is carried through into the Auckland Regional Plan: Air, Land and Water, and the Proposed Auckland Unitary Plan (PAUP). The National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS) is designed to be implemented by each territorial and unitary authority in accordance with their section 31 functions under the RMA relating to contaminated land, specifically section 31 (b) *"the prevention or mitigation of any adverse effects of the development, subdivision, or use of contaminated land"*. The Ministry for the Environment has also prepared a series of guideline documents on contaminated land management (Contaminated Land Management Guidelines (CLMG)). These guidelines are intended to ensure consistency of reporting on the investigation, assessment, and remediation of contaminated sites in New Zealand.

4.2 RMA

The primary duty in relation to the discharge of contaminants into the environment is covered by Section 15 of the Act. Section 15 states that no person may discharge a contaminant into water, into or onto land or into the air, from a place or any source, in a manner that contravenes a national environmental standard or regional rule unless the discharge is expressly allowed by other regulations, a resource consent or an existing activity.

Contaminant under the act is defined as any substance (including gases, odorous compounds, liquids, solids, and micro-organisms) or energy (excluding noise) or heat, that either by itself or in combination with the same, similar, or other substances, energy, or heat—

- When discharged into water, changes or is likely to change the physical, chemical, or biological condition of water; or
- When discharged onto or into land or into air, changes or is likely to change the physical, chemical, or biological condition of the land or air onto or into which it is discharged

The Act's legislative tools include National Environmental Standards, National Policy Statements, and local and regional government plans. The contamination aspects of the Project have been assessed against these legislative tools, where applicable.

4.3 Resource Management (National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011

4.3.1 Overview

The *Resource Management (National Environmental Standards for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulations 2011 (NESCS)* regulates activities undertaken on potentially contaminated land and provides nationally consistent human health risk based criteria for the assessment of risks to human health.

The NESCS includes criteria for protection of human health but does not include criteria environmental protection. However, by reference, the NESCS incorporates relevant Ministry for the Environment (MfE) guidelines for site assessment such as the New Zealand Contaminated Land Management Guidelines which are based upon a tiered approach to assess the risks to human health and the environment.

The NESCS applies to 'pieces of land' on which any activity in the Hazardous Activities and Industries List (HAIL) has likely occurred.

4.3.2 Applicability

The intention of the NESCS is to enable safe use of contaminated land, to ensure that contaminated land is appropriately assessed prior to development, and if necessary, the land is made safe for human activity.

As the NESCS regulates activities, including soil disturbance on potentially contaminated sites it is necessary to ascertain whether any HAIL activities are more likely than not to have occurred onsite. This purpose of this Preliminary Site Investigation was to determine the likelihood that HAIL activities have occurred within or adjacent[2] to the Project area, and also to assess the potential risks posed by potentially contaminated land during construction and operation of the Project.

The NESCS triggers that are likely to be relevant to contaminated land for this Project include:

- Disturbing soil;
- Subdividing the land;
- Changing land use;
- Soil removal.

Whilst the NESCS has provisions for assessing concentrations of contaminants in soil (DSI), it is beyond the scope of this PSI to investigate contaminant concentrations in soil.

4.4 Auckland Regional Plan: Air, Land and Water and Proposed Auckland Unitary Plan

Whilst both these plans are important for the regulation of contaminated land, these largely relate to environmental effects (as opposed to site screening and identification) and as such are considered further in *Volume 3: Technical Report 17 – Assessment of Contaminated Land Effects.*

[2] Adjacent land use is considered under Category H of the HAIL where *any land that has been subject to the migration of hazardous substances from adjacent land in sufficient quantity that it could be a risk to human health or the environment*

5 Existing Environment

The Project area is highly industrialised and as such there has been a relatively large number of contaminated land investigations in the area since the 1990's, including several major projects by the authors. In addition, geotechnical and groundwater investigations completed for the EWL Project have added to our understanding of the existing environment. Below is a brief summary of the geology and hydrogeology of the area, as it relates to contaminated land. More detailed descriptions can be found in Volume 3: *Technical Report 13 – Groundwater Assessment.*

5.1 Geology

The Onehunga area is underlain by the Manukau Lava Field built largely by lava flows from One Tree Hill and Mount Smart volcanoes, but also from Mt Wellington volcano in the east. Mt Smart volcano is the oldest of these (38,000 years) and is understood to have erupted on a pre-existing land surface that is now well below sea-level in the mouth of a valley system. The Hōpua explosion crater (Gloucester Park) comprises an elevated tuff ring that erupted some 34,000 years ago. When sea-level rose, the tuff ring was breached and marine and organic muds were deposited within. The breach was closed some 70 years ago and the tuff ring reclaimed with both urban refuse and fill. The basalt lava and tuff overlie and are locally interbedded with a variable thickness of Tauranga Group alluvium, comprising pumiceous silt, sand and gravel with muddy peat and non-welded and alluvially reworked ignimbrite and tephra.

The Onehunga Bay and Māngere Inlet foreshore has been progressively reclaimed with landfill and engineered fill. The volcanics are bound to the east by an uplifted block of Waitemata Group sandstone and siltstone, although some lava and tuff from Mt Wellington volcano have flowed around the block from the north-east in the area of Anns Creek.

5.2 Hydrogeology

Groundwater flows from elevated ground in the north and discharges to the coastal areas of the Māngere Inlet, as springs at the original shoreline, from basalt flow margins into Anns Creek (which discharges to the coast) and through the pre-reclamation basalt margins offshore. Anns Creek also drains water from Mutukāroa-Hamlins Hill. Actual flow paths may be quite sinuous according to variations in hydraulic characteristics of the lava flows and the underlying Waitemata Group paleo-topography.

Most groundwater flow occurs within the shallow, unconfined basalt aquifers. These aquifers have moderate to very high permeability, due to fractures (shrinkage and structural) within the rock, cavities resulting from differential cooling of the flows and high porosity of associated scoriaceous or vesicular basalt. Rainfall directly infiltrates these near surface aquifers, limiting surface runoff and the formation of significant rivers or streams. The basalt aquifers are underlain by lower permeability tuff, Tauranga Group alluvial sediments and Waitemata Group sandstone and mudstone that have more limited ability to transmit groundwater. As a result, where the gradient of the basalt aquifers decreases near the coast and groundwater levels approach the surface and spring discharges occur.

Groundwater is used as a resource for a range of industrial purposes and by Watercare Services Ltd for potable supply. These bores are understood to utilise the basalt aquifer.

Historically, springs were prevalent in the Onehunga area although most have been intercepted by stormwater drains and the natural flow has been disturbed by development and abstraction.

Along the margin of the southern Onehunga foreshore there is a leachate interception drain for the closed Pikes Point landfills, for which Auckland Council is responsible.

More detailed discussion on hydrogeology can be found in *Volume 3:Technical Report 13 – Groundwater Assessment.*

5.3 Historic Overview

The EWL project area passes through one of the more heavily industrialised parts of Auckland. The earliest industrial establishments through Onehunga, Te Papapa and Westfield included wool scourers, oil recyclers, carpet manufacturers, tanneries, soap manufacturing, fertiliser works, and abattoirs (Southdown and Westfield). These were largely established post World War II (WWII), prior to which land use was dominated by pastoral grazing and residential land use.

The industrial growth was coupled with extensive land reclamation and landfilling along the Onehunga foreshore that occurred from after WWII through to the late 1970's, and through to 1984 for Pikes Point East[3]. The reclamations / landfills included[4]:

- Gloucester Reserve reclamation
- Galway Street Landfill (includes "75 Acre Reclamation")
- Pikes Point East reclamation and landfill
- Pikes Point West reclamation and landfill

In addition to the above reclamations there was also numerous other landfills[5] proximate to the project area including:

- Mount Smart Landfill
- Former One Tree Hill Borough Council Tip Site
- Former New Zealand Rail Landfill
- Church Street Closed Landfill

Detailed information on the environmental status of these landfills is relatively limited overall. However some information is available on recently closed municipal landfills, such as Galway Street and the Pikes Point landfills. Anecdotal and geotechnical investigations have shown that the landfills do not incorporate modern engineered landfill design such as liners or caps.

During the 1950's and 1960's industrial and commercial developments intensified throughout Onehunga, Te Papapa, and to a lesser extent through Southdown and Westfield. The 1970's and 1980's saw further commercial and industrial intensification through Southdown and Westfield.

These historic land use activities generally did not operate with modern controls and environmental stewardship. As such they have in many instances led to contamination of soil and / or groundwater. In addition, many current commercial, industrial and service oriented land uses have led to degradation of the soil and groundwater quality. This is more prevalent in the inherently noxious industries such as automotive dismantlers, scrap metal recovery centres and oil / chemical recovery.

The following section summarises the identified key HAIL activities and contamination risks for each sector.

[3] Earthtech 1993: Groundwater Investigation Scoping Report. Pikes Point Aftercare, Auckland Regional Council. Earthtech Consulting Ltd, 11 June 1993. Ref 2112.

[4] Ibid.

[5] Ibid

5.4 Historic and current land use: Sector Specific Summaries

The following sector discussions provide a summary of historic and current land use. The contaminated sites inventory with risk rankings is provided in Appendix A1. A site location plan is provided in Appendix A2.

The descriptions below only include summaries of sites that will likely be disturbed as part of the Project development works for EWL and local road connections or improvements.

5.4.1 Sector 1

The main HAIL activities and associated contaminated land issues that should be considered for Sector 1 include:

- Te Hōpua Crater / Gladstone Park. Uncontrolled fill. Not recognised as a former municipal landfill. Considered relatively low risk.
- "75 Acre Reclamation" and Galway Street Landfill (Onehunga Borough Landfill). Considered high risk with contaminated soil, groundwater and leachate likely present. Landfill gas may also pose a moderate risk.
- Corner Onehunga Mall and Neilson Street – former Mobil Service Station and Drycleaners. Chlorinated solvent plume known to extend offsite to the south. Petroleum hydrocarbons also likely to be present. Moderate risk.
- Tanneries and wool scourers – potential sources of metals and phenols. Low to moderate risk.
- Chemical manufacturing – Nuplex Industries Limited (corner Neilsen and Victoria Street) with likely groundwater discharges. Possible solvent contamination. Moderate risk.

5.4.2 Sector 2

The main HAIL activities and associated contaminated land issues that should be considered for Sector 2 include:

- Landfills including Pikes Point East and West, New Zealand Rail, One Tree Borough municipal tip. Considered high risk with contaminated soil, groundwater and leachate likely present. Landfill gas may also pose a risk.
- Automotive dismantlers – petroleum hydrocarbons and metals. Moderate risk – however site not likely to be disturbed as part of the Project.

Sector 2 includes the Coastal Marine Area, which is not subject to the NESCS and is not considered further in this report.

5.4.3 Sector 3

The main HAIL activities and associated contaminated land issues that should be considered for Sector 3 include:

- Former Southdown and Westfield Freezing works – asbestos and metal contamination from demolition. Local road connections may disturb soil near the former sites. High likelihood of encountering asbestos, moderate risk.
- Southdown Power Station and associated land filling at the time of construction. Possible metal and hydrocarbon contamination. Low probability of PCB and mercury contamination as plant was only commissioned in 1996.
- Asbestos and general fill site located on Hugo Johnstone Drive. High risk site with significant quantities of asbestos.
- Uncontrolled filling at TR Group site (Great South Road) – metal contamination. Relatively low risk.

5.4.4 Sector 4

The main HAIL activities and associated contaminated land issues that should be considered for Sector 4 include:

- Former Westfield Freezing works asbestos and metal contamination from demolition. High likelihood of encountering asbestos, moderate risk.
- Bulk fuel storage at Z Truck stop. Moderate risk. Likely to be disturbed during Sylvia Park Road.
- Former Mazda assembly plant at the now Turner and Growers site. Documented chlorinated solvent plume beneath site. Risks not likely to be significant for the project due to depth to groundwater, and relatively low concentrations.
- PGG paint manufacturer – potential solvent and metal contamination. Low to moderate risk.

5.4.5 Sector 5

Overall Sector 5 is considered relatively low risk as current and historic land use has been dominated by residential and pastoral farming land use.

The main HAIL activities and associated contaminated land issues that should be considered for sector five are:

- Former glass houses. Moderate risk of encountering persistent pesticides such as organochlorine pesticides and acid herbicides, and metal contamination. Low risk.

5.4.6 Sector 6

The main HAIL activities and associated contaminated land issues that should be considered for sector 6 include:

- Dominion Oil and Chem Waste – Chemical recycling facilities with known ground contamination issues. High risk.
- Electroplating – moderate risks. Metals and potential groundwater issues considered to relatively low risk.
- Pikes Point East and West landfills. Considered high risk with contaminated soil and groundwater present. Existing interception system (trenches and sumps) in the coastal fringe operated by Auckland Council. Landfill gas may also pose a risk. The proposed alignment will disrupt Pikes Point East Landfill.

5.4.7 Sector Summary

Table 5.1 provides an overview of the key HAIL activities along the alignment that may have led to soil and/or groundwater contamination.

Table 5-1: Summary of Sector HAIL Activities

HAIL Activity	Sector 1		Sector 2		Sector 3		Sector 4		Sector 5		Sector 6	
Media / HAIL Activity	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination
Chemical Manufacture			✓	✓							✓	✓
Dry-Cleaning	✓	✓										

HAIL Activity	Sector 1		Sector 2		Sector 3		Sector 4		Sector 5		Sector 6	
Media / HAIL Activity	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination	Potential Soil Contamination	Potential GW Contamination
Landfill	✓	✓	✓	✓							✓	✓
Waste Disposal to land	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Asbestos	✓		✓		✓		✓				✓	
Railway	✓				✓							
Wood Treatment	✓	✓										
Metal Manufacturing	✓	✓										
Tannery / Wool Scourer	✓	✓							✓	✓	✓	✓
Automotive Dismantlers / Scrap Metal	✓	✓	✓	✓							✓	✓
Waste Recycling	✓	✓	✓	✓							✓	✓
Chemical storage or liquid wastes	✓	✓	✓	✓			✓	✓			✓	✓
Paint Manufacturing	✓	✓	✓	✓			✓	✓				
Cemetery			✓	✓								
Transport Yard					✓	✓						
Abrasive Blasting					✓						✓	✓
Service station / Commercial Refuelling							✓	✓				
Automotive Workshops							✓	✓			✓	✓
Intentional or Accidental Release of Hazardous Substances	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓
Persistent Pesticide Use										✓		
Petroleum or petrochem industry											✓	✓
Port Activities	✓	✓										
Metal Treatment												

6 Conclusions and Recommendations

Based upon the findings of this investigation, it can be concluded that numerous HAIL activities are present or have historically been present along or adjacent to the Project alignment. As HAIL activities are present within or adjacent to the alignment, the NESCS is considered to apply. In addition, the Project will:

- Disturb contaminated land
- Subdivide land
- Change land use
- Remove contaminated soil

It is recommended that further investigations be completed prior to construction starting.

Appendix A1

Contaminated Sites Inventory

Site ID #	Name	Project Sector	Contamination Hazard Rating	HAIL Activity	Contaminants of Concern	Potential receptors	Current Land Use	Potential Soil Disturbance from EWL	Relevant consents or activity info from contaminated sites register search	consent may be affected?	Consent Number	Comments	Information Source(s)
1	Gloucester Park	Sector 1	Low	G5, I	Metals, PAHs	Marine ecology	Park	✓				Uncontrolled filling and possible land filling. Largely filled prior to 1940 so risk of asbestos contamination is considered low. Will potentially undergo soil disturbance from the EWL project.	1946, 1947, 1948, 1966, 1967 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Hochstetter, F.V. and Petermann, A., 1864. Geological and Topographical Atlas of New Zealand. Auckland, Deiattre. Pers. Comm. Cyril Skilton – Onehunga Fencible and Historical Society Inc – 17.02.2016. Gloucester Park - Geddes Basin: History from Opua basin to Park - 31/12/2013 (Onehunga Fencible & Historical Society Inc). Old land claim plan 339 - Map of Waihihi farm belonging to Mr J T Jackson - 1847 (New Zealand Archives).
2	Foreshore Reclamations associated with current Port of Onehunga and Storage King Onehunga	Sector 1	Moderate	G3, G5, E1, I	Metals, PAHs, asbestos	Marine ecology, Human health	Park, commercial and industrial	✓				Uncontrolled fill used for reclamation. Will potentially undergo soil disturbance from the EWL project.	1946, 1947, 1948, 1950, 1966, 1967 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Hochstetter, F.V. and Petermann, A., 1864. Geological and Topographical Atlas of New Zealand. Auckland, Deiattre. Town of Onehunga Borough Map, 1911. Old land claim plan 339 - Map of Waihihi farm belonging to Mr J T Jackson - 1847 (New Zealand Archives).
3	Onehunga Borough Council Landfill / Galway Street Landfill	Sector 1 and Sector 2	High	G3, G5, E1, I	Metals, PAHs, SVOCs, COPS, VOC, microbiological, nutrients, landfill gas, asbestos			✓	Discharge of contaminants to ground and surface water Take Groundwater		34282 (Galway Street Landfill) 30895	Uncontrolled landfilling was conducted on this site. Will potentially undergo soil disturbance from the EWL project. Properties that are part of the landfill area and contained potential HAIL activities are included elsewhere in this list. Contaminated Sites Search Details: Consent to authorise the ongoing diffuse discharge of contaminants to ground and groundwater. Application for trenching works in contaminated land associated with an extension of the Hunua No.4 Watermain in the vicinity of the Galway Street Closed Landfill, Onehunga.	1946, 1947, 1948, 1949, 1950, 1966, 1967 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Earthtech 1993: Groundwater Investigation Scoping Report. Pikes Point Aftercare, Auckland Regional Council. Information provided by Auckland Council Closed Landfill Team. Old land claim plan 339 - Map of Waihihi farm belonging to Mr J T Jackson - 1847 (New Zealand Archives). Pers. Comm. Cyril Skilton – Onehunga Fencible and Historical Society Inc – 17.02.2016.
4	Waikaraka Cemetery	Sector 2	Low	G1	Metals, PAHs, SVOCs, COPS, VOC, microbiological, nutrients, landfill gas, asbestos	Marine ecology	Cemetery	✓	Landfill Discharge			Will potentially undergo soil disturbance from the EWL project. To discharge leachate from a closed sanitary landfill into the ground and ground water beneath the site. - Waikaraka Park.	Site visit (2016). 1946, 1947, 1948, 1949, 1950, 1955, 1966, 1967, 1977 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
5	Pikes Point West Landfill	Sector 2 and Sector 6	High	G3, G5, E1, I	Metals, PAHs, SVOCs, COPS, VOC, microbiological, nutrients, landfill gas, asbestos	Marine ecology, Human health	Waste Transfer Station, Commercial	✓	Discharge of contaminants to ground and surface water Take Groundwater Discharge To Air Landfill Discharge		Divert and take groundwater containing leachate from within a closed landfill. Permit No. 928155 & 928156 (expiry date 31 December, 2023) - Pikes Point East Divert and take groundwater containing leachate from within a closed landfill. Permit No. 928103 & 928104 (expiry date 31 December, 2023) - Pikes Point West - Current; Diffuse leachate discharge through the base of the landfill into ground. Permit No. 928157 (expiry date 31 December, 2023) - Pikes Point East - Current; Diffuse leachate discharge through the base of the landfill into ground. Permit No. 928105 (expiry date 31 December, 2023) - Pikes Point West - Current. To discharge contaminants into air from a refuse transfer station for the acceptance, handling, temporary storage and transfer of up to 150,000 tonnes per year of municipal solid waste.	Properties that are part of the landfill area and contained potential HAIL activities are included elsewhere in this list. Uncontrolled landfilling was conducted on this site. Will potentially undergo soil disturbance from the EWL project. Contaminated Sites Search Details: -60 and 69 Captain Springs Road, 5 Miami Parade discharge leachate through the base of the landfill into the ground.	Enviro Waste Services, 2010: *Site Management Plan – Pikes Point Closed Landfill.* Earthtech 1993: *Groundwater Investigation Scoping Report. Pikes Point Aftercare*, Auckland Regional Council. Earthtech Consulting Ltd, 11 June 1993. 1955, 1966, 1973, 1975, 1991 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Pers. Comm. Cyril Skilton – Onehunga Fencible and Historical Society Inc – 17.02.2016.
6	Pikes Point East Landfill	Sector 2 and Sector 6	High	G3, G5, E1, I			Heliport, commercial	✓				Properties that are part of the landfill area and contained potential HAIL activities are included elsewhere in this list. Will potentially undergo soil disturbance from the EWL project. Uncontrolled landfilling was conducted on this site. Contaminated Sites Search Details: -59 Miami Parade has boreholes recorded. -Discharge of leachate through the base of the landfill into the ground.	
7	One Tree Hill Borough Landfill		Moderate	G3, G5, E1	Metals, PAHs, SVOCs, asbestos	Human health	Ports of Auckland Metro port					Properties that are part of the landfill area and contained potential HAIL activities are included elsewhere in this list. Uncontrolled landfilling was conducted on this site.	Earthtech 1993: Groundwater Investigation Scoping Report. Pikes Point Aftercare, Auckland Regional Council. Earthtech Consulting Ltd, 11 June 1993. 1966, 1973, 1975 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
8	NZR Landfill Area	Sector 6, Sector 3, and Sector 2	Moderate	G3, G5, E1	Metals, PAHs, SVOCs, asbestos	Human health	Ports of Auckland Metro port	✓	Contaminated Site Discharge - development of industrial site for warehousing, remediation of soils required.	N	activity ID 20588 & 20077	Properties that are part of the landfill area and contained potential HAIL activities are included elsewhere in this list. Will potentially undergo soil disturbance from the EWL project. Uncontrolled landfilling was conducted on this site.	Earthtech 1993: Groundwater Investigation Scoping Report. Pikes Point Aftercare, Auckland Regional Council. Earthtech Consulting Ltd, 11 June 1994. 1955, 1966, 1973, 1975, 1991 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Pers. Comm. Cyril Skilton – Onehunga Fencible and Historical Society Inc – 17.02.2016.

Site ID #	Name	Project Sector	Contamination Hazard Rating	HAIL Activity	Contaminants of Concern	Potential receptors	Current Land Use	Potential Soil Disturbance from EWL	Relevant consents or activity info from contaminated sites register search	consent may be affected?	Consent Number	Comments	Information Source(s)
9	Church Street Landfill		Moderate	G3, G5, E1	Metals, PAHs, SVOCs, asbestos	Human health	Ports of Auckland Metro port					Properties that are part of the landfill area and contained potential HAIL activities are included elsewhere in this list. Uncontrolled landfilling was conducted on this site.	Earthtech 1993: Groundwater Investigation Scoping Report. Pikes Point Aftercare, Auckland Regional Council. Earthtech Consulting Ltd, 11 June 1995. 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
10	NZ Farmers Fertiliser Works Site		Moderate	A2, A6, A17	Copper, Phosphorus, Sulphate, and Fluoride, asbestos	Ecological fresh water and marine	Residential, Commercial		1999 AEE for discharge to air - found to be insignificant and effects minor.			MfE Contaminated Sites Remediation Fund Priority List. The URS Green Stream Report contained the following relevant information: -Extensive contamination plume coming from the former New Zealand Farmers Fertiliser site containing elevated levels of sulphate, flouride, copper, cadmium, phosphorous, lead, arsenic, boron, cobalt, iron, lead, nickel, zinc, and also groundwater pH as low as 3.2.	1939, 1949, 1962, 1974 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Pers. Comm. Cyril Skilton – Onehunga Fencible and Historical Society Inc – 17.02.2016. Contaminated sites register. URS New Zealand Limited, 2010. Green Stream Groundwater Plume: Characterisation and Risk Assessment, Auckland: s.n.
11	Mount Smart Landfill		Low	G3, G5, E1	Metals, PAHs, SVOCs, asbestos	Human health	Recreational - stadium		Discharge to Ground			Uncontrolled landfilling was conducted on this site.	Earthtech 1993: Groundwater Investigation Scoping Report. Pikes Point Aftercare, Auckland Regional Council. Earthtech Consulting Ltd, 11 June 1995. 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
12	Southdown Freezing Works	Sector 3	Moderate	G5, E1	Metals, PAHs, asbestos, petroleum hydrocarbons	Human health	Commercial	✓	Contaminated Site Discharge - Land disturbance notification received 17/04/08 in accordance with rule 5.5.40. Risk assessment to be carried out to determine whether ARC officers should be involved in works. Contaminated Site Discharge (61 Hugo Johnston Drive)	Y	20927 (activity ID) 43781	Uncontrolled landfilling was conducted on this site. Will potentially undergo soil disturbance from the EWL project. Properties that are part of the landfill area and contained potential HAIL activities are included elsewhere in this list. Property files contain the following relevant information: **-10 Autumn Place:** Five borehole logs to maximum depth of 11.5m and a layout plan of the Southdown Freezing Works including locations of truck wash, drum wash, refinery building, coal pits, drainage network, fuel oil storage, and laboratory. **-108-136 Hugo Johnston Drive:** Demolition photos, AEE, asbestos management plan, and demolition plan from Southdown Freezing Works. **-120 Hugo Johnston Drive:** Environmental Site Assessment, Soil Validation Report, resource consent application, test pit logs, and Site Management Plan. **-121 Hugo Johnston Drive:** Geotechnical assessment including test pit and borehole logs. **-141-199 Hugo Johnston Drive:** AEE, RAP, Monitoring and Management Plan, photos of asbestos dumping, test pit and borehole logs and analytical soil results indicating widespread soil, shallow and deep groundwater contamination from heavy metals and hydrocarbons. Contaminated sites register - Contaminated Site Discharge (61 Hugo Johnston Drive) - Long-term discharge of contaminants to land and water from a contaminated site.	1930, 1945, 1946, 1949, 1972 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). City of Auckland District Plan Annexure 8 - Contaminated Sites. NZMS Onehunga Map 1951. Pers. Comm. Cyril Skilton – Onehunga Fencible and Historical Society Inc – 17.02.2016. Contaminated sites register. Property files: -Drainage & City Water, n.d. Southdown Works Layout Plan, Auckland: s.n. -URS New Zealand Limited, 2009. Resource Consent Application and Assessment of Effects on the Environment - Water Supply from Southpark Property to the Mighty River Power Cogeneration Plant, Auckland: s.n. -Nikau Contractors Limited, 2008. Demolition & Asbestos Removal Methodology - Southdown, Auckland: s.n. -Dowdall & Associates Limited, 2008. Asbestos Assessment - Southdown Site, Hugo Johnston Drive (post fire), Auckland: s.n. -Soil & Rock Consultants, 2010. Site Validation Report for Health Pak Site: 120 Hugo Johnston Drive, Penrose, Auckland: s.n. -Soil & Rock Consultants, 2009. Environmental Site Assessment for Health Pak at 120 Hugo Johnston Drive, Penrose, Auckland: s.n. -Tonkin & Taylor Limited, 2008. 141 Hugo Johnston Drive, Te Papapa, Auckland Remediation Action, Earthworks Management and Sediment Control Plan, Auckland: s.n. -Tonkin & Taylor Limited, 2008. Assessment of Environmental Effects - Discharge of Contaminants and Earthworks 141 Hugo Johnston Drive, Auckland: s.n.
13	Union Soap and Candle Company (Taniwha Soap Powder Company)		Low	A17	Surfactants, caustics, metals, PCP	Human health	Commercial		Contaminated Site Discharge - redevelopment of site (15-21 Bell Ave)	N	40873	Contaminated Sites Search Details: -long-term discharge of contaminants to land or water, associated with the presence of subsurface soils contaminated in exceedance of the Permitted Activity criteria of the Auckland Council Regional Plan: Air, Land and Water (ACRP:ALW) within the site Property files contain the following relevant information: **-11-13 Bell Avenue:** Six borehole logs and a summary of environmental testing outlining minor hydrocarbon contamination and no apparent heavy metals or PCP contamination. A geotechnical inspection report including photos is also included.	1930, 1949 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Contaminated sites register. Property files: -Tonkin & Taylor Limited, 1996. Broadway Developments Limited, Auckland: s.n.
14	Hickson's Timber Treatment Yard	Sector 6	Moderate	A18	Arsenic, copper, chromium, boron, PCP, chlordane, SVOC, dioxins, furans, OCPs	Human health, Ecological	Commercial, Warehousing					Property files contain the following relevant information: **-122 Captain Springs Road:** 2002 Soil Investigation Report contains test pit logs and soil analytical results including details of historic works at the site. Extensive heavy metals, PCPs, OCPs, TBT, PAHs, chlordane, SVOCs contamination.	1966, 1977 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). City of Auckland District Plan Annexure 8 - Contaminated Sites. Property files: -Tonkin & Taylor Limited, 2002. Ground Investigation Report - 122 Captain Springs Road, Auckland: s.n.
15	Lee and Arlington Ltd Tannery (Established 1913)	Sector 5	Moderate	A16	Metals, sulphides, formaldehyde, SVOC, petroleum hydrocarbons, OCPs	Human health, Ecological			Contaminated Site Discharge - 50 Luke St - Soil contaminated with chromium above commercial threshold levels		Activity ID 20412	Extension to building proposed. PSI indicates extensive chromium contamination which may have arisen from tanning. Property files contain the following relevant information: **-38 Luke Street:** 2003 Detailed Site Investigation detailing 15 boreholes, 10 groundwater wells, analytical results showing TPH, SVOCs, heavy metals, asbestos in soil and tannins, sulphate, formaldehyde, heavy metals, TPH, SVOCs in groundwater. A UST was removed from the site. The resource consent memo outlines the details of the site transformation to a school. **-50 Luke Street:** AEE, 1945 building permit which mentions that fibrolite roofing will be used on the tannery, 2005 PSI outlining heavy metal and OCPs contamination.	1930 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Contaminated sites register. Property files: -URS New Zealand Limited, 2003. Morning Star Enterprises Phase II Environmental Site Assessment, Auckland: s.n. -URS New Zealand Limited, 2003. Resource Consent Application and Assessment of Environmental Effects Report, Auckland: s.n. -Beca Planning, 2002. Assessment of Environmental Effects: 50 Luke Street, Otahuhu, Auckland: s.n. -Groundwater and Environmental Services, 2005. Preliminary Site Investigation: 50 Luke Street, Otahuhu, Auckland: s.n.
16	1883 - 1896 - New Zealand Iron and Steel Company. McColls Timber Company. Parker Lamb Timber Company. North half of the building was used to make tar paper (Pad Company) - 1950s. Onehunga Railway Station	Sector 1	Moderate	F6, A18, D4	PAHs, metals, asbestos, petroleum hydrocarbons, acid herbicides, PCP, arsenic, copper, chromium, dioxins, furans	Human health, Ecological	Railway station		Contaminated Site Discharge - Onehunga Railway Station - To authorise the discharge of contaminants from land that is undergoing remediation/land disturbance.	N	Activity ID 21131	Application for the discharge from contaminated land associated with the rehabilitation of a 4.3km section of railway being the Onehunga Branch Line.	1946, 1947, 1948, 1949, 1950, 1966, 1967 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Princes Street History Document provided by Onehunga Fencible and Historical Society Inc (2016). Contaminated sites register. Property files.

Site ID #	Name	Project Sector	Contamination Hazard Rating	HAIL Activity	Contaminants of Concern	Potential receptors	Current Land Use	Potential Soil Disturbance from EWL	Relevant consents or activity info from contaminated sites register search	consent may be affected?	Consent Number	Comments	Information Source(s)
17	1854 - 1888 - Boycrofts Mill. 1888 - W Sutherland & Co Ltd Tannery. NZWMA Wool Scourers Ltd. Graham Lowe Tannery.	Sector 1	Moderate	A16	Metals, nutrients, asbestos, phenols, sulphides Chromium (including hexavalent Cr), manganese, copper, ammonia, nitrite, sulphides, acids, sodium hydroxide, lime, formaldehyde, solvents, cyanide, detergents, pesticides, and bleaching agents (e.g., hydrogen peroxide). PAH, Petroleum hydrocarbons.	Human health, Ecological	Tannery, Bus Depot, Metal Engineering		Contaminated Site Discharge - Contamination at Colyer Watson Hides Ltd Discharge To Air - To discharge Contaminants to air from a tannery Industrial or Trade Process		activity ID 20169 (file ref M096-52-0088) Consent #39138 (discharge to air) Consent #39031	Contaminated Sites Search Details: -Contamination by chrome liquor at site. -Application to discharge contaminants into air from the operation of two adjoining wet blue tanneries and hide salting facilities. -140 Neilson St - Bus Depot: To discharge contaminants into or onto land from an industrial or trade process, from a bus depot with refuelling and wash down facilities. -Application for Resource Consents: Discharge of contaminants to land or water from land undergoing disturbance (38926) associated with 2.0324-ha earthworks for the redevelopment of three existing industrial properties for future use as a bus depot. -Remediation of historic tannery site for future redevelopment of the site into a bus depot. -Application to discharge industrial storm water from Sutherlands tannery site (1 of 2 sites). -Multiple consents for construction of bores. Property files contain the following relevant information: **-102 Neilson Street:** 2014/2015 SMP and PSI outlining potential soil and groundwater contamination. **-104/140/140A Neilson Street:** 2002 Site Investigation Report outlining groundwater heavy metal contamination, soil heavy metal (including hexavalent chromium) contamination and asbestos. No other testing was undertaken (TPH etc.) and boreholes and test pit logs are included in the report. 2011 AEE included. 2011 Site Validation Report outlines former tannery waste material (extending to more than 4 m bgl at the south of the site) on the site including asbestos, and heavy metal, PAH, and TPH contamination. 2011 RAP outlining approach to remove, cover, and monitor contamination. Floor plan of W Sutherland & Co Ltd Tannery showing chemical tank sizes and locations. Above ground storage tank plans relating to NZ Bus depot.	Pers. Comm. Cyril Skilton – Onehunga Fencible and Historical Society Inc – 17.02.2016. Tanneries History Document provided by Onehunga Fencible and Historical Society Inc (2016). Princes Street History Document provided by Onehunga Fencible and Historical Society Inc (2016). 1946, 1947, 1948, 1949, 1950, 1966, 1967 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Contaminated sites register. Property files: -Tonkin & Taylor Limited, 2015. 102 Neilson Street, Onehunga: Site Management Plan for Ground Contamination, Auckland: s.n. -Tonkin & Taylor Limited, 2014. 102 Neilson Street, Onehunga: Preliminary Site Investigation, Auckland: s.n. -Groundwater and Environmental Services, 2002. Site Investigation Report: 104 Neilson Street, Onehunga, Auckland: s.n. -Groundwater and Environmental Services, 2011. Assessment of Environmental Effects: 104 Neilson Street, Onehunga, Auckland: s.n. -Groundwater and Environmental Services, 2011. Site Validation Report: 104, 140 & 140A Neilson Street, Onehunga, Auckland: s.n.
18	Onehunga Wool Mill	Sector 6	Low	A16	Asbestos, phenols,	Human health	Commercial					One 10 m deep borehole recorded on site in 1991. Property files contain the following relevant information: **-273 Neilson Street:** 1987 geotechnical assessment including borehole logs.	1946 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Foundation Engineering Limited, 1987. Firdel Properties Ltd Foundation Design, Auckland: s.n.
19	Automotive Dismantler	Sector 1	Moderate	G4	Metals, petroleum hydrocarbons	Human health	Commercial	✓ Local road connections only				Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-101-103 Neilson Street:** 2003 and 2007 Geotechnical assessments including borehole and test pit logs. 2007 RAP outlining heavy metal soil contamination and landfill gas. 2007 Landfill Gas Building Protection Measures Report. 2006 Long term site management plan.	1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Tonkin & Taylor Limited, 2003. Proposed ITM Project Geotechnical Investigation, Auckland: s.n. -Planned Solutions Limited, 2004. Proposed Discharge of Stormwater Assessment of Environmental Effects, Auckland: s.n. -Tonkin & Taylor Limited, 2007. Rockfield Properties 103 Neilson Street, Onehunga Geotechnical Report, Auckland: s.n. -Tonkin & Taylor Limited, 2007. Rockfield Properties Ltd Building Protection Measures - Landfill Gas, Auckland: s.n. -Tonkin & Taylor Limited, 2007. Rockfield Properties Limited Remediation Action Plan, Auckland: s.n.
20	Automotive Dismantler, Waste recycling	Sector 2	Moderate	G4	Metals, petroleum hydrocarbons, PCBs, PAHs	Human health, Ecological	Automotive Dismantler	✓	Contaminated Site Discharge - PCB contamination at 6A Alfred Street, Onehunga		activity ID 20206	Will potentially undergo soil disturbance from the EWL project. From contaminated sites register - PCB contamination on site to be remediated Property files contain the following relevant information: **-12 Alfred Street:** 2011 AEE outlining heavy metals, PAHs, TPH and asbestos contamination. 1993-2006 borehole logs. 2011 Preliminary Site Investigation outlining heavy metal, PAH, TPH, and asbestos contamination. **-12A-B Alfred Street:** 2007 Geotechnical Assessment outlining heavy metals, leachate, and landfill gas issues. 2007 Landfill Gas Building Protection Measures Report and borehole logs. 1993 Groundwater and Gas Testing Report outlining an extensive survey of the groundwater quality at the site. 2007 Refuse, Leachate, and Landfill Gas Management Plan Version 1 and 2. 2009 Supplementary Geotechnical Report outlines further testing of landfill gas, soil, and groundwater. Photos showing landfilling materials, test pits, and settlement. 2013 Geotechnical Completion Report including borehole logs. 2007 AEE for removal of a stockpile which was mildly contaminated (below industrial limits). Summary of soil laboratory testing results from the Wreckers' yard investigation showing significantly elevated levels of heavy metals, PAHs, TPHs, and the presence of landfill gas. 2011 Geotechnical Investigation. 2014 AEE for CID Resource Recovery. 2006 AEE for 29 Victoria Street. **-2 Alfred Street:** 2013 PSI outlining heavy metals, PAH, TPH, and asbestos soil contamination, and the presence of landfill gas.	1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Merestone Planning and Resource Management, 2011. Victoria Street CID Resource Recovery Centre Application for Resource Consent and Assessment of Environmental Effects, Auckland: s.n. -Geosciences Limited, 2011. Preliminary Site Investigation: 12 A&B Alfred Street, Onehunga, Auckland: s.n. -GROUNDSEARCH EES Limited, 1993. 31 Victoria Street Landfill Groundwater and Gas Testing, Auckland: s.n. -Tonkin & Taylor Limited, 2007. Galway Street Landfill Assessment of effects on the environment for removal of a stockpile, Auckland: s.n. -SKM Limited, 2007. Peer Review of Landfill Gas Protection Measures for the Building Associated with the Proposed Materials Recovery Facility at the Galway Street Closed Landfill, Auckland: s.n. -Merestone Planning and Resource Management, 2014. CID Resource Recovery Limited Resource Recovery Centre Application for Resource Consent and Assessment of Environmental Effects, Auckland: s.n. -Tonkin & Taylor Limited, 2013. Contaminated Soils Preliminary Site Investigation 2 Alfred Street, Onehunga, Auckland: s.n.
21	Uncontrolled fill	Sector 3	Moderate	G5, E1	Metals, petroleum hydrocarbons, SVOC, asbestos	Human health, Ecological	Vacant Land	✓				Will potentially undergo soil disturbance from the EWL project. Uncontrolled landfilling was conducted on this site. Contaminated Sites Search Details: -144-199 Hugo Johnston Drive - Landfill discharge. Property files contain the following relevant information: **-121 Hugo Johnston Drive:** Geotechnical assessment including test pit and borehole logs. **-141-199 Hugo Johnston Drive:** AEE, RAP, Monitoring and Management Plan, photos of asbestos dumping, test pit and borehole logs and analytical soil results indicating widespread soil, shallow and deep groundwater contamination from heavy metals and hydrocarbons. **-164-220 Hugo Johnston Drive:** 2012 AEE refers to the site the MRP generation plant was built on being stripped back to basalt and all asbestos removed. 1994 AEE doesn't mention contaminated land. 1995 Geotechnical assessment mentions up to 7.5 m of fill on the site including asbestos and Southdown Freezing Works waste sludges.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Babbage Consultants, 2008. Geotechnical Assessment Report, Auckland: s.n. -Transpower NZ Limited, 2012. Application for Resource Consent and Assessment of Effects on the Environment, Auckland: s.n. -Tonkin & Taylor Limited, 1995. Southdown Cogeneration Site Geotechnical Investigation Report, Auckland: s.n. -Tonkin & Taylor Limited, 2001. 142-162 Hugo Johnston Drive - Annual Inspection, Auckland: s.n. -Tonkin & Taylor Limited, 2008. 141 Hugo Johnston Drive, Te Papapa, Auckland Remediation Action, Earthworks Management and Sediment Control Plan, Auckland: s.n.
22	Chemical Recovery Factory / BP Oil Limited Dominion Oil Site	Sector 6	High	A13, A7, A2, A17	Metals, petroleum hydrocarbons, SVOC, VOCs, chlorinated solvents	Human health, Ecological	Chemical Recovery	✓ Local road connections only	Contaminated Site Discharge		22017	Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-23 Pukemiro Street:** Multiple plans showing layout of the facility including drainage and tank locations. Borehole logs from 1988. 1999 application for consent outlines the extensive hydrocarbon and heavy metals contamination at the site and the two product interception trenches which run along the southern and eastern boundary to collect hydrcarbons that are migrating off the site. The Fraser Thomas Ltd report outlines analytical results showing extensive hydrocarbon and heavy metals results and contains the plans for the product interception systems. Consent to discharge, pursuant to section 15(1)(b) of the Act, residual contaminants into the ground and ground water from a hydrocarbon contaminated site (ex-oil re-refinery).	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). City of Auckland District Plan Annexure 8 - Contaminated Sites. Property files: -Land & Water Quality, 1999. Application Number Cg12898 by BP Oil New Zealand Ltd for consent to discharge residual contaminants into the ground and groundwater at 23 Pukemiro St, Onehunga, Auckland: s.n. -Fraser Thomas Limited, 2005. Environmental Site Investigation (Stages 1 & 2) - 55-57 Angle Street, Onehunga, Auckland: s.n. Contaminated sites register

Site ID #	Name	Project Sector	Contamination Hazard Rating	HAIL Activity	Contaminants of Concern	Potential receptors	Current Land Use	Potential Soil Disturbance from EWL	Relevant consents or activity info from contaminated sites register search	consent may be affected?	Consent Number	Comments	Information Source(s)
23	Rapa Casings Ltd Hide and Gut Scraping Factory		Low	A16	Metals, asbestos, petroleum hydrocarbons, SVOCs, PAHs	Human health	Tannery, Tallow Storage, Transport Depot, Rail Yard					Property files contain the following relevant information: **-345 Neilson Street:** 1992 Geotechnical assessment that includes test pit logs revealing details on fill materials across the site including cables, crushed 44 gallon drums with remnant clear liquid and strong ammonia smell, shredded asbestos, steel bars, and plastic/nylon textiles. The site was operated by Rapa Casings Ltd as a hide and gut scraping factory. 2002 Environmental Investigation recorded heavy metal and PAH contamination. 2006 Environmental Investigation and Environmental Management Plan outline soil contamination from heavy metals, PAHs, TPH, SVOCs.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1973 oblique historic aerial photos (National Library of New Zealand). Property files: -WORKS Consultancy Services Limited, 1992. New Zealand Post 345 Neilson Street Site Development Potential Additional Geotechnical Assessment for Revised Site Plan, Auckland: s.n. -Beca Limited, 2002. Auckland City Council Resource Consent Application - 345 Neilson Street, Onehunga, Auckland: s.n. -Beca Infrastructure Limited, 2006. Five Star Properties Limited Environmental Investigation - Stage 2a, Auckland: s.n.
24	Uncontrolled fill from South Down Cogen Plant	Sector 3	High	E1, G5	Metals, petroleum hydrocarbons, SVOC	Human health	Vacant Land	✓	Contaminated Site Discharge and landfill discharge	Y	42849 and 42959	Will potentially undergo soil disturbance from the EWL project. Contaminated Sites Search Details: -144-199 Hugo Johnston Drive - Landfill discharge. Property files contain the following relevant information: **-164-220 Hugo Johnston Drive:** 2012 AEE refers to the site the MRP generation plant was built on being stripped back to basalt and all asbestos removed. 1994 AEE doesn't mention contaminated land. 1995 Geotechnical assessment mentions up to 7.5 m of fill on the site including asbestos and Southdown Freezing Works waste sludges. **-141-199 Hugo Johnston Drive:** AEE, RAP, Monitoring and Management Plan, photos of asbestos dumping, test pit and borehole logs and analytical soil results indicating widespread soil, shallow and deep groundwater contamination from heavy metals and hydrocarbons. **-142-162 Hugo Johnston Drive:** 2001 letter indicates yearly inspections of asbestos dumping areas and removal of asbestos as it comes to the surface. Site is currently being used as the carpark for the MRP cogeneration facility. 1999 AEE outlying the spreading of asbestos contaminated soil across the 1500 m2 area between Carter Holt Harveys paper mill and the MRP cogeneration plant and then capping with clay. Consent to authorise the short term controlled discharge of contaminants to land or water associated with the proposed redevelopment of the project site and for long term discharge of contaminants to land or water from the site containing. Oil and asbestos disposed of on site in the past. It is intended to provide thicker cap on the site and dynamically compact it. Monitoring measures put in place to ensure no impact on surrounding environment.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1930, 1945, 1946, 1949, 1972 oblique historic aerial photos (National Library of New Zealand). Property files: -Tonkin & Taylor Limited, 2001. 142-162 Hugo Johnston Drive - Annual Inspection, Auckland: s.n. -Transpower NZ Limited, 2012. Application for Resource Consent and Assessment of Effects on the Environment, Auckland: s.n. -Tonkin & Taylor Limited, 1995. Southdown Cogeneration Site Geotechnical Investigation Report, Auckland: s.n. -Tonkin & Taylor Limited, 2008. Assessment of Environmental Effects - Discharge of Contaminants and Earthworks 141 Hugo Johnston Drive, Auckland: s.n. -Tonkin & Taylor Limited, 2008. 141 Hugo Johnston Drive, Te Papapa, Auckland Remediation Action, Earthworks Management and Sediment Control Plan, Auckland: s.n. Contaminated sites register
25	Uncontrolled fill	Sector 3	Moderate	G5, E1	Metals, asbestos, petroleum hydrocarbons, OCPs, PCBs	Human health	Truck rental, logistics					Property files contain the following relevant information: **-781 Great South Road:** 2008 Archaeological Assessment for the filling of Ann's Creek area identified no significant archaeological areas were being affected by the proposed work. 2006 Ann's Creek shrub land management plan to protect and rehabilitate indigenous lava-shrub land. 2004 PSI shows extensive heavy metal contamination associated with filling occurring on the site rather than any activities occurring on the site. 2006 DSI provided more analytical testing and confirmed heavy metal contamination in soils and groundwater. PCB, TPH, OCP not detected in groundwater. Copper, lead, nickel, and zinc primary contaminants. 2008 AEE. 2007 map of ecological area. Multiple geotechnical assessments conducted on the site and historical maps/photos of the site. Cu, Ni, Pb and Zn exceed guideline values. Elevated heavy metal concentrations not just present in surface samples - also contamination in 0.5 m samples. Note that Cu and Pb exceed guideline values by up to 5 times. Contamination is thought to have come from external areas and is not related to activity on the site.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1930, 1945, 1946, 1949, 1972 oblique historic aerial photos (National Library of New Zealand). Property files: -Clough & Associates Limited, 2008. Proposed Plan Change for 791-793 Great South Road Archaeological Assessment, Auckland: s.n. -GHD Limited, 2004. TR Group 791-793 Great South Road Preliminary Site Investigation, Auckland: s.n. -GHD Limited, 2006. TR Group 791-793 Great South Road Detailed Site Investigation, Auckland: s.n. -hay Resource Management Practice, 2008. Proposal for Site Development and Rehabilition - Resource Consent Applications and Assessment of Effects on the Environment, Auckland: s.n.
26	Westfield Freezing Works Timber Yard	Sector 3 and Sector 4	High	G5, E1, A18	Metals, PAHs, asbestos, PCP, dioxins, petroleum hydrocarbons	Human health	Commercial	✓	Contaminated Site Discharge - Truck Stop 2 Vestey Drive - Lube oil spill	N	activity ID 21109	Will potentially undergo soil disturbance from the EWL project. Contaminated Sites Search Details: -Approx. 2400lts of Delo400 LE engine oil has leaked into the ground from a broken underground oil delivery line running under the concrete floor of the workshop building. Property files contain the following relevant information: **-1 Niall Burgess Road:** 1994 Geotechnical Report outlining refuse pits, oil spills, tallow deposits, unknown fill and coal ash. **-1 Vestey Drive:** 1993 Geotechnical Report outlining fill >3 m depth from approximately 1940 comprising of organic matter with iron, asbestos, concrete, bricks, ash. 1996 Geotechnical Report with borehole logs. **-1048-1050 Great South Road:** 1993 Summary Geotechnical Report outlining 80 organic waste pits encountered in the Westfield holding paddocks, a coal ash and rubbish pile, and a freezing works fellmongery lagoon. 1994 Environmental Assessment outlined land uses on the site including butchers shop, canteen, tallow storage tanks, blood house, above ground fuel tank, UST, underground light fuel oil tank, bacteriological laboratory. **-2-6 Niall Burgess Road:** 1994 Management plan for removing approximately 30,000 m3 of coal ash. 1993 stabilisation of organic material excavated from waste pits at Westfield Industrial Park report and Environmental Management Plan for the Fellmongery Lagoon at Westfield Park (including a map of the Westfield Freezing Workings site) which outline the processes undertaken to remove and treat the waste found on the site. **-26-30 Vestey Drive:** 1999 Contamination Assessment outlining an investigation consisting of 12 soil and one groundwater sample showing low level PAH/TPH contamination.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). City of Auckland District Plan Annexure 8 - Contaminated Sites. NZMS Onehunga Map 1951. Contaminated sites register. 1930, 1938, 1939, 1945, 1949, 1951, 1962, 1977, 1980 oblique historic aerial photos (National Library of New Zealand). Property files: -Beca Carter Hollings & Ferner Limited, 1994. Broadway Park (Subdivision of Lots 13 & 14 Westfield Park) Summary Geotechnical Report, Auckland: s.n. -Beca Carter Hollings & Ferner Limited, 1993. Westfield Park Stage 3 Development Vestey Drive Old Fill Geotechnical Report, Auckland: s.n. -Foundation Engineering Limited, 1996. Geotechnical Completion Report on Lot 10 Westfield Park, Auckland: s.n. -Beca Carter Hollings & Ferner Limited, 1993. Westfield Park Stage 2 Subdivision Summary Geotechnical Report , Auckland: s.n. -Beca Carter Hollings & Ferner Limited, 1994. Assessment of effects on the environment of earthworks associated with the westfield park stage 3 subdivision, Auckland: s.n. -Beca Carter Hollings & Ferner Limited, 1993. Westfield Park completion of earthworks & services stage 1 subdivision geotechnical report, Auckland: s.n. -Beca Carter Hollings & Ferner Limited, 1995. Westfield Park Stage 3B (Lots 14 and 25) Completion of Earthworks Geotechnical Report, Auckland: s.n. -Beca Carter Hollings & Ferner Limited, 1994. Westfield Park Subdivision (Stage 3) Management Plan for Coal Ash Removal, Auckland: s.n. -Oostrom, A. v., 1993. Stabilisation of Organic Material Excavated from Waste Pits at Westfield Industrial Park, Auckland: s.n. -Tonkin & Taylor Limited, 1999. 26-30 Vesty Drive, Mt Wellington Former Tegel/NRM Feed Mill Contamination Assessment, Auckland: s.n.
27	Waste Disposal to Land	Sector 3	Low	G5,E1	Metals, PAHs, asbestos	Human health	Market Gardening distribution centre						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1930, 1949 oblique historic aerial photos (National Library of New Zealand).
28	Kempthorne and Prosser Company Ltd and NZ Drug Company Ltd - Fertiliser/Chemical/Drug Works		Moderate	A2,A6,A1,A14, A17	Metals, PAHs, asbestos, nutrients, petroleum hydrocarbons, PAHs	Human health, Ecological	Commercial warehousing					Property files contain the following relevant information: **-11-13 Bell Avenue:** Six borehole logs and a summary of environmental testing outlining minor hydrocarbon contamination and no apparent heavy metals or PCP contamination. A geotechnical inspection report including photos is also included. **-12-16 Bell Avenue:** Five photos taken of the freezing works in 1992 during demolition. **-22 Bell Avenue:** 1994 lead contour plots showing soil contamination. 2015 Contamination Assessment Report contains soil analytical results which indicate low level heavy metals, TPH, and PAH contamination. **-815-819 Great South Road:** 2004 Contamination Assessment outlines low levels of lead contamination in the fill on the site. **-827-829 Great South Road:** 2015 Site Management Plan outlining elevated levels of lead, tin, zinc, TPH, and asbestos.	1906, 1938, 1946, 1961, 1962 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Tonkin & Taylor Limited, 1996. Broadway Developments Limited, Auckland: s.n. -Latham Construction, 2005. Geotechnical Inspection Report: Bell Ave, Auckland: s.n. -GROUNDSEARCH EES Limited, 1994. Shortland Site Phase III, Auckland: s.n. -Tonkin & Taylor Limited, 2015. 22 to 28 Bell Avenue, Otahuhu Summary of ground contamination assessments, Auckland: s.n. -Maunsell Limited, 2004. Soil Investigation, Auckland: s.n. -Geosciences Limited, 2015. Site Management Plan: 827-831 Great South Road, Mt Wellington, Auckland, Auckland: s.n.

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29	Former Mazda NZ Assembly Site	Sector 4 and Sector 5	Low	F4, I	Petroleum, hydrocarbons, metals, chlorinated solvents	Human health	Produce distribution centre and auction house	✓	Contaminated Site Discharge		35826 and 42415	Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-2 Monahan Road:** Trichloro-ethene in soil exceeds guideline standards (Dutch Intervention Guidelines) and range between 0.9-60.4 mg/kg. No BTEX or VOC's in soil. Tri-chloro-ethene in groundwater exceeds Dutch Intervention Guidelines (DIG) at 9 of 13 wells monitored and range from 0.001 - 7.92 g/m^3. Concentrations of vinyl chloride in groundwater exceed DIG at 10 of 13 wells, with 0.01 to 0.33 g/m^3. Benzene was detected in groundwater which exceeded DIG at 0.520 g/m^3. Xylene in groundwater exceeded the DIG at 2 wells and was measured 11.0 g/m3 in one location. Underground solvent and petrol tanks were present on site. Earthworks were undertaken to remove contaminated soil and replaced with cleanfill. **-5 Monahan Road:** 2000 Remediation and Validation report outlining hydrocarbon contamination from tank farms. 2010 AEE outlines BTEX and methanol contamination due to UST tank farm. Environmental Log - basalt encountered at about 1.5 - 3.0 m with soil overlay. Hydrocarbon analysis lab results. Elevated levels of toluene, ethylbenzene and xylene in BH1 (27,000; 14,000 and 27,000 mg/L respectively). Contamination occurred in the lower 0.5-1.0 m; above the surface of the basalt. Underground storage tanks and contaminated soil removed. Residual contamination does not pose hazard for continued work on the site assuming industrial land use. Significant groundwater contamination from monoaromatic hydrocarbons due to leak in UST. Consent to authorise the discharge of chlorinated hydrocarbon contaminants to ground water in accordance with Section 15(1)(a) of the Resource Management Act 1991.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Focus Environmental Services Limited, 2014. Site Management Plan & Assessment of Environmental Effects: 2, 4 & 6 Monahan Road, Mount Wellington, Auckland, Auckland: s.n. -Tonkin & Taylor Limited, 2000. Coatings Manufacturing Plant, 5 Monahan Drive, Mt Wellington Remediation and Validation, Auckland: s.n. -AECOM New Zealand Limited, 2010. PPG Industries Limited: Application to establish a new dangerous goods bund, Auckland: s.n. -Tonkin & Taylor Limited, 1998. Ground Contamination Investigation Report: Stage One, Auckland: s.n. Contaminated sites register
30	Market Gardening		Low	A10	Metals, organochlorine pesticides, acid herbicides	Human health, Ecological	Residential						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
31	Uncontrolled Fill Market Gardening	Sector 5	Low	G5, A10	Metals, organochlorine pesticides, acid herbicides	Human health	Zealandia Hydroponics / Market Gardening	✓ Local road connections only				Will potentially undergo soil disturbance from the EWL project.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
32	Power Station - Mighty River Power	Sector 3	High	B4	PCBs, petroleum hydrocarbons, caustics, metals, mercury	Human health, Ecological	Power Station	✓	Discharge To Air and Industrial or Trade Process		39725 and 36197	Will potentially undergo soil disturbance from the EWL project. Possible uncontrolled landfilling was conducted on this site. Property files contain the following relevant information: **-164-220 Hugo Johnston Drive:**Resource consent application and AEE contained in property files. Mentions contaminants of concern as being asbestos, inorganic (heavy metals) and organic (hydrocarbons, PCBs) contaminants. Commissioned in 1996. Given the age of the plant the likelihood of encountering PCBs is considered relatively low. Nitrous Oxide was considered to be a primary contaminant in terms of air quality being produced by the power station; however, detailed modelling showed that NO_x will not exceed guidelines or create issues regarding air quality. Asbestos contaminated fill was removed and replaced with cleanfill for an expansion in 1994. Consent to discharge contaminants into air from a power station made up of two gas fired turbines, a gas/diesel fired turbine, ancillary boiler and associated activities with a nominal combined daily fuel usage of 40 TJ as an annual average. Consent to vary condition 16 relating to the sampling of the site stormwater treatment system / divert and discharge stormwater and discharge contaminants into or onto land from an industrial or trade process in accordance with section 15 of the RMA 1991.	1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Mercury Energy, 1994. Southdown Cogeneration Project Assessment of Environmental Effects, Auckland: s.n. -Opus International Consultants Limited, 2003. Mighty River Power Southdown Power Station Expansion, Hamilton: s.n. Contaminated sites register
33	Service Station Dry Cleaners	Sector 1	High	F7, A13, A5	Petroleum hydrocarbons, PAHs, lead, chlorinated solvents	Human Health	Commercial					Property files contain the following relevant information: **-15-19 Selwyn Street:** The 2006 Resource Consent Application mentions the presence of USTs and API seperators being installed on the site.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Sinclair Knight Merz, 2006. Exxon Mobil Service Station Upgrade: Resource Consent Application, Auckland: s.n.
34	Service Station		High	F7, A13	Petroleum hydrocarbons, PAHs, lead	Human Health	Service Station					Property files contain the following relevant information: **-165 Neilson Street:** API seperator and USTs.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Fuelquip NZ Limited, 2005. Shell Waikaraka Existing Commercial Petroleum Service Station Assessment of Environmental Effects, Auckland: s.n.
35	Scrap Metal Yard	Sector 6	High	G4	Petroleum hydrocarbons, PAHs, metals, PCBs, SVOC	Human Health	Scrap Metal Yard		Contaminated Site Discharge	N	44931	Property files contain the following relevant information: **-296 Neilson Street:** Analytical results from the DSI were presented in the SMP and indicated localised mercury contamination and heavy metals values in excess of the Auckland background soil guideline levels. TPH and PCB's were also encountered on the site as levels above the relevant industrial criteria. Asbestos was encountered in the soils across the site. Groundwater testing indicated low level copper and zinc contamination; however all results were below the trigger levels for freshwater with species 80% protection level. Consent to discharge of contaminants to land and water from the disturbance of contaminated land.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -ENGEO Limited, 2015. Site Management Plan: 296 Neilson Street, Onehunga, Auckland, Auckland: s.n. Contaminated sites register
36	Scrap Metal Yard		High	G4	Petroleum hydrocarbons, PAHs, metals, PCBs, SVOC	Human Health	Scrap Metal Yard					Property files contain the following information: **-318 Neilson Street:** Site Management Plan outlines contaminated soil discovery protocol for earthworks on the site but doesn't contain any environmental assessments or analytical results.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Geosciences Limited, 2014. Site Management Plan: 318 Neilson Street, Penrose, Auckland: s.n.
37	Liquid Fertiliser Manufacturing Plant		Moderate	A6, A1, A2, A17	Nutrients, sulphate, cadmium, uranium	Ecology	Liquid Fertiliser Manufacturing Plant		Contaminated Site Discharge		activity 21066	Contaminated Sites Search Details: -Decommissioning and removal of underground tank	Contaminated sites register. 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).

Site ID #	Name	Project Sector	Contamination Hazard Rating	HAIL Activity	Contaminants of Concern	Potential receptors	Current Land Use	Potential Soil Disturbance from EWL	Relevant consents or activity info from contaminated sites register search	consent may be affected?	Consent Number	Comments	Information Source(s)
38	BP Chemical Store Liquid Recycling and Filtration Automotive Dismantler	Sector 6	Moderate	G4, A2	Petroleum hydrocarbons, metals	Human Health	Automotive Dismantler	✓ Local road connections only	Contaminated Site Discharge - redevelop car wreckers car, to seal site for continuation of car wrecking activities	Y	activity ID 20391	Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-59 Miami Parade:** The 2011 Preliminary Site Investigation report outlines soil analysis results from test pits across the site which show heavy metal concentrations are below the commercial/industrial land use criteria, but above background levels. No VOCs were detected however PAHs were detected at levels below the PAUP:ALW Schedule 10 criteria for a permitted activity. Plasticisers, dyes, and insecticides were also detected in soil at one test pit. Low levels (<0.001% dry weight) of asbestos was discovered in all soil samples analysed. Significant landfill gas was detected throughout the site. The 2006 Ecological Assessment of Pikes Point waterfront concluded that the bird life would be relatively unaffected by the development onshore and that due to existing contamination local ecology would not suffer effects more than minor. It also noted low levels of heavy metals, TPH, and PAHs in the muddy surface sediments of the intertidal zone. The 2012 Site Validation Report provides evidence of environmental testing being conducted upon the import capping material that was used as the base layer on 39 and 59 Miami Parade. Testing showed acceptable levels of contaminants. **-57 Angle Street:** The 2005 Environmental Site Assessment Report described elevated levels of heavy metals and TPHs in the top layer of hardfill on the site (approx 300mm), extending only a few centimetres into the clay layer beneath. The Dominion Oil site at 23 Pukemiro St is listed as a source of contamination at 57 Angle Street due to the migration of seperate phase hydrocarbons onto the site. Large volumes of TPHs, VOCs, and PAHs can be expected along the boundary between the two sites. **-63 Angle Street:** A 1986 Liquid Recycling & Flitration Ltd report contains the application and approval to operate oil storage compound tanks (5 x 55,000 L). A 1985 New Zealand Fire Service report outlines recommendations for using flouroprotein foam for fire fighting. While fluoroprotein foam is not included in the synthetic AFFF products which are highly toxic, it is toxic and it's use is often associated with the use of other foams that contain PFOA/PFOS. The 2004 Auckland Regional Council Site Audit mentions multiple sources of contamination on the site including a fluid draining area, a car part removal area, the storage of car parts, and scrap metal bins.	Contaminated sites register. 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Babbage Consultants Ltd, 2006. Pikes Point East Stage 2: Ecological Assessment of the Proposed Stormwater Discharge, Auckland: s.n. -Beca Ltd, 2012. Updated Site Validation Report - Pikes Point Stage 2, Auckland: s.n. -Geosciences Limited, 2011. Preliminary Site Investigation: 39 and 59 Miami Parade, Onehunga, Auckland: s.n. -Fraser Thomas Limited, 2005. Environmental Site Investigation (Stages 1 & 2) - 55-57 Angle Street, Onehunga, Auckland: s.n. -Land & Water Quality, 1999. Application Number Cg12898 by BP Oil New Zealand Ltd for consent to discharge residual contaminants into the ground and groundwater at 23 Pukemiro St, Onehunga, Auckland: s.n. -Liquid Recycling & Filtration Limited, 1986. Planning approval to construct and operate an oil storage compound, Auckland: s.n. -New Zealand Fire Service, 1985. Recommendations for bulk flammable liquid and chemical firefighting protection, Auckland: s.n. -Auckland Regional Council, 2004. Auckland Regional Council Site Audit of 10 December 2003, Auckland: s.n.
39	Service Station		High	F7, A13	Petroleum hydrocarbons, PAHs, lead	Human Health	Service Station		Contaminated Site Discharge - SVR after tank pull provided to AC on 27 May 2010, and a site assessment provided to AC on 24 September 2010 & construction of bores for the purpose of contaminated site and water quality investigation.	N	Activity ID 21203	Property files contain the following relevant information: **-510 Mt Wellington Highway:** Between September and October 2009, four USTs were removed and the site was redeveloped. Three new USTs were installed. Nine of the 36 in-situ samples representative of soil remaining on-site, returned concentrations of BTEX above the Tier 1 acceptance.	Contaminated sites register. 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Tonkin & Taylor Limited, 2007. Warehouse and office building development Geotechnical Investigation, Auckland: s.n. -Incite (Auckland) Ltd, 2006. District Plan Assessment and Assessment of Effects on the Environment, Auckland: s.n.
40	Glass Houses	Sector 5	Low	A10	Metals, OCPs, Acid Herbicides	Human Health	Abandoned glass houses	✓ Local road connections only	Contaminated Site Discharge - Transit motorway construction		Activity ID 20446	Will potentially undergo soil disturbance from the EWL project.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
41	Yuasa/Century Batteries		High	A2, A4, A17, B1	Lead, acid, metals	Human health, Ecological	Yuasa/Century Batteries		Contaminated site discharge		Permit # 24110	Property files contain the following relevant information: **-265 Church Street:** 2011 Stage II RAP mentions heavy metals contamination (including lead and cadmium) associated with battery manufacture. 1998 Phase 2 Environmental Site Investigation records extensive lead, acid, arsenic, antimony, cadmium, and chloride in the soils across the site. Groundwater contamination was also encountered with evidence of extensive acid (low pH), sulphate, zinc, copper, cadmium, chloride, and lead contamination. The 2007 Environmental Site Assessment discovered soil contamination consisting of arsenic, cadmium, copper, chromium, nickel, zinc, lead, tin, and sulphate. The 2007 RAP also mentions the presence of hydrocarbons.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Contract Environmental Limited, 2011. Stage II Development for Church Park Properties Remedial Action Plan, Auckland: s.n. -Woodward-Clyde (NZ) Ltd, 1998. Phase 2 Environmental Site Investigation and Risk Assessment Century Yuasa Batteries, Auckland: s.n. -URS New Zealand Limited, 2007. Environmental Site Assessment - Proposed Stage 1 Development, Century Yuasa Battery Factory, Auckland: s.n. -URS New Zealand Limited, 2007. Remediation Action Plan - Proposed Stage 1 Development, Century Yuasa Battery Factory, Auckland: s.n.
42	Automotive workshop	Sector 6	Moderate	F4	Petroleum hydrocarbons, PAHs, lead	Human Health	Automotive workshop	✓ Local road connections only				Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-71-73 Captain Springs Road:** The 1996 Environmental Investigation discovered heavy metals and PAHs in the fill/landfill under the site. Groundwater results were within typical leachate ranges found in Auckland landfills. **-79 Captain Springs Road:** The 1997 Babbage report outlines methane and carbon dioxide gas coming out of the landfill waste beneath the site.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Worley Consultants Limited, 1996. Environmental Investigation, Pikes Pt. Yard, Captain Springs Road, Te Papapa Report, Auckland: s.n. -Babbage Consultants Ltd, 1997. 79 Captain Springs Road Geotechnical and Environmental Assessment, Auckland: s.n.
43	Waste Recycling	Sector 1	Moderate	G6	Metals, petroleum hydrocarbons, SVOC	Human health, Ecological	Waste Recycling	✓				Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-21 Waikaraka Road:** The GHD PSI outlines the contamination risks posed from the Waikaraka Cemetery as nitrate, lead, formaldehyde, and biological hazards due to historic landfilling, filling, and land use as a cemetery. It also mentions that due to the potential contamination from surrounding land use, and the unknown contents of the fill on the site, all excavated material will require characterisation. **-12A-B Alfred Street:** 2007 Geotechnical Assessment outlining heavy metals, leachate, and landfill gas issues. 2007 Landfill Gas Building Protection Measures Report and borehole logs. 1993 Groundwater and Gas Testing Report outlining an extensive survey of the groundwater quality at the site. 2007 Refuse, Leachate, and Landfill Gas Management Plan Version 1 and 2. 2009 Supplementary Geotechnical Report outlines further testing of landfill gas, soil, and groundwater. Photos showing landfilling materials, test pits, and settlement. 2013 Geotechnical Completion Report including borehole logs. 2007 AEE for removal of a stockpile which was mildly contaminated (below industrial limits). Summary of soil laboratory testing results from the Wreckers' yard investigation showing significantly elevated levels of heavy metals, PAHs, TPHs, and the presence of landfill gas. 2011 Geotechnical Investigation. 2014 AEE for CID Resource Recovery. 2006 AEE for 29 Victoria Street.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -GHD Limited, 2007. Waikaraka Cemetery Preliminary Site Investigation, Auckland: s.n. -Geosciences Limited, 2011. Preliminary Site Investigation: 12 A&B Alfred Street, Onehunga, Auckland: s.n. -GROUNDSEARCH EES Limited, 1993. 31 Victoria Street Landfill Groundwater and Gas Testing, Auckland: s.n. -Tonkin & Taylor Limited, 2007. Galway Street Landfill Assessment of effects on the environment for removal of a stockpile, Auckland: s.n. -SKM Limited, 2007. Peer Review of Landfill Gas Protection Measures for the Building Associated with the Proposed Materials Recovery Facility at the Galway Street Closed Landfill, Auckland: s.n. -Merestone Planning and Resource Management, 2014. CID Resource Recovery Limited Resource Recovery Centre Application for Resource Consent and Assessment of Environmental Effects, Auckland: s.n.
44	Chemical manufacture, formulation, or bulk storage - Nuplex Ltd	Sector 1	High	A2, A17, A9	VOCs, SVOC, Metals, petroleum hydrocarbons	Human health, Ecological	Vacant land		Discharge To Air	N	Activity ID 3220	Contaminated Sites Search Details: -Discharge to air permits, no bores. -Application to authorise the discharge of contaminants to air from the manufacture of synthetic resins and associated processes in accordance with Section 15 (1)(c) of the Resource Management Act 1991. Property files contain the following relevant information: **-147 Neilson Street:** A 2016 Aecom contamination extent zone map and cross sections shows extensive chemical and dangerous goods tanks across the site and indicates the contamination extent. The cross sections also show the landfilling beneath the site.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -AECOM New Zealand Limited, 2016. Nuplex Onehunga Investigation: Contamination extent zone map and cross sections, Auckland: s.n.
45	Automotive Dismantler		High	G4	Metals, petroleum hydrocarbons	Human Health	Automotive Dismantler						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).

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46	Automotive Dismantler - Active 4x4 Commercial Dismantlers		High	G4	Metals, petroleum hydrocarbons	Human Health	Automotive Dismantler		Landfill Discharge - To discharge leachate from a closed sanitary landfill into the ground and groundwater beneath the site To discharge contaminants into air from an enclosed building on a closed landfill.	N	34282	Contaminated Sites Search Details: -Discharges to ground/groundwater/air and bores/piezos. -Application to change consent conditions to allow for construction and operation of a materials recycling facility on part of the site and to retrospectively permit the relocation and management of a stockpile of contaminated material. -Application to authorise the ongoing diffuse discharge of contaminants to ground and groundwater. -Application to discharge contaminants to land or water from the construction of a proposed industrial and demolition resource centre which will also include development earthworks, roading, and processing buildings over former Auckland Council landfill. -Bores for groundwater monitoring. Property files contain the following relevant information: **-12 Alfred Street:** 2011 AEE outlining heavy metals, PAHs, TPH and asbestos contamination. 1993-2006 borehole logs. 2011 Preliminary Site Investigation outlining heavy metal, PAH, TPH, and asbestos contamination.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Merestone Planning and Resource Management, 2011. Victoria Street CID Resource Recovery Centre Application for Resource Consent and Assessment of Environmental Effects, Auckland: s.n. -Geosciences Limited, 2011. Preliminary Site Investigation: 12 A&B Alfred Street, Onehunga, Auckland: s.n. -GROUNDSEARCH EES Limited, 1993. 31 Victoria Street Landfill Groundwater and Gas Testing, Auckland: s.n.
47	Port Activities	Sector 1	Low	F5, E4	Metals, petroleum hydrocarbons, Lime, calcium hydroxide, alkalis; boron and arsenic in fly ash , ammonia	Ecological	Port & Holcim cement	✓	Discharge To Air Industrial or Trade Process	Y?	29466	Will potentially undergo soil disturbance from the EWL project. Contaminated Sites Search Details: -Holcim NZ - Discharge to air - To discharge contaminants to air from the bulk storage and pneumatic conveyance of cement products. -To authorise the discharge of contaminants into the coastal marine environment, namely the Manukau Harbour, from an industrial or trade process comprising the Port of Onehunga by Ports of Auckland Ltd. Property files contain the following relevant information: **-55 Onehunga Harbour Road:** 1999 Woodward-Clyde tank pull report on behalf of BP Oil New Zealand Limited mentions slight TPH contamination around the area of the UST and includes lab results. A letter from the Auckland Regional Council to the Ports of Auckland Limited in 1998 describes two spills from the site. One from a 200L Hydrogen Peroxide and a 200L "Amcal 3001" drum, the other from a hydrocarbon spill. Both spills enabled contaminants to enter the stormwater system.	1946, 1947, 1948, 1950, 1966, 1967 oblique historic aerial photos (National Library of New Zealand). 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Contaminated sites register. Property files: -Woodward-Clyde (NZ) Ltd, 1999. Onehunga Wharf, 55 Onehunga Harbour Road - Tank Pull Report, Auckland: s.n. -Auckland Regional Council, 1998. Pollution Incident 98/413 Onehunga Wharf and 98/427 Fergusson Wharf, Auckland: s.n.
48	Port a Loo Depot	Sector 1	Low	A17	Surfactants, nutrients, faecal coliforms, E.coli	Human health	Port a Loo Depot	✓ Local road connections only				Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-40 Onehunga Mall:** 2013 Soil & Rock Consultants Limited Geotechnical Investigation outlines fill across the site ranging in depth from 0.2m to 0.8m. The nature of this fill was not investigated.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Soil & Rock Consultants Ltd, 2013. Geotechnical Investigation: Proposed Development 40 Onehunga Mall, Onehunga, Auckland: s.n.
49	Historic Service Station - Mobil	Sector 1	High	F7, A13	Petroleum hydrocarbons, PAHs, lead, chlorinated solvents	Human health	Commercial	✓ Local road connections only	Contaminated Site Discharge	N	Activity ID 20261 (file ref 7-52-2855) Activity ID 21395 Activity ID 21655	Contaminated Sites Search Details: -Discharge of contaminants containing elevated levels of contaminants that is undergoing remediation. -Spill of PCE waste migration to groundwater well, potential impact to groundwater. -Long term discharge of contaminants (10 years). -Multiple consents for installation of groundwater monitoring bores. Property files contained the following relevant information: **-102 Onehunga Mall:** 2015 Post-Remediation Health Risk Assessment states that after the remediation undertaken in early 2015, the levels of vapour coming out of the ground beneath the site are unlikely to pose an unaccpetable risk to human health of site occupants under the assessed scenario. The primary contaminants of concern were TPH from service station land use and volatile chlorinated hydrocarbons (VCH) from historic dry cleaning activities. The 2015 AEE and Summary of Environmental Condition reports outline the VCH (primarily tetrachloroethylene (PCE)) and TPH contamination extents and concentrations. TPH contamination was generally within Tier 1 acceptance criteria for commercial industrial land use and the protection of groundwater quality. PCE soil concentrations were encountered up to 2,900 mg/kg between 3 and 4.5 m bgl. This is well in excess of the Auckland Council criteria of 0.5 mg/kg. 2007 Groundwater Monitoring report records contamination in excess of acceptable limits of seperate phase hydrocarbons in the groundwater beneath the site in two locations and PCE in the groundwater at 5 locations. 2015 Site Management Plan mentions issues around site development and the management of the remaining contamination risks.	Contaminated sites register. 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Golder Associates (NZ) Limited, 2015. Former Mobil Onehunga Motors: Post-Remediation Health Risk Assessment, Auckland: s.n. -Golder Associates (NZ) Ltd, 2015. Application for resource consent and assessment of effects on the environment: Discharge of contaminants to land and water at 102 Onehunga Mall, Onehunga, Auckland: s.n. -Prattle Delamore Partners Ltd, 2007. Former Mobil Onehunga Service Station, Onehunga: Groundwater sampling and monitoring, Auckland: s.n. -Golder Associates (NZ) Ltd, 2015. 102 Onehunga Mall, Onehunga: Site Management Plan, Auckland: s.n.
50	Auto Dismantler		High	G4	Metals, petroleum hydrocarbons	Human health	Concrete Plant		Discharge To Air	N	41787	Contaminated Sites Search Details: -To discharge contaminants into air from the handling of cement, aggregate, limestone, sand and additives in the manufacture of no more than 17 tonnes/hour of dry mix products and the use of a sand dryer/cooler with a maximum thermal cap of 1000 kW.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Contaminated sites register.
51	Steel pipe manufacture - Steelpipe Ltd	Sector 6	Moderate	D5,D3	Metals, petroleum hydrocarbons	Human health, Ecological	Steel pipe manufacture - Steelpipe Ltd		Industrial or Trade Process - To discharge contaminants from Industrial and trade processes from relocating a steel pipe manufacturing facility. Discharge To Air	N	39679 39693	Contaminated Sites Search Details: -To discharge contaminants into air from a steel pipe production in order to upgrade production facilities on site and to improve environmental controls across the new and existing parts of the operation -To undertake contaminated land disturbance activities for the proposed re-location of production of steel pipes at 2245 Neilson Street, Onehunga. Property files contain the following relevant information: **-224 Neilson Street:** 2011 PSI indicated historical filling operations along the western boundary of the site has resulted in low level heavy metals contamination and some undesirable material such as plastic, metal, and timber. 2011 SMP was prepared to allow stockpiling of contaminanted material on site while a DSI is undertaken. Both the PSI and SMP discuss the intention of completing a DSI; however there doesn't appear to be a DSI in the property file.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1949 oblique historic aerial photo (National Library of New Zealand). Contaminated sites register. Property files: -Geosciences Limited, 2011. Preliminary Site Investigation: 224 Neilson Street (West), Te Papapa, Auckland: s.n. -Geosciences Limited, 2011. Site Management Plan: 224 Neilson Street (West), Te Papapa, Auckland: s.n.
52	Auto Dismantler - Parts Connection Ltd	Sector 6	High	G4	Metals, petroleum hydrocarbons	Human health	Auto Dismantler - Parts Connection Ltd						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
53	Auto Dismantler - Parts Connection Ltd	Sector 6	High	G4	Metals, petroleum hydrocarbons	Human health	Auto Dismantler - Parts Connection Ltd	✓ Local road connections only				Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-75-77 Captain Springs Road:** The 1997 Geotechnical and Environmental Assessment outlines issues with landfill gas potentially penetrating the thin clay cap beneath the site, and also mentions landfill leachate as being a consideration on site. The 1996 Environmental Investigation contained analytical results that showed organic and inorganic contaminants were encountered above acceptable levels within both soil and groundwater beneath the site.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Babbage Consultants Ltd, 1997. 79 Captain Springs Road Geotechnical and Environmental Assessment, Auckland: s.n. -Worley Consultants Limited, 1996. Environmental Investigation, Pikes Pt. Yard, Captain Springs Rd., Te Papapa, Auckland: s.n.
54	Composting windrows Living Earth	Sector 2 and Sector 6	Low	G5	Metals, nutrients	Ecological	Warehousing, transport and logistics services - Seamount	✓				Will potentially undergo soil disturbance from the EWL project. Uncontrolled landfilling was conducted on this site. Property files contained the following relevant information: **-69 Captain Springs Road:** The 2007 Ground Contamination Assessment mentions analytical testing of the soil which showed heavy metal concentrations above background levels, but below commercial industrial human health guidelines. Landfill gas was also identified and gas protection systems were required for buildings constructed on the site. The 2007 Stage II & III report outlines lead and benzo(a)pyrene contamination above commercial industrial limits in the fill layers above the landfill refuse. Landfill gas is also mentioned as a risk that needs to be managed carefully. The 2008 Stockpile Investigation Report outlined the contamination issues associated with approximately 50,000 cubic metres of soil which was stockpiled on the site. All of the material was found to be in excess of Auckland City Council Tier 1 human health criteria for industrial use. Contaminants encountered included heavy metals, PAHs, TPHs, and asbestos. The 2008 Landfill Gas AEE describes the risk from landfill gas beneath the site and the appropriate mitigation measures that need to be put in place during development of the site.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Tonkin & Taylor Limited, 2007. Waterford Park, 69 Captain Springs Road, Te Papapa Ground Contamination Assessment, Auckland: s.n. -Tonkin & Taylor Limited, 2007. Stage II & III Proposed Extension of Existing Bulk Storage, Auckland: s.n. -Tonkin & Taylor Limited, 2008. Stockpile Investigation Report 5-9 Miami Parade, Onehunga, Auckland: s.n. -Tonkin & Taylor Limited, 2008. Assessment of Environmental Effects: Landfill gas 6-9 Miami Parade, Auckland: s.n.

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55	Demolition Yard - Ward Demolition	Sector 2 and Sector 6	High	G4, G6	Metals, petroleum hydrocarbons, asbestos	Human health, Ecological	Demolition Yard - Ward Demolition	✓				Will potentially undergo soil disturbance from the EWL project. Uncontrolled landfilling was conducted on this site. Property files contained the following relevant information: **-19 - 21 Miami Parade:** Elevated concentrations of metals and VOC's present in soils. Do not exceed guideline values (ANZECC B) but are above background concentrations and show contamination is present. Elevated PAH concentrations in soil exceed guideline values and present potential health risk to humans. PAH's likely derive from bitumen related activity or leaks from storage tanks. 1989 Soils report outlines 1.3 m of uncontrolled fill beneath Zinc Oxide Limited, Miami Parade, and suggests that further investigation is undertaken prior to any major development work involving foundations.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Tonkin & Taylor Limited, 1999. Chemwaste Industries Environmental Site Assessment, Auckland: s.n. -Harrison Grierson Consultants Limited, 1989. Zinc Oxide Ltd, Miami Parade, Te Papapa: Soils Report, Auckland: s.n. -
56	Chemical Waste Facility - ChemWaste	Sector 2 and Sector 6	High	A2, A17, G6	Metals, petroleum hydrocarbons, SVOC, VOCs, chlorinated solvents	Human health, Ecological	Chemical Waste Facility - ChemWaste	✓	Discharge To Air and Industrial or Trade Process	N	37017 and 31169	Will potentially undergo soil disturbance from the EWL project. Uncontrolled landfilling was conducted on this site. Property files contained the following relevant information: **-21B Miami Parade:** Elevated concentrations of metals and VOC's present in soils. Do not exceed guideline values (ANZECC B) but are above background concentrations and show contamination is present. Elevated PAH concentrations in soil exceed guideline values and present potential health risk to humans. PAH's likely derive from bitumen related activity or leaks from storage tanks. **-39 Miami Parade:** Groundwater monitoring showed that solvents and petoleum hydrocarbons are below detection level and metals are within background concentrations expected in the aquifer. Trace amounts of asbestos was detected in the soil. Soils contain low levels of TPH, PAH and metals which do not present a risk to human health; however, concentrations generally exceed the PARP:ALW and do not meet the criteria for cleanfill. Consents to authorise the discharge of contaminants into air from the storage, transfer and treatment of hazardous and non-hazardous wastes including waste chemicals and oils and associated processes at Miami Parade, Onehunga, in accordance with Section 15(1) and To discharge contaminants for an industrial trade or process, being a chemical treatment facility. (comment: Through application of source controls the applicant seeks to prevent any discharge of contaminants resulting from the activities occurring on site. However, it is inevitable that minor discharges will occur and this proposal seeks to minimise such disch [sic])	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Tonkin & Taylor Limited, 1999. Chemwaste Industries Environmental Site Assessment, Auckland: s.n. -Tonkin & Taylor Limited, 2011. Assessment of environmental effects for Chemwaste treatment plant at Miami Parade, Onehunga, Auckland, Auckland: s.n. -Tonkin & Taylor Limited, 2009. Additional contamination related investigations for 23A and part of 39 Miami Parade, Onehunga, Auckland: s.n. contaminated sites register
57	Recycling yard - Green vision recycling	Sector 2 and Sector 6	Moderate	G6	Metals, asbestos	Human health, Ecological	Recycling yard - Green vision recycling	✓ Local road connections only	Discharge To Air and Industrial or Trade Process		39312 and 38931	Will potentially undergo soil disturbance from the EWL project. Contaminated Sites Search Details: -Multiple borehole consents. - Consent to discharge contaminants to air from the operation of a material recycling facility. -Consent to enable the establishment of a construction material recycling facility at 39-59 Miami Parade, Onehunga. The creation of this plant would involve earthworks over an area of approximately 3.19ha Property files contain the following relevant information: **-35 Miami Parade:** 1998 Leachate Pollution report outlines the leachate control systems that were put in place around the Pikes Point East landfill. It also mentions these sytems being discontinued prior to 1988 due to what was considered "negligible" leachate production. 1989 Soils report outlines 1.3 m of uncontrolled fill beneath Zinc Oxide Limited, Miami Parade, and suggests that further investigation is undertaken prior to any major development work involving foundations. 1988 report on the effects of urbanising the landfill reclamation sites outlines issues with stormwater and leachate drainage, water table control, construction issues, and landfill gas. **-37 Miami Parade:** 1980 site report for the installation of a 10,000 L UST at 35A Miami Parade outlines the issues with a high groundwater table causing potential bouyancy issues with the UST. **-39 Miami Parade:** Groundwater monitoring showed that solvents and petoleum hydrocarbons are below detection level and metals are within background concentrations expected in the aquifer. Trace amounts of asbestos was detected in the soil. Soils contain low levels of TPH, PAH and metals which do not present a risk to human health; however, concentrations generally exceed the PARP:ALW and do not meet the criteria for cleanfill.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Beca Carter Hollings & Ferner Limited, 1988. Engineering report on Pikes Point East reclamation area for use as industrial subdivision with particular reference to the prevention of leachate pollution of Manukau Harbour, Auckland: s.n. -Harrison Grierson Consultants Limited, 1989. Zinc Oxide Ltd, Miami Parade, Te Papapa: Soils Report, Auckland: s.n. -Beca Carter Hollings & Ferner Limited, 1988. Pikes Point East and West reclamations and 75 acre reclamation report on the effects of urbanising the landfill reclamation sites, Auckland: s.n. -Brown & Thomson Consenting Civil & Structural Engineers, 1980. Site report for proposed installation of 10,000 L underground fuel storage tank pit for Zinc Oxide Ltd at 35A Miami Parade, Te Papapa, Auckland: s.n. -Tonkin & Taylor Limited, 2011. Assessment of environmental effects for Chemwaste treatment plant at Miami Parade, Onehunga, Auckland, Auckland: s.n. -Tonkin & Taylor Limited, 2009. Additional contamination related investigations for 23A and part of 39 Miami Parade, Onehunga, Auckland: s.n. Contaminated sites register
58	Scrap metal yard - Warren Metals	Sector 6	High	G4	Petroleum hydrocarbons, PAHs, metals, PCBs, SVOC	Human health, Ecological	Metal Scrap/Automotive Dismantlers - Warren Metals	✓ Local road connections only	Industrial or Trade Process		Consent number 37405	Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-59 Miami Parade:** The 2011 Preliminary Site Investigation report outlines soil analysis results from test pits across the site which show heavy metal concentrations are below the commercial/industrial land use criteria, but above background levels. No VOCs were detected however PAHs were detected at levels below the PAUP:ALW Schedule 10 criteria for a permitted activity. Plasticisers, dyes, and insecticides were also detected in soil at one test pit. Low levels (<0.001% dry weight) of asbestos was discovered in all soil samples analysed. Significant landfill gas was detected throughout the site. The 2006 Ecological Assessment of Pikes Point waterfront concluded that the bird life would be relatively unaffected by the development onshore and that due to existing contamination local ecology would not suffer effects more than minor. It also noted low levels of heavy metals, TPH, and PAHs in the muddy surface sediments of the intertidal zone. The 2012 Site Validation Report provides evidence of environmental testing being conducted upon the import capping material that was used as the base layer on 39 and 59 Miami Parade. Testing showed acceptable levels of contaminants. Consent to authorise the discharge of contaminants onto or into land from a scrap metal and automotive recycling facility for various sites	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Babbage Consultants Ltd, 2006. Pikes Point East Stage 2: Ecological Assessment of the Proposed Stormwater Discharge, Auckland: s.n. -Beca Ltd, 2012. Updated Site Validation Report - Pikes Point Stage 2, Auckland: s.n. -Geosciences Limited, 2011. Preliminary Site Investigation: 39 and 59 Miami Parade, Onehunga, Auckland: s.n. Contaminated sites register
59	Chemical Storage/Manufacture - Mobil Oil	Sector 6	Moderate	A2	Petroleum hydrocarbons, PAHs, metals	Human health, Ecological						Contaminated Sites Search Details: -Environmental bore for Mobil Oil NZ. Property files contain the following relevant information: **-14 Miami Parade:** 1973 letter from Onehunga Borough Council consented the establishment of a tallow melting factory at 14 Miami Parade. 1982 consent to establish a fertiliser manufacturing plant on 14A Miami Parade. **-16 Miami Parade:** 1986 building permit application for underground storage tanks for vinyl acetate monomers and solvents. **-18 Miami Parade:** 1998 environmental complaint made regarding strong organic solvent smell coming up through drains.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property Files: -Onehunga Borough Council, 1973. Proposed establishment of an offensive trade: Tallow melting, Auckland: s.n. -Department of Labour, 1982. Factory Registration: Plant Plasma Industries Ltd, Auckland: s.n. -Onehunga Borough Council, 1986. Application for building permit: 16 Miami Parade Protective Paints, Auckland: s.n. -Auckland City Environments, 1998. Auckland City Environments Environmental Effects Complaint Form, Auckland: s.n.
60	Auto Dismantler	Sector 6	Moderate	G4	Metals, petroleum hydrocarbons	Human health	Auto Dismantler						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
61	Electroplating - ACME Plating Ltd	Sector 6	High	D3	Metals, acids	Human health, Ecological	Electroplater						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
62	Auto Dismantler - Chiland Development Ltd	Sector 6	Moderate	G4	Metals, petroleum hydrocarbons	Human health	Auto Dismantler						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
63	Electroplating - Marlin Electroplating Ltd (Since 1988?)	Sector 6	High	D3	Metals, acids	Human health, Ecological	Electroplater					Property files contain the following relevant information: **-54 Angle Street:** 1995 ARC Environment site visit identified potential source of contamination - no bund around plating area and potential for spills to run into storm water.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Auckland Regional Council, 1995. ARC Environment Site Visit: 54 Angle Street, Auckland: s.n.
64	Auto Dismantler - Bamian Auto Parts Ltd	Sector 6	Moderate	G4	Metals, petroleum hydrocarbons	Human health	Auto Dismantler		Industrial or Trade Process		Consent number 37115	Consent to authorise the discharge of contaminants onto or into land or water from an industrial or trade process namely automotive dismantling.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).

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65	Scrap metal yard - Hayes Metals	Sector 6	High	G4	Petroleum hydrocarbons, PAHs, metals, PCBs, SVOC	Human health, Ecological	Scrap Metal Yard		Discharge To Air	N	Consent number 34683	Consent to discharge contaminants into air from the melting and refining of metal products.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Contaminated sites register.
66	Scrap metal yard - Warren Scrap Metals	Sector 6	High	G4	Petroleum hydrocarbons, PAHs, metals, PCBs, SVOC	Human health, Ecological	Scrap Metal Yard		Contaminated Site Discharge - Potential contamination of site	N	Activity ID 20205		Contaminated sites register. 1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
67	Uncontrolled Fill	Sector 3	Moderate	G5	Petroleum hydrocarbons, PAHs, metals,	Human health, Ecological		✓				Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-791 - 793 Great South Road:** Granted land-use consent to use 100,000m^3 of cleanfill at the site (2000) to prepare for commercial/industrial use. Burst water main pipe in 2007. Subdivision of ~6.6 ha of land on area known as Ann's Creek.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property Files: -Metro Planning Limited, 2000. Application for Land Use Consent for Clean fill, Auckland: s.n. -Toan, D. V., 1989. Geotechnical report on the proposed stormwater pipe alignment at Westfield freezing works, Auckland: s.n. -Kingett Mitchell & Associates Limited, 1994. Ecological Status of a Wetland at Anne's Creek, Auckland: s.n.
68	Transport Depot - TR Group	Sector 3	Moderate	F8, D1, G5	Lead, copper, zinc, petroleum hydrocarbons	Human health, Ecological	Truck rental	✓	Discharge of contaminants to ground		36531	Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-781 Great South Road:** 2008 Archaeological Assessment for the filling of Ann's Creek area identified no significant archaeological areas were being affected by the proposed work. 2006 Ann's Creek shrub land management plan to protect and rehabilitate indigenous lava-shrub land. 2004 PSI shows extensive heavy metal contamination associated with filling occurring on the site rather than any activities occurring on the site. 2006 DSI provided more analytical testing and confirmed heavy metal contamination in soils and groundwater. PCB, TPH, OCP not detected in groundwater. Copper, lead, nickel, and zinc primary contaminants. 2008 AEE. 2007 map of ecological area. Multiple geotechnical assessments conducted on the site and historical maps/photos of the site. Cu, Ni, Pb and Zn exceed guideline values. Elevated heavy metal concentrations not just present in surface samples - also contamination in 0.5 m samples. Note that Cu and Pb exceed guideline values by up to 5 times. Contamination is thought to have come from external areas and is not related to activity on the site. Consent to permit the long-term discharge of contaminants to land or water pursuant to sections 14 and 15 of the Resource Management Act 1991.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Clough & Associates Limited, 2008. Proposed Plan Change for 791-793 Great South Road Archaeological Assessment, Auckland: s.n. -GHD Limited, 2004. TR Group 791-793 Great South Road Preliminary Site Investigation, Auckland: s.n. -GHD Limited, 2006. TR Group 791-793 Great South Road Detailed Site Investigation, Auckland: s.n. -hay Resource Management Practice, 2008. Proposal for Site Development and Rehabilition - Resource Consent Applications and Assessment of Effects on the Environment, Auckland: s.n. Contaminated sites register
69	Packaging manufacture - Stratex	Sector 3 and Sector 4	Low	A2, A17	Metals, SVOCs	Human Health	Packaging	✓				Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-13 - 21 Sylvia Park Road:** Storm water interceptor changed from API to SPEL (2013 AEE). Contamination risk presents less than minor risk to human health. Underground storage tank removed and replaced with 3 tanks.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Harrison Grierson Consultants Limited, 2010. Proposed vehicle crossing at 19-21 Sylvia Park Road, Mount Wellington: Land use resource consent application and assessment of effects on the environment, Auckland: s.n. -Burton Planning Consultants Limited, 2013. Assessment of Environmental Effects: Z Sylvia Park truck stop, 13 Sylvia Park Road., Auckland: s.n. -Pattle Delamore Partners Limited, 2001. Shell - Sylvia Park Road Truckstop Upgrade Assessment of Environmental Effects, Auckland: s.n. -Environmental Engineering Limited, 2011. Environmental Management Plan for site works at petroleum handling facilities, Wellington: s.n.
70	Truck Stop - Z Energy	Sector 4	Low	F7, A13	Petroleum hydrocarbons, PAHs, lead	Human Health	Service Station	✓	Industrial or Trade Process		41621	Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-13 - 21 Sylvia Park Road:** Storm water interceptor changed from API to SPEL (2013 AEE). Contamination risk presents less than minor risk to human health. Underground storage tank removed and replaced with 3 tanks. Consent to discharge contaminants from a 2315m automated self service truck refuelling facility.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Harrison Grierson Consultants Limited, 2010. Proposed vehicle crossing at 19-21 Sylvia Park Road, Mount Wellington: Land use resource consent application and assessment of effects on the environment, Auckland: s.n. -Burton Planning Consultants Limited, 2013. Assessment of Environmental Effects: Z Sylvia Park truck stop, 13 Sylvia Park Road., Auckland: s.n. -Pattle Delamore Partners Limited, 2001. Shell - Sylvia Park Road Truckstop Upgrade Assessment of Environmental Effects, Auckland: s.n. -Environmental Engineering Limited, 2011. Environmental Management Plan for site works at petroleum handling facilities, Wellington: s.n. Contaminated sites register
71	Vector Gas	Sector 4		A17, A13				✓				Will potentially undergo soil disturbance from the EWL project.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
72	Rail Yard	Sector 3 and Sector 6	Moderate	F6	Petroleum hydrocarbons, PAHs, metals, creosote	Human health, Ecological	Rail Yard	✓				Will potentially undergo soil disturbance from the EWL project. Uncontrolled landfilling was conducted on this site.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
73	Southdown Reserve	Sector 3	High	E1, G5	Asbestos	Human Health	Reserve	✓ Local road connections only				Will potentially undergo soil disturbance from the EWL project. Uncontrolled landfilling was conducted on this site. Extreme asbestos hazard identified during investigations. Property files contain the following relevant information: **-127-139 Hugo Johnston Drive:** 1999 resource consent application to conduct emergency remediation of exposed asbestos on the Southdown Reserve site.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Woodward-Clyde Limited, 1999. Application for land use consent - Auckland City Parks and Streetscape Services Division - Remediation of a Contaminated Site - Southdown Reserve, Auckland: s.n.
74	BP Truck Stop		High	F7, A13	Petroleum hydrocarbons, PAHs, lead	Human Health	Service Station						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
75	Paint and coatings manufacture - PPG Industries	Sector 4 and Sector 5	Moderate	A9, A17	Metals, petroleum hydrocarbons	Human Health		✓				Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-5 Monahan Road:** 2000 Remediation and Validation report outlining hydrocarbon contamination from tank farms. 2010 AEE outlines BTEX and methanol contamination due to UST tank farm. Environmental Log - basalt encountered at about 1.5 - 3.0 m with soil overlay. Hydrocarbon analysis lab results. Elevated levels of toluene, ethylbenzene and xylene in BH1 (27,000; 14,000 and 27,000 mg/L respectively). Contamination occurred in the lower 0.5-1.0 m; above the surface of the basalt. Underground storage tanks and contaminated soil removed. Residual contamination does not pose hazard for continued work on the site assuming industrial land use. Significant groundwater contamination from monoaromatic hydrocarbons due to leak in UST.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Property files: -Tonkin & Taylor Limited, 2000. Coatings Manufacturing Plant, 5 Monahan Drive, Mt Wellington Remediation and Validation, Auckland: s.n. -AECOM New Zealand Limited, 2010. PPG Industries Limited: Application to establish a new dangerous goods bund, Auckland: s.n. -Tonkin & Taylor Limited, 1998. Ground Contamination Investigation Report: Stage One, Auckland: s.n.

Site ID #	Name	Project Sector	Contamination Hazard Rating	HAIL Activity	Contaminants of Concern	Potential receptors	Current Land Use	Potential Soil Disturbance from EWL	Relevant consents or activity info from contaminated sites register search	consent may be affected?	Consent Number	Comments	Information Source(s)
76	Rail Yard	Sector 3	Moderate	F6	Petroleum hydrocarbons, PAHs, metals, creosote	Human health, Ecological	Rail Yard						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1958, 1961, 1962, 1965 oblique historic aerial photos (National Library of New Zealand).
77	Automotive Dismantler - Pre 1980s	Sector 6	Moderate	G4	Metals, petroleum hydrocarbons	Human health	Auto Dismantler		Industrial trade or process and Contaminated Site Discharge	Y	32270 and 32403	consents to To authorise the discharge of contaminants onto or into land from an industrial or trade process in accordance with Section 15 of the Resource Management Act 1991. and To passively discharge contaminants into land and groundwater from contaminants remaining in soil at the site	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). Contaminated sites register
78	Manukau Timber Company Ltd		Moderate	A18	Arsenic, copper, chromium, boron, PCP, dioxins, furans	Human health, Ecological	Commercial						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1985 oblique historic aerial photo (National Library of New Zealand).
79	Davis Gelatine Plant	Sector 6	Low	A2, A17	Caustics, acids, metals	Ecological							1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1949, 1977 oblique historic aerial photos (National Library of New Zealand).
80	Fletcher Galvanising		Moderate	D3	Metals, acids, PAHs	Human health, Ecological							1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
81	NZ Co-op Wool Marketing Association Limited		Low	A16	Phenols, metals, asbestos	Human health, Ecological							1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1946 oblique historic aerial photo (National Library of New Zealand).
82	Goodes & Son Tannery	Sector 6	Moderate	G5, A16, A17	Metals, sulphides, formaldehyde, acids	Human health, Ecological	Cleaning products and food processors and packers	✓ Local road connections only				Will potentially undergo soil disturbance from the EWL project. Property files contain the following relevant information: **-54 Angle Street:** 1995 ARC Environment site visit identified potential source of contamination - no bund around plating area and potential for spills to run into storm water. **-63 Angle Street:** A 1986 Liquid Recycling & Flitration Ltd report contains the application and approval to operate oil storage compound tanks (5 x 55,000 L). A 1985 New Zealand Fire Service report outlines recommendations for using flouroprotein foam for fire fighting. While fluoroprotein foam is not included in the synthetic AFFF products which are highly toxic, it is toxic and it's use is often associated with the use of other foams that contain PFOA/PFOS. The 2004 Auckland Regional Council Site Audit mentions multiple sources of contamination on the site including a fluid draining area, a car part removal area, the storage of car parts, and scrap metal bins. **-3 Edinburgh Street:** 2014 Asbestos Management Plan outlines the removal of approximately 200 m2 of asbestos vinyl tiles to allow for the safe demolition of a building on the site. A 2001 pollution incident report outlines a spill of approximately 600-800 litres of dobanic acid, some of which entered the stormwater system, and subsequently Manukau Harbour.	1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales). 1949 oblique historic aerial photo (National Library of New Zealand). Property files: -Auckland Regional Council, 1995. ARC Environment Site Visit: 54 Angle Street, Auckland: s.n. -Liquid Recycling & Filtration Limited, 1986. Planning approval to construct and operate an oil storage compound, Auckland: s.n. -New Zealand Fire Service, 1985. Recommendations for bulk flammable liquid and chemical firefighting protection, Auckland: s.n. -Auckland Regional Council, 2004. Auckland Regional Council Site Audit of 10 December 2003, Auckland: s.n. -ATL Specialist Asbestos Management Ltd, 2014. Asbestos management removal plan: 3 Edinburgh Street, Te Papapa, Auckland: s.n. -Auckland Regional Council, 2001. Pollution Incident 01/705 - Auckland Regional Council Site Visit, Auckland: s.n.
83	EcolWool		Low	A16	Phenols, metals, asbestos	Human health, Ecological	Warehousing						1940, 1959, 1972, 1980, 1988, 1996, 2006, 2008, 2010, 2016 vertical historical aerial photos (Opus Photo sales).
84	Trotting Track	Sector 5	Low	I	Asbestos	Human Health	Park	✓					Site Drive by 2010 historical aerial photo 1959 historical aerial photo
85	Glass Houses	Sector 5	Moderate	A10	Metals, OCPs, Acid Herbicides	Human Health	Motorway on ramp	✓					Site Drive by 2010 historical aerial photo 1959 historical aerial photo
86	Glass Houses	Sector 5	Moderate	A10	Metals, OCPs, Acid Herbicides	Human Health	Residential Motorway storm water retention pond	✓					Site Drive by 2010 historical aerial photo 1959 historical aerial photo 1963 historical photo from Princes Street over bridge
87	Piggery	Sector 5	Low	A1	Metals, asbestos	Human Health	Residential Motorway on ramp	✓					Site Drive by 2010 historical aerial photo 1959 historical aerial photo 1963 historical photo from Princes Street over bridge
88	Glass Houses	Sector 5	Moderate	A10	Metals, OCPs, Acid Herbicides	Human Health	Residential	✓					
89	Owens Transport	Sector 3	Moderate	F8	Petroleum hydrocarbons, PAHs	Human Health	Transport depot		Contaminated Site Discharge - Tank removal	N	Activity ID 21196	Contaminated Sites Search Details: -Two 10,000 litre diesel USTs were removed from site in March 2010. One soil sample exceeded the c10-c14 guideline, however when sampled for PAH's, the sample met the PAH soil acceptance criteria.	Contaminated sites register
90	Vehicle sales and former truck repairers	Sector 4	Moderate	F4, F8	Petroleum hydrocarbons, Metals	Human Health		✓	Contaminated Site Discharge - Workshop with Fuel USTs removed and remediation undertaken	not existing consent?	Activity ID 20894	Contaminated Sites Search Details: -Workshop with Fuel USTs removed and remediation undertaken.	Contaminated sites register
91	Ludowici (NZ) Ltd	Sector 1	Low	A2	Petroleum hydrocarbons, Metals	Human Health	Synthetic rubber manufacture						
92	Airfield	Sector 2	Low	A3	Petroleum hydrocarbons, Metals	Human Health	Heliport, Greenvision Recycling,	✓					
93	Abrasive Blasting	Sector 6	Low	D1	Petroleum hydrocarbons, Metals	Human Health	Abrasive Blasting	✓					
94	Galvanising Services Limited	Sector 6	Moderate	D3	Metals, acids, PAHs	Human health, Ecological	Galvanising		Discharge To Air	N	35960	Contaminated Sites Search Details: -Consent to discharge pollutants to air from hot dip zinc galvanising processes.	Contaminated sites register

Appendix A2

HAIL / Site location Map

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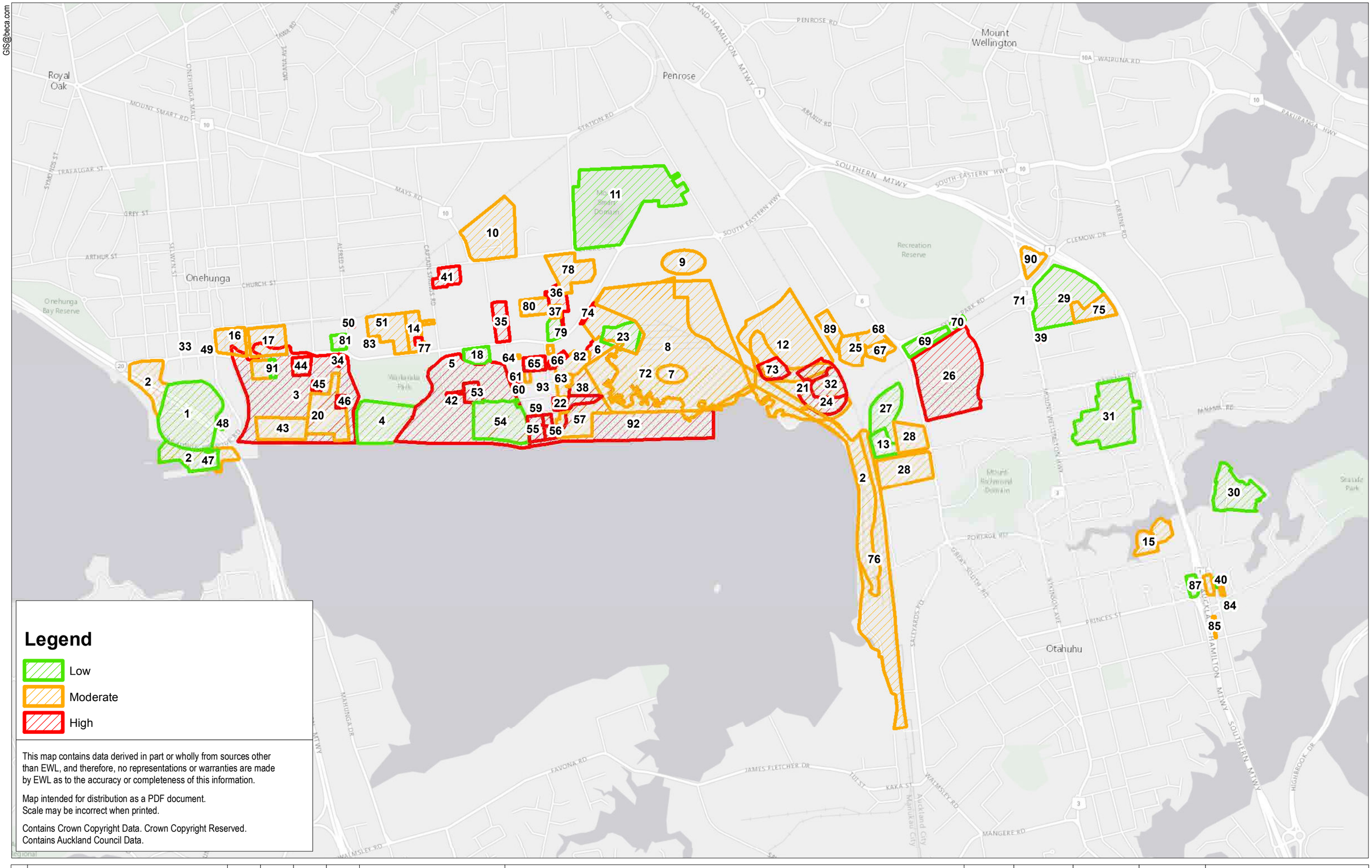

Legend

- Low
- Moderate
- High

This map contains data derived in part or wholly from sources other than EWL, and therefore, no representations or warranties are made by EWL as to the accuracy or completeness of this information.

Map intended for distribution as a PDF document.
Scale may be incorrect when printed.

No	Revision	Note: * indicates signatures on original issue of drawing or last revision of drawing	Drawn	Verified	Approved	Date
A	Original Issue		RJL	BAP	MJ	30/05/20

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NZ TRANSPORT AGENCY WAKA KOTAHI

East West Link

Drawn:	Draft Check:	Reviewed (Design Manager)	Approved (Alliance Manager)
Designed:	Design Check:		

Scale: 1:20,000 — Original Size: A3

Contract No PA4041

Discipline: Environment
Title: Contaminated Land Preliminary Site Investigation HAIL Map

Drawing No: GIS-CL-AEE-001 **Rev:** A

Plot Date: 25/10/2016 Plotted by: Rod Lockie File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\Environmental\WORKING\GIS-4216210-029_HAIL_Maps.mxd

Appendix B

Figures

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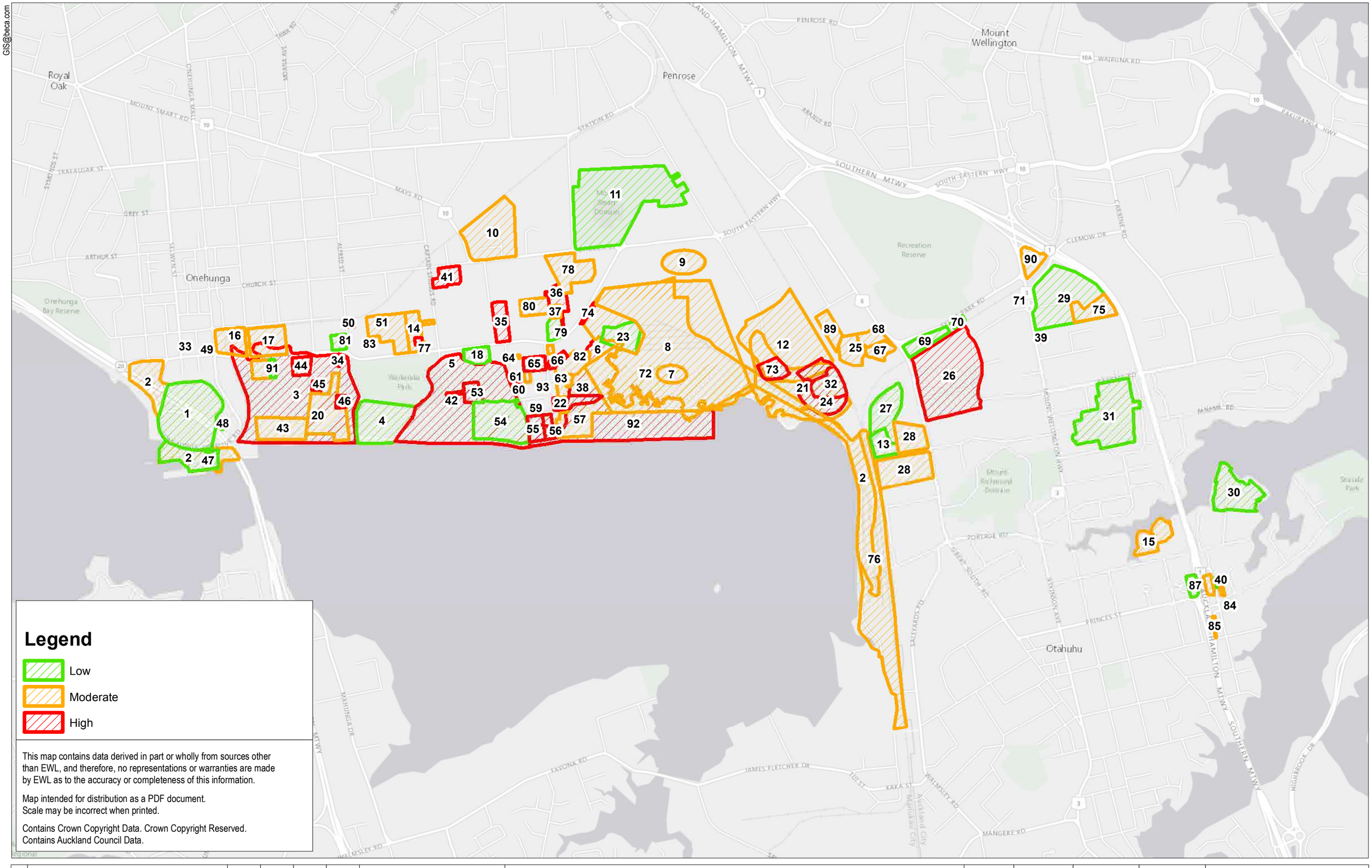

Legend

- Low
- Moderate
- High

This map contains data derived in part or wholly from sources other than EWL, and therefore, no representations or warranties are made by EWL as to the accuracy or completeness of this information.

Map intended for distribution as a PDF document.
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Designed:	Design Check:		

Scale: 1:20,000 — Original Size: A3

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Discipline: Environment
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Drawing No: GIS-CL-AEE-001 **Rev:** A

Plot Date: 25/10/2016 Plotted by: Rod Lockie File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\Environmental\WORKING\GIS-4216210-029_HAIL_Maps.mxd

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Legend

- Geotechnical Boreholes over water (BH) and In-situ Geonor Vane Test (GN)
- Geotechnical Boreholes (BH)
- Environmental Boreholes (BH)
- Groundwater Boreholes (BH)
- Test Pits (TP)
- Cone Penetration Test (CPT)
- EWL Alignment

No	Issued Status	Drawn	Check'd	App'd	Date
A	ISSUED FOR INFORMATION ONLY	Bap	SW	SW	25/10/16

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East West Link

Drawn	Drafting Check	Reviewed Design Manager	Approved Alliance Manager
Designed	Design Check		
Scale: 1:5,000	Original Size: A3	Contract No PA4041	

Drawing Title: GEOTECHNICAL
2016 Ground Investigations

Drawing Number: GIS-Q-AEE-001

Rev No. A

Plot Date: 25/10/2016 Plotted by: Ben Peyton

File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\Geotech (Q)\DRAFTS\GIS-Q-AEE-001_006_GeoTech_EWC_GroundInvestigations.mxd

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Legend

- Geotechnical Boreholes over water (BH) and In-situ Geonor Vane Test (GN)
- Geotechnical Boreholes (BH)
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- Groundwater Boreholes (BH)
- Test Pits (TP)
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No	Issued Status	Drawn	Check'd	App'd	Date
A	ISSUED FOR INFORMATION ONLY	Bap	SW	SW	25/10/16

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East West Link

Drawn	Drafting Check	Reviewed Design Manager	Approved Alliance Manager
Designed	Design Check		

Scale: 1:5,000 | Original Size: A3 | Contract No PA4041

Drawing Title: GEOTECHNICAL
2016 Ground Investigations

Drawing Number: GIS-Q-AEE-002 | Rev No. A

Plot Date: 25/10/2016 Plotted by: Ben Peyton

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No	Issued Status	Drawn	Check'd	App'd	Date
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East West Link

Drawn	Drafting Check	Reviewed Design Manager	Approved Alliance Manager
Designed	Design Check		
Scale: 1:5,000	Original Size: A3	Contract No PA4041	

Drawing Title: GEOTECHNICAL
2016 Ground Investigations

Drawing Number: GIS-Q-AEE-003

Rev No. A

Plot Date: 25/10/2016 Plotted by: Ben Peyton

File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\Geotech (Q)\DRAFTS\GIS-Q-AEE-001_006_GeoTech_EWC_GroundInvestigations.mxd

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BH2034
BH2012
BH2010
BH2011
BH2009
BH2013
BH2007
BH2033
BH2015
BH2014
BH2008
BH2006
BH2005
BH2016
TP2007
TP2002
TP2003
BH2004
BH2003
CPT2009
BH2040
TP2008
TP2010
BH2017
CPT2003
BH2018
CPT2004
TP2011

Legend

- Geotechnical Boreholes over water (BH) and In-situ Geonor Vane Test (GN)
- Geotechnical Boreholes (BH)
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- Groundwater Boreholes (BH)
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- Cone Penetration Test (CPT)
- EWL Alignment

No	Issued Status	Drawn	Check'd	App'd	Date
A	ISSUED FOR INFORMATION ONLY	Bap	SW	SW	25/10/16

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East West Link

Drawn	Drafting Check	Reviewed Design Manager	Approved Alliance Manager
Designed	Design Check		

Scale: 1:5,000 Original Size: A3 Contract No PA4041

Drawing Title: GEOTECHNICAL
2016 Ground Investigations

Drawing Number: GIS-Q-AEE-004 Rev No. A

Plot Date: 25/10/2016 Plotted by: Ben Peyton File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\Geotech (Q)\DRAFTS\GIS-Q-AEE-001_006_GeoTech_EWC_GroundInvestigations.mxd

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Legend

- Geotechnical Boreholes over water (BH) and In-situ Geonor Vane Test (GN)
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- Groundwater Boreholes (BH)
- Test Pits (TP)
- Cone Penetration Test (CPT)
- EWL Alignment

No	Issued Status	Drawn	Check'd	App'd	Date
A	ISSUED FOR INFORMATION ONLY	Bap	SW	SW	25/10/16

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East West Link

Drawn	Drafting Check	Reviewed Design Manager	Approved Alliance Manager
Designed	Design Check		
Scale: 1:5,000	Original Size: A3	Contract No PA4041	

Drawing Title: GEOTECHNICAL
2016 Ground Investigations

Drawing Number: GIS-Q-AEE-005

Rev No.: A

Plot Date: 25/10/2016 Plotted by: Ben Peyton

File: W:\CAD\ArcGIS\TGI\55_Workspaces\01_mxd\Geotech (Q)\DRAFTS\GIS-Q-AEE-001_006_GeoTech_EWC_GroundInvestigations.mxd

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Legend

- Geotechnical Boreholes over water (BH) and In-situ Geonor Vane Test (GN)
- Geotechnical Boreholes (BH)
- Environmental Boreholes (BH)
- Groundwater Boreholes (BH)
- Test Pits (TP)
- Cone Penetration Test (CPT)
- EWL Alignment

No	Issued Status	Drawn	Check'd	App'd	Date
A	ISSUED FOR INFORMATION ONLY	Bap	SW	SW	25/10/16

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East West Link

Drawn	Drafting Check	Reviewed Design Manager	Approved Alliance Manager
Designed	Design Check		
Scale: 1:5,000	Original Size: A3	Contract No PA4041	

Drawing Title: GEOTECHNICAL
2016 Ground Investigations

Drawing Number: GIS-Q-AEE-006

Rev No. A

Plot Date: 25/10/2016 Plotted by: Ben Peyton

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FIGURE 3 : CONCEPTUAL SITE MODEL
(SCHEMATIC, NOT TO SCALE)

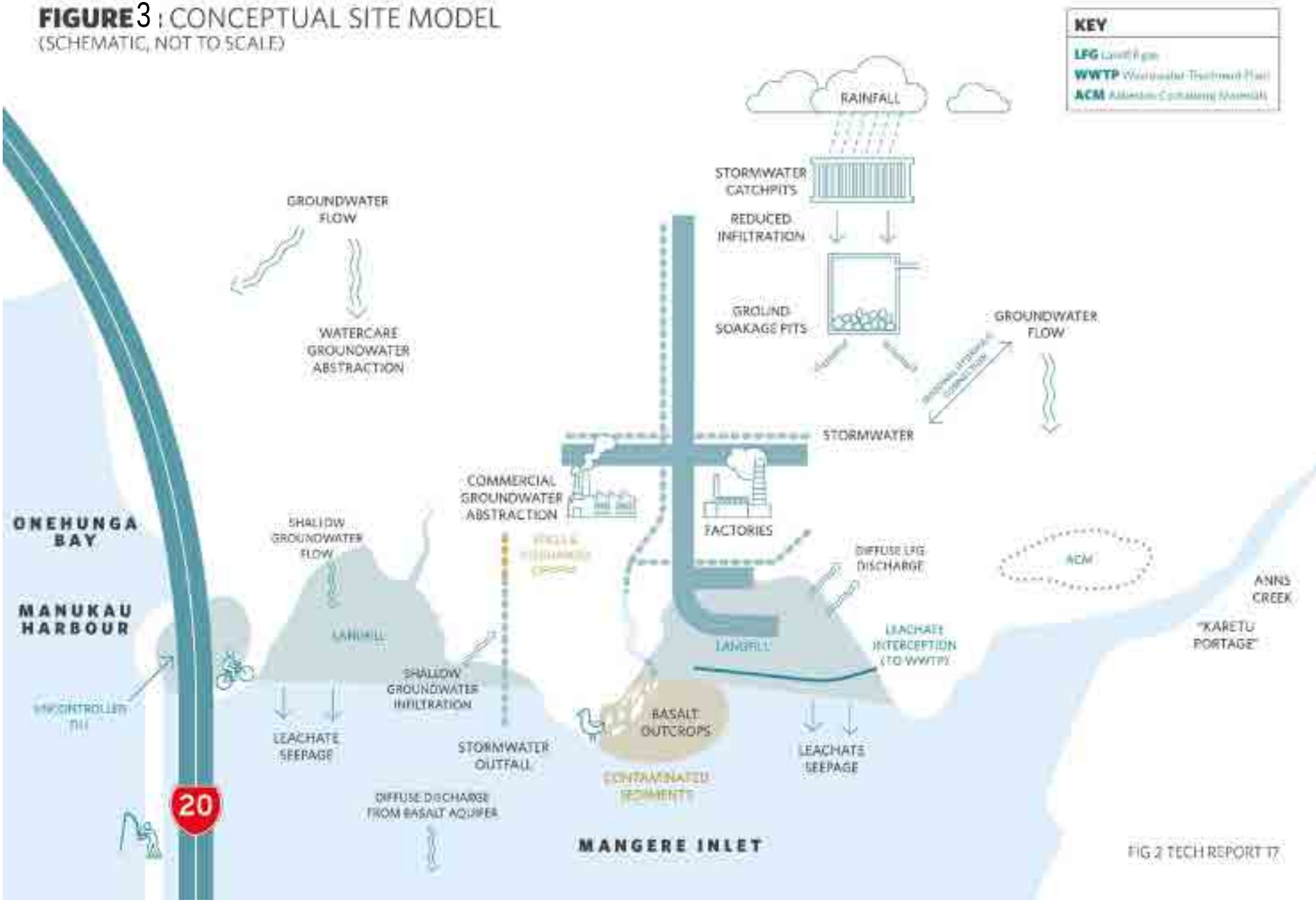


FIG 2 TECH REPORT 17

Figure 4 – Sensitive Areas

Appendix C

Field Observations

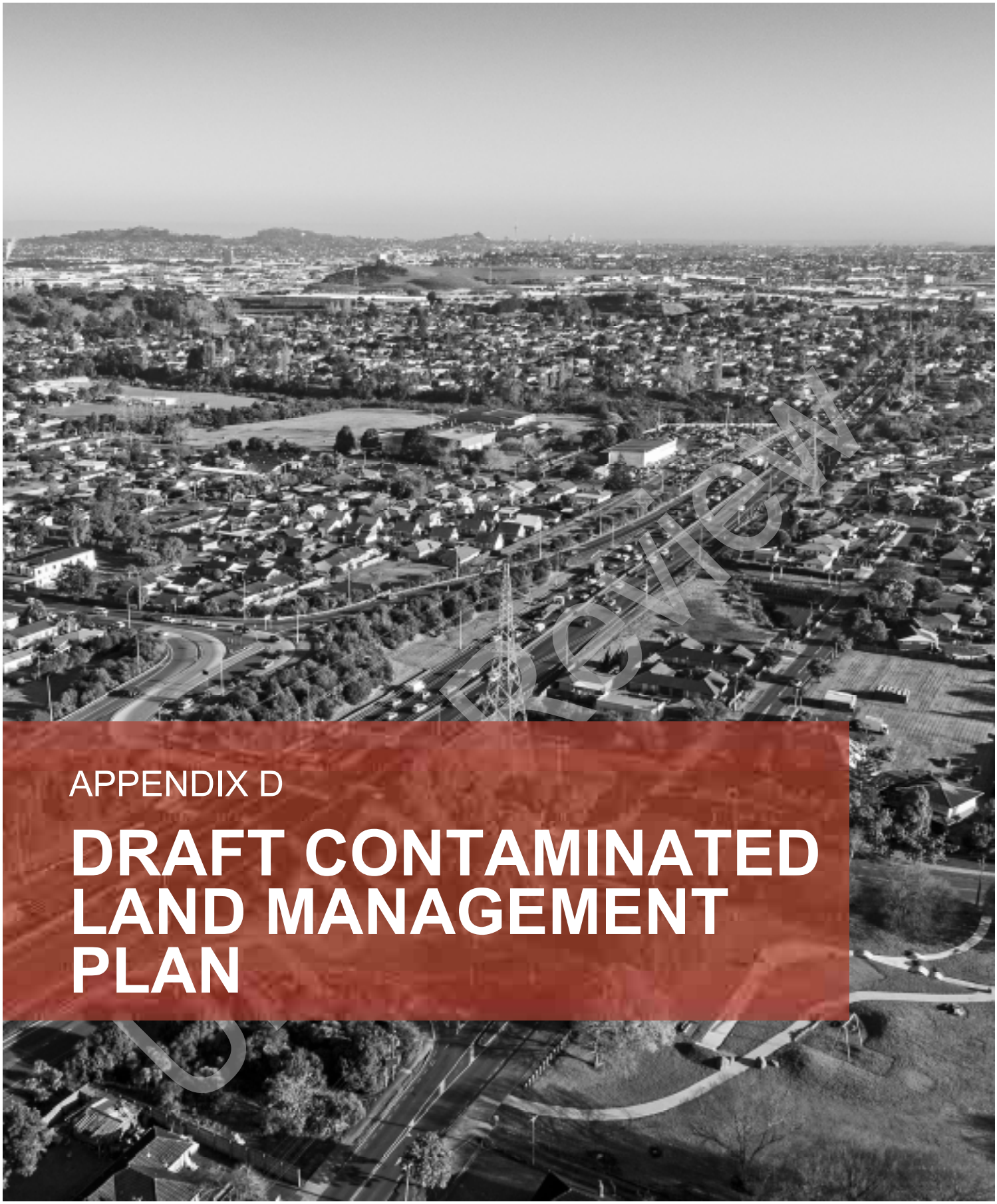
Summary of field observations

Observation	Bore ID	Depth (m bgl)	Comment
Asbestos fragments	BH2001	0.25	Southdown Reserve
	BH2002	1.5, 4.5 5.35 – asbestos boulder	141-199 Hugo Johnston Drive
	BH2039	4, 4.95	141-199 Hugo Johnston Drive
	TP2001	Surface – 1.5	141-199 Hugo Johnston Drive
	TP2001A	Surface – 1.7	141-199 Hugo Johnston Drive
	TP2015	0.2	Adjacent to 36 Mataroa Road
Refuse	BH2001		Southdown Reserve
	BH2005	0.8-1.2	Trace refuse and steel at 9-11 Sylvia Park Rd
	BH2010	0-0.5	Refuse in fill material, 430 Mt Wellington Highway
	BH2019	1-1.5	Rear of property at 59 Mataroa Rd bricks and glass
	BH2022	2.20	Rail corridor west of Hugo Johnston Drive trace refuse. glass and metal.
	BH2023	2-4	Pikes Point
	BH2027	2	Pikes Point Refuse: metal
	BH2031	Up to 8	Galway Street
	BH2032	Up to 7m	Pikes Point
	BH2036	2-7	Pikes Point
	BH2037	Surface to 2m	Pikes Point
	BH2038	0.6-4.2	Pikes Point
	BH2039	0.25-6	141-199 Hugo Johnston Drive - Adjacent to rail
	BH2040	Surface - 3	Former Market Gardens - 801-802 Great South Road
	BH4002	1.5-4.5	Galway St
	BH4003	1.8	Opposite 114 Princes St, Onehunga Trace refuse (brick)
	BH4009	Surface to 2.7	Pikes Point
	BH4012	Surface to 5.25	12 Southpark Place
	BH5001	0.5-5.3	Galway St
	BH5002	3 - 4.2	Voids 1.7-3 m Galway St
	BH5003	1.5 - 3.75	Galway St
	BH5004	Surface – 1.2	Pikes Point
	BH5005 pump	1.25-2 (void 2- 3m)	Pikes Point
	BH5007	1.25-3.8	Pikes Point
	BH5008	0.3-2.2	Pikes Point
	BH5008 pump	1.5 – 4.5	Pikes Point
	BH5008a	0.2-3.5	Pikes Point

Observation	Bore ID	Depth (m bgl)	Comment
	TP2001 and TP2001A	0-1.5	Refuse and asbestos sheeting 141-199 Hugo Johnston Drive
	TP2002	0-2.5	793 Great South Road wood, plastic, wire, fabric, metal
	TP2003	2	Trace refuse 781 Great South Road
	TP2010	0-1.3	Vacant lot on Panama road, alongside Southern Motorway plastic, iron, glass, wood
	TP2015	0-0.25	Adjacent to 36 Mataroa Road Refuse: glass, ceramics, plastic, possible asbestos
	TP2020	0-1.6	Pikes Point
	TP2022	0.5-3.5	Pikes Point Refuse; brown; saturated. Refuse: glass, plastic, wood, hydrocarbons including separate phase.
	TP2023	0-3.7	Pikes Point
	TP2024	1-5	Pikes Point
	TP2025	0.25-4	Pikes Point
	TP2026	1	Pikes Point
	TP2027	0.2-3	Pikes Point
Odours	BH2002	1.5 – 6.5	Hydrocarbon odour
	BH2004	4.5	Organic odour
	BH2022	3.2	Strong organic odour
	BH2037	3 – 4.8	Hydrocarbon odour
	BH2038	2 - 2.5	Minor decomposition odour (with refuse)
	BH4002	1.7	Hydrocarbon odour
	BH4009	2.95	Hydrocarbon odour
	BH5002	13	Odorous (peat)
	BH5003	3-3.2	Hydrocarbon odour
	BH5008	1.5 - 2.5, 4.3	Hydrocarbon odour
	BH5008a	2	Hydrocarbon odour
	BH5009	1.8	Hydrocarbon odour
	TP2020	2.2	Hydrocarbon odour
	TP2022	0.6 – 3.5	Extensive hydrocarbon odour
	TP2024	4.5	Slight hydrocarbon odour
	TP2027	0.5 – 1.2	Hydrocarbon odour

Appendix D

Contaminated Land Management Plan



APPENDIX D

DRAFT CONTAMINATED LAND MANAGEMENT PLAN

NZ TRANSPORT AGENCY

East West Link

Quality Assurance Statement	
Prepared by	Laura Bell
Reviewed by	Dr Murray Wallis
	Camilla Needham
Approved for release	Patrick Kelly (EWL Alliance Manager)

Revision schedule					
Rev. N°	Date	Description	Prepared by	Reviewed by	Approved by
0	November 2016	Final for Lodgement	Laura Bell	Murray Wallis Camilla Needham	Patrick Kelly

Disclaimer

This report has been prepared by East West Link Alliance on the specific instructions of our Client. It is solely for our Client's use for the purpose for which it is intended in accordance with the agreed scope of work. Any use or reliance by any person contrary to the above, to which East West Link Alliance has not given its prior written consent, is at that person's own risk.

Table of Contents

1 Introduction

1.1 Proposed work

The EWL Project involves the construction, operation and maintenance of a new four lane arterial road from State Highway 20 (SH20) at the Neilson Street Interchange in Onehunga, connecting to State Highway 1 (SH1) at Mt Wellington as well as an upgrade to SH1 between the Mt Wellington Interchange and the Princes Street Interchange at Ōtāhuhu. New local road connections are provided at Galway Street, Captain Springs Road, the port link road and Hugo Johnston Drive. Cycle and pedestrian facilities are provided along the alignment.

1.2 Purpose

This draft Contaminated Land Management Plan (CLMP) sets out the systems and procedures that will be implemented by the construction contractor to manage potential adverse environmental and human health effects associated with disturbing contaminated soil during construction. This CLMP provides a description of the measures (including safeguards and contingency plans where relevant) to be undertaken to help prevent or reduce the actual or potential effects of disturbing contaminated land. This plan also provides specific controls for sensitive areas that have been identified to exist within the project area.

This draft CLMP is a Management Plan that will form a suite of plans comprising the Construction Environmental Management Plan (CEMP) for construction of the East West Link project (EWL).

The purpose of the CLMP is to guide the construction works, by identifying suitable practices to minimise the potential for adverse effects on the environment and human health from disturbance of contaminated soil and groundwater within construction areas. Where possible this plan has been prepared to preserve flexibility for the contractor as construction methodologies may vary and there is a need to avoid being overly prescriptive.

It is anticipated that further site environmental investigations will be completed prior to this document being finalised for construction. The nature and extent of any further investigations will depend upon the construction methods chosen by the contractor, including their decisions as to the management and off-site disposal of contaminated soil. Further design will also be undertaken before this CLMP is finalised. Both the investigations and design will allow more specific management measures to be defined.

Updates to this CLMP and its implementation during construction must be supervised by a Suitably Qualified and Experienced Practitioner (SQEP), as defined by the Ministry for the Environment *Users Guide: National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health 2012*.

The requirements of this plan shall be complied with by all personnel on site and shall be implemented and maintained throughout the entire construction period. This CLMP may be reviewed and amended during the construction phase of the project to reflect changes to activities, risks, mitigation measures, responsibilities and management processes. This CLMP is intended as a live document that will be updated throughout construction in response to the actual site conditions experienced during the works, and also if necessary to respond to modifications in construction techniques or consent conditions.

For matters pertaining to the management and control of potential human health risks to construction personnel, the provisions of the Health and Safety at Work Act 2015 are also relevant, and the contractor in charge of the place of work will have the primary responsibility for the health and safety of their workforce.

1.3 Scope

The scope of this CLMP is to provide guidance on managing the construction phase environmental and human health risks associated with the contaminated land that will be affected by the proposed East West Link Project (hereafter the Project). As such, this CLMP addresses:

- Construction activities that will disturb the ground surface, including bulk earth works and trenching
- Sensitive areas as identified in the Contaminated Land Assessment report (i.e. the closed landfills and an asbestos site at Hugo Johnston Drive)
- Appropriate control measures to minimise potential environmental and human health risks from soil and groundwater contamination that may be disturbed by construction.

1.4 Objectives and targets

The management of contaminated land during construction will follow the objectives set out in the CEMP and be undertaken in accordance with legislative requirements set out in the CEMP and any relevant conditions of consent or designation granted for the Project.

1.5 General site setting and background

A preliminary site investigation (PSI) was undertaken for the Project and found that there are many historic and current activities and industries in the wider Project area that have caused or could have caused contamination of the land (including soil and groundwater). Closed municipal landfills and reclamations with uncontrolled fill are prevalent around the Māngere Inlet. Filling is also evident at Ōtāhuhu Creek. As such, construction of the EWL Project will encounter contaminated land.

Limited soil sampling was undertaken during the geotechnical investigations, however it is expected that further investigations will be conducted by the contractor to support detailed design. The final CLMP shall take account of the existing information and any additional investigation data.

This Draft CLMP is based on existing information from the PSI and the environmental investigations undertaken to support the notices of requirement and resource consent applications for the Project.

The investigations identified that there are a wide range of potential contaminant sources in the land that will be directly affected by the Project:

- Pesticide contaminants in surficial soil from historic horticultural land uses;
- Contaminants in soil and groundwater from current and historic industrial land uses including metals, nutrients, petroleum hydrocarbons, polynuclear aromatic hydrocarbons (PAHs), solvents;
- Landfills and uncontrolled fill – contaminants in soil including asbestos containing material (ACM), metals, hydrocarbons, solvents, pesticides;
- Landfills – contaminants in groundwater including metals, hydrocarbons, solvents, nutrients;
- Landfills – contaminants in soil gas including the landfill gas (LFG) methane, sulphides and odiferous products of anaerobic waste decomposition; and
- Stormwater –contaminants in runoff that may affect the land, including metals, PAHs and a wide range of contaminants from unauthorised spills of hazardous products that have been stored and used in the area.

1.5.1 Sensitive Receptors

The ecological receptors for the Project are addressed in the relevant assessment reports. Ecological receptors in the marine receiving environment are considered most relevant to the potential adverse effects that could be generated by disturbance of contaminated land. In particular, the Project is situated adjacent to or in the vicinity of the Māngere Inlet. The inlet is the environmental receptor for

contaminants that could potentially migrate from contaminated land in the Onehunga/ Te Papapa area via groundwater, stormwater and surface water runoff.

Human receptors are also relevant for the management of the Project. The construction workers are considered most prone to contaminant exposure during construction of the Project. The nature of the work will require earthworks in contaminated soil. The workers may be affected by both direct and indirect contact with contaminated soil and groundwater, due to their proximity to the source of contaminants in the land that will be disturbed by the Project. By contrast, the public will be excluded from the works area for health and safety reasons for the construction phase of the Project.

1.6 Summary of construction risks

This section provides a summary of the risks associated with the disturbance of contaminated land during construction, as identified in the Assessment of Environmental Effects (AEE).

The Project area crosses a number of existing contaminated sites. Construction activities associated with the Project will disturb these areas and therefore soil disturbance will require careful management to prevent unacceptable discharges of any contaminants to the environment and to protect the health and safety of the local community.

The actual and potential construction effects of the Project on contaminated land are:

1. Disturbance of contaminants and associated discharges of contaminants to air, land and water (surface and groundwater) where there may be an effect on the environment; and

2. Discharge of contaminants where there may be an effect on human health – including site workers and/or the public.

In particular, two sensitive areas have been identified. These areas are the known closed landfill areas and an asbestos site.

1.6.1 Known landfill areas

The Project works will disturb the southern extents of the following closed landfills:

- Galway Street Landfill,
- Pikes Point West Landfill (including Waikaraka Park landfill),
- Pikes Point East Landfill.

These landfills include Municipal Solid Waste[1] (MSW), demolition waste and soils last placed before 1993. The waste and cover soils vary in depth. The MSW extends up to 9 metres below ground level (bgl). Over the time that the landfills were filled and also since they were closed, the MSW in the landfills has been subject to decomposition. As such, the landfills have generated leachate and landfill gas (LFG). The landfills therefore pose a number of environmental and human health risks during the construction of the Project.

The landfills are unlined, constructed directly on marine muds/ basalt. Furthermore, in general the landfills have not been constructed with an engineered capping layer (i.e. a low permeability clay cover). A form of leachate interception system is functioning in Pikes Point East and West, however the system does not fully drain the landfills and the lower portion of the waste is saturated and odorous from the anaerobic and decomposing waste.

[1] Refer to the Contaminated Land Assessment for definition

The Project Works require the construction of a road corridor over the existing Pikes Point landfills. Because the road alignment overlies the existing leachate interception system, the interception system will need to be relocated and replaced. The necessary works therefore include installation of a drainage system to collect leachate, and requisite controls for landfill gas. Within the footprint of the new road corridor, landfill waste will be removed and over excavated to approximately 1 m depth followed by placement of a geo-grid reinforced raft, with installation of piles as required and based upon predicted settlement.

The Galway landfill does not have a leachate collection system, and the Project works are limited to a local road connection on the western margin of the landfill footprint. The main East West Link alignment is separate from the landfill footprint. As such, the effect of the Project works on the Galway landfill will be limited to over excavation and installation of a geo-grid raft (as for the main alignment at Pikes Point landfills) with further removal of landfill waste beneath the road pavement or piling to meet geotechnical requirements.

The Municipal Solid Waste excavated from the landfills will be disposed to a Class A licensed landfill facility, licenced to receive such materials and the MSW will be replaced with engineered fill. Some in situ landfill waste south of the replacement interception system at the Pikes Point landfills will not be disturbed and will remain under the road corridor of the main EWL alignment. Some in situ landfill waste at the Galway Street landfill will not be disturbed and will remain in place.

Management controls will be required to address the following:

- Construction management of earthworks associated with landfill waste
- Landfill waste management and disposal
- Landfill gas management and odour control
- Landfill gas - Permanent Construction Considerations
- Leachate management and disposal
- Landfill reinstatement
- Construction in confined spaces
- Human health (contact with chemical and biologically contaminated materials).

Specific controls for works in the closed landfill areas are provided in Section 4 of this CLMP. Refer to the content of Appendix E of the Contaminated Land Assessment for the Project.

1.6.2 Known asbestos areas

The Project requires construction in filled areas that contain asbestos containing materials (ACM), and in particular the site at 141-199 Hugo Johnston Drive which has been filled with ACM to a depth of several metres.

For the Project as a whole (the remainder of the construction area), ACM may also be encountered (such as the dispersed asbestos cement fragments in soil along the Waikaraka cycleway). In the general area of the Project, the Contaminated Land Management Plan shall be implemented, and the risks shall be assessed under the provisions of the accidental discovery protocol (Section 3.1). The excavation and handling of ACM shall be managed under the supervision of a Suitably Qualified and Experienced Practitioner.

Excavation at the 141-199 Hugo Johnston Drive site will be required to accommodate stormwater management infrastructure as well as construction of the Hugo Johnston Drive connection to East West Link.

Excavation through soil that contains ACM is proposed. Any spoil removed off site shall be disposed of to a landfill certified to accept ACM.

The management controls for ACM need to address the following:

- Construction management of earthworks
- Excavation
- Offsite transportation and disposal
- Onsite disposal
- Human health
- Post construction activities.

Specific controls for works in asbestos areas are provided in Section 5 of this CLMP. Refer to the content of Appendix F of the Contaminated Land Assessment for the Project.

2 Roles and Responsibilities

This section outlines the roles and responsibilities of all construction personnel in regard to the implementation of this CLMP. This includes the roles and responsibilities of the Construction Manager, Site Supervisor, Workers, Site Environmental, Health and Safety Officer, New Zealand Transport Agency and Auckland Council.

2.1 Construction personnel

The roles and responsibilities of construction personnel are summarised in Table 1.

Table 1: Roles and responsibilities

Role	Responsibilities – All areas
Construction Manager	• Ensure that a final CLMP is prepared by a SQEP, and that the works shall be undertaken with an appropriate level of supervision by a SQEP • Confirm that the relevant hazards and controls are implemented to reflect the work activities • Confirm all controls are in place for the proposed works before the works commence • Monitor the effectiveness of the CLMP through regular audits to ensure the works practices conform with the control measures (including audits by the SQEP) • Ensure that corrective action procedures are adopted to modify and update the CLMP as may be required • Ensure that the Project designation and consent conditions are complied with
Site Supervisor / Foreman	• Read, understand and implement these Controls in the field. • Ensure workers comply with the Controls. • Manage waste disposal record keeping requirements • Monitor for visual evidence of contamination and landfill gas (LFG). • Manage the implementation of the Control measures, including the induction process, training and safety precautions
Workers	• Attend requisite induction(s), training and/or toolbox talk to ensure an understanding of this CLMP • Wear appropriate personal protective equipment (PPE) • Maintain active observation for signs of contamination and report to the Site Supervisor/Foreman • Responsible person(s) to monitor for LFG, report and implement control measures and any additional health and safety precautions that may be necessary.
Site Environmental, Health and Safety Officer	• Shall be suitably trained and experienced to take responsibility for the works, including asbestos works and works within landfills • Liaise with regulatory authorities as required by legislation and the designation/resource consents. • Understand the requirements of these Controls • Monitor conformance with the CLMP • Record and manage any incidents • Report environmental incidents to Council within the relevant regulatory timeframes for any unauthorised discharge of contaminants • Undertake worker health surveillance monitoring as may be required • Record the results of the monitoring activities

2.2 The NZ Transport Agency and Auckland Council

This section will be prepared in accordance with the designation and consent conditions for the Project. This section shall outline the roles and responsibilities of NZ Transport Agency and Auckland Council personnel during implementation and monitoring of this CLMP.

3 Management Measures - works in all general locations

3.1 Contamination discovery

The Project traverses a large area of filled ground, and the presence of contaminants in the subsurface under such conditions is inherently variable. Groundwater may be impacted from the land directly affected by the Project, and contaminants may also have migrated into the land from neighbouring sites. Therefore, no matter how intensive the future environmental investigations for the Project may be, there will remain a risk of the discovery of contaminated soil and groundwater in the subsurface. All environmental investigations rely on inferred conditions from field observations. Investigation boreholes and groundwater wells intersect a limited volume of soil and groundwater. Test pits can yield useful information about the subsoil conditions because they allow direct observation of the exposed subsurface. Nevertheless, a degree of uncertainty always remains at any site for the untested zone between the tested locations.

This section provides an outline of the steps to be taken by the contractor if contaminated soil and/or groundwater are discovered during the construction phase. The actual contingency measures needed will be site and contamination specific, and depend on the extent and nature of the discovered contamination.

Contaminant indicators in soil may include:

- Visual (buried refuse, metal objects, building material, staining or discolouration)
- Olfactory (fuel or solvent odour, sulphurous, rotting vegetation or sewage)
- Auditory (gas leaks, flowing or dripping liquid)
- Fibrous cement based board materials may contain asbestos that is not visible to the naked eye

Contaminant indicators in groundwater may include:

- Visual (presence of discoloured groundwater, sheens or separate phase hydrocarbons)
- Olfactory (fuel or solvent odour, sulphurous, sewage)

If any such indicator is observed during earthworks, the following steps should be taken:

- If possible, immediately contain any contaminated material (e.g. provide bunding around the area or cover the soil)
- Advise the Site Environmental, Health and Safety Officer
- The Site Environmental, Health and Safety Officer shall assess the discovery location and consider whether the management procedures outlined within this CLMP adequately manage the hazard and the potential risks
- The Site Environmental, Health and Safety Officer shall consult with the Site Supervisor and the SQEP as may be necessary
- The Construction Manager shall be notified that contamination has been discovered
- If there is a risk of migration of contaminants from the exposed soil/groundwater in the discovery area, measures shall be adopted to isolate the contaminated material to avoid any uncontrolled migration until a permanent solution is adopted. For example, if contaminated soil has been excavated the soil should be contained in covered skips. Larger soil volumes should be covered and bunded.
- Dispose of any pooled rainwater to an appropriately licensed treatment facility and ensure it is not discharged to the sediment retention ponds.

- Where friable asbestos containing material is confirmed in the soil matrix, all works (including the excavation and disposal of affected materials) shall be undertaken in accordance with the Health and Safety at Work (Asbestos) Regulations 2016. If ACM is removed the removal of ACM shall be undertaken in accordance with an Asbestos Removal Control Plan and by a Licensed Asbestos Removalist.
- Maintain a register of any contaminated material discovered, including location, type, quantity and disposal (with landfill receipts and waste manifests).

3.2 Public Health

It is important that effective site controls are in place for the entire duration of the proposed excavation and construction works.

The following controls should be implemented:

- Secure fencing and signage
- Clear directions for pedestrians with barriers and signage for closed footpaths;
- Mitigation of dust generation through wetting down during site earthworks
- Monitoring in accordance with resource consent conditions

3.3 Stormwater and Sediment Management

Erosion and sediment control is covered in the Surface Water Assessment for the Project. Key principles for works in contaminated areas to limit the generation of any contaminated stormwater are:

1. The disturbed area of exposed contaminated soil shall be kept to a practicable minimum

2. Uncontaminated stormwater from outside the works area shall be diverted away from the work area (clean water diversions).

The CLMP will inform the erosion and sediment control plan (ESCP) for the Project, by identifying areas of contamination and the nature of the contaminants in soil and groundwater that will be disturbed by Project activities.

The standard erosion and sediment control (ESC) practices designed to manage sediment at a construction site will also provide effective control of some contaminants in soil for the Project, including heavy metals and PAHs, because these contaminants are sorbed (attached) strongly to the inorganic and organic fraction of soil, particularly fine textured soil (silts and clays). However, not all contaminants bind strongly to soil.

If hydrocarbons (including separate phase hydrocarbons, SPH) are encountered in excavations for the Project, those areas will require special management depending upon the nature of the works in that area. For example, if stormwater infrastructure needs to be constructed in an area with SPH, the new stormwater system will need to be properly isolated from the SPH, such as with the use of a low permeability bentonite or bentonite/cement barrier. Depending upon the extent of the SPH impact, localised remediation of the SPH impacted zone could be undertaken through excavation and dewatering activities. In an area with SPH, the ESC measures are not to be relied upon as the primary method of control to manage contaminant migration in runoff. However, additional safeguard measures can be adopted such as the use of sorbent booms and mats in the sediment retention ponds.

The standard ESC measures in uncontaminated soil would allow for sediments collected in the stormwater treatment devices (such as sediment retention ponds, SRPs and decanting earth bunds, DEBs) to be de-watered and distributed back into the earthworks site. However, in contaminated areas of the Project, sediment removed from the treatment devices may need to be disposed of to an appropriately licensed facility depending on the level of contamination.

3.4 Dewatering water disposal

Dewatering may be required during construction of the general area of the Project, such as for stormwater reticulation pipes. Other options for construction include installation of shoring and temporary sheetpiles that may reduce the amount of groundwater ingress into open excavations. As the detailed design has not yet been completed, the amount of dewatering required is not yet known.

If necessary, the options for disposal of any contaminated groundwater will be assessed following detailed design and further site investigations. If the water meets relevant surface water guideline criteria is may be suitable for discharge through the site stormwater system. Alternatively, the water may require discharge to trade waste, or removal by a licensed liquid waste contractor. The construction contractor will be responsible for testing any groundwater prior to discharge.

Groundwater investigations to assess groundwater quality prior to construction need to take account of the zone of influence for any planned dewatering activities. Pumping of groundwater will cause draw down of groundwater towards the excavation, meaning that if there are pockets of more contaminated material, groundwater surrounding this material may be drawn towards the excavation.

3.5 Contaminated Soil Stockpiling

As a general principle, stock piling of contaminated soils on the site should be avoided or minimised.

Wherever possible, spoil should be direct loaded into trucks and transported to the chosen licensed waste disposal facility.

If there is an accidental discovery of contaminated soil that requires temporary stockpiling on site (such as to allow for testing of the soil material prior to disposal), the soil should preferably be direct loaded into skip bins and covered with a tarpaulin to avoid run off in the event of rainfall. The contractor should make arrangements with a local supplier of suitable hire skip bins to facilitate this contingency method, should it be required. If the soil volume or other considerations preclude the use of skip bins, soil stockpiles will need to be covered with tarpaulins within a bunded area.

3.6 Control of Discharges to Air

The Air Quality Assessment for the Project covers the assessment of effects on the environment and provides recommended management and monitoring measures. The key principle for control of dust discharges from contaminated areas is to address the source to prevent dust generation. In this respect, the measures are similar to those required for discharges from other construction sites. Soils should be adequately wetted and dust controlled during the removal of the known or potentially contaminated materials.

In addition to wetting down areas of exposed soil, the contaminated soils will require specific management measures. Additional control measures should include:

- Open areas should be minimised as much as possible at all times, including ensuring that odorous sources are covered or temporarily backfilled when not excavating
- Where practicable, material will be excavated and placed directly in trucks for off-site disposal at appropriately licenced facilities
- Contaminated material stockpiled on site will be covered and/or wetted to manage dust discharges
- Trucks used to transport material will be covered by tarpaulin or clean soil/fill to reduce potential odour effects as the material is being transported
- Installing odour fences if necessary, with multiple high level spray nozzles that provide a perfumed mist downwind
- Use of an odour masking agent or deodoriser applied to the surface of odorous material as it is exposed. Such a deodoriser can be applied by backpack pressurised sprayer

- Use of active ventilation if necessary, to disperse odours and vapours from the exposed soil material (e.g. from open trenches)

3.7 Transportation and Disposal of Contaminated Spoil

To the extent possible, contaminated spoil material needs to be directly loaded into trucks, to avoid double handling and stockpiling onsite. Trucks and trailers will need to have a sealed tray to minimise the risk of inadvertent spillages during transportation. The truck and trailers will also need to be covered to avoid dust loss during transportation.

Wheel wash bays need to be established to provide for washing trucks and other vehicles exiting the earthworks areas.

Chain of custody procedures will need to be followed to enable tracking of the spoil and confirm disposal at the appropriate landfill facility. Waste manifests / weigh bridge receipts will need to be retained as proof of disposal.

There are special regulatory requirements, including labelling and transportation requirements for asbestos waste. Refer to Section 5 for requirements specific for known asbestos areas. The disposal shall be in accordance with all current, relevant regulatory requirements. All excavated material will require dampening down and transportation to an appropriately licensed landfill facility as per the Asbestos Regulations.

In the event that friable asbestos contamination is encountered in any area other than the sensitive area identified as known to contain asbestos, this should be dampened down and covered and the advice of the SQEP (who shall have suitable asbestos experience) shall be sought.

3.8 Re-use of contaminated material

It is recommended that material excavated from the sensitive areas (landfill Municipal Solid Waste and ACM from 141-199 Hugo Johnston Drive) should not be re-used on site.

Soil from general areas may be re-used on site if further investigations are conducted and find that contaminant levels meet permitted activity criteria or are otherwise deemed suitable for the intended land use. Assessment will be required by a SQEP, with Auckland Council approval.

Soil capping material from the landfills may also be suitable for re-use depending upon the contaminant concentrations and the final disposition of the material (e.g. if it is to be used as compacted clay beneath the road alignment where the potential exposure pathways are rendered incomplete by burial under asphalt).

Should the contractor wish to re-use any contaminated soil on site, and depending upon the circumstances and the specific site involved, the Council may impose a requirement for a consent to discharge contaminants to ground.

3.9 Occupational Health and Safety

3.9.1 Introduction

This section is not intended to fulfil the requirements of the New Zealand Health and Safety at Work Act 2015. Rather, it is intended to provide guidance regarding controls that the contractor should address in the context of their construction methodology and design.

For contaminated land, the key principle is that the work processes and practices should be designed to avoid or minimise the potential exposure of the construction workers to the contaminants. For example,

methods of construction for laying subsurface utilities can be adopted that minimise the need for personnel to work in trenches.

The measures set out below for worker protection address some of the key risks that are particular to the Project, and should not be construed as a complete list of controls for the hazards associated with the contaminants.

3.9.2 Personal Protective Equipment

As a minimum, the following personal protective equipment (PPE) is required:

- Full body cover:
  - If cotton overalls are used, then these should be washed weekly or when dirty by a third party laundry. Overalls should not be washed at home to mitigate the risk of contaminating family clothing.
- Gloves appropriate to the identified hazards and must be immediately available – i.e. on person:
  - Nitrile gloves or similar (Latex gloves are not considered to provide sufficient protection against materials that may be encountered in a closed landfill).
- Safety glasses:
  - Dark safety glasses are not to be worn between sunset and sunrise or in dark environs
- Hard hat;
- Respiratory protection:
  - P2 Dust masks must be within easy accessibility (i.e. vehicle/site huts/etc.) and used when required.
- Safety boots: Above ankle lace up safety boots; and
- Hi visibility safety vest.

3.9.3 Confined Space Entry

As a general principle, confined space entry should be avoided to the extent possible. Safety in design practice should be applied to avoid the need for confined space entry during construction and operation of the Project.

Where confined space entry is required, a task specific management plan should be prepared in conjunction with a full risk assessment identifying the hazards and associated management protocols.

Toxic gases and low oxygen atmospheres can develop in the subsurface at contaminated sites, depending upon the nature of the contamination and the ground conditions. Hazardous atmospheres may exist at the closed landfills, in sites near closed landfills, at uncontrolled fill sites where organic matter has decomposed in the subsurface, and at other sites (e.g. sites with subsurface hydrocarbon contamination). Due to the multiple potential hazards for the Project, testing of the confined space for fixed gases (to assess the oxygen level in particular) and flammable gases must be undertaken prior to any entry. No entry is to occur if the atmosphere exceeds 5% of the gaseous atmosphere lower explosive limit (LEL). A personal gas monitor shall also be used for any persons undertaking the confined space entry.

Notes:

Hydrogen sulphide is a landfill gas constituent and occurs when organic matter decomposes anaerobically. Hydrogen sulphide respirator filters can become quickly overloaded and should be worn for short durations only. The limitations of the filters should be clearly understood (suppliers should be consulted). Full face self-contained breathing apparatus (SCBA) is the preferred methodology for respiratory protection.

Work requiring confined space entry including work requiring SCBA is hazardous and requires notification to WorkSafe NZ (http://www.business.govt.nz/worksafe/notifications-forms/particular-hazardous-work).

3.9.4 Worker Welfare Management

The management of health and safety of workers at contaminated sites should include the following provisions:

- Establishment of zones on site to demarcate “contaminated zones” and “clean zones”
- Transition between these zones must be through a dedicated area where clothing and equipment can be left in the “contaminated zone” with decontamination procedures prior to transitioning to the clean zone
- Activities within the clean zone must be restricted to administrative and other activities such as eating and drinking.
- Briefing of staff should be undertaken informing them of the environmental management structure and associated management documents including this CLMP. The training needs to cover roles and responsibilities, health and safety, environmental management processes and procedures, consent requirements, accidental discovery procedures, emergency contacts and response

4 Management Measures - works within known landfill areas

4.1 Landfill Environmental Controls

4.1.1 Introduction

The Project works will disturb the southern extents of the following closed landfills:

i. Galway Street,

ii. Pikes Point West (including Waikaraka Park landfill),

iii. Pikes Point East.

These landfills include Municipal Solid Waste (MSW), demolition waste and soils last placed before 1993. The waste and cover soils vary in depth from 5 to 9 metres and the waste is expected to be partially degraded and could pose a number of environmental and human health risks during the construction of the East West Link (EWL).

The landfills are unlined, constructed directly on marine muds/ basalt and are predominantly uncapped. A form of leachate interception system is functioning in Pikes Point East and West, however the system does not fully drain the landfills and the lower portions of the waste is saturated and odorous from the anaerobic and decomposing waste.

To manage the environmental and human health risks posed by disturbance of closed landfills for construction and operation of the East West Link Project, these controls are recommended. They are intended to guide the works, and the Project Contractor should design and implement the site specific controls upon completion of detailed site investigation and risk assessment.

For those matters pertaining to the management and control of potential human health risks, the provisions of the Health and Safety at Work Act 2015 are also relevant, and the contractor in charge of the place of work will have the primary responsibility for the health and safety of its workforce.

4.1.2 Construction

The Project Works require the construction of a road corridor over the existing Pikes Point landfills. Because the road alignment overlies the existing leachate interception system it will need to be replaced by the Transport Agency. The necessary works therefore include installation of a drainage system to collect leachate on the downgradient (southern) side of the landfills, and requisite controls for landfill gas (LFG). Within the footprint of the new road corridor, landfill waste will be removed and over excavated to a depth of approximately 1 to 2 m followed by placement of a geo-grid reinforced raft, with installation of piles as required and based upon predicted settlement.

The Galway landfill does not have a leachate collection system and the Project works are limited to a local road connection on the western margin of the landfill footprint. The main East West Link alignment is separate from the landfill footprint. As such, the effect of the Project works on the Galway landfill will be limited to over excavation and installation of a geo-grid raft (as for the main alignment at Pikes Point landfills) with further removal of landfill waste beneath the road pavement or piling to meet geotechnical requirements.

Waste excavated from landfills will be disposed to a facility licenced to receive such materials and replaced with engineered fill. Some landfill waste south of the replacement interception system at the Pikes Point landfills and at the Galway Street landfill will be retained under the road corridor.

Management controls will be required to address the following:

i. Construction management of earthworks associated with landfill waste

ii. Landfill waste management and disposal

iii. Landfill gas management and odour

iv. Landfill gas - Permanent Construction Considerations

v. Leachate management and disposal

vi. Landfill reinstatement

vii. Construction in confined spaces

viii. Human health contact with chemical and biologically contaminated materials

4.1.3 Construction Management

As a general principle, construction through the landfill waste requires installation of controls, minimisation of the excavation zone, and isolation from influences that could compromise the environmental and human health controls.

Installation of controls

Prior to excavation into the waste, surface water perimeter controls will be installed to divert flows from entering the excavations and retain runoff from disturbed areas. Stockpiles of backfill will be placed on hard surfaces or tarpaulins, and sufficient tarpaulins or cover material will be available to cover the extent of exposed waste should odour and/or air monitoring exceed acceptable levels. Monitoring and management of landfill gas is discussed in more detail under *Landfill Gas and Odour*.

Leachate management provisions in the form of pumping pits and pipework conveyance to trade waste will be installed so that immediate control of leachate can be made as soon as encountered. The existing system may be utilised for this purpose subject to Council agreement and the staging of the works (e.g. by commencing the works at the distal ends of the existing system).

Lined areas will be installed to allow excavated waste that is saturated to drain prior to loading onto trucks for removal and disposal off site.

Minimisation of the excavation zone

The excavation of the interception trench will be limited to a reasonable extent of open excavation that can be backfilled progressively.

For the interception trench, the open area shall be limited to 40 linear metres of trench in each work area, with a maximum of two separate work areas at any time.

For shallow earthworks that may encounter landfill waste but do not intersect groundwater (including the over excavation to construct the geogrid), the open area shall be limited to 5000 square metres in each work area, with a maximum of two separate work areas at any time.

Open areas shall be deemed closed once they have been covered by a minimum of 300 mm imported clean fill material (including the materials imported and placed to construct the geogrid).

If necessary and based upon site monitoring, the open areas shall be reduced to mitigate any adverse effects from the works.

Isolation

Open excavations and all works on the landfills will be fenced at all times with safety barriers to restrict unauthorised access.

4.1.4 Landfill Waste Management and Disposal

Any refuse excavated from the landfills and not placed elsewhere within the landfills will be appropriately handled, transported and disposed at an appropriately licensed facility.

Waste management practices will include:

- Where waste is stockpiled overnight for any reason, the stockpiles will be covered with tarpaulins or cover soil. Contaminated spoil material will be directly loaded into trucks where possible, to avoid the need for stockpiling on site.
- Landfill waste removed off site will be drained first within the works area to remove free water. In the works area within Pikes Point landfill, the waste can be drained to the section of open trench that will be under construction for the replacement leachate collection system. Dewatering for the replacement leachate collection system will adopt a discharge to trade waste.
- Landfill waste materials will be placed directly into trucks where it is required to be removed off site. Trucks will be covered prior to departing site to ensure no inadvertent spillage or emission of dust or odour from the truck during transport.
- Waste manifests will be used to control and record the movement of the waste materials and ensure that each load removed is appropriately disposed.
- Weigh bridge receipts shall be retained as proof of disposal.

4.1.5 Landfill Gas and Odour During Construction

The landfill gases of most concern include Hydrogen Sulphide as a poison that can accumulate in excavations, and methane as a flammable gas. Procedures are required to identify and manage landfill gas during construction and long term, to prevent landfill gas migrating through preferential pathways and also to avoid accumulation of LFG in structures.

When earthworks are undertaken within the footprint of landfills and within 20 m of the known extent of a landfill, ambient air in the working environment will be continuously monitored for landfill gases using a daily calibrated lower explosive limit (LEL) meter. Each worker that enters an excavation deeper than 1.0 m into a landfill or a confined space must have his/her own personal LEL meter.

As a minimum the LEL meter must be able to measure the following parameters:

- LEL
- Oxygen
- Carbon Monoxide
- Hydrogen sulphide

The LEL alarm levels should be set at not greater than 20% of the LEL for methane (approximately 1% methane by volume in air). Methane may be flammable or explosive at 4.4% by volume in normal atmosphere. The contractor should seek specialist occupational exposure monitoring advice to establish appropriate monitoring and health controls for workers.

Table 2: Recommended air monitoring limits

Meter Type	Short Term Exposure limit average	8hr Time weighted average
Methane LEL	Not greater than 20% of LEL (based upon methane)	
Carbon monoxide	50 ppm (60 mins)	25 ppm
Carbon dioxide	3%v/v	0.5%v/v
Hydrogen sulphide	15 ppm	10 ppm
Oxygen	19.5% - 23.5%v/v	

Some landfill gases are heavier than air, and therefore may have a tendency to accumulate and concentrate in the excavations. To the extent practicable, workers shall avoid entering the trenches and excavations, to minimise inhalation of vapours. Confined space entry training requirements, entry procedures and notification requirements shall be adhered to, in accordance with the Health and Safety at Work Act 2015 and the guidance from WorkSafe New Zealand.

In the event that a trigger level is exceeded, work shall stop immediately, and a task-specific risk assessment should be undertaken. Appropriate mitigation measures shall be implemented before work is permitted to resume.

Odour relating to exposure of party decomposed landfill waste will be managed through minimisation of landfill exposed at any one time, removal of waste off site as soon as possible and covering exposed landfill waste with soil or tarpaulins. Additional contingency measures for odour are identified in the CLMP.

Contingency plan

In the event that during excavations and road construction the limits set out in Table 2 above are exceeded or separate phase hydrocarbons are present, then the following contingency actions will be undertaken immediately:

- The excavation will be immediately evacuated. The Construction Manager is responsible for managing and enforcing these limits in liaison with the on-site Environmental, Health and Safety Officer.
- The excavation will be actively ventilated, such as through the use of fan forced ventilation and continuous gas monitoring re-initiated.
- In extreme cases, where the previous contingency measures have been ineffective then the excavation will be isolated with security fencing or refilled and the advice from a SQEP should be sought.
- The Site Environmental, Health and Safety Officer will amend the HSE Plan to manage risks to workers and the public during construction. The measures may include but not be limited to reduced areas of open earthworks.

4.1.6 Landfill Gas - Permanent Construction Considerations

Interception trench

Methane and other landfill gases (LFG) will travel from high concentration to low concentration through the path of least resistance.

For the interface of the Waikaraka, Pikes Point East and West landfills, the Project works involve construction of a high permeability leachate interception trench (with open graded aggregate), for the full depth of landfill waste. The trench will provide pore space for LFG. On the down gradient side of the interception trench, mudcrete with low permeability will be placed to support the road pavement, for the full height of the interception trench. This will provide the hydraulic barrier to limit leachate flow from the landfill.

The granular interception trench will have a perforated pipe along the trench length, connected to a series of stack pipes that have wind turbo vents attached. This will create a slight negative pressure in the top of the trench and create the preferred pathway for landfill gas emanating from the landfill waste.

Any services laid in the granular interception trench will be isolated from landfill gas with flexible membranes around the service trench.

Pipes and services laid through the landfill waste

Methane and other landfill gases travel the path of least resistance. Given the age of the landfills and their rudimentary cap, landfill gas is unlikely to be fully contained and therefore pressurised. However any excavations or pipework installed within the landfill may become preferential migration pathways for landfill gas. Back filled material will need to use less permeable material such as clay, or incorporate regularly spaced gas resistant barriers to minimise the risk of gas migration through the services granular backfill.

The following measures should be considered during design and construction to minimise risk of landfill gas migration.

Cut Off Walls / Flowable Fill

The proposed method to minimise risk of landfill gas migration through the backfill and bedding in pipe trenches is to use cut off walls and low permeability flowable fill at regular distances along the trench length. This is a proven method for limiting gas and water / liquid contaminant migration horizontally and vertically in the soil profile.

Flowable fill is a low strength concrete that is used as the bedding and backfill material for the pipe. This flowable fill can be augmented with bentonite to reduce permeability of the material. Some designs may use flowable fill as barriers over the cross section of the pipe trench and backfill to create a gas and leachate barrier.

These proposed measures are considered to provide long term, maintenance free, protection measures against landfill gas and leachate migration within service trenches laid in landfills

It is considered that the flowable fill will be sufficiently impermeable (when compared to the surrounding soil) and therefore will provide appropriate mitigation of gas migration along the services.

4.1.7 Leachate Management

Construction phase

Based upon leachate data obtained to date, it is unlikely that leachate and groundwater from the landfill areas during construction will be suitable for disposal to stormwater (untreated), largely due to the ammoniacal nitrogen that has been measured in water samples.

A trade waste discharge permit will be sought in order to discharge any leachate that needs to be removed during the interception trench construction at the Pikes Point landfills.

As the construction of the replacement trench extends to the top of the basalt rock which is deeper than the current leachate extraction levels, it is likely that more leachate will be removed than is provided for in the existing trade waste consents.

Where excavation through the waste to the basalt is required and de-watering of the leachate is not possible, open graded granular backfill can be placed through the leachate. The premixed mudcrete that will be placed alongside the granular interception trench can be pushed over the granular material to displace the leachate as is successfully undertaken in marine reclamation projects similar to the Fergusson Container Terminal extension for Ports of Auckland.

The Galway Street connection to East West Link will be partly constructed over the Galway Street landfill. It is proposed that the road construction will be supported on steel piles driven through the landfill waste and the road supported on granular/geogrid pile cap placed on those piles. Leachate is therefore not expected to be encountered during construction of the portion of the Project in this location.

Permanent leachate management

The Galway Street landfill has no leachate management assets that require relocation and the current consent provides for the diffuse discharge of leachate to ground.

It is proposed that for Pikes Point East and West, the existing leachate pump stations 1, 2 and 4 be replaced with similar assets. Pump station 3 is outside the construction works area and will be retained. The pump stations will be connected with new leachate collection drainage laid in the leachate interception trench discussed above. The ends of the leachate collection drainage pipe will be accessible from the pump stations as well as rodding eyes at the far end of the leachate drainage pipes, located at the top of the batters in Council controlled land.

A portion of the Pikes Point landfill waste will be retained between the current Pikes Point landfill seawall and the proposed leachate interception trench. As this waste is isolated from the leachate within the balance of the Pikes Pont landfill and will be covered with impermeable road surface, little leachate is expected to arise in this truncated waste.

However as a contingency measure, inclined plastic pipes capable of accepting insertion of inline pumps will be installed to connect to the existing leachate collection trench drainage media that is part of the pre-existing leachate collection system for Pikes Point landfill. These pipes can be used for monitoring the depth and composition of leachate should it accumulate. Where necessary and as a contingency measure, pumps can be installed to the existing pipework to remove the leachate.

4.1.8 Landfill reinstatement

Whilst an engineered cap is not apparent across much of the landfill, it is recommended that any areas of the landfill that are excavated and not covered by pavement have a landfill cap applied that meets current landfill engineering best practice. The extent of the landfill where this cap is proposed to be installed is the cut face into Pikes Point West landfill where the proposed road is up to 3.0m lower than the surface of the landfill.

The cut face and engineered cap will have a gradient of 1 vertical: 3 horizontal and consist of (top to bottom) the following:

- Topsoil 150mm
- Low permeability clay fill 600mm
- Geotextile
- Capillary break aggregate 300mm
- Geogrid (to support the aggregate on the landfill waste)

4.1.9 Human health

In addition to the RMA requirements, the Project construction contractor will be required to comply with the Health and Safety at Work Act 2015. When the design for the Project is finalised and the construction methodology has been fully resolved all of the relevant hazards can be identified.

At this time, the identified hazards that relate to works on the closed landfills include the following:

- Contact with harmful chemical and biological liquids and gases
- Dust inhalation
- Contact with sharp objects
- Landfill gas, fire or explosion
- Confined spaces
- Inundation and unstable ground
- Vermin

As a minimum the following personal protective equipment (PPE) and monitoring equipment is recommended during works where contact with landfill waste is likely:

- If cotton overalls are used, then these should be washed daily by a third party launderer. Overalls should not be washed at home to mitigate the risk of contaminating family clothing.
- Synthetic disposable overalls (such as the DuPont™ Tyvek® or Tychem® brand) are recommended as an alternative to cotton overalls, due to reduced absorbency of the material, and therefore reduced likelihood of skin exposure. Disposable overalls should be replaced daily.
- Latex/Nitrile gloves overlaid with puncture proof gloves.
- Dust masks when required
- Eye protection
- Safety boots
- Landfill Gas monitor

Worker welfare management

The contractor's management of health and safety of workers will consider:

- Briefing of the environmental management structure including roles and responsibilities; statutory, approvals, permits and licensing requirements; training requirements; and emergency contacts and response
- Establishment of zones on site to demarcate "contaminated zones" associated with exposed refuse and "clean zones".
- Transition between these zones should be through a decontamination zone where protective clothing can be removed and decontamination procedures undertaken prior to transitioning to the clean zone.
- Activities within the clean zone should be restricted to eating, drinking and office work.

4.1.10 Post construction monitoring

On completion of the Project works, alteration to the closed landfills will be recorded with the preparation of the following documents.

As-built information

As-built plans related to the closed landfills to be prepared on completion will include the following:

- Topographical plans of any areas of landfill altered by the Project works.
- Details of the construction and extent of engineered landfill cap installed.
- Surface water management devices related to the landfills

- Extents of retained landfill waste
- Extent and construction of the leachate/landfill gas interception trench
- Location of leachate and landfill gas management structures and services
- Location of monitoring wells

Groundwater monitoring and reporting

Monitoring wells and piezometers that exist on the southern boundary of Waikaraka, Pikes Point East and West landfills will be removed as part of the Project works. These wells are required by the resource consents held by Auckland Council, and as such they will need to be replaced on completion of the works.

The leachate level and composition is benchmarked through many years of monitoring by Auckland Council and the managers of the closed landfills. On completion, further monitoring will be undertaken to confirm the leachate levels and composition from the altered landfills meet the resource consent requirements and that there are no adverse impacts arising from the construction of the Project.

Where required, a report will be prepared documenting the changes made to the existing landfills to support any necessary variations to the existing landfill resource consents. This information may also be used to support a geospatial hazard register maintained by the Transport Agency.

5 Management Measures - works within known asbestos area

5.1 Asbestos Environmental Controls

5.1.1 Introduction

The following controls should be considered during the construction phase of the Project. Following completion of detailed design, site specific controls will need to be developed by the Project construction contractor with specialist support.

These controls have been prepared considering the high risk Asbestos Containing Materials (ACM) site at 141-199 Hugo Johnston Drive. For the Project as a whole where low risk ACM is encountered (i.e. the general area), the general control measures under the Contaminated Land Management Plan will be implemented, and the excavation and handling of ACM managed under the supervision of a Suitably Qualified and Experienced Practitioner (SQEP; refer to the MfE guide to the Soil NES). [2]

Some excavation of the Hugo Johnston Drive site is proposed to accommodate stormwater management infrastructure for the Project. Disturbance of this site may also be required as part of the construction of the Hugo Johnston Drive connection to East West Link.

5.1.2 Relevant Legislation

The controls described here in, need to be considered in conjunction with relevant New Zealand legislation and guidelines including:

- Health and Safety at Work Act 2015 and
- Health and Safety at Work (Asbestos) Regulations 2016
- *Asbestos - New Zealand guidelines for the management and removal of asbestos* (3rd Edition) This guideline has not been updated to reflect the Health and Safety at Work Act 2015 and the Health and Safety at Work (Asbestos) Regulations 2016, and should be read in conjunction with the new legislation and related guidance material.

5.1.3 Construction

The Project Works require construction in filled areas that contain ACM. Excavation through soil that contains ACM is proposed and the spoil removed off site and disposed of to a landfill certified to accept ACM.

The management controls for ACM address the following:

i. Construction management of earthworks

ii. Excavation

iii. Offsite transportation and disposal

iv. Onsite disposal

v. Human health

vi. Post construction activities

[2] http://www.mfe.govt.nz/publications/rma-land-hazards/users-guide-national-environmental-standard-assessing-and-managing

5.1.4 Construction Management

The considerations relating to asbestos management largely relate to disturbance of ACM.

Removal of asbestos requires at least 5 days' prior notice to WorkSafe New Zealand as a notifiable activity of intended commencement of works.

The following construction management measures will be adopted:

- Adoption of clear responsibilities for the works
- Minimising any unnecessary soil disturbance
- Minimising any release of asbestos fibres by wetting down the soil and/or misting the air
- Capping any remaining ACM

5.1.5 Excavation and Handling ACM

The ACM removal contractor must be licensed and experienced in the removal of asbestos, employ asbestos-registered staff holding a registration with WorkSafeNZ to work with asbestos.

The entire work area shall be fenced securely. The areas of the site containing ACM shall be clearly identified on the ground and isolated from any uncontaminated areas of the site with warning tape and signs. The areas to be isolated should be such that an excavator and truck can work inside the isolated area.

Abrasive cutting that will generate dust is not permitted as part of the ACM excavation operations.

If the wind exceeds 10 m/s for 30 minutes or more, work should be stopped and ACM covered (unless remaining wet) until such time the wind decreases.

Soils containing ACM should be kept continually wet with water mist sprays until that material is placed in covered trucks and removed off site. Water should be applied in a fine spray to prevent dust from being generated by high pressure or volumes of water.

Water spray should be used to control dust where stump grinding takes place (if required). The haul road should also be mist sprayed with water.

It is envisaged that the ACM contaminated soils will be removed using an excavator and carefully placed in the tray of a tip-truck for removal off site. Every effort should be made to avoid the uncontrolled spread of ACM across the site; for example, from the tracks of the excavator.

Wheel-wash facilities for plant leaving the site will be required where clean haul routes are not provided.

All personnel should wear PPE appropriate for the type of ACM and observe good personal hygiene at all times on site. Breathing apparatus should be carried by all workers within the marked ACM area as an emergency precaution and should be worn if any visible dust is generated.

A photographic record should be kept of the ACM excavation and disposal procedures and form part of the verification report.

All vehicles that leave the exclusion zone to have the wheels checked to ensure no soil or ACM is attached to the wheels. Where wheels are contaminated, these are to be washed. Wash waste to be directed to silt control ponds for treatment prior to disposal.

At the end of each working day, exposed areas of ACM to be covered with clean soil or a tarpaulin. Clean soil cover should be removed and stockpiled for re-use on commencement of removal of ACM. Cross contamination of this cover material to be avoided.

Monitoring for respirable asbestos fibres at the site perimeter and to monitor workplace exposure shall be undertaken.

5.1.6 Offsite Transport and Disposal of ACM

The following section sets out the controls for transport and disposal of ACM to offsite landfills.

The contractor shall demonstrate how public and private roads are to be used safely. This should include signage to be attached to vehicles transporting ACM, notifying the presence of asbestos and emergency spill response procedures.

Prior arrangement is to be made with a landfill consented to accept ACM before delivery of ACM.

All trucks to be lined with plastic liners and covered in accordance with WorkSafe New Zealand Guidelines for transporting asbestos containing materials.

Saturated soils are to be mixed with dry material or drained prior to loading to trucks to prevent loss of liquids from truck trays during transportation.

Truck manifest record sheets are to be maintained for all loads removed off site, and landfill receipts for the ACM loads shall be obtained and cross referenced to the manifests to ensure that no loads are disposed to unlicensed tip locations.

A report shall be prepared to summarise all ACM sent off-site.

5.1.7 On site Disposal of ACM

The Project applications do not include a consent for the re-use of ACM on site. The Contractor will be responsible for obtaining consent if this option is elected.

5.1.8 Human Health Contact with ACM

In addition to the RMA requirements, the Project construction contractor will need to comply with the Health and Safety at Work Act 2016. When the design for the Project is finalised and the construction methodology has been fully resolved all of the relevant hazards can be identified.

In relation to the asbestos hazard, the primary controls to protect human health will involve:

- Minimising the disturbance of soils containing ACM;
- Avoiding placing staff within the vicinity of the excavation unless necessary;
- Minimising dust generation;
- Dust suppression by wetting down the ACM materials and work site, and
- Secure cartage and disposal of the ACM.

There is also a risk of cross contamination of ACM onto workers clothing, equipment and vehicles where it could release fibres in other environments that are not controlled against dust generation. Consequently, all equipment plant and clothing will be decontaminated or removed and bagged for cleaning when passing from the contaminated to the non-contaminated zones.

As a minimum the following personal protective equipment is required:

- Synthetic disposable overalls (such as the DuPont™ Tyvek® or Tychem® brand) shall be used instead of cotton overalls, due to reduced absorbency of the material, and therefore reduced likelihood of skin exposure. New overalls need to be used each day.
- Latex/Nitrile gloves.
- Eye protection
- Safety boots
- At a minimum a P2 dust respirator (specialist advice shall be sought on respirator protection)

Worker welfare management

The contractor's management of health and safety of workers needs to include:

- Briefing of the environmental management structure including roles and responsibilities; statutory, approvals, permits and licensing requirements; training requirements; and emergency contacts and response

- Establishment of zones on site to demarcate “contaminated zones” and “clean zones”
- Transition between these zones through a decontamination zone where protective clothing can be removed and decontamination procedures undertaken prior to transitioning to the clean zone
- Activities within the clean zone shall be restricted to eating, drinking and office work.

5.1.9 Post Construction Activities

An ACM removal and disposal verification report will be prepared at the end of the work. This report shall include:

- Details of the ACM removal and disposal operations
- As-built drawings indicating the dimensions and locations of areas that were contaminated with ACM and are now free of ACM, together with any areas where ACM remains in situ
- Details of encapsulation or capping installed for retained ACM
- The results of air monitoring and validation sampling
- Copies of all waste manifest sheets and landfill disposal receipts verifying disposal to a landfill consented to accept and dispose ACM.

The report information may also be used to support a geospatial hazard register maintained by the Transport Agency.

6 Monitoring, Review and Document Control

6.1 General Site Monitoring

In addition to occupational safety and health monitoring, a range of general environmental site monitoring activities should also be undertaken. The recommended monitoring regime for the Project includes the following:

- Daily – The Construction Manager or Site Supervisor should conduct walkover inspections of all areas subject to active work activity, and note any issues identified. These inspections comprise informal visual checks to supplement the formal process outlined below.
- Daily – The weather has an important influence on any earthworks project, and as such there should be a formal process of checking the weather forecast, with a particular focus on any potential storm events. This monitoring may be the responsibility of the Site Environmental, Health and Safety Officer.
- Ad Hoc - Inspections as required by environmental control procedures e.g. sediment control devices. These checks will focus on ensuring that the measures are operating effectively and properly maintained
- Weekly – Formal site inspections are to be undertaken to check compliance with this CLMP. These inspections will be completed by the Site Environmental, Health and Safety Officer at active working areas. Checklists will be developed and used to check compliance with resource consent conditions. Issues will be logged that may need corrective action or improvement.
- Triggered inspections will be undertaken and recorded in response to the following:
    - Issues – upon being informed of an issue through a complaint or from a Council inspection, an inspection of the area affected or involved will be undertaken
    - Extreme weather / tides – site control measures will be inspected immediately before, during and after extreme weather
- Non-compliance – inspections will be undertaken immediately following spills or other incidents or emergencies and after “near miss” events.

6.2 Inspections and Review by SQEP

Reports from the inspections outlined above shall be provided to the SQEP. Furthermore, the SQEP should be involved directly in the regular inspections on at least a monthly basis throughout the period of construction on contaminated land.

6.2.1 Dust monitoring

A dust monitoring programme will be implemented during the earthworks phases of the development. The objective of this programme would be to assess whether the mitigation and control measures implemented through the Construction Air Quality Management Plan (CAQMP) are effective in minimising dust emissions particularly where contaminated soils are exposed.

6.2.2 Odour monitoring

Odour monitoring will be required:

- If significant odour discharges occur onsite (i.e. offensive odour is observed during earth moving)

- While contaminated soils are being excavated and loaded into trucks, and
- If there are complaints regarding odour from construction activities.

This should take the form of 'odour scout' monitoring along the site boundaries between the suspected source(s) and highly sensitive receivers as well as upwind of the suspected source(s). Refer to the Air Quality Assessment report for further detail. The aim of this monitoring is to assess the effectiveness of odour control and mitigation measures.

6.3 Incident and Emergency Management

An environmental incident is an occurrence which has (or potentially could have) an adverse effect on the environment or human health. An adverse effect is something that causes (or could have caused) potential harm. This means there has been a failure to follow the established process or procedures that help the project achieve best practice or that there is an unforeseen risk that needs to be addressed.
Incidents may include (but are not limited to):

- A spill of a hazardous substance (including chemical, fuel or oil) to ground
- A spill of a hazardous substance to surface water
- A fire, explosion or other emergency incident
- A worker who suffers from exposure to a hazardous substance

Emergency Management procedures shall be included in the CLMP to address the reasonably foreseeable range of environmental incidents for the Project works, including those identified above. For example, these contingency measures may include the name and contact details for specialist subcontractors who are able to mobilise specialist equipment to deal with accidental releases of hazardous substances. The objective of these measures is to be prepared with safeguards and contingency measures, before an incident occurs.

6.4 Environmental Incident Reporting

In the event of an environmental incident, an Environmental Non Compliance Report (ENCR) should be completed by the Site Environmental, Health and Safety Officer and submitted for review to the Construction Manager. The Site Environmental, Health and Safety Officer shall involve the SQEP in the preparation of the ENCR, as may be appropriate to the particulars of the incident. The ENCR will include the identification of improvement measures to avoid repeat incidents.

A register of the environmental incidents should be established to capture a complete record of all environmental incidents. Data from completed ENCRs are included in the Register as soon as practicable.

Discussion of ENCRs and the incident register should be an agenda item for all project management team meetings. These meetings will review the incidents that have occurred, the suitability of the response and the safeguard measures that were adopted, and consider any patterns that may emerge over time and how these should be managed to avoid future incidents.

6.5 Environmental Risk Register

An Environmental Risk Register is a tool for the identification, prioritisation and management of risks that have the potential to impact human health and/or the environment. An Environmental Risk Register should form part of the CLMP for the Project.

The Register should be reviewed and updated at regular intervals throughout the Project, and should be informed by the on-site observations of the environmental conditions as the Project progresses.

6.6 Issues Management

Environmental issues that may be raised as complaints for the Project will comprise a sub-set of the issues that will need to be managed by the Stakeholder and Communications team. As such, the Communications Manager should ensure that the details of the issue and any follow up actions are completed and recorded, including follow-up with the complainant.

6.6.1 Issues Register

An Issues Register (IR) will be maintained for the Project and include all issues for the Project. The register of environmental incidents forms a useful tool to communicate to the construction workers during regular “tool box” sessions.

Appendix E

Recommended Controls for Landfills

Landfill Environmental Controls

Introduction

The Project works will disturb the southern extents of the following closed landfills:

i. Galway Street,

ii. Pikes Point West (including Waikaraka Park landfill),

iii. Pikes Point East.

These landfills include Municipal Solid Waste (MSW), demolition waste and soils last placed before 1993. The waste and cover soils vary in depth from five to nine metres and the waste is expected to be partially degraded and could pose a number of environmental and human health risks during the construction of the EWL.

The landfills are unlined, constructed directly on marine muds/ basalt and are predominantly uncapped. A form of leachate interception system is functioning in Pikes Point East and West, however the system does not fully drain the landfills and the lower portions of the waste is saturated and odorous from the anaerobic and decomposing waste.

To manage the environmental and human health risks posed by disturbance of closed landfills for construction and operation of the Project, these controls are recommended. They are intended to guide the works, and the Project Contractor should design and implement the site specific controls upon completion of detailed site investigation and risk assessment.

For those matters pertaining to the management and control of potential human health risks, the provisions of the Health and Safety at Work Act 2015 are also relevant, and the contractor in charge of the place of work will have the primary responsibility for the health and safety of its workforce.

Construction

The Project Works require the construction of a road corridor over the existing Pikes Point landfills. Because the road alignment overlies the existing leachate interception system it will need to be replaced by the Transport Agency. The necessary works therefore include installation of a drainage system to collect leachate on the downgradient (southern) side of the landfills, and requisite controls for landfill gas (LFG). Within the footprint of the new road corridor, landfill waste will be removed and over excavated to a depth of approximately 1 to 2m followed by placement of a geo-grid reinforced raft, with installation of piles as required and based upon predicted settlement.

The Galway landfill does not have a leachate collection system and the Project works are limited to a local road connection on the western margin of the landfill footprint. The Main Alignment is separate from the landfill footprint. As such, the effect of the Project works on the Galway landfill will be limited to over excavation and installation of a geo-grid raft (as for the Main Alignment at Pikes Point landfills) with further removal of landfill waste beneath the road pavement or piling to meet geotechnical requirements.

Waste excavated from landfills will be disposed to a facility licenced to receive such materials and replaced with engineered fill. Some landfill waste south of the replacement interception system at the Pikes Point landfills and at the Galway Street landfill will be retained under the road corridor.

Management controls will be required to address the following:

i. Construction management of earthworks associated with landfill waste

ii. Landfill waste management and disposal

iii. Landfill gas management and odour

iv. Landfill gas - Permanent Construction Considerations

v. Leachate management and disposal

vi. Landfill reinstatement

vii. Construction in confined spaces

viii. Human health contact with chemical and biologically contaminated materials

Construction Management

As a general principle, construction through the landfill waste requires installation of controls, minimisation of the excavation zone, and isolation from influences that could compromise the environmental and human health controls.

Installation of controls

Prior to excavation into the waste, surface water perimeter controls will be installed to divert flows from entering the excavations and retain runoff from disturbed areas. Stockpiles of backfill will be placed on hard surfaces or tarpaulins, and sufficient tarpaulins or cover material will be available to cover the extent of exposed waste should odour and/or air monitoring exceed acceptable levels. Monitoring and management of landfill gas is discussed in more detail under *Landfill Gas and Odour*.

Leachate management provisions in the form of pumping pits and pipework conveyance to trade waste will be installed so that immediate control of leachate can be made as soon as encountered. The existing system may be utilised for this purpose subject to Council agreement and the staging of the works (e.g. by commencing the works at the distal ends of the existing system).

Lined areas will be installed to allow excavated waste that is saturated to drain prior to loading onto trucks for removal and disposal off site.

Minimisation of the excavation zone

The excavation of the interception trench will be limited to a reasonable extent of open excavation that can be backfilled progressively.

For the interception trench, the open area shall be limited to 40 linear metres of trench in each work area, with a maximum of two separate work areas at any time.

For shallow earthworks that may encounter landfill waste but do not intersect groundwater (including the over excavation to construct the geogrid), the open area shall be limited to 5000 square metres in each work area, with a maximum of two separate work areas at any time.

Open areas shall be deemed closed once they have been covered by a minimum of 300mm imported clean fill material (including the materials imported and placed to construct the geogrid).

If necessary and based upon site monitoring, the open areas shall be reduced to mitigate any adverse effects from the works.

Isolation

Open excavations and all works on the landfills will be fenced at all times with safety barriers to restrict unauthorised access.

Landfill Waste Management and Disposal

Any refuse excavated from the landfills and not placed elsewhere within the landfills will be appropriately handled, transported and disposed at an appropriately licensed facility.

Waste management practices will include:

- Where waste is stockpiled overnight for any reason, the stockpiles will be covered with tarpaulins or cover soil. Contaminated spoil material will be directly loaded into trucks where possible, to avoid the need for stockpiling on site.
- Landfill waste removed off site will be drained first within the works area to remove free water. In the works area within Pikes Point landfill, the waste can be drained to the section of open trench that will be under construction for the replacement leachate collection system. Dewatering for the replacement leachate collection system will adopt a discharge to trade waste.
- Landfill waste materials will be placed directly into trucks where it is required to be removed off site. Trucks will be covered prior to departing site to ensure no inadvertent spillage or emission of dust or odour from the truck during transport.
- Waste manifests will be used to control and record the movement of the waste materials and ensure that each load removed is appropriately disposed.
- Weigh bridge receipts shall be retained as proof of disposal.

Landfill Gas and Odour During Construction

The landfill gases of most concern include Hydrogen Sulphide as a poison that can accumulate in excavations, and methane as a flammable gas. Procedures are required to identify and manage landfill gas during construction and long term, to prevent landfill gas migrating through preferential pathways and also to avoid accumulation of LFG in structures.

When earthworks are undertaken within the footprint of landfills and within 20m of the known extent of a landfill, ambient air in the working environment will be continuously monitored for landfill gases using a daily calibrated lower explosive limit (LEL) meter. Each worker that enters an excavation deeper than 1.0m into a landfill or a confined space must have his/her own personal LEL meter.

As a minimum the LEL meter must be able to measure the following parameters:

- LEL
- Oxygen
- Carbon Monoxide
- Hydrogen sulphide

The LEL alarm levels should be set at not greater than 20% of the LEL for methane (approximately 1% methane by volume in air). Methane may be flammable or explosive at 4.4% by volume in normal atmosphere. The contractor should seek specialist occupational exposure monitoring advice to establish appropriate monitoring and health controls for workers.

Table 2: Recommended air monitoring limits

Meter Type	Short Term Exposure limit average	8hr Time weighted average
Methane LEL	Not greater than 20% of LEL (based upon methane)	
Carbon monoxide	50 ppm (60 mins)	25 ppm
Carbon dioxide	3%v/v	0.5%v/v
Hydrogen sulphide	15 ppm	10 ppm
Oxygen	19.5% - 23.5%v/v	

Some landfill gases are heavier than air, and therefore may have a tendency to accumulate and concentrate in the excavations. To the extent practicable, workers shall avoid entering the trenches and excavations, to minimise inhalation of vapours.

Confined space entry training requirements, entry procedures and notification requirements shall be adhered to, in accordance with the Health and Safety at Work Act 2015 and the guidance from WorkSafe New Zealand.

In the event that a trigger level is exceeded, work shall stop immediately, and a task-specific risk assessment should be undertaken. Appropriate mitigation measures shall be implemented before work is permitted to resume.

Odour relating to exposure of party decomposed landfill waste will be managed through minimisation of landfill exposed at any one time, removal of waste off site as soon as possible and covering exposed landfill waste with soil or tarpaulins. Additional contingency measures for odour are identified in the CLMP.

Contingency plan

In the event that during excavations and road construction the limits set out in Table 2 above are exceeded or separate phase hydrocarbons are present, then the following contingency actions will be undertaken immediately:

- The excavation will be immediately evacuated. The Construction Manager is responsible for managing and enforcing these limits in liaison with the on-site Environmental, Health and Safety Officer.
- The excavation will be actively ventilated, such as through the use of fan forced ventilation and continuous gas monitoring re-initiated.
- In extreme cases, where the previous contingency measures have been ineffective then the excavation will be isolated with security fencing or refilled and the advice from a SQEP should be sought.
- The Site Environmental, Health and Safety Officer will amend the HSE Plan to manage risks to workers and the public during construction. The measures may include but not be limited to reduced areas of open earthworks.

Landfill Gas - Permanent Construction Considerations

Interception trench

Methane and other landfill gases (LFG) will travel from high concentration to low concentration through the path of least resistance.

For the interface of the Waikaraka, Pikes Point East and West landfills, the Project works involve construction of a high permeability leachate interception trench (with open graded aggregate), for the full depth of landfill waste. The trench will provide pore space for LFG. On the down gradient side of the interception trench, mudcrete with low permeability will be placed to support the road pavement, for the full height of the interception trench. This will provide the hydraulic barrier to limit leachate flow from the landfill.

The granular interception trench will have a perforated pipe along the trench length, connected to a series of stack pipes that have wind turbo vents attached. This will create a slight negative pressure in the top of the trench and create the preferred pathway for landfill gas emanating from the landfill waste.

Any services laid in the granular interception trench will be isolated from landfill gas with flexible membranes around the service trench.

Pipes and services laid through the landfill waste

Methane and other landfill gases travel the path of least resistance. Given the age of the landfills and their rudimentary cap, landfill gas is unlikely to be fully contained and therefore pressurised. However any excavations or pipework installed within the landfill may become preferential migration pathways for

landfill gas. Back filled material will need to use less permeable material such as clay, or incorporate regularly spaced gas resistant barriers to minimise the risk of gas migration through the services granular backfill.

The following measures should be considered during design and construction to minimise risk of landfill gas migration.

Cut Off Walls / Flowable Fill

The proposed method to minimise risk of landfill gas migration through the backfill and bedding in pipe trenches is to use cut off walls and low permeability flowable fill at regular distances along the trench length. This is a proven method for limiting gas and water / liquid contaminant migration horizontally and vertically in the soil profile.

Flowable fill is a low strength concrete that is used as the bedding and backfill material for the pipe. This flowable fill can be augmented with bentonite to reduce permeability of the material. Some designs may use flowable fill as barriers over the cross section of the pipe trench and backfill to create a gas and leachate barrier.

These proposed measures are considered to provide long term, maintenance free, protection measures against landfill gas and leachate migration within service trenches laid in landfills

It is considered that the flowable fill will be sufficiently impermeable (when compared to the surrounding soil) and therefore will provide appropriate mitigation of gas migration along the services.

Leachate Management

Construction phase

Based upon leachate data obtained to date, it is unlikely that leachate and groundwater from the landfill areas during construction will be suitable for disposal to stormwater (untreated), largely due to the ammoniacal nitrogen that has been measured in water samples.

A trade waste discharge permit will be sought in order to discharge any leachate that needs to be removed during the interception trench construction at the Pikes Point landfills.

As the construction of the replacement trench extends to the top of the basalt rock which is deeper than the current leachate extraction levels, it is likely that more leachate will be removed than is provided for in the existing trade waste consents.

Where excavation through the waste to the basalt is required and de-watering of the leachate is not possible, open graded granular backfill can be placed through the leachate. The premixed mudcrete that will be placed alongside the granular interception trench can be pushed over the granular material to displace the leachate as is successfully undertaken in marine reclamation projects similar to the Fergusson Container Terminal extension for Ports of Auckland.

The Galway Street connection to EWL will be partly constructed over the Galway Street landfill. It is proposed that the road construction will be supported on steel piles driven through the landfill waste and the road supported on granular/geogrid pile cap placed on those piles. Leachate is therefore not expected to be encountered during construction of the portion of the Project in this location.

Permanent leachate management

The Galway Street landfill has no leachate management assets that require relocation and the current consent provides for the diffuse discharge of leachate to ground.

It is proposed that for Pikes Point East and West, the existing leachate pump stations 1, 2 and 4 be replaced with similar assets. Pump station 3 is outside the construction works area and will be retained.

The pump stations will be connected with new leachate collection drainage laid in the leachate interception trench discussed above. The ends of the leachate collection drainage pipe will be accessible from the pump stations as well as rodding eyes at the far end of the leachate drainage pipes, located at the top of the batters in Council controlled land.

A portion of the Pikes Point landfill waste will be retained between the current Pikes Point landfill seawall and the proposed leachate interception trench. As this waste is isolated from the leachate within the balance of the Pikes Pont landfill and will be covered with impermeable road surface, little leachate is expected to arise in this truncated waste.

However as a contingency measure, inclined plastic pipes capable of accepting insertion of inline pumps will be installed to connect to the existing leachate collection trench drainage media that is part of the pre-existing leachate collection system for Pikes Point landfill. These pipes can be used for monitoring the depth and composition of leachate should it accumulate. Where necessary and as a contingency measure, pumps can be installed to the existing pipework to remove the leachate.

Landfill reinstatement

Whilst an engineered cap is not apparent across much of the landfill, it is recommended that any areas of the landfill that are excavated and not covered by pavement have a landfill cap applied that meets current landfill engineering best practice. The extent of the landfill where this cap is proposed to be installed is the cut face into Pikes Point West landfill where the proposed road is up to 3.0m lower than the surface of the landfill.

The cut face and engineered cap will have a gradient of 1 vertical: 3 horizontal and consist of (top to bottom) the following:

- Topsoil 150mm
- Low permeability clay fill 600mm
- Geotextile
- Capillary break aggregate 300mm
- Geogrid (to support the aggregate on the landfill waste)

Human health

In addition to the RMA requirements, the Project construction contractor will be required to comply with the Health and Safety at Work Act 2015. When the design for the Project is finalised and the construction methodology has been fully resolved all of the relevant hazards can be identified.

At this time, the identified hazards that relate to works on the closed landfills include the following:

- Contact with harmful chemical and biological liquids and gases
- Dust inhalation
- Contact with sharp objects
- Landfill gas, fire or explosion
- Confined spaces
- Inundation and unstable ground
- Vermin

As a minimum the following personal protective equipment (PPE) and monitoring equipment is recommended during works where contact with landfill waste is likely:

- If cotton overalls are used, then these should be washed daily by a third party launderer. Overalls should not be washed at home to mitigate the risk of contaminating family clothing.

- Synthetic disposable overalls (such as the DuPont™ Tyvek® or Tychem® brand) are recommended as an alternative to cotton overalls, due to reduced absorbency of the material, and therefore reduced likelihood of skin exposure. Disposable overalls should be replaced daily.
- Latex/Nitrile gloves overlaid with puncture proof gloves.
- Dust masks when required
- Eye protection
- Safety boots
- Landfill Gas monitor

Worker welfare management

The contractor's management of health and safety of workers will consider:

- Briefing of the environmental management structure including roles and responsibilities; statutory, approvals, permits and licensing requirements; training requirements; and emergency contacts and response
- Establishment of zones on site to demarcate "contaminated zones" associated with exposed refuse and "clean zones".
- Transition between these zones should be through a decontamination zone where protective clothing can be removed and decontamination procedures undertaken prior to transitioning to the clean zone.
- Activities within the clean zone should be restricted to eating, drinking and office work.

Post construction monitoring

On completion of the Project works, alteration to the closed landfills will be recorded with the preparation of the following documents.

As-built information

As-built plans related to the closed landfills to be prepared on completion will include the following:

- Topographical plans of any areas of landfill altered by the Project works.
- Details of the construction and extent of engineered landfill cap installed.
- Surface water management devices related to the landfills
- Extents of retained landfill waste
- Extent and construction of the leachate/landfill gas interception trench
- Location of leachate and landfill gas management structures and services
- Location of monitoring wells

Groundwater monitoring and reporting

Monitoring wells and piezometers that exist on the southern boundary of Waikaraka, Pikes Point East and West landfills will be removed as part of the Project works. These wells are required by the resource consents held by Auckland Council, and as such they will need to be replaced on completion of the works.

The leachate level and composition is benchmarked through many years of monitoring by Auckland Council and the managers of the closed landfills. On completion, further monitoring will be undertaken to confirm the leachate levels and composition from the altered landfills meet the resource consent requirements and that there are no adverse impacts arising from the construction of the Project.

Where required, a report will be prepared documenting the changes made to the existing landfills to support any necessary variations to the existing landfill resource consents. This information may also be used to support a geospatial hazard register maintained by the Transport Agency.

Appendix F

Recommended Controls for Asbestos Sites

Asbestos Environmental Controls

Introduction

The following controls should be considered during the construction phase of the Project. Following completion of detailed design, site specific controls will need to be developed by the Project construction contractor with specialist support.

These controls have been prepared considering the high risk Asbestos Containing Materials (ACM) site at 141-199 Hugo Johnston Drive. For the Project as a whole where low risk ACM is encountered (i.e. the general area), the general control measures under the CLMP will be implemented, and the excavation and handling of ACM managed under the supervision of a Suitably Qualified and Experienced Practitioner (SQEP; refer to the MfE guide to the Soil NES). [29]

Some excavation of the Hugo Johnston Drive site is proposed to accommodate stormwater management infrastructure for the Project. Disturbance of this site may also be required as part of the construction of the Hugo Johnston Drive connection to EWL.

Relevant Legislation

The controls described here in, need to be considered in conjunction with relevant New Zealand legislation and guidelines including:

- Health and Safety at Work Act 2015 and
- Health and Safety at Work (Asbestos) Regulations 2016
- *Asbestos - New Zealand guidelines for the management and removal of asbestos* (3rd Edition) This guideline has not been updated to reflect the Health and Safety at Work Act 2015 and the Health and Safety at Work (Asbestos) Regulations 2016, and should be read in conjunction with the new legislation and related guidance material.

Construction

The Project Works require construction in filled areas that contain ACM. Excavation through soil that contains ACM is proposed and the spoil removed off site and disposed of to a landfill certified to accept ACM.

The management controls for ACM address the following:

i. Construction management of earthworks

ii. Excavation

iii. Offsite transportation and disposal

iv. Onsite disposal

v. Human health

vi. Post construction activities

Construction Management

The considerations relating to asbestos management largely relate to disturbance of ACM.

[29] http://www.mfe.govt.nz/publications/rma-land-hazards/users-guide-national-environmental-standard-assessing-and-managing

Removal of asbestos requires at least five days' prior notice to WorkSafe New Zealand as a notifiable activity of intended commencement of works.

The following construction management measures will be adopted:

- Adoption of clear responsibilities for the works
- Minimising any unnecessary soil disturbance
- Minimising any release of asbestos fibres by wetting down the soil and/or misting the air
- Capping any remaining ACM

Excavation and Handling ACM

The ACM removal contractor must be licensed and experienced in the removal of asbestos, employ asbestos-registered staff holding a registration with WorkSafeNZ to work with asbestos.

The entire work area shall be fenced securely. The areas of the site containing ACM shall be clearly identified on the ground and isolated from any uncontaminated areas of the site with warning tape and signs. The areas to be isolated should be such that an excavator and truck can work inside the isolated area.

Abrasive cutting that will generate dust is not permitted as part of the ACM excavation operations.

If the wind exceeds 10 m/s for 30 minutes or more, work should be stopped and ACM covered (unless remaining wet) until such time the wind decreases.

Soils containing ACM should be kept continually wet with water mist sprays until that material is placed in covered trucks and removed off site. Water should be applied in a fine spray to prevent dust from being generated by high pressure or volumes of water.

Water spray should be used to control dust where stump grinding takes place (if required). The haul road should also be mist sprayed with water.

It is envisaged that the ACM contaminated soils will be removed using an excavator and carefully placed in the tray of a tip-truck for removal off site. Every effort should be made to avoid the uncontrolled spread of ACM across the site; for example, from the tracks of the excavator.

Wheel-wash facilities for plant leaving the site will be required where clean haul routes are not provided.

All personnel should wear PPE appropriate for the type of ACM and observe good personal hygiene at all times on site. Breathing apparatus should be carried by all workers within the marked ACM area as an emergency precaution and should be worn if any visible dust is generated.

A photographic record should be kept of the ACM excavation and disposal procedures and form part of the verification report.

All vehicles that leave the exclusion zone to have the wheels checked to ensure no soil or ACM is attached to the wheels. Where wheels are contaminated, these are to be washed. Wash waste to be directed to silt control ponds for treatment prior to disposal.

At the end of each working day, exposed areas of ACM to be covered with clean soil or a tarpaulin. Clean soil cover should be removed and stockpiled for re-use on commencement of removal of ACM. Cross contamination of this cover material to be avoided.

Monitoring for respirable asbestos fibres at the site perimeter and to monitor workplace exposure shall be undertaken.

Offsite Transport and Disposal of ACM

The following section sets out the controls for transport and disposal of ACM to offsite landfills.

The contractor shall demonstrate how public and private roads are to be used safely. This should include signage to be attached to vehicles transporting ACM, notifying the presence of asbestos and emergency spill response procedures.

Prior arrangement is to be made with a landfill consented to accept ACM before delivery of ACM.

All trucks to be lined with plastic liners and covered in accordance with WorkSafe New Zealand Guidelines for transporting asbestos containing materials.

Saturated soils are to be mixed with dry material or drained prior to loading to trucks to prevent loss of liquids from truck trays during transportation.

Truck manifest record sheets are to be maintained for all loads removed off site, and landfill receipts for the ACM loads shall be obtained and cross referenced to the manifests to ensure that no loads are disposed to unlicensed tip locations.

A report shall be prepared to summarise all ACM sent off-site.

On site Disposal of ACM

The Project applications do not include a consent for the re-use of ACM on site. The Contractor will be responsible for obtaining consent if this option is elected.

Human Health Contact with ACM

In addition to the RMA requirements, the Project construction contractor will need to comply with the Health and Safety at Work Act 2016. When the design for the Project is finalised and the construction methodology has been fully resolved all of the relevant hazards can be identified.

In relation to the asbestos hazard, the primary controls to protect human health will involve:

- Minimising the disturbance of soils containing ACM;
- Avoiding placing staff within the vicinity of the excavation unless necessary;
- Minimising dust generation;
- Dust suppression by wetting down the ACM materials and work site, and
- Secure cartage and disposal of the ACM.

There is also a risk of cross contamination of ACM onto workers clothing, equipment and vehicles where it could release fibres in other environments that are not controlled against dust generation. Consequently, all equipment plant and clothing will be decontaminated or removed and bagged for cleaning when passing from the contaminated to the non-contaminated zones.

As a minimum the following personal protective equipment is required:

- Synthetic disposable overalls (such as the DuPont™ Tyvek® or Tychem® brand) shall be used instead of cotton overalls, due to reduced absorbency of the material, and therefore reduced likelihood of skin exposure. New overalls need to be used each day.
- Latex/Nitrile gloves.
- Eye protection
- Safety boots
- At a minimum a P2 dust respirator (specialist advice shall be sought on respirator protection)

Worker welfare management

The contractor's management of health and safety of workers needs to include:

- Briefing of the environmental management structure including roles and responsibilities; statutory, approvals, permits and licensing requirements; training requirements; and emergency contacts and response
- Establishment of zones on site to demarcate "contaminated zones" and "clean zones"

- Transition between these zones through a decontamination zone where protective clothing can be removed and decontamination procedures undertaken prior to transitioning to the clean zone
- Activities within the clean zone shall be restricted to eating, drinking and office work.

Post Construction Activities

An ACM removal and disposal verification report will be prepared at the end of the work. This report shall include:

- Details of the ACM removal and disposal operations
- As-built drawings indicating the dimensions and locations of areas that were contaminated with ACM and are now free of ACM, together with any areas where ACM remains in situ
- Details of encapsulation or capping installed for retained ACM
- The results of air monitoring and validation sampling
- Copies of all waste manifest sheets and landfill disposal receipts verifying disposal to a landfill consented to accept and dispose ACM.

The report information may also be used to support a geospatial hazard register maintained by the Transport Agency.