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Preliminary Site Assessment

Site 9 Inchicore - Poolbeg 220 kV

Electricity Supply Board

Project number: PR-427640_ACM_RP_ENV_004_8

10 January 2020

Quality Information

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The site reconnaissance consisted of a general external inspection of the site aimed at identifying potential sources of ground contamination affecting the site. An environmental compliance audit and/or detailed structural inspection of existing buildings were outside the project brief. Similarly, the site visit excluded detailed consideration of the ecological or archaeological aspects of the site, and if such are believed to be of potential significance then it is recommended that specialist advice is sought.

Any risks identified in this Report are perceived risks, based on the information reviewed during the desk study and therefore partially based on conjecture from available information. The study is limited by the non-intrusive nature of the work and actual risks can only be assessed following a physical investigation of the site.

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Reference to historical Ordnance Survey (OS) maps and/or data provides invaluable information regarding the land use history of a site. However, it should be noted that historical evidence will be incomplete for the period pre-dating the first edition and between the release of successive maps and/or data.

Certain statements made in the Report that are not historical facts may constitute estimates, projections or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. AECOM specifically does not guarantee or warrant any estimate or projections contained in this Report.

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Table of Contents

ABBREVIATIONS

AECOM	AECOM Ireland Limited
APEC	Area of Potential Environmental Concern
bgl	Below Ground Level
BH	Borehole
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CSM	Conceptual Site Model
ESB	Electricity Supply Board
EPA	Environmental Protection Agency
GSI	Geological Survey Ireland
IEL	Industrial Emissions Licence
IPC	Integrated Pollution Control
ITM	Irish Transverse Mercator
km	Kilometre
kV	Kilovolt
LAB	Linear Alkyl Benzene
m OD	Metres above Ordnance Datum
NHA	Natural Heritage Areas
NAPL	Non-Aqueous Phase Liquid
NPWS	National Park and Wildlife Service
NWCPO	National Waste Collection Permit Office
OECD	Organisation for Economic Co-operation and Development
OPW	Office of Public Works
OSI	Ordnance Survey Ireland
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PCOC	Potential Constituents of Concern
pNHA	Proposed Natural Heritage Area
PSA	Preliminary Site Assessment
RFP	Request for Proposal
SAC	Special Area of Conservation
SDS	Safety Data Sheet
SIDS	Screening Information Datasets
SPA	Special Protection Area
TPH	Total Petroleum Hydrocarbons
WAC	Waste Acceptance Criteria
WFD	Water Framework Directive

EXECUTIVE SUMMARY

Introduction

AECOM Ireland Limited (AECOM) completed a Preliminary Site Assessment (PSA) of a cable fluid leak location on Charlemont Place, Dublin 2 (the site).

ESB Networks operates and maintains a network of High Voltage (HV) underground cables of over 1,600 kilometres (km) across Ireland, of which approximately 175 km are insulated by a cable fluid. The majority of the fluid filled cables are located in urban settings across Dublin City and Cork City. The remainder are located outside these areas with limited numbers of fluid filled cables in other counties.

The length of each cable route varies and cable routes frequently extend across county boundaries. The cable fluid acts as an electrical insulator and aids the conduction of heat away from the conductor allowing the cable to be run more efficiently. Fluid filled cables are largely located in urban/suburban areas and so are particularly vulnerable to third party interference or damage. Over time cables can develop leaks due to corrosion / fracture/ defects in the cable sheath and in joints and terminations. When such leaks occur there is potential for pollution to occur to surface water, groundwater, soils and ecology.

A leak was identified by Electricity Supply Board (ESB) at the site in November 2014 and repaired in July 2016. AECOM understand that the fluid type lost from the cable was a mixture of linear alkyl benzene (LAB) and mineral oil based products.

Objective

The assessment reported herein comprises the first step of Stage 1: Site Characterisation & Assessment – Preliminary Site Assessment (PSA) and was carried out in accordance with *EPA Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites (July 2013),* and specifically the Guideline Template for Preliminary Site Assessment Report. This guidance draws on the *EPA Code of Practice (CoP), Code of Reference for Unregulated Waste Disposal Sites (2007*) and *UK Environment Agency, Model Procedures for the Management of Land Contamination, Contaminated Land Report (CLR) 11 (September 2004).*

In terms of the data requirement for PSA reports, both the EPA CoP and CLR 11 outline that the findings of this initial risk assessment stage are largely based on desk-study information and a site walkover to identify potential pollutant linkages, which are then evaluated using appropriate criteria.

As such, the objective of the PSA reported herein is to:

- Identify potential contamination sources (i.e. the cable fluid), pathways (i.e. breathing in vapours, movement through made ground / soil) and receptors (i.e. who/what will be affected) and the likely interactions between each element;
- Assess the potential severity of the hazard and the sensitivity of the receptor (ranging from minor to severe);
- Assess the likelihood that a risk will occur (ranging from unlikely to high likelihood); and
- Develop a preliminary conceptual site model (CSM) based on an overall assessment of each of these elements above.

The preliminary CSM will then be used to identify potential risks to human health (site users and/or nearby residents) and controlled waters (i.e. groundwater and surface water) which may be associated with a fluid leak from the identified location. It should be noted that this stage of the risk assessment process is based mostly on qualitative information sources and identification of a potential risk at this stage does not necessarily indicate the presence of a risk, but rather the need for further assessment.

A table cross referencing the template headings from the EPA Guidance Template and where the corresponding information is reported herein is presented in Appendix B.

Assessment Findings

Based on the findings of the desktop study, the overall environmental sensitivity of the site is considered to be moderate. Identified sensitive receptors within 1 km of the site include:

- The Grand Canal located immediately south of the site, although this may be protected by low permeability clay (natural and/or engineered when the canal was constructed);
- The Swan river located approximately 500 m to the south of the site, although this may be protected by low permeability clay deposits which are likely to be encountered beneath the site; and
- The groundwater aquifer beneath the site, although this may also be protected by low permeability clay deposits which are likely to be encountered beneath the site.

It is estimated that 3,989 litres of cable fluid was released between November 2014 and July 2016. It is assumed, based on information provided to AECOM by ESB, that the fluid lost was a mixture of LAB and mineral oil based products. Due to its high biodegradability, lower volatility and low solubility, it is considered that LABs are of less concern for adverse environmental impact than mineral oil based products. Given that there is potential for a mixture of both types of cable fluids to have been used at this site, potential contaminants of concern have been identified.

A summary of the source audit findings is as follows:

Area of Potential Environmental Concern

Number	APEC	Potential Contaminants of Concern	Potential Media Impacted
1	Leak at (9) Inchicore – Poolbeg 220 kV (November 2014 – July 2016)	LABs TPH BTEX VOCs SVOCs PCBs	Soil Groundwater Soil Vapour Ground Gas

The preliminary conceptual site model (CSM) developed for the site looked at potential source-pathway-receptor linkages identified during the assessment works and identified a moderate potential risk to the following receptors:

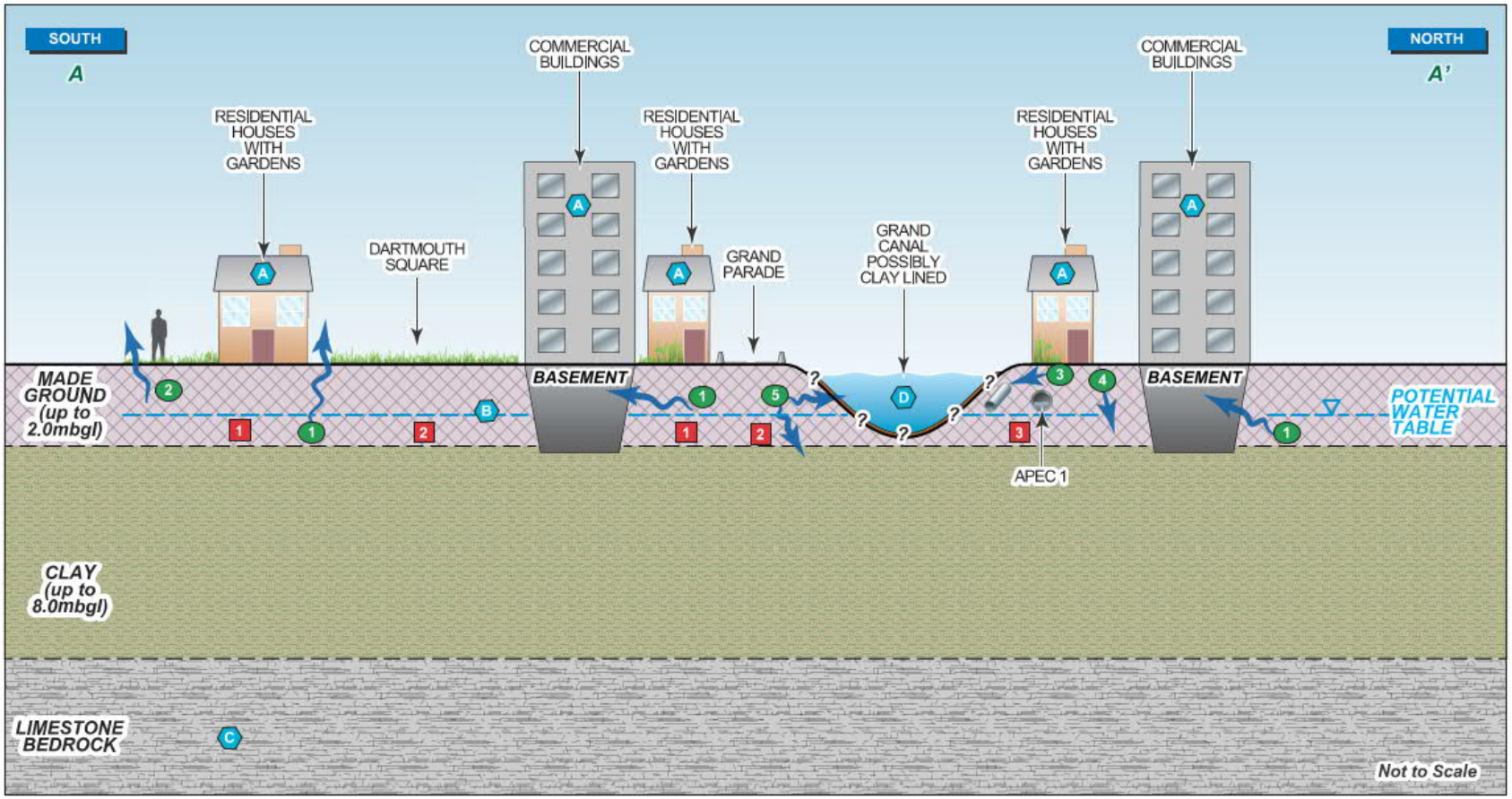
- Site users due to the potential for ground gas generation resulting from degradation of NAPL (if present); and
- Shallow groundwater due to potential impact to groundwater chemistry from the presence of NAPL and associated biodegradation products.

A low to moderate risk was identified to site users from the potential for vapour migration from mineral oil based cable fluid.

Potential risk to the Grand Canal was considered to be low to moderate given that canals are generally lined with impermeable materials which would prevent the migration of NAPL into the canal from groundwater. In addition, potential impact to the deeper groundwater aquifer and other nearby surface water bodies was considered to be low to moderate due to the geology beneath the site and likely dilution at the receptor respectively.

Risks associated with other potential source-pathway-receptor (SPR) linkages were considered to be low.

The risk assessment completed herein is preliminary in nature as it can only be based on an evaluation of qualitative data sources (i.e. not on intrusive site investigation works). Consequently, identification of potential risk does not necessarily indicate a risk to a receptor, rather that further assessment may be required to investigate assumptions made in the CSM and quantify whether a potential risk actually exists. Generally, where a low or very low risk has been identified further assessment may not be deemed necessary to assess a particular SPR linkage, although further assessment may be deemed to be required to investigate CSM assumptions where the potential risk is considered to be low or very low due to the sensitivity of the receptor.



SOURCES	PATHWAYS	RECEPTORS
1 GROUND GAS	1 GROUND GAS MIGRATION	A RESIDENTIAL / COMMERCIAL SITE USERS
2 NON-VOLATILE CONTAMINANTS IN SOIL	2 DERMAL CONTACT / DUST INGESTION	B SHALLOW GROUNDWATER
3 CONTAMINANTS IN GROUNDWATER	3 PERMEATION OF AND MIGRATION ALONG EXISTING UNDERGROUND SERVICES	C BEDROCK GROUNDWATER
	4 LEACHING FROM SOIL TO GROUNDWATER	D SURFACE WATER
	5 VERTICAL & HORIZONTAL MIGRATION OF CONTAMINATED GROUNDWATER	

NOTES:

FOR INFORMATION

Client: ELECTRICITY SUPPLY BOARD

Location: Inchicore Poolbeg Two 220 kV

Title: FIGURE 3 CONCEPTUAL SITE MODEL

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EPA Contaminated Land and Groundwater Risk Assessment Methodology

Table 1. EPA Methodology

Stage	Methodology	Report Reference	Report Date	Status
Stage 1: Site Characterisation and Assessment				
1.1	Preliminary Site Assessment	PR-427640_ACM_RP_ENV_004	10 January 2020	Final
1.2	Detailed Site Assessment			
1.3	Quantitative Risk Assessment			
Stage 2: Corrective Action and Feasibility Design				
2.1	Outline Corrective Action Strategy			
2.2	Feasibility Study and Outline Design			
2.3	Detailed Design			
2.4	Final Strategy and Implementation Plan			
Stage 3: Corrective Action Implementation and Aftercare				
3.1	Enabling Works			
3.2	Corrective Action Implementation and Verification			
3.3	Aftercare			

Source: EPA Guidance on the Management of Contaminated Land at EPA Sites

1. Introduction

AECOM Ireland Limited (AECOM) is pleased to this preliminary site assessment (PSA) completed on behalf of Electricity Supply Board (ESB) for a site on Charlemont Place, Dublin 2, Ireland (the site).

This report was commissioned by ESB under a request for proposal (RFP) issued on 26 June 2019 (Ref. Qd-354120-01R460_002-001-001) and carried out in accordance with AECOM proposal reference PR-427640_ACM_PL_ENV_001_3, dated 03 July 2019. AECOM understand that ESB has undertaken these works on behalf of ESB Networks.

1.1 Project Background

ESB Networks operates and maintains a network of High Voltage (HV) underground cables of over 1,600 kilometres (km) across Ireland, of which approximately 175 km are insulated by a cable fluid. The majority of the fluid filled cables are located in urban settings across Dublin City and Cork City. The remainder are located outside these areas with limited numbers of fluid filled cables in other counties.

The length of each cable route varies and cable routes frequently extend across county boundaries. The cable fluid acts as an electrical insulator and aids the conduction of heat away from the conductor allowing the cable to be run more efficiently. Fluid filled cables are largely located in urban/suburban areas and so are particularly vulnerable to third party interference or damage. Over time cables can develop leaks due to corrosion / fracture/ defects in the cable sheath and in joints and terminations. When such leaks occur there is potential for pollution to occur to surface water, groundwater, soils and ecology.

A leak was identified by Electricity Supply Board (ESB) at this location in November 2014 and repaired in July 2016. AECOM understand that the fluid type lost from the cable was a mixture of linear alkyl benzene (LAB) and mineral oil based products.

The site location is presented in Figure 1 and the site layout showing the site is presented in Figure 2.

1.2 Project Objective

The assessment reported herein comprises the first step of Stage 1: Site Characterisation & Assessment – Preliminary Site Assessment (PSA) and was carried out in accordance with *EPA Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites (July 2013),* and specifically the Guideline Template for Preliminary Site Assessment Report. This guidance draws on the *EPA Code of Practice (CoP), Code of Reference for Unregulated Waste Disposal Sites (2007*) and *UK Environment Agency, Model Procedures for the Management of Land Contamination, Contaminated Land Report (CLR) 11 (September 2004).*

In terms of the data requirement for PSA reports, both the EPA CoP and CLR 11 outline that the findings of this initial risk assessment stage are largely based on desk-study information and a site walkover to identify potential pollutant linkages, which are then evaluated using appropriate criteria.

As such, the objective of the PSA reported herein is to:

- Identify potential contamination sources (i.e. the cable fluid), pathways (i.e. breathing in vapours, movement through made ground / soil) and receptors (i.e. who/what will be affected) and the likely interactions between each element;
- Assess the potential severity of the hazard and the sensitivity of the receptor (ranging from minor to severe);
- Assess the likelihood that a risk will occur (ranging from unlikely to high likelihood); and
- Develop a preliminary conceptual site model (CSM) based on an overall assessment of each of these elements above.

The preliminary CSM will then be used to identify potential risks to human health (site users and/or nearby residents) and controlled waters (i.e. groundwater and surface water) which may be associated with a fluid leak from the identified location. It should be noted that this stage of the risk

assessment process is based mostly on qualitative information sources and identification of a potential risk at this stage does not necessarily indicate the presence of a risk, but rather the need for further assessment.

A table cross referencing the template headings from the EPA Guidance Template and where the corresponding information is reported herein is presented in Appendix B.

2. Scope of Work

To achieve this objective, the following scope of work was undertaken:

- A site walkover by AECOM staff (completed on 04 July 2019);
- A desktop review of site history to identify areas of potential environmental concern (APEC);
- A desktop review of publicly available information regarding the site's environmental setting and sensitivity, including:
  - Geological Survey of Ireland (GSI) Groundwater Public Viewer Maps (https://dcenr.maps.arcgis.com/apps/MapSeries), accessed 04 July 2019;
  - EPA Geoportal Site (https://gis.epa.ie/EPAMaps), accessed 04 July 2019;
  - EPA Incidents Database (https://www.epa.ie/newsandevents/incidents/recent/), accessed 04 July 2019;
  - Ordnance Survey of Ireland (OSI) (http://geohive.ie), accessed 04 July 2019;
  - Glucksman Map Library, Trinity College, Dublin, accessed 10 July 2019;
  - Office of Public Works (OPW) Flood Maps (http://www.floodinfo.ie), accessed 04 July 2019;
  - National Parks and Wildlife Service (NPWS) (http://webgis.npws.ie/npwsviewer/), accessed 04 July 2019;
  - National Waste Collection Permit Office (NWCPO) (http://www.nwcpo.ie/) accessed 04 July 2019;
- A review of information provided by ESB in the RFP; and
- Data assessment and reporting.

3. Environmental Setting

3.1 Topography

The site is located on the northern bank of the Grand Canal at Charlemont Place, Dublin 2 (ITM 716000 732577). The north and south banks for the Grand Canal are low-lying at approximately 20m above ordnance datum (m OD) where the surrounding topography is generally flat and urbanised.

3.2 Geology

The Teagasc Soils Map indicates the site locality comprises made ground on the north bank of the Grand Canal. Till derived from limestone bedrock underlies the site locality on the south bank of the Grand Canal.

The GSI Bedrock Geology Map (scale 1:100,000) indicates that the site is underlain by dark limestone and shale of the Lucan Formation. The formation comprises dark-grey to black, fine-grained, occasionally cherty, micritic limestones that weather paler, usually to pale grey. The beds are predominantly fine-grained distal turbidites in the north Dublin Basin. The formation ranges from 300m to 800m in thickness.

A number of geotechnical records are located within the vicinity of the site. Immediately north of the site on the north bank of the Grand Canal, adjacent to the Charlemont Luas Station, cable percussion borehole records (CB1) show the stratigraphic sequence as being fill/made ground to 2m, underlain by stiff grey/brown, silty, gravelly clay to approximately 3.2m. Underlying this is very stiff to hard black, silty, gravelly clay recorded to 8.2m. Similarly, on the south bank of the Grand Canal, beneath the Charlemont Luas Station, cable percussion borehole records (CB2) show the stratigraphic sequence

as being fill/made ground to 1.5m, underlain by stiff to very stiff grey/brown, silty, gravelly clay to approx. 3m. Underlying this is very stiff to hard black, silty, gravelly clay recorded to 8.6m. Boulders are recorded to depths of 8.8m.

3.3 Hydrology

3.3.1 Surface Water Features

The closest surface water body to the site is the Grand Canal (a proposed Natural Heritage Area (pNHA), Site Code 002104), located immediately south of the leak location. The canal flows to the east and discharges to the River Liffey Estuary approximately 2.1 km northeast of the site, which flows into South Dublin Bay (an SAC). This comprises the following protected sites:

- South Dublin Bay Special Area of Conservation (SAC) (Site Code 000210);
- South Dublin Bay and River Tolka Special Protection Area (SPA) (Site Code 004024); and
- South Dublin Bay proposed Natural Heritage Area (pNHA) (Site Code 000210).

As impervious materials are generally used to line canals during construction, it is not considered likely that the Grand Canal is in hydrological continuity with groundwater in the area.

The culverted Swan River is located approximately 500 m south of the site and flows in an easterly direction towards the River Dodder.

The site lies within the lower catchment of the River Liffey and Dublin Bay, which covers an area of 1,625 km^2. The River Liffey is located approximately 1.8 km north of the site and flows easterly into Dublin Bay.

The River Dodder is located approximately 1.8 km east of the site and flows to the north into the Liffey Estuary, and then Dublin Bay.

Given its proximity to the site, the Grand Canal is considered to be the most sensitive surface water receptor.

3.3.2 Surface Water Quality

The Grand Canal, which bounds the site to the south, is referred to as an Artificial Water Body (AWB) by the EPA under the Water Framework Directive (WFD). Waterways Ireland assess the biological quality of the Grand Canal, which along the section adjacent to the site during the period 2015 – 2017 was classified as 'Good' quality[1].

The most significant surface water feature in the wider area is the River Liffey Estuary. The Water Framework Directive (WFD) status of both the upper and lower sections of the estuary (classified as a Transitional Water Body) is classified as 'Moderate' and characterised as being at risk of not meeting its WFD objectives.

The WFD status of the River Dodder is classified as moderate and at risk of not achieving good status. There is no surface water quality information available for the Swan River.

3.3.3 Flooding

According to OPW Flood Maps, the area and surrounding 1 km radius does not lie within the "River – Low Probability", "River – Medium Probability" or "River – High Probability" modelled extent of land that might be flooded by rivers in a moderate to very extreme event. Further, the area is not in close proximity to the extent of land affected by coastal flood events.

[1] EPA, *Water Quality in 2017, An Indicators Report*, 2018

3.4 Hydrogeology

3.4.1 Aquifer Classification

According to the GSI, the bedrock aquifer beneath the site is classified as a Locally Important Aquifer which is Moderately Productive only in Local Zones. The soil permeability in the surrounding area is low; consequently the groundwater recharge in the aquifer is estimated by the GSI to be approximately 60 millimetres/year (mm/yr).

Regional groundwater flow direction is likely to be to the north and northeast towards the River Liffey and South Dublin Bay. A more detailed site assessment would be required to assess the local groundwater flow regime.

The closest groundwater wells and springs are located over 1 km east of the site.

The site is not mapped as being located within a Source Protection Area for either a public water supply or a group water supply scheme.

3.4.2 Groundwater Vulnerability

The GSI National Groundwater Vulnerability Mapping identified some spatial variation in groundwater vulnerabilities within the site area, varying from low to moderate. The site itself is classified as moderate; however, 0.7 km south, the area is classed as low. The variation in vulnerability classification correlates to the variable depth and nature of overburden across the site.

3.4.3 Groundwater Quality

Groundwater beneath the site is part of the Dublin Groundwater Body (IE_EA_G_008) which, according to the WFD Ireland website, is classified as having 'Good' status and is characterised as being not at risk.

3.5 Natural Habitats and Protected Species

The Grand Canal, which lies immediately south of the site, is a pNHA throughout its course.

South Dublin Bay, which is approximately 3.2 km east of the site, is an SAC, SPA and pNHA. Site Codes for each of these protected areas are provided in Section 3.3.1.

3.6 Regulatory Database Search

3.6.1 National Waste Collection Permit Office

The National Waste Collection Permit Office (NWCPO) website was reviewed to identify authorised waste facilities within the jurisdiction of Dublin City County Council near the site. The NWCPO website indicated that there is one waste facility within 1 km of the site as summarised in Table 2 below.

Table 2. Dublin City County Council Waste Facilities within 1 km of the Site

Authorisation Number	Facility Name	Location	Waste Activity
WFP-DC-08-0002-02	G&T McGoverns Ltd	2-4, 9 &12 Price's Place Rear 31 Ranelagh Road Ranelagh Dublin 6	Scrap metal recycling

3.6.2 Storm Water Discharges

Two Irish Water storm water overflow discharge locations have been identified within 1 km of the site, as summarised in Table 3 below.

Table 3. Storm Water Discharges

Emission ID	Name	Register No.
TPEFF0700D0034SW165	Ringsend	D0034-01
TPEFF0700D0034SW169	Ringsend	D0034-01

3.6.3 EPA Licensing

The EPA database of Industrial Emissions (IE), Integrated Pollution Control (IPC) and Waste licences was consulted and no active licensed facilities were identified within 1 km of the site.

According to the EPA, there have been no reported environmental incidents within the vicinity of the site from at least 2010.

3.7 Environmental Sensitivity

The overall environmental sensitivity of the site is considered to be moderate. Identified sensitive receptors within 1 km of the site include:

- The Grand Canal located immediately south of the site, although this may be protected by low permeability clay (natural and/or engineered when the canal was constructed);
- The Swan river located approximately 500 m to the south of the site, although this may be protected by low permeability clay deposits which are likely to be encountered beneath the site; and
- The groundwater aquifer beneath the site, although this may also be protected by low permeability clay deposits which are likely to be encountered beneath the site.

4. Source Audit Findings

4.1 Site Description

The location of the leak is situated adjacent to the Grand Canal at the end of Harcourt Terrace in Dublin City Centre. The leak site was located along a 400 m long section of a 220 kV cable running from Inchicore to Poolbeg. The cable was installed in 1984 and is 11.3 km in length (see Figure 2). The location of the leak at cable Joint No. 7 – Joint No. 9 is located beneath Charlemont Place at the junction with Harcourt Terrace (ITM 716000 732577). It is estimated that the cable loss of fluid from the cable occurred between November 2014 and July 2016 with an estimated fluid volume loss of 3,989 litres during that period.

No evidence of impact from the cable fluid release was noted during the site walkover, with strong vegetation growth observed along the canal banks.

4.2 Surrounding Land Use

Land use in the immediate vicinity of the site is a mixture of commercial and residential, as summarised in Table 4.

Table 4 Adjacent Land Use

Site Boundary	Land Use
North	Land use immediately north of the site is predominantly residential along Harcourt Terrace, comprising low density housing with gardens. The former Harcourt Terrace Garda Station site is also present immediately north. It is understood that this site is to be redeveloped as a primary school. A hotel is located at the northern end of Harcourt Terrace, which is surrounded by commercial and retail use buildings on either side. The Royal Victoria Eye and Ear Hospital is located approximately 200 m north of the site on Adelaide Road. Iveagh Gardens is located approximately 380 m north and St. Stephen's Green is located 600 m north. Fitzwilliam Square is located 550 m north east of the site.
East	Land use to the east of the site is predominantly commercial land use with some residential use

Site Boundary	Land Use
	above commercial properties and low density residential housing. Commercial buildings to the east include the Zendesk building (with basement). Smaller residential, typically terraced and semi-detached, buildings are interspersed. The Leeson Street Upper and Leeson Street Lower bridge crossing is located to the east and bounds the site. Directly east of the site is the Department of Communications, Climate Action and Environment. Amazon Ireland Burlington Plaza is located approx. 1km to the east of the site. A Maxol petrol station is located approx. 0.5km east of the site on- the south bank of the Grand Canal.
South	Land use to the south of the site is predominately residential with commercial buildings interspersed. Residential buildings are typically terraced and semi-detached housing with gardens. Commercial land use includes offices (2 Grand Parade building), cafés, bars and restaurants. The Royal Hospital Donnybrook is located approx. 1km south of the site. Dartmouth Square is located 50m south of the site.
West	Land use to the west of the site is predominantly commercial with high density residential. Commercial land use includes offices, hotels, childcare, retail and restaurants.

4.3 Historic Site Review

A review of historical maps and aerial photographs available from OSI, Glucksman Map Library (Trinity College Dublin) and Google Earth was carried out. A summary of the findings is presented in Table 5.

Table 5 Historic Map and Aerial Photograph Review

Year	Description
1829 to 1841 (OSI)	The site and immediate area appear to be partially developed. The area to the north of the site bound by Charlemont Street, Charlemont Place and Harcourt Terrace appears to be occupied by residential terraced buildings. The land to the north east of the immediate site appears to be largely unused and undeveloped. Land between Adelaide Road and St. Stephens Green appears to be occupied mainly by parks and gardens. An historic water reservoir (the City Basin) is located approx. 0.2km west of the site. A small historic water body lies beside the City Basin reservoir to the west in the historic Portobello Gardens on the north banks of the Grand Canal. The Portobello Barracks is located to the west of the site on the south bank of the Grand Canal. The land immediately to the south of the site is predominantly unoccupied and undeveloped. An old convent known as the Ranelagh Convent and Retreat is historically located 0.3km south of the site with the surrounding land occupied by gardens and fields. The greater land use to the south, west and east is predominantly agricultural and residential. The greater land use to the north of the site is predominantly urbanized. The Grand Canal water course appears unchanged to present day.
1888 to 1913 (OSI)	There are significant developments from the previous historical maps, most notably the increase in residential housing and urban development. To the north of the immediate site sees an increase in residential housing and a reduction in suburban gardens. Three significant features to the north of the site include the appearance of the Royal Victoria Eye and Ear Hospital, the appearance of the Harcourt Tram line, and the disappearance of the City Basin reservoir. The south immediate site, on the south bank of the Grand Canal, sees a significant increase in residential terracing housing with the appearance of Dartmouth Square. The old Ranelagh Convent recorded in the previous map has been rerecorded as Carmalite Monastery with the surrounding land and gardens remaining undeveloped. The Harcourt Tram line runs north, form the Harcourt Street terminus, across the Grand Canal to the south through Ranelagh and bisects the site. Urban development can be seen south in the greater area of the site extending southwards to Milltown. The Grand Canal water course appears unchanged to present day.
1847 (Five feet to one statute mile) Trinity Maps	Harcourt Terrace is present to the north of the site. The Grand Canal runs west to east immediately to the south. Adelaide Road runs west to east north of the site beyond Harcourt Terrace. Land to the east of the site is undeveloped while land to the west comprises residential housing. Charlemont Bridge is also located to the west of the site crossing over the Grand Canal. Portobello Harbour is located further west along the northern bank of the Grand Canal.
1864 (Five feet to one statute mile) Trinity Maps	The Dublin Wicklow and Wexford railway runs north to south through the residential area located to the west of the site. The railway terminal is located to the northwest along Harcourt Street. Albert place West runs east of Charlemont Street Lower passing over the railway.

Year	Description
1882-1887 (Five feet to one statute mile) Trinity Maps	There are no major changes compared to the previous historical map. There is residential development shown on this map to the south of the Grand Canal.
1909 (Five feet to one statute mile) Trinity Maps	There are no major changes compared to the previous historical map. There has been further residential development to the south of the site. The Domestic Training Institute is noted to be present to the west of the site. Uxbridge Terrace West is located south of the Grand Canal.
1936 (1:1,250) Trinity Maps	There is a Butter Testing station located to the northeast of the site, there is also a Turraun Peat Works to the northeast. There is an engine shed located along the Dublin Wicklow and Wexford railway to the northwest of the site within the residential developments. The train terminal is now named as Harcourt Street Terminals. There is a towing path along the southern bank of the Grand Canal. Royal Victoria Eye & Ear hospital is located along Adelaide Road to the northeast of the Site. Eustace bridge is located along the Grand Canal to the east of the site. Dartmouth Square is to the south of the site.
1969 (1:1,000) Trinity Maps	There is a Garda station to the northeast where the Turruan Peat Works used to be. There is a tennis ground to the west off of Harcourt Terrace further west of the tennis ground is a factory. There is a building to the south along Grand Parade where a tank and chimney is located.
1988 (1:1,000) Trinity Maps	There are no major changes compared to the previous site. There is an electrical substation located to the southwest of the site along Grand Parade.
1995 (OSI)	Further development can be seen in the 1995 aerial photos when compared to the historical maps, with evident increase in commercial and residential buildings with continued urban development. The west of the site sees continued loss of garden areas and continued development of residential expansion. The most significant change seen in the 1995 aerial images is the decommissioning of the Harcourt Tram line where new development can be seen to occupy the terminus station and tram line areas. From anecdotal evidence and a review of historic Photographs online, a retail petrol station was historically present on the corner of Harcourt Street and Harcourt Road immediately north-east of the site prior to 1960 and up until 1999 when the petrol station closed. This site was extensively redeveloped in the early 2000s into 'The Harcourt Building' development. The Grand Canal water course appears unchanged to present day.
2000 (OSI)	Further development is noticeable north of the immediate site bound by Charlemont Street and Charlemont place where new residential and office blocks have appeared. The north and south banks of the Grand Canal in the immediate vicinity of the site appear to be almost at capacity for commercial and residential development. The old historic Harcourt Tram line is seen to be over grown with vegetation. The Grand Canal water course appears unchanged to present day.
2005 (OSI)	Very few changes appear to have taken place at the site between 2000 and 2005 in relation to urban development. The most significant development is the appearance of the Green Luas line that runs along the old Harcourt Tram line and crosses the Grand Canal and bisects the site. The Grand Canal water course appears unchanged to present day.
2012 (Google Earth)	Again, few changes appear to have taken place at the site between 2005 and 2012 with the immediate vicinity of the site appearing to be at capacity for commercial and residential development.

4.4 Potential Sources

4.4.1 Cable Fluid Source

Information on the potential fluids released was provided in the ESB RFP document. Typically, fluid filled cables are installed in trenches approximately 1.2 m deep, 1.1 m wide and the depth to the top of the cable is typically 0.9 m – 1 m. The cables are typically surrounded by 0.35 m of sand and then the trench backfilled with either clause 804 fill or trench arisings.

Based on information from the GSI, it is likely that the cable on this site is installed within sand and backfilled with made ground, therefore leaked fluid is likely to have migrated through either the sand surround or made ground (if sufficient permeability).

It is estimated that 3,989 litres of cable fluid was released between November 2014 and July 2016. As the estimated leak size is less than the overall circuit volume of 29,594 litres, it is assumed that some of the original cable fluid may still be present.

It is assumed, based on records and Safety Data Sheets (SDS) provided to AECOM by ESB, that the fluid lost was a mixture of the following cable fluid products:

- 'T 3788' manufactured by H&R ESP Ltd of Milton Keynes in the UK;
- 'Masse 106' produced by Felten & Guilleaume Energietechnik AG in Germany; and
- Shell Diala Cable Oil.

T 3788 is a low viscosity blend of linear alkyl benzenes (LABs) (CAS # 67774-74-7). Shell Diala Cable Oil has the same CAS # as T 3788, so is essentially the same product but made by a different manufacturer. The SDS for Masse 106 does not give its CAS # or details of its composition but states that it is a blend of highly refined mineral oils and additives.

4.4.1.1 Linear Alkyl Benzenes (LABs)

Physical and Chemical Properties

LABs have side alkyl chains of 10-13 carbon atoms in length attached to a benzene ring. The alkyl chain may be attached to the benzene ring at any position except the terminal (end) position. As LABs are a mixture, their precise physio-chemical properties are dependent upon the components of the mixture, but they are generally colourless, oily liquids, less dense than water, with very low aqueous solubility and low volatility. Their potential spreading in the ground will therefore be similar to other light non-aqueous phase liquids (LNAPL) but with very little mass loss due to volatilisation or dissolution.

Information relating to the nature and toxicity of linear alkyl benzenes has been primarily sourced from the following documents:

- Safety Data Sheet (SDS) for T 3788;
- European Union Risk Assessment Report, Benzene, C10-13 alkyl derivatives, 20 June 1997; and
- Organisation for Economic Co-operation and Development (OECD) Screening Information Datasets (SIDS) Initial Assessment Reports for High Production Volume Chemicals, United Nations Environment Programme, Chemicals Branch, May 2002.

The table below summarises the basic physical and chemical properties of LABs.

Table 6 Linear Alkyl Benzene Physical and Chemical Properties

Property	Description
Molecular Weight	239-243 g/mol
Melting Point	<-70^{o}C
Boiling Point	251-320^{o}C @ 1 atm (OECD)
Vapour Pressure @ 25^{o}C	6.5 x 10^{-5} kPa (OECD)
Aqueous Solubility	0.041 mg/L (OECD)
Henry's Law Constant	9.34 x 10^{-4} atm-m^{3}/mol (OECD)
Density	0.86 @ 20^{o}C
Flash Point	140^{o}C
Explosive Properties	None

LAB (C12) has a calculated octanol-water partition coefficient (Koc) of $2.2x10^4$ and is classified by the EU risk assessment as a high adsorptive substance.

Degradation

The OECD SIDS (2002) review concluded that LABs undergo "rapid primary biodegradation in natural waters and complete mineralisation by micro-organisms under aerobic conditions". A measured half-life in water of four to nine days was reported. Microorganisms in sewage sludge and soil were reported to rapidly and completely biodegrade LABs. Anaerobic biodegradation was inferred to occur, but at a slow rate.

Degradation in soil is expected to occur but to be slower than in surface water due to the much slower mixing and the limited availability of oxygen. Where oxygen is available, aerobic degradation would occur at the fringes of a body of LNAPL in the soil/groundwater, producing elevated carbon dioxide levels in the soil and potentially elevated alkalinity in the groundwater. In the absence of oxygen, anaerobic degradation may occur by methanogenesis or by reduction of sulphate, nitrate, ferric iron (Fe^{3+}) and manganese (Mn^{3+}). These processes could lead to reducing conditions in the groundwater, with depleted concentrations of sulphate (SO_4^-) and nitrate (NO_3^-) and increased concentrations of dissolved methane (CH_4), ferrous iron (Fe^{2+}) and dissolved manganese (Mn^{2+}). Such conditions would be expected to occur close to the LNAPL body and locally downgradient. With increased distance from the LNAPL, mixing with the surrounding groundwater and aeration from seasonal fluctuations and groundwater recharge would gradually allow ambient (most likely oxidised) conditions to be re-established.

Toxicity

According to the OECD review, LABs were assessed to be not acutely toxic to human health. Data from repeat exposure, reproductive and genotoxicity studies also indicated a low potential for toxic effects. The OECD concluded that "Linear alkyl benzenes do not present any significant acute or sub-chronic health effects by various exposure routes. LAB is not teratogenic (i.e. causing birth defects) and does not produce selective reproductive toxicity."

Laboratory studies have shown that repeated exposure to LABs may be irritating to the skin, and the SDS recommends the use of gloves when handling LABs. The low vapour pressure of LABs limits the potential for exposure via inhalation, and this is not expected to be a significant exposure route at normal temperatures.

Eco-toxicity studies reviewed by the OECD found no acute toxic effects on aquatic species tested at concentrations up to and exceeding solubility limits. The only exception to this was for the water flea Daphnia magna. No data was available regarding terrestrial eco-toxicity studies.

Due to its high biodegradability and rapid metabolism, the OECD concluded that LABs were of little concern for adverse environmental impact. The OECD and EU reviews of LABs both concluded that LABs were a low priority for further investigation.

4.4.1.2 Masse 106 Mineral Oil

Information on Masse 106 has been obtained from a Safety Data Sheet (SDS) dated 1995 provided by ESB.

Physical and Chemical Properties

Masse 106 is understood to be a blend of highly refined mineral oils and additives. The SDS does not provide information on the identity of the mineral oils or additives, or on their proportions within the oil.

The SDS states that containers of Masse 106 should be kept tightly closed and in a well-ventilated space and that it should be used only in well-ventilated areas. This suggests that Masse 106 may contain volatile components.

The table below summarises information from the SDS for Masse 106.

Table 7 Masse 106 Physical and Chemical Properties

Property	Description
Vapour Pressure @ 20°C	<0.01 hPa
Aqueous Solubility	negligible
Density	888 kg/m^3
Flash Point	145°C
Flammability range	0.6% volume to 6.5% volume
Kinematic viscosity@ 40°C	8.5 mm^2/s

Based on these properties, Masse 106 would behave as a relatively viscous LNAPL in the ground. The SDS states that if the product enters soil it will be adsorbed to soil particles and not be mobile.

Degradation

The SDS for Masse 106 indicates that it is not readily biodegradable. Nevertheless, as it is expected to be comprised mainly of petroleum hydrocarbon compounds, gradual degradation is expected to occur, especially in water. The rate of biodegradation is likely to depend on the availability of oxygen and of favourable geochemical conditions. As with LABs and with other petroleum hydrocarbons, where oxygen is available, aerobic degradation would be expected to occur at the fringes of a body of LNAPL in the soil/groundwater, producing elevated carbon dioxide levels in the soil and potentially elevated alkalinity in the groundwater. In the absence of oxygen, anaerobic degradation may occur by methanogenesis or by reduction of sulphate, nitrate, ferric iron (Fe^{3+}) and manganese (Mn^{3+}). These processes could lead to reducing conditions in the groundwater, with depleted concentrations of sulphate (SO_4^-) and nitrate (NO_3^-) and increased concentrations of dissolved methane (CH_4), ferrous iron (Fe^{2+}) and dissolved manganese (Mn^{2+}). Such conditions would be expected to occur close to the LNAPL body and locally downgradient. With increased distance from the LNAPL, mixing with the surrounding groundwater and aeration from seasonal fluctuations and groundwater recharge would gradually allow ambient (most likely oxidised) conditions to be re-established.

Toxicity

The 1995 SDS for Masse 106 states that the components of the preparation are not expected to impart hazardous properties to the product. Whilst this suggests the product is not hazardous, it is noted that standards for hazard assessment and SDS production have evolved since 1995 and therefore the information cannot be relied upon with full confidence in relation to current standards for hazard assessment.

The SDS indicates that Masse 106 is expected to be practically non-toxic to aquatic organisms.

In relation to human toxicity, the SDS gives the following information:

- It is expected to be slightly irritant, so all forms of skin contact should be minimised. It is not expected to be a skin sensitiser.
- Respiratory protection is not normally required but it should be used only in well-ventilated spaces. It is based on mineral oils and other components not known to be carcinogenic.

4.4.1.3 Conclusion

Based on the above, underground leakage of LABs is not likely to lead to significant issues from dissolved hydrocarbons or vapours. Although the components of Masse 106 are not known and its aqueous solubility is stated on the SDS as “negligible”, it is unclear what this means in the context of dissolution of components from a NAPL. Based on the requirement for it to be used only in well-ventilated spaces, it appears that Masse 106 contains some relatively volatile components.

The main concern from LABs and a concern also for mineral oils such as Masse 106 is the potential for them to migrate and spread as a LNAPL, downwards through unsaturated soil that is present and then laterally in the vicinity of the groundwater table. The extent of LNAPL migration will depend on the properties of the surrounding soil and on the saturation and pressure distribution within the LNAPL. These in turn would depend on the quantity of cable fluid lost and the timescale over which the leakage occurred.

Vapour impacts are considered to be unlikely from LABs but could be of concern for Masse 106.

Degradation of the cable fluid may lead to the generation of ground gas (including carbon dioxide and methane) and affect groundwater chemistry in the vicinity and locally downgradient of the LNAPL.

Given that a mixture of LABs and a mineral oil based cable fluid have been used in the past, potential contaminants of concern associated with mineral oil based fluids would include the following:

- Total Petroleum Hydrocarbons (TPH);
- Benzene, toluene, ethylbenzene and xylene (BTEX) compounds;
- Volatile organic compounds (VOCs);
- Semi volatile organic compounds (SVOCs); and
- Polychlorinated biphenyls (PCBs).

4.4.2 Potential Off-Site Sources of Contamination

Based on a review of historic maps and the current site setting, land use surrounding the site has been principally residential and commercial. The following potential off-site sources of contamination have been identified as part of the assessment works completed:

- Former petrol station located on the corner of Harcourt Street and Harcourt Road;
- Former Harcourt Street railway station;
- Historic industrial activity on the former Garda station site on Harcourt Terrace;
- Fill materials (understood to be up to 2 m bgl) present in the surrounding area; and
- Fuel / chemicals (e.g. for back-up generators) present in commercial buildings around the site.

4.5 Source Audit Summary

Based on the assessment works completed, the primary Area of Potential Environmental Concern (APEC) for this site comprises the leak location identified by ESB. This is presented in Figure 2 and a description is provided in Table 8 below.

Table 8 Area of Potential Environmental Concern

Number	APEC	Potential Contaminants of Concern	Potential Media Impacted
1	Leak at (9) Inchicore – Poolbeg 220 kV (November 2014 – July 2016)	LABs TPH BTEX VOCs SVOCs PCBs	Soil Groundwater Soil Vapour Ground Gas

Other potential off-site sources have also been identified based on the type of activity. However no information is available for these sites therefore the only APEC assessed herein is the leak site beneath Charlemont Place.

5. Conceptual Site Model

A preliminary Conceptual Site Model (CSM) has been developed identifying potential contaminant sources, contaminant migration pathways and potential receptors.

In the context of land contamination, there are three essential elements to any risk:

- A **source** – a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of controlled waters;
- A **receptor** – in general terms, something that could be adversely affected by a contaminant, such as people, an ecological system, property, or a water body; and
- A **pathway** – a route or means by which a receptor can be exposed to, or affected by, a contaminant.

Each of these elements can exist independently, but they create a risk only where they are linked together, so that a particular contaminant affects a particular receptor through a particular pathway. This kind of linked combination of contaminant–pathway–receptor is described as a pollutant linkage. The preliminary CSM was developed to describe viable source-pathway-receptor (SPR) linkages for the site, which are presented in Table 13 below.

By considering potential SPR linkages, an assessment of the human health and environmental risks is made with reference to the significance and degree of the risk. The risk assessment has been undertaken with reference to BS10175-2011 + A2 2017 and CIRIA Document C552: 'Contaminated Land Risk assessment - A Guide to Good Practice' (2001).

The preliminary risk assessment completed for this site is based on consideration of whether a potential source of contamination can reach a receptor, and hence whether it is of major or minor significance. Considering that assessment works are still at preliminary stage and no intrusive investigation work has been completed, development of the preliminary CSM and assessment of potential risk is based on information provided by ESB on the nature of the leak, and on the AECOM site reconnaissance and desk based study. As such, only a qualitative assessment can be made around potential risks to receptors. This means that identification of potential risk does not necessarily indicate a risk to a receptor, rather that further assessment may be required to investigate assumptions made in the CSM and quantify whether a potential risk actually exists.

5.1 Qualitative Risk Assessment Methodology

A qualitative risk assessment has been carried out by assessing the severity of the potential consequence, taking into account both the potential severity of the hazard and the sensitivity of the target, based on the categories given in Table 9 below.

Table 9 Potential Hazard Severity Definition

Category	Definition
Severe	Acute risks to human health, catastrophic damage to buildings/property, major pollution of controlled waters.
Medium	Chronic risk to human health, pollution of sensitive controlled waters, significant effects on sensitive ecosystems or species, significant damage to buildings or structures.
Mild	Pollution of non-sensitive waters, minor damage to buildings or structures.
Minor	Requirement for protective equipment during site works to mitigate health effects, damage to non-sensitive ecosystems or species.

The likelihood of an event (probability) takes into account both the presence of the hazard and target and the integrity of the pathway and has been assessed based on the categories given in Table 10 below.

Table 10 Probability of Risk Definition

Category	Definition
High likelihood	Pollutant linkage may be present, and risk is almost certain to occur in long term, or there is evidence of harm to the receptor.
Likely	Pollutant linkage may be present, and it is probable that the risk will occur over the long term.
Low likelihood	Pollutant linkage may be present, and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Pollutant linkage may be present, but the circumstances under which harm would occur are improbable.

The potential severity of the risk and the probability of the risk occurring have been combined in accordance with the following matrix in order to give a level of risk for each potential hazard as shown in the table overleaf.

Table 11 Level of Risk for Potential Hazard Definition

	Potential Severity			
Probability of Risk	Severe	Medium	Mild	Minor
High	Very high	High	Moderate	Low/Moderate
Likely	High	Moderate	Low/Moderate	Low
Low	Moderate	Low/Moderate	Low	Very low
Unlikely	Low/Moderate	Low	Very low	Very low

A description of the levels of risk outlined in Table 11 is provided in the following table:

Table 12 Description of the Classified Risks and Likely Action Required

Level of Risk	Description
Very High Risk	There is a high probability that severe harm could arise to a designated receptor from an identified hazard, or there is evidence that severe harm to a designated receptor is currently happening. This risk, if realised, is likely to result in substantial liability. Urgent investigation and remediation are likely to be required.
High Risk	Harm is likely to arise to a designated receptor from an identified hazard. Realisation of the risk is likely to present a substantial liability. Urgent investigation is required and remedial works may be necessary in the short term and are likely over the long term.
Moderate Risk	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, or if any harm were to occur it is more likely that the harm would be relatively mild, if realised.
Low Risk	It is possible that harm could arise to a designated receptor from an identified hazard, but it is likely that this harm, if realised, would at worst normally be mild.
Very Low Risk	There is a low possibility that harm could arise to a receptor. In the event of such harm being realised it is not likely to be severe.

5.2 Preliminary CSM Assumptions

Based on the findings of the desktop study and information provide in the RFP by ESB, the following assumptions made in development of the CSM:

- The fluid assumed (based on records provided) to have leaked from the cable is a mixture of LAB and a mineral oil based cable fluid;
- The leak is assumed to have occurred at a depth less than 2 m below ground;
- The geology beneath the site is assumed to comprise approximately 2 m of made ground underlain by clay up to a depth of 8 m bgl. Limestone bedrock is assumed to be present at a depth of approximately 8 m bgl;
- Groundwater is assumed to be present at relatively shallow depths within the made ground;
- It is assumed that the Grand Canal adjacent to the site is lined with a low permeability material such as clay, as was commonly used from the 1700s to early 20th Century to prevent leakage from the canal and thus loss of water level restricting navigation;
- It is assumed that the is no direct connection between the site and surface water bodies;
- Other below ground utilities including mains water are assumed to be present in the vicinity of the site; and
- It is assumed that commercial buildings adjacent to the site have basements.

The preliminary CSM is presented graphically in Figure 3.

Table 13 Conceptual Site Model

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
LAB / Volatile TPH and VOC concentrations in soils	Inhalation of vapours which have migrated from the ground to above ground buildings and basements.	Site users in a commercial/low to high density residential with plant uptake scenario.	Medium	Low Likelihood	Low / Moderate	Based on records provided, a mixture of LAB and mineral oil is assumed to be the cable fluid used. The low vapour pressure of LABs limits the potential for exposure via inhalation, and this is not expected to be a significant exposure route at normal temperatures. It is considered that there is a low to moderate risk from the inhalation of vapours from potential mineral oil-based products present beneath the site. Further assessment would be required to fully evaluate this potential risk.
NAPL and non-volatile TPH, VOC, SVOC and PCB concentrations in soils	Soil and dust ingestion from near surface soils. Dermal contact with near surface soils. Inhalation of fugitive dust from near surface soils. Ingestion of soils via consumption of vegetables grown in near surface soils.	Site users in a commercial/low to high density residential with plant uptake scenario.	Medium	Unlikely	Low	Based on the volume of cable fluid released and the assumed mixture of cable fluid used in the past, it is possible that a mineral based cable fluid may have migrated beneath low density residential houses with gardens or public open space adjacent to the canal. Given the likely depth to the cable, surface soils are unlikely to be affected and exposure via this pathways is not considered likely.
		Intrusive site workers.	Minor	Likely	Low	Workers carrying out intrusive works adjacent to the site may come into contact with mineral oil based NAPL and impacted soil, meaning there will be a requirement to wear personal protective equipment to mitigate against potential impacts. Given the relatively low toxicity of LABs (assessed to be not acutely toxic), exposure to LABs is not considered to represent a significant risk.
NAPL and TPH, VOC, SVOC and PCB concentrations in soils	Migration of ground gas generated from the degradation of the cable fluid to above ground buildings and basements.	Site users in an industrial/commercial/ low to high density residential scenario.	Severe	Low Likelihood	Moderate	If a significant source of NAPL (LAB or mineral oil) is present on groundwater, there is potential for ground gas to be generated from degradation processes. The likelihood of ground gas being generated in significant quantities is considered to be low, however given the potential severity of the impact, further assessment would be required to fully evaluate this potential risk.

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
NAPL and TPH, VOC, SVOC and PCB concentrations in soils	Permeation of LAB or mineral oil NAPL through plastic water supply pipes.	Site users in a commercial/low to high density residential with plant uptake scenario.	Medium	Unlikely	Low	Public water mains likely to be present in the vicinity of the leak, servicing commercial and residential properties have the potential to be impacted. With respect to LABs, the WHO drinking water guideline (DWG) for the relevant aromatic fraction[2] is 0.09 mg/l and as the solubility limit of LAB is 0.041 mg/L (OECD) i.e. less than the DWG, LAB cannot dissolve into the water supply above this level. Furthermore, water will be moving rapidly in the pipe under pressurised conditions making it unlikely to reach the solubility limit. In respect of the potential presence of mineral oil, the aqueous solubility of the known product used (Masse 106) is stated on the SDS as "negligible". It is unclear what this means in the context of dissolution of components from a NAPL ESB has consulted with Irish Water (statutory body responsible for water supply) regarding the potential risk for cable fluid present in the vicinity of water supply pipes. Following review of their records, AECOM understands that Irish Water do not have concerns regarding impact of water supplies from cable fluid leaks. It is therefore considered that the potential risk of a pollutant linkage being present is low. As a precaution, investigation works should be carried out as part of future assessment works to further assess this source-pathway-receptor linkage.
NAPL and TPH, VOC, SVOC and PCB concentrations in soils	Migration of potential contaminants along preferential flow pathways such as underground services and permeable backfill around the electricity cable.	Nearby surface water bodies including the Grand Canal.	Medium	Unlikely	Low	It is understood that the leak at this location was repaired in July 2016. Given that there was no evidence of impact along the canal during the site walkover and no reported incidents of cable fluid release, it is likely that NAPL released from the cable has stabilised over the 3-year period since the leak was repaired and risk to the canal is low. Further assessment would be required to fully evaluate this potential risk.

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
NAPL and TPH, VOC, SVOC and PCB concentrations in soils	Migration of potential contaminants along preferential flow pathways such as underground services and permeable backfill around the electricity cable, and consequently vapour inhalation and / or ingestion, dermal contact.	Site users in a commercial /low to high density residential with plant uptake scenario.	Medium	Low Likelihood	Low / Moderate	Likely to be a high concentration of services present in the vicinity of the leak given the urban setting. If the soil / made ground around the leak is generally clay, the leaking fluid will likely have migrated mainly along any permeable backfill around the cable. The cable fluids used are likely to absorb strongly to aquifer materials (made ground and clay), consequently the potential for migration over significant distances is considered to be low to moderate. Further assessment would be required to fully evaluate this potential risk.
NAPL	Migration in saturated and unsaturated soil.	Groundwater beneath the site.	Medium	Likely	Moderate	Considering the volume of cable fluid released over the 21-month leak period, it is considered likely that shallow groundwater has been impacted. Impacts could occur due to the presence of NAPL and associated biodegradation products. Further works would be required to assess for the presence of NAPL in the vicinity of the leak location and fully evaluate this potential risk.
Dissolved phase leaching from NAPL or from soils containing elevated concentrations of TPH, VOCs, SVOCs and PCBs	Leaching from soil to groundwater. Vertical and horizontal migration of contaminants through groundwater. Horizontal migration of contaminants through groundwater to nearby surface water receptors.	Groundwater in superficial deposits beneath the site.	Medium	Likely	Moderate	Considering the volume of cable fluid released over the 21-month leak period, it is considered highly likely that shallow groundwater has been impacted. Further assessment would be required to quantify any impact from the presence dissolved phase contamination in groundwater.
LAB, TPH, VOC, SVOC and PCB concentrations in groundwater		Groundwater in limestone bedrock aquifer beneath the site.	Medium	Low Likelihood	Low / Moderate	Information on the local geology indicates the presence of underlying stiff clay, which would reduce vertical migration of groundwater to the bedrock aquifer. Further assessment would be required to fully evaluate this potential risk.
		Off-site surface water including Swan River, River Liffey and River Dodder.	Medium	Low Likelihood	Low / Moderate	The potential risk to the Swan River and River Liffey and Dodder is considered low to moderate due to distance to receptor and dilution at receptor. Further assessment would be required to fully evaluate this potential risk.
		Grand Canal.	Severe	Unlikely	Low / Moderate	The volume of cable fluid released could cause major pollution of the canal, however given the canal is likely lined with impermeable material, the likelihood of horizontal migration through to the canal

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
						waters is considered low to moderate. In addition, no evidence of impact from the cable fluid release was noted during the site walkover, with strong vegetation growth observed along the canal banks. Further assessment would be required to fully evaluate this potential risk.

6. Conclusions

AECOM completed a Preliminary Site Assessment of the leak location on Charlemont Place, Dublin 2. The objective of the works was to identify potential risks to human health and the environment that may be associated with a fluid leak from the identified location.

Based on the findings of the desktop study, the overall environmental sensitivity of the site is considered to be moderate. Identified sensitive receptors within 1 km of the site include:

- The Grand Canal located immediately south of the site, although this may be protected by low permeability clay (natural and/or engineered when the canal was constructed);
- The Swan river located approximately 500 m to the south of the site, although this may be protected by low permeability clay deposits which are likely to be encountered beneath the site; and
- The groundwater aquifer beneath the site, although this may also be protected by low permeability clay deposits which are likely to be encountered beneath the site.

It is estimated that 3,989 litres of cable fluid was released between November 2014 and July 2016. It is assumed, based on information provided to AECOM by ESB, that the fluid lost was a mixture of LAB and mineral oil based products. Due to its high biodegradability, lower volatility and low solubility, it is considered that LABs are of less concern for adverse environmental impact than mineral oil based products. Given that there is potential for a mixture of both types of cable fluids to have been used at this site, potential contaminants of concern have been identified. A summary of the source audit findings is as follows:

Table 14 Area of Potential Environmental Concern

Number	APEC	Potential Contaminants of Concern	Potential Media Impacted
1	Leak at (9) Inchicore – Poolbeg 220 kV (November 2014 – July 2016)	LABs TPH BTEX VOCs SVOCs PCBs	Soil Groundwater Soil Vapour Ground Gas

The preliminary CSM developed for the site looked at potential source-pathway-receptor linkages identified during the assessment works and identified a moderate potential risk to the following receptors:

- Site users due to the potential for ground gas generation resulting from degradation of NAPL (if present); and
- Shallow groundwater due to potential impact to groundwater chemistry from the presence of NAPL and associated biodegradation products.

A low to moderate risk was identified to site users from the potential for vapour migration from mineral oil based cable fluid.

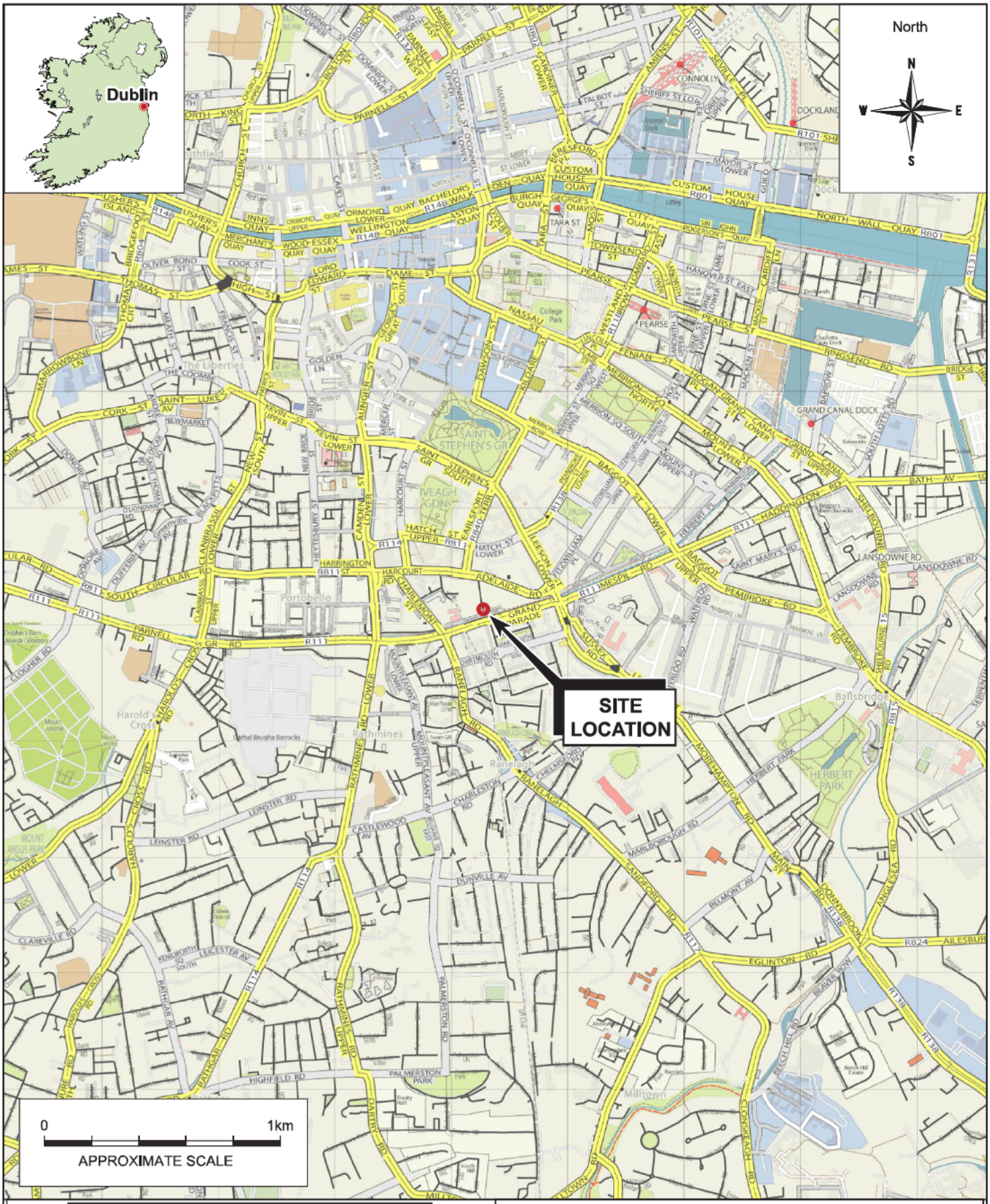
Potential risk to the Grand Canal was considered to be low to moderate given that canals are generally lined with impermeable materials which would prevent the migration of NAPL into the canal from groundwater. In addition, potential impact to the deeper groundwater aquifer and other nearby surface water bodies was considered to be low to moderate due to the geology beneath the site and likely dilution at the receptor respectively.

Risks associated with other potential source-pathway-receptor linkages were considered to be low.

The risk assessment completed herein is preliminary in nature as it can only be based on an evaluation of qualitative data sources (i.e. not on intrusive site investigation works). Consequently, identification of potential risk does not necessarily indicate a risk to a receptor, rather that further assessment may be required to investigate assumptions made in the CSM and quantify whether a

potential risk actually exists. Generally, where a low or very low risk has been identified further assessment may not be deemed necessary to assess a particular SPR linkage, although further assessment may be deemed to be required to investigate CSM assumptions where the potential risk is considered to be low or very low due to the sensitivity of the receptor.

Figures



Client

ELECTRICITY SUPPLY BOARD

Location

Inchicore - Poolbeg Two 220 kV

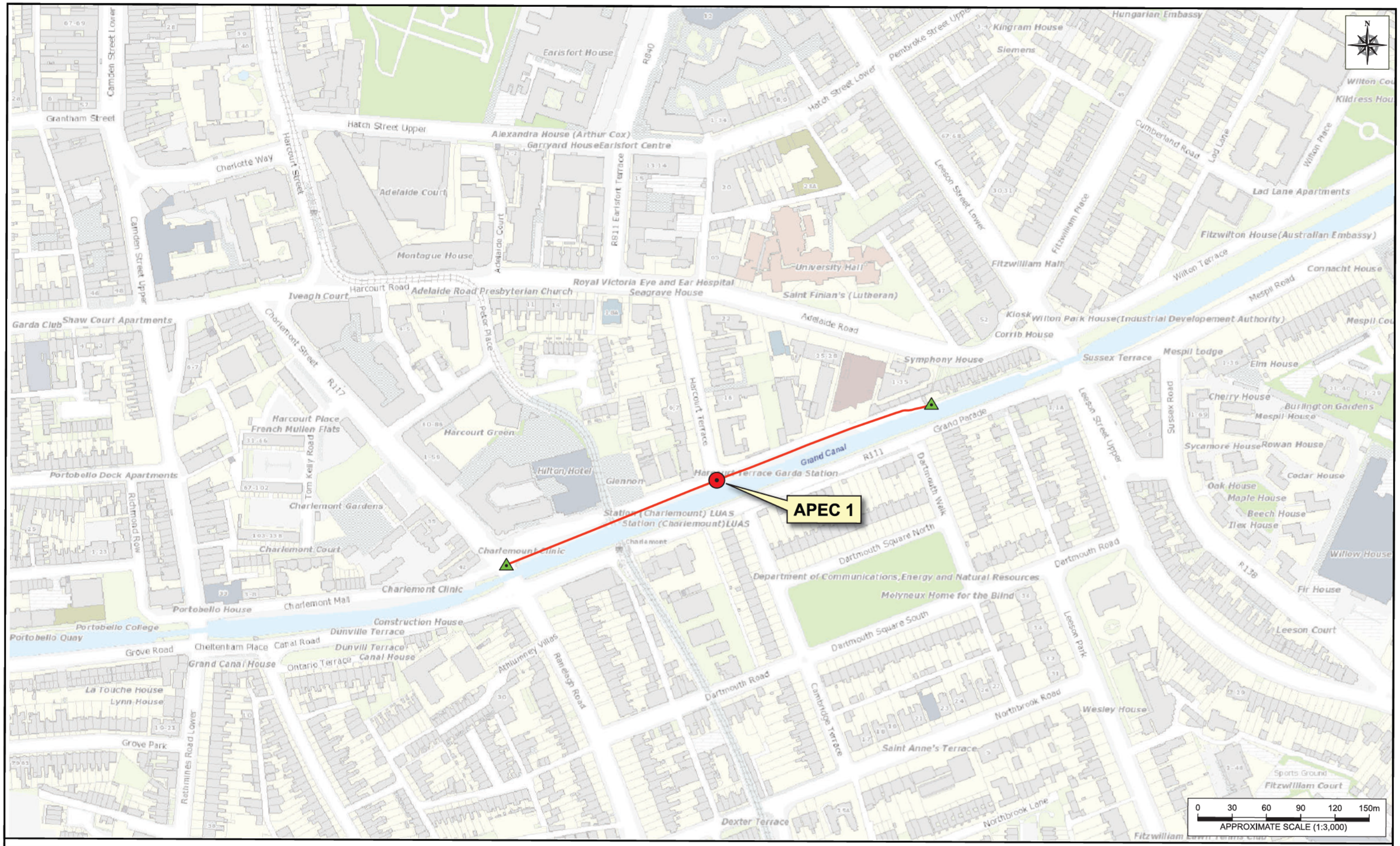
Drawing Title

FIGURE 1 - SITE LOCATION MAP

AECOM

4TH FLOOR, ADELPHI PLAZA, ADELPHI CENTRE, GEORGE'S STREET UPPER,
DUN LAOGHAIRE, CO. DUBLIN, IRELAND. T+353 (0)1 238 3100, F +353 (0)1 238 3199

DRAWN	ILLUSTRATED	CHECKED	APPROVED	DATE
RH		CC	DM	JULY 19
SCALE	Job No.			REV.
N.T.S	TBA			0



KEY:

- Leak Location
- 200 m marker from Leak Location
- Joint Section of Leak

Rev	Date	Detail	Made	Chk'd	App'd
Status: FOR INFORMATION					

NOTES:

Client: ELECTRICITY SUPPLY BOARD

Location: Inchicore Poolbeg Two 220 kV

Title: FIGURE 2 SITE LAYOUT PLAN

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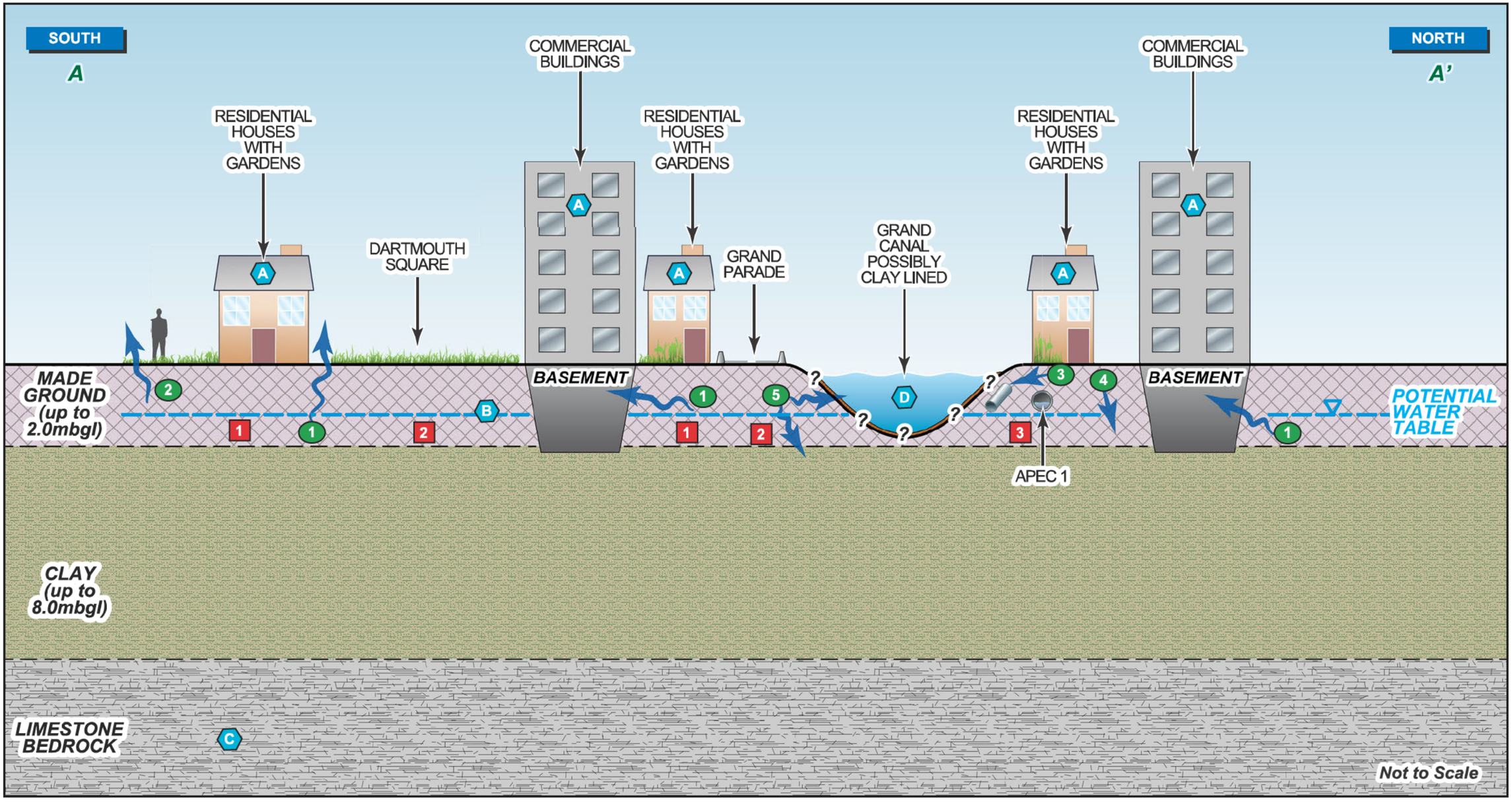
Fax: +353 (0) 1 293 3201
www.aecom.com

Design: ESB	Drawn: RDH		
Chk'd: CC	App'd: DM		
Date: JULY 2019	Scale: As Shown		
Project No. TBA	Drg No. 2	Stat. -	Rev: 0



SOURCES	PATHWAYS	RECEPTORS
1 GROUND GAS	1 GROUND GAS MIGRATION	A RESIDENTIAL / COMMERCIAL SITE USERS
2 NON-VOLATILE CONTAMINANTS IN SOIL	2 DERMAL CONTACT / DUST INGESTION	B SHALLOW GROUNDWATER
3 CONTAMINANTS IN GROUNDWATER	3 PERMEATION OF AND MIGRATION ALONG EXISTING UNDERGROUND SERVICES	C BEDROCK GROUNDWATER
	4 LEACHING FROM SOIL TO GROUNDWATER	D SURFACE WATER
	5 VERTICAL & HORIZONTAL MIGRATION OF CONTAMINATED GROUNDWATER	

Rev	Date	Detail	Made	Chk'd	App'd
Status: FOR INFORMATION					

NOTES:

Client: ELECTRICITY SUPPLY BOARD

Location: Inchicore Poolbeg Two 220 kV

Title: FIGURE 3 CONCEPTUAL SITE MODEL

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www.aecom.com

Design: ESB	Drawn: RDH		
Chk'd: CC	App'd: DM		
Date: JULY 2019	Scale: As Shown		
Project No. 60610407	Drg No. 3	Stat. .	Rev. 0

Appendix A Site Photographs

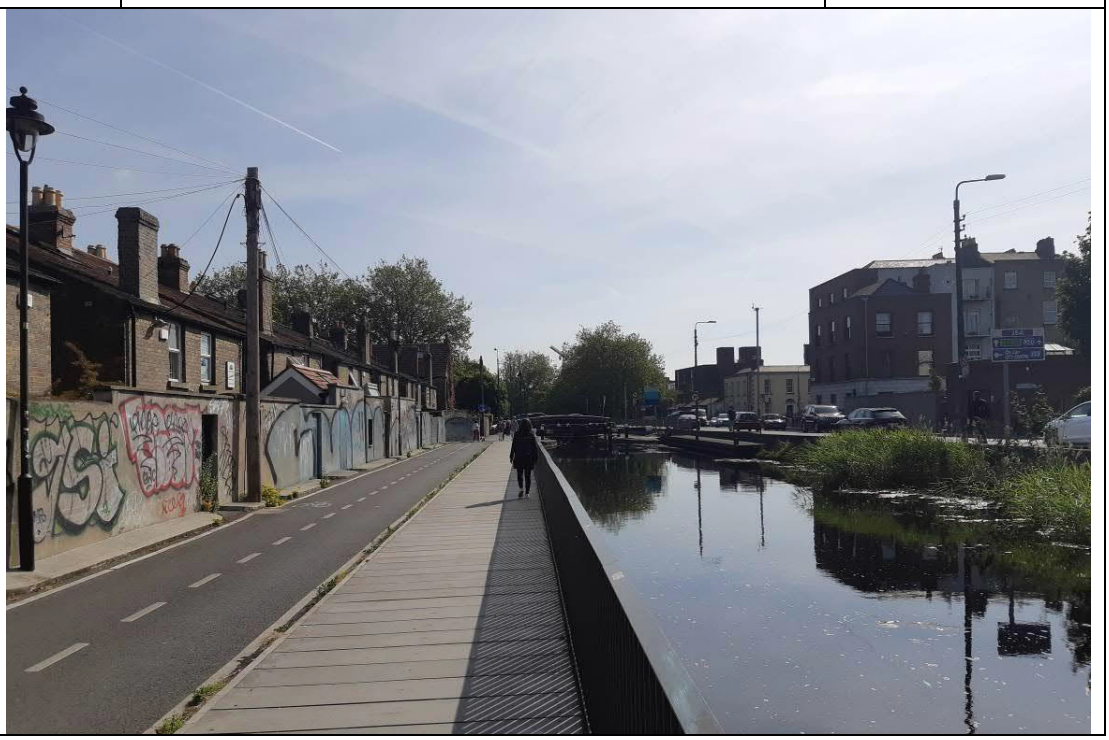
AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site 9: Inchicore – Poolbeg (Charlemont Place)	**Project No.** PR-427640

Date:
04 July 2019

Photo 1

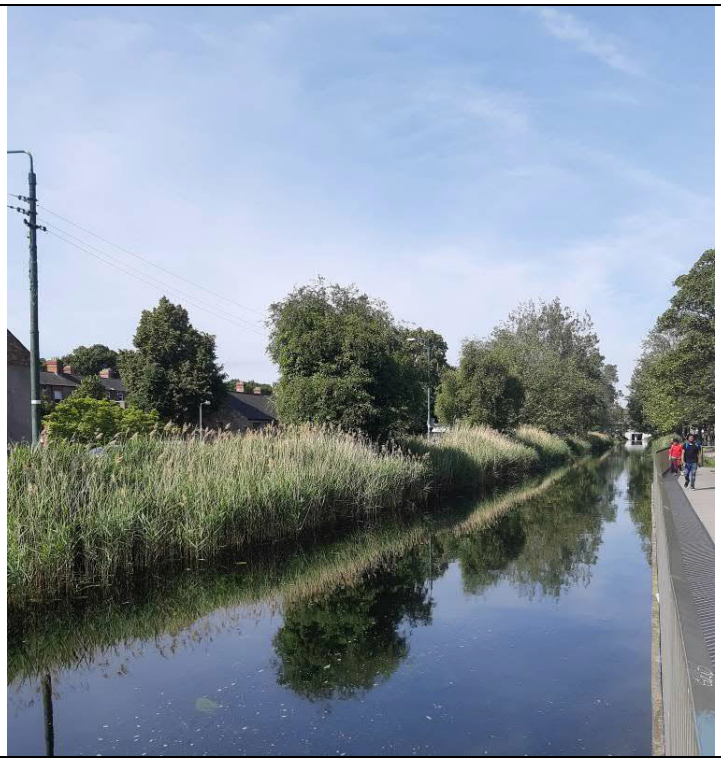


Description:

Looking east along the Grand Canal from the eastern extent of the site, showing terraced residential houses

Date:
04 July 2019

Photo 2



Description:

Southern bank of the Grand Canal adjacent to the site, showing established vegetation

AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site 9: Inchicore – Poolbeg (Charlemont Place)	**Project No.** PR-427640

Date:
04 July 2019

Photo 3

Description:

Looking south across Grand Canal towards residential houses on Dartmouth Walk

Date:
04 July 2019

Photo 4

Description:

Residential buildings immediately north of the site on Charlemont Place

AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site 9: Inchicore – Poolbeg (Charlemont Place)	**Project No.** PR-427640

Date: 04 July 2019

Photo 5

Description

Looking southwest across the Grand Canal at residential houses on Dartmouth Square and 2 Grand Parade commercial office building

Date: 04 July 2019

Photo 6

Description:

Looking north onto Harcourt Terrace from Charlemont Place at the indicative leak location

AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site 9: Inchicore – Poolbeg (Charlemont Place)	**Project No.** PR-427640

Date:
04 July 2019

Photo 7

Description

Looking north along Harcourt Terrace from the indicative leak location

Date:
04 July 2019

Photo 8

Description:

Looking south across the Grand Canal from the indicative leak location

AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site 9: Inchicore – Poolbeg (Charlemont Place)	**Project No.** PR-427640

Date:
04 July 2019

Photo 9

Description

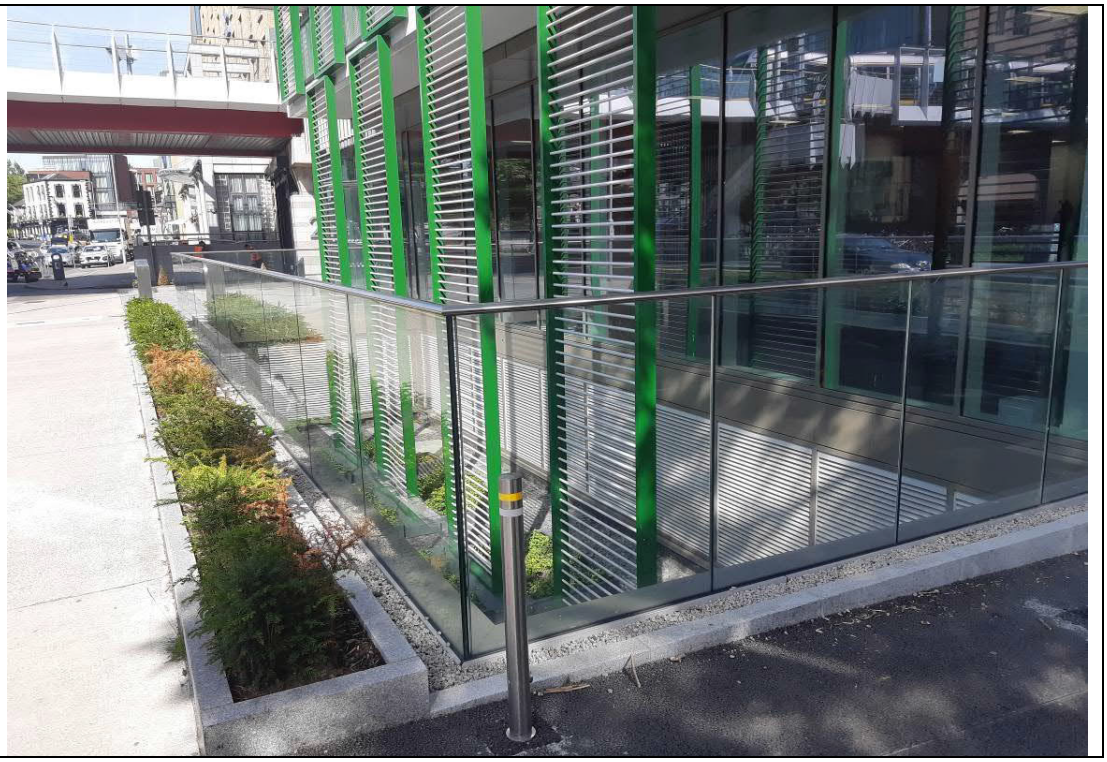
Looking east along Charlemont Place from the indicative leak location

Date:
04 July 2019

Photo 10

Description:

Commercial building on Charlemont Place adjacent to the site, with basement visible from street level



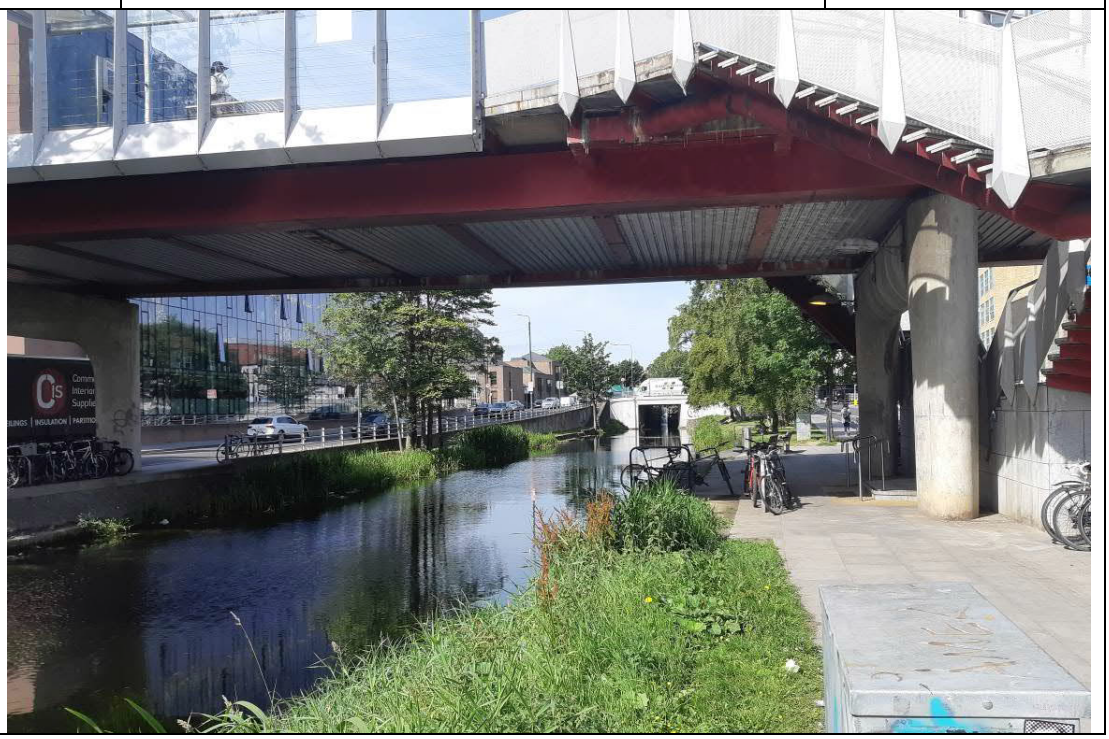
AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site 9: Inchicore – Poolbeg (Charlemont Place)	**Project No.** PR-427640

Date:
04 July 2019

Photo 11



Description

Looking west along Grand Canal towards Luas bridge

Date:
04 July 2019

Photo 12

Description:

Looking east along Grand Canal

AECOM

PHOTOGRAPHIC LOG

Client Name: ESB	**Site Location:** Site 9: Inchicore – Poolbeg (Charlemont Place)	**Project No.** PR-427640

Date:
04 July 2019

Photo 13

Description

Former Harcourt Terrace Garda Station, adjacent to indicative leak location

Appendix B PSA Template Report Table of Contents Cross Reference

EPA Template Table of Contents	Production Area Preliminary Site Assessment Report
Executive Summary	Executive Summary
1. Introduction	Section 1
1.1 Project Contractual Basis & Personnel Involved	Section 1
1.2 Background Information	Section 1.1
1.3 Project Objectives	Section 1.2
1.4 Scope of Works	Section 2
2. Source Audit Findings	Section 4
2.1 Current Site Operations	Section 4.1 to Section 4.2
2.2 Previous Site Operations	Section 4.3
2.3 Chemicals of Potential Concern	Section 4.4
3. Site Environmental Setting	Section 3
3.1 General Introduction	Section 3
3.2 Regional Geology and Hydrogeology	Section 3.2 and Section 3.4
3.3 Site Geology and Hydrogeology	Section 3.2 and Section 3.4
3.4 Summary of Previous Site Sampling and Monitoring Data	Not Applicable
4. Summary and Conclusions	Section 6
4.1 Summary and Conclusions	Section 6
4.2 Recommended Way Forward	Separate Cover Letter
5. References	Throughout Text