

Preliminary Site Assessment

Site 19 Inchicore - Marrowbone Lane 38 kV

Electricity Supply Board

Project number: PR-427640_ACM_RP_ENV_009_4

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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.

It should be noted that the effects of ground and water borne contamination on the environment are constantly under review, and authoritative guidance values are potentially subject to change. The conclusions presented herein are based on the guidance values available at the time this Report was prepared, however, no liability by AECOM can be accepted for the retrospective effects of any changes or amendments to these values.

The opinions expressed in this report and the comments and recommendations given are based on a desk assessment of readily available information and an initial site reconnaissance by an AECOM employee. At this stage intrusive investigations have yet to be undertaken at site to establish actual ground and groundwater conditions and to provide data for an assessment of the geo-environmental status 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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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 James's Walk and Forbes Lane, Dublin 8 (the site).

Electricity Supply Board (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 ESB at the site in September 2011 and repaired in June 2014. 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 Rivers Camac, Poddle and Liffey located approximately 650 m, 750 m and 830 m from the site respectively, although these waterbodies may be protected by low permeability clay deposits that are likely to be encountered beneath the site;
- The Grand Canal located 900 m south of the site, although this may be protected by low permeability clay (natural and/or engineered when the canal was constructed); and
- The groundwater aquifer beneath the site, although this may also be protected by low permeability clay deposits that are likely to be encountered beneath the site.

It is estimated that 14,562 litres of cable fluid was released between September 2011 to June 2014. 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 (19) Inchicore – Marrowbone Lane 38 kV (September 2011 – June 2014)	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.

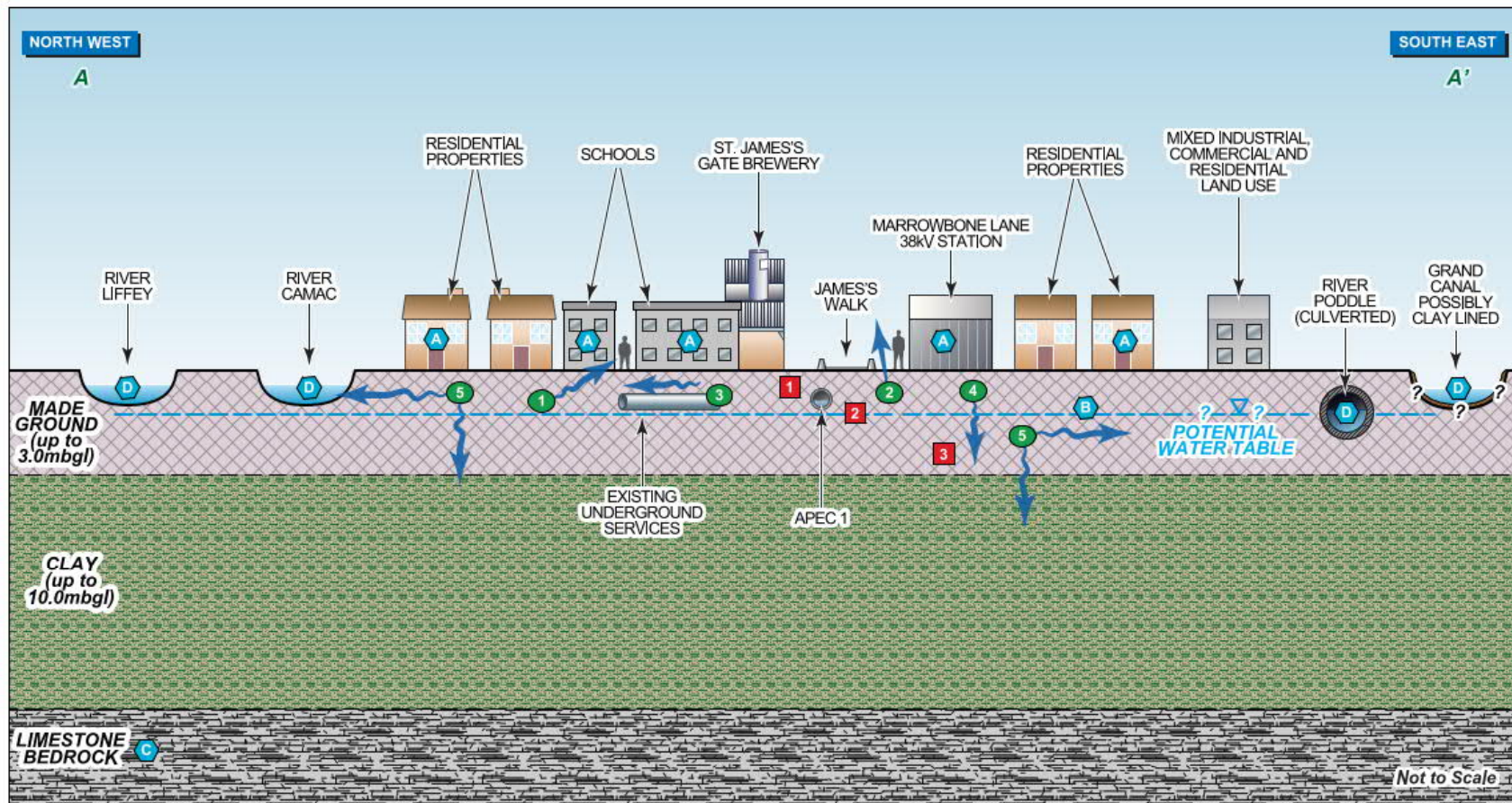
A low to moderate risk was identified to site users from the potential for vapour migration from mineral oil based cable fluid.

A low to moderate risk was also identified to site users from the migration of NAPL and potential breakdown products along preferential flow pathways such as existing underground services.

A low to moderate risk was identified to nearby surface water bodies via potential migration of cable fluid on groundwater. In addition, potential impact to the deeper groundwater aquifer was considered to be low to moderate due to the geology beneath the site.

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.



SOURCES	PATHWAYS	RECEPTORS
1 GROUND GAS	1 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		Client: ELECTRICITY SUPPLY BOARD	Location: SITE 19 Inchicore Marrowbone Lane 38 kV	Title: FIGURE 3 CONCEPTUAL SITE MODEL	AECOM <small>400 River Avenue, North Sydney, New South Wales 1585, Australia Tel: +61 (0) 2 955 5000 Fax: +61 (0) 2 955 5001 www.aecom.com</small>	Design: CSB Date: 02 Scale: As Shown Project No: 60610407 Rev: 3 Date: JULY 2018	Drawn: RCH Appr: CH Rev: 0	
FOR INFORMATION								

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_009	24 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) completed a Preliminary Site Assessment (PSA) of a cable fluid leak location for a site on James's Walk and Forbes Lane, Dublin 8, 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 ESB at the site in September 2011 and repaired in June 2014. 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 the above objective, the following scope of work was undertaken:

- A site walkover by AECOM staff (completed on 11 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 05 July 2019;
 - EPA Geoportal Site (<https://gis.epa.ie/EPAMaps>), accessed 05 July 2019;
 - EPA Incidents Database (<https://www.epa.ie/newsandevents/incidents/recent/>), accessed 05 July 2019;
 - Ordnance Survey of Ireland (OSI) (<http://geohive.ie>), accessed 05 July 2019;
 - Glucksman Map Library, Trinity College, Dublin, accessed 10 July 2019;
 - Office of Public Works (OPW) Flood Maps (<http://www.floodinfo.ie>), accessed 05 July 2019;
 - National Parks and Wildlife Service (NPWS) (<http://webgis.npws.ie/npwsviewer/>), accessed 05 July 2019;
 - National Waste Collection Permit Office (NWCPO) website (<http://www.nwcpo.ie/>), accessed 05 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 James's Walk and Forbes Lane, Dublin 8 (ITM 713991 733494). The elevation of the site is approximately 20 m above ordnance datum (m OD) where the surrounding topography is generally flat and urbanised.

3.2 Geology

The Teagasc Soils Map indicates that the site is underlain by made ground. Immediately surrounding the site to the south, east and west, the Quaternary geology of the site is comprised of till derived from the underlying limestone bedrock.

The GSI Bedrock Geology Map (scale 1:100,000) indicates the site is underlain by a dark fine-grained limestone and shale of the Lucan formation. No geological features are noted within the surrounding area.

A number of geotechnical records are located within the vicinity of the site. Two boreholes were drilled on St. James's Walk (R3064) which encountered made ground up to 3.2 metres below ground level (m bgl) underlain by stiff gravelly clay up to 9.5 m bgl. Bedrock was not encountered. Five boreholes were drilled on a site between Forbes Lane and Marrowbone Lane (R848), which encountered made ground up to 1.5 m bgl, underlain by sandy gravelly clay up to 7 m bgl. Again, bedrock was not encountered.

Bedrock was encountered in boreholes drilled approximately 150 m south of the site (R4796), at depths of approximately 8 m bgl.

3.3 Hydrology

3.3.1 Surface Water Features

The site lies within the lower catchment of the River Liffey and Dublin Bay, which covers an area of 1624 km².

The closest surface water body to the site is the Camac River, located approximately 650 m northwest of the site. The River Camac flows into the River Liffey at Heuston Station approximately 900 m northwest 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).

The River Poddle is located approximately 750 m east of the site and traverses heavily urbanised areas of Templeogue, Kimmage, Harold's Cross, Crumlin and Temple Bar; it is culverted for several sections of its course.

The Grand Canal (a pNHA) is located 900 m south of the site, which flows to the east and discharges to the River Liffey Estuary approximately 3.9 km northeast of the site, and then South Dublin Bay. 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.

Given their proximity to the site, both the Camac River and River Poddle are considered to be sensitive surface water receptors.

3.3.2 Surface Water Quality

The closest surface water feature in the wider area is the Camac River. The most recent reported EPA water quality status of the Camac River (monitoring station below Blackhorse Bridge) is a Q Value of 3 and a rating 'Poor'. The Water Framework Directive (WFD) ecological status of the Camac River is characterised as being 'at risk' of not meeting its WFD objectives.

The WFD status of the Poddle River is characterised as 'at risk' of not meeting its WFD objectives. The most recent reported EPA water quality status of the Poddle River (monitoring station 'The Priory' Kimmage Road) is a Q Value of 3 and a rating 'Poor'.

The most significant surface water feature in the wider area is the River Liffey Estuary. The 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 Grand Canal, located to the south of the site, is referred to as an Artificial Water Body (AWB) by the EPA under the 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' quality¹.

3.3.3 Flooding

According to OPW Flood Maps, the site 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.

Parts of the surrounding area located within a 1 km radius to the northwest and southeast of the site lie within the "River – Low Probability", "River – Medium Probability" and "River – High Probability" indicating that flooding by rivers may occur during moderate to very extreme event in these areas.

The site 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 67 millimetres/year (mm/yr).

Regional groundwater flow direction is likely to be to the north towards the River Liffey. 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 low; however 150 m south, the area is classed as moderate. 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 approximately 900 m south of the site, is a pNHA throughout its course.

South Dublin Bay, which is approximately 5 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 in the vicinity of the site. The NWCPO website indicated that there are two waste permitted facilities within 1 km of the site as summarised in Table 2 below.

Table 2 Dublin City County Council Waste Permitted Facilities within 1 km of the site

Authorisation Number	Facility Name	Location	Waste Activity
WFP-DC-11-0022-02	Mullen Scrap	31 & 32 Upper Clanbrassil Street Dublin 8	Scrap metal recycling
WFP-DC-11-0028-02	Mitchell Taylor Exports Limited	Newmarket Dublin 8	Edible oil and fat

3.6.2 Storm Water Discharges

Thirteen 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.
TPEFF0700D0034SW055	Ringsend	D0034-01
TPEFF0700D0034SW056	Ringsend	D0034-01
TPEFF0700D0034SW057	Ringsend	D0034-01
TPEFF0700D0034SW058	Ringsend	D0034-01
TPEFF0700D0034SW059	Ringsend	D0034-01
TPEFF0700D0034SW201	Ringsend	D0034-01
TPEFF0700D0034SW030	Ringsend	D0034-01
TPEFF0700D0034SW044	Ringsend	D0034-01
TPEFF0700D0034SW022	Ringsend	D0034-01
TPEFF0700D0034SW231	Ringsend	D0034-01
TPEFF0700D0034SW198	Ringsend	D0034-01
TPEFF0700D0034SW204	Ringsend	D0034-01
TPEFF0700D0034SW104	Ringsend	D0034-01

3.6.3 EPA Licensing

The EPA database of Waste licences was consulted and no active licensed waste facilities were identified within 1 km of the site.

The EPA database of Industrial Emissions (IE) and Integrated Pollution Control (IPC) licences was consulted which identified one licence within 1 km of the site of the site. Table 4 provides further details.

Table 4 Dublin City County Council Waste Facilities within 1 km of the Site

IE Register Number	Facility Name	Location	Distance to Site	Activity
P0301-04, IE Licensed	Diageo Ireland (St. James Gate)	St. James's Gate, Dublin 8, Dublin	180 m north	Brewing and combustion of fuel

According to the EPA website, there are no Section 4 discharges² to water within 1 km of the site and there have been no reported environmental incidents within 1 km of the site since 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 Rivers Camac, Poddle and Liffey located approximately 650 m, 750 m and 830 m from the site respectively, although these waterbodies may be protected by low permeability clay deposits likely to be encountered beneath the site;
- The Grand Canal located 900 m south of the site, although this may be protected by low permeability clay (natural and/or engineered when the canal was constructed); and
- The groundwater aquifer beneath the site, although this may also be protected by low permeability clay deposits likely to be encountered beneath the site.

² Section 4 discharges to water to support the characterisation of waterbodies for the 2nd Cycle of River Basin Management Planning. This dataset takes in account, among other datasets, the Section 4s dataset developed in 2005 as Point Source Pressures for the Article 5 Characterisation and Risk Assessment Report for the Water Framework Directive 2000/60/EC; (European Communities (Water Policy) Regulations 2003 (SI 722 of 2003)).

4. Source Audit Findings

4.1 Site Description

The site is situated in the Liberties area of Dublin's south inner city. The leak site was located along a 400 m section of a 38 kV fluid filled cable running from Inchicore to Marrowbone Lane (see Figure 2). The cable was installed in 1950 and is 3.9 km in length in its entire length. The location of the leak is at cable joint UG6027 – UG0455 (see Figure 2).

No evidence of impact from the cable fluid release was noted during the site walkover.

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 5.

Table 5 Adjacent Land Use

Site Boundary	Land Use
North	To the north of the site are four schools; Canal Way Educate Together National School, C.B.S James Street, St. James's Primary School and Mater Dei National School. Further north is mostly residential buildings along with the Guinness Storehouse located approximately 290 m north of the site. St Patrick's University Hospital and the Guinness Brewery are both located north of the site bordering Heuston station and the River Liffey.
East	St. Catherine's sports centre is located immediately south of the Marrowbone Lane 38 kV substation at the eastern extent of the site. The Dublin Corporation Water & Sanitary Division is located approximately 130 m east of the site. The land use in the surrounding area east of the site is mostly residential with some commercial and industrial land use located with the area also.
South	The land use to the south of the site is predominately residential with the Coombe Women's Hospital located approximately 460 m to the south of the site. The area is mostly residential with some commercial and industry also in the area.
West	Directly west of the site is mixture of greenfield and buildings that extend approximately 180 m west, following this is St. James' hospital which extends for approximately 600 m to the west including the current construction area. The Fatima and Rialto Luas stops are also located to the west and run parallel to St. James' hospital. St. James' hospital is bordered on its westside by a housing estate that extends for over 1 km.

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 completed. A summary of the findings is presented in Table 6.

Table 6 Historic Map and Aerial Photograph Review

Year	Description
1837 to 1842 (OSI)	The earliest online map is from between 1837 to 1842. Forbes Lane is present and a section of the Grand Canal (now infilled) is also present immediately west of the site flowing south to north to the Grand Canal Docks. The City Basin is located to the northwest of the site. There is a distillery located immediately south of the site. The land to the north and east is heavily developed with a mixture of residential and commercial buildings. While the land to the south and west has been less developed. The land to the west contains the South Dublin Union Workhouse.
1888 to 1913 (OSI)	The next available online map is from between 1888-1913. In this map the distillery is still present to the south of the site there are also four tanks located near the site. The Grand Canal Dock is now the Grand Canal Harbour. There are two schools (Christian Brothers' School and St. James's School) both located to the northwest of the site. The City Basin has

Year	Description
	been renamed as James's Basin. There is a hospital located to the northwest beside James's Basin. There is a Tannery and Glue Works approximately 250 - 300 m to the east of the site. The surrounding area has been more developed to the west and south.
1847 (Five feet to one statute mile) Trinity Maps	The land to the north and east of the site is developed; however, the land to the west has not been developed. Forbes Lane is present running west to east. The Grand Canal borders the site to the west, running north to south. The distillery is still located to the south of the site. There is a timber yard and Liberty Basin that borders the site to the north. Marrowbone Lane is to the east running southwest to northeast. Pim Street is perpendicular to the north side of Forbes Street. There is a scavenging depot to the east of the site. To the west beyond the Grand Canal is a large body of water named City Basin. The River Poddle runs from the southwest to the distillery.
1864 (Five feet to one statute mile) Trinity Maps	The timber yard is no longer present. The distillery is still located to the south of the site. To the west of the distillery is a building named as Walworth. The land to the west of the Grand Canal has been developed.
1887 (Five feet to one statute mile) Trinity Maps	The Grand Canal Harbour is located to the north of the site. The development to the west is labelled as South Union Workhouse; five tanks are indicated. There is also a hospital located to the west. The Liberty Basin is no longer present.
1907 (Five feet to one statute mile) Trinity Maps	Long's Place is shown on the eastern bank of the Grand Canal running north to south. The distillery is still located to the south of the site; a tank is indicated on the property. Portland Works (Malt Roasting) is located to the northeast of the site. A large tank is located to the southeast of the site on the eastern side of Marrowbone Lane. A Saw Mill is located to the northwest.
1943 (1:1,250) Trinity Maps	The distillery is now labelled the Portland Grain Store and Delphenium Pottery Works. Basin View opposite the site, across the Grand Canal, contains tanks. The South Union Workhouse is now labelled as St. Kevin's Institution. The City Basin is no longer present (presume infilled). There are no other major changes compared to the previous historical map.
1969 (1:1,000) Trinity Maps	There are several factories that are located in the surrounding area. The Dept. of Public Lighting is to the east of the site. There is an electrical substation located to the east, off of Marrowbone Lane, there is also an electrical substation to the northeast also off of Marrowbone Lane. A grain store is indicated where Portland Works used to be located. James's Walk runs along the southern and eastern bank of the Grand Canal.
1988 (1:1,000) Trinity Maps	The Grand Canal is no longer present and has been diverted further to the west. There is a telephone exchange located on the corner of Forbes Lane, within the property is an electrical substation. There are two more electrical substations also shown on this map; one is located east of the site on Marrowbone Lane, while the other is to the northeast approximately 400 m.
1995 (OSI)	The 1995 photograph shows the site as seen in modern day (heavily developed) with both Forbes Lane and James's Walk present. The Grand Canal no longer flows by the site as it is diverted approximately 1.2 km west of the site. St. James's Hospital is also present.
2000 (OSI)	There haven't been any major changes since the previous photograph. There has been some construction to the north of the site near what used to be the Grand Canal Harbour.
2005 (OSI)	The Luas tram line is present in the 2005 aerial photograph, which is the most significant change compared to previous years.

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 is 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 14,562 litres of cable fluid was released between September 2011 and June 2014. As the leak size is greater than the circuit volume (10,606 litres), it is assumed that the original fluid that was present when the cable was installed has been replaced.

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 & Guillaume 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 7 Linear Alkyl Benzene Physical and Chemical Properties

Property	Description
Molecular Weight	239-243 g/mol
Melting Point	<-70°C
Boiling Point	251-320°C @ 1 atm (OECD)
Vapour Pressure @ 25°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°C
Flash Point	140°C
Explosive Properties	None

LAB (C12) has a calculated octanol-water partition coefficient (Koc) of 2.2×10^4 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 8 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 (Fe³⁺) and manganese (Mn³⁺). These processes could lead to reducing conditions in the groundwater, with depleted concentrations of sulphate (SO₄⁻) and nitrate (NO₃⁻) and increased concentrations of dissolved methane (CH₄), ferrous iron (Fe²⁺) and dissolved manganese (Mn²⁺). 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:

- Current and historic industrial practices in the vicinity of the site;
- Fill materials (understood to be up to 3 m bgl) present in the surrounding area; and
- Fuel / chemicals (e.g. for back-up generators) present in industrial 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 9.

Table 9 Area of Potential Environmental Concern

Number	APEC	Potential Contaminants of Concern	Potential Media Impacted
1	Leak at (19) Inchicore – Marrowbone Lane 38 kV (September 2011 – June 2014)	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 James’s Walk and Forbes Lane.

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 14 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 10 below.

Table 10 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 11 below.

Table 11 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 below.

Table 12 Level of Risk for Potential Hazard Definition

Probability of Risk	Potential Severity			
	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 12 is provided in the following table:

Table 13 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 3 m of made ground underlain by clay up to a depth of 10 m bgl. Limestone bedrock is assumed to be present at a depth of approximately 10 m bgl;
- Groundwater is assumed to be present at relatively shallow depths within the made ground;
- It is assumed that there 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 do not have basements.

The preliminary CSM is presented graphically in Figure 3.

Table 14 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.	Site users in a commercial/low to high density residential 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 in the vicinity of the site. 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.	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 NAPL through plastic water supply pipes.	Site users in a commercial/low to high density residential with plant uptake scenario.	Medium	Unlikely	Low	<p>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 fraction³ 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.</p> <p>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.</p> <p>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.</p>
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 Rivers Camac, Poddle and Liffey and the Grand Canal.	Medium	Unlikely	Low	<p>It is understood that the leak at this location was repaired in June 2014. Given that the nearest surface water body is relatively distant from the site (650 m) and that there has been no reported evidence of impact or incidents of cable fluid release, it is likely that NAPL released from the cable has stabilised over the 5-year period since the leak was repaired and risk to surface water bodies is low.</p>
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	<p>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.</p>

Source	Pathway	Receptor	Severity	Likelihood	Potential Risk	Discussion
NAPL	Migration in saturated and unsaturated soil.	Groundwater beneath the site.	Medium	Likely	Moderate	Considering the volume of cable fluid released over the 31-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.	Groundwater in superficial deposits beneath the site.	Medium	Likely	Moderate	Considering the volume of cable fluid released over the 31-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	Horizontal migration of contaminants through groundwater to nearby surface water receptors.	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 bodies including the Rivers Camac, Poddle and Liffey and the Grand Canal.	Medium	Low Likelihood	Low / Moderate	The potential risk to nearby surface water bodies 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. Given the canal is likely lined with impermeable material, the likelihood of horizontal migration through to the canal waters is considered low. Further assessment would be required to fully evaluate this potential risk.

6. Conclusions

AECOM completed a Preliminary Site Assessment of the site located at James's Walk and Forbes Lane, Dublin 8. 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 Rivers Camac, Poddle and Liffey located approximately 650 m, 750 m and 830 m from the site respectively, although these waterbodies may be protected by low permeability clay deposits, which are likely to be encountered beneath the site;
- The Grand Canal located 900 m south of the site, although this may be protected by low permeability clay (natural and/or engineered when the canal was constructed); 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 14,562 litres of cable fluid was released between September 2011 and June 2014. 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 15 Area of Potential Environmental Concern

Number	APEC	Potential Contaminants of Concern	Potential Media Impacted
1	Leak at (19) Inchicore – Marrowbone Lane 38 kV (September 2011 – June 2014)	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.

A low to moderate risk was also identified to site users from the migration of NAPL and potential breakdown products along preferential flow pathways such as existing underground services.

A low to moderate risk was identified to nearby surface water bodies via potential migration of cable fluid on groundwater. In addition, potential impact to the deeper groundwater aquifer was considered to be low to moderate due to the geology beneath the site.

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

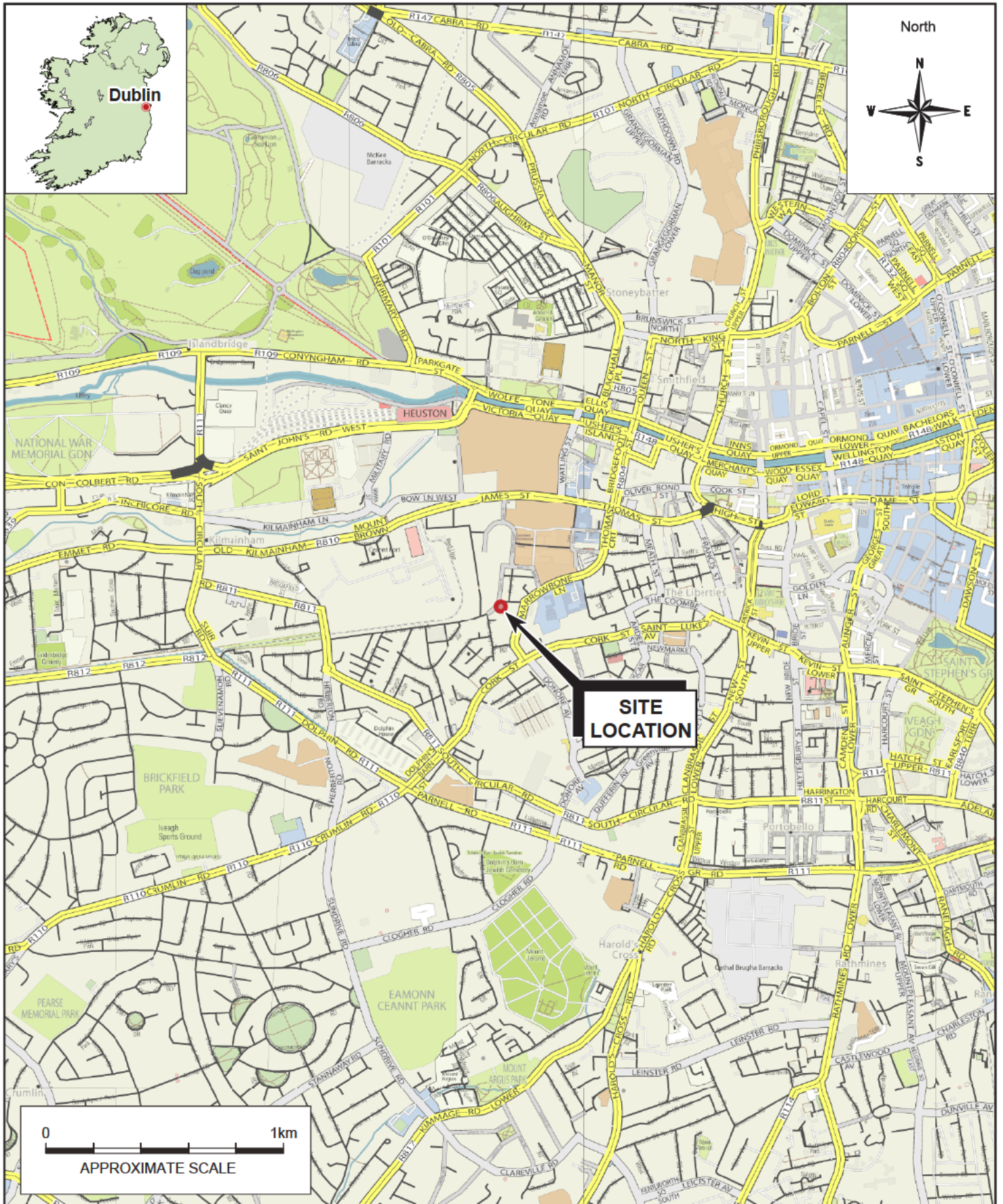
assessment may be required to investigate assumptions made in the CSM and quantify whether a potential risk actually exists. Generally, where a low or very low risk has been identified further assessment may not be deemed necessary to assess a particular SPR linkage, although further assessment may be 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

Figure 1. Site Location Plan

Figure 2. Areas of Potential Environmental Concern

Figure 3. Conceptual Site Model



Client
ELECTRICITY SUPPLY BOARD

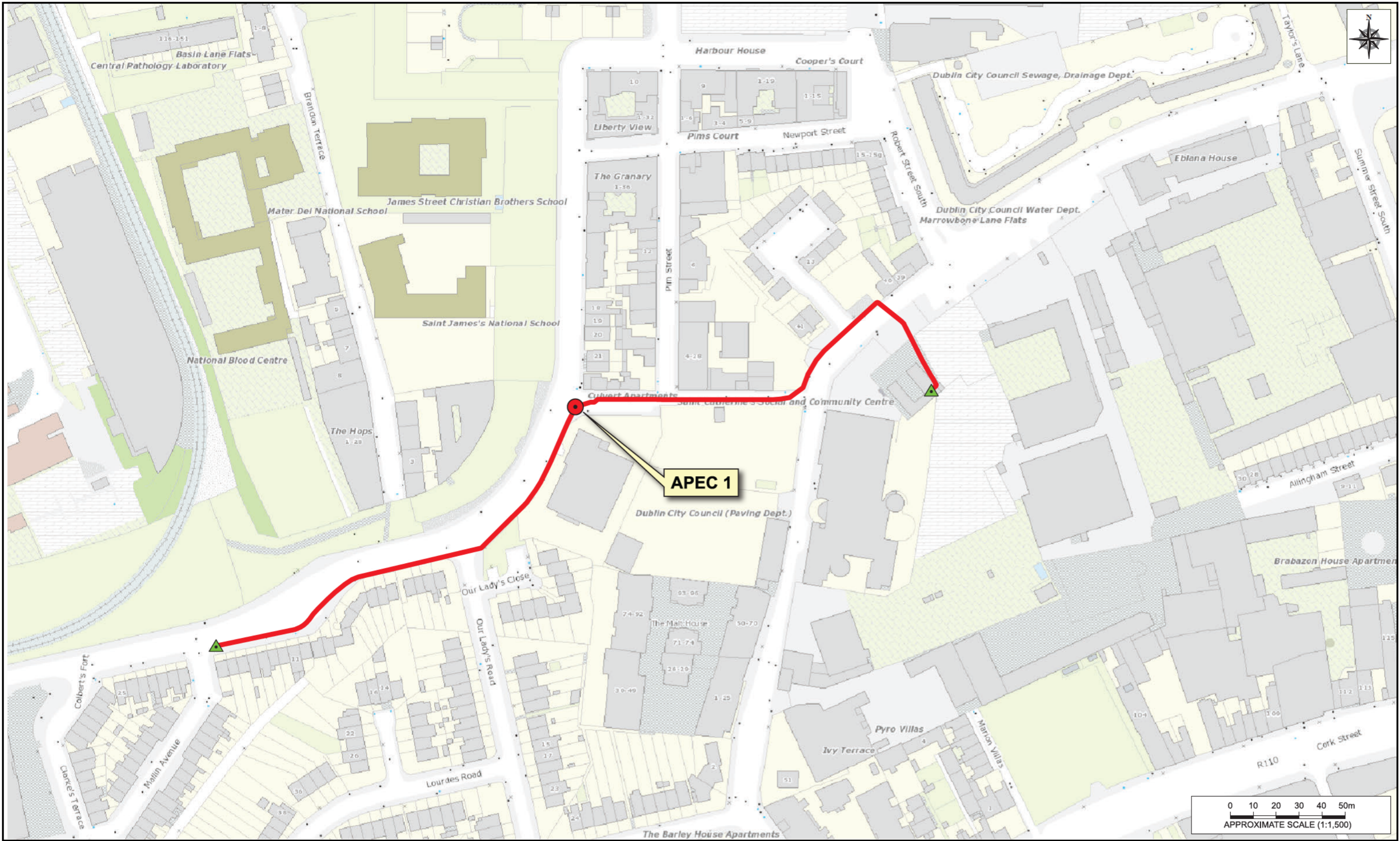
Location
SITE 18
Inchicore
Marrowbone Lane 38 kV

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 RH	ILLUSTRATED CC	CHECKED CC	APPROVED DM	DATE JULY 19
SCALE N.T.S	Job No. 60610407		REV. 0	



KEY:

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

Rev	Date	Drawn	Check	App'd

Status: **FOR INFORMATION**

NOTES:	

Client: **ELECTRICITY SUPPLY BOARD**

Location: **SITE 19
Inchicore
Marrowbone Lane 38 kV**

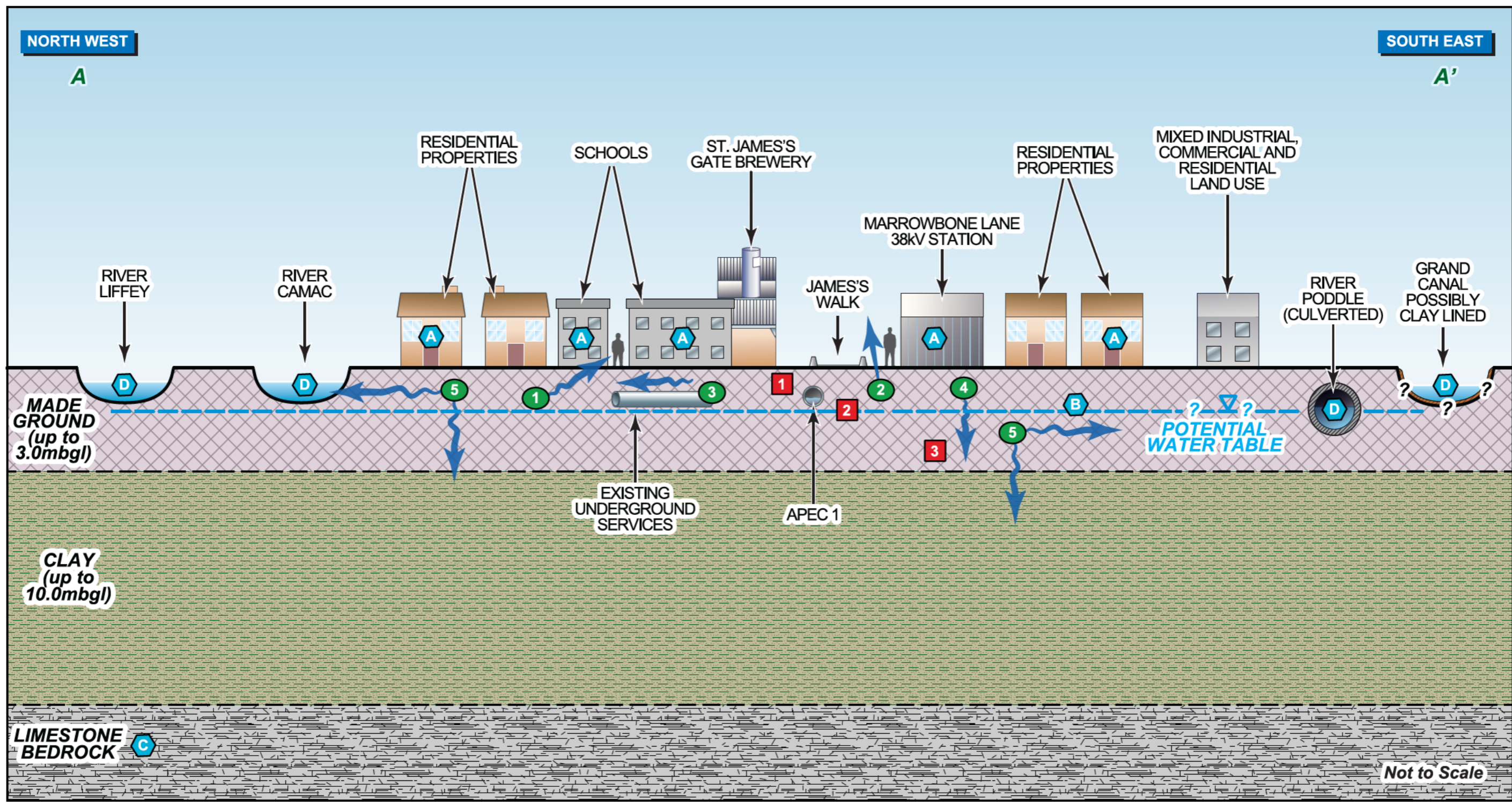
Title: **FIGURE 2
SITE LAYOUT PLAN**

AECOM

4th Floor, Adelphi Plaza, Adelphi Centre, George's Street Upper, Dun Laoghaire, Co. Dublin, Ireland.

Tel: +353 (0) 1 293 3200
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: 60610407	Dwg No: 2



SOURCES	
1	GROUND GAS
2	NON-VOLATILE CONTAMINANTS IN SOIL
3	CONTAMINANTS IN GROUNDWATER

PATHWAYS	
1	GAS MIGRATION
2	DERMAL CONTACT / DUST INGESTION
3	PERMEATION OF AND MIGRATION ALONG EXISTING UNDERGROUND SERVICES
4	LEACHING FROM SOIL TO GROUNDWATER
5	VERTICAL & HORIZONTAL MIGRATION OF CONTAMINATED GROUNDWATER

RECEPTORS	
A	RESIDENTIAL / COMMERCIAL SITE USERS
B	SHALLOW GROUNDWATER
C	BEDROCK GROUNDWATER
D	SURFACE WATER

Rev	Date	Detail	Made	Checked	Approved
Status: FOR INFORMATION					

NOTES:

Client: ELECTRICITY SUPPLY BOARD


Location: **SITE 19**
Inchicore
Marrowbone Lane 38 kv

Title: **FIGURE 3**
CONCEPTUAL SITE MODEL

AECOM
4th Floor, Adelphi Plaza, Adelphi
Centre, George's Street Upper,
Dun Laoghaire, Co. Dublin, Ireland.
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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	Dwg No: 3
Stat: -	Rev: 0

Appendix A Site Photographs

Client Name: ESB	Site Location: Site: 19 Inchicore – Marrowbone Lane 38 kV	Project No. PR-427640
Date: 11 July 2019		
Description Substation located 200m from the indicative leak location.		

Date: 11 July 2019		
Description: The substation is bound to the north east by a recycling centre.		

Client Name:
ESB

Site Location:
Site: 19 Inchicore – Marrowbone Lane 38 kV

Project No.
PR-427640

Date:
11 July 2019

Description

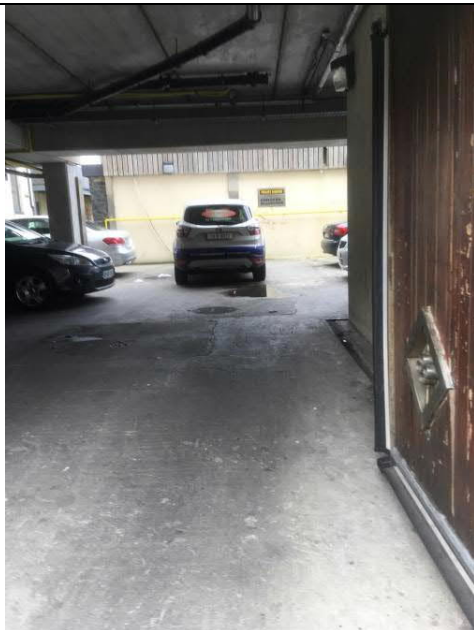
Apex Electrical located long the likely joint section of leak on the corner of Forbes Lane and Marrowbone Lane.




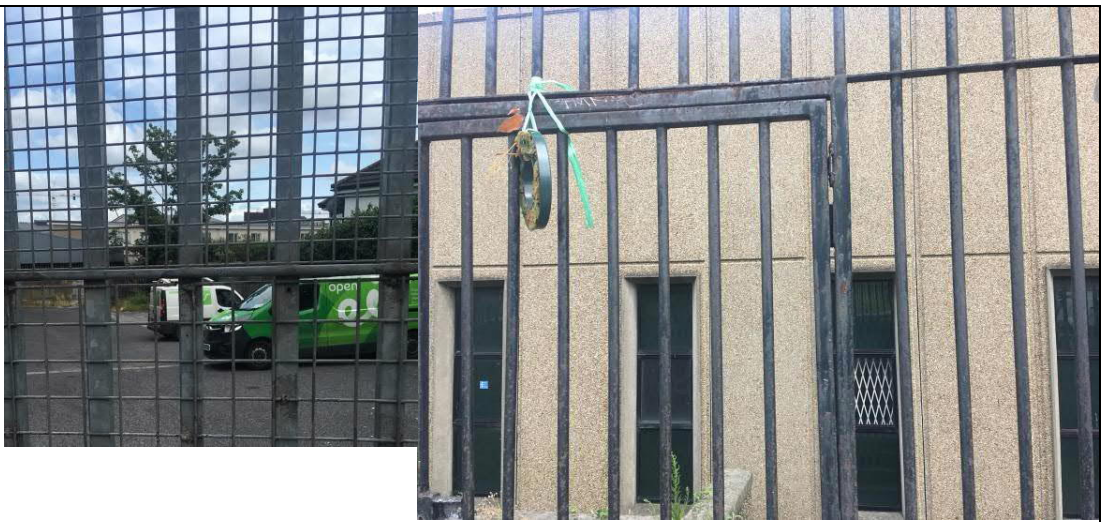
Date:
11 July 2019

Description:


Facing north on Forbes Lane. Two story terraced housing and apartment blocks. No evidence for basement parking.



Client Name: ESB	Site Location: Site: 19 Inchicore – Marrowbone Lane 38 kV	Project No. PR-427640
Date: 11 July 2019		
Description Facing east on Pim Street		

Date: 11 July 2019		
Description: The likely joint section of the leak is bound to the south by a gated compound likely owned by Eir.		

Client Name: ESB	Site Location: Site: 19 Inchicore – Marrowbone Lane 38 kV	Project No. PR-427640
Date: 11 July 2019		
Description Facing west from the leak location. Compound appears to consist of an overgrown private space with a disused building titled 'Water Equipment'.		

Date: 11 July 2019		
Description: South west of the leak location. The Hops apartment complex and Liberty Saints RFC		

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

