Environmental Assessment of Contamination and Remediation

Volume 1

AS PART OF PREPARATION OF THE

STRATEGIC DEVELOPMENT ZONE PLANNING SCHEME

FOR

POOLBEG WEST

(SI No. 279 of 2016)

for: **Dublin City Council**

Civic Offices

Wood Quay

Dublin 8

by: **CAAS Ltd.**

2nd Floor, The Courtyard,

25 Great Strand Street,

Dublin 1

January 2017

Contents

Terms of Reference

This report has been prepared by CAAS Ltd. to provide an Environmental Assessment of Contamination and Remediation for the Poolbeg Planning Scheme Area.

It provides a desk-based assessment that is appropriate to the scale and level of detail of the Planning Scheme. It has regard to the EPA Guidance on the Management of Contaminated Land and Groundwater at EPA Licenced Sites. It provides a review of available documentation, a conceptual site model for the area of the Planning Scheme, a high-level qualitative risk assessment to establish low, medium and high risk areas. It also includes outline remediation measures.

Development proposals for individual sites within the Scheme area will require detailed site specific investigations and contaminated land risk assessments.

Study Team

This assessment has been led by Paul Fingleton, under Director, Conor Skehan. Each have over 25 years' experience in preparation and review of environmental assessments for projects and plans. David L'Estrange, who is leading the parallel Strategic Environmental Assessment of the Planning Scheme and has over 10 years' experience in SEA of Plans has also contributed to this assessment.

Review of Documentation

Document	Main Points
Site Description of IGB Site ARUP, 2016	• Site history and description • Remediation Works • Services
North Lotts & Grand Canal Dock Planning Scheme SEA ER Planning and Economic Development Department, Dublin City Council, 2013	• SEA ER (including NTS) • Integration of SEA Process with Appropriate Assessment and Flood Risk Assessment Process • Matrix and Evaluation of the Planning Scheme • North Lotts and Grand Canal Dock Flood Risk Assessment
Desktop Study and Qualitative Risk Assessment of Potentially Contaminated Undeveloped Sites within North Lotts and Grand Canal Dock Flannery Nagel Environmental Ltd, 2012 (DCC SDZ Risk Assessment of Potentially Contaminated Undeveloped Sites)	• Source-pathway-receptor identification and assessment of severity and consequence • Qualitative risk assessment • Risk Assessment findings • Outline remediation measures
Poolbeg Peninsula : Geomorphological Perspectives J.A.G. Cooper & D.W.T. Jackson (not dated)	• Geomorphological & Sedimentological aspects of proposed work • Dune accumulation • Changes in sea bed

Section 7 of EIS for Dublin Docklands Development Authority Poolbeg Peninsula Planning Scheme – Geotechnical, Soils & Ground Conditions Malone O'Regan, 2009	• Existing Conditions • Contaminated Land • Appendix 7.1 is Geotechnical Report for Poolbeg Peninsula Planning Scheme by Mott MacDonald, May 2008 • Appendix 7.2 is "Investigation of Possible Oil Leak at South Bank Road, Ringsend, Dublin" from the 2004 EIS for the Fabrizia Mixed Use proposal, by NES
DDDA Civic Infrastructure Audit Poolbeg and Sandymount DDDA, 2008 (*DDDA Civic Infrastructure Audit Poolbeg & Sandymount Dublin Docklands Development Authority Final Report April 2008*)	• A detailed land use study (included identifying civic infrastructure Facilities) in the Poolbeg / Sandymount study area • Current situation/ Demographics/ Community/Gap analysis/ Recommendations • Area analysis and school analysis
Environmental Sustainability and Traffic & Transportation Baseline Report Cunnane Stratton Reynolds, RPS Ireland and MVA Consultancy, 2008 (*Environmental Impact Statement For Poolbeg Peninsula Emerging Draft Planning Scheme Environmental, Sustainability and Traffic & Transportation Baseline Report August 2008*)	• Description of the emerging Draft Planning Scheme; area and scope • Baseline Overview (EIS Chapters + Seveso Sites)
Dublin Waste to Energy Project EIS Elsam, 2006	• Appendix 11.1 is Geo-environmental Engineering Assessment
Dublin South Bank Strategic Development Framework Final Report DGEW, 2002 (*for Dublin City Council*)	• Detailed evaluation of the site • Drivers for change/ Character Area Approach/ Landscape and View Structure/Movement & Access/ Land Use Pattern/ Amenity Provision/ Volumetric Expression/ Potential Capacity/ Phasing

Assessment Objectives

This assessment has been prepared to provide an appropriate level of assessment of contaminated land issues for use in the development of the Planning Scheme and its associated Strategic Environmental Assessment. The assessment is strategic only and it prepared on the understanding that site specific desk study and intrusive investigations will be carried out as part of the detailed design and consent procedures for each site.

Figure 1 Site Characterisation Zones used in this assessment

Introduction

The site can be characterised as five distinct areas of use. The detailed site characteristics are assessed using these areas as a basis for description and analysis.

A The Western Lands – the former Irish Glass Bottle site

An unoccupied area that has been cleared of contaminated soils

B The Northern Lands – Dublin Port lands

Lands currently used for a range of port-related and logistics uses

C The Central Lands – the Fabrizia site

An unoccupied area

D The Eastern Lands – the ESB site

Lands with a variety of active uses

E The Shore Lands

Amenity areas used for public recreation.

Baseline

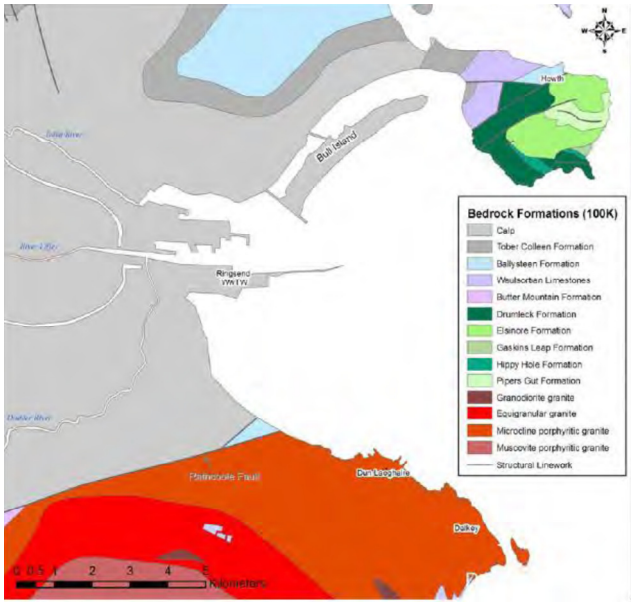

Figure 2 Generalised Bedrock Geology - Extract from the Ringsend WWTP Extension EIS

Geology

Bedrock Geology

The bedrock underlying the local area comprised moderately strong to strong, slightly laminated, grey to dark grey, fine to medium grained limestone with layers of Shale and occasional calcite veining.

Ground investigations carried out previously in the immediate vicinity of the Site indicate rock head levels between 36m and 45m bgl (-32mOD and -40mOD). Bedrock is completely obscured by an extensive blanket of Quaternary drift deposits and recent reclamation fill.

Drift Geology and Recent Deposits

Drift is a general term applied to all mineral material (clay, sand, silt, boulders) transported by a glacier and deposited directly by or from the ice, or by running water emanating from the glacier. It generally applies to Pleistocene glacial deposits.

The drift geology of the area principally reflects the depositional process of the last glaciation when an extensive ice sheet that extended into the Irish Sea covered the region. Typically during the ice advance boulder clays were deposited sub-glacially as lodgement till over the eroded rock head surface, whilst moraine deposits were laid down at the glacier margins.

Subsequently, with the progressive retreat of the ice sheet from the region, fluvio-glacial deposits (sand, gravel and silt) were laid down by melt waters discharging from the front of the glacier. Recent deposition prior to reclamation of the site principally reflects marine erosional and depositional processes, which have modified the glacial deposits.

The site is located entirely on made ground (fill deposits). Site lies on an area of reclamation that was formally the foreshore. Reclamation fill covers all remnants of the natural ground. The reclamation fill was deposited in the early 1970s, consisting of between 1.5m and 5.5m in thickness consisting of a mixture of gravels, sands, silts and clays, including rubble, bricks, concrete, glass, timber and cinders.

The attached Baseline Report [Volume 2] contains more detail on subsurface conditions.

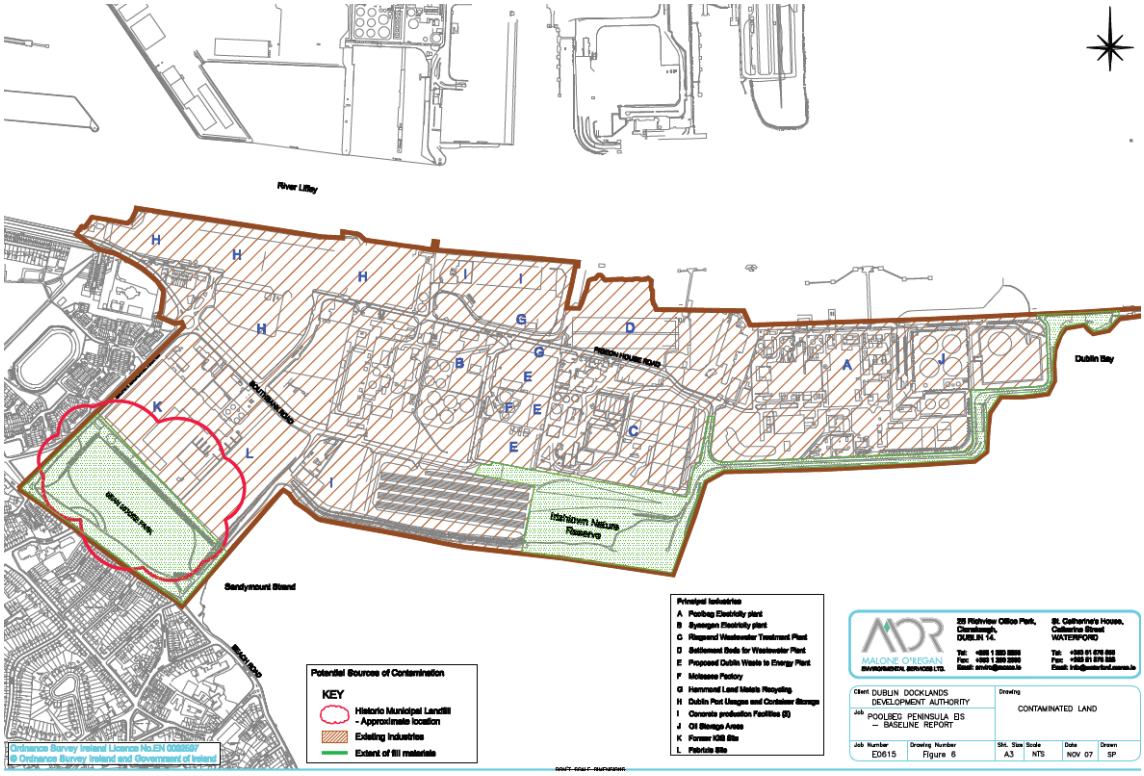

Figure 3 Summary of previous land-uses Extract from 2008 EIS Baseline DCC

Historical Background and Uses.

The eastern edge of the Draft Planning Scheme Area was first used in 1903 to generate electricity in Pigeon House. Land further to the east was subsequently reclaimed where Poolbeg Power Station, powered by oil, was opened in 1971.

Lands to the west were historically used by Dublin City Council as a landfill. The Irishtown Tip Head, which was reported to have commenced operation in 1948, was closed and capped in 1978. It is reported that the landfill was worked in a sequential fashion, with landfilling activities moving in an easterly direction over time (AWN, 2004). Following capping of the former landfill area around 1978, lands to the west of the overall development lands were leased to Irish Glass Bottlers (IGB) Ltd. until 2004. The IGB plant was also built on part of this landfill.

The central area of the site was and is currently used for the tank storage of molasses and oil. Other areas of the site were used by Dublin Port for storage and other associated port-related activities.

Areas within ESB lands have been used for pipe construction and latterly as a construction compound.

Concrete production facilities and a scrap metal works also currently operate in the scheme area.

Site Decommissioning, Demolition and Remediation (DDR) works were completed at the former Irish Glass Bottle facility between December 2007 and December 2008. The DDR works were designed to remove all vestiges of plant, buildings, operations and ancillary services associated with glass bottle manufacture at the facility in order to facilitate surrender of the site IPC Licence from the EPA.

Made Ground/ Fill Material

The made ground consists of distinct types of material which include the municipal waste filled as part of the Irishtown Tip Head (1945-1978) and general construction and demolition (C&D) waste. It is also reported that hydraulic fill material was used to reclaim distinct areas of the site (Arup, 2006).

Mott MacDonald Pettit (2008) report that site investigations in the Poolbeg area have previously logged made ground as being 1.6 to 5.6m in thickness. Typically, builder's rubble and similar dry fill were used to construct roads at locations to the west of the peninsula; landfill material was then tipped on either side of the roads.

Historically, the Fabrizia and IGB sites were constructed upon part of a Dublin Corporation landfill. It is understood that the general public also dumped refuse in this area during this period. The domestic and other waste beneath this site is expected to have been in the ground for somewhere in the region of 30 to 50 years. No soil gas venting or collection systems were installed on these sites during operation or after closure. Therefore landfill gas could potentially be still present (see further comment under Section 7.3.7).

There are no records available as to the exact types and quantities of materials which were dumped at the different sites across the Draft Scheme Area. However, from an examination of the trial pit logs and boreholes from site investigations carried out on the Fabrizia and IGB sites and from a review of a geotechnical assessment report produced by Mott MacDonald Pettit (2008) it would appear that much of the fill comprised of domestic and Construction and Demolition (C&D) waste. The composition varied greatly but commonly consist of a mixture of gravels, sands, silts, clays, rubble, bricks, concrete, glass, timber, concrete slabs, cabling, piping, rags, metal household containers and cinders (non-exhaustive list).

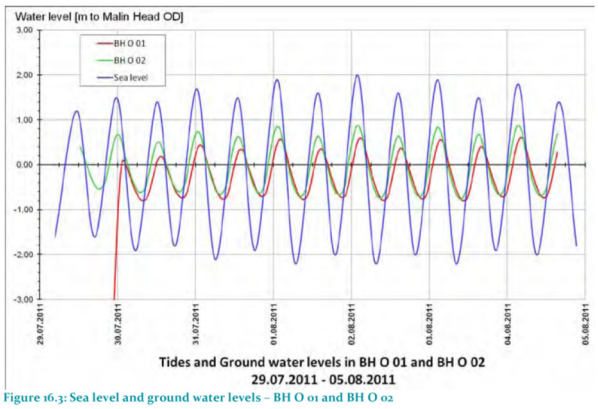

Figure 16.3: Sea level and ground water levels – BH O 01 and BH O 02

Figure 4 Extract from the Ringsend WWTP Extension EIS illustrating the link between tidal movements and groundwater levels

Hydrogeology

Groundwater movement in the region is likely to move principally in the drift layers rather than the hard limestone bedrock. The flow will also be restricted mainly to the sand and gravel drift layers since the stiff clay layers are less permeable. Given that the Peninsula is surrounded three sides by the sea and that no part of the Peninsula is more than 500m from the sea, tide levels will have a significant influence on groundwater. Previous studies suggest that groundwater is likely to be encountered at depths of 2m to 4m below ground level – i.e. tying in with high tide levels. See Figure above] Shallow groundwater across the Site was interpreted to flow from generally west to east.

The effect of the sea is also seen in groundwater quality. Saline intrusion is likely meaning that the water is likely to be brackish. The shallow depths of soil cover over the groundwater table means the groundwater in the area would be classified as highly vulnerable. This combined with the industrial history of the area means that much of the groundwater in the area is likely to be polluted. Previous studies have confirmed this.

The Final Characterisation Report of the Eastern River Basin District says that the Dublin City water body is one of only two groundwater bodies in the entire Eastern River Basin District that is classified as being “At Risk of not reaching good status”.

Under the EU’s Groundwater Directive, there is a requirement to improve groundwater quality regardless of whether or not it is ever intended to use it. Remediation measures associated with the proposed works may lead to some improvement in groundwater quality but should certainly lead to no reduction in quality.

Contamination

Indications at this stage are that some level of contamination can be expected in most areas of the Peninsula[1]. This is due to the previous history of landfilling and reclamation and the many heavy industrial uses that have been in place on the Peninsula. The extent of contamination is likely to vary widely.

Landfill gases are also likely to be encountered at some sites with significant methane concentrations having been noted in previous studies.

For less serious contamination, it may be possible to trap the contaminants using material such as dense, impermeable clays. Provision for venting of gases may still be required. It should be noted that this approach is only really practical if deep or extensive excavations are not required.

There is considerable evidence of low level contamination with hydrocarbons across the entire Docklands area, including the Poolbeg Peninsula. These include total Petroleum Hydrocarbons and Polynuclear Aromatic Hydrocarbons (PAHs). These can come from oil or tar or from burnt tires or domestic waste. In some area, this material is in

concentrations above intervention limits and may need to be removed off site or treated.

There have been reports of high sulphate levels in parts of the Docklands including the Poolbeg Peninsula, meaning that Sulphate Resisting Cement may need to be considered on some sites.

Volatile Organic Compounds have been detected in previous studies. These would include benzene which is a proven carcinogen, as well as xylene, toluene and ethylbenzene.

Toxic metal including arsenic have been found in concentrations above intervention limits. Other heavy metals encountered included barium, chromium, mercury, nickel, lead and tin.

In many areas it will not be sufficiently contaminated to require that level of treatment. However, hydrocarbons can have very significant impacts on water pipes particularly the modern High Performance Polyethylene (HPPE) pipes which are now commonly used. Hydrocarbons can migrate through the walls of these pipes causing drinking water contamination. For this reason, pollutant resistant pipes are frequently specified in the Dockland areas. These would include, for example, aluminium lined HPPE pipes which are resistant to hydrocarbon ingress. These cost six times more than conventional HPPE but there is no impact on laying/ backfill costs so the overall cost difference is not that significant.

There is a possibility that phenolic compounds and cyanide compounds associated with the manufacture of town gas could be encountered. Phenolic compounds are a particular concern as they can cause tainting of water in plastic pipes.

It is anticipated that many development sites will have contaminated soil and groundwater arising from previous landfilling and heavy industrial uses. Landfill gases may also be encountered.

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[1] *Indications at this stage are that some level of contamination can be expected in most areas of the Peninsula. This is due to the previous history of landfilling and reclamation and the many heavy industrial uses that have been in place on the Peninsula*. Dublin Docklands Development Authority Poolbeg Peninsula Planning Scheme Geotechnical Report Mott MacDonald Pettit May 2008 – See Volume 2, Appendix 3

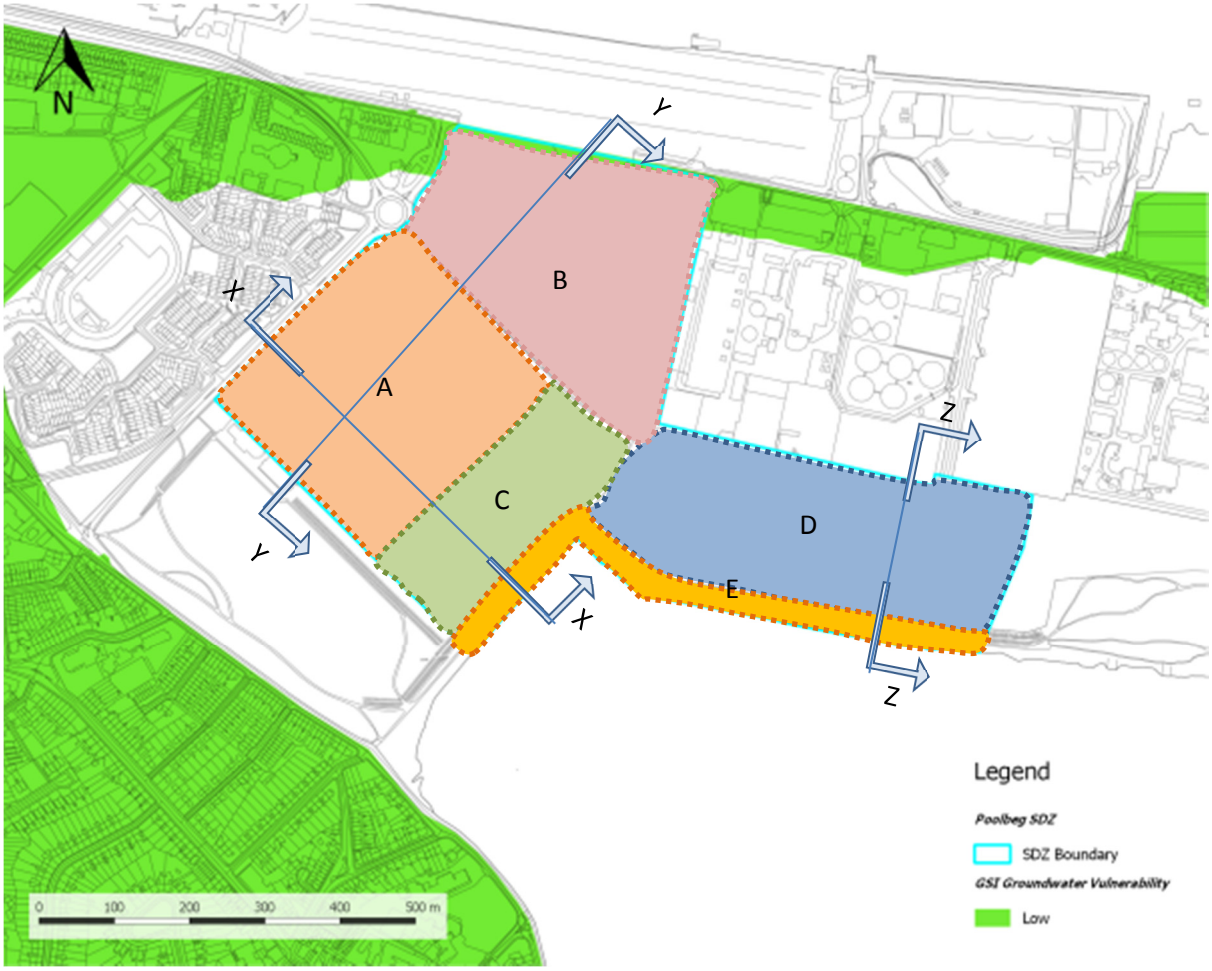


Figure 5 Characterisation Areas used for study

Conceptual Site Model [Plan]

The Site is initially characterised as having Five Regimes;

A The Western Lands – the former Irish Glass Bottle site

These filled lands were formerly occupied by the Irish Glass Bottle company. The lands have been remediated by the excavation and disposal of the upper layers of contaminated soil and by the establishment of a resolved surface to receive new development.

B The Northern Lands – Dublin Port lands

These filled lands are currently in a variety of uses – these include tanked storage areas, port-related activities and transport and logistics activities – as well as a road network.

C The Central Lands – the Fabrizia site

These filled lands are currently unused. The previous land use history is unclear – though parts are thoughts to have been used for the disposal of wastes from the IGB operations.

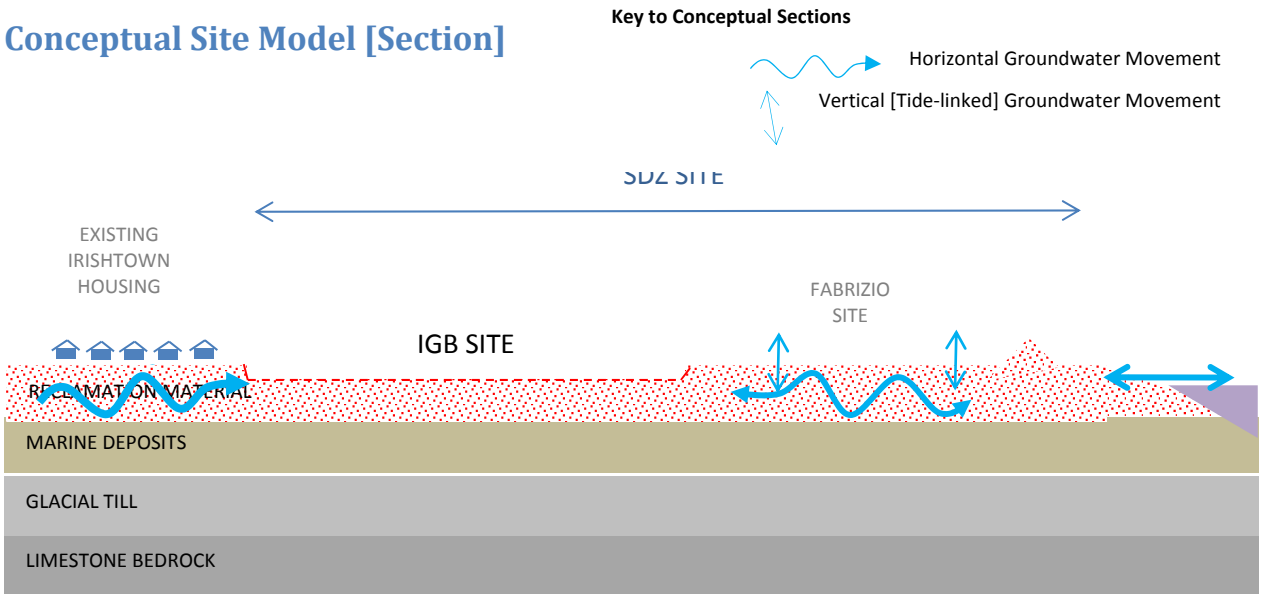
D The Eastern Lands – the ESB site

These filled lands were used for the disposal of municipal wastes, latterly as an amenity area associated with the adjoining power plant and subsequently have been used as an area for the manufacturing and dispatch of under-sea piping and more recently as a construction compound for an adjoining development project.

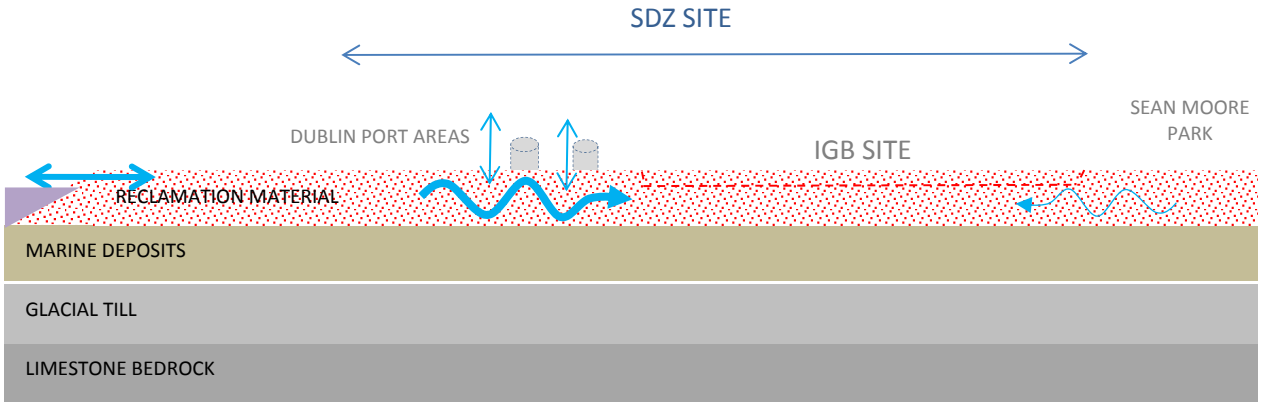
E The Shore Lands

These filled lands were used to enclose and contain placement of municipal waste. Subsequently a raised earthen berm was placed along the northern and western boundary to delineate a shore walk.

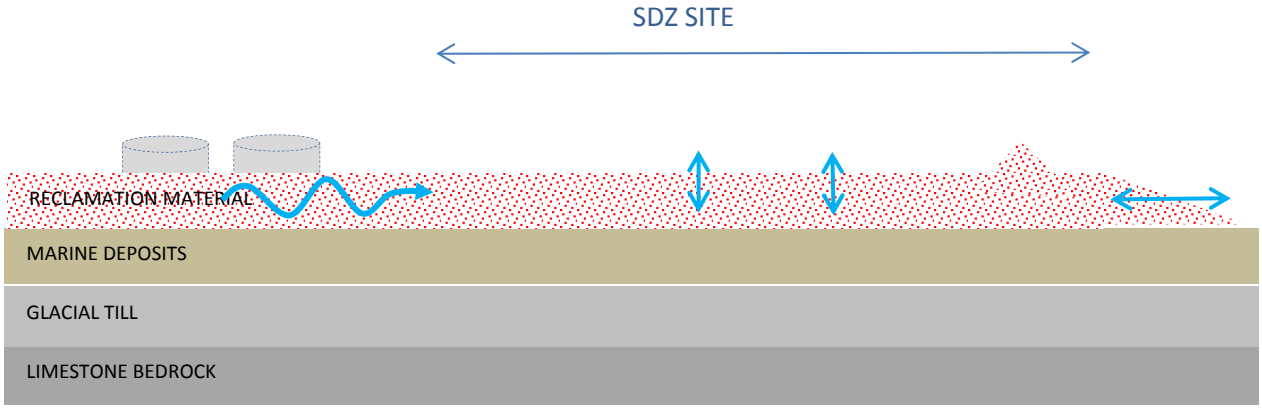
Conceptual Site Model [Section]



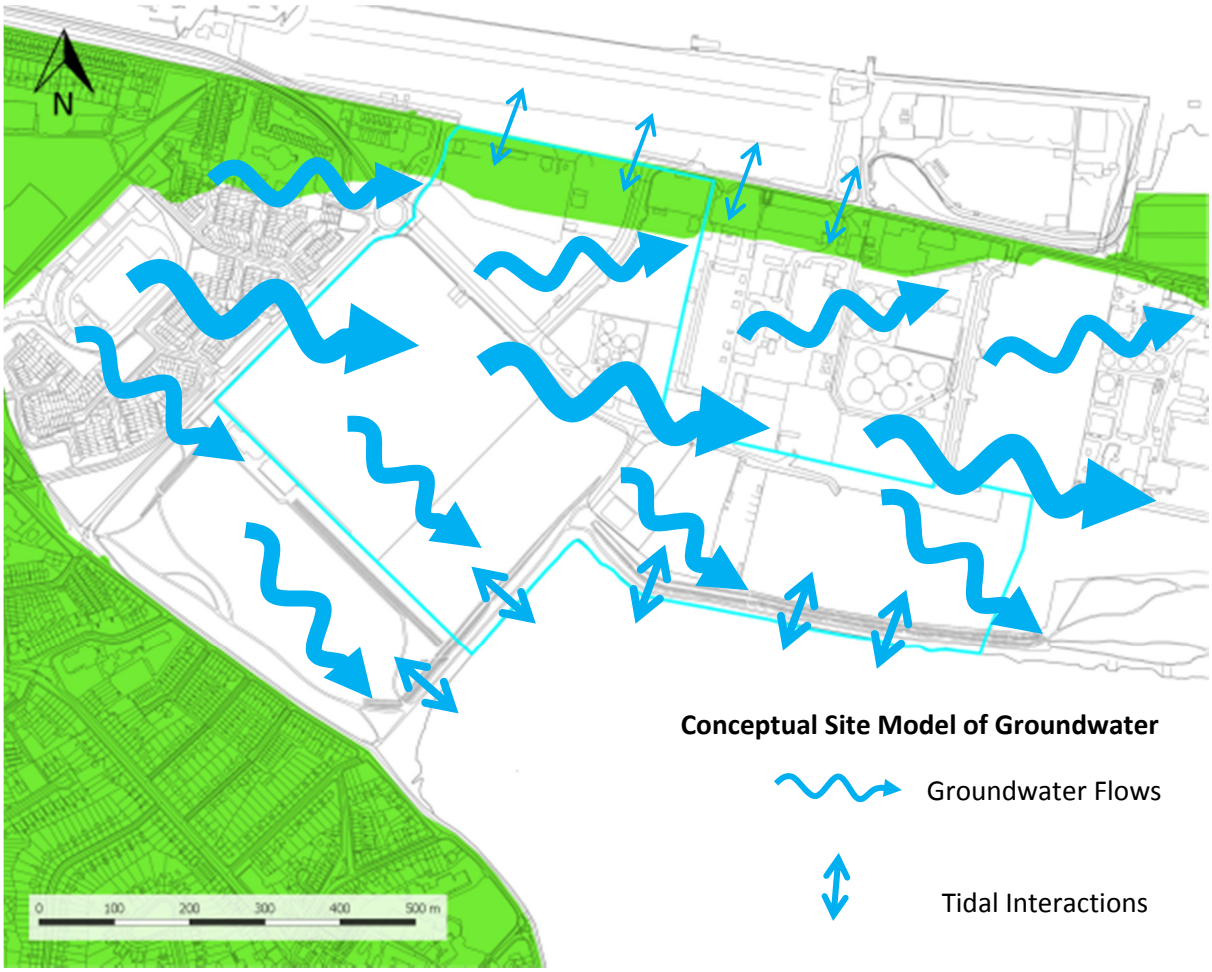
CONCEPTUAL SITE MODEL SECTION X - X



CONCEPTUAL SITE MODEL SECTION Y - Y



CONCEPTUAL SITE MODEL SECTION Z - Z



Conceptual Site Model of Groundwater

Groundwater is recorded at shallow depth – 3-4m bgl which is close to mean sea-level – and is characterised as being brackish to saline. Furthermore groundwater levels exhibit tidal variations

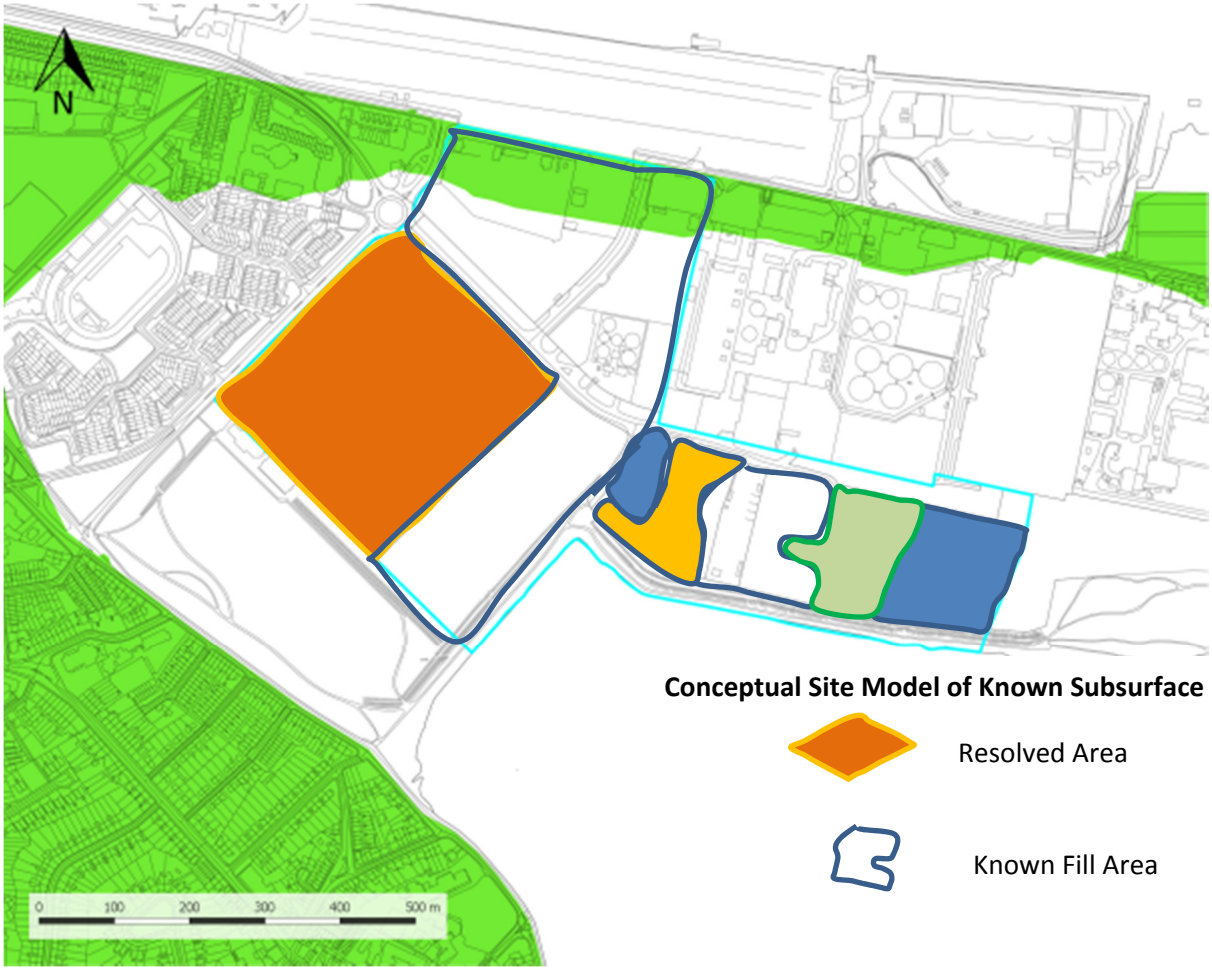
The upper layers of the site consist of dominantly porous material which facilitates unconfined groundwater movement. Potential for groundwater movement diminishes in the lower layers of marine sediments and glacial tills.

Groundwater investigations indicate that groundwater movement below the site has two principal components.

A vertical component –which follows both daily tidal movements [2m+] as well variations of larger amplitude that are influenced by seasonal tidal extremes as well as even larger irregular variations driven by atmospheric conditions – such as storms and low-pressure extremes.

A horizontal component – which generally flows from east to west – which diverts to run perpendicular to the shore along the land-sea junction. It is likely that there is slightly more rapid horizontal movement along the more porous southern and eastern shores.

The Conceptual Model of Site Groundwater illustrated above illustrates these movements – the thickness of the lines indicating the relative volumes of the flows. In general movement will have a higher velocity nearer to the surface and nearer the shore.



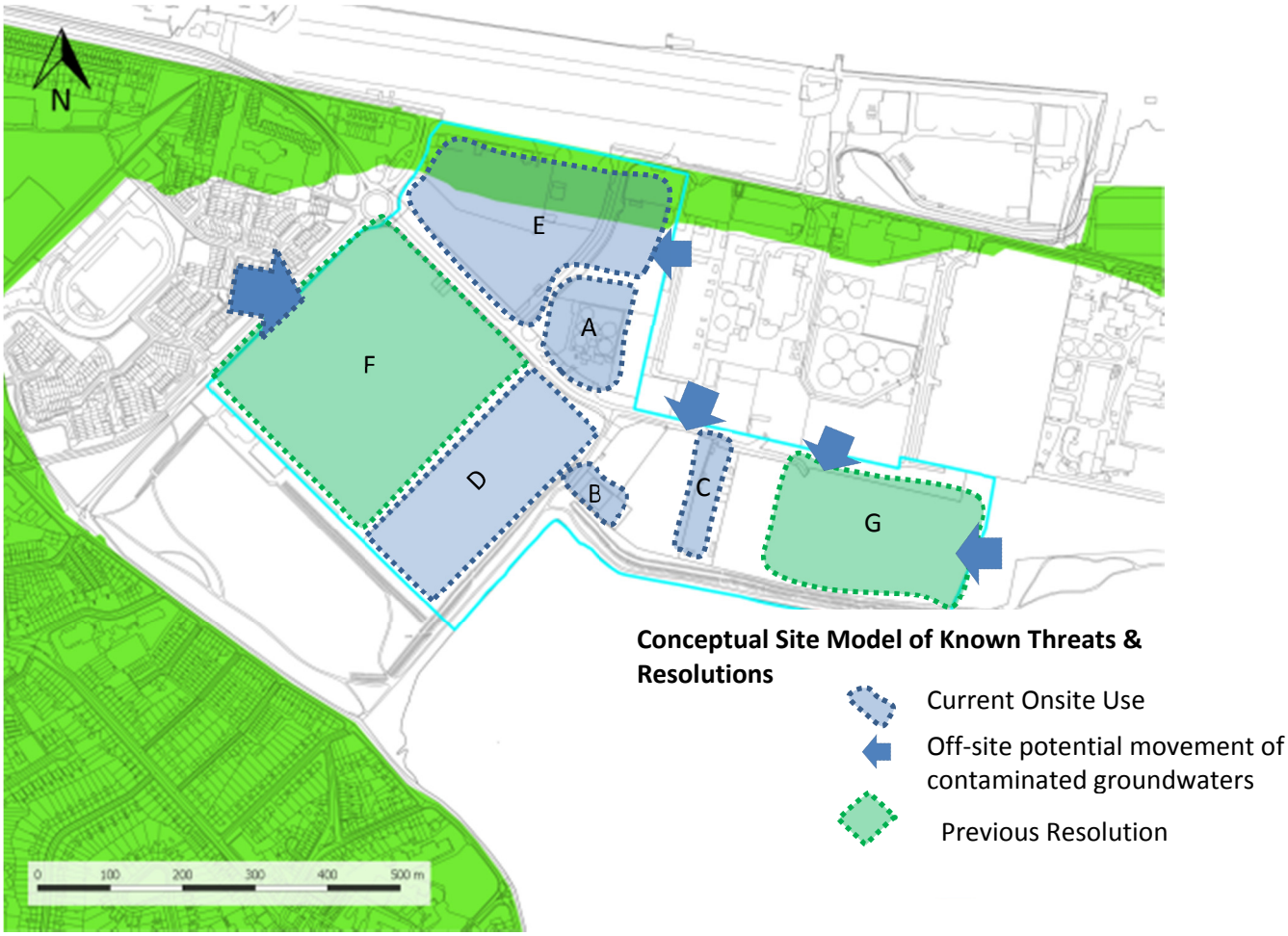
Conceptual Site Model of Known Subsurface

Lands to the west were historically used by Dublin City Council as a landfill. The Irishtown Tip Head, which was reported to have commenced operation in 1948, was closed and capped in 1978. It is reported that the landfill was worked in a sequential fashion, with landfilling activities moving in an easterly direction over time (AWN, 2004). Following capping of the former landfill area around 1978, lands to the west of the overall development lands were leased to Irish Glass Bottlers (IGB) Ltd. until 2004. The IGB plant was also built on part of this landfill.

It is understood that the general public also dumped refuse in this area during this period. The domestic and other waste beneath this site is expected to have been in the ground for somewhere in the region of 30 to 50 years. No soil gas venting or collection systems were installed on these sites during operation or after closure. Therefore landfill gas could potentially be still present.

There are no records available as to the exact types and quantities of materials which were dumped at the different sites across the Draft Scheme Area. However, from an examination of the trial pit logs and boreholes from site investigations carried out on the Fabrizia and IGB sites and from a review of a geotechnical assessment report produced by Mott MacDonald Pettit (2008) it would appear that much of the fill comprised of domestic and Construction and Demolition (C&D) waste. The composition varied greatly but commonly consist of a mixture of gravels, sands, silts, clays, rubble, bricks, concrete, glass, timber, concrete slabs, cabling, piping, rags, metal household containers and cinders (non-exhaustive list).

The results of surveys showed concentrations of contaminants at elevated levels reflecting the filling activities and industrial history of the area.



Threats and Resolutions

While all of the lands have been recovered from the sea using fill - at a conceptual level, the site can be conceived as having zones of known threat and resolution that locally increase or reduce the potential threats of contamination.

Known Threats

Contamination Threats are known or suspected to exist from the following Sources

A. Storage tanks exist in this area
B. These areas are known to be used for metal working
C. These areas are known to be used for concrete production
D. These areas are known to have been used, in part, for IGB waste disposal
E. These areas have been used for external storage, and for servicing of vehicles

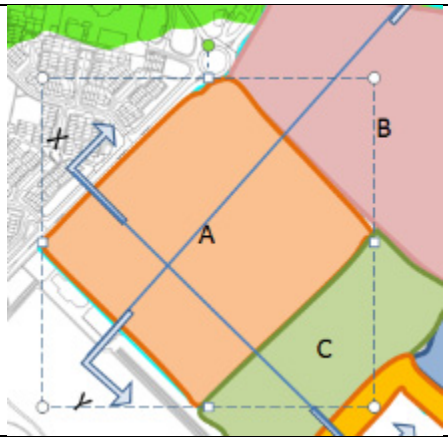
Known Resolutions

Resolutions or partial resolutions to contamination Threats are known to exist on the following Lands

F. IGB Site – full contaminated soil resolution
G. Laydown and Compound areas have been resurfaced with imported hardcore.

The factors set out previously were used to carry out an evaluation of the potential risk of contamination for each of the Characterisation Areas. The results are set out below.

A The Western Lands – the former Irish Glass Bottle site

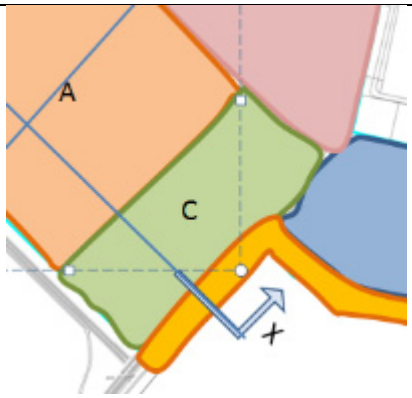


Sub-surface Conditions	• Marine Sediments • Residual landfill material
Previous Landuses	• Municipal Landfill • Glass Bottle Factory
Knowledge of Contamination Potential	• High • Substantial de-contamination completed
Potential Risk of Contamination	• Low • Residual risk of lateral movement of contaminants
Sources	• Malone O'Regan 2008

B The Northern Lands – Dublin Port lands

Sub-surface Conditions	• Marine Sediments • Landfill Material • Subsurface Foundations and Hardcore
Previous Landuses	• Port-related Activities • Unknown Previous Activities
Knowledge of Contamination Potential	• Low
Potential Risk of Contamination	• Unknown
Sources	• AWN 2004

C The Central Lands – the Fabrizia site



Sub-surface Conditions	• Marine Sediments • Landfill Material
Previous Landuses	• Municipal Landfill
Knowledge of Contamination Potential	• Moderate - good 2004 investigation by AWN
Potential Risk of Contamination Note 'Risk' includes consideration of the knowledge of the conditions. The knowledge of this site's high contamination potential increases the certainty – which reduces risk	• Medium • Evidence of landfill gas emission • Evidence of Soil Contamination • Polycyclic Aromatic Hydrocarbons (PAHs • Gasworks waste • Asbestos
Sources	• NES 1999 • AWN 2004 • Mott MacDonald Pettit 2008 • Malone O'Regan 2008

D The Eastern Lands – the ESB sites

Sub-surface Conditions	• Marine Sediments • Landfill Material • Surface Dressing of hardcore
Previous Landuses	• Municipal Landfill • Pitch and Putt Golf [part of] • Laydown/ casting site for pipeline • Construction Compound
Knowledge of Contamination Potential	• Poor – only inferred from 2004 investigation by AWN
Potential Risk of Contamination	• High
Sources	• AWN 2004 • Malone O'Regan 2008

E The Shore Lands

Sub-surface Conditions	• Marine Sediments • Landfill Edging Material • Pathway fill material
Previous Landuses	• Perimeter Landfill enclosure
Knowledge of Contamination Potential	• Very Poor
Potential Risk of Contamination	• High
Sources	• none

Description of Key Identified Risk

Conceptual Site Model of Contamination Risk

KEY	RISK	Definition	Source of Definition
	LOW RISK	No additional remediation was required.	IGB Site ARUP, 2016
	LOW-MEDIUM RISK	There is a low probability that remediation actions will be required. In most cases the development design will be able to mitigate the majority of risks	Desktop Study and Qualitative Risk Assessment of Potentially Contaminated Undeveloped Sites within North Lotts and Grand Canal Dock Flannery Nagel Environmental Limited 2016
	MEDIUM RISK	There is a medium probability that remediation actions will be required. However, such actions are likely to be localised or limited in extent and in some cases the development design could be used to mitigate some of the potential risks.	
	HIGH RISKS	There is a high probability that remediation actions will be required to manage risk, including removal & disposal, on site treatment, off-site treatment. Such activities are likely to require a waste management licence.	
	UNKNOWN RISKS	There is insufficient data to make any assessment of likely or probable risk. Treat same as 'High Risk'	

Summary, Conclusions and Recommendations

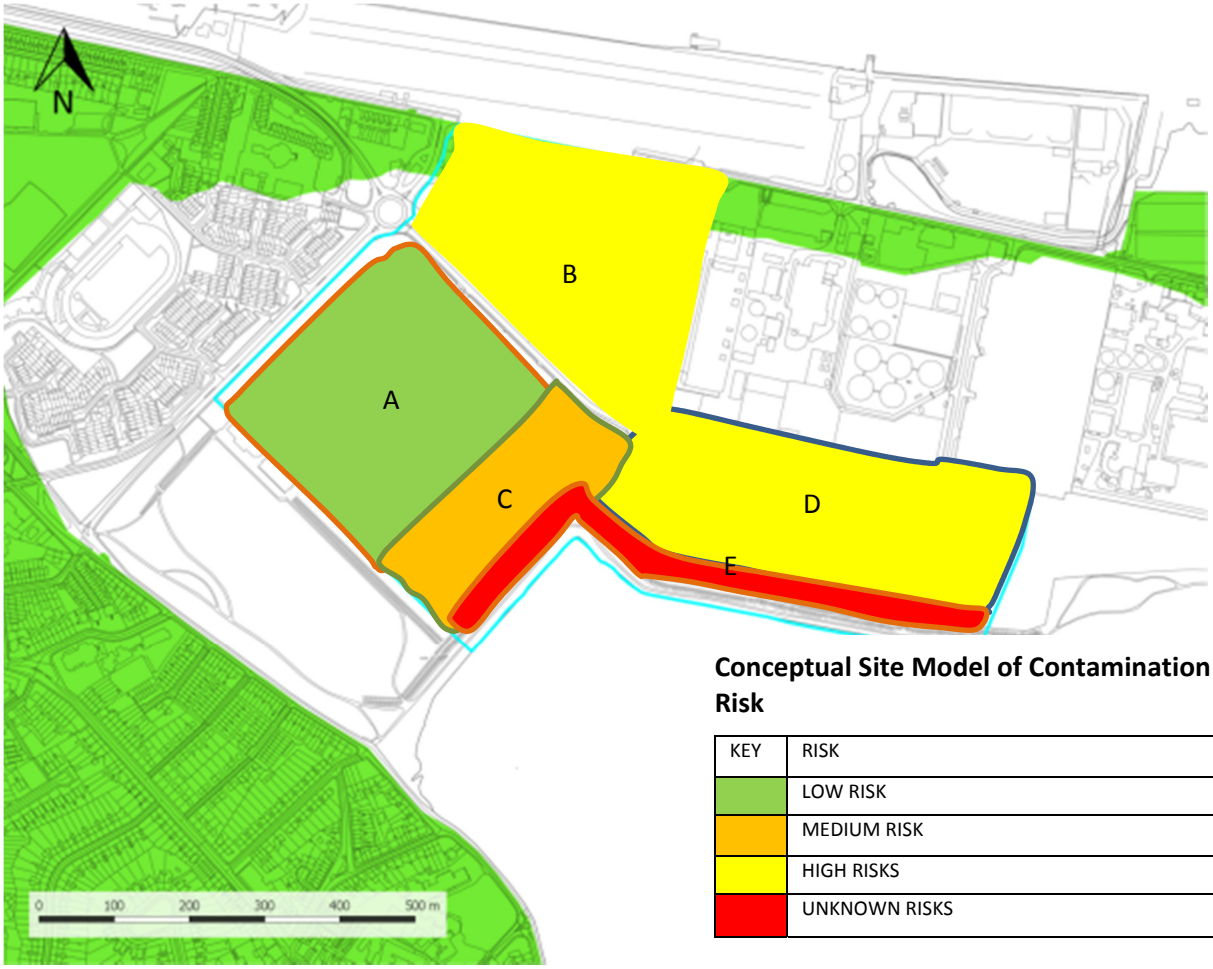
This investigation indicates that contamination of soil and water are likely to be encountered throughout these lands. This is a well understood feature that is commonly encountered during the redevelopment of brownfield sites – and especially in port-related areas.

The existence of contamination must be taken into account during both the planning and design states, though it does not represent an insurmountable obstacle to development. With the correct approach – and following the general recommendations set out below – the site can be redeveloped and used without giving rise to threats to either human health or to the natural environment.

The approach set out here is one of avoidance – to minimise excavation or disturbance during construction and to minimise exposure and/or occupation during use. This conservative approach is approach for an SDZ because it establishes very clear and unambiguous instructions for circumstances where many actors and agencies are likely to be involved in implementation.

The 'Conclusion and Recommendations' set out below indicates how the consideration of the issue of contamination should influence the development of the SDZ.

conclusion



Conceptual Site Model of Contamination Risk

KEY	RISK
	LOW RISK
	MEDIUM RISK
	HIGH RISKS
	UNKNOWN RISKS

The development of the SDZ should accommodate the issue of contamination by adopting th following approaches:

1. Accept that the entire site has the potential for legacy effects of contamination

The history of contamination together with the porous soils and the dynamic marine-influenced nature of the groundwater regime means that there will always be a residual risk of effects on health and the stability of structures and services. A Strategic approach that acknowledges and accepts these realities will lead to an approach of avoidance – which is likely to be the most reliable, robust and resilient approach. The principle implication of this approach will be to adopt a vertical separation approach throughout the site.

2. Maintain a vertical separation barrier

All of the lands [including those that have been rehabilitated] have the potential to continue to be affected by the results of prior contamination in varying degrees. For this reason the strategic approach should continue to follow the approach adopted at the IGB site – as advised by ARUPs, namely

'The provision of basement space, beneath the future proposed mixed use development for car-parking and ancillary services - as a method to create a wide (and ventilated) physical barrier between the existing legacy fill and the future habitable space of the new development.'

Specific Recommendations

1. Achieve Protection by Strategic Guidelines for Land-use allocation

The SDZ can remediate and ameliorate the potential effects of contamination by ensuring that proposed landuse types are compatible with the potential risks. [see table below]

	Risk Profile			
LANDUSE TYPE	**Known Low Risk**	**Medium Risk**	**High Risk**	**Unknown Risk**
Below-grade occupation	Avoid	Avoid	Avoid	Avoid
At-grade Occupation	Avoid	Avoid	Avoid	Avoid
Un-occupied Ground Floor	Permissible	Permissible subject to finding of Site Remediation Report	Limited and Permissible only with conditions subject to finding of Site Remediation Report	Avoid
Un-occupied and ventilated Ground Floor	Permissible	Permissible with conditions	Permissible subject to finding of Site Remediation Report	Limited and Permissible only with conditions subject to finding of Site Remediation Report

2. Require Developers to prepare Site Remediation Report

Prior to the grant of approval developers will be required to carry out a full contaminated land risk assessment to demonstrate

- How the proposed landuses will be compatible with the protection of health and safety [including the durability of structures and services] – during both construction and occupation
- How any contaminated soil or water encountered will be appropriately dealt with. Any site investigation carried out on the Peninsula should include a requirement for gas monitoring.

Details of the likely actions required are set out in Appendix 1,2

3. Implement a contamination interception, monitoring and mitigation management system

- Prior to the implementation of the scheme devise and implement a contamination interception, monitoring and mitigation management system for the whole site – and especially for all marine-land boundaries – to safeguard against the mobilisation of contaminants during construction and operation.
- Put in place organisational and financial mechanisms to ensure that this system is kept in place for the foreseeable future.

Appendices

Appendix 1 Range of Outline Remediation Actions

Extracted from Desktop Study and Qualitative Risk Assessment of Potentially Contaminated Undeveloped Sites within North Lotts and Grand Canal Dock - Flannery Nagel Environmental Limited 2016

Pre-Development Phase:

• Site specific desk study and intrusive investigations (All Sites)
• Based on site investigations, establish Conceptual Site Model to identify whether risks exist (All Sites)
• Identify Risk Management Actions

These may range progressively from minor to rigorous as follows:

- 'do nothing'
- monitored natural attenuation,
- modifying the development to prevent exposure/migration (i.e. vapour barrier in basement)
- insitu / exsitu treatment (assisted bio degradation of contaminants) or
- contaminated soils removal and disposal.

Development Phase:

• Implementation of agreed Risk Management Action (minor to rigorous, as applicable)
• Protection of residents and workers during excavations/ demolition works
• Clearing/ sealing contaminant pathways in historical drains
• Protecting new services from contaminant ingress
• Contaminant controls during dewatering works
• Cross contamination controls to/ from adjoining sites
• Establish environmental risk management procedures

Post-Development

• Completion and Verification assessment of remediation works

Appendix 2 Range of Detailed Remediation Actions

Extracted from Desktop Study and Qualitative Risk Assessment of Potentially Contaminated Undeveloped Sites within North Lotts and Grand Canal Dock - Flannery Nagel Environmental Limited 2016

Pre-Development of Potentially Contaminated Land

The following activities need to be undertaken as part of planning and prior to commencement of any development on potentially contaminated land.

1. Desk Study

A desk based qualitative risk assessment will be required specific to the area proposed for development and for the type/nature of the development intended. The desk based assessment should include an initial conceptual site model, qualitative risk assessment and a justified scoping for an intrusive investigation. The work should be undertaken in accordance with the EPA Draft Framework for the Management of Contaminated Land and Groundwater at EPA Licensed Facilities, 2012, Stage 1, Preliminary Risk Assessment and the DEFRA Model Procedures for the Management of Land Contamination (CLR 11, 2004).

Particular attention should be given to any development that incorporates garden/common areas, deep/extensive excavations, potential off site sources of contamination and development where new services (pipelines/ drains etc) are required.

2 Intrusive Investigation

Intrusive investigations should be undertaken for all developments and should follow best practice including the EPA Draft Framework for the Management of Contaminated Land and Groundwater at EPA Licensed Facilities, 2012, Stage 1, Preliminary Risk Assessment and the DEFRA/ EA Model Procedures for the Management of Land Contamination (Contaminated Land Report 11, 2004.

The following should be key requirements:

1. Intrusive investigation should be undertaken on the basis of the conceptual site model completed within the desk study and prioritised based on the initial qualitative risk assessment (Task Stage 1);
2. The amount and location of boreholes, window samples of trial pits used for sampling purposes should have a sufficiently robust statistical basis, but should include specific targeting of identified environmental issues;
3. Sampling should be undertaken of underlying alluvial sediments as background or to support study into migration;
4. The chemical analysis should include a broad range of determinants' but should also reflect the specific industrial activity sources identified for the site, and associated typical contaminants (including asbestos);
5. Groundwater and surface water should be sampled, tested and monitored using a similar suite of chemical determinants';
6. Groundborne gas (methane/ carbon dioxide) and volatile organics, as well as pressure, flow and weather conditions should be monitored within the site;
7. Off-site contaminative sources and migration to or from the site should be considered;
8. Testing should include geotechnical soils classification, leachate testing and waste characterisation.

After intrusive site investigation, the conceptual site model and risk assessment should be updated from the desk study and specifically for the proposed development and related activities. The risk assessment should be undertaken using Generic Assessment Criteria (EA Using Soil Guideline Values) and if required full quantitative risk assessment methodologies. Modelling of contaminant fate and transport may be required for groundwater and a soil gas risk assessment may also be required.

The intrusive investigation is the basis of assessment of risk management options.

3 Risk Management Actions

The initial risk assessment provides a guide to the likely level of risk management requirements. The desk study and investigation for the specific development area will determine the environmental risks that will need to be managed.

Step 1: Options Assessment

At this stage available options for risk management are assessed, compared and agreed. Risk management options can range progressively as follows:

- 'do nothing'
- monitored natural attenuation,
- modifying the development to prevent exposure/migration
- insitu/exsitu treatment or
- contaminated soils removal and disposal.

The options assessment should take into account each source/pathway/receptor, potential residual risks, constraints, possible environmental impacts associated with each method, the ability to demonstrate that the risk management action is successful, as well as the requirements for regulatory licensing/ permits. Remedial options, in line with the EPA Draft Guidelines 2012, Stage 2, will need to consider how the site may change within the future and the requirements for maintenance where below-ground activities may be necessary. Both EA and CIRIA have guidance on options assessment requirements (Remedial Treatments for Contaminated Land SP104). The final assessment should arrive at a benefit analysis and the solution may involve one or more techniques.

Step 2: Selection and Implementation

The most appropriate options should be selected and objectives agreed prior to implementation. Implementation can be undertaken prior or during area development (i.e. soil removal, or vapour barrier construction, etc). The implementation should be appropriately managed and recorded to demonstrate that measures are completed and work undertaken have had no negative environmental impact (e.g. dust generation).

Step 3: Verification

Verification is an important step that is required to demonstrate that the risk management actions have achieved their objectives and that risks are being managed effectively. Verification may be as simple as recording that an activity has been undertaken, through to sampling and chemical testing to demonstrate that there is no residual contamination or that the treatment technology used has performed.

Step 4: Residual Risks

Where there is uncertainty or there is a possibility of residual risk or where additional future security is required, then further risk management measures such as warranty or insurance may be necessary.

Licences and Permits

Existing
Some plots have existing EPA Waste or IPPC licences which have ceased, are surrendered or, in some cases are still active (even though the operation is closed). In any such case, consultation will be required with the EPA to determine the most appropriate course of action to ensure that any environmental liabilities are managed prior or in completion of development. Where an active licence exists, it may be possible that its' conditions could encompass possible remedial options.

Required
In some cases the remedial requirements (soil removal/ remediation) or nature of the development (proposed waste facility or IPPC activity) will require an appropriate EPA licence. Any remediation licence should be related to the selected remedial objectives, and surrendered on completion of risk management work and prior to the completion of the development. Waste removal/ disposal must be undertaken by permitted operators.
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Development of Lands
These are activities that may be required as part of the development stage and which are often linked to the Risk Management Options Assessment carried out previously. The task numbering relates to the tasks described in *Risk Management Actions* [above]

1 Protection of residents
Risk management and development actions have the potential to impact on humans and property. Any development where this is a potential issue will be required to demonstrate that the residents are sufficiently protected from potential issues such as contaminant migration, dust, vibration and noise.

2 Potential asbestos management
The made ground underlying the site may have asbestos containing materials within the general demolition rubble or historical industrial waste. Further, many older buildings incorporate asbestos containing materials within the building fabric.
It is standard practice to test any suspected materials on a reasonable statistical basis and to demonstrate that appropriate actions have been taken to protect construction workers and nearby humans as well as ensuring that future users of the areas are also protected from any possible exposure.

3 Demolition
Most areas will require building demolition. Buildings may contain hazardous materials resulting from their industrial past such as old sumps, containers, supply pipelines, transformers (PCBs), refrigerants (F-gases/ODS) or asbestos. All potentially hazardous materials need to be assessed and removed prior to demolition, with appropriate procedures followed to protect workers, the public and property from exposure to contamination as well as ensuring there is no residual hazards to contaminate the soil or water.

4 Historical drainage and services
Some plots have, or are likely to have historical drainage and services. The developer will be required to assess whether any residual contamination is in the drains, and if so have them cleaned out, waste removed and properly disposed. To prevent old services becoming potential contaminant pathways in the future (and where there is no intention to re-use the service) they should be removed, filled in with clean material or sealed.

5 New or upgraded services
Where new services are required (particularly water services) then consideration should be given to the ground conditions and whether any aggressive or damaging contaminants are present in the soil which may migrate into services or in the long term damage the integrity of construction materials. This should be identified as part of the intrusive investigation (Task 2). Where there is a potential issue then the developer must demonstrate that new services have been suitable protected (i.e. using different materials, use of clean inert backfill, lining service trenches etc).

Measures may also be required to protect any workers who are involved with excavations where contamination may be present.

6 Dewatering

Dewatering may be required to support development where deeper foundations or basements are required. In these circumstances there is potential risk of contamination within the water and risk of pulling contamination towards the development area from an adjacent source (increasing migration). While this is an issue that should be taken into account at the risk management options stage (Task 3) the developer will need to demonstrate that they are not causing or aggravating a pollution problem and that the dewatering and disposal are appropriately managed and permitted.

7 Cross Contamination

Some plots and development areas may be located down-gradient from a potential source of contamination. This is an issue that should be addressed at the risk management options pre-development stage (Task 3). The developer should protect the development from future re-contamination resulting from migration from an adjacent and up-gradient contaminant source.

Environmental Risk Management

There are a number of development activities that may change the environmental profile and risk, including:

1. Deep excavations;
2. Laying new services;
3. Storage or placement of made ground; and
4. Deep drilling or piling.

These activities have the potential of increasing the pathways or contaminant migration or increasing the risk of exposure. These issues can be managed via a construction management plan which should be used to support demonstration that the developer has not introduced new contaminant pathways in the overall plot area.

Post Development

This is an activity that is required where environmental risks have been identified and where risk management measures have been applied during the development stage.

Completion and Verification

As specified in the requirements for the Risk Management Options (Task 3), the developer will need to demonstrate how all of the identified risks have been addressed and whether there is any residual risk that requires ongoing or future management. The final outcome is a deliverable identifying all risks, how each risk has been addressed and managed and how this has been verified through sampling, testing or monitoring and hence a demonstration that all environmental objectives have been met. Where residual risks may still be present the developer will be required to produce a strategy /procedure setting out how these are to be managed for the future or possible future changes that may occur within the development area

Planning Authority Recommendations

DCC will require documents from developers and will integrate these within its information management system. Furthermore, any strategy for the development zone will consider not only the areas suitable for private development but also the related public areas.

Review and authorisation
The following are potential documents that may be generated by each proposed development and will require review by the Planning Authority prior to planning approval, commencement of development works and on completion of the development.

- Desk Study
- Desk based study to identify site specific risks and scope intrusive investigation based on specific development requirements.

- Intrusive Investigation Asbestos Survey
- Intrusive investigation required for all development areas

- Risk Management Options Assessment
- Identifies the risks, the options and the selected solutions required for managing the risks.

- Licences and/or Permits
- Possible requirement where remedial or waste activity is required, Licence application to EPA, with copy to DCC for information.

- Waste Collection Permits are issued by the National Waste Collection Permit Office. Waste Facility Permits are issued by Local Authorities.

- Building Hazardous Materials Survey
- Survey required to identify residual hazards within buildings as part of demolition warrant/permit.

- Demolition Warrant/Permit
- Likely requirement for most areas of development.

- Environmental Management Plan
- Plan and implementation of management measures during construction works
- Completion and Verification Report

Final report detailing all risks, work undertaken in risk management and sampling, monitoring or otherwise to verify that the construction and development works have met the required objectives.

Managing Common Risks
Public infrastructure components within the SDZ area, include roads, tramways, services, pavements, quay-sides and parks. These are areas of land usually located between the private plots. It is possible that contamination could migrate from the private plot areas to public spaces and may present a potential future risk.
A management strategy is required to manage potential risk associated with common areas including:
• Development of a procedure to manage future excavations relating to services and/or infrastructure; and
• Review the development risk management options to ensure that the migration of contamination resulting from historical or construction activities is managed.

Information Management
Given the large number of references and publications as well as the numerous site investigations, remediation works, and waste licences relating to the study area, it is recommended that all the documents are site referenced, kept, maintained and managed centrally. This is particularly important if future developments need to rely on previous work undertaken and also to ensure that future work activities are co-ordinated.