

Limerick Gas Works Remediation

Environmental Impact Statement

Report Number 1021927/R/07

March 2012

For Bord Gáis Eireann

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Non Technical Summary

Introduction	<p>Bord Gáis is proposing to remediate the former Limerick Gas Works site to remove existing potential environmental liabilities and any physical and chemical constraints to future site redevelopment. The final site use has not yet been determined, therefore a conservative approach is being taken by assuming a residential (no gardens) end use.</p> <p>Remediation of the site will be undertaken in co-operation with all regulatory bodies such as Limerick City Council, the EPA and in compliance with all national and EU Regulations. The works will be subject to a planning application and will require a Waste Licence from the EPA.</p> <p>The project will deal with the ground conditions only and any eventual development on the site will be the subject of a separate planning application.</p>
Project Description	<p>Phase 1 of remediation works will involve the removal of free phase liquids, generally comprising coal tars as dense non-aqueous phase liquids (DNAPL). These are generally present within underground tanks, the former quarry and deep limestone feature. The preferred option is 'pump and treat' technology and it is estimated that 200m³ of DNAPL will be removed and recycled / disposed of.</p> <p>Phase 2 of remediation works will involve stabilisation / solidification of the uppermost 3m of made ground across the entire site, where present. This would also ensure the removal of the majority of underground structures. An estimated 32,500m³ of material will require stabilisation / solidification.</p> <p>A full specification of works will be prepared following detailed design of remediation works in consultation with regulators and specialist contractors.</p>
Environmental Effects	<p>The proposed remediation aims to improve the quality of the site by reducing the potential risks to future developers, site users, groundwater and the adjacent river. The works are likely to create a temporary local disturbance but will ultimately have a positive social and economic benefit for the area.</p> <p>Two structures on site currently have 'Protected Status': the boundary wall fronting Dock Road and the Power Generation Building. Works will need to be designed to minimise any disturbance to the structures.</p> <p>The urban type landscape is dominated by two and three storey residential, commercial and industrial buildings with a multi-storey hotel on the river's edge. There are limited views beyond the boundaries due to the low lying nature of the site, but views onto site can be gained from surrounding buildings. The site is currently a derelict site with remnant gasworks structures, therefore site remediation will potentially improve the views onto site and improve the general character of the area.</p> <p>The site offers limited ecological value and the works are therefore unlikely to have any adverse impact on flora and fauna.</p> <p>The remediation works themselves will have a potential impact on the people living and working in the vicinity of the site in respect of traffic, noise, odours and dust. However the works will ultimately result in a positive impact to the local environment by reducing contamination levels in site soils and groundwater. On completion of the remediation it is envisaged that any current risks will be reduced to acceptable limits.</p> <p>The final specification of works will be undertaken in consultation with regulators and specialist contractors and will detail any mitigation measures required to reduce potential environmental impacts.</p>

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1021927/R03/007 Encountered free phase product

1021927/R03/013 Site Photographic Log

Appendices

The following documents are provided electronically on CD.

Appendix A Qualitative Risk Assessment and Options Appraisal

Appendix B Stakeholder Management Plan & Information Flyers

Appendix C Archaeological Assessment

Appendix D Ecological Assessments

Appendix E Ground Investigation and Groundwater Monitoring Reports

Appendix F Air Quality Survey

Appendix G Noise Survey

Appendix H Vibration Survey

Appendix I Traffic Scoping Assessment

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1 Introduction

Bord Gáis is a commercial semi-state organisation that builds, owns and operates natural gas transportation networks in Ireland.

As part of the rationalisation of the gas industry in the mid-1980s Bord Gáis acquired a number of disused gasworks sites. While Bord Gáis did not contribute to the current status of these former gasworks, it is endeavouring to eliminate any potential environmental liabilities and bring the sites back into productive use.

Bord Gáis has already remediated former gasworks sites at Cork and Waterford. Plans are now underway to deal with the former gasworks site in Limerick.

Bord Gais are committed to keeping the general public and those directly affected by the remediation process informed of all remediation proposals as well as the project's progress.

The proposed remediation project will deal with the ground conditions only and any eventual development on the site will be the subject of a separate planning application. The remediation works will be undertaken in two phases: Phase 1 will comprise a 'pump and treat' technique to remove free phase liquids with Phase 2 comprising the stabilisation of the uppermost 3m of made ground across the site.

This report has been prepared to support a planning application to Limerick City Council for the proposed remediation works and also for an application for a waste licence from the EPA which will be required for the works.

1.1 Legal Context

1.1.1 *Environmental Impact Assessment*

Environmental Impact Assessment (EIA) is the term applied to the systematic examination of the likely impacts of development proposals on the environment prior to the beginning of any activity.

EIA involves a number of procedures and stages:

1. Identification of projects requiring EIA, sometimes known as screening;

2. Identification of the key issues to be addressed in an EIA, called scoping;
3. Impact assessment and evaluation;
4. Impact mitigation and monitoring;
5. Review of the completed EIS and;
6. Public participation.

The result of an EIA is assembled in a document known as an Environmental Impact Statement (EIS) which looks at all the positive and negative effects of a particular project on the environment. This report is just one component of the information required to aid decision makers in making their ultimate choices about a project.

Ireland has had a form of EIA since 1963 but more specifically since the 1976 Local Government (Planning and Development) Act which specified that environmental studies be carried out where a project was polluting or likely to cause pollution and where the project cost was in excess of 5 million pounds.

The First Schedule of the 1989 Regulations specifies which projects require an EIS and relates to Annexes I and II of the EC Directive. All projects listed in Parts I and II of the First Schedule to the 1989 Regulations require an EIS.

1.1.2 *Appropriate Assessment*

With the introduction of the Birds Directive in 1979 and the Habitats Directive in 1992 came the obligation to establish the Natura 2000 network of sites of highest biodiversity importance for rare and threatened habitats and species across the EU. In Ireland, the Natura 2000 network of European sites comprises Special Areas of Conservation (SACs, including candidate SACs), and Special Protection Areas (SPAs, including proposed SPAs). The Birds and Habitats Directives set out various procedures and obligations in relation to nature conservation management in Member States in general, and of the Natura 2000 sites and their habitats and species in particular. A key protection mechanism, and the subject of this guidance, is the requirement to consider the possible nature conservation implications of any plan or project on the Natura 2000 site network before any decision is made to allow that plan or project to proceed. Not only is every new plan or project captured by this requirement but each plan or project, when being considered for approval at any stage, must take into consideration the possible effects it may have in combination with other plans and projects when going through the process known as appropriate

assessment (AA). The obligation to undertake appropriate assessment derives from Article 6(3) and 6(4) of the Habitats Directive, and both involve a number of steps and tests that need to be applied in sequential order. The first test is to establish whether, in relation to a particular plan or project, appropriate assessment is required. This is termed AA screening. Its purpose is to determine, on the basis of a preliminary assessment and objective criteria, whether a plan or project, alone and in combination with other plans or projects, could have significant effects on a Natura 2000 site in view of the site's conservation objectives.

An AA screening exercise has been undertaken by Mouchel and is detailed in the following report; Natura Impact Statement- 1021927/R16, dated February 2012.

1.2 Document Layout

The proposed remediation works are subject to planning and waste licence applications, which recognise the potential for short term local impacts due to the works. In support of the applications, assessments have been undertaken assessing the baseline conditions at the site and considering the potential impacts of the remediation works on the local environment.

A description of the project is presented in Section 2. This is followed by a detailed assessment of environmental aspects including human environment, cultural heritage, landscape, ecology, water quality, soils, air quality, dust, odour, noise and traffic. Each aspect is considered in terms of existing conditions, the potential impact of the remediation, and proposed mitigation measures if required.

1.3 Supporting Documents

Supporting documents, including site investigation reports, quantitative risk assessment and specification for the remediation contract are detailed in the references in Section 14. The following reports which directly relate to the site are included in the following Appendices on CD;

Appendix A Qualitative Risk Assessment and Options Appraisal

Appendix B Stakeholder Management Plan & Information Flyers

Appendix C Archaeological Assessments

Appendix D Ecological Assessments

Appendix E Ground Investigation and Groundwater Monitoring Reports

Appendix F Air Quality Survey

Appendix G Noise Survey

Appendix H Vibration Survey

Appendix I Traffic Scoping Assessment

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2 Project Description

2.1 Introduction

The purpose of the project is to remediate the site to remove existing potential environmental liabilities and physical and chemical constraints to future site redevelopment in line with the Limerick City Council Development Plan.

The only alternative to remediation at the site would be to follow a 'do nothing' strategy, and leave the site in its present condition until a suitable purchaser and final development scheme was proposed. This option was not considered as appropriate as the site would retain the potential liabilities until it became viable for development, which could take some time as the nature of the liabilities would be likely to put off prospective developers. BGN are keen to see the site brought back into use and propose the remediation as the first step to facilitate this.

This section of the report identifies the principal components of the site remediation and discusses the possible options and programme for their implementation.

2.2 Site Description and History

The 1.4 ha site is located in the City of Limerick approximately 100 m south east of the River Shannon and immediately south east of the Dock Road. The national grid co-ordinates for the site are E156950 N156650. A location plan is included as Figure 1.

The site, roughly rectangular in shape, is generally level at about 5 m MHD but rises to approximately 8 m MHD towards the south and east boundaries.

The site is surrounded by housing and light industry to the northeast and housing to the southeast and southwest. To the northwest some commercial properties are present and beyond this are the Graving Dock, Wet Dock and the River Shannon.

The site is currently not in use and access is managed by Bord Gais. The site includes a two-storey office block and other ancillary buildings, none of which are used on a permanent basis. The Bord Gais offices are also to be retained after the remediation works. A photographic record of the site is included on Drawing 1021927/R03/13.

The site history is summarised below:

- in the 1830's a limestone quarry was situated in the eastern part of the site, with a small gas works located to the north west;
- by 1872 the gas works occupied the majority of the site, with a small pond located at the edge of the remaining quarry;
- the quarry had been backfilled by 1938, and an electricity substation was located along the north east boundary;
- coal gas manufacture ceased in 1974 and the works became an oil gas plant until 1986 when natural gas was introduced; and
- demolition and site clearance took place between 1988 and 1995.

2.3 Remediation Options Appraisal

A detailed remediation options appraisal was undertaken by Mouchel following the Characterisation works and is detailed within the Quantitative Risk Assessment, Options Appraisal and Remediation Report, reference 1021927/R03, March 2010¹, provided in Appendix A (CD) along with an Addendum report issued in January 2012.

The appraisal concluded that the following remediation options are the most appropriate for the site:

- Pump and Treat
- Solidification/ Stabilisation Ex-situ
- Solidification/ Stabilisation In-situ
- Thermal Based Technologies (Thermal desorption or incineration)

It is proposed to undertake remediation works in two distinct phases, as described in Section 2.4 below.

2.4 Components of Remediation

2.4.1 Phase 1 Works

The first phase of remediation works will involve the removal of free phase liquids. These liquids generally comprise coal tars (predominantly dense non-aqueous phase liquids (DNAPL)) and are present at the base of several

underground tanks, within the former quarry and a deep limestone feature located in the western side of the site. The preferred option for removal of the DNAPL has been identified as 'pump and treat' technology.

It is estimated that a total volume of DNAPL requiring removal from site for recycling/ disposal will be approximately 200m³.

Several 'pump and treat' technologies are available and the advice of specialist contractors will be sought to assess the suitability of their proprietary techniques to the contaminants identified on site. The systems are 'closed' with volatile compounds being 'captured' and passed through carbon filters to minimise any odour emissions. It is anticipated that a large proportion of the volatile organic compounds will be removed by this process.

The Phase 1 works are anticipated to take 6-12 months to complete depending on the rate of extraction of free phase liquids achieved.

2.4.2 Phase 2 Works

The second phase of remediation works will involve stabilisation / solidification treatment of the uppermost 3m across the entire site, except where site constraints preclude its use or limestone is encountered at shallower depth. This would ensure that the majority of underground structures are removed to facilitate the possible future redevelopment of the site. It would also identify and allow treatment / removal of other free product present within this 3m depth not removed as part of the Phase 1 works. Any remaining obstructions could be surveyed to record their exact locations for future reference. These underground structures/ foundations etc would be crushed and reused, where possible, as a clean capping layer, anticipated to be some 0.5m deep. Any groundwater encountered during the excavation process would need to pass through a water treatment plant prior to disposal to foul sewer under an appropriate discharge licence obtained from the drainage authority.

The volume of material requiring stabilisation/ solidification is estimated to be in the order of 32,500m³.

Sophisticated stabilisation/ solidification plant is now available and has been used in the UK and Ireland. The plant allows excavated contaminated soils to be placed on conveyor belts, weighed and mixed thoroughly (using paddle mixers) with appropriate binders prior to replacement in the excavations. The binder would be designed by specialist contractors but would usually comprise cement, pfa (pulverised fuel ash) or a mixture, added by approximately 3-5% by weight. The strength of the stabilised material can also be designed to improve geotechnical properties. Granular materials are usually easier to treat than

cohesive materials as thorough mixing of the binder is more easily achieved. There are some cohesive fill materials within the former quarry area although the fill is predominantly granular. It is possible that mixing of the granular and cohesive materials may be required prior to introducing the binder.

It is noted that odour emissions during the mixing process are generally low as a 'hood' fits over the mixing tank where air is extracted from the process and passed through carbon filters to minimise any odour emissions. Furthermore, as a large proportion of volatile organic compounds will have already been removed during the Phase 1 works, odour emissions from excavations are not anticipated to be significant.

Ex-situ stabilisation / solidification treatment is considered more appropriate than an in-situ process due the large number of obstructions present in the made ground, identified during the previous ground investigations undertaken.

It is anticipated that the Phase 2 works will be undertaken in approximately 6 months.

2.4.3 Detailed specification

A full specification of works will be prepared following detailed design of remediation works. This will be undertaken in consultation with regulators and specialist contractors.

2.5 Sequence of Operations

In fulfilling the Remediation Strategy, the scope of the work to be carried out by the Contractor shall include the following:

- Obtain Waste Licence and Planning Permission for the works.
- Provision of safe access/ egress from the site with appropriate signage.
- Further temporary works to support the site boundary walls/ fencing.
- Set up site accommodation, wheel wash etc.

PHASE 1 REMEDIATION WORKS

- Extraction and disposal of DNAPL from underground tanks, former quarry area and deep limestone feature (as described above).

PHASE 2 REMEDIATION WORKS

- Provision of any additional support to existing unstable walls and groundwater control measures required to enable excavation/remediation to the desired depth (approximately 3m).
- Excavation and crushing of old foundations and slabs (crushing may be permitted off site at a suitably licensed facility).
- Excavation, screening and sorting of soils on site into suitable and unsuitable materials. Some mixing of cohesive and granular materials may be required to obtain a suitable material for stabilisation.
- Stabilisation of suitable materials with appropriate binders from the uppermost 3m.
- Disposal off-site of any contaminated materials unsuitable for stabilisation/ solidification at a suitably licensed facility.
- Treat waters from the site and dispose to sewer, under discharge licence.
- Backfilling using suitable material from site, plus imported fill, if required.
- Preparation of a Verification Report detailing the remediation works undertaken and the post-remediation conditions of the site.
- Discharge of Planning Conditions.
- Surrender of the Waste Licence.

The remediation works will be undertaken in compliance with the following:

- All necessary control of noise, dust, odours etc emanating from the works. It is anticipated that odour nuisance will be minimised by the remediation techniques being proposed.
- All necessary monitoring, geotechnical and chemical proof testing.
- All necessary Safety, Health and Welfare measures.
- Compliance with the Conditions of the Waste Licence.

- Obtaining and comply with permits for waste collections.
- Obtaining and comply with any other permits, licences etc., necessary.

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3 Human Environment

3.1 Existing Environment

The site is in an area of mixed use. Housing and light industry are present to the northeast with housing to the southeast and southwest. To the northwest some commercial properties are present and beyond this are a Graving Dock, Wet Dock and the River Shannon (as shown on Figure 1, Site Location Plan).

The site has been derelict for several years after falling into disuse following the closure of the Bord Gáis offices on site. The remediation works will allow the site to be brought back into productive use and enhance the character of the area.

3.2 Consultation

Bord Gáis have kept local residents and businesses informed of any works planned to date. Three letter drops have been carried out, informing the community of site clearance, ground investigation and boundary improvement works. Distribution of information flyers has been restricted to the immediate vicinity to date, as impact was minimal. The consultation distance regarding the remediation works will be increased to reflect the potential increased impact of such works in agreement with the LCC planning department.

A public information event to inform stakeholders of progress to date and proposals for the remediation works at the site was run by Bord Gáis on the 16th February 2012.

A Stakeholder Management Plan has been produced which is included in Appendix B along with copies of information flyers distributed to date.

Bord Gáis have indicated that the planned remediation works have received a generally positive opinion from local residents and businesses.

3.3 Impact and Mitigation

The remediation of the site will have some impact on people living and working in the vicinity, in respect of site traffic, odours, noise and dust, for the duration of the proposed works. It will also impact on the personnel working on the site remediation works.

A full specification of works will be prepared following detailed design of remediation works. This will be undertaken in consultation with regulators and specialist contractors and will detail any mitigation measures required. Mitigation measures are likely to include the following:

- limitation of site working hours;
- restricted traffic access / egress;
- use of plant silencing equipment; and
- use of dust and odour suppression measures;

Remediation of the site is designed to reduce risks to subsequent site users to acceptable levels, and therefore will result in a beneficial impact to the human environment.

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4 Cultural Heritage

4.1 Introduction

An archaeological assessment undertaken by National Archaeological Services Ltd in 2009 (included in Appendix C). Two structures on site are included on the National Inventory of Archaeological Heritage (NIAH), both listed as structures of regional importance; these are:

- The boundary wall fronting onto Dock Road (NIAH ref no 21517005); and
- The former Power Generation Building (NIAH ref 21517006).

The Limerick City Development Plan 2010 – 2016 shows that the site is not located within an Architectural Conservation Area (ACA).

The site is not located within the zone of archaeological potential of any recorded monument. The nearest recorded monument is the City of Limerick Historic Town (LI05:017) located approximately 600m to the north east of the site.

4.2 Current Site Condition

A site visit was undertaken by Mouchel on Thursday 19th of August 2009 to assess the condition of the site in respect of archaeology and architecture.

At the time of the visit, the site had been cleared of materials stored on site and some of the external boundary walls had been cleared of growth and exposed.

A tree surgeon completed pruning to external boundary wall as well as cutting the base of some of the larger ivy tree stumps. A significant amount of vegetation still remains to portions of the site boundary walls and internal structures.

The boundary walls and buildings within the site have been cleared in places of excessive tree, plant and shrubby growth, exposing stone and brick work. In places this stone work is in good structural condition with the mortar still intact. In other instances large pieces of mortar have been leached from the walls. While the iron work is exposed to the elements it continues to rust.

4.3 Impact and Mitigation

No new structures are currently proposed therefore there will be no visual intrusion and no negative visual impact.

The remediation works will require the introduction and removal of materials to and from the site, although these quantities are not anticipated to be significant as the works are predominantly ex-situ treatment on-site. Therefore, it is anticipated that the existing access / egress routes will be adequate and hence there should be no need to demolish any sections of the Dock Road wall to improve access provision.

The remediation contractors will be required to take all necessary steps in methods of working to prevent damage to on-site and adjacent structures due to excavations and vibrations caused by executing the Works, and shall detail his proposed methods of working in method statements.

Discussions with the Department of the Environment, Heritage and Local Government have confirmed that the remediation works do not require archaeological monitoring. The Department and Limerick City Council Planning Departments will be kept informed of archaeological and architectural developments across the site to prevent any unnecessary delays to the project.

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5 Landscape

5.1 The Existing Context

5.1.1 *The Wider Setting*

Limerick lies off the south eastern banks of the River Shannon, with the former gasworks site located to the south west of the town centre.

Dock Road is present immediately to the north west of the site, with the docks beyond and the River Shannon approximately 100m away. The surrounding land use is a mix of residential, and small commercial and industrial businesses.

The River Shannon flows westwards, towards the Atlantic, and the topography rises to the south away from the river. The historically developed nature of the site area and the Dock Road wall limits views of the Shannon, with the skyline dominated by a multi-storey hotel, as shown in the photograph below.



5.1.2 The Site and its Immediate Setting

The site is 1.4 ha in size and is roughly rectangular in shape. Site level rises from around 5 m MHD (Malin Head Datum) in the north west to around 8 m MHD at the southern and eastern boundaries.

The site includes a two-storey office block and the protected former Power Generation Building) which are both to be retained. Some other smaller structures are present, such as the booster house, which are to be removed prior to remediation works commencing. The existing Above Ground Installation (AGI) and electricity substation are also to be removed with a new electricity substation and a District Regulator Installation (DRI) to be located adjacent to the O'Curry Street boundary. A variety of structures are present in the surrounding area, therefore the on-site structures are not imposing.

Views from the site are restricted by the high perimeter walls and existing structures. The Dock Road wall, which has Protected Status, has a Limestone face up to 5m high. The wall extends into the site and is up to 10m high in one section. Beyond the boundary views are generally limited to the surrounding land uses: three storey housing to the north east, perimeter vegetation and housing residences to the south east, housing and industrial property to the south west and the perimeter wall and water side buildings / multi-storey hotel to the north west.

Publicly accessible views into the site are available from surrounding residences and the hotel.

The site itself is derelict and contains remnants of the former gasworks. Most vegetation has recently been removed, although some low weed with some willow and sycamore saplings and a small number of mature trees are present.

5.2 Impact and Mitigation

Hoardings have been installed along the site boundaries at O'Curry Street, to screen the works.

The removal of derelict structures (Booster House) and AGI, together with vegetation, will improve the views onto site, although the remediation works are not considered to pose a significant impact to the landscape character of the area as no buildings or significant changes in level are proposed.

6 Ecology

6.1 Introduction

The site has no formal conservational designations. The nearest designated habitat is the Lower River Shannon Special Area of Conservation (SAC). There are currently no Special Protection Areas (SPA) or Natural Heritage Areas (NHA) near the site, although the River Shannon is proposed for NHA status.

A site visit was undertaken on the site in August 2009, following site clearance, by Moore Group Environmental Services². At this time the predominant habitats were recolonising bare ground and artificial ground / buildings. This is generally of low ecological value and is typical of urban areas. The report is included in Appendix D (CD).

6.2 Existing Flora

Three main habitat categories were identified: Exposed Rock, Disturbed Ground and Built Land.

Exposed bedrock was recorded to the south eastern boundary and was covered in dense ivy and occasional Shining cranesbill.

The predominant habitat is recolonising bare ground present across the majority of open space. Vegetation in these areas included ragwort, dandelion, wildflower trefoil, dock, Plantain, Smooth hawsbeard, Butterfly bush, Thistle and Red valerian.

In addition, Sycamore and Willow saplings, nettle and bramble were also common across the site.

A small area of wet grassland was also present in the low lying north eastern end of the site. Species include Nettles, Silver weed, Creeping cinquefoil and soft rush.

6.3 Existing Fauna

A preliminary bat detector survey was undertaken during the site visit in August 2009 and recorded two Common pipistrelle to be active on site. A more

detailed bat survey was therefore commissioned and undertaken in September 2009 by Aardwolf Wildlife Surveys³ and is included within Appendix D.

The on site structures are considered favourable for bats as the older, stone-built buildings have open access for these animals and offer roosting potential within crevices between stonework or behind heavy ivy *Hedera helix* cover. The remaining Bord Gáis offices and Governor House are disused and so are undisturbed and offer dark interiors or roof spaces that are favourable for roosting bats.

The office building has an expanse of roof with gaps beneath slating, soffit and barge boards which allow access for these animals and bat access to the 'lean-to' shed is available through its open door or via gaps beneath its roofing. The older site structures offer bat access opportunities through decaying stonework, loose plaster, holes in walls, crevices between stonework, disused chimneys, ivy cover and roots in walls etc. As such, these buildings show good potential for bat use both in summer and winter as roosting sites within the structures are limitless.

The office building, including its roof space, was examined internally as well as externally and a search for bat signs and bat corpses was made but none were found. Similarly, the Governor House showed no evidence of bat presence. The high stone walls and derelict stone building were carefully inspected for signs of bat presence but again none were found.

Although no bats were observed on site during the more detailed survey, soprano pipistrelle, Leisler's and brown long-eared bats are expected to occur occasionally as they have been recorded in the local area. However, there is no evidence that any of these bat species is currently roosting within the on site structures.

With regard to other fauna, only Wood Pigeon were recorded on site; these are listed as green under BirdWatch Ireland Birds of Conservation Concern website and thus have a favourable conservation status.

6.4 Impact and Mitigation

The structures on site would, on general appearance, appear to offer very favourable features for bat use being extensive, undisturbed and sheltered. However, despite the buildings' apparent favourability for bats, no bats are presently using the structures as major roosting areas. This finding is likely as a result of the site being located within a built-up urban area which is consequently bright at night. Also, as there is no on site water course or water

body and no mature tree lines or hedgerows which might act as commuting corridors for bats off site to reach the area or as habitats in which insects might occur and act as prey for bats. This lack of vegetation on site is not conducive to supporting foraging bats.

Due to the lack of evidence of use of the site by bats and that the site is not conducive to supporting bats the proposed remediation works are not expected to have any adverse impact on these animals and mitigation measures in relation to bats are deemed unnecessary.

As no bat roost was found in any of the impacted buildings, a derogation licence is not required for the proposed remediation works to proceed.

The appointed Contractor will be required to specify arrangements to protect flora and fauna during the works in their method statements.

A pest prevention programme has been implemented by Bord Gais which will continue to run during the remediation works, a copy is included in Appendix D (on CD).

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7 Soils

7.1 Existing Conditions

7.1.1 Physical conditions

Published information indicates rockhead, to be close to the surface in places, with little or no drift cover. Where cover is present, it comprises made ground or recent alluvium associated with the River Shannon flood plain.

Bedrock is indicated to comprises the Visean Limestones of the Lower Carboniferous Period. The limestones are mainly oolitic, occasionally containing clay 'wayboards' which formed following exposure of the platform above sea level and accumulation of volcanic ash. The limestone often contains chert nodules (siliceous concretions) and thin interbedded shales. The Visean Limestone is also known as 'Clean Shell Limestone'. The total thickness of the limestone is more than 800 m.

Beneath the site, the beds dip approximately 8° to the north. The site is located on the southern limb of an east-west trending syncline.

Several intrusive ground investigations have been undertaken at the site^{4, 5, 6, 7 & 8} and are included within Appendix E. These have shown the general sequence of soils at the site to comprise made ground underlain by limestone, with localised alluvium around the site boundary extending from the north west to the south west of the site.

7.1.2 Chemical conditions

Recent investigations, undertaken by Mouchel in 2009⁶, have identified widespread contamination of the site has been identified, typically associated with by-products and waste products produced during the sites active gasworks use. Contaminants mainly comprise total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbons (PAHs) (predominantly associated with coal tars), cyanides and heavy metals.

Qualitative assessment of the pollutant linkages for the site has identified potentially significant risks to future site users and adjacent premises. Potentially significant risks exist to site users via dermal contact and ingestion of shallow made ground contaminants across the site and inhalation of dust and vapours.

7.2 Impact and Mitigation

The remediation strategy, outlined in Section 2, has been designed to reduce the risks associated with site soils to acceptable levels. As such the works will result in a considerable beneficial impact to site soils.

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8 Water Quality

8.1 Existing Hydrogeology

8.1.1 Regional Hydrogeology

The Groundwater Protection Maps for County Limerick (Maps 1-6)⁹ indicate that the Clean Shelf Limestone is a 'Locally Important Aquifer' that is generally Moderately Productive (40-100 m³/d). The hydraulic properties of the aquifer are dominated by fissure flow and well-developed karst features have been observed in the area. The nearest abstraction well is 6 km to the south east of the site. The oolitic limestones of the Limerick Syncline are known to have relatively high permeabilities. The aquifer is classified as 'Vulnerable' due to the lack of impermeable cover or thick unsaturated zone.

There are no recorded active wells or boreholes in the vicinity of the site; although the historical site plan dated 1977 shows a well 5 m to the north west of Gasholder No.3. This may or may not have been grouted up and may form a pathway for surface contamination to groundwater.

8.1.2 Site Specific Hydrogeology

Ground investigation at the site has encountered made ground lying directly over limestone bedrock with localised alluvium in the west.

Recent assessments, undertaken by Mouchel in 2009⁶ (see Appendix E) identified perched water to be present within the made ground. This generally drained away quickly, indicating the presence of impermeable obstructions within the made ground which have created localised areas of perched water. Generally hydraulic continuity exists between the Made Ground and the bedrock due to the granular nature of the made ground, and therefore the groundwater potentially acts as one body.

The water table has been found to generally fall from approximately 7.8m MHD in the south eastern section of the site, to approximately 2.7m MHD in the western section of the site. The general groundwater flow direction appears to be in an approximate westerly direction toward the River Shannon.

The groundwater data implies that there may be two sources of groundwater entering the site:

- Source 1 – Originating from the southern corner of the site from within the rock outcrop; and
- Source 2 – Originating from the south east section where water is draining into the site.

The hydraulic conductivity of both the made ground and the limestone were found to be variable. The values obtained for the made ground would appear to reflect mainly cohesive conditions, whilst in some areas where the made ground may be more granular, higher hydraulic conductivities may be applicable. However, the logs mainly suggest a highly granular made ground of limestone and brick rubble, but with a clay matrix decreasing permeability.

The geometric mean permeability calculated from the full range of data obtained for the limestone is 1×10^{-7} m/s. Based on data known to have been obtained from just the weathered horizon, this would appear to be 1×10^{-6} m/s. This accords with a value from the UK Aquifer Properties database for moderately karstified limestone of 3.3×10^{-6} m/s (0.285 m/day). Within the groundwater modelling the geometric mean (1×10^{-7} m/s) was used. As a result, groundwater flow velocities averaging between 50 and 150 m/year can be expected.

8.1.3 Chemical conditions

Significant free phase product was identified within underground tanks and the former quarry. In addition, the made ground and limestone aquifer have been significantly impacted with dissolved phase phenols, PAHs (naphthalene in particular), cyanides, sulphate, ammonia, BTEX, TPH and heavy metals.

In addition, localised arsenic, nickel and selenium were identified as hotspots across the site. Groundwater monitoring reports are included in Appendix E.

8.2 Existing Hydrology

8.2.1 Physical conditions

The site is situated on the southern side of the River Shannon estuary, which flows westerly into the Atlantic. At the site, the estuary is approximately 200 m in width and subject to tidal influence.

The average rainfall for the area is 850 mm/yr.

The site currently comprises approximately 60 % hard cover and 40 % free draining material (with many underground structures that may impinge on the infiltration and flow of rainwater/perched water through the made ground). There is a fall in the site level from the south east (8 m MHD) to the west and north west (5 m MHD), directing surface run-off in this direction. The River Shannon's water level is typically 0 m MHD near to the site. The mean high and low waters at spring tide vary from 3.10 to -2.6m MHD, with the neap tides fluctuating between 1.6 and -1.8m MHD, giving the mean tidal level at the Dock as being -0.1m MHD.

Drainage of the site has historically been to the city's sewers, which historically discharged into the river via a main sewer on Dock Road. It is our understanding that the drainage from the site has now been incorporated into the new Limerick Main Drainage Scheme, although some drains have reportedly been sealed by the scheme.

The 1996 Ove Arup Site Investigation Report⁷ recorded that storm water flooding had occurred in the past along the Dock Road at its junctions with O'Curry Street and St Alphonsus Street, i.e. close to the site. The maximum recorded flood level for the City was reported as 4.25 m MHD.

Along this length of the River Shannon, the site is separated from the River by the Wet Dock and the Graving Dock. The Graving Dock (a dry dock that could be flooded from the wet dock), is partially infilled, but by its nature would have had low permeability dock walls of stone or brick. The Wet Dock is in continuity with the river, but is likely to be similarly lined, decreasing continuity between groundwater and river.

8.2.2 Chemical conditions

The site wide presence of hydrocarbons, PAHs, cyanide, ammonium, copper and selenium pose a potential risk to waters, although the latter three only have Environmental Quality Standards (EQS) screening values set for freshwater, rather than marine environments. A large proportion of samples containing the BTEX, phenol, sulphate and chromium also failed for fresh and marine environments, with hotspots identified where arsenic, nickel, zinc and chlorinated volatiles exceeded screening values.

The volatiles generally consisted of the methylated and chlorinated BTEX, however a number of solvents were identified such as tetrachloroethene, trichloroethene, 1,2 Dichloroethane, styrene, 1,1,1 & 1,1,2 Trichloroethane etc. These were predominantly found in gasholder 3 (see Figure 2). Styrene was detected during the second monitoring visit at B8 and C7 around gasholder 2.

Waters were all identified as alkali, as would be expected for limestone groundwater.

8.3 Impact and Mitigation

The initial groundwater assessment identified that there could be potentially significant risks posed to the River Shannon and the limestone aquifer by the presence of benzene, phenol, ammonium, hydrocarbons (aliphatics C5-10, aromatics C5-8) and to a lesser extent the other lighter aromatic hydrocarbons (C8-21), identified in site soils and groundwater beneath the site.

The hydraulic conductivity and gradient however, suggest that groundwater will take 3.38 years to migrate the 100m, and thus contamination will in most cases take longer, thus allowing for increased degradation and dilution. In addition, the docks (wet dock and graving dock) are likely to impede the flow of groundwater directly to the River Shannon, altering the flow path in a longer, more westerly direction. Thus the travel time will increase allowing for more degradation. Finally, it is possible that the alluvial deposits (predominantly cohesive) encountered near the Dock Road boundary may extend towards the river and be present beneath the river further impeding groundwater flow directly into the river. Therefore although a theoretical risk has been identified, it is unlikely that the site poses an actual risk due to contaminant degradation and increased travel times.

The remediation strategy outlined in Section 2, involves the removal of free phase liquids, predominantly dense non-aqueous phase liquids (DNAPL) by 'Pump and Treat' techniques followed by the removal of sources within the uppermost 3m of made ground. As such the works will result in a beneficial impact to site waters.

9 Air Quality, Dust and Odour

9.1 Introduction

Remediation of the site will involve disturbing soil that may be contaminated with various hydrocarbon compounds. Once exposed to the atmosphere, easily volatilised compounds such as Volatile Organic Compounds (VOCs) may be released into the atmosphere. Works may also generate dust, which is not only a nuisance in itself but may contain pollutants.

An Air Quality Survey has been undertaken by Mouchel¹⁰ and is included as Appendix F. Monitoring was carried out over a three month period to establish baseline conditions in order to determine whether future remediation works causes an increase in exposure to pollutants in the local environment.

9.2 Existing Air Quality

9.2.1 Methodology

VOCs were monitored for low level benzene, toluene and xylene hydrocarbon analyser using a Photo Ionisation Detector and Gas Chromatograph (continuous monitor) which was located in the north of the site. Diffusion tubes were also used at four locations off-site: St Alphonsus Street to the south west, Upper Henry Street to the south east and two on O'Curry Street to the north east. Tubes were replaced every four weeks by trained staff.

The Continuous Monitoring Unit was in operation from the 1st December 2009 until 12th March 2010. Diffusion tube monitoring was conducted from 10th December 2009 to 4th March 2010.

9.2.2 Assessment Criteria

In Ireland, the Environmental Protection Agency (EPA) monitors air quality for a number of atmospheric pollutants. EU Directives set out limits or targets for specific pollutants and cover sulphur dioxide, nitrogen dioxide, oxides of nitrogen, particulate matter (PM10 and PM2.5), lead, carbon monoxide, benzene, ozone, arsenic, cadmium, nickel and benzo(a)pyrene.

In the UK, the Environment Agency authorises some 460 substances or groups of substances for release into the environment and many of these may be released to air. Where limit or target values have not been specified within EU

Directives, the UK Environment Agency has adopted interim values known as Environmental Assessment Levels (EALs). The Irish EPA has not formulated an equivalent list of EALs so the UK values have been used as assessment criteria for site data.

EALs provide a level below which no harm is likely and have been derived by the methodology described in the UK Environment Agency's Guidance Document H1 Environmental Risk Assessment for Permits¹¹. EALs are derived for long-term and short-term exposure; however, reflecting the extended duration of exposure outside of normal working hours EALs are available for Annual Mean exposure (long term) and 1 Hour Mean exposure (short term).

In addition, EALs also take into consideration the expectation that the general population consists of individuals that are more sensitive to changes in air quality than that of the working population. Such individuals typically comprise, children, the elderly and those with upper track respiratory diseases such as asthma. Consequently, when deriving EALs conservative factors of 30 times and 100 times are typically used.

Table 1 shows the relevant values for comparison with the Continuous Monitoring Unit. Table 2 shows additional values for comparison with the Diffusion Tube results. EALs for other substances detected are not available in the guidance documents

Table 1: EALs Relevant to Continuous Monitoring Unit Data

Substance	Long Term ^(a) (Annual Mean) EAL $\mu\text{g}/\text{m}^3$	Short Term ^(b) (1-Hour Mean) EAL $\mu\text{g}/\text{m}^3$
Benzene	5 ^(*)	-
Toluene	1,910	8,000
Xylene o-, m-, p- or mixed isomers	4,410	66,200 ^{(c),(d)}
Notes:	*	EU Limit Value
	a	Unless otherwise stated, derived from UK Health & Safety Executive, EH40/2001, Occupational Exposure Limits 2001, 8 hour reference period converted to annual mean (see notes on derivation below).
	b	Unless otherwise stated, derived from UK Health & Safety Executive, EH40/2001, Occupational Exposure Limits 2001, 15 minute reference period converted to hourly mean. Where marked by *, indicates that no short term OEL or MEL is provided in EH40, and the value has been derived by multiplying the long term OEL or MEL by a factor of 30.
	c	World Health Organisation WHO, Air quality guidelines 2000 [please consult the reference for the relevant averaging times]
	d	EAL derived from values for 24 hour reference period

Table 2: Additional EALs Relevant to Diffusion Tube Data

Substance	Long Term ^(a) (Annual Mean) EAL $\mu\text{g}/\text{m}^3$	Short Term ^(b) (1-Hour Mean) EAL $\mu\text{g}/\text{m}^3$
2-butanone	6,000	89,900
Ethylbenzene	4,410	55,200
Napthalene	530	8,000
Notes	a	Unless otherwise stated, derived from Health & Safety Executive, EH40/2001, Occupational Exposure Limits 2001, 8 hour reference period converted to annual mean (see notes on derivation below).
	b	Unless otherwise stated, derived from Health & Safety Executive, EH40/2001, Occupational Exposure Limits 2001, 15 minute reference period converted to hourly mean. Where marked by *, indicates that no short term OEL or MEL is provided in EH40, and the value has been derived by multiplying the long term OEL or MEL by a factor of 30.

9.2.3 Results

The continuous monitor recorded concentrations of benzene, toluene, m,p-xylene and o-xylene at 15 minute intervals, with a data capture of 94.6%. These data were used to calculate hourly means. The unit was not operational between 10:00 on 31st December 2009 and 12:50 on 5th January 2010 due to the power being switched off. A summary of the results is presented in Table 3.

Table 3: Continuous Monitoring Unit Hourly Concentration Summary ($\mu\text{g}/\text{m}^3$)

	Benzene	Toluene	m,p-Xylene	o-Xylene
Minimum	0.000	0.000	0.000	0.000
Mean	0.000	0.007	0.001	0.000
Maximum	0.066	0.155	0.031	0.009
1-Hour EAL	-	8,000	66,200	

The results show the maximum concentrations measured are significantly lower than the relevant EALs.

The results for the top ten compounds measured on each diffusion tube are provided in the Air Quality Survey Report in Appendix F. Concentrations measured over the three month period are consistently lower than the annual mean EALs.

9.3 Dust

9.3.1 Methodology

Dust was monitored using two British Standard deposition (frisbee) gauges, both located on the site. Monitoring was conducted from 10th December 2009 to 4th March 2010.

9.3.2 Assessment Criteria

The potential for dust arising from sites is often a matter of public concern. The fear is that the nuisance created during works will affect local amenity value and quality of life for the period during operations. The level of concern, and potential for nuisance, may be directly related to the number and proximity of residential areas to the site.

The degree of nuisance experienced depends on the rate of deposition, and is discernible at two levels:

- nuisance, experienced when the dust cover is sufficient to be visible when contrasted to an adjacent clean surface, such as when a finger is wiped across the surface. This is particularly annoying when it occurs regularly over long periods; and
- severe nuisance, experienced when the dust cover is perceptible without a clean reference surface for comparison. This usually occurs over short periods during very dusty conditions.

Nuisance complaints are usually associated with periods of peak deposition, occurring during particular weather conditions. There is a “normal” level of dust deposition in every community and it is only when the rate of deposition is high relative to the norm that complaints tend to occur. The impact of dust on a community will therefore be determined by five main factors:

- the short-term dustiness during periods of dry weather (climatic factors);
- the location of the potential dust source relative to the community;
- the effectiveness of dust control measures adopted by the site operator;
- the frequency or regularity with which these occur; and
- the duration of the site activities that contribute to dust.

The amount of dust that might cause complaint or nuisance in a particular circumstance is very difficult to determine and there are no statutory limits such as those applicable to suspended particulates or gaseous pollutants. However, guidance relating specifically to mineral operations but applicable to other similar situations suggests that complaints are likely when the rate of dust deposition is at two to three times the normal background level of dust deposition in the area (*The Environmental Effects of Surface Mineral Workings*¹²).

9.3.3 Results

Baseline dust deposition measurements are shown in 4.

Table 4: Dust Deposition Results

Period	Deposition (mg per m ² per day)	
	Location A	Location B
1	13	22
2	18	25
3	59	50
Period Average	30	32

9.4 Impact and Mitigation

Baseline levels of volatile pollutants are currently below the assessment criteria.

The results of the dust monitoring indicate very low concentrations and no nuisance is anticipated from baseline conditions.

The proposed remediation methodologies will minimise odour emissions. Firstly, the 'pump and treat' method uses a 'closed' system in which volatile compounds are captured and passed through carbon filters to minimise odours. Secondly, during the stabilisation / solidification mixing processes a 'hood' fits over the mixing tank where air is extracted from the process and passed through carbon filters, again keeping odours to a minimum. Furthermore, odour emissions from excavations are not anticipated to be significant as the majority of volatiles will have been removed as part of the 'pump and treat' phase of works.

A full specification of works will be prepared following detailed design of remediation works. This will be undertaken in consultation with Limerick City

Council and specialist contractors and will detail any mitigation measures required.

Mitigation measures are likely to include the following:

- monitoring of wind direction, mean wind speed, precipitation and olfactory indicators of odours on site;
- monitoring of dust deposition at site boundaries;
- the use of dust and odours control measures, including damping down, sealing/covering stockpiles and selecting working areas relative to wind direction and speed; and
- the use of odour control spray systems.

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10 Noise

10.1 Introduction

Noise is defined as unwanted sound. The range of audible sound is from 0dB to 140dB. The frequency response of the human ear is usually taken to be about 18Hz (number of oscillations per second) to 18,000Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and, because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument (the sound level meter). The weighting which is most widely used and which correlates best with subjective response to noise is the A-weighting. This is an internationally accepted standard for noise measurements.

For variable noise sources such as traffic, an increase of 1dB(A), which equates for example to an approximate 25% increase in road traffic, is barely perceptible. In addition, a doubling of traffic flow will increase the overall noise by 3dB (A), providing that a number of factors, including speed, remain unchanged. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/decrease of 10dB (A) corresponds to a doubling or halving in perceived loudness.

External noise levels are rarely steady, but rise and fall according to surrounding activities. In an attempt to produce a figure that relates this variable noise level to the subjective response, a number of noise metrics have been developed. These include:

The LAeq noise level: the 'equivalent continuous A-weighted sound pressure level, in decibels', defined in British Standard BS 7445 as the 'value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time'. It is a unit commonly used to describe construction noise, and noise from industrial premises and is the most suitable unit for the description of many other forms of environmental noise.

The LAmax noise level: the maximum noise level recorded over a particular measurement period.

The LA10 noise level: the noise level that is exceeded for 10% of the measurement period, and gives an indication of the noisier levels. It is a unit

that has been used over many years for the measurement and assessment of road traffic noise.

The LA90 noise level: noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the 'background' noise level.

A Preconstruction Background Noise Level Survey has been undertaken by Mouchel¹³ and is included as Appendix G. Background noise levels at nearby noise sensitive receptors to the Gasworks site have been quantified so as to enable potential future noise impacts associated with the proposed remediation of the Gasworks site to be accurately assessed.

10.2 Existing Conditions

10.2.1 Survey Methodology

A noise survey was completed on the 13th October 2009 between 0800hrs and 1800hrs by a qualified Mouchel Acoustic consultant. The baseline survey was undertaken wholly in accordance with the principles of BS 7445¹⁴.

A Norsonic 118 Type 1 Sound Level Meter (serial number 31787) was used to undertake the noise measurements and was calibrated with a Norsonic 1251 calibrator (serial number 31461) before and after the measurement. No significant calibration drift was recorded.

The sound level meter was tripod mounted with the microphone at a height of approximately 1.5m above the ground. Due to site specific constraints relating to the practical monitoring positions available, some of the measurements were undertaken within the influence of nearby façades (within 3.5m), otherwise the measurements were conducted under free field conditions (no façades within 3.5m).

Six measurement locations were identified around the periphery of the site so as to represent the nearest noise sensitive receptors. The locations are shown in Table 5.

Table 5: Noise Sensitive Receptors

Receptor Location	Location Description	Distance from Limerick Gasworks site perimeter	Monitoring Position	Receptor Type
1	Adjacent to No 7 O'Curry Street	10 metres	Free field	Residential
2	Adjacent to the Dock Road Office building	10 metres	Façade	Commercial
3	Adjacent to No 33 O'Curry Street	20 metres	Free field	Residential
4	On Site adjacent to the side of Ryan's Bar	Within the site perimeter	Free field	Commercial/Residential
5	On Site adjacent to the side of No 2 St Alphonsus St	Within the site perimeter	Façade	Residential
6	On Site adjacent to the side of No 10 St James Mews	Within the site perimeter	Free field	Residential

10.2.2 Weather Conditions

The meteorological conditions during the survey period were noted to be dry with approximately 70 – 80% humidity and some (roughly 75%) high level cloud cover. Temperatures were measured to be between 16 and 19 °C and wind speeds averaged 0.4ms⁻¹ gusting up to 1.1ms⁻¹.

10.2.3 Results

The table below details the results of the noise survey. In addition to the measured noise levels a brief description of the noise climate at each location is also included.

The following table summarises the results of the noise survey. This information is likely to be useful for comparison to the results of any post development completion noise survey.

The data presented within Table 6 has been calculated by the logarithmic (L_{Aeq} value) or the arithmetic (L_{A90} value) averages of the monitored data throughout the entire survey period.

Table 6: Summary of Noise Levels

Site	Description	Overall Level (dB)	
		L _{Aeq}	L _{A90}
1	Adjacent to No 7 O'Curry Street	63.2	51.1
2	Adjacent to the Dock Road Office building	78.3	72.0
3	Adjacent to No 33 O'Curry Street	61.5	47.1
4	On Site adjacent to the side of Ryan's Bar	64.1	57.5
5	On Site adjacent to the side of No 2 St Alphonsus St	46.6	42.3

Site	Description	Overall Level (dB)	
		L _{Aeq}	L _{A90}
6	On Site adjacent to the side of No 10 St James Mews	49.2	44.8

Monitoring Position (MP) 1 was situated in a freefield position to the north east of the Site. The noise climate in the area was dominated by traffic moving along Dock Road with some contribution from local traffic on O'Curry Street. Industrial noise was audible at this location particularly associated with unloading and vehicle movements within the scrap metal facility.

MP 2 was situated within 3.5m of a reflecting surface other than the ground being the façade and door of the office building on the north side of Dock Road and as such should be considered as a façade noise level. This location was considered to be dominated by noise contributed by vehicle movements on the N69, Dock Road. It is noted that in general the N69 is the dominant noise source within the area, as shown by the much higher noise levels at this position.

MP 3 was positioned on the pavement in front of the disused Garda training building, adjacent to 33 O'Curry Street. The constraints of the location due to the pavement width and lack of access to the Garda building grounds, dictated that the meter was placed approximately 2m away from a 1.5m high perimeter wall surrounding the training building. The wall would have had some façade influence over the results and as such the noise levels presented should be considered as façade levels.

At MP3 noise levels were not dominated by road traffic noise due to the increased distance to Dock Road compared to MP1. Local traffic and the general movement of pedestrians, talking, door slams etc. was heard as well as the background noise of traffic on Dock Road and the operations on the Docks themselves.

The location used as MP 4 was a freefield location within the compound of the proposed remediation works, towards the rear of a number of commercial properties (public houses). Noise from the nearby Dock Road dominates the noise environment at this location.

MP 5 was positioned between the compound retaining wall and a 2m high perimeter wall that had previously enclosed site workings. Again, due to the positioning of this location, the noise levels should therefore be considered as façade levels taken to be representative of the noise levels inherent at the most exposed façade of the closest residential receptors on St Alphonsus St. The façades of all the buildings looking on to the site at this location include opening

windows. This position was the quietest of the six positions, mostly due to the attenuation of the N69 afforded by the surrounding walls and buildings and was dominated by low level background traffic noise on Dock Road.

MP 6 was positioned in a freefield location close to an exposed earth bank on the site to the rear of St James Mews. The measured noise levels will be representative of the rear gardens and façades of the properties on St James Mews which have upper floor bedroom windows overlooking the site. The noise climate at MP6 was noted to be dominated by low level background traffic noise on Dock Road.

In general, the predominant noise source of the area as noted to be road traffic noise from Dock Road. This was coupled with industrial noises, particularly the unloading, moving and sorting of scrap metal from within the docklands site which were noted to be sporadic in nature.

10.3 Impact Assessment

The remediation of the site will create a temporary increase in noise levels in the vicinity and will have some impact on local people. It will also impact on the personnel working on the site remediation itself. Sources of the increased noise will include construction traffic and on-site plant.

A full specification of works will be prepared following detailed design of remediation works. This will be undertaken in consultation with LCC and the EPA and specialist contractors and will detail any mitigation measures required.

The Contractor shall employ the best practical means to minimise noise and vibration produced by his operations. Measures are likely to include the following:

- limitation of site working hours;
- the use of screening between noise sources and receiving positions;
- the use of exhaust silencers on vehicles and mechanical plant;
- the use of 'sound reduced' compressors and pneumatic percussive tools fitted with mufflers or silencers; and
- shutting down machinery / plant or throttling down to a minimum when not required for use.

11 Vibration

11.1 Introduction

Preliminary Vibration Monitoring was carried out by Mouchel¹⁵ to ascertain the current ambient levels of vibration that are experienced at the site in advance of construction work that is due to take place on this site. The report is included as Appendix H.

This survey has been conducted with a view to logging typical vibration levels at sensitive locations. Two monitoring locations were chosen; adjacent to the site on Dock Road and within the site on the former Bord Gáis Offices in the west of the site. Continual monitoring was conducted between 18th May and 24th June 2009 using an InstanTel Blastmate Type III Vibration Analyser with attached tri-axial geophone.

11.2 Existing Conditions

Tables 7 and 8 below review the measured levels at Locations 1 and 2 respectively and summarise the maximum vibration levels monitored during the current survey period in various frequency bands. The magnitude of vibration is measured in terms of Peak Particle Velocity (PPV).

Table 7: Maximum Levels Monitored in Frequency Bands at Location 1.

Frequency of vibration	Tran PPV mm/s	Vert PPV mm/s	Long PPV mm/s
<i>Threshold Vibration Values</i>	<i>0.127 – 0.254</i>	<i>0.127 – 0.254</i>	<i>0.127 – 0.254</i>
Less than 10Hz	0.127	0.127	0.127
10 to 50Hz	0.762	0.254	0.127
50 to 100Hz (and above)	0.889	0.762	0.762

Table 8: Maximum Levels Monitored in Frequency Bands at Location 2.

Frequency of vibration	Tran PPV mm/s	Vert PPV mm/s	Long PPV mm/s
<i>Threshold Vibration Values</i>	<i>0.127 – 0.254</i>	<i>0.127 – 0.254</i>	<i>0.127 – 0.254</i>
Less than 10Hz	0.254	0.254	0.254
10 to 50Hz	28.4	0.254	0.254
50 to 100Hz (and above)	0.381	43.1	37.2

Guidance limits for vibration are set out in British Standard's BS 7385-2: *Evaluation and measurement vibration in buildings*¹⁶; and BS 5228-2 (2009): *Code of practice for noise and vibration*¹⁷. These are summarised in Table 9.

Table 9: Peak Particle Velocities (ppv in mm/s) Below Which Transient Vibration Should Not Cause Cosmetic Building Damage

Type of structure	Frequency of vibration	
	4 to 15Hz	15Hz (and above)
Reinforced or framed structures	50mm/s	50mm/s
Industrial and heavy commercial buildings		
Unreinforced and light framed structures	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above
Residential or light commercial buildings		

It is evident that the levels monitored from both locations during this period do not exceed the levels prescribed above.

The vibration levels recorded from Location 1 are regarded as being consistent as to what would be expected from vibration associated with traffic movements. These levels would be considered as "slight" and would reflect the levels of vibration emanating from traffic movements at a location such as this.

The vibration levels from Location 2 were generally consistent for this location. There was one occurrence on the 5th June at 13:19hrs when the recorded vibration levels experienced a rise relative to the former and latter readings. The levels and frequencies recorded in the transverse, vertical and longitudinal components were 28.4mm/s at 43Hz, 43.1mm/s above 100Hz and 37.2mm/s above 100Hz respectively. It is understood that there is a dancing and band practice studio to the rear of this location. It is possible that the source of this vibration may have emanated from this facility however it could also be attributed to a different source.

Notwithstanding the levels recorded on 5th June at Location 2, there were no noticeable sources of vibration which is borne out by the values recorded. These values were generally at threshold levels. It would be expected that vibration levels from demolition events or similar occurrences and similar distances from the structures of interest would result in similar levels of vibration assuming similar ground composition.

11.3 Impact and Mitigation

The remediation of the site will create a temporary increase in local vibration levels in the vicinity of the site and will have some impact on local people. It will also impact on the personnel working on the site remediation itself. Sources of the vibration will include construction traffic and on-site plant.

The Contractor shall take all necessary steps in his method of working to prevent damage to the protected structures and adjacent properties due to vibrations caused by the works.

A full specification of works will be prepared following detailed design of remediation works. This will be undertaken in consultation with LCC and the EPA and specialist contractors and will detail any mitigation measures required. Mitigation is likely to include the following:

- vibration monitoring near the protected structures and at the site boundaries;
- limitation of site working hours;
- restricted traffic access/egress.

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12 Traffic

12.1 Introduction

A traffic scoping assessment has been undertaken, which comprised a site walkover to establish the areas of potential concern based on the likely site activities during remediation and included a site meeting with a representative of LCC. A copy of the traffic scoping assessment is included in Appendix I (CD).

The assessment provides a summary of the scoping meeting regarding all traffic required for removal of material from the former Gasworks site, Dock Road Limerick including construction traffic, staff, general maintenance and delivery vehicles.

12.2 Impact and Mitigation

Any material requiring removal is expected to be removed by road either to Limerick Docks or to a facility in Ireland east of Limerick. 2 to 3 construction vehicles arriving at and leaving the site per day have been assumed.

The possible impact on highway capacity of this traffic was discussed on site and it was confirmed by LCC due to the minimal impact expected that capacity assessments would not be required.

LCC have stated that they would prefer construction traffic not to enter or leave the site through Limerick City Centre and that the new Limerick Tunnel Link be used to access the N7.

At this stage, therefore, it is intended that HGVs would turn left out of the site onto Dock Road (N69), before joining the N7 via the new Limerick Tunnel Link road and onto the motorway network (M7) which leads to the east.

The possibility of increasing movements as a “one off event” in order to take material to the Dock for travel by sea were discussed. LCC will require a Traffic Management Plan to be agreed between them and Bord Gáis in order for vehicles to access the site safely and not have a detrimental affect on others using the local highway network.

Road Permits will require to be sought in order to transport Abnormal Loads, Wide Loads and Contaminated Material from LCC and each County which material is being carried through to their destination.

There are Protected Structures on the site, and agreement will be required between LCC's planning department and Bord Gáis to ensure that these structures are not compromised during the remediation process.

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13 Conclusions

13.1 Background

Bord Gáis are planning to remediate the former gasworks site in Limerick to enable the site to be brought back into productive use.

Remediation of the Limerick site will be done in co-operation with all regulatory bodies such as Limerick City Council, the EPA and in compliance with all national and EU Regulations. In addition, the local community will be kept informed of all remediation proposals and project progress.

The proposed remediation project will deal with the ground conditions only and any eventual development on the site will be the subject of a separate planning application and EIA as required.

13.2 Proposed Remediation Works

The remediation works will be undertaken in two phases: Phase 1 will comprise a 'pump and treat' technique to remove free phase liquids with Phase 2 comprising the stabilisation of the uppermost 3m of made ground across the site, where present.

It is estimated that a total volume of DNAPL requiring removal from site for recycling/ disposal will be approximately 200m³. These generally comprise coal tars and are present at the base of several underground tanks, within the former quarry and the deep limestone feature. The preferred option for removal of the DNAPL has been identified as 'pump and treat' technology.

The volume of material requiring stabilisation/ solidification is estimated to be in the order of 32,500m³. This phase of works would ensure that the majority of underground structures are removed and also allow treatment / removal of residual free product present following Phase 1 works. Stabilisation / solidification is likely to be carried out ex-situ due to the large number of obstructions present in the made ground.

The Phase 1 works are anticipated to take 6-12 months to complete depending on the rate of extraction of free phase liquids achieved. Phase 2 is expected to take approximately 6 months.

13.3 Potential Environmental Impact

The proposed remediation aims to improve the quality of the site by reducing the potential risks to future developers, site users, groundwater and the adjacent river. The works will ultimately result in a positive impact to the local environment by reducing contamination levels in site soils and groundwater and enabling future productive economic use of the site.

The remediation works themselves may have a temporary negative impact on the people living and working in the vicinity of the site in respect of landscape views, air quality, dust, odours, noise and vibration. The contractor will be required to implement mitigatory measures, to be agreed with LCC and the EPA to keep these to a practical minimum.

Two 'Protected Structures' are present on site: the boundary wall fronting Dock Road and the Power Generation Building which may be negatively affected by the proposed remediation works.

No significant impacts are anticipated with respect to site ecology.

A full specification of works will be prepared following detailed design of remediation works. This will be undertaken in consultation with regulators and specialist contractors and will detail any mitigation measures required.

Mitigation measures are likely to include, but not restricted to, the following:

- Protection of listed structures;
- limitation of site working hours;
- restricted traffic access / egress;
- use and maintenance of plant silencing equipment;
- use of dust and odour suppression measures, such as damping down, covering / sealing stockpiles and the operation of odour control spray systems; and
- appropriate monitoring of dust, odours, noise and vibration.

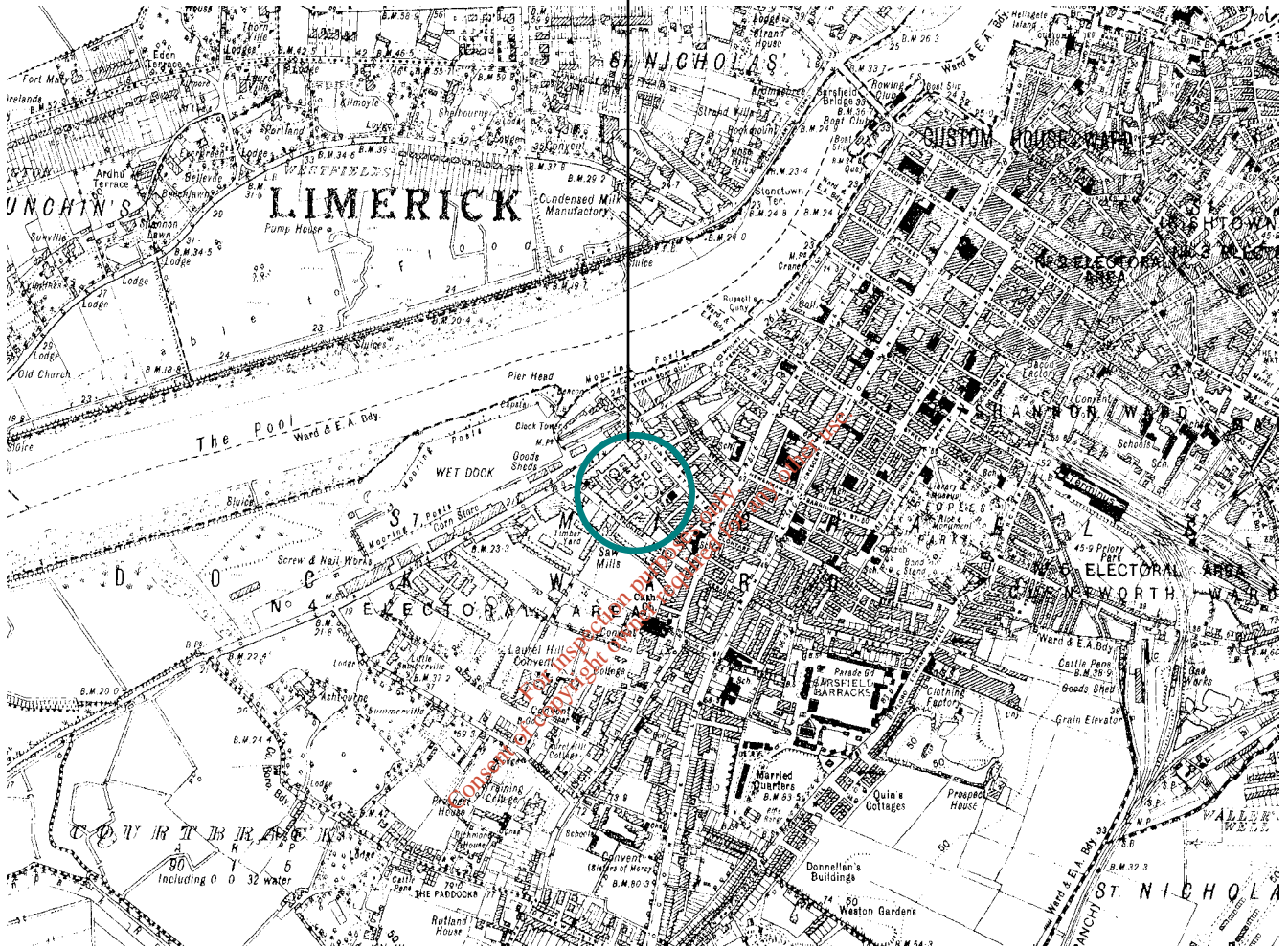
Mitigation requirements for the proposed works will be detailed in an Environmental Management Plan (EMP) which will form part of the contract with the remediation contractor.


14 REFERENCES

- ¹ Mouchel, 2010, Quantitative Risk Assessment, Options Appraisal and Remediation Report, reference 1021927/R03.
- ² Moore Group Environmental Services, 2009, Habitat Assessment of the Limerick Gasworks Site, reference 09LK02.
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- ⁸ Parkman, 2003, Ground Investigation into Boundary Conditions and Quarry Backfill, reference 25837/R/11A.
- ⁹ <http://www.maps.epa.ie>.
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- ¹¹ Environment Agency, 2010, H1 Environmental Risk Assessment for Permits.
- ¹² Roy Wailer Associates Ltd, 1992, Environmental Effects of Surface Mineral Workings, HMSO 1992.
- ¹³ Mouchel, 2009, Preconstruction Background Noise Level Survey, reference 1021927/R/01.
- ¹⁴ British Standard BS 7445: 1991, Description and Measurement of Environmental Noise.
- ¹⁵ AWN Consulting Limited, 2009, Bord Gáis Dock Road Site Preliminary Vibration Monitoring – 18th May to 24th June 2009, reference NV/09/3857NL01
- ¹⁶ British Standard BS 7385-2: 1993, Evaluation and measurement vibration in buildings Part 2: Guide to damage levels from ground borne vibration.
- ¹⁷ British Standard BS 5228-2: 2009, Code of practice for noise and vibration. Vibration.

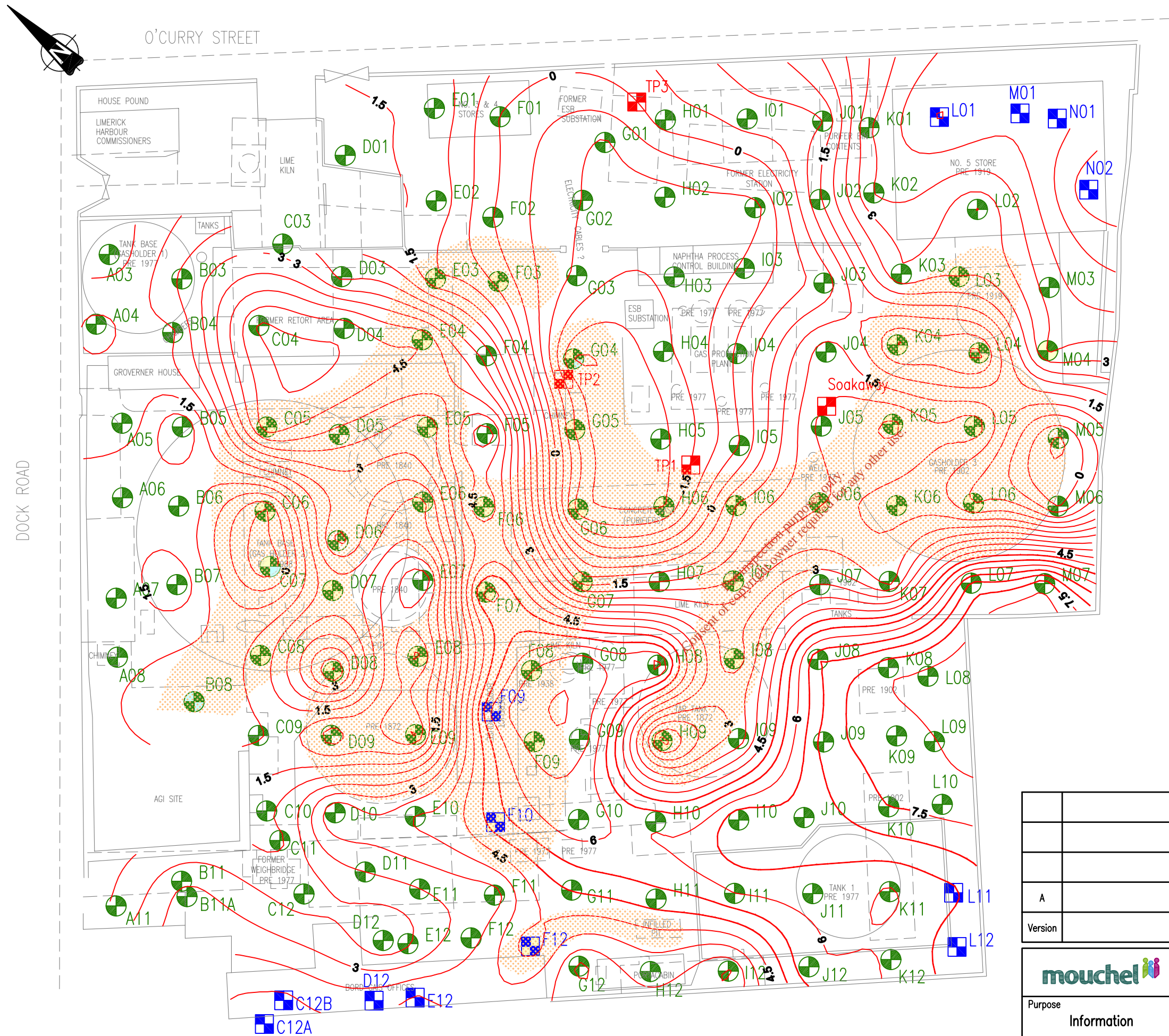


Site Location



	Client Bord Gáis Éireann	
	Project Limerick Gas Works	
Title Figure 1) Site Location Plan		
Purpose Report	Draft	Scale (at A4)
	Issue	Not to scale
Issuing Office: Cheshire	Drawing number	Version
Telephone: 0151 356 5555	1021927/R03/001	A

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Key

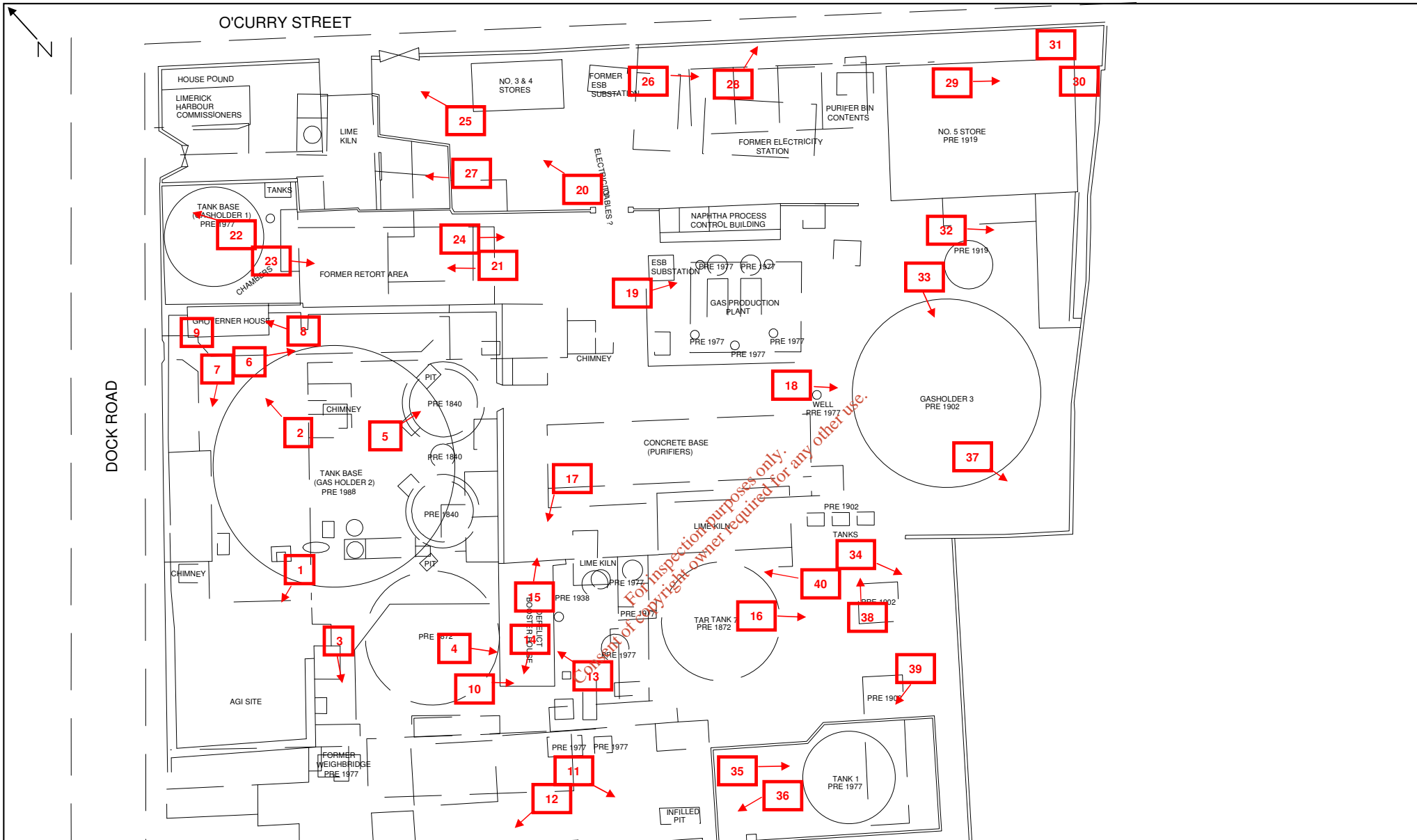
- Approximate Location of Former Structure


2009 Site Investigation

- Sonic Drilled Boreholes
- Window Sample Location
- Trial Pit
- Extensive free phase observed during 2009 SI
- Free phase observed during groundwater monitoring
- Free phase observed during 2009 SI and groundwater monitoring
- Predicted extent of free phase
- Rock head contour (mMHD)

A	First Issue	K.Hodgkinson 26/01/10	D.Megson 26/01/10	D.Watts 26/01/10
Version	Amendment	Originated by and date	Checked by and date	Approved by and date

mouchel		Client BORD GÁIS		
Purpose Information		Project Limerick Gasworks		
		Drawing Title Figure 7 Encountered Free Phase product		
Draft	●	Scale (at A3 size) 1:500	Issuing Office Ellesmere Port	Drawing number 1021927/R03/007
Issue			Telephone 0151 356 5555	Version A



		Client: Bord Gais	
		Project: Limerick Gasworks	
		Title: Figure 13) Site photographic log	
Purpose Report	Draft		Scale (at A3)
	Issue	•	Not to scale
Issuing Office: Cheshire		Drawing number 1021927/R03/013	Version A
Telephone: 0151 356 5555			

Limerick Gasworks - Site Photographs, July 2009



Photo 1) AGI site



Photo 2) Gasholder 2 and Groverner house

Limerick Gasworks - Site Photographs, July 2009



Photo 3) Bord Gais offices



Photo 4) Back wall of booster house

Limerick Gasworks - Site Photographs, July 2009



Photo 5) Looking west from Gasholder 2



Photo 6) Gasholder 2

Limerick Gasworks - Site Photographs, July 2009



Photo 7) Gas holder 2 and AGI



Photo 8) Groverner house

Limerick Gasworks - Site Photographs, July 2009



Photo 9) Inside manhole



Photo 10) Booster house slab

Limerick Gasworks - Site Photographs, July 2009



Photo 11) Corner of tank 1 bund



Photo 12) Bord Gais offices

Limerick Gasworks - Site Photographs, July 2009



Photo 13) Booster house



Photo 14) Inside booster house

Limerick Gasworks - Site Photographs, July 2009



Photo 15) Inside Booster house



Photo 16) Excavated wall

Limerick Gasworks - Site Photographs, July 2009



Photo 17) Booster house



Photo 18) View towards Gasholder 3

Limerick Gasworks - Site Photographs, July 2009



Photo 19) No. 5 stores



Photo 20) North east site boundary

Limerick Gasworks - Site Photographs, July 2009



Photo 21) View towards Gasholder 1



Photo 22) Gasholder 1

Limerick Gasworks - Site Photographs, July 2009



Photo 23) Former retort area



Photo 24) View towards ESB substation

Limerick Gasworks - Site Photographs, July 2009



Photo 25) O' Curry St site entrance



Photo 26) No. 5 Stores

Limerick Gasworks - Site Photographs, July 2009



Photo 27) Harbour commissioners land



Photo 28) North eastern boundary

Limerick Gasworks - Site Photographs, July 2009



Photo 29) Inside No. 5 stores



Photo 30) Behind No. 5 stores

Limerick Gasworks - Site Photographs, July 2009



Photo 31) Limestone behind No. 5 stores



Photo 32) South west side of No.5 stores

Limerick Gasworks - Site Photographs, July 2009



Photo 33) Gasholder 3



Photo 34) Exposed wall

Limerick Gasworks - Site Photographs, July 2009



Photo 35) Tank 1 bund



Photo 36) Tank 1 bund

Limerick Gasworks - Site Photographs, July 2009



Photo 37) Site corner from Gasholder 3



Photo 38) Exposed limestone bedrock

Limerick Gasworks - Site Photographs, July 2009



Photo 39) Tank 1 bund exterior



Photo 40) View west across the site