East Tip, Haulbowline Island, Cork

Foreshore Waste Assessment
Addendum to Detailed Quantitative Risk Assessment

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DETAILED QUANTITATIVE RISK ASSESSMENT PEER REVIEW

In February 2012 SKM Enviros (SKME) were appointed by Cork County Council from their Multi-Disciplinary Environmental Advisory Services in relation to the waste licensing and land remediation/reclamation project at Haulbowline Island, Co Cork. Under the scope of services relating to this framework agreement is the requirement to undertake peer review of a number of technical reports and studies carried out by other consultancy providers appointed by Cork CC under a parallel framework agreement.

In May 2012 Cork CC requested that SKME provide on-going technical peer review related services to assist in the delivery of a Detailed Quantitative Risk Assessment (DQRA) and supporting investigations at the East Tip in order to progress towards assessment of potential remedial options to support remediation and reclamation of the site.

WYG Environmental Planning and Transport Ltd (WYG EPT Ltd) have undertaken detailed site investigations and a quantitative risk assessment of the East Tip, details of which are contained within the attached report.

SKM Enviros have undertaken an independent technical review of the investigations and subsequent report, which has included a review of the overall approach adopted and a review of work and methodologies employed against current relevant national and international best practice and guidance. Having completed our review we are in agreement with the methodologies applied, the report findings, and the conclusions and recommendations contained therein. It should be noted that in completing our review, factual information presented within the report such as geological data, testing and analysis data compiled by WYG EPT Ltd. has been taken at face value by SKM Enviros as being factually correct.

For and on behalf of SKM Enviros

Mike McDonald

Project Manager

18th October 2013

Executive Summary

Instruction and outline	WYG were appointed by Cork County Council, on 27th January 2012, for the provision of multi-disciplinary environmental consultancy services for the site investigation and Detailed Quantitative Risk Assessment (DQRA) of the East Tip, on Haulbowline Island in Cork Harbour. This project relates to geo-environmental services required under Phase IV of the project programme, consultant contract requirements of the Council's regularisation programme for the East Tip which involves the completion of intrusive site investigations and a Detailed Quantitative Risk Assessment (DQRA). WYG were further instructed to assess the contamination potential and potential risks to receptors of the waste which is present and buried in the area of the foreshore as an addendum to the DQRA in order to determine whether the waste material currently present outside the proposed line of the perimeter engineered structure can remain.
Aims	The overall aim of the works completed at the East Tip was to undertake an assessment of the significance of the risks to human health and the environment receptors, in order to assist in identifying risks which may require mitigation as part of the licensing process. Specifically, this report aims to provide a Generic Quantitative Risk Assessment for the East Tip foreshore using relevant data gathered during a trial pit investigation on the foreshore to characterise the contamination associated with this waste material and determine whether it would be capable of causing significant risks to the health of site users, Cork Harbour waters and/or ecology.
Site Investigation Scope	A foreshore trial pit site investigation was completed between 14th and 16th January 2013 to provide information on the type and extent of waste present in the area of the foreshore and allow collection of samples for subsequent laboratory chemical analysis for contamination characterisation and assessment purposes. The site investigation works included completion of 29 No. trial pits to maximum depth of 4.5m below ground level (bgl) and chemical and NRA leachability testing of solid samples. The site investigation identified that the waste in the foreshore area typically comprised of slag with inclusions of metal pieces and was consistent with the findings of the DQRA. Approximately one third of the trial pits had other waste types present, predominantly demolition and construction waste.
Generic Quantitative Risk Assessment	The laboratory analysis results were assessed against relevant GACs. In regard to human health, these were compared to commercial land use GACs. With the exception of nickel, contaminant concentrations did not exceed applicable GACs. One isolated measured nickel concentrations exceeded the commercial GACs at FTP26 at 2.2-2.5mbgl, the source of which was considered to be due to a buried battery. Nickel is not a volatile contaminant and therefore human health exposure can only occur through direct contact, ingestion and inhalation of dust pathways. However these pathways are not viable for contaminants at depths greater than 1mbgl. As a result this nickel concentration is not considered to be capable of causing significant risks to the health of current or future site users. Additionally, the proposed remediation will effectively cover most of the foreshore area with rock armour preventing people from coming into contact with the waste, it will also not form part of the future proposed park and therefore future access will be restricted and additionally the waste in the foreshore area will be constantly wet lowering the potential for exposure via dust inhalation pathways.
Water DQRA Context	The aim was to consider whether the measured average conservative leachable concentrations relating to foreshore waste would cause a WQS to be exceeded after discharge into Cork Harbour. As per the DQRA (WYG, 2013) basic flux calculations were completed to consider a tidal theoretical daily flux of water from the foreshore waste into the Cork Harbour. The flux was estimated based on a difference in tidal water levels within the waste of the foreshore of 0.5m depth. Following calculated dilution by Cork Harbour waters the predicted concentrations were added to those that were predicted during the completion of the DQRA (WYG, 2013) for the same permeability as the proposed perimeter engineered structure and with reduced infiltration to account for a low permeable capping layer. As the cumulative predicted concentrations did not exceed the applicable WQSs, significant risks of pollution to Cork Harbour waters have not been

	identified (WYG, 2013).
Conclusions	This conservative assessment has not identified significant risks to human health or Cork Harbour waters considered in a post remediation context for waste in the foreshore area of the East Tip. Trace levels of asbestos have been identified in waste material, however the current proposed remedial solution incorporating the construction of a perimeter engineered structure faced with rock armour allied with the fact that there is limited potential for dust generation or asbestos fibre release from waste material in the foreshore environment given that it is in a constant state of saturation will effectively mitigate any risk by breaking the human health pathways. Furthermore access to the foreshore will not be facilitated as part of the future proposal for a park on the East Tip. The conservative leachability analysis results were compared to relevant WQSs to consider risks to Cork Harbour water and have identified leachable chromium VI, copper, manganese and mercury. However their concentrations are not considered to be sufficiently high enough to cause a WQS to be exceeded even when considered cumulatively in the context of predicted potential groundwater contaminant discharge from the main East Tip waste in Cork Harbour following remediation. This is further supported by the results of marine water sampling and analysis which did not identify contaminant concentrations in excess of relevant WQSs (WYG, 2013).

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1 Introduction

1.1 Instruction

WYG Environment, Transport and Planning (WYG EPT) were appointed by Cork County Council (CCC) on 27th January 2012, for the provision of multi-disciplinary environmental consultancy services for the site investigation and Detailed Quantitative Risk Assessment (DQRA) of the East Tip, on Haulbowline Island in Cork Harbour, (Figure 1 and Figure 2). This project relates to geo-environmental services required under Phase IV of the Council's regularisation programme of the waste in the East Tip (http://www.corkcoco.ie/haulbowline) which involved the completion of intrusive site investigations and a Detailed Quantitative Risk Assessment (DQRA) (WYG, 2013).

WYG were further instructed to assess the contamination potential and potential risks to receptors from the waste which is currently present a outside the line of the proposed Perimeter Engineered Structure (PES) and determine whether it can remain in-situ post remediation. The findings of that assessment is contained in this addendum.

1.2 Legal Context and Assessment Framework

The European Court of Justice ruling in case C494/01 requires that the East Tip is regularised in accordance with the Waste Framework Directive (WFD) (licensing requirements) and in particular an application will be made to the Environmental Protection Agency (EPA) for a waste licence.

The Environmental Risk Assessment for the East Tip, including site investigations and monitoring, completion of DQRA and design of an appropriate outline remediation plan, are required to support this waste licensing process. The work, as presented in this report, has been completed in accordance with best practice guidance documents including "Framework Approach for the Management of Contaminated Land and Groundwater at EPA Licensed Facilities" (EPA, 2012); the "Code of Practice: Environmental Risk Assessment for Unregulated Disposal Sites" (EPA, 2007) and the "Model Procedures for the Management of Land Contamination – Contaminated Land Report" (EA, 2004). This latter piece of guidance is specifically relevant to land contamination in the United Kingdom (UK), however it is relevant as the EPA's framework has been broadly based on it.

The framework approach identifies three stages as outlined below:

- Stage 1 – Site Investigation and Assessment including
    - Preliminary Site Assessment
    - Detailed Site Investigation
    - Quantitative Risk Assessment
- Stage 2 – Corrective Action Feasibility and Design
    - Outline Corrective Action Strategy (Objectives)
    - Feasibility study and outline design
    - Detailed design
    - Final Strategy and implementation plan
- Stage 3 – Corrective Action Implementation and Aftercare
    - Enabling works
    - Corrective Action Implementation and Verification
    - Aftercare

This assessment presented in this report presents the results of a trial pit site investigation in the foreshore area of the East Tip and quantitative risk assessment in accordance with Stage 1 above.

The risk assessment process is underpinned by the establishment and continual refinement of a Conceptual Site Model (CSM). A CSM describes the potential sources of contamination at a site, the contaminant migration pathways it may follow and the receptors that could be or are being impacted. When all three are present i.e. source, pathway and receptor, then a potential pollutant linkage is considered to be present, requiring characterisation and assessment in order to determine whether remedial works are needed to adequately address any potentially unacceptable risks.

1.3 Limitations of the Report

Attention is drawn to the report conditions, included in Appendix A. It should be noted that WYG has undertaken this risk assessment using the results of the analysis of samples collected by RPS who undertook the investigation.

1.4 Aims and Objectives

The overall aim of the work completed at the East Tip and this report is to present the results of an assessment of the significance of the risks to human and the environment receptors, in order to assist in identifying risks which may require mitigation as part of the waste licensing process.

Specifically, this report aims to provide a Generic Quantitative Risk Assessment for the East Tip foreshore using relevant data gathered during a trial pit investigation on the foreshore to characterise the contamination associated with this waste material and determine whether it would be capable of causing significant risks to the health of site users, Cork Harbour waters and ecology.

The scope of work included:

- Providing data to characterise the chemical and physical nature of waste material in the foreshore area;
- Providing a detailed interpretation of testing results from the 2013 foreshore trial pit investigation in respect to sources, pathways and receptors;
- Assessment of contaminants of concern to assess their significance through comparison of chemical analysis results (solid and leachability analysis) with relevant standards and thresholds;
- Development and presentation of a revised conceptual site model; and
- Providing recommendations for managing any unacceptable risks identified.

It should be noted that the term “waste” utilised within this report refers to non-natural materials which have been deposited in the East Tip above alluvium or natural sediments. Any use of the term “soil” within this report refers to natural materials, soils or sediments, including alluvium, sands, silts, clays and gravel.

1.5 Initial Conceptual Site Model

In regard to the foreshore area, waste was observed to be present on the surface of the foreshore and for the purposes of the DQRA it was assumed to extend below the surface with an unknown lateral and vertical extent. For the purposes of the foreshore investigation undertaken by RPS the following initial conceptual model (Table 1 and Table 2) was developed based on the results of the East Tip DQRA (WYG, 2013).

Table 1 - Initial Conceptual Site Model – Water

Source	Pathway	Receptor
Heavy metallic contamination / organic contamination associated with waste material on and below the surface of the East Tip foreshore.	Leaching from unsaturated zone	Cork Harbour waters
	Leaching within tidal zone through wetting and drying	Cork Harbour waters
	Lateral and vertical water movement	Cork Harbour waters
	Uptake by flora and fauna	Flora and fauna in Cork Harbour particularly on foreshore

Table 2 - Initial Conceptual Site Model – Human Health

Source	Pathway	Receptor
Shallow metal, organic and asbestos contamination associated with waste material on and below the surface of the East Tip foreshore.	Direct dermal contact Ingestion dust and soil Inhalation of dust/fibres	Current & future site users

1.6 Report Content

This report sets forth the findings of this study in the following chapters:

Chapter 2 Foreshore Site Investigation

Chapter 3 Generic Quantitative Risk Assessment (GQRA) for human health and waters

Chapter 4 Water DQRA Context

Chapter 5 Conclusions

2 Foreshore Site Investigation

A foreshore intrusive trial pit site investigation was completed between 14th January 2013 to 16th January 2013 to provide information on the type and extent of waste present in the area of the foreshore and allow collection of samples for subsequent laboratory chemical analysis for contamination characterisation and assessment purposes.

The intrusive investigation undertaken by RPS included the excavation of 29 No. trial pits at low tide. Trial pits were spaced at lateral 20-50m intervals along the foreshore surrounding the East Tip and were typically excavated to a depth of 2-3 mbgl. The maximum depth was 4.5mbgl. It is considered that this trial pit investigation is sufficiently dense to allow for broad characterisation of the waste along with identification and sampling of waste with the greatest contamination potential. A trial pit location plan is presented as Figure 3 and trial pit investigation logs with recorded observed ground conditions presented in Appendix B.

All site investigation works were supervised on a full time basis by a suitably qualified Environmental Consultant who logged the observed ground conditions in accordance with Eurocode 7. This person also supervised the main East Tip site investigation (WYG, 2013) and therefore provides consistency between the two investigations. Waste types were defined in accordance with the procedures used in previous investigations of the East Tip. Solid waste samples were obtained for subsequent laboratory chemical and leachability testing.

2.1 Ground Conditions

During the excavation of the trial pits and as summarised in Table 3, waste was observed in the foreshore area to an average depth of 1.5m and a maximum depth of 4.5m at FTP21. The waste typically comprised of granular slag with inclusions of metal pieces and refractory bricks and was consistent with the waste observed during the main East Tip investigation (WYG, 2013). Near surface waste in approximately half the trial pit locations was either consolidated, fused or comprised of coarse slag cobbles and boulders. At 10 No. out of the 29 No. trial pits other waste types were observed, however typically these were not observed to be near the ground surface of the foreshore. For example at FTP13 abundant construction and demolition waste mixed with slag was observed underlying consolidated slag at 1.5-2.1mbgl, similarly at FTP21 from 1.8-4.5mbgl and at FTP24 from 0.8-2.7mbgl. There were a few locations where other waste types were present near the ground surface including FTP17 and FTP18 comprising of slag mixed with construction and demolition waste, however this is not typical with the near surface deposits predominantly comprising of granular slag with inclusion of refractory brick and metal pieces.

Table 3 - Summary of Ground Conditions Encountered During 2012 Site Investigation in Foreshore Area

Stratum Title	Strata Description	Thickness Range (m)	Average / Median (m)
Waste	Comprised predominantly slag (granular) with metal pieces and refractory bricks and to a lesser extent construction and demolition type waste	0.1-4.5m	1.44 / 1.5
Alluvium	Grey silt	Not proven	N/A

2.2 Potential Contaminants of Concern

To identify contaminants of concern in respect of waste present within the foreshore area, reference has been made to the contaminants of concern included within the East Tip DQRA report (WYG, 2013), particularly those that have been measured at concentrations in excess of human health Generic Assessment Criteria (GACs) and Water Quality Standard (WQSs). Based on the trial pit log information, the waste within the foreshore area is typically comprised of the same material within the main body of the East Tip, mainly slag and to a lesser extent construction and demolition waste. The DQRA considered that the contaminants of concern were predominantly metals including chromium and chromium VI, copper, zinc, lead, manganese, nickel and mercury. Consequently the following contaminants of concern have been identified:

Solid waste;

- Metals including arsenic, cadmium, lead, mercury, nickel, zinc, manganese and vanadium. However for the purposes of this assessment chromium (total), hexavalent chromium (or chromium VI) will also be considered to be a contaminant of concern along with other heavy metals even though the measured concentrations were less that the applicable GACs.
- Organic compounds including benzo(a)pyrene. However additionally, other organic compounds including: phenols total and speciated, mineral oil, speciated total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, xylene (BTEX), methyl tertiary butly ether (MTBE), polyaromatic hydrocarbons (PAHs), volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) have also been considered to be contaminants of concern where visual or olfactory evidence of hydrocarbon contamination was observed during the intrusive investigations; and
- Inorganics including asbestos.

Groundwater, surface water and leachate from leachability tests;

Metals including arsenic, cadmium, chromium (total), hexavalent chromium (or chromium VI), copper, zinc, lead, manganese, mercury and nickel as the predominant contaminants which have been measured in excess of WQSs either in groundwater or in leachate from leachability tests.

2.3 Methodology Assessment Criteria

For a risk of harm to human health or the environment to occur as a result of ground contamination, all of the following elements must be present:

- A source, i.e. a substance that is capable of causing pollution or harm;
- A receptor (or target), i.e. something which could be adversely affected by the contaminant; and
- A pathway, i.e. a route by which the contaminant can reach the receptor.

If one of these elements is missing there can be no risk. If all are present then the magnitude of the risk is a function of the magnitude and mobility of the source, the sensitivity of the receptor and the nature of the migration pathway.

In order to assess the human health and environmental risks posed by potential contaminants within the waste material and underlying groundwater an initial screen of the laboratory results was undertaken using Generic Assessment Criteria (GACs). GACs are generic screening values used for comparison purposes to assess the risk associated with contaminant concentrations found on site and are derived using non-site-specific information. Where contaminant concentrations fall below relevant GACs, they are not considered to be capable of causing a risk to the receptor being considered and as a result do not warrant further consideration.

2.3.1 Human Health – Chemical Analysis of Solid Samples

In order to assess the solid laboratory analyses results for waste material observed in the foreshore area, WYG have utilised the same human health receptor GACs as outlined in the DQRA report (WYG, 2013) which comply with current Irish Framework Guidance (EPA, 2012). These include appropriate commercially available GACs which are regularly used in Ireland and the UK for generic human health risk assessments. GACs are contaminant specific and have been derived for various land use types including commercial / industrial, low density and high density housing and park / playgrounds and allotments.

The foreshore area, post remediation, will not be utilised for recreational purposes as for the main East Tip. Access routes will not be provided onto the foreshore. The 'Priests Stairs' (Section 15.33 of the EIS; RPS, 2013) currently located in the seawall adjacent to the south western corner of the East Tip will be removed during the remediation and the foreshore will almost entirely be covered with the proposed perimeter engineered structure including rock armour as shown in drawings in Appendix C. Pathways along the edge of the East Tip and foreshore are avoided in the Landscape Design Plan to prevent access the foreshore area which not only reduces impacts to wildlife but avoids potential impacts from a health and safety aspect with respect to the public from accessing water and the foreshore areas (Section 4.6.1.1 of the EIS; RPS, 2013)

Consequently the GACs relevant to assessing contamination within the foreshore area are the commercial and industrial land use GACs, which have been recently derived in the UK by the Chartered Institute of Environmental Health (CIEH) and the Land Quality Management Team at the University of Nottingham. These were developed through collaboration of a number of UK contaminated land specialist practitioners and published jointly by CLAIRE and CIEH, (CIEH, 2009). These screening criteria can be considered to be appropriate in assessing risks to the health of users of the site. They assume that buildings are present, normally for office use on site and that indoor pathways are therefore applicable. Outdoor contact pathways are restricted to lunchtimes or break times. These lower exposure durations are still considered to be conservative when considering should persons access the foreshore area, they can only be present in this area for a limited time during low tides.

A full list of the GACs is provided in Appendix D. Solid sampling laboratory analysis results compared to relevant GACs are presented in Appendix E.

2.3.2 Methods for Water Assessment

The analytical data from solid leachability tests (National Rivers Authority (NRA) leachability tests) has been assessed by direct comparison with water quality standards (WQS) as presented in Table 4. Where a specific Irish Surface Water Standard is not available, then other standards such as drinking water standards (Irish standards if available) or environmental quality standards (EQS) from the UK were utilised. These are mainly national statutory standards sourced from, in order of preference, European Communities Environmental Objectives (Surface Waters) Regulations 2009 (Annual Average) for surface waters other than inland waters e.g. coastal and transitional waters; European Communities Environmental Objectives (Surface Waters) Regulations 2009 (Annual Average) for inland surface waters; and other international water quality standards namely UK Environmental Quality Standards (EQS) and UK Drinking Water Standards (DWS). These are used as screening standards in the first instance to determine which of the potential contaminants of concern (PCOC) should be further assessed for significance of the risk posed.

In order to assess COCs, compliance point standards are required which should be appropriate for the receptor being considered. For the East Tip site, the Cork Harbour waters are considered to be the primary receptor. As a result the preferred quality standards adopted are those as in Table 4 and are WQS values for “other surface waters”.

Table 4 - Water Quality Standards from European Communities Environmental Objectives (Surface Waters) Regulations 2009 (Annual Average)(DoEHLG, 2009)

Contaminant	Water Quality Standard (WQS) (µg/l)
Arsenic	20
Chromium III	4.6 (inland water – no other surface water)
Chromium VI	0.6
Copper	5
Zinc	40
Lead	7.2
Nickel	20
Phenol	8
Mercury	0.05
Cadmium	0.2
Total Ammonia (mg/l N/l)(good status)	60
Ammoniacal Nitrogen (by calculation from ammonia)	50
Benzene	8
Xylene	10
Toluene	10
Anthracene	0.1
Benzo(a)pyrene	0.05
Benzo(b & k)fluoranthene (sum)	0.03
Benzo(g,h,i)perylene & indeno (1,23-cd)pyrene (sum)	0.02
Fluoranthene	0.1
Naphthalene	1.2

Other standards:
Aluminium – Drinking Water Standard – 0.2mg/l Water Soluble Boron – UK Marine Water EQS - 7mg/l Manganese – UK freshwater EQS – 0.03mg/l

NRA leachability test results in summary screening sheets are presented in Appendix F. These sheets summarise the laboratory analysis results and compare them to a contaminant specific GAC (appropriate water quality standard), with concentrations in excess of WQS highlighted.

2.4 Analysis Results – Foreshore Solid Waste Quality

2.4.1 Asbestos Tests on the Solid Matrix

In total 4 No. samples were analysed by IOM Consulting Laboratory to identify asbestos fibres. Out of the 4 No. samples submitted for analysis, all tested positive for asbestos. 2 No. comprised of bound chrysotile fibres, 1 No. of bound amosite and 1 No. of loose amosite fibres. However quantification analysis has shown that asbestos is present in very low quantities in the 0.003%-0.01% range. Further examination of the fibres by the laboratory has identified that the asbestos fibres had not been subjected to heat treatment and as a result are not considered to originate from the slag or raw scrap metal that was used by the steelworks. The laboratory results are presented in Appendix G.

2.4.2 Chemical Analysis Results – Foreshore Solid Waste Quality

In undertaking this assessment, to consider solid waste quality as present in the foreshore area, data for samples collected from the 2013 trial pit investigation were compared to the commercial GACs as presented in Appendix E, with summary data for contaminants with concentrations that exceed the GAC in Table 5. The analysed samples all comprised of waste slag typically with scrap metal and refractory bricks. Other waste types including construction and demolition type waste, cables and batteries were also encountered and analysed.

The selection of samples for analysis was determined based on a review of the trial pit investigation logs in light of the DQRA investigation and assessment findings and was as follows;

- Samples from FTP2 0-0.2mbgl, FTP6 0.6-1mbgl and FTP10 0.1-0.4mbgl were selected as “slag samples” being representative of the predominant waste type of the East Tip and foreshore area, based on investigation logs and the DQRA report (WYG, 2013). Shallow samples from FTP2 and FTP10 were also selected for analysis to provide data on surface or near surface likely contaminant concentrations;

- Samples from FTP17 1.7-1.9mbgl, FTP19 1.2-1.5mbgl, FTP21 2-2.5 and FTP26 2.2-2.5 were selected as samples with the greatest potential to contain the highest contaminant concentrations, due to inclusions of other waste types including construction and demolition waste, metal pieces, bricks, cables, plastic and batteries and as considered in the DQRA report (WYG, 2013). Samples were also selected for analysis due to visual and olfactory evidence of contamination noted on the site investigation logs specifically hydrocarbon odours in FTP17 1.7-1.9mbgl and FTP19 1.2-1.5mbgl and black staining observed in FTP17 at 1.7-1.9mbgl.

Table 5 - Summary Analysis Results from Solid Samples in 2013 where Concentrations of Contaminants of Concern exceed GACs

Contaminant	No. of Samples	Maximum Conc. (mg/kg)	No. of Samples below Detection Limit	Commercial Land Use GAC		
				GAC (mg/kg)	No. of Samples Exceeding GAC	Location and Depth (mbgl)
Nickel	7	2160	0	4,640	1	FTP26 2.2-2.5mbgl

Heavy Metals

The waste samples were analysed for a number of metal contaminants in accordance with testing undertaken previously on East Tip materials. Concentrations of heavy metals, including chromium and chromium VI were not measured in excess of the commercial land use GACs (Appendix E). Consequently they are not considered to be capable of causing significant risks to human health.

This is with the exception of one measured nickel concentration 5,770mg/kg, out of 7 No. analysed, which exceeded the commercial land use GAC of 1,800mg/kg (Table 5). This was in the sample obtained from FTP26 at 2.2-2.5mbgl which comprised of slag with frequent metal pieces, cable and a battery. It is considered that the battery at this location is a potential source of the elevated and isolated nickel concentration.

Organic Compounds

The waste samples were analysed for a number of organic parameters which included speciated polyaromatic hydrocarbons (PAHs), phenol, speciated total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylene (BTEX), volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Comparison with commercial land use GACs did not identify measured concentrations in excess of the GAC and consequently they are not considered to be capable of causing significant risks to human health.

2.5 Solid Leachability Analysis Results – Foreshore Waste

Leachability testing was undertaken using NRA leachability tests in order to determine the potential for contaminants to leach from the waste to water and pose a risk to Cork Harbour waters. It should be noted that the use of NRA leachability tests provides a very conservative assessment due to its procedure of grinding down the sample. This increases the sample's specific surface which will be in contact with pore water thus increasing the potential for contaminants to leach versus reality which is that leachable metal concentration will only be generated through available fused and coarse slag surface area in contact with seawater. Haulbowline Island is also in a relatively low energy setting and would not be subject to the same grinding wave action that is present at other coastal locations.

The NRA contaminant leachability data were compared to respective Water Quality Standards (WQS) for each of the potential contaminants of concern (COCs) and the results for those COCs which exceed applicable WQS are presented in Table 6. The leachability test results for all samples tested as compared to relevant WQSs are presented in Appendix F.

Table 6 - Summary Foreshore Waste Leachability Test Analysis Results 2013

Contaminant	Water Quality Standard (WQS) (µg/l)	Total No. of Samples	Range (µg/l)	No. Samples Exceeding WQS	WQS Exceedance Locations and Depth (mbgl)
Chromium VI	0.6	7	2-3	7	FTP2 (0-0.2), FTP6 (0.6-1.0), FTP10 (0.1-0.4), FTP17 (1.7-1.9), FTP 19 (1.2-1.5), FTP21 (2-2.5), FTP26 (2.2-2.5)
Copper	5	7	<3-66	1	FTP2 (0-0.2)
Manganese	30	7	<1.5-54.3	1	FTP17 (1.7-1.9)
Mercury	0.05	7	0.02-0.11	2	FTP 19 (1.2-1.5), FTP21 (2-2.5)

The leachable concentrations of metals including arsenic, barium, beryllium, boron, cadmium, chromium, lead, nickel, selenium, vanadium and zinc were measured at concentrations below the relevant WQSs and are therefore not of concern in respect to their potential to leach from solid to liquid phase.

Leachable concentrations of chromium VI, copper, manganese and mercury exceeded the relevant WQS. The greatest number of exceedances was observed in respect of chromium VI which exceeded the applicable WQS of 0.6µg/l, with leachable concentrations ranging from 2-3µg/l which is just at the laboratory limit of detection of 2µg/l. These leachable concentrations are considered to be very small being only just detectable. It has been noted that the laboratory limit detection 2µg/l is above the WQS, however this was the lowest detection limit being achieved by commercial laboratories in Ireland and the UK.

One leachable copper concentration of 66µg/l exceeded the WQS of 5µg/l in a sample from FTP2 at 0-0.2mbgl comprised of slag with metal debris. All other measured concentrations of copper were less than the laboratory detection limit of 3µg/l. The solid analysis result for copper at this location was 1,344mg/kg and does not appear to be elevated by comparison to the other copper results which ranged from 308mg/kg to 1,675mg/kg and for which leachability analysis did not identify leachable concentrations above laboratory detection limits. To consider the potential source of this leachable copper, reference has been made to the trial pit logs. The trial pit log entry for this sample does not identify material that is significantly different from the other sampled locations that could give rise to higher leachable concentrations. Consequently the leachable copper concentration of 66 µg/l is not considered to be representative of the entire slag waste in the foreshore area further supported by the fact that other samples measured leachable copper concentrations at less than laboratory detection limits.

One sample had a leachable manganese concentration of 54.3 µg/l which exceeded the WQS of 30 µg/l. This sample was from FTP17 at 1.7-1.9mbgl and comprised of slag with occasional construction and demolition type waste. All other leachable manganese concentrations were measured at less than the laboratory detection limit of 1.5µg/l. The solid analysis result for manganese at this location was 12,310mg/kg and does not appear to be significantly elevated by comparison to the other manganese analysis results which ranged from 10,520mg/kg to 28,460mg/kg and for which leachability analysis did not identify leachable concentrations above laboratory detection limits.

Two samples assessed for leachable mercury had measured concentrations in excess of the WQS of 0.05 µg/l with concentrations of 0.06 µg/l marginally above the WQS measured at FTP19 1.2-1.5mbgl and 0.11 µg/l measured in the sample from FTP21 at 2-2.5mbgl. The solid mercury analysis results for these two samples measured mercury concentrations at less than laboratory detection limits of 0.5mg/kg.

3 Generic Quantitative Risk Assessment (GQRA)

3.1 Human Health GQRA

The results of the chemical laboratory analysis of the samples collected from waste present on the foreshore area of the East Tip were assessed against GACs for a commercial landuse. In regards to human health and GACs, where contamination is present with concentrations that exceed GAC at depths greater than 1m, the probability of human exposure via the direct contact pathways is significantly reduced, leaving inhalation of volatile compounds as the dominant pathway with regard to human health risks. Typically, volatile compounds only significantly affect the indoor inhalation pathway.

The results of the comparison of the measured concentrations of the Contaminants of Concern, with the exception of nickel has not identified contaminant concentrations in excess of relevant Human Health GACs for waste material in the foreshore area.

Table 6 shows that a measured nickel concentration from FTP26 at 2.2-2.5mbgl was in excess of the commercial land use GAC, the source of which is considered to be due to a buried battery. Nickel is not a volatile contaminant and therefore human health exposure can only occur through direct contact, ingestion and inhalation of dust pathways. However these pathways are not viable for contaminants at depths greater than 1mbgl. As a result this nickel concentration is not considered to be capable of causing significant risks to the health of current or future site users.

In considering the above it should also be noted that post remediation, the foreshore area will be almost entirely covered by the proposed perimeter engineered structure which effectively will remove any direct contact human health exposure pathways. Exposure through dust generation pathways will also be highly unlikely due to the damp nature of the waste material which is in the tidal zone, is constantly wet and is mostly submerged by seawater. Access to the foreshore will also not be provided post remediation and will be limited by the proposed perimeter engineered structure and rock armour.

Consequently potential significant risks to human health from contaminant concentrations in waste in the foreshore area have not been identified.

3.2 Generic Waters Assessment

Section 2.5 described the leachability analysis results with respect to locations where contaminant concentrations were measured in excess of applicable WQSs. The laboratory analysis results compared to relevant WQSs are presented in Appendix F. Laboratory certificates are included in Appendix H.

In all samples analysed concentrations of chromium VI ranging from 2-3µg/l were in excess of the WQS of 0.6µg/l. However this does not consider the dilution factor offered by Cork Harbour waters, that sampling and analysis of the Cork Harbour waters has not measured contaminant concentrations in excess of applicable WQSs including chromium and chromium VI (WYG, 2013) and the fact that the NRA leachability analysis test is conservative as noted in Section 2.5. It should also be noted that the leachable concentrations appear to be lower than those actually measured and reported in the DQRA report (WYG, 2013) where a maximum leachable concentration of 457µg/l was measured.

One copper and one manganese sample had a leachable concentration that was measured in excess of their respective WQS. These are considered to be isolated occurrences and as a result do not represent the leachable potential of all the waste within the foreshore area. This is further supported by the median contaminant concentrations of <3µg/l copper and <1.5µg/l manganese being less than laboratory detection limits, less than their respective WQSs of 5µg/l and 30µg/l and the fact that analysis of the Cork Harbour waters has not measured contaminant concentrations in excess of applicable WQSs (WYG, 2013). The DQRA report (WYG, 2013) also measured leachable copper in excess of the WQS in 44% of waste samples analysed with a maximum of 266µg/l and as a result this concentration is within the range of that measured during the main East Tip site investigation.

Two leachable mercury concentrations were in excess of the WQS, however they are considered to be marginal being less than an order of magnitude above. As for copper and manganese the median value of 0.04µg/l does not exceed the WQS and analysis of the Cork Harbour waters has not measured contaminant concentrations in excess of applicable WQSs (WYG, 2013). Consequently leachable mercury is not considered to pose a risk of pollution to Cork Harbour waters.

3.3 Updated Conceptual Model (Post Generic)

3.3.1 Human Health

On the basis of comparison of solid analysis results with appropriate GACs and consideration of leachability analysis results, significant pollutant linkages have typically not been identified in regard to waste in the foreshore area of the East Tip as shown in Table 7 which is presented for the site in its current condition without remediation.

3.3.2 Sources

Only one nickel concentration exceeded the applicable commercial land use GACs out of 7 No. analysed. However this was not encountered in near surface material (<1mbgl) and as a result is at a depth where human contact is not possible (i.e. a potential pollutant pathway does not exist) and therefore it is not considered to be capable of causing significant human health risks. All other contaminant concentrations were less than the commercial GACs.

Asbestos

All samples screened were identified as containing very low quantities of asbestos fibres, typically 0.003%-0.01% comprising of the lower risk chrysotile and also amosite. Further examination identified that the asbestos fibres had not been subjected to a heat treatment and as a result are not considered to originate from the slag or raw scrap metal that was used by the steelworks. It is considered that the most likely source is construction and demolition type waste deposited both at depth and present at the surface. More detailed results are presented in Appendix G. Asbestos is considered to have the potential to cause risks to the health of current and future site users through inhalation pathways however the risks are minimised as the waste is within the tidal area and is always wet reducing the potential for fibre release to air.

Table 7 – Updated Foreshore Conceptual Site Model – Human Health Under Current Site Conditions

Source	Pathway	Receptor
Asbestos in waste material	Inhalation of fibres	Current commercial users, future park users and construction workers

3.4 Water and Ecology

On the basis of comparison of solid and leachability analysis results with appropriate GACs, a number of pollutant linkages have been identified in respect of potential contaminants in pore water in the foreshore area, which are summarised in Table 8.

3.4.1 Sources

Leachable concentrations of chromium VI and to a lesser extent copper, manganese and mercury have been measured above applicable WQSs. Elevated concentrations of these contaminants have also been identified in groundwater sampled from the waste material within the larger East Tip and therefore at the generic stage pollutant linkages are considered to be present with respect to leaching to water and will be considered further in respect of their potential to pollute Cork Harbour waters in Section 4.

Table 8 - Updated Conceptual Site Model –Water and Ecology

Source	Pathway	Receptor
Leachable chromium VI, copper, manganese and mercury in waste	Leaching from unsaturated zone	Cork Harbour waters
	Leaching within tidal zone through wetting and drying	Cork Harbour waters
	Lateral and vertical water migration waste	Cork Harbour waters
	Uptake by flora and fauna	Flora and fauna in Cork Harbour particularly on foreshore
	Erosion and leaching	Cork harbour waters and flora and fauna in Cork Harbour particularly on foreshore

3.4.2 Pathways

Based on the results of the DQRA (WYG, 2013) and foreshore trial pit investigation, the following pathways have been identified with respect to water receptors:

- Leaching of mobile compounds through rainwater infiltration in the unsaturated zone, i.e. leaching of materials from slag waste and other waste (construction and demolition) in the foreshore area. It should be noted that this pathway is considered to be limited as an unsaturated zone will only be present during low tide and is considered to be of a shallow depth. The majority of the waste material in the foreshore area is submerged even at low tide;
- Leaching of compounds within tidally influenced waste material and saturated waste materials from tidal flows i.e. leaching of materials from slag material to Cork Harbour waters; and
- Vertical and lateral contaminant migration in porewater in waste.

However it should be noted that as identified in the DQRA report (WYG, 2013), sampling of the harbour waters has not identified contaminant concentrations in excess of relevant WQSs for all measured contaminants showing that the actual pollutant linkages are not present and the Harbour Waters are not being significantly impacts by elevated contaminant concentrations in waste in the foreshore area or from waste within the larger East Tip.

3.4.3 Receptors

The primary receptor in regard to water is considered to be Cork Harbour. In considering this as the primary receptor it is also considered to be protective of ecology, flora and fauna in the Cork Harbour.

4 Water DQRA Context

The DQRA report (WYG, 2013) presented the results of a conservative bespoke assessment (Mass Transport model) of theoretical impact to the Cork Harbour waters, specifically from dissolved phase contaminants within the saturated parts of the entire East Tip site. This approach determined a conservative estimate of the mass of dissolved phase contaminant flux potentially leaving the site as part of the local tidal regime.

There were two key component parts to the Mass Transport model. The first was a flux model which quantified the volume of water flux from the site and the second was a dilution model based on the calculation and application of dilution factors which were applied to representative concentrations of identified contaminants in the groundwater being discharged into the receptor, in this instance, the tidal waters of Cork Harbour. The models considered the site in its current condition.

The foreshore area was included within these calculations as the East Tip waste was assumed to extend to the low tide water mark and consequently the DQRA CSM and Mass Transport model completed are relevant for considering the observed COC concentrations measured during the foreshore trial pit investigation.

4.1 Flux modelling

The flux model was developed to estimate contaminant discharge through the East Tip from each tidal cycle and was based primarily on Darcy's Law using site specific conservative hydraulic gradients, hydraulic conductivities and average contaminant concentrations as presented in Table 9. Table 9 also presents average leachable metal concentrations as measured in samples collected from the foreshore area as part of this investigation.

Table 9 – Contaminants of Concern (COCs)

Determinant	WQS (µg/l)	East Tip Waste Groundwater	Foreshore Waste Leachability		
		Average Concentration (µg/l)	Average Concentration (µg/l)	Minimum (µg/l)	Maximum (µg/l)
Chromium VI	0.6	**22**	2	2	3
Chromium	4.6	**11**	0.5	<0.2	2.3
Copper	5	**12**	12	<3	66
Zinc	40	**9**	1.5	<1.5	<1.5
Lead	7.2	**2.4**	0.5	<0.4	1
Manganese	30	**535**	9	<1.5	54.3
Nickel	20	**6.4**	0.9	<0.2	4.8
Mercury	0.05	**0.2**	0.05	0.02	0.11

Note: LOD values have been used in the calculation of averages where concentrations were measured as less than the LOD.

As can be seen from Table 9, the averages and maximum measured leachable metal concentrations were less than the groundwater concentrations measured in the waste material of the East Tip, with the exception of copper where a single sample had a leachate concentration of 66ug/l as identified in Section 2.5.

To consider whether the above average leachable concentrations would cause a WQS to be exceeded after discharge into the Cork Harbour, as per the DQRA (WYG, 2013), flux calculations have been completed.

It has been estimated, from an average of measurements of lateral distance between the perimeter engineered structure and low tide water mark, that approximately 7m of the foreshore will remain outside the perimeter structure. The length of the foreshore is 865m so this equates to an area of 6,055m^2.

The tidal daily flux takes the difference in observed tidal water levels within the waste of the foreshore of 0.5m depth. It is known that most of the depth of the waste material in the foreshore is always submerged by the Cork Harbour waters with an observed difference in water levels of less than 0.5m on average, i.e. the depth to water level in trial pits at low tide as presented in Appendix B. The tidal daily flux has been conservatively calculated as 6,055m^2 x 0.5m (tidal range in foreshore waste) x 0.34 (porosity) = 1029m^3 x 2 cycles per day = 2059m^3. However, this considers the cross-sectional area of the waste on the foreshore as a rectangle when it is more akin to a triangle and in doing so over estimates the flux by a potential order of 2. This has been used to calculate the dilution factors as in Table 10 which have then been applied to the average leachable concentrations from Table 9.

The DQRA dilution model (WYG, 2013) described a process whereby the daily mixing of a given volume of water (defined by the flux model) containing a given concentration of a particular contaminant is diluted by varying volumes of water in the receptor representing increasing distances away from the site within the wider harbour. Similarly the dilution factors for flux calculated above were determined using the same method as the DQRA report, (WYG, 2013) by applying a series of arbitrary radial 'zones' adopted with increasing distance/radii from the site. These were summarised as follows:

- Zone 1: 0- 10m (volume of water for dilution 2.65x$10^4$$m^3$ per tidal cycle)
- Zone 2: 0- 15m (volume of water for dilution 4.0x$10^4$$m^3$ per tidal cycle)
- Zone 3: 0- 25m (volume of water for dilution 6.79x$10^4$$m^3$ per tidal cycle)
- Zone 4: 0- 50m (volume of water for dilution 1.416x$10^5$$m^3$ per tidal cycle)
- Zone 5: 0- 100m (volume of water for dilution 2.595x$10^5$$m^3$ per tidal cycle)

Table 10 – Daily Tidal Theoretical Flux Dilution Calculation Outputs

	WQS (µg/l)	Average Foreshore Waste (µg/l)	Predicted Concentrations (µg/l)				
			Zone 1 (Shoreline perimeter to 10m)	Zone 2 (Shoreline perimeter to 15m)	Zone 3 (Shoreline perimeter to 25m)	Zone 4 (Shoreline perimeter to 50m)	Zone 5 (Shoreline perimeter to 100m)
Dilution Factor			3.89.E-02	2.57.E-02	1.52.E-02	7.27.E-03	3.97.E-03
Chromium VI	0.6	2	0.08	0.05	0.03	0.01	0.01
Chromium	4.6	0.5	0.02	0.01	0.01	0.00	0.00
Copper	5	12	0.47	0.31	0.18	0.09	0.05
Zinc	40	1.5	0.06	0.04	0.02	0.01	0.01
Lead	7.2	0.5	0.02	0.01	0.01	0.00	0.00
Manganese	30	9	0.35	0.23	0.14	0.07	0.04
Nickel	20	0.9	0.04	0.02	0.01	0.01	0.00
Mercury	0.05	0.00	0.00	0.00	0.00	0.00	0.00

Table 10 in consideration of a tidal daily theoretical flux, does not show predicted leachable contaminant concentrations in excess of WQS when dilution factors calculated are applied. However, it does not include the potential cumulative impact from groundwater that will discharge from the main East Tip through the perimeter engineered structure. To consider the potential cumulative impact the above predicted concentrations have been added to the predicted concentrations calculated during the DQRA (WYG, 2013) for a permeability of 1 x 10^{-5}m/s such as that proposed for the perimeter engineered structure and with 10% infiltration to account for a reduced permeability capping layer. This is presented in Table 11.

As expected, Table 11 does not show cumulative concentrations in Cork Harbour Zone 1 in excess of WQSs following application of daily tidal flux data.

Table 11 – Cumulative Concentrations Using Theoretical Tidal Fluxes

	WQS (µg/l)	Average Foreshore Waste (µg/l)	Tidal Daily Predicted Concentrations from Foreshore Waste in Cork Harbour Zone 1 (Shoreline perimeter to 10m) (µg/l)	Predicted Concentrations from main East Tip (post remediation) in Cork Harbour Zone 1 (Shoreline perimeter to 10m) (µg/l)	Maximum Predicted cumulative concentrations Cork Harbour Zone 1 (Shoreline perimeter to 10m) (µg/l)
Dilution Factor			4.E-02	8.E-4	
Chromium VI	0.6	2	0.08	0.018	0.098
Chromium	4.6	0.5	0.02	0.009	0.029
Copper	5	12	0.47	0.01	0.48
Zinc	40	1.5	0.06	0.008	0.068
Lead	7.2	0.5	0.02	0.002	0.022
Manganese	30	9	0.35	0.449	0.8
Nickel	20	0.9	0.04	0.005	0.045
Mercury	0.05	0.00	0.00	0.00	0.00

Consequently, Table 11 has indicated that there are no theoretical impacts post remediation to the waters of Cork Harbour from leachable metal concentrations in waste material in the foreshore area, as also supported by the fact that analysis of Cork Harbour waters has not identified concentrations in excess of applicable WQSs (WYG, 2013).

5 Conclusions

The following conclusions have been determined from the preceding sections:

- Results of a foreshore trial pit investigation deemed to be appropriate for the foreshore area providing a lateral density of an investigation location every 20-50m, have been presented through sampling and analysis of the waste material including solid and leachability analysis results for a large suite of COCs. The results are considered to be consistent with that which has been presented in the main East Tip DQRA report (WYG, 2013)
- The approach conducted in this assessment is purposely conservative, which includes the use of average contaminant concentrations likely to be higher than actual averages due to inclusion of laboratory detection limits; and, NRA leachability testing which increases the surface area from which contaminants can leach therefore resulting in higher leachable concentrations compared to actual leaching from massive consolidated slag waste which is found along the foreshore. The assessment assumes instantaneous and complete discharge of foreshore waste water contaminants through flushing whereas in reality discharge is likely to be over a much slower timescale. It also assumes in the calculations of flux that the cross-sectional area of the waste on the foreshore is a rectangle when it is more akin to a triangle and in doing so over estimates the flux by a potential order of two.
- The analytical results were compared to relevant GACs to consider risks to human health and did not identify contaminant concentrations in excess of commercial land use GACs. This is with the exception of one nickel concentration which is at a depth through which persons cannot come into contact, mitigating any potential human health risk. Trace levels of asbestos fibres have also been identified as being present within the waste material. However, in terms of remediation, the installation of rock armour along the majority of the foreshore will break the pathways by preventing end users from coming into contact with waste material in the foreshore area. Additionally this area is constantly wet being washed by the tides which will minimise any dust generation.
- The leachability analysis results from solid foreshore waste samples were compared to relevant WQSs to consider risks to the Cork Harbour including ecology and have identified leachable chromium VI, copper, manganese and mercury. However their concentrations are not considered to be sufficiently high enough to cause a WQS to be exceeded in the Cork Harbour. This is further supported by the results of marine water sampling and analysis completed as part of the DQRA (WYG, 2013) which did not identify contaminant concentrations in excess of relevant WQSs.
- Cumulative impacts have also been considered for potential metal contaminant leaving the main East Tip waste material post remediation through the perimeter engineered structure. The post remediation flux model and dilution model concentrations for metals in harbour waters from the DQRA (WYG, 2013) when added to predicted groundwater concentrations from foreshore waste using leachability test

results have not shown predicted concentrations to exceed applicable WQSs. Consequently significant pollution risks to Cork Harbour waters have not been identified.

- In conclusion, the conservative risk assessment presented in this report has not identified any significant risk to human health or the Cork Harbour waters should the foreshore waste, currently present outside the proposed line of the perimeter engineered structure, remain in situ.

Abbreviations

BH Borehole

BS British Standard

CCC. Cork County Council

CIEH Chartered Institute of Environmental Health

CIRIA Construction Industry Research and Information Association

CLAIRE Contaminated Land Applications in the Real Environment

CLEA Contaminated Land Exposure Assessment

COC Contaminants of Concern

Conc. Concentration

CV-AF Cold Vapour Atomic Fluorescence

DoEHLG Department of the Environment, Heritage and Local Government

DQRA Detailed Quantitative Risk Assessment

EA Environment Agency

EPA Environmental Protection Agency

EQS Environmental Quality Standards

FOC Fractional Organic Content

GSV Gas Screening Value

ICP-MS Inductively Coupled Plasma Mass Spectrometry

ICP-OES Inductively Coupled Plasma Optical Emission Spectrometry

IGVs Interim Guideline Values

Kd Partician Co-efficient

LOD Laboratory Detection Limit

mAOD Metres Above Ordnance Datum

mbgl Metres Below Ground Level

NRA National Rivers Authority

OD Ordnance Datum

PAHs Polycyclic aromatic hydrocarbons

PCBs Polychlorinated biphenyls

PCOC Preliminary Contaminants of Concern

PGL Priority Geotechnical Limited

ppm Parts per Million

PSD Particle size distribution

QRA Quantitative Risk Assessment

RTM Remedial Targets Methodology (developed by the UK's Environment Agency)

SGV Soil Guideline Values

SI Site Investigation

SSTL Site Specific Target Level

SVOC Semi-Volatile Organic Compounds

TOC Total Organic Carbon

TP Trial Pit

TPH Total Petroleum Hydrocarbons

UCL Upper Confidence Limit

UK United Kingdom

UK EA EQS United Kingdom (UK) Environment Agency (EA) Environmental Quality Standard (EQS).

US EPA United States Environmental Protection Agency

VOCs Volatile organic compounds

WQS Water Quality Standard

WFD Waste Framework Directive

WFD Water Framework Directive

GLOSSARY

Aquifer A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of water.

Carboniferous The Carboniferous is a geologic period and system that extends from the end of the Devonian period, about 359.2 ± 2.5 Ma (million years ago), to the beginning of the Permian period, about 299.0 ± 0.8 Ma.

Conceptual Site Model A conceptual model represents the characteristics of a site in diagrammatic or written form that shows the possible relationships between contaminants, pathways and receptors (pollutant linkages).

Contaminant a substance that is in, on or under the land and has the potential to cause harm or to cause pollution of the surrounding environment.

Contaminants of concern refer to contaminants which should be considered within future investigations and risk assessments due to the expectation that they are likely to be present in elevated concentrations. and therefore this determination indicates that further consideration should be given with respect to future investigations and risk assessments. It has not yet been determined that they are capable of causing risks to receptors that would require remedial action.

Composite Sampling – the formation of a composite sample which is obtained by blending or mixing two or more individual samples.

Cyanide Cyanide is any chemical compound that contains the cyano group (C≡N), which consists of a carbon atom triple-bonded to a nitrogen atom.

Dataloggers Instruments placed in boreholes that can record frequent measurements of water levels/

Dioxins and Furans 'Dioxins' is a collective term for the category of 75 polychlorinated dibenzo-para-dioxin compounds (PCDDs) and 135 polychlorinated dibenzofuran compounds (PCDFs). Seventeen PCDD and PCDF compounds are likely to be of toxicological significance. The most toxic of these is 2,3,7,8-tetrachlorodibenzo-pdioxin (2,3,7,8-TCDD). The toxicity of each compound depends on the number and position of the chlorine atoms within the molecules.

EPA Environmental Protection Agency. The agency protects the environment through its licensing, enforcement and monitoring activities in Ireland.

EPA EQS AA Environmental Protection Agency Environmental Quality Standard Annual Average. This means that for each representative monitoring point within the water body, the arithmetic mean of the concentrations measured over a 12 month monitoring period does not exceed the standard.

EPA EQS MAC Environmental Protection Agency Environmental Quality Standard Maximum Allowable Concentration. This means for each representative monitoring point within the water body no measured concentration exceeds the standard.

Foreshore Also known as the intertidal zone, the foreshore is the area that is exposed to the air at low tide and submerged at high tide.

Generic Assessment Criteria (GACs) Contaminant concentrations values used for comparison purposes to assess risk associated with contaminant concentrations found on site and are derived using non-site-specific information.

Groundwater Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations.

Groundwater abstraction is the process of taking water from a ground source, either temporarily or permanently.

Hexavalent Chromium Chromium a transition metal exists in the environment in a number of oxidation states ranging from -2 to +6. The Cr (III) or trivalent state is the most stable form. Cr(VI) hexavalent chromium is the form primarily used in the manufacture of steel. Both forms are present as cations in solution as well as forming several different oxyanions and oxide or hydroxyl compounds. In natural groundwaters, trivalent Cr is the prevalent form as hexavalent Cr is readily reduced to the trivalent form. Hexavalent chromium is considered toxic to human health through the inhalation pathway.

ICP Inductively Coupled Plasma spectrometry is a technique for elemental analysis which is applicable to most elements over a wide range of concentrations.

Leachate A solution resulting from leaching, as of soluble constituents from soil, landfill, etc., by downward percolating ground water.

Millscale Mill scale is a milling waste generated while rolling the metal in metal extrusion industries.

NRA Leachability Tests A laboratory test derived from the UK's Environment Agency Recommended Test (R&D note 301). The leaching fluid used in this method is intended to represent materials coming into contact with acid rain. Leaching is carried out by adding to the required sample weight, a volume of water left overnight to attain carbonate equilibrium (pH ~ 5.6) to give a 10:1 ratio of water to soil. The bottle is tumbled at a rate of ~0.5 revolutions per minute at room temperature for 24 hours. The resultant leachant can then be analysed for any parameters desired.

PAHs Polycyclic aromatic hydrocarbons are chemical compounds that consist of fused aromatic rings and do not contain heteroatoms or carry substituents. They are a group of over 100 different chemicals that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco

Partician Coefficent (Kd) The Kd parameter is a factor related to the partitioning of a contaminant between the solid and aqueous phases.

Pathway a route or means by which a receptor can be exposed to, or affected by, a contaminant.

PCBs Polychlorinated Biphenyls are a class of organic compounds with 1 to 10 chlorine atoms attached to biphenyl which is a molecule composed of two benzene rings each containing six carbon atoms. The chemical formula for all PCBs is C12H10-xClx.

Phenol Phenol is both a manufactured chemical and a natural substance. It is a toxic, colourless crystalline solid with a sweet tarry odour.

Pollutant linkage The relationship between a contaminant, pathway and receptor.

Receptor is something that could be adversely affected by a contaminant, such as people, an ecological system, property or a water body.

Refractory A refractory is a material that retains its strength at high temperatures.

Seepages where groundwater exits the waste during low tide onto the foreshore.

SGV Soil Guideline Values are a series of measurements and values used by the United Kingdom's Department for Environment, Food and Rural Affairs (DEFRA) to measure contamination of the soil.

Slag Slag is the by-product of smelting ore to purify metals.

Source A substance that is capable of causing harm

TPH Total Petroleum Hydrocarbons is a term used to describe a large family of several hundred chemical compounds that originally come from crude oil.

VOCs Volatile Organic Compound(s) are organic chemical compounds that have high enough vapour pressures under normal conditions to significantly vaporize and enter the atmosphere.

Waulsortian Limestone Formation Waulsortian Limestone consists of poorly bedded, dense, pale grey mudstone-wackestone and fine-grained packstonegrainstone.

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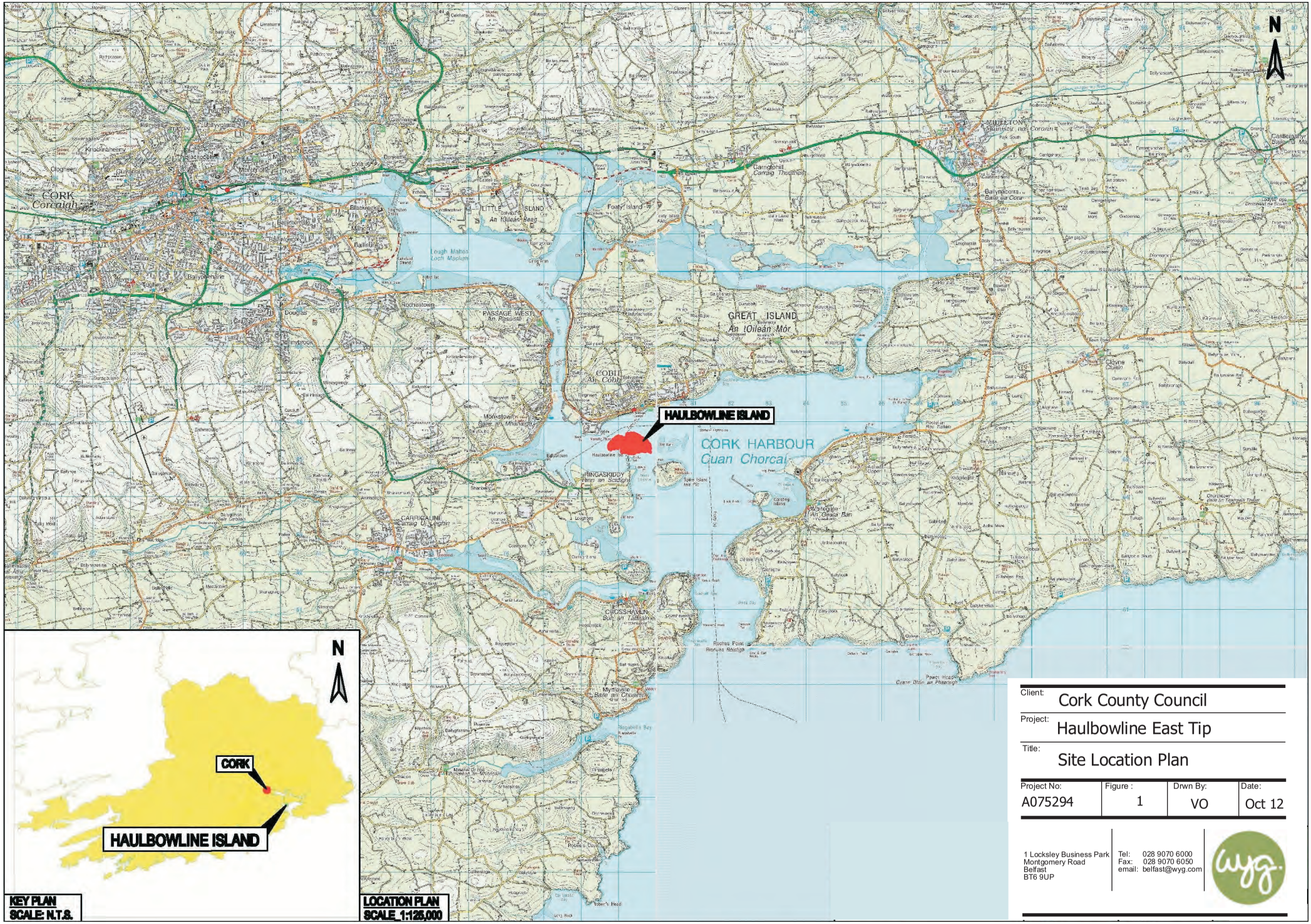
Figures



KEY PLAN
SCALE: N.T.S.

LOCATION PLAN
SCALE 1:125,000

Client: Cork County Council

Project: Haulbowline East Tip

Title: Site Location Plan

Project No:	Figure :	Drwn By:	Date:
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Cork County Council - Haulbowline
Aerial Photograph

Figure No. 2.

Job No. CE08671	**Date.** Aug. 2012
Finalised By - DH	**Office** - 1404
Drawn By: J Farrar - CS2,Illustrator	

NOTE: Drawing is for diagrammatic purposes only. No measurements to be taken.

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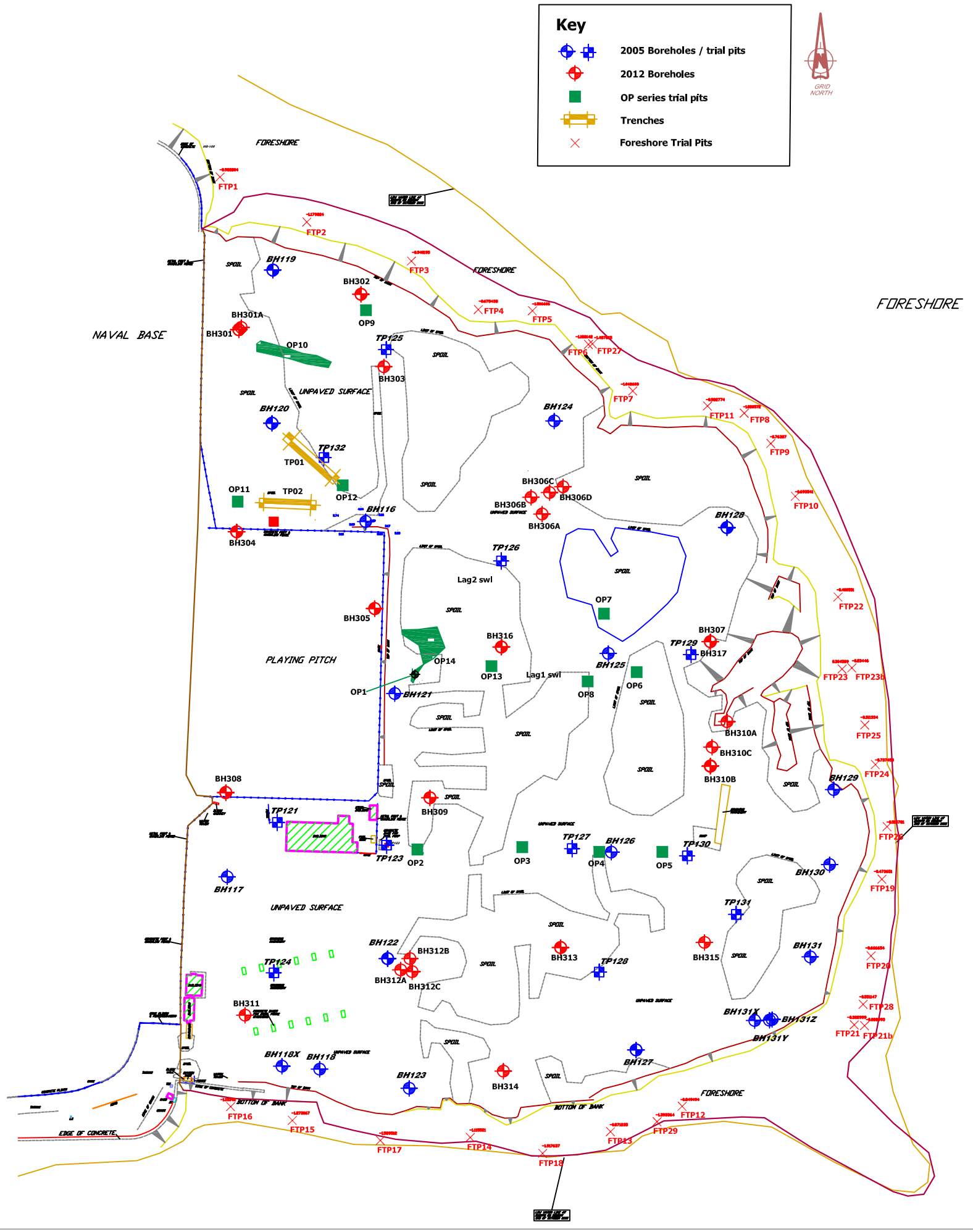

REV	DESCRIPTION	BY	CHK	APP	DATE

CLIENT

Cork County Council

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MONTGOMERY ROAD
BELFAST
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Project:

Haulbowline East Tip

Drawing Title:

Foreshore Trial Pit Location Plan

Scale A3 @ 1:2000	Drawn VO	Date Mar 13	Checked Date YB Mar 13	Approved Date Mar 13
Project No. A075294	Office 46	Type	Drawing No. Fig. 3	Revision Final

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Appendices

Appendix A – Report Conditions

WYG Environmental (EPT) Ltd

Report Conditions

East Tip, Haulbowline

This report is produced solely for the benefit of Cork County Council and no liability is accepted for any reliance placed on it by any other party unless specifically agreed in writing otherwise.

This report is prepared for the proposed uses stated in the report and should not be used in a different context without reference to WYGE. In time improved practices, fresh information or amended legislation may necessitate a re-assessment. Opinions and information provided in this report are on the basis of WYGE using due skill and care in the preparation of the report.

This report refers, within the limitations stated, to the environment of the site in the context of the surrounding area at the time of the inspections. Environmental conditions can vary and no warranty is given as to the possibility of changes in the environment of the site and surrounding area at differing times.

This report is limited to those aspects reported on, within the scope and limits agreed with the client under our appointment. It is necessarily restricted and no liability is accepted for any other aspect. It is based on the information sources indicated in the report. Some of the opinions are based on unconfirmed data and information and are presented as the best obtained within the scope for this report.

Reliance has been placed on the documents and information supplied to WYGE by others but no independent verification of these has been made and no warranty is given on them. No liability is accepted or warranty given in relation to the performance, reliability, standing etc of any products, services, organisations or companies referred to in this report.

Whilst skill and care have been used, no investigative method can eliminate the possibility of obtaining partially imprecise, incomplete or not fully representative information. Any monitoring or survey work undertaken as part of the commission will have been subject to limitations, including for example timescale, seasonal and weather related conditions.

Although care is taken to select monitoring and survey periods that are typical of the environmental conditions being measured, within the overall reporting programme constraints, measured conditions may not be fully representative of the actual conditions. Any predictive or modelling work, undertaken as part of the commission will be subject to limitations including the representativeness of data used by the model and the assumptions inherent within the approach used. Actual environmental conditions are typically more complex and variable than the investigative, predictive and modelling approaches indicate in practice, and the output of such approaches cannot be relied upon as a comprehensive or accurate indicator of future conditions. The potential influence of our assessment and report on other aspects of any development or future planning requires evaluation by other involved parties.

The performance of environmental protection measures and of buildings and other structures in relation to acoustics, vibration, noise mitigation and other environmental issues is influenced to a large extent by the degree to which the relevant environmental considerations are incorporated into the final design and specifications and the quality of workmanship and compliance with the specifications on site during construction. WYGE accept no liability for issues with performance arising from such factors.

Appendix B Trial Pit Logs

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP1**
Date:	14/01/2013
Survey Point ID.:	h1
Depth (m)	Strata Encountered
0 - 0.1	Waste concrete and occasional fill debris (metal bands and plastic tubing)
0.1 - 0.7	Angular - subangular Cobbles and Boulders with sand, silt and shells
0.7 - 1.10	Grey very silty SAND with shells and occasional angular cobbles
1.1	End of Pit
Samples taken from:	0.7 - 0.9m
Notes / Comments:	
Trial Pit located close to base of Revetment from Naval Base in NW corner of East Tip site	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP2**
Date:	14/01/2013
Survey Point ID.:	h2
Depth (m)	Strata Encountered
0 - 0.2	Very sandy SLAG with metal debris with abundant seashells
0.2 - 1.5	Grey SLAG with metal pieces
1.5 - 2.0	Grey very silty SAND with shells
2	End of Pit
Samples taken from:	0 - 0.2m 1.6 - 1.8m
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP3**
Date: 14/01/2013	
Survey Point ID.:	h3
Depth (m)	Strata Encountered
0 - 0.3	Consolidated SLAG with metal pieces
0.3 - 1.8	Grey SLAG with concrete, refractory bricks and metal pieces
1.8 - 2.0	Grey silty SAND with shells
2	End of Pit
Samples taken from:	0.5 - 1.0, 1.8 - 2.0
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP4**
Date: 14/01/2013	
Survey Point ID.:	h4
Depth (m)	Strata Encountered
0 - 0.10	Boulders of SLAG with metal, tyres and abundant shells
0.10 - 1.50	Consolidated SLAG with some refractory bricks
1.50 - 2.0	Grey SILT with occasional seashells
Samples taken from:	0.5 - 1.0 1.8 - 2.0
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP5**
Date:	14/01/2013
Survey Point ID.:	h5
Depth (m)	Strata Encountered
0 - 1.2	Consolidated SLAG with rebar, metal pieces, refractory bricks
1.2 - 1.8	Sandy black silty SLAG
1.8 - 2.0	Grey SILT
Samples taken from:	0.3 - 0.5 1.8 - 2.0
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP6**
Date:	14/01/2013
Survey Point ID.:	h6
Depth (m)	Strata Encountered
0 - 0.5	Brown sandy SLAG in Cobble and Boulder form with rebar and metal scrap debris
0.5 - 2.3	Grey slightly consolidated fine grained SLAG with abundant waste material including steel barrels and refractory bricks
2.3 - 2.5	Grey SILT
Samples taken from:	0.6 - 1.0 2.3 - 2.5
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP7**
Date: 14/01/2013	
Survey Point ID.:	h7
Depth (m)	Strata Encountered
0-0.4	Brown sandy shelly gravel sized SLAG with some refractory brick.
0.4 - 0.7	Grey sandy shelly gravel sized SLAG with occasional metal and plastic waste
0.7 - 1.0	Abundant shells with occasional plastic and refractory bricks
1.0 - 1.2	Grey SILT
Samples taken from:	0.2 - 0.4 1 - 1.2
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP8**
Date: 14/01/2013	
Survey Point ID.:	h8
Depth (m)	Strata Encountered
0-0.1	Large SLAG boulders on surface
0.1 - 0.7	Grey SILT
Samples taken from:	None
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP9**
Date:	14/01/2013
Survey Point ID.:	h9
Depth (m)	Strata Encountered
0-0.1	Grey SLAG cobbles & boulders on surface
0.1 - 0.3	Grey SILT
Samples taken from:	0 - 0.1 0.1 - 0.2
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP10**
Date:	14/01/2013
Survey Point ID.:	h10
Depth (m)	Strata Encountered
0 - 0.6	Brown gravelly SLAG with occasional refractory brick
0.6 - 1.0	Grey SILT
Samples taken from:	0.1 - 0.4
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP11**
Date:	14/01/2013
Survey Point ID.:	h11
Depth (m)	Strata Encountered
0 - 0.8	Brown Gravel sized SLAG with metal pieces
0.8 - 1.0	Grey SILT

Samples taken from: 0.4 - 0.6

0.8 - 1.0

Notes / Comments:

Excavated using a 13.5t tracked excavator

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP12**
Date:	15/01/2013
Survey Point ID.:	h15
Depth (m)	Strata Encountered
0 - 0.5	Very consolidated SLAG
0.5 - 2.3	Consolidated SLAG with scrap metal, refractory brick and possible millscale (~20%)
2.3 - 2.5	Black SILT

Samples taken from: 0.3 - 0.5

2.3 - 2.5

Notes / Comments:

Track Machine scaping surface for 40 minutes to break through from 0 -0.50m

Excavated using a 13.5t tracked excavator

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP13**
Date:	15/01/2013
Survey Point ID.:	h13
Depth (m)	Strata Encountered
0 - 0.3	Very Consolidated SLAG
0.3 - 1.5	Consolidated SLAG and occasional refractory bricks & scrap metal (<5%)
1.5 - 2.1	Dark brown / grey gravel sized consolidated SLAG with abundant C&D waste - plastic, glass, metal & timber
2.1 - 2.3	Dark grey SILT

Samples taken from: 1.8 - 2.0

2.1 - 2.3

Notes / Comments:

Track Machine scaping surface for 20 minutes to break through from 0 - 0.30m

Excavated using a 13.5t tracked excavator

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP14**
Date:	15/01/2013
Survey Point ID.:	h14
Depth (m)	Strata Encountered
0 - 1	Consolidated gravel sized SLAG with occasional refractory bricks
1 - 1.2	Grey SILT

Samples taken from: 0.5 - 1.0

Notes / Comments:

Excavated using a 13.5t tracked excavator

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP15**
Date:	15/01/2013
Survey Point ID.:	h15
Depth (m)	Strata Encountered
0 - 0.3	Loose gravel sized SLAG (highly fused slab at inland end of trial pit - no progress through it with excavator)
0.3 - 0.9	Unprocessed SLAG with abundant refractory bricks and occasional C&D waste
0.9 - 1.1	Grey SILT
Samples taken from:	0.6 - 0.8
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP16**
Date:	15/01/2013
Survey Point ID.:	h16
Depth (m)	Strata Encountered
0 - 0.3	Loose gravel sized SLAG
0.3 - 1.4	Loose gravel sized SLAG with abundant refractory bricks and waste metal (rebar and steel)
1.4 - 1.6	Grey SILT
Samples taken from:	None Taken
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP17**
Date:	15/01/2013
Survey Point ID.:	h17
Depth (m)	Strata Encountered
0 - 2.0	Unconsolidated SLAG with occasional C&D waste including metal scrap and refractory bricks. Some black staining with slight HC odours.
2.0 - 2.2	Grey SILT
Samples taken from:	1.7 - 1.9 2 - 2.2
Notes / Comments: Excavated at base of bank of slag outside line of proposed perimeter as outlined for SI Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP18**
Date:	15/01/2013
Survey Point ID.:	h18
Depth (m)	Strata Encountered
0 - 1.5	Loose SLAG with abundant C&D waste - rebar steel, refractory bricks, tyres
1.5 - 1.7	Grey SILT
Samples taken from:	None Taken
Notes / Comments: Excavated at base of bank of slag outside line of proposed perimeter as outlined for SI Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP19**
Date:	15/01/2013
Survey Point ID.:	h19
Depth (m)	Strata Encountered
0 - 1.0	Brown gravel and cobble sized SLAG with occasional rebar steel
1.0 - 1.8	Dark grey very consolidated SLAG with rebar steel, Scrap metal with moderate hydrocarbon odours with occasional pipes and wires.
1.8 - 2.2	Consolidated brown SLAG with frequent wires.
2.2 - 2.5	Grey SILT
Samples taken from:	0.3 - 0.5 1.2 - 1.5 2.2 - 2.5
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP20**
Date:	15/01/2013
Survey Point ID.:	h20
Depth (m)	Strata Encountered
0 - 1.5	Brown partly consolidated gravel and cobble sized SLAG
1.5 - 1.7	Grey SILT
Samples taken from:	0.5 - 0.7 1.5 - 1.7
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation

Trial Pit No:	**TP21**
Date:	15/01/2013
Survey Point ID.:	h21

Depth (m)	Strata Encountered
0 - 0.5	Brown partly consolidated gravel and cobble sized SLAG with frequent shells
0.5 - 1.8	Dark brown / grey partly consolidated gravel and cobble sized SLAG with shells
1.8 - 4.5	Unconsolidated SLAG with abundant shells and C&D waste including timber, refractory bricks, cables, plastic, springs, metal fragments, batteries.

Samples taken from: 2 - 2.5

Notes / Comments:

TP terminated as no progress made below 4.5m and high risk of undermining track machine during excavation

Excavated using a 13.5t tracked excavator

RPS East Tip Foreshore Investigation

Trial Pit No:	**TP21b**
Date:	16/01/2013
Survey Point ID.:	h21b

Depth (m)	Strata Encountered
0 - 0.1	Loose SLAG
0.1 - 0.50	Grey SILT

Samples taken from: None

Notes / Comments:

TP located 4m seaward of TP21 below a 0.3m step on the consolidated slag surface at this location

Excavated using a 13.5t tracked excavator

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP22**
Date:	16/01/2013
Survey Point ID.:	h22
Depth (m)	Strata Encountered
0 - 0.1	Loose gravel sized SLAG with occasional cobble sized pieces of SLAG
0.1 - 0.4	Grey SILT
Samples taken from:	0.2 - 0.4
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP23 / TP23b**
Date:	16/01/2013
Survey Point ID.:	h23 / h23b
Depth (m)	Strata Encountered
TP23	
0 - 0.9	Brown gravel and cobble sized SLAG with abundant shells and occasional refractory bricks and scrap metal.
0.9	Very consolidated SLAG - No progress made - Pit extended to TP23b
TP23b	
0-0.4	Brown gravel and cobble sized SLAG with abundant shells and occasional refractory bricks and scrap metal.
0.4 - 0.7	Grey SILT with abundant shells
Samples taken from:	0.2 - 0.4 0.4 - 0.7
Notes / Comments:	
TP23 excavated inside line of proposed perimeter due to wide beach and possible shallow slag as identified in pits to the north. Pit extended onto line of proposed perimeter (TP23b) and shallow SLAG encountered there. Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP24**
Date: 16/01/2013	
Survey Point ID.:	h24
Depth (m)	Strata Encountered
0 - 0.8	Very Consolidated brown moottled dark brown/grey gravel and cobble sized SLAG
0.8 - 2.7	Unprocessed SLAG with abundant C&D waste - plastic, metal, pipe, tiles, cables and wires
2.7 - 3.0	Grey SILT
Samples taken from:	0.3 - 0.5 1.5 - 1.8 2.7 - 3.0
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP25**
Date: 16/01/2013	
Survey Point ID.:	h25
Depth (m)	Strata Encountered
0 - 0.3	Gravel sized SLAG on surface
0.3 - 1.9	Very consolidated gravel and cobble sized SLAG with abundant shells
1.9 - 2.2	Grey SILT
Samples taken from:	1 - 1 .2
Notes / Comments:	
TP25 excavated 20m north of TP24 to delineate the C&D waste encountered in TP24 Excavated using a 13.5t tracked excavator	

RPS East Tip Foreshore Investigation

Trial Pit No:	**TP26**
Date:	16/01/2013
Survey Point ID.:	h26

Depth (m)	Strata Encountered
0 - 1.2	Cobble and boulder sized SLAG infilled with gravel sized SLAG and grey silt
1.2 - 2.0	Consolidated slag with occasional metal waste and rebar steel
2.0 - 3.0	Dark grey gravel sized SLAG with frequent metal pieces, cables and a battery
3.0 - 3.2	Grey SILT

Samples taken from: 2.2 - 2.5
3 - 3.2

Notes / Comments:

Excavated using a 13.5t tracked excavator

RPS East Tip Foreshore Investigation

Trial Pit No:	**TP27**
Date:	16/01/2013
Survey Point ID.:	h27

Depth (m)	Strata Encountered
0 - 0.9	Gravel sized SLAG with frequent refractory bricks, metal & steel
0.9 - 1.1	Grey SILT

Samples taken from: None

Notes / Comments:

TP excavated 3m seaward of TP6

Excavated using a 13.5t tracked excavator

RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP28**
Date:	16/01/2013
Survey Point ID.:	h28
Depth (m)	Strata Encountered
0 - 2.5	Loose gravel and cobble sized SLAG with seashells and occasional waste material - wiring, metal , plastic
2.5 - 2.7	Grey SILT
Samples taken from:	No Samples
Notes / Comments:	
Excavated using a 13.5t tracked excavator	

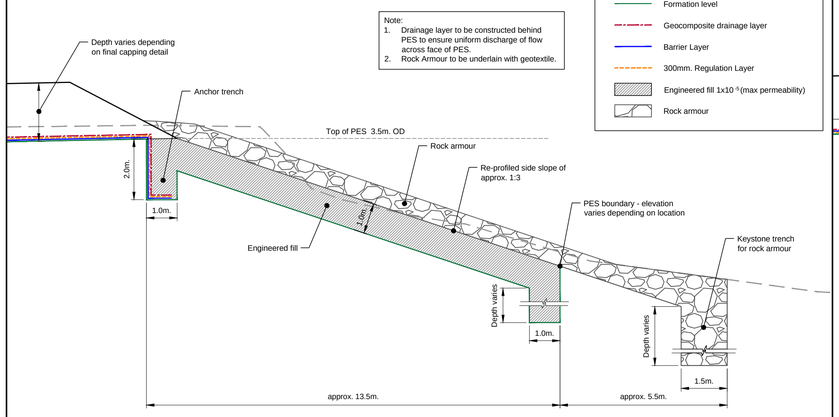
RPS East Tip Foreshore Investigation	
Trial Pit No:	**TP29**
Date:	16/01/2013
Survey Point ID.:	h29
Depth (m)	Strata Encountered
0 - 0.4	Very consolidated SLAG excavated as gravel
0.4	TP Terminated following 45 minutes and no progress
Samples taken from:	None
Notes / Comments:	
TP29 located between TP12 and TP13 and located at the low water mark	
Excavated using a 13.5t tracked excavator	

Groundwater Encountered during Trial Pitting		
Trial Pit Number	**Depth From Top of Trial Pit**	**Notes**
TP1	0.3	
TP2	0.3	
TP3	0.3	
TP4	0.3	
TP5	0.3	
TP6	1.5	TP excavated higher up the foreshore, on a steep slope
TP7	0.6	
TP8	-	No water encountered, Silt at 0.01m BGL and Pit terminated at 0.7m BGL
TP9	-	No water encountered, Silt at 0.01m BGL and Pit terminated at 0.2m BGL
TP10	-	No water encountered, Silt at 0.06m BGL and Pit terminated at 1m BGL
TP11	0.1	TP excavated close to the tide, on a very shallow slope
TP12	GL	TP full of water throughout excavation
TP13	GL	TP full of water throughout excavation
TP14	0.1	TP full of water throughout excavation
TP15	0.1	TP full of water throughout excavation
TP16	0.4	Water entering TP from East Tip end of pit aswell as from below
TP17	0.2	TP excavated close to tide due to bank of slag material to the north of the location
TP18	0.1	TP excavated close to tide due to bank of slag material to the north of the location, Water entering TP from East Tip side of pit aswell as from below
TP19	1.3	TP located on steeply sloping foreshore
TP20	0.4	
TP21	0.3	
TP21b	0.1	
TP22	-	No water encountered, Silt at 0.1m BGL and Pit terminated at 0.4mBGL
TP23	0.3	
TP24	?	Depth to water in Pit not recorded
TP25	?	Depth to water in Pit not recorded
TP26	1.2	TP excavated on steeply sloping foreshore. Water entering pit from East Tip side of pit as well as from below.
TP27	0.2	TP excavated closer to tide than TP6.
TP28	?	Depth to water in Pit not recorded
TP29	GL	Pit unsuccesfully excavated before incoming tide entered pit.
Overall Summary		

Groundwater encountered during the excavation of the trial pits along the East Tip foreshore typically comprised seawater which migrated through the granular slag material that makes up the upper subsurface material surrounding the East Tip. Typically groundwater was encountered just below the surface in the majority of the trial pits excavated at depths ranging from GL to 0.4m BGL. The pits were usually excavated when the tide was approaching LW conditions, or shortly after LW conditionsand rising, up to half tide. The pits were typically located along the half tide line around the East Tip. Where GW was encountered at deeper depths, these pits were usually located higher up the foreshore, or on steeper sloping sections of the foreshore. There are a number of locations where there is no record of the depth at which GW was encountered.

Appendix C Proposed Perimeter Engineered Structure

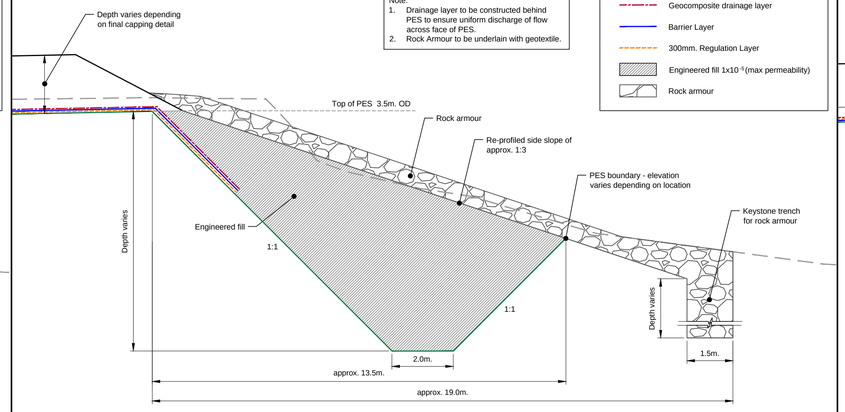
PES - Typical Sectional Detail 1: Trench and Wedge Option



Note:
1. Drainage layer to be constructed behind PES to ensure uniform discharge of flow across face of PES.
2. Rock Armour to be underlain with geotextile.

LEGEND
- Finished level
- Existing ground level
- Formation level
- Geocomposite drainage layer
- Barrier Layer
- 300mm. Regulation Layer
- Engineered fill 1x10 $^{-9}$(max permeability)
- Rock armour

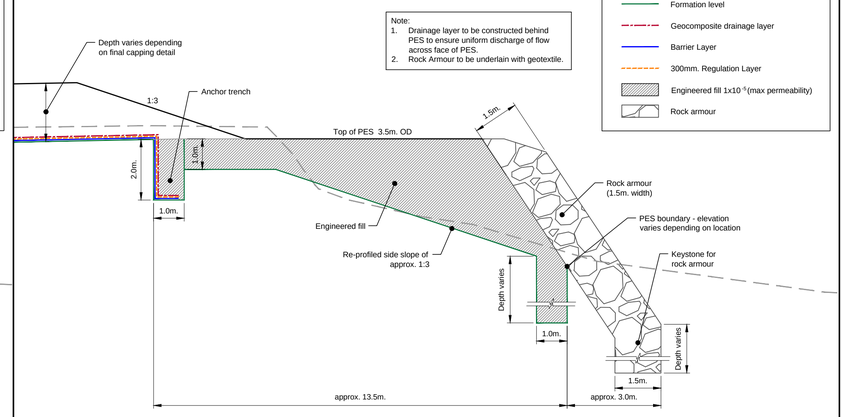
PES - Typical Sectional Detail 1: Wedge Option



Note:
1. Drainage layer to be constructed behind PES to ensure uniform discharge of flow across face of PES.
2. Rock Armour to be underlain with geotextile.

LEGEND
- Finished level
- Existing ground level
- Formation level
- Geocomposite drainage layer
- Barrier Layer
- 300mm. Regulation Layer
- Engineered fill 1x10 $^{-9}$(max permeability)
- Rock armour

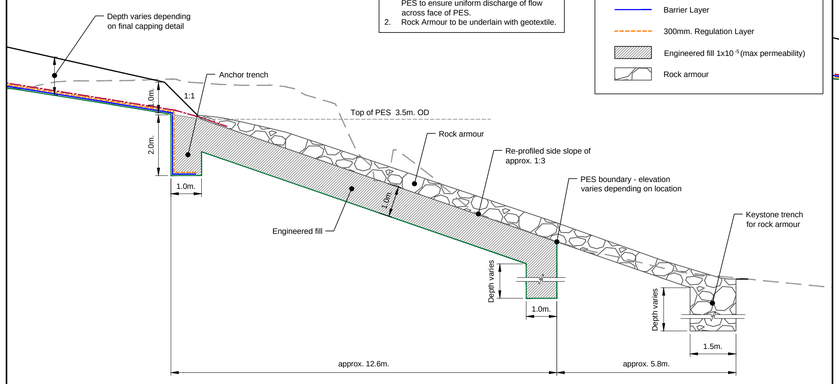
PES - Typical Sectional Detail 1: Berm and 1 to 1:5 Side Slope Option



Note:
1. Drainage layer to be constructed behind PES to ensure uniform discharge of flow across face of PES.
2. Rock Armour to be underlain with geotextile.

LEGEND
- Finished level
- Existing ground level
- Formation level
- Geocomposite drainage layer
- Barrier Layer
- 300mm. Regulation Layer
- Engineered fill 1x10 $^{-9}$(max permeability)
- Rock armour

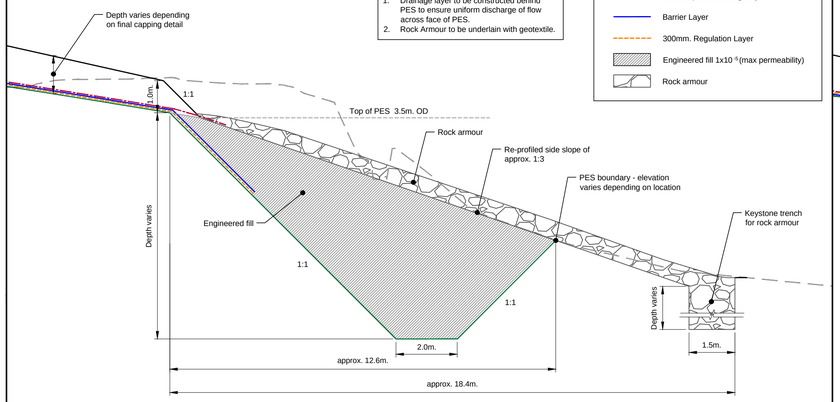
PES - Typical Sectional Detail 2: Trench and Wedge Option



Note:
1. Drainage layer to be constructed behind PES to ensure uniform discharge of flow across face of PES.
2. Rock Armour to be underlain with geotextile.

LEGEND
- Finished level
- Existing ground level
- Formation level
- Geocomposite drainage layer
- Barrier Layer
- 300mm. Regulation Layer
- Engineered fill 1x10 $^{-9}$(max permeability)
- Rock armour

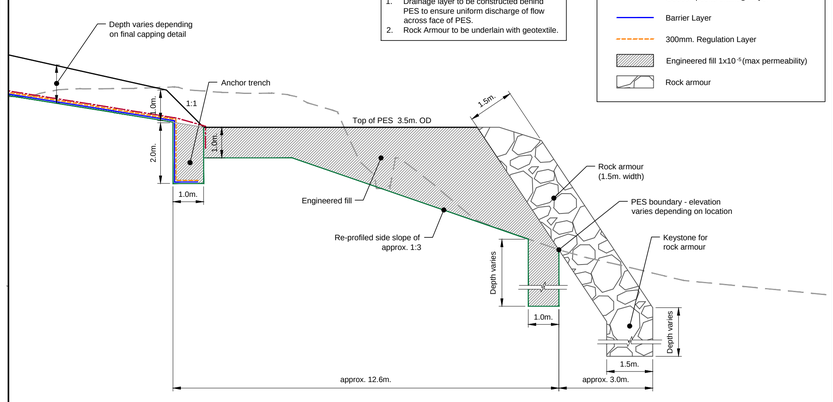
PES - Typical Sectional Detail 2: Wedge Option



Note:
1. Drainage layer to be constructed behind PES to ensure uniform discharge of flow across face of PES.
2. Rock Armour to be underlain with geotextile.

LEGEND
- Finished level
- Existing ground level
- Formation level
- Geocomposite drainage layer
- Barrier Layer
- 300mm. Regulation Layer
- Engineered fill 1x10 $^{-9}$(max permeability)
- Rock armour

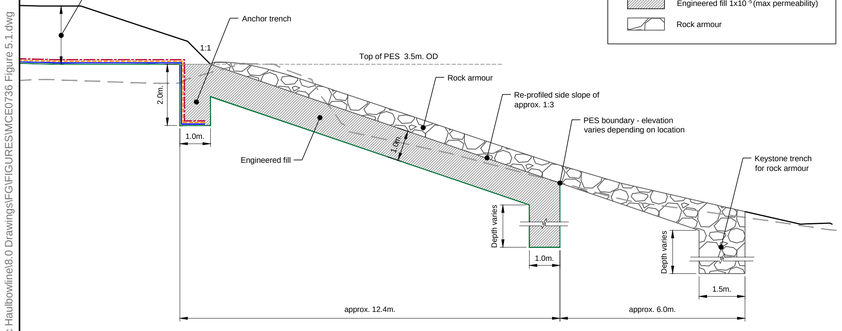
PES - Typical Sectional Detail 2: Berm and 1 to 1:5 Side Slope Option



Note:
1. Drainage layer to be constructed behind PES to ensure uniform discharge of flow across face of PES.
2. Rock Armour to be underlain with geotextile.

LEGEND
- Finished level
- Existing ground level
- Formation level
- Geocomposite drainage layer
- Barrier Layer
- 300mm. Regulation Layer
- Engineered fill 1x10 $^{-9}$(max permeability)
- Rock armour

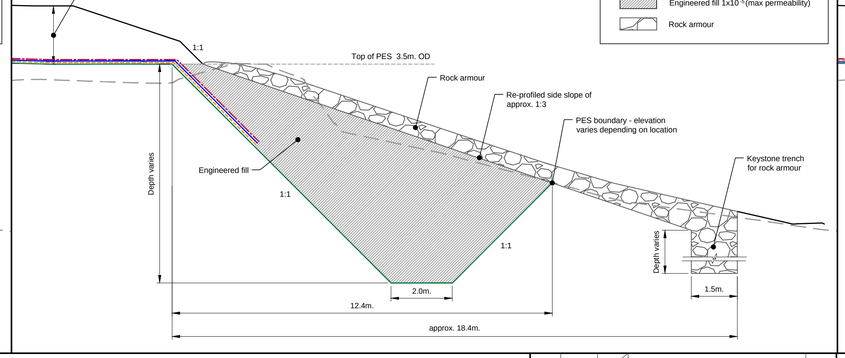
PES - Typical Sectional Detail 3: Trench and Wedge Option



Note:
1. Drainage layer to be constructed behind PES to ensure uniform discharge of flow across face of PES.
2. Rock Armour to be underlain with geotextile.

LEGEND
- Finished level
- Existing ground level
- Formation level
- Geocomposite drainage layer
- Barrier Layer
- 300mm. Regulation Layer
- Engineered fill 1x10 $^{-9}$(max permeability)
- Rock armour

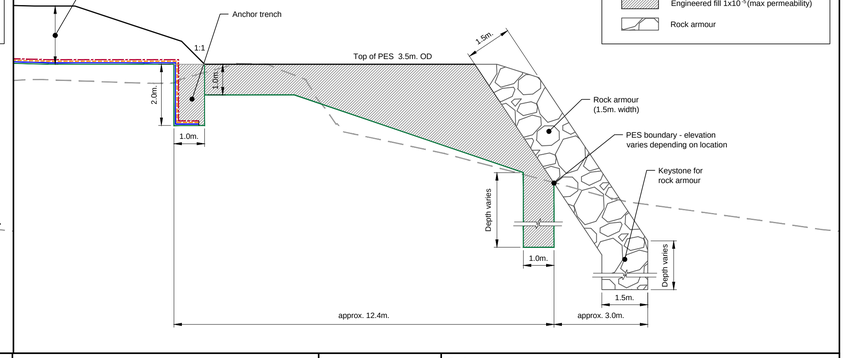
PES - Typical Sectional Detail 3: Wedge Option



Note:
1. Drainage layer to be constructed behind PES to ensure uniform discharge of flow across face of PES.
2. Rock Armour to be underlain with geotextile.

LEGEND
- Finished level
- Existing ground level
- Formation level
- Geocomposite drainage layer
- Barrier Layer
- 300mm. Regulation Layer
- Engineered fill 1x10 $^{-9}$(max permeability)
- Rock armour

PES - Typical Sectional Detail 3: Berm and 1 to 1:5 Side Slope Option



Note:
1. Drainage layer to be constructed behind PES to ensure uniform discharge of flow across face of PES.
2. Rock Armour to be underlain with geotextile.

LEGEND
- Finished level
- Existing ground level
- Formation level
- Geocomposite drainage layer
- Barrier Layer
- 300mm. Regulation Layer
- Engineered fill 1x10 $^{-9}$(max permeability)
- Rock armour

Client

CORK COUNTY COUNCIL

Note:

For Plan locations of Sections 1, 2 & 3 above see Figure 6.1

General Notes

(i) This drawing is the property of RPS Consulting Engineers, it is a confidential document and must not be copied, used, or its content divulged without prior written consent.

(ii) All Levels refer to Ordnance Survey Datum, Malin Head.

(iii) DO NOT SCALE, use figured dimensions only, if in doubt ask.

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No.	Date	Drn. / Chk.	Amendment / Issue	App
D02	14.03.13	RH / CP	DRAFT ISSUE	CP

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Checked	CP
Approved	CP
Date	MAR 2013
Scale	1:100 @ A1
	nts @ A3
Job No.	MCE0736

Project: **HAULBOWLINE EAST TIP REMEDIATION**

Title: PES TYPICAL SECTIONAL DETAILS

File Ref. MCE0736 Figure 5.1.dwg | Drg. No. Figure 5.1 | Rev. D02

R:\MCE0736_Design & Foreshore Lic Haulbowline\8.0 Drawings\FIGFIGURES\MCE0736 Figure 5.1.dwg

Appendix D Human Health Generic Assessment Criteria (GAC)

Human Health GACs

	CIEH Commercial Industrial GAC (mg/kg)
Cyanide, Free	36
Metals	
Antimony	
Arsenic	640
Barium	
Beryllium	420
Boron, water soluble	192000
Cadmium	230
Chromium	30400
Chromium, Hexavalent	35
Copper	71700
Lead	4640
Mercury	3640
Nickel	1800
Selenium	13000
Vanadium	3160
Zinc	665000
Phenols	
Cresols	
Phenol	482
Phenols, Total 5 speciated	
Phenols, Total monohydric	
TPH Criteria Working Group (TPH CWG)	
Aliphatics >C5C6	3400
Aliphatics >C6C8	8300
Aliphatics >C8C10	2100
Aliphatics >C10C12	10000
Aliphatics >C12C16	61000
Aliphatics >C16C21	1000000
Aliphatics >C21C35	1000000
Aromatics >EC5EC7	28
Aromatics >EC7EC8	59000
Aromatics >EC8EC10	3700
Aromatics >EC10EC12	17000
Aromatics >EC12EC16	36000
Aromatics >EC16EC21	28000
Aromatics >EC21EC35	28000
Methyl tertiary butyl ether (MTBE)	
Benzene	28
Ethylbenzene	518
m,p,oXylene	
m,pXylene	312
oXylene	
Toluene	869
mi Volatile Organic Compounds (SVOCs) (Solids)	
2,4Dimethylphenol (S)	
2,4Dinitrotoluene (S)	
2,6Dinitrotoluene	
2Chloronaphthalene	
2Methylphenol	
4Methylphenol (S)	
Acenaphthene	85000
Acenaphthylene	84000
Anthracene	530000
Benzo(a)anthracene	90
Benzo(a)pyrene	14
Benzo(b)fluoranthene	100
Benzo(g,h,i)perylene	650
Benzo(k)fluoranthene	140
bis(2Ethylhexyl) phthalate	
Chrysene	140
Dibenzo(a,h)anthracene	13
Diethyl phthalate	
Fluoranthene	23000
Fluorene	64000
Hexachloroethane	
Indeno(1,2,3cd)pyrene	60
Naphthalene	200
Phenanthrene	22000
Phenol	0.482
Pyrene	54000

Human Health GACs

Volatile Organic Compounds (VOCs) (Solids)	
1.1.1.2Tetrachloroethane	120
1.1.1Trichloroethane	700
1.1.2.2Tetrachloroethane	290
1.1.2Trichloroethane	
1.1Dichloroethane	
1.1Dichloroethene	
1.2.4Trimethylbenzene	
1.2Dichloroethane	0.71
1.2Dichloropropane	
Benzene	28
Bromobenzene	
Bromodichloromethane	
Bromoform	
Carbon Disulphide	
Carbontetrachloride	3
Chlorobenzene	
Chloroethane	
Chloroform	110
Chloromethane	
cis12Dichloroethene	
Dibromochloromethane	
Dichloromethane	
Ethylbenzene	518
Isopropylbenzene	
Naphthalene	
p/mXylene	312
Propylbenzene	
Tetrachloroethene	130
Toluene	869
trans12Dichloroethene	
Trichloroethene	12
Vinyl Chloride	0.063

Appendix E Waste Solid Analysis Results

East Tip 2013 Foreshore Solid Samples , Laboratory Analysis Results

			Very sandy SLAG with metal debris with abundant seashells	Consolidated SLAG with rebar, metal pieces, refractory bricks	Brown gravelly SLAG with occasional refractory brick	SLAG with occasional C&D waste including metal scrap and refractory bricks. Some black staining with slight HC odours.	consolidated SLAG with rebar steel, Scrap metal with moderate hydrocarbon odours with occasional pipes and wires.	Unconsolidated SLAG with abundant shells and C&D waste including timber, refractory bricks, cables, plastic, springs, metal fragments, batteries.	slag with frequent metal pieces, cable and battery
Sample Identity	**Commercial Human Health GAC (mg/kg)**		FTP 2	FTP 6	FTP 10	FTP 17	FTP 19	FTP 21	FTP 26
Depth (m)			0-0.2	0.6-1.0	0.1-0.4	1.7-1.9	1.2-1.5	2-2.5	2.2-2.5
Laboratory data									
Carbon									
Fraction Organic Carbon (FOC)			0.017	0.014	0.004	0.015	0.002	<0.001	NA
Inorganics									
pH			9.25	10.18	9.32	8.28	8.9	9.47	NA
Metals									
Arsenic	640	mg/kg	16.8	13.7	<0.5	28.3	0.5	<0.5	<0.5
Barium		mg/kg	163	257	665	346	579	884	494
Beryllium	420	mg/kg	1.5	1.1	<0.5	2	1.3	<0.5	0.7
Boron, water soluble	192000	mg/kg	29.9	42.9	23.4	21.2	19	19	31.2
Cadmium	230	mg/kg	8.1	27.8	1.9	6.2	1.7	0.8	4.7
Chromium	30400	mg/kg	1317	1591	2916	1060	3378	3736	3824
Chromium, Hexavalent	35	mg/kg	<0.3	0.6	<0.3	<0.3	<0.3	<0.3	<0.3
Chromium III	30400	mg/kg	1317	1590.4	2916	1060	3378	3736	3824
Copper	71700	mg/kg	1344	1225	639	894	1543	308	1675
Lead	4640	mg/kg	1243	2160	440	424	193	99	1048
Manganese		mg/kg	13510	20540	27680	12310	28460	37610	10520
Mercury	3640	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7
Nickel	1800	mg/kg	288.4	193.1	416.9	182.8	270.5	38.4	**5770**
Selenium	13000	mg/kg	5	6	7	5	9	11	4
Vanadium	3160	mg/kg	92	104	248	157	388	371	92
Zinc	665000	mg/kg	10920	22530	1155	2912	721	530	3897
PAHs									
Acenaphthene	85000	mg/kg	NA	NA	NA	<0.05	0.84	NA	NA
Acenaphthylene	84000	mg/kg	NA	NA	NA	<0.03	0.05	NA	NA
Anthracene	530000	mg/kg	NA	NA	NA	0.09	2.27	NA	NA
Benzo(a)anthracene	90	mg/kg	NA	NA	NA	0.22	5.05	NA	NA
Benzo(a)pyrene	14	mg/kg	NA	NA	NA	0.12	3.43	NA	NA
Benzo(b)fluoranthene	100	mg/kg	NA	NA	NA	0.19	4.28	NA	NA
Benzo(ghi)perylene	650	mg/kg	NA	NA	NA	0.09	1.71	NA	NA
Benzo(k)fluoranthene	140	mg/kg	NA	NA	NA	0.08	1.66	NA	NA
Chrysene	140	mg/kg	NA	NA	NA	0.22	4.32	NA	NA
Dibenzo(ah)anthracene	13	mg/kg	NA	NA	NA	<0.04	0.69	NA	NA
Fluoranthene	23000	mg/kg	NA	NA	NA	0.42	9.3	NA	NA
Fluorene	64000	mg/kg	NA	NA	NA	<0.04	0.78	NA	NA
Indeno(123cd)pyrene	60	mg/kg	NA	NA	NA	0.09	1.96	NA	NA
Naphthalene	200	mg/kg	NA	NA	NA	<0.04	0.04	NA	NA
Phenanthrene	22000	mg/kg	NA	NA	NA	0.27	7.04	NA	NA
Pyrene	54000	mg/kg	NA	NA	NA	0.32	6.38	NA	NA
PAH 16 Total		mg/kg	NA	NA	NA	2.1	49.8	NA	NA
TPH Criteria Working Group (TPH CWG)									
Aliphatics >C5C6	3400	mg/kg	NA	NA	NA	<0.1	<0.1	NA	NA
Aliphatics >C6C8	8300	mg/kg	NA	NA	NA	<0.1	<0.1	NA	NA
Aliphatics >C8C10	2100	mg/kg	NA	NA	NA	0.1	<0.1	NA	NA

East Tip 2013 Foreshore Solid Samples , Laboratory Analysis Results

Sample Identity	Commercial Human Health GAC (mg/kg)		FTP 2	FTP 6	FTP 10	FTP 17	FTP 19	FTP 21	FTP 26
Depth (m)			0-0.2	0.6-1.0	0.1-0.4	1.7-1.9	1.2-1.5	2-2.5	2.2-2.5
Aliphatics >C10C12	10000	mg/kg	NA	NA	NA	4.5	<0.2	NA	NA
Aliphatics >C12C16	61000	mg/kg	NA	NA	NA	47	<4	NA	NA
Aliphatics >C16C21	1000000	mg/kg	NA	NA	NA	38	<7	NA	NA
Aliphatics >C21C35	1000000	mg/kg	NA	NA	NA	413	144	NA	NA
Aliphatics >C35C44		mg/kg	NA	NA	NA	NA	NA	NA	NA
Aromatics >EC5EC7	3400	mg/kg	NA	NA	NA	<0.1	<0.1	NA	NA
Aromatics >EC7EC8	8300	mg/kg	NA	NA	NA	<0.1	<0.1	NA	NA
Aromatics >EC8EC10	2100	mg/kg	NA	NA	NA	<0.1	<0.1	NA	NA
Aromatics >EC10EC12	10000	mg/kg	NA	NA	NA	<0.2	<0.2	NA	NA
Aromatics >EC12EC16	61000	mg/kg	NA	NA	NA	<4	<4	NA	NA
Aromatics >EC16EC21	1000000	mg/kg	NA	NA	NA	25	43	NA	NA
Aromatics >EC21EC35	1000000	mg/kg	NA	NA	NA	305	18	NA	NA
Methyl tertiary butyl ether (MTBE)		µg/kg	NA	NA	NA	<5	<5	NA	NA
Benzene	28000	µg/kg	NA	NA	NA	<5	<5	NA	NA
Ethylbenzene	518000	µg/kg	NA	NA	NA	<5	<5	NA	NA
m,pXylene	312000	µg/kg	NA	NA	NA	<5	<5	NA	NA
oXylene		µg/kg	NA	NA	NA	<5	<5	NA	NA
Toluene	869000	µg/kg	NA	NA	NA	<5	<5	NA	NA
SemiVolatile Organic Compounds (SVOCs)									
1,2,4Trichlorobenzene		µg/kg	NA	NA	NA	NA	NA	<50	<50
1,2Dichlorobenzene		µg/kg	NA	NA	NA	NA	NA	<50	<50
1,3Dichlorobenzene		µg/kg	NA	NA	NA	NA	NA	<50	<50
1,4Dichlorobenzene		µg/kg	NA	NA	NA	NA	NA	<50	<50
2,4,5Trichlorophenol		µg/kg	NA	NA	NA	NA	NA	<50	<50
2,4,6Trichlorophenol (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
2,4Dichlorophenol (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
2,4Dimethylphenol (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
2,4Dinitrotoluene (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
2,6Dinitrotoluene		µg/kg	NA	NA	NA	NA	NA	<50	<50
2Chloronaphthalene		µg/kg	NA	NA	NA	NA	NA	<50	<50
2Chlorophenol (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
2Methylnaphthalene		µg/kg	NA	NA	NA	NA	NA	<50	120
2Methylphenol		µg/kg	NA	NA	NA	NA	NA	<50	<50
2Niitroaniline (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
2Nitrophenol (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
3Nitroaniline		µg/kg	NA	NA	NA	NA	NA	<50	<50
4Bromophenylphenylether		µg/kg	NA	NA	NA	NA	NA	<50	<50
4Chloro3methylphenol (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
4Chloroaniline		µg/kg	NA	NA	NA	NA	NA	<50	<50
4Chlorophenylphenylether		µg/kg	NA	NA	NA	NA	NA	<50	<50
4Methylphenol (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
4Nitroaniline		µg/kg	NA	NA	NA	NA	NA	<50	<50
4Nitrophenol (S)		µg/kg	NA	NA	NA	NA	NA	<50	<50
Acenaphthene	85000000	µg/kg	NA	NA	NA	NA	NA	252	366
Acenaphthylene	84000000	µg/kg	NA	NA	NA	NA	NA	114	167
Anthracene	530000000	µg/kg	NA	NA	NA	NA	NA	185	489
Azobenzene		µg/kg	NA	NA	NA	NA	NA	<50	<50
Benzo(a)anthracene	90000	µg/kg	NA	NA	NA	NA	NA	736	841
Benzo(a)pyrene	14000	µg/kg	NA	NA	NA	NA	NA	468	531
Benzo(bk)fluoranthene	100000	µg/kg	NA	NA	NA	NA	NA	699	900
Benzo(g,h,i)perylene	650000	µg/kg	NA	NA	NA	NA	NA	245	279
Bis(2chloroethoxy)methane		µg/kg	NA	NA	NA	NA	NA	<50	<50
bis(2Chloroethyl)ether		µg/kg	NA	NA	NA	NA	NA	<50	<50
bis(2Ethylhexyl) phthalate		µg/kg	NA	NA	NA	NA	NA	<50	<50

East Tip 2013 Foreshore Solid Samples , Laboratory Analysis Results

Sample Identity	Commercial Human Health GAC (mg/kg)		FTP 2	FTP 6	FTP 10	FTP 17	FTP 19	FTP 21	FTP 26
Depth (m)			0-0.2	0.6-1.0	0.1-0.4	1.7-1.9	1.2-1.5	2-2.5	2.2-2.5
Butylbenzyl phthalate		µg/kg	NA	NA	NA	NA	NA	<50	<50
Carbazole		µg/kg	NA	NA	NA	NA	NA	<50	113
Chrysene	140000	µg/kg	NA	NA	NA	NA	NA	854	970
Dibenzo(a,h)anthracene	13000	µg/kg	NA	NA	NA	NA	NA	103	144
Dibenzofuran		µg/kg	NA	NA	NA	NA	NA	<50	182
Diethyl phthalate		µg/kg	NA	NA	NA	NA	NA	<50	<50
Dimethyl phthalate		µg/kg	NA	NA	NA	NA	NA	<50	<50
Di-n-butyl phthalate		µg/kg	NA	NA	NA	NA	NA	<50	<50
Di-n-Octyl phthalate		µg/kg	NA	NA	NA	NA	NA	<50	<50
Fluoranthene	23000000	µg/kg	NA	NA	NA	NA	NA	760	1472
Fluorene	64000000	µg/kg	NA	NA	NA	NA	NA	185	374
Hexachlorobenzene		µg/kg	NA	NA	NA	NA	NA	<50	<50
Hexachlorobutadiene		µg/kg	NA	NA	NA	NA	NA	<50	<50
Hexachlorocyclopentadiene		µg/kg	NA	NA	NA	NA	NA	<50	<50
Hexachloroethane		µg/kg	NA	NA	NA	NA	NA	<50	<50
Indeno(1,2,3cd)pyrene	60000	µg/kg	NA	NA	NA	NA	NA	200	241
Isophorone		µg/kg	NA	NA	NA	NA	NA	<50	<50
Naphthalene	200000	µg/kg	NA	NA	NA	NA	NA	137	429
Nitrobenzene		µg/kg	NA	NA	NA	NA	NA	<50	<50
nNitrosondipropylamine		µg/kg	NA	NA	NA	NA	NA	<50	<50
Pentachlorophenol		µg/kg	NA	NA	NA	NA	NA	<50	<50
Phenanthrene	22000000	µg/kg	NA	NA	NA	NA	NA	362	1183
Phenol	482000	µg/kg	NA	NA	NA	NA	NA	<50	1072
Pyrene	54000000	µg/kg	NA	NA	NA	NA	NA	1036	1427
Tic Report									
Volatile Organic Compounds (VOCs) (Solids)									
1.1.1.2Tetrachloroethane	120000	µg/kg	NA	NA	NA	NA	NA	<3	<3
1.1.1Trichloroethane	700000	µg/kg	NA	NA	NA	NA	NA	<3	227
1.1.2.2Tetrachloroethane	290000	µg/kg	NA	NA	NA	NA	NA	<3	<3
1.1.2Trichloroethane		µg/kg	NA	NA	NA	NA	NA	<3	<3
1.1Dichloroethane		µg/kg	NA	NA	NA	NA	NA	<3	<3
1.1Dichloroethene		µg/kg	NA	NA	NA	NA	NA	<6	<6
1.1Dichloropropene		µg/kg	NA	NA	NA	NA	NA	<3	<3
1.2.3Trichlorobenzene		µg/kg	NA	NA	NA	NA	NA	<7	<7
1.2.3Trichloropropane		µg/kg	NA	NA	NA	NA	NA	<4	<4
1.2.4Trichlorobenzene		µg/kg	NA	NA	NA	NA	NA	<7	<7
1.2.4Trimethylbenzene		µg/kg	NA	NA	NA	NA	NA	<6	60
1.2Dibromo3chloropropane		µg/kg	NA	NA	NA	NA	NA	<4	<4
1.2Dibromoethane		µg/kg	NA	NA	NA	NA	NA	<3	<3
1.2Dichlorobenzene		µg/kg	NA	NA	NA	NA	NA	<4	<4
1.2Dichloroethane	710	µg/kg	NA	NA	NA	NA	NA	<4	<4
1.2Dichloropropane		µg/kg	NA	NA	NA	NA	NA	<6	<6
1.3.5Trimethylbenzene		µg/kg	NA	NA	NA	NA	NA	<3	15
1.3Dichlorobenzene		µg/kg	NA	NA	NA	NA	NA	<4	<4
1.3Dichloropropane		µg/kg	NA	NA	NA	NA	NA	<3	<3
1.4Dichlorobenzene		µg/kg	NA	NA	NA	NA	NA	<4	<4
2.2Dichloropropane		µg/kg	NA	NA	NA	NA	NA	<4	<4
2Chlorotoluene		µg/kg	NA	NA	NA	NA	NA	<3	<3
4Chlorotoluene		µg/kg	NA	NA	NA	NA	NA	<3	<3
4Isopropyltoluene		µg/kg	NA	NA	NA	NA	NA	<4	<4
Benzene	28000	µg/kg	NA	NA	NA	NA	NA	<3	8
Bromobenzene		µg/kg	NA	NA	NA	NA	NA	<2	<2
Bromochloromethane		µg/kg	NA	NA	NA	NA	NA	<3	<3
Bromodichloromethane		µg/kg	NA	NA	NA	NA	NA	<3	<3

East Tip 2013 Foreshore Solid Samples , Laboratory Analysis Results

Sample Identity	Commercial Human Health GAC (mg/kg)		FTP 2	FTP 6	FTP 10	FTP 17	FTP 19	FTP 21	FTP 26
Depth (m)			0-0.2	0.6-1.0	0.1-0.4	1.7-1.9	1.2-1.5	2-2.5	2.2-2.5
Bromoform		µg/kg	NA	NA	NA	NA	NA	<3	<3
Bromomethane		µg/kg	NA	NA	NA	NA	NA	<1	<1
Carbontetrachloride	3000	µg/kg	NA	NA	NA	NA	NA	<4	<4
Chlorobenzene		µg/kg	NA	NA	NA	NA	NA	<3	<3
Chloroethane		µg/kg	NA	NA	NA	NA	NA	<2	<2
Chloroform	110000	µg/kg	NA	NA	NA	NA	NA	<3	<3
Chloromethane		µg/kg	NA	NA	NA	NA	NA	<3	<3
cis12Dichloroethene		µg/kg	NA	NA	NA	NA	NA	<3	<3
cis13Dichloropropene		µg/kg	NA	NA	NA	NA	NA	<4	<4
Dibromochloromethane		µg/kg	NA	NA	NA	NA	NA	<3	<3
Dibromomethane		µg/kg	NA	NA	NA	NA	NA	<3	<3
Dichlorodifluoromethane		µg/kg	NA	NA	NA	NA	NA	<2	<2
Dichloromethane		µg/kg	NA	NA	NA	NA	NA	<7	<7
Ethylbenzene	518000	µg/kg	NA	NA	NA	NA	NA	<3	53
Hexachlorobutadiene		µg/kg	NA	NA	NA	NA	NA	<4	<4
Isopropylbenzene		µg/kg	NA	NA	NA	NA	NA	<3	8
Methyl Tertiary Butyl Ether		µg/kg	NA	NA	NA	NA	NA	<2	<2
nButylbenzene		µg/kg	NA	NA	NA	NA	NA	<4	<4
oXylene		µg/kg	NA	NA	NA	NA	NA	<3	36
p/mXylene	312000	µg/kg	NA	NA	NA	NA	NA	<6	56
Propylbenzene		µg/kg	NA	NA	NA	NA	NA	<4	8
secButylbenzene		µg/kg	NA	NA	NA	NA	NA	<4	<4
Styrene		µg/kg	NA	NA	NA	NA	NA	<3	30
tertButylbenzene		µg/kg	NA	NA	NA	NA	NA	<5	<5
Tetrachloroethene	130000	µg/kg	NA	NA	NA	NA	NA	<3	<3
Toluene	869000	µg/kg	NA	NA	NA	NA	NA	<3	10
trans12Dichloroethene		µg/kg	NA	NA	NA	NA	NA	<3	<3
trans13Dichloropropene		µg/kg	NA	NA	NA	NA	NA	<3	<3
Trichloroethene	12000	µg/kg	NA	NA	NA	NA	NA	<3	<3
Trichlorofluoromethane		µg/kg	NA	NA	NA	NA	NA	<2	43
Vinyl Chloride	63	µg/kg	NA	NA	NA	NA	NA	<2	<2

turquoise indicates value exceeds commercial GAC

Screen Unformatted Data Screen Formatted Data

Appendix F Leachability Analysis Results

2012/13 Investigation Foreshore Waste Solid Samples, Laboratory Analysis Leachability

			Very sandy SLAG with metal debris with abundant seashells	Consolidated SLAG with rebar, metal pieces, refractory bricks	Brown gravelly SLAG with occasional refractory brick	SLAG with occasional C&D waste including metal scrap and refractory bricks. Some black staining with slight HC odours.	consolidated SLAG with rebar steel, Scrap metal with moderate hydrocarbon odours with occasional pipes and wires.	Unconsolidated SLAG with abundant shells and C&D waste including timber, refractory bricks, cables, plastic, springs, metal fragments, batteries.	gravel sized SLAG with frequent metal pieces, cables and a battery	
Sample Identity	**Units**	**WQS**	**FTP 2**	**FTP 6**	**FTP 10**	**FTP 17**	**FTP 19**	**FTP 21**	**FTP 26**	
Depth (m)			**0-0.2**	**0.6-1.0**	**0.1-0.4**	**1.7-1.9**	**1.2-1.5**	**2-2.5**	**2.2-2.5**	
Sample Type			**SOLID**	**SOLID**	**SOLID**	**SOLID**	**SOLID**	**SOLID**	**SOLID**	
Laboratory data										
Metals										
NRA - Arsenic	µg/l	20	4.7	1.9	6.4	1.5	<0.9	2.4	<0.9	
NRA-barium	µg/l		4.5	74.7	11	19.8	20.7	57.3	51.2	
NRA-beryllium	µg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
NRA - Boron	µg/l	7000	668	1090	399	576	649	862	780	
NRA - Cadmium	µg/l	0.2	<0.03	0.11	0.15	<0.03	<0.03	<0.03	<0.03	
NRA - Chromium	µg/l	4.6	<0.2	<0.2	2.3	<0.2	<0.2	<0.2	<0.2	
NRA - Chromium, Hexavalent	mg/l	0.0006	**0.002**	**0.002**	**0.003**	**0.003**	**0.002**	**0.002**	**0.002**	
NRA Chromium III	mg/l		<0.03	<0.03	2.3	<0.03	<0.03	<0.03	<0.03	
NRA - Copper	µg/l	5	**66**	<3	<3	<3	<3	<3	<3	
NRA - Lead	µg/l	7.2	<0.4	<0.4	1	<0.4	<0.4	<0.4	<0.4	
NRA - Manganese	µg/l	30	<1.5	<1.5	<1.5	**54.3**	<1.5	<1.5	<1.5	
NRA - Nickel	µg/l	20	4.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
NRA - Selenium	µg/l		<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	
NRA - Vanadium	µg/l		0.8	<0.6	22.5	<0.6	<0.6	1.1	<0.6	
NRA - Zinc	µg/l	40	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	
NRA Mercury disolved by CVAF	µg/l	0.05	0.04	0.02	0.03	0.05	**0.06**	**0.11**	0.03	
yellow indicates value exceeds WQS										

Appendix G Asbestos Analysis Results

WORKING FOR A HEALTHY FUTURE

CERTIFICATE OF ANALYSIS

ANALYSIS REQUESTED BY: WYG Environmental Ltd
1 Locksley Business Park
Montgomery Road
Belfast
BT6 9UP

CONTRACT NO: 32524

PROJECT NO: 610

DATE OF ISSUE: 07.02.13

DATE SAMPLES RECEIVED: 04.02.13

DATE SAMPLES ANALYSED: 07.02.13

SAMPLE DESCRIPTION: Four soil/loose aggregate samples each weighing approximately 1.1-1.2kg.

ANALYSIS REQUESTED: Qualitative and quantitative analysis of soil/loose aggregate samples for mass determination of asbestos.

METHODS:

Qualitative - The samples were analysed qualitatively for asbestos by polarised light and dispersion staining as described by the Health and Safety Executive in HSG 248.

Quantitative - The analysis was carried out using our documented in-house method based on HSE Contract Research Report No. 83/1996: Development and Validation of an analytical method to determine the amount of asbestos in soils and loose aggregates (Davies *et al*, 1996) and HSG 248. Our method includes initial examination of the entire sample, detailed analysis of a representative sub-sample and quantification by hand picking/weighing and/or fibre counting/sizing as appropriate.

RESULTS:

Initial Screening

Asbestos was detected in all four soil samples by stereo-binocular and polarised light microscopy.

A summary of the qualitative and quantitative results are given in Tables 1 & 2 respectively.

RESEARCH CONSULTING **SERVICES**
Multi-disciplinary specialists in Occupational and Environmental Health and Hygiene
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Telephone: +44 (0)131 449 8000, Facsimile: +44 (0)131 449 8084, Email: iom@iom-world.org
REGISTERED IN SCOTLAND NO. SC205670. IOM CONSULTING LIMITED IS A WHOLLY OWNED SUBSIDIARY OF THE INSTITUTE OF OCCUPATIONAL MEDICINE, A REGISTERED SCOTTISH CHARITY
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UKAS TESTING
0374

RESULTS: (cont.)

Table 1: Qualitative Results

IOM sample number	Client sample number	ACM type detected	PLM result
S20327	TP02 0-0.2	Free Fibres	Amosite
S20328	TP07 0.2-0.7	Bound Insulation	Amosite
S20329	TP21 2-2.5	Bound Insulation	Chrysotile
S20330	TP24 1.5-1.8	Bound Insulation	Chrysotile

Our detection limit for this method is 0.001%.

Table 2: Quantitative Analysis Results

Client Sample Number	Sample weight (g)	% Asbestos by hand picking/weighing	% Asbestos by fibre counting/sizing	Total % Asbestos in Sample
TP02 0-0.2	1184	0.003	-	0.003
TP07 0.2-0.7	1114	0.004	-	0.004
TP21 2-2.5	1092	0.006	-	0.006
TP24 1.5-1.8	1119	0.010	-	0.010

- not applicable

The detection limit for this method is around 0.0001% with a limit of quantification of 0.001%.

COMMENTS:

IOM Consulting cannot accept responsibility for samples that have been incorrectly collected or despatched by external clients.

Any opinions and interpretations expressed herein are outwith the scope of our UKAS accreditation.

Appendix H Laboratory Certificates

Jones Environmental Laboratory

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

WYG
1 Locksley Business Park
Montgomery Park
Belfast
Northern Ireland
BT6 9UP

No.4225

Attention :	Yvonne Buchanan
Date :	13th February, 2013
Your reference :	A080615-1
Our reference :	Test Report 13/1433 Batch 1
Location :	East Tip - Foreshaw
Date samples received :	4th February, 2013
Status :	Final report
Issue :	1

Twenty eight samples were received for analysis on 4th February, 2013. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Bruce Leslie
Project Co-ordinator

Bob Millward B.Sc
Principal Chemist

Client Name: WYG

Reference: A080615-1

Location: East Tip - Foreshaw

Contact: Yvonne Buchanan

JE Job No.: 13/1433

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	4-6	22-24	34-36	52-54	58-60	64-66	79-81				LOD	Units	Method No.
Sample ID	FTP 2	FTP 6	FTP 10	FTP 17	FTP 19	FTP 21	FTP 26						
Depth	0-0.2	0.6-1.0	0.1-0.4	1.7-1.9	1.2-1.5	2-2.5	2.2-2.5						
COC No / misc													
Containers	V T	V T	V T	V T	V T	V T	V T						
Sample Date	29/01/2013	29/01/2013	29/01/2013	01/02/2013	01/02/2013	01/02/2013	01/02/2013						
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil						
Batch Number	1	1	1	1	1	1	1						
Date of Receipt	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013						
Arsenic #	16.8	13.7	<0.5	28.3	0.5	<0.5	<0.5				<0.5	mg/kg	TM30/PM15
Barium #	163	257	665	346	579	884	494				<1	mg/kg	TM30/PM15
Beryllium	1.5	1.1	<0.5	2.0	1.3	<0.5	0.7				<0.5	mg/kg	TM30/PM15
Cadmium #	8.1	27.8	1.9	6.2	1.7	0.8	4.7				<0.1	mg/kg	TM30/PM15
Chromium #	1317.0	1591.0	2916.0	1060.0	3378.0	3736.0	3824.0				<0.5	mg/kg	TM30/PM15
Copper #	1344	1225	639	894	1543	308	1675				<1	mg/kg	TM30/PM15
Lead #	1243	2160	440	424	193	99	1048				<5	mg/kg	TM30/PM15
Manganese #	13510	20540	27680	12310	28460	37610	10520				<1	mg/kg	TM30/PM15
Nickel #	288.4	193.1	416.9	182.8	270.5	38.4	5770.0				<0.7	mg/kg	TM30/PM15
Selenium #	5	6	7	5	9	11	4				<1	mg/kg	TM30/PM15
Vanadium	92	104	248	157	388	371	92				<1	mg/kg	TM30/PM15
Water Soluble Boron #	29.9	42.9	23.4	21.2	19.0	19.0	31.2				<0.1	mg/kg	TM74/PM32
Zinc #	10920	22530	1155	2912	721	530	3897				<5	mg/kg	TM30/PM15
Mercury CVAF	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.7				<0.5	mg/kg	TM61/PM15
PAH MS													
Naphthalene #	-	-	-	<0.04	0.04	-	-				<0.04	mg/kg	TM4/PM8
Acenaphthylene	-	-	-	<0.03	0.05	-	-				<0.03	mg/kg	TM4/PM8
Acenaphthene #	-	-	-	<0.05	0.84	-	-				<0.05	mg/kg	TM4/PM8
Fluorene #	-	-	-	<0.04	0.78	-	-				<0.04	mg/kg	TM4/PM8
Phenanthrene #	-	-	-	0.27	7.04	-	-				<0.03	mg/kg	TM4/PM8
Anthracene #	-	-	-	0.09	2.27	-	-				<0.04	mg/kg	TM4/PM8
Fluoranthene #	-	-	-	0.42	9.30	-	-				<0.03	mg/kg	TM4/PM8
Pyrene #	-	-	-	0.32	6.38	-	-				<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	-	-	-	0.22	5.05	-	-				<0.06	mg/kg	TM4/PM8
Chrysene #	-	-	-	0.22	4.32	-	-				<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	-	-	-	0.27	5.94	-	-				<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	-	-	-	0.12	3.43	-	-				<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	-	-	-	0.09	1.96	-	-				<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	-	-	-	<0.04	0.69	-	-				<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	-	-	-	0.09	1.71	-	-				<0.04	mg/kg	TM4/PM8
PAH 16 Total	-	-	-	2.1	49.8	-	-				<0.6	mg/kg	TM4/PM8
Benzo(b)fluoranthene	-	-	-	0.19	4.28	-	-				<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	-	-	-	0.08	1.66	-	-				<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	-	-	-	102	104	-	-				<0	%	TM4/PM8

Please see attached notes for all abbreviations and acronyms

Client Name: WYG

Reference: A078423

Location: Morans Derry

Contact: Yvonne Buchanan

JE Job No.: 13/1433

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	4-6	22-24	34-36	52-54	58-60	64-66	79-81				LOD	Units	Method No.
Sample ID	FTP 2	FTP 6	FTP 10	FTP 17	FTP 19	FTP 21	FTP 26						
Depth	0-0.2	0.6-1.0	0.1-0.4	1.7-1.9	1.2-1.5	2-2.5	2.2-2.5						
COC No / misc													
Containers	V T	V T	V T	V T	V T	V T	V T						
Sample Date	29/01/2013	29/01/2013	29/01/2013	01/02/2013	01/02/2013	01/02/2013	01/02/2013						
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil						
Batch Number	1	1	1	1	1	1	1						
Date of Receipt	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013						
TPH CWG													
Aliphatics													
>C5-C6 #	-	-	-	<0.1	<0.1	-	-				<0.1	mg/kg	TM36/PM12
>C6-C8 #	-	-	-	<0.1	<0.1	-	-				<0.1	mg/kg	TM36/PM12
>C8-C10	-	-	-	0.1	<0.1	-	-				<0.1	mg/kg	TM36/PM12
>C10-C12 #	-	-	-	4.5	<0.2	-	-				<0.2	mg/kg	TM5/PM16
>C12-C16 #	-	-	-	47	<4	-	-				<4	mg/kg	TM5/PM16
>C16-C21 #	-	-	-	38	<7	-	-				<7	mg/kg	TM5/PM16
>C21-C35 #	-	-	-	413	144	-	-				<7	mg/kg	TM5/PM16
Total aliphatics C5-35	-	-	-	503	144	-	-				<19	mg/kg	TM5/TM36/PM12/PM16
Aromatics													
>C5-EC7	-	-	-	<0.1	<0.1	-	-				<0.1	mg/kg	TM36/PM12
>EC7-EC8	-	-	-	<0.1	<0.1	-	-				<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	-	-	-	<0.1	<0.1	-	-				<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	-	-	-	<0.2	<0.2	-	-				<0.2	mg/kg	TM5/PM16
>EC12-EC16 #	-	-	-	<4	<4	-	-				<4	mg/kg	TM5/PM16
>EC16-EC21 #	-	-	-	25	43	-	-				<7	mg/kg	TM5/PM16
>EC21-EC35 #	-	-	-	305	18	-	-				<7	mg/kg	TM5/PM16
Total aromatics C5-35	-	-	-	330	61	-	-				<19	mg/kg	TM5/TM36/PM12/PM16
Total aliphatics and aromatics(C5-35)	-	-	-	833	205	-	-				<38	mg/kg	TM5/TM36/PM12/PM16
MTBE #	-	-	-	<5	<5	-	-				<5	ug/kg	TM31/PM12
Benzene #	-	-	-	<5	<5	-	-				<5	ug/kg	TM31/PM12
Toluene #	-	-	-	<5	<5	-	-				<5	ug/kg	TM31/PM12
Ethylbenzene #	-	-	-	<5	<5	-	-				<5	ug/kg	TM31/PM12
m/p-Xylene #	-	-	-	<5	<5	-	-				<5	ug/kg	TM31/PM12
o-Xylene #	-	-	-	<5	<5	-	-				<5	ug/kg	TM31/PM12
Hexavalent Chromium	<0.3	0.6	<0.3	<0.3	<0.3	<0.3	<0.3				<0.3	mg/kg	TM38/PM20
Chromium III	1317.0	1590.4	2916.0	1060.0	3378.0	3736.0	3824.0				<0.3	mg/kg	NONE/NONE
Fraction Organic Carbon	0.017	0.014	0.004	0.015	0.002	<0.001	-				<0.001	None	TM21/PM24
pH #	9.25	10.18	9.32	8.28	8.90	9.47	-				<0.01	pH units	TM73/PM11

Client Name: WYG

Reference: A080615-1

Location: East Tip - Foreshaw

Contact: Yvonne Buchanan

JE Job No.: 13/1433

Report : NRA Leachate

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

Please see attached notes for all abbreviations and acronyms

J E Sample No.	4-6	22-24	34-36	52-54	58-60	64-66	79-81					
Sample ID	FTP 2	FTP 6	FTP 10	FTP 17	FTP 19	FTP 21	FTP 26					
Depth	0-0.2	0.6-1.0	0.1-0.4	1.7-1.9	1.2-1.5	2-2.5	2.2-2.5					
COC No / misc												
Containers	V T	V T	V T	V T	V T	V T	V T					
Sample Date	29/01/2013	29/01/2013	29/01/2013	01/02/2013	01/02/2013	01/02/2013	01/02/2013					
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Batch Number	1	1	1	1	1	1	1					
Date of Receipt	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013					
											LOD	**Units**	**Method No.**
Dissolved Arsenic	4.7	1.9	6.4	1.5	<0.9	2.4	<0.9				<0.9	ug/l	TM30/PM14
Dissolved Barium	4.5	74.7	11.0	19.8	20.7	57.3	51.2				<1.8	ug/l	TM30/PM14
Dissolved Beryllium	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5				<0.5	ug/l	TM30/PM14
Dissolved Boron	668	1090	399	576	649	862	780				<2	ug/l	TM30/PM14
Dissolved Cadmium	<0.03	0.11	0.15	<0.03	<0.03	<0.03	<0.03				<0.03	ug/l	TM30/PM14
Dissolved Chromium	<0.2	<0.2	2.3	<0.2	<0.2	<0.2	<0.2				<0.2	ug/l	TM30/PM14
Dissolved Copper	66	<3	<3	<3	<3	<3	<3				<3	ug/l	TM30/PM14
Dissolved Lead	<0.4	<0.4	1.0	<0.4	<0.4	<0.4	<0.4				<0.4	ug/l	TM30/PM14
Dissolved Manganese	<1.5	<1.5	<1.5	54.3	<1.5	<1.5	<1.5				<1.5	ug/l	TM30/PM14
Dissolved Nickel	4.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2				<0.2	ug/l	TM30/PM14
Dissolved Selenium	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2				<1.2	ug/l	TM30/PM14
Dissolved Vanadium	0.8	<0.6	22.5	<0.6	<0.6	1.1	<0.6				<0.6	ug/l	TM30/PM14
Dissolved Zinc	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5				<1.5	ug/l	TM30/PM14
Mercury Dissolved by CVAF	0.04	0.02	0.03	0.05	0.06	0.11	0.03				<0.01	ug/l	TM61/PM38
Chromium III	<0.03	<0.03	2.30	<0.03	<0.03	<0.03	<0.03				<0.03	mg/l	NONE/NONE
Hexavalent Chromium	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03				<0.03	mg/l	TM38/PM0

Jones Environmental Laboratory

Client Name: WYG

SVOC Report : **Solid**

Reference: A080615-1

Location: East Tip - Foreshaw

Contact: Yvonne Buchanan

JE Job No.: 13/1433

J E Sample No.	64-66	79-81											
Sample ID	FTP 21	FTP 26											
Depth	2-2.5	2.2-2.5									Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V T	V T											
Sample Date	01/02/2013	01/02/2013											
Sample Type	Soil	Soil											
Batch Number	1	1									**LOD**	**Units**	**Method No.**
Date of Receipt	04/02/2013	04/02/2013											
SVOC MS													
Phenols	x5 dilution	x5 dilution											
2-Chlorophenol	<50	<50									<10	ug/kg	TM16/PM8
2-Methylphenol	<50	<50									<10	ug/kg	TM16/PM8
2-Nitrophenol	<50	<50									<10	ug/kg	TM16/PM8
2,4-Dichlorophenol	<50	<50									<10	ug/kg	TM16/PM8
2,4-Dimethylphenol	<50	<50									<10	ug/kg	TM16/PM8
2,4,5-Trichlorophenol	<50	<50									<10	ug/kg	TM16/PM8
2,4,6-Trichlorophenol	<50	<50									<10	ug/kg	TM16/PM8
4-Chloro-3-methylphenol	<50	<50									<10	ug/kg	TM16/PM8
4-Methylphenol	<50	<50									<10	ug/kg	TM16/PM8
4-Nitrophenol	<50	<50									<10	ug/kg	TM16/PM8
Pentachlorophenol	<50	<50									<10	ug/kg	TM16/PM8
Phenol	<50	1072									<10	ug/kg	TM16/PM8
PAHs													
2-Chloronaphthalene	<50	<50									<10	ug/kg	TM16/PM8
2-Methylnaphthalene	<50	120									<10	ug/kg	TM16/PM8
Naphthalene	137	429									<10	ug/kg	TM16/PM8
Acenaphthylene	114	167									<10	ug/kg	TM16/PM8
Acenaphthene	252	366									<10	ug/kg	TM16/PM8
Fluorene	185	374									<10	ug/kg	TM16/PM8
Phenanthrene	362	1183									<10	ug/kg	TM16/PM8
Anthracene	185	489									<10	ug/kg	TM16/PM8
Fluoranthene	760	1472									<10	ug/kg	TM16/PM8
Pyrene	1036	1427									<10	ug/kg	TM16/PM8
Benzo(a)anthracene	736	841									<10	ug/kg	TM16/PM8
Chrysene	854	970									<10	ug/kg	TM16/PM8
Benzo(bk)fluoranthene	699	900									<10	ug/kg	TM16/PM8
Benzo(a)pyrene	468	531									<10	ug/kg	TM16/PM8
Indeno(123cd)pyrene	200	241									<10	ug/kg	TM16/PM8
Dibenzo(ah)anthracene	103	144									<10	ug/kg	TM16/PM8
Benzo(ghi)perylene	245	279									<10	ug/kg	TM16/PM8
Phthalates													
Bis(2-ethylhexyl) phthalate	<50	<50									<10	ug/kg	TM16/PM8
Butylbenzyl phthalate	<50	<50									<10	ug/kg	TM16/PM8
Di-n-butyl phthalate	<50	<50									<10	ug/kg	TM16/PM8
Di-n-Octyl phthalate	<50	<50									<10	ug/kg	TM16/PM8
Diethyl phthalate	<50	<50									<10	ug/kg	TM16/PM8
Dimethyl phthalate	<50	<50									<10	ug/kg	TM16/PM8

Jones Environmental Laboratory

Client Name: WYG

SVOC Report : **Solid**

Reference: A078423

Location: Morans Derry

Contact: Yvonne Buchanan

JE Job No.: 13/1433

J E Sample No.	64-66	79-81											
Sample ID	FTP 21	FTP 26											
Depth	2-2.5	2.2-2.5									Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V T	V T											
Sample Date	01/02/2013	01/02/2013											
Sample Type	Soil	Soil											
Batch Number	1	1											
Date of Receipt	04/02/2013	04/02/2013									**LOD**	**Units**	**Method No.**
SVOC MS													
Other SVOCs													
1,2-Dichlorobenzene	<50	<50									<10	ug/kg	TM16/PM8
1,2,4-Trichlorobenzene	<50	<50									<10	ug/kg	TM16/PM8
1,3-Dichlorobenzene	<50	<50									<10	ug/kg	TM16/PM8
1,4-Dichlorobenzene	<50	<50									<10	ug/kg	TM16/PM8
2-Nitroaniline	<50	<50									<10	ug/kg	TM16/PM8
2,4-Dinitrotoluene	<50	<50									<10	ug/kg	TM16/PM8
2,6-Dinitrotoluene	<50	<50									<10	ug/kg	TM16/PM8
3-Nitroaniline	<50	<50									<10	ug/kg	TM16/PM8
4-Bromophenylphenylether	<50	<50									<10	ug/kg	TM16/PM8
4-Chloroaniline	<50	<50									<10	ug/kg	TM16/PM8
4-Chlorophenylphenylether	<50	<50									<10	ug/kg	TM16/PM8
4-Nitroaniline	<50	<50									<10	ug/kg	TM16/PM8
Azobenzene	<50	<50									<10	ug/kg	TM16/PM8
Bis(2-chloroethoxy)methane	<50	<50									<10	ug/kg	TM16/PM8
Bis(2-chloroethyl)ether	<50	<50									<10	ug/kg	TM16/PM8
Carbazole	<50	113									<10	ug/kg	TM16/PM8
Dibenzofuran	<50	182									<10	ug/kg	TM16/PM8
Hexachlorobenzene	<50	<50									<10	ug/kg	TM16/PM8
Hexachlorobutadiene	<50	<50									<10	ug/kg	TM16/PM8
Hexachlorocyclopentadiene	<50	<50									<10	ug/kg	TM16/PM8
Hexachloroethane	<50	<50									<10	ug/kg	TM16/PM8
Isophorone	<50	<50									<10	ug/kg	TM16/PM8
N-nitrosodi-n-propylamine	<50	<50									<10	ug/kg	TM16/PM8
Nitrobenzene	<50	<50									<10	ug/kg	TM16/PM8

Client Name: WYG **VOC Report :** **Solid**

Reference: A080615-1

Location: East Tip - Foreshaw

Contact: Yvonne Buchanan

JE Job No.: 13/1433

J E Sample No.	64-66	79-81											
Sample ID	FTP 21	FTP 26											
Depth	2-2.5	2.2-2.5									Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V T	V T											
Sample Date	01/02/2013	01/02/2013											
Sample Type	Soil	Soil											
Batch Number	1	1									LOD	Units	Method No.
Date of Receipt	04/02/2013	04/02/2013											
VOC MS													
Dichlorodifluoromethane	<2	<2									<2	ug/kg	TM15/PM10
Methyl Tertiary Butyl Ether #	<2	<2									<2	ug/kg	TM15/PM10
Chloromethane #	<3	<3									<3	ug/kg	TM15/PM10
Vinyl Chloride	<2	<2									<2	ug/kg	TM15/PM10
Bromomethane	<1	<1									<1	ug/kg	TM15/PM10
Chloroethane #	<2	<2									<2	ug/kg	TM15/PM10
Trichlorofluoromethane #	<2	43									<2	ug/kg	TM15/PM10
1,1-Dichloroethene (1,1 DCE) #	<6	<6									<6	ug/kg	TM15/PM10
Dichloromethane (DCM) #	<7	<7									<7	ug/kg	TM15/PM10
trans-1-2-Dichloroethene #	<3	<3									<3	ug/kg	TM15/PM10
1,1-Dichloroethane #	<3	<3									<3	ug/kg	TM15/PM10
cis-1-2-Dichloroethene #	<3	<3									<3	ug/kg	TM15/PM10
2,2-Dichloropropane	<4	<4									<4	ug/kg	TM15/PM10
Bromochloromethane #	<3	<3									<3	ug/kg	TM15/PM10
Chloroform #	<3	<3									<3	ug/kg	TM15/PM10
1,1,1-Trichloroethane #	<3	227									<3	ug/kg	TM15/PM10
1,1-Dichloropropene #	<3	<3									<3	ug/kg	TM15/PM10
Carbon tetrachloride #	<4	<4									<4	ug/kg	TM15/PM10
1,2-Dichloroethane #	<4	<4									<4	ug/kg	TM15/PM10
Benzene #	<3	8									<3	ug/kg	TM15/PM10
Trichloroethene (TCE) #	<3	<3									<3	ug/kg	TM15/PM10
1,2-Dichloropropane #	<6	<6									<6	ug/kg	TM15/PM10
Dibromomethane #	<3	<3									<3	ug/kg	TM15/PM10
Bromodichloromethane #	<3	<3									<3	ug/kg	TM15/PM10
cis-1-3-Dichloropropene	<4	<4									<4	ug/kg	TM15/PM10
Toluene #	<3	10									<3	ug/kg	TM15/PM10
trans-1-3-Dichloropropene	<3	<3									<3	ug/kg	TM15/PM10
1,1,2-Trichloroethane #	<3	<3									<3	ug/kg	TM15/PM10
Tetrachloroethene (PCE) #	<3	<3									<3	ug/kg	TM15/PM10
1,3-Dichloropropane #	<3	<3									<3	ug/kg	TM15/PM10
Dibromochloromethane #	<3	<3									<3	ug/kg	TM15/PM10
1,2-Dibromoethane #	<3	<3									<3	ug/kg	TM15/PM10
Chlorobenzene #	<3	<3									<3	ug/kg	TM15/PM10
1,1,1,2-Tetrachloroethane	<3	<3									<3	ug/kg	TM15/PM10
Ethylbenzene #	<3	53									<3	ug/kg	TM15/PM10
p/m-Xylene #	<6	56									<6	ug/kg	TM15/PM10
o-Xylene #	<3	36									<3	ug/kg	TM15/PM10
Styrene	<3	30									<3	ug/kg	TM15/PM10
Bromoform #	<3	<3									<3	ug/kg	TM15/PM10
Isopropylbenzene #	<3	8									<3	ug/kg	TM15/PM10
1,1,2,2-Tetrachloroethane #	<3	<3									<3	ug/kg	TM15/PM10
Bromobenzene	<2	<2									<2	ug/kg	TM15/PM10
1,2,3-Trichloropropane #	<4	<4									<4	ug/kg	TM15/PM10
Propylbenzene #	<4	8									<4	ug/kg	TM15/PM10
2-Chlorotoluene	<3	<3									<3	ug/kg	TM15/PM10
1,3,5-Trimethylbenzene #	<3	15									<3	ug/kg	TM15/PM10
4-Chlorotoluene	<3	<3									<3	ug/kg	TM15/PM10
tert-Butylbenzene #	<5	<5									<5	ug/kg	TM15/PM10
1,2,4-Trimethylbenzene #	<6	60									<6	ug/kg	TM15/PM10
sec-Butylbenzene #	<4	<4									<4	ug/kg	TM15/PM10
4-Isopropyltoluene #	<4	<4									<4	ug/kg	TM15/PM10
1,3-Dichlorobenzene #	<4	<4									<4	ug/kg	TM15/PM10
1,4-Dichlorobenzene #	<4	<4									<4	ug/kg	TM15/PM10
n-Butylbenzene #	<4	<4									<4	ug/kg	TM15/PM10
1,2-Dichlorobenzene #	<4	<4									<4	ug/kg	TM15/PM10
1,2-Dibromo-3-chloropropane #	<4	<4									<4	ug/kg	TM15/PM10
1,2,4-Trichlorobenzene #	<7	<7									<7	ug/kg	TM15/PM10
Hexachlorobutadiene	<4	<4									<4	ug/kg	TM15/PM10
1,2,3-Trichlorobenzene #	<7	<7									<7	ug/kg	TM15/PM10

Jones Environmental Laboratory

Notification of Deviating Samples

Matrix : Solid

Client Name: WYG

Reference: A080615-1

Location: East Tip - Foreshaw

Contact: Yvonne Buchanan

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
13/1433	1	FTP 17	1.7-1.9	52-54	EPH	Sample received in inappropriate container
13/1433	1	FTP 19	1.2-1.5	58-60	EPH	Sample received in inappropriate container

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 13/1433

SOILS

Please note we are only MCERTS accredited for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. If we are instructed to keep samples, a storage charge of £1 (1.5 Euros) per sample per month will be applied until we are asked to dispose of them.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

WATERS

Please note we are not a Drinking Water Inspectorate (DWI) Approved Laboratory . It is important that detection limits are carefully considered when requesting water analysis.

UKAS accreditation applies to surface water and groundwater and one other matrix which is analysis specific, any other liquids are outside our scope of accreditation

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

NOTE

Data is only accredited when all the requirements of our Quality System have been met. In certain circumstances where the requirements have not been met, the laboratory may issue the data in an interim report but will remove the accreditation, in this instance results should be considered indicative only. Where possible samples will be re-extracted and a final report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

#	UKAS accredited.
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance.
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
++	Result outside calibration range, results should be considered as indicative only and are not accredited.
*	Analysis subcontracted to a Jones Environmental approved laboratory.
CO	Suspected carry over
NFD	No Fibres Detected

JE Job No 13/1433

Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Solid Results expressed on Dry/Wet basis
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction			AR	DRY
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction	Yes		AR	DRY
TM4	16 PAH by GC-MS, modified USEPA 8270	PM8	End Over End extraction			AR	
TM5	EPH by GC-FID, modified USEPA 8015	PM16	Aliphatic/Aromatic fractionation	Yes		AR	DRY
TM5/TM36	TPH CWG by GC-FID	PM12/PM16	CWG GC-FID			AR	DRY
TM15	VOC - Target by GC-MS, modified USEPA 8260	PM10	VOC GC-MS			AR	DRY
TM15	VOC - Target by GC-MS, modified USEPA 8260	PM10	VOC GC-MS	Yes		AR	DRY
TM16	SVOC - Target by GC-MS, modified USEPA 8270	PM8	End Over End extraction			AR	DRY
TM21	TOC and TC by Combustion	PM24	Eltra preparation			AD	DRY
TM30	Metals by ICP-OES	PM14	Metals by ICP (Waters)			AR	WET
TM30	Metals by ICP-OES	PM15	Aqua Regia extraction (Soils)			AD	DRY
TM30	Metals by ICP-OES	PM15	Aqua Regia extraction (Soils)	Yes		AD	DRY
TM31	BTEX/MTBE by GC-FID, modified USEPA 8015	PM12	GRO GC-FID			AR	DRY
TM31	BTEX/MTBE by GC-FID, modified USEPA 8015	PM12	GRO GC-FID	Yes		AR	DRY
TM36	GRO by Headspace GC-FID	PM12	GRO GC-FID			AR	DRY
TM36	GRO by Headspace GC-FID	PM12	GRO GC-FID	Yes		AR	DRY
TM38	SO4,Cl,NO3,NO2,F,PO4, Amm N2,ThioCN, Hex Cr by Aquakem	PM0	No Preparation			AR	WET
TM38	SO4,Cl,NO3,NO2,F,PO4, Amm N2,ThioCN, Hex Cr by Aquakem	PM20	1:2 soil to water extraction			AR	DRY
TM61	Mercury - low level CVAF	PM15	Aqua Regia extraction (Soils)			AD	DRY
TM61	Mercury - low level CVAF	PM38	Mercury CVAF			AR	WET
TM73	pH in by Metrohm	PM11	1:2.5 soil/water extraction	Yes		AR	WET
TM74	Water Soluble Boron by ICP-OES	PM32	Preparation of soils for WSB	Yes		AD	DRY
NONE	No Method Code	NONE	No Method Code				DRY
NONE	No Method Code	NONE	No Method Code			AR	WET

Jones Environmental Laboratory

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WYG
1 Locksley Business Park
Montgomery Park
Belfast
Northern Ireland
BT6 9UP

Attention :	Yvonne Buchanan
Date :	25th February, 2013
Your reference :	A080615-1
Our reference :	Test Report 13/1433 Batch 1 Schedule E
Location :	East Tip- Foreshaw
Date samples received :	4th February, 2013
Status :	Final report
Issue :	1

Twenty eight samples were received for analysis on 4th February, 2013. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Phil Sommerton B.Sc
Project Manager

Bob Millward B.Sc
Principal Chemist

Jones Environmental Laboratory

Client Name: WYG

Reference: A080615-1

Location: East Tip- Foreshaw

Contact: Yvonne Buchanan

JE Job No.: 13/1433

Report : NRA Leachate

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	4-6	22-24	34-36	52-54	58-60	64-66	79-81						
Sample ID	FTP 2	FTP 6	FTP 10	FTP 17	FTP 19	FTP 21	FTP 26						
Depth	0-0.2	0.6-1.0	0.1-0.4	1.7-1.9	1.2-1.5	2-2.5	2.2-2.5						
COC No / misc													
Containers	V T	V T	V T	V T	V T	V T	V T						
Sample Date	29/01/2013	29/01/2013	29/01/2013	01/02/2013	01/02/2013	01/02/2013	01/02/2013						
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil						
Batch Number	1	1	1	1	1	1	1						
Date of Receipt	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013	04/02/2013						
Hexavalent Chromium	0.002	0.002	0.003	0.003	0.002	0.002	0.002				<0.002	mg/l	TM38/PM0

Please see attached notes for all abbreviations and acronyms

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JE Job No.: 13/1433

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JE Job No 13/1433

Test Method No.	Description	Prep Method No. (if appropriate)	Description	UKAS	MCERTS (soils only)	Analysis done on As Received (AR) or Air Dried (AD)	Solid Results expressed on Dry/Wet basis
TM38	SO4,Cl,NO3,NO2,F,PO4, Amm N2,ThioCN, Hex Cr by Aquakem	PM0	No Preparation				