






**southern scientific  
services ltd**

**APPROPRIATE ASSESSMENT  
REMEDIAL NATURA IMPACT STATEMENT  
Application for Substitute Consent for proposed  
development on Tulla Road, Ennis, Co. Clare**

<b>Requested By:</b>	Valley Healthcare Fund - Infrastructure Investment Fund ICAV
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# 1. Introduction

The subsections below provide the background to the report, a description of the project and development site, the approach which included a desktop review and a field survey. It also provides the regulatory framework against which this remedial Natura Impact Statement (rNIS) has been prepared.

## 1.1 Background

HRA Planning Consultants on behalf of Valley Healthcare Fund – Infrastructure Investment Fund ICAV, Unit 1D, The Liffey Trust Building, 117-126 Upper Sheriff Street, Dublin (the applicant) intends to apply for Substitute Consent for a development which has taken place at their site at Tulla Road, Knockanoura, Ennis, Co. Clare (An Bord Pleanála Ref. ABP-307172-20).

Southern Scientific Services Ltd. was commissioned by HRA Planning Consultants to prepare a remedial Natura Impact Statement (rNIS) which will identify and assess the impacts, if any, which have occurred, are occurring or which are likely to occur on nearby Natura 2000 sites due to the development. The purpose of this assessment is to determine, the appropriateness, or otherwise, of the development in the context of the conservation status of such Natura 2000 sites.

This rNIS follows on from a decision by the developer to apply for a Substitute Consent from An Bord Pleanála in connection with its site at Knockanoura under the Planning and Development Acts 2000 to 2020.

An Appropriate Assessment (AA) is an assessment of the potential impacts of a project or plan on nearby Natura 2000 sites and the development where necessary of mitigation and/or avoidance measures to preclude negative effects. In terms of this rNIS, it has been undertaken as part of an AA where the potential impacts on Natura 2000 sites of the development being assessed have already taken place and that this requires a particular approach where the potential impacts are being assessed retrospectively. The impacts assessed must include the direct, indirect, and cumulative impacts of approving the project, together with any current or proposed activities and developments impacting the site. The potential impacts of projects/developments outside the Natura 2000 sites, but potentially impacting upon them must also be included in the assessment.

## 1.2 Brief Description of the Project and the Development Site

### 1.2.1 Outline of the project

This rNIS accompanies a Substitute Consent application for the unauthorised infilling with hardcore material that has taken place on the development site. In May 2020 the Applicant in an effort to regularise the planning permission applied for Leave to Apply for Substitute Consent. This was subsequently granted by An Bord Pleanala.

The Applicant is intent on regularising the infill groundworks relating to the 0.32-hectare site only and has arranged for an rNIS to be undertaken in conjunction with its application for Substitute Consent.

### 1.2.2 Development Site Description

The development site is part of a 1.2-hectare land parcel which, in its current state, is completely covered in hardcore material. The development site is bounded to the north and east with residential housing developments and to the southwest, there are several commercial premises. There is a surface water drain (dry & approx. 1m deep) bordering the development site. The drain starts on the eastern boundary adjacent to the residential dwellings and runs south around the site boundary. It was noted that this surface water drain does not appear to be connected to any watercourse. Further south and west the development site is border by the flood relief works and beyond this, the Fort Fergus Stream is located.

Using Google Street View and satellite views the development site can be observed before infilling took place (see Appendix I). It would appear the site was covered with scrub vegetation (WS1) as per Fossitt (Fossitt, 2000) prior to infilling with hardcore material. However, evidence of this pre-existing habitat type no longer exists as at present the development site is predominantly composed of spoil and bare ground (ED2). Vegetation is confined to annual weeds. A treeline – WL2 along the eastern boundary is composed of non-native Poplar (*Populus sp*).

Satellite mapping prior to infilling of the site and the flood relief scheme show that there was a surface water drain that ran in a north-south direction along the boundary with the Fort Fergus Stream.

### 1.2.3 Development Site Location

The development site is located in the townland of Knockanoura, approximately 1.6km from the Ennis Town centre (see Figure 1). Access to the site is via an entrance on the R352 Tulla Road. Landuse in the vicinity is predominately made up of residential housing developments to the north, east and southeast, with commercial units to the southwest. According to Corine Land Cover (CLC) data, the development site is situated in an area classified as Artificial Surfaces with Discontinuous urban fabric. The original soil type before infilling was described as marine/estuarine silts and clays.



Figure 1: Site Location (Source biodiversityireland.ie).

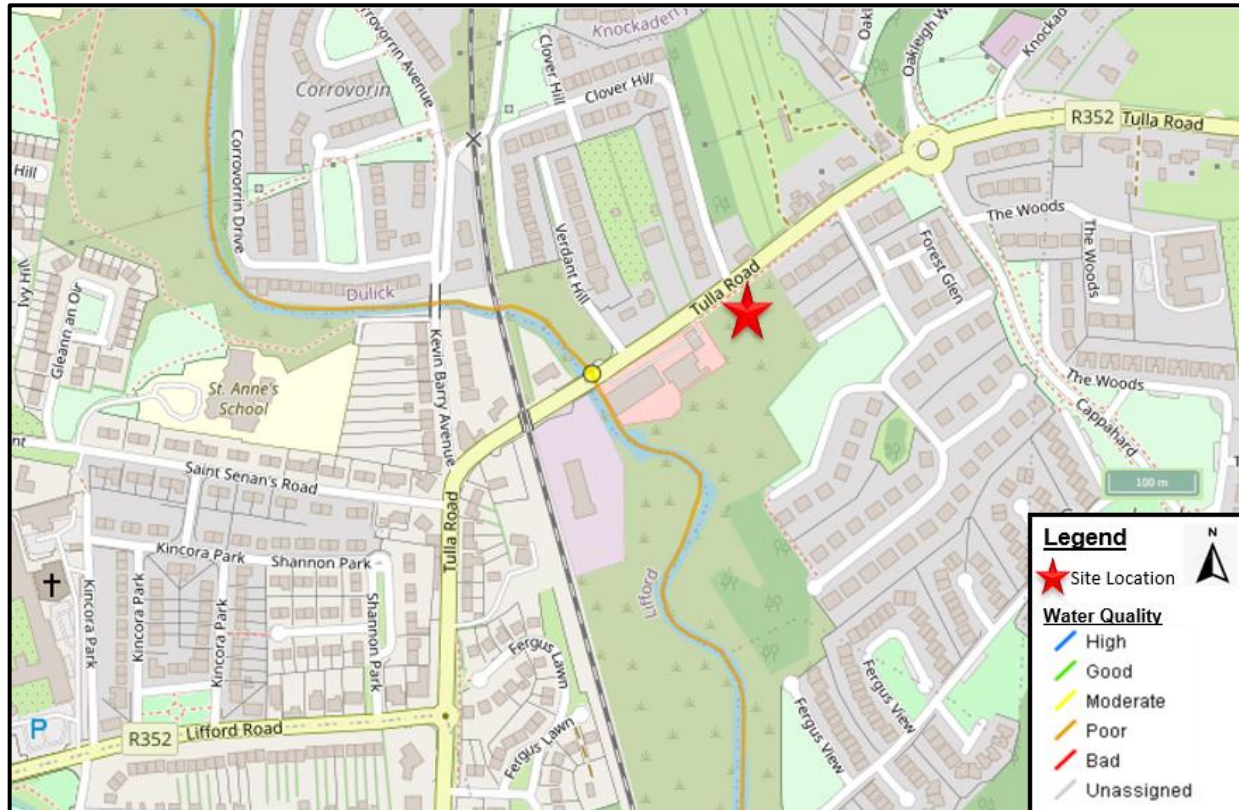
The development site is located in the Fergus subcatchment which in turn lies within the Shannon Estuary North catchment. It is located within Irish National Grid square R37, with hydrological connections to R36.

The Fort Fergus Stream flows south approximately 100m southwest of the site. This stream joins the River Fergus approx. 450m further south. The site and surrounds are drained by the Fort Fergus Stream and River Fergus which comprises part of the Lower River Shannon SAC.

The Fort Fergus Stream and River Fergus are classified as 'Poor' status under the Water Framework Directive 2013-2018 (EPA, 2019). In addition, water quality analysis in 2019, at



Corravarrin Bridge (Station Code RS27F100590) located adjacent to the development site scored a Q value of Q3-4 indicating Moderate 'slightly polluted' water (see Figure 2).



**Figure 2: Location of development site in relation to nearby watercourses and their waterbody status (Source EPA.ie).**

### 1.3 Desktop Review

The first step in undertaking a remedial Natura Impact Statement is the gathering of information on the how the development potentially impacted on the site, how it is impacting the existing environment and how the development site will be impacted in the future. A desktop review was performed to identify features of ecological importance within the development site and surrounding region. Additional information was sourced from a number of online sources which included:

- Clare County Council ([www.clarecoco.ie/services/planning](http://www.clarecoco.ie/services/planning));
- National Parks and Wildlife Service Maps & Databases ([www.npws.ie](http://www.npws.ie));
- National Biodiversity Data Centre (<https://maps.biodiversityireland.ie>);
- Environmental Protection Agency (EPA) Water Quality Data ([www.epa.ie](http://www.epa.ie));
- Water Framework Directive ([www.catchments.ie](http://www.catchments.ie)).

## 1.4 Field Survey

A site visit was carried out on the 10<sup>th</sup> November 2021. The purpose of the visit was:

- To identify potential pathways for pollutants to enter nearby watercourses;
- To identify habitats within and surrounding the development site.

## 1.5 Regulatory Context

The Council Directive 92/43/EEC (European Commission, 1992) on the Conservation of Natural Habitats and of Wild Fauna and Flora – Habitats Directive – provides a legal framework for the legal protection of habitats and species of European importance. Articles 3 to 9 of this Council Directive provides the legislative means to protect habitats and species of community interest through the establishment and conservation of an EU-wide network of sites known as Natura 2000. Natura 2000 sites are those identified as sites of community importance, namely Special Areas of Conservation (SACs), under the Habitats Directive or classified as Special Protection Areas (SPAs) under the Conservation of Wild Birds Directive (79/409/EEC).

Articles 6(3) and 6(4) of the Habitats Directive outlines the decision-making tests for projects/plans likely to affect Natura 2000 sites. Article 6(3) establishes the requirement for Appropriate Assessment:

*“Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site’s conservation objectives. In the light of the conclusions of the assessment of the implications for the site and subject to the provisions of paragraph 4, the competent National Authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site concerned and, if appropriate, after having obtained the opinion of the general public”.*

The European Commission “*Methodological Guidance on the provisions of Article 6(3) and 6(4) of the Habitats Directive 92/43/EEC* and the European Commission Guidance on “*Managing Natura 2000 Sites* promotes a four-stage process to complete the AA. Stages 1-2 deal with the main requirements for assessment under Article 6(3), namely, ‘Screening’ and ‘Natura Impact Statement’. Stage 3 may be part of Article 6(3) or may be a necessary precursor to Stage 4. Stage 4 is the main derogation step of Article 6(4). Article 6(4) of the Directive deals with alternative solutions, the test of “imperative reasons of overriding public interest” and compensatory measures.

Stage 3 and Stage 4 of the AA are carried out by the appropriate authority if deemed necessary in Stages 1 & 2.

Section 177T of the Planning and Development Act 2000 states the following with respect to meaning of a Natura Impact Statement:

(1) (b) A Natura Impact Statement means a statement, for the purposes of Article 6 of the Habitats Directive, of the implications of a proposed development, on its own or in combination with other plans or projects, for one or more than one European site, in view of the conservation objectives of the site or sites.

(2) Without prejudice to the generality of subsection (1), a Natura Impact Report or a Natura Impact Statement, as the case may be, shall include a report of a scientific examination of evidence and data, carried out by competent persons to identify and classify any implications for one or more than one European site in view of the conservation objectives of the site or sites.

Section 177G of the Planning and Development Act 2000 states the following with respect to required content of a remedial Natura Impact Statement:

(1) A remedial Natura Impact Statement shall contain the following:

(a) a statement of the significant effects, if any, on the relevant European site which have occurred or which are occurring or which can reasonably be expected to occur because the development the subject of the application for was carried out;

(b) details of—

(i) any appropriate remedial or mitigation measures undertaken or proposed to be undertaken by the applicant for Substitute Consent to remedy or mitigate any significant effects on the environment or on the European site;

(ii) the period of time within which any such proposed remedial or mitigation measures shall be carried out by or on behalf of the applicant;

(c) such information as may be prescribed under section 177N;

(d) and may have appended to it, where relevant, and where the applicant may wish to rely upon same:

(i) a statement of imperative reasons of overriding public interest;

(ii) any compensatory measures being proposed by the applicant.



## 2. Methodology

This assessment has been undertaken in accordance with the European Commission methodological guidance (European Commission, 2007).

In complying with the obligations under Article 6(3) and following the above guidelines, this assessment has been prepared using the following structure:

### **Stage 1: Screening**

Screening has been undertaken by Clare County Council and An Bord Pleanála. Site assessments and relevant literature reviews carried out by these authorities indicate that an rNIS is required to assess the impacts to the Natura 2000 sites potentially impacted by the development site.

Screening for AA examines the likely effects of a project or plan, alone and in combination with other projects or plans, upon a Natura 2000 site and considers whether it can be objectively concluded that these effects will not be significant. If it is determined during screening that the development may have a significant effect on a Natura 2000 site, then a NIS will need to be prepared. In addition, the precautionary principle must be observed and where there is any doubt as to whether there could be potential impacts on a Natura 2000 site it would be appropriate to proceed to Stage 2.

### **Stage 2: Appropriate Assessment (Natura Impact Statement)**

This includes:

- Description of the Natura 2000 site(s) which will be considered further in the assessment;
- Impact Prediction: description of significant impacts on the integrity of the Natura 2000 site(s) as defined by the conservation objectives and status of the site(s).;
- Recommendations and mitigation measures.

The Natura Impact Statement (NIS) in this particular case is retrospective in nature and is referred to as a remedial NIS. In accordance with Article 177(G) of the Planning and Development (Amendment) Act (2010), this rNIS contains a statement of significant effects, if any, which have occurred, are occurring or which can be reasonably expected to occur because of the development.

### 3. Description of the Project

#### 3.1 Description of the Proposed Development

The project relates to a Substitute Consent application for the infilling of land with hardcore material and associated works which have taken place at the development site (0.32ha site) since 1997. The development site is shown in Figure 3.



**Figure 3. Illustration showing the development site (in red) in relation to the larger area that was landfilled as part of the River Fergus Lower (Ennis) Certified Drainage Scheme (in green).**

On review of the relevant planning documents, it was observed that the development site was potentially filled with small quantities of imported material between 1997 to 2005 and again between 2013 to 2015 where the bulk of the inert material was imported.

Investigations have revealed that the development prior to the 2013 had mounds of material previously deposited throughout the site which were overgrown (see 2011 site photos in Appendix I, Plate A, B & C).

In circa 2013, the development site was cleared, levelled and additional hardcore material was imported and deposited within the site. These works have resulted in a difference in site levels between the development site and adjoining lands to the east. In 2015 the land was used as a temporary compound for improvements to a water supply scheme.

During these works between nearly the whole of the landholding (Area A and B combined) was filled with material imported onto the site (see Figure 4). The works which took place as part of the certified drainage scheme has led to the construction of a high berm forming a barrier between Fort Fergus Stream and the area infilled.



**Figure 4. Area B indicates location of drainage scheme works (extracted from Brendan Mc Grath & Associates letter dated 1st September 2017).**

Photos of the development site prior to infilling occurring (2011) and present-day site photos of development site are included in Appendix I.

### 3.2 Identification of Natura 2000 sites

A list of all Natura 2000 sites within a 15km radius of the development site located at Tulla Road, Knockanoura, Ennis, Co. Clare can be found in the table below. Any potential impacts associated with the development will be identified and any likely significant impacts will be assessed. Designated Natura 2000 sites within 15km of the development site and their distance to the site are shown in Table 1 and Figure 6 below.

**Table 1: Designated Natura 2000 sites within 15km of the site.**

Designated Site	Site Code	Distance and direction from retention development site
Lower River Shannon SAC	002165	Approx. 0.1 km southwest
Ballyallia Lake SAC	000014	Approx. 0.8 km north
Ballyallia Lough SPA	004041	Approx. 1.8 km north
River Shannon and River Fergus Estuaries SPA	004077	Approx. 4.3 km south
Newhall and Edenvale Complex SAC	002091	Approx. 4.5 km southwest
Pouladatig Cave SAC	000037	Approx. 5 km southwest
Dromore Woods and Loughs SAC	000032	Approx. 5 km north
Pouladatig Cave SAC	000037	Approx. 5.1 km southwest
Toonagh Estate SAC	002247	Approx. 5.2 km northwest
Ballycullinan, Old Domestic Building SAC	002246	Approx. 8.5 km northwest
Ballycullinan Lake SAC	000016	Approx. 8.7 km northwest
East Burren Complex SAC	001926	Approx. 9.1 km north
Old Domestic Buildings, Rylane SAC	002314	Approx. 9.3 km northeast
Slieve Aughty Mountains SPA	004168	Approx. 9.5 km northeast
Newgrove House SAC	002157	Approx. 9.6 km east
Corofin Wetlands SPA	004220	Approx. 10.5 km northwest
Moyree River System SAC	000057	Approx. 10.6 km northeast
Lough Gash Turlough SAC	000051	Approx. 11.2 km southeast
Ballyogan Lough SAC	000019	Approx. 11.2 km northeast

The development site is sufficiently distant from, and not hydrologically linked with the Ballyallia Lake SAC, Ballyallia Lough SPA, Newhall and Edenvale Complex SAC, Pouladatig Cave SAC, Dromore Woods and Loughs SAC, Pouladatig Cave SAC, Toonagh Estate SAC, Ballycullinan Lake SAC, East Burren Complex SAC, Old Domestic Building SAC, Ballycullinan Lake SAC, Old Domestic Buildings, Rylane SAC, Slieve Aughty Mountains SPA, Newgrove House SAC,

Corofin Wetlands SPA, Moyree River System SAC, Lough Gash Turlough SAC and Ballyogan Lough SAC. Therefore, it is highly unlikely that the development has impacted, is impacting or will impact upon their conservation objectives and so these sites has been screened out and will not be discussed further.

The Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA are considered to be the only Natura 2000 site of relevance in this assessment. Species within the SAC and SPA could have been potentially impacted by the unapproved and uncontrolled infilling operations that have taken place and which are still in place and may contribute to long term effects. Development of such projects usually creates potential for the generation of contaminated runoff. A list of the qualifying features of conservation interest for the two relevant Natura 2000 sites are shown in Table 2 below.

For full site synopsis and conservation objectives for the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA see Appendix II & III. Information pertaining to designated sites contained in the site synopses, including conservation objectives and other relevant information is available from the NPWS website ([www.npws.ie](http://www.npws.ie)).



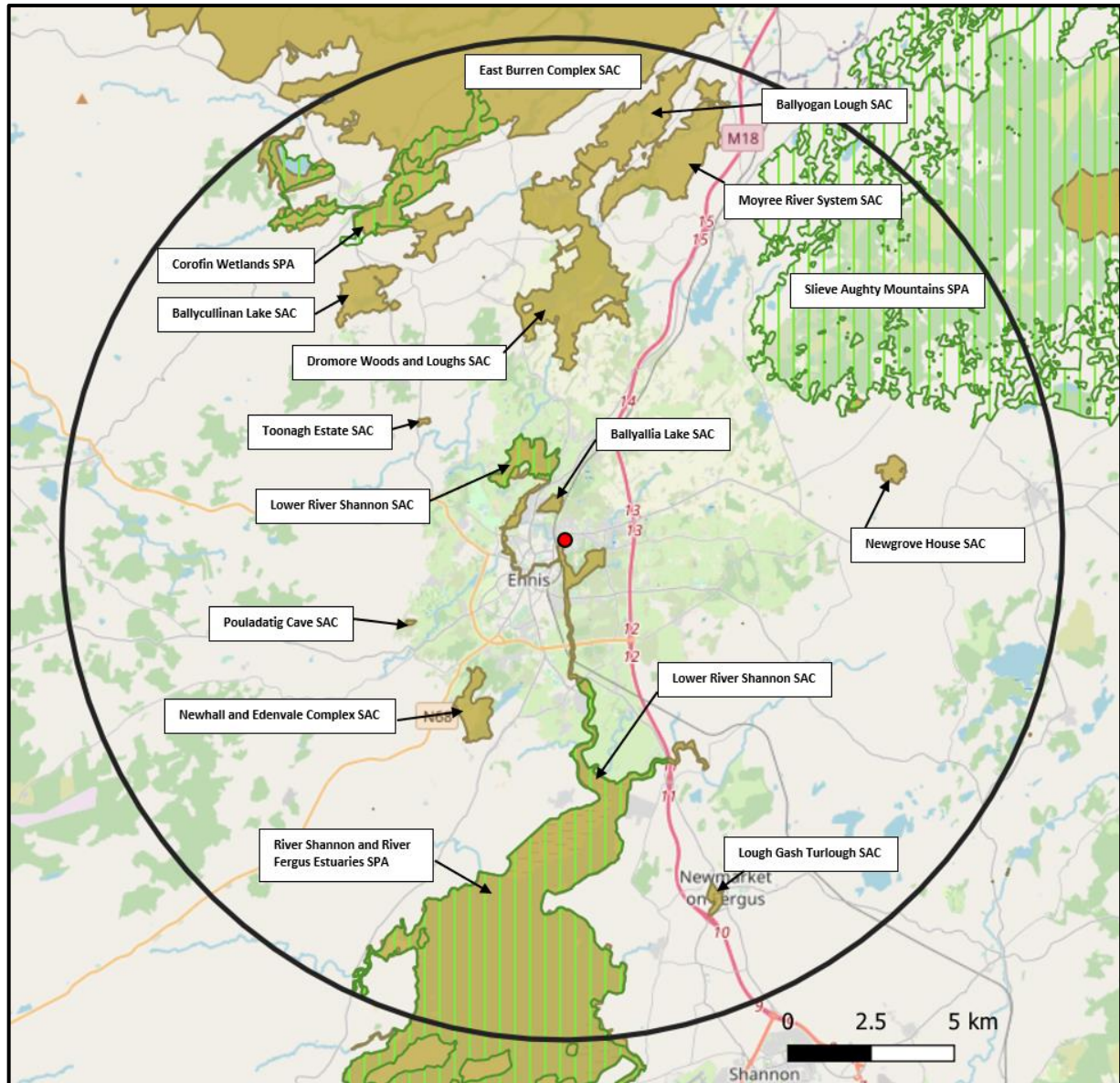


Figure 6: Natura 2000 sites (SAC- brown, SPA- green) located within a 15km radius of the proposed development site (red).

Table 2: Designated site with qualifying features of conservation interest.

Designated Site	Qualifying features of conservation interest
River Shannon SAC (002165)	<b>Habitats</b> [1110] Sandbanks [1130] Estuaries [1140] Tidal Mudflats and Sandflats [1150] Coastal Lagoons* [1160] Large Shallow Inlets and Bays [1170] Reefs [1220] Perennial Vegetation of Stony Banks [1230] Vegetated Sea Cliffs [1310] Salicornia Mud [1330] Atlantic Salt Meadows [1410] Mediterranean Salt Meadows [3260] Floating River Vegetation [6410] Molinia Meadows

Designated Site	Qualifying features of conservation interest
	[91E0] Alluvial Forests* <b>Species</b> [1029] Freshwater Pearl Mussel ( <i>Margaritifera margaritifera</i> ) [1095] Sea Lamprey ( <i>Petromyzon marinus</i> ) [1096] Brook Lamprey ( <i>Lampetra planeri</i> ) [1099] River Lamprey ( <i>Lampetra fluviatilis</i> ) [1106] Atlantic Salmon ( <i>Salmo salar</i> ) [1349] Bottle-nosed Dolphin ( <i>Tursiops truncatus</i> ) [1355] Otter ( <i>Lutra lutra</i> )
River Shannon and River Fergus Estuaries SPA (004077)	<b>Species</b> [A017] Cormorant ( <i>Phalacrocorax carbo</i> ) [A038] Whooper Swan ( <i>Cygnus cygnus</i> ) [A046] Light-bellied Brent Goose ( <i>Branta bernicla hrota</i> ) [A048] Shelduck ( <i>Tadorna tadorna</i> ) [A050] Wigeon ( <i>Anas Penelope</i> ) [A052] Teal ( <i>Anas crecca</i> ) [A054] Pintail ( <i>Anas acuta</i> ) [A056] Shoveler ( <i>Anas clypeata</i> ) [A062] Scaup ( <i>Aythya marila</i> ) [A137] Ringed Plover ( <i>Charadrius hiaticula</i> ) [A140] Golden Plover ( <i>Pluvialis apricaria</i> ) [A141] Grey Plover ( <i>Pluvialis squatarola</i> ) [A142] Lapwing ( <i>Vanellus vanellus</i> ) [A143] Knot ( <i>Calidris canutus</i> ) [A149] Dunlin ( <i>Calidris alpine</i> ) [A156] Black-tailed Godwit ( <i>Limosa limosa</i> ) [A157] Bar-tailed Godwit ( <i>Limosa lapponica</i> ) [A160] Curlew ( <i>Numenius arquata</i> ) [A162] Redshank ( <i>Tringa tetanus</i> ) A164 Greenshank ( <i>Tringa nebularia</i> ) [A179] Black-headed Gull ( <i>Chroicocephalus ridibundus</i> ) [A999] Wetlands

### 3.3 Conservation Objectives

According to the Habitat's Directive, the *conservation status of a natural habitat* will be taken as 'favourable' within its biogeographic range when:

- its natural range and areas it covers within that range are stable or increasing, and
- the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and
- the conservation status of its typical species is favourable as defined below.

According to the Habitat's Directive, the conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations. The conservation status will be taken as 'favourable' within its biogeographic range when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and

- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Conservation objectives for relevant Natura sites were considered, this together with other designated site information can be accessed at <http://www.npws.ie/protectedsites/>.

### 3.4 Natura 2000 Sites Potentially Impacted by the Development

The Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA are the only Natura 2000 sites considered to be potentially impacted by unauthorised infilling of the development site. The nearest point to the Lower River Shannon SAC is the Fort Fergus Stream which flows south, located approximately 100m southwest of the development site. The Fort Fergus Stream is located within the SAC and flows in a southerly direction before joining with the River Fergus approximately 450m south of the development site (see Figure 6). The area around the development site is relatively flat, however the gradient slopes gently towards the Fort Fergus Stream, therefore, a potential source-pathway-receptor linkage is present and significant impacts could arise for the SAC and SPA.

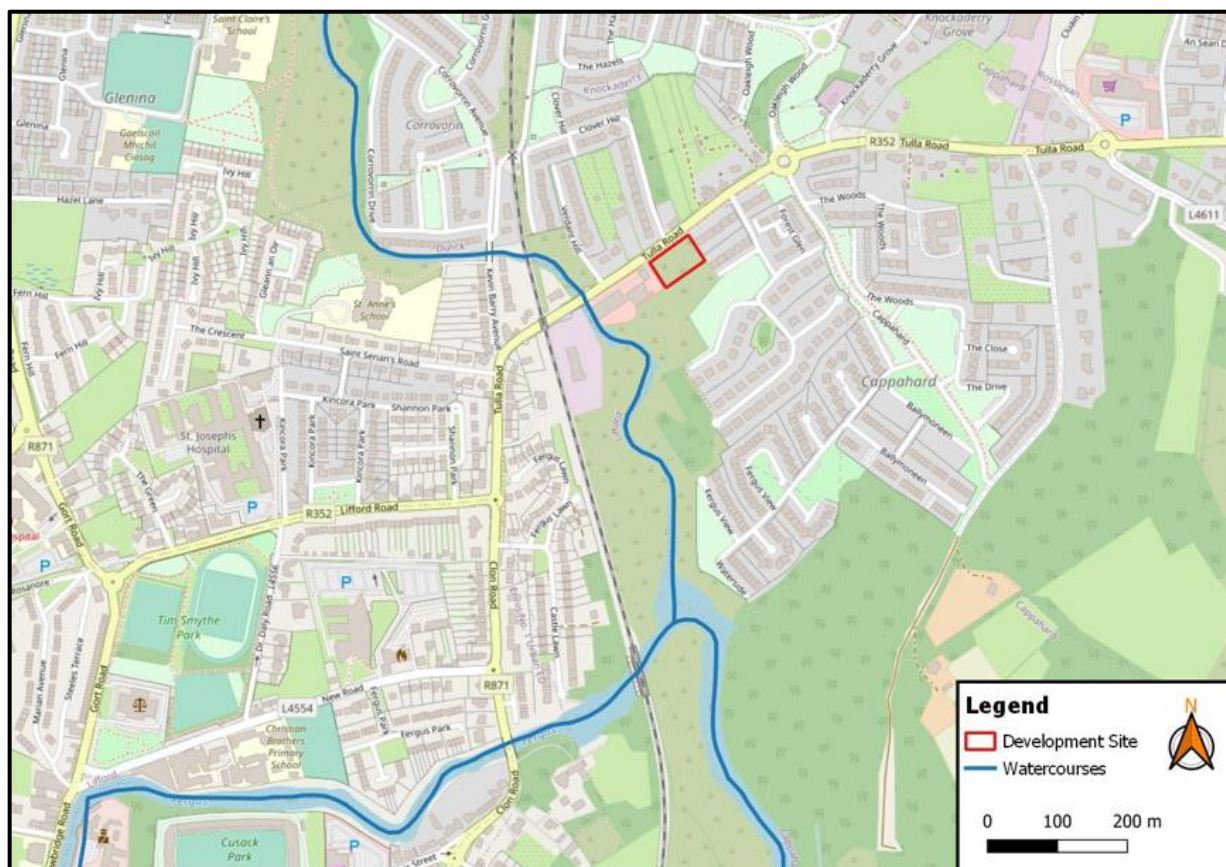


Figure 6. Map showing water courses in relation to the development site.



Associated species within the Fort Fergus Stream and the River Fergus downstream of the site could have been potentially impacted both previously and in the future by the above-mentioned development as the infilling phase of such projects creates potential for the generation of contaminated runoff from the site. Potential impacts associated with the development could arise from:

- Excavation works to facilitate infilling;
- Use of fuels/oils/chemicals during the infilling phase of the project;
- Use of construction equipment, vehicles, and plant;
- The risk of contaminated runoff during the infilling phase;
- The risk of accidental spillages of fuels/oils during the infilling phase;
- The risk of imported unapproved contaminated material;
- Cumulative impacts arising from discharges associated with the development site, the area infilled as part of the drainage scheme interacting with other sources of water pollution such as wastewater treatment discharges or agricultural runoff.

For full site synopsis for the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA see Appendix II & III.

## **4 Natura Impact Statement**

Section 2 above mentioned the methodology for the preparation of a Stage 2 AA (NIS). This section outlines the scope of the stage 2 process. This includes a description of the Natura 2000 sites and details potential impacts on significant habitats and species for which the sites have been designated

### **4.1 Background**

The potential for a plan/project, individually or in combination with other plans or projects, to adversely affect the integrity of European sites must be examined in accordance with Stage 2 of Appropriate Assessment if Stage 1 screening established that there could be potential impacts on a Natura 2000 site. The rNIS may require specific mitigation measures and/or monitoring and remediation for future impacts that will be implemented to ensure significant negative impacts on the integrity of European sites can be avoided. The aim of the assessment is to provide a sufficient level of information to the competent authority on which to base their Appropriate Assessment of the plan or project.

## 4.2 Scope of the Assessment

When Natura 2000 sites are selected for Stage 2 Appropriate Assessment (Natura Impact Statement), all the qualifying features of conservation interest must be included in that stage of the assessment. However, when assessing impact, qualifying features are only considered relevant where a credible source-pathway-receptor link exists between the development and a protected habitat or species. For significant effects to arise, there must be a risk enabled by having a 'source' (e.g., construction works at a proposed development site), a 'receptor' (e.g., a European site or its qualifying interests), and a pathway between the source and the receptor (e.g., a watercourse connecting a proposed development site to a European site). The identification of a pathway does not automatically mean that significant effects will arise. The likelihood for significant effects will depend upon the characteristics of the source (e.g., type and duration of construction works), the characteristics of the pathway (e.g., direct or indirect, water quality status of watercourse receiving run-off from construction) and the characteristics of the receptor (e.g., the sensitivities of the European site and its qualifying interests). The level and significance of the impact will depend upon the nature of the risk, the extent of the exposure to the risk and the characteristics of the receptor. Not all receptors will necessarily be within the zone of potential impact of the proposal. Also, with a rNIS there is the added need to consider what has occurred, is occurring as well as what might occur subsequently.

## 4.3 Description of the Natura 2000 Sites

The Lower River Shannon SAC (002165) and River Shannon and River Fergus Estuaries SPA (004077) are considered to be the only Natura 2000 sites of relevance in this assessment.

The Lower River Shannon SAC (002165) is of great ecological interest as it contains a large number of habitats and species listed on Annexes I and II of the E.U. Habitats Directive, including the priority habitats, lagoon and alluvial woodland, the only known resident population of Bottle-nosed Dolphin in Ireland and all three Irish lamprey species. Red Data Book species are also present, perhaps most notably the successful populations of Triangular Club-rush. A number of species listed on Annex I of the E.U. Birds Directive are also present, either wintering or breeding. Indeed, the Shannon and Fergus Estuaries form the largest estuarine complex in Ireland and support more wintering wildfowl and waders than any other site in the country. Most of the estuarine part of the SAC has been designated a Special Protection Area (SPA), under the E.U. Birds Directive, primarily to protect the large numbers of migratory birds present in winter (NPWS, 2013).



The River Shannon and River Fergus Estuaries SPA is described as an internationally important site that supports an assemblage of over 20,000 wintering waterbirds (NPWS, 2015). It holds internationally important populations of four species, i.e. Light-bellied Brent Goose, Dunlin, Black-tailed Godwit and Redshank. In addition, there are 17 species that have wintering populations of national importance. The site also supports a nationally important breeding population of Cormorant. Of particular note is that three of the species which occur regularly are listed on Annex I of the E.U. Birds Directive, i.e. Whooper Swan, Golden Plover and Bar-tailed Godwit. Parts of the River Shannon and River Fergus Estuaries SPA are Wildfowl Sanctuaries (NPWS, 2015).

Refer to Appendix II & III for full site synopsis. The qualifying features of the SAC & SPA are listed below in Table 3.

#### **4.4 Assessment of Potential Impacts on Natura 2000 sites**

This section of the rNIS assesses the potential past, present and future impacts in relation to their possible effect on the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA.

Infilling activities which took place on the development site had the potential to negatively affect water quality within the Fort Fergus Stream as well as downstream watercourses, namely the River Fergus, both located within the Lower River Shannon SAC (Site Code 002165).

A further investigation, using trial holes was to monitor ground water quality and assess the under the makeup of the imported material was undertaken. These results would indicate if leachate from the unauthorised fill material is impacting groundwater. If results indicate any impacts have occurred, are occurring, or could occur in the future, appropriate action can be considered by the relevant authority.

Based on reviews of available published distribution maps and data ([www.npws.ie](http://www.npws.ie) and [www.biodiversityireland.ie/](http://www.biodiversityireland.ie/)), Table 3 & 4 lists the potential direct and indirect impacts on the qualifying interests/features of the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. Table 5 lists the habitats and species which may potentially be directly or indirectly impacted by the development.

**Table 3: Potential impacts on the Lower Shannon SAC**

Qualifying Interest	Observations	Potential Direct/ In-situ Impacts	Potential Indirect/ Ex-situ Impacts
[1110] Sandbanks	As this habitat is not within the 10km grid squares R37 or R36 it is concluded that the historic development had no potential risk for negative impact to the quality of the habitat (NPWS, 2019a).	No	No
[1130] Estuaries	This habitat is located within the 10km grid square R37 & R36. However, there would have been no reduction in habitat area as a result of sediment silt or other pollutant input from the development (NPWS, 2019a).	No	No
[1140] Tidal Mudflats and Sandflats	As [1130] above	No	No
[1150] Coastal Lagoons*	As this habitat is not within the 10km grid squares R37 or R36 it is concluded that the historic development had no potential risk for negative impact to the quality of the habitat (NPWS, 2019a).	No	No
[1160] Large Shallow Inlets and Bays	As [1150] above	No	No
[1170] Reefs	As [1150] above	No	No
[1220] Perennial Vegetation of Stony Banks	As [1150] above	No	No
[1230] Vegetated Sea Cliffs	As [1150] above	No	No
[1310] Salicornia Mud	As [1150] above	No	No
[1330] Atlantic Salt Meadows	As this habitat is not within the 10km grid squares R37 or R36 it is concluded that the historic development had no potential risk for negative impact to the quality of the habitat (NPWS, 2019a).	No	No
[1410] Mediterranean Salt Meadows	As [1330] above	No	No
[3260] Floating River Vegetation	This habitat is within the 10km grid square R37 & R36. Therefore, there was potential for the historic development was a potential risk for negative impact to the quality of the habitat (NPWS, 2019a).	No	Yes
[6410] Molinia Meadows	As this habitat is not within the 10km grid squares R37 or R36 it is concluded that the historic development had no potential risk for negative impact to the quality of the habitat (NPWS, 2019a).	No	No
[91E0] Alluvial Forests*	As [6410] above	No	No
[1029] Freshwater Pearl Mussel ( <i>Margaritifera margaritifera</i> )	As this species is not found within the 10km grid squares R37 or R36 it is concluded that the historic development had no potential risk for negative impact to this specie(NPWS, 2019b).	No	No
[1095] Sea Lamprey ( <i>Petromyzon marinus</i> )	This species is found within the 10km grid square R37. Therefore, there was potential	No	Yes

Qualifying Interest	Observations	Potential Direct/ In-situ Impacts	Potential Indirect/ Ex-situ Impacts
	for the historic development to pose a risk to this species (NPWS, 2019b).		
[1096] Brook Lamprey ( <i>Lampetra planeri</i> )	As [1095] above	No	Yes
[1099] River Lamprey ( <i>Lampetra fluviatilis</i> )	As this species is not found within the 10km grid squares R37 or R36 it is concluded that the historic development had no potential risk for negative impact to this specie(NPWS, 2019b).	No	No
[1106] Atlantic Salmon ( <i>Salmo salar</i> )	This species is found within the 10km grid square R37. Therefore, there was potential for the historic development to pose a risk to this species (NPWS, 2019b).	No	Yes
[1349] Bottle-nosed Dolphin ( <i>Tursiops truncatus</i> )	As this species is not found within the 10km grid squares R37 or R36 it is concluded that the historic development had no potential risk for negative impact to this species (NPWS, 2019b).	No	No
[1355] Otter ( <i>Lutra lutra</i> )	This species is found within the 10km grid square R37. Therefore, there was potential for the historic development to pose a risk to this species (NPWS, 2019b).	No	Yes

**Table 4: Potential impacts on the River Shannon and River Fergus Estuaries SPA**

Qualifying Interest	Observations	Potential Direct/ In-situ Impacts	Potential Indirect/ Ex-situ Impacts
[A017] Cormorant ( <i>Phalacrocorax carbo</i> )	Forages and roosts in the vicinity of the development, so it is concluded that the development had a potential risk for negative impact to this species.	No	Yes
[A038] Whooper Swan ( <i>Cygnus cygnus</i> )	Winter migrant - does not forage or roost in the vicinity of the development, so it is concluded that the historic development had no potential risk for negative impact to this species	No	No
[A046] Light-bellied Brent Goose ( <i>Branta bernicla hrota</i> )	As [A038] above.	No	No
[A048] Shelduck ( <i>Tadorna tadorna</i> )	Does not forage or roost in the vicinity of the development, so it is concluded that the development had no potential risk for negative impact to this species.	No	Yes
[A050] Wigeon ( <i>Anas Penelope</i> )	Winter migrant - does not forage or roost in the vicinity of the development, so it is concluded that the development had no potential risk for negative impact to this species.	No	No
[A052] Teal ( <i>Anas crecca</i> )	As [A050] above	No	No
[A054] Pintail ( <i>Anas acuta</i> )	As [A050] above	No	No

Qualifying Interest	Observations	Potential Direct/ In-situ Impacts	Potential Indirect/ Ex-situ Impacts
[A056] Shoveler ( <i>Anas clypeata</i> )	As [A050] above	No	No
[A062] Scaup ( <i>Aythya marila</i> )	As [A050] above	No	No
[A137] Ringed Plover ( <i>Charadrius hiaticula</i> )	As [A050] above	No	No
[A140] Golden Plover ( <i>Pluvialis apricaria</i> )	As [A050] above	No	No
[A141] Grey Plover ( <i>Pluvialis squatarola</i> )	As [A140] above.	No	No
[A142] Lapwing ( <i>Vanellus vanellus</i> )	Forages and roosts in the vicinity of the historic development, so it is concluded that the development had a potential risk for negative impact to this species.	No	Yes
[A143] Knot ( <i>Calidris canutus</i> )	Winter migrant - does not forage or roost in the vicinity of the development, so it is concluded that the development had no potential risk for negative impact to this species.	No	No
[A149] Dunlin ( <i>Calidris alpina</i> )	As [A143] above.	No	No
[A156] Black-tailed Godwit ( <i>Limosa limosa</i> )	As [A143] above.	No	No
[A157] Bar-tailed Godwit ( <i>Limosa lapponica</i> )	As [A143] above.	No	No
[A160] Curlew ( <i>Numenius arquata</i> )	Forages and roosts in the vicinity of the historic development, so it is concluded that the historic development had a potential risk for negative impact to this species.	No	Yes
[A162] Redshank ( <i>Tringa tetanus</i> )	Winter migrant - does not forage or roost in the vicinity of the historic development, so it is concluded that the historic development had no potential risk for negative impact to this species.	No	No
A164 Greenshank ( <i>Tringa nebularia</i> )	As [A162] above.	No	No
[A179] Black-headed Gull ( <i>Chroicocephalus ridibundus</i> )	As [A162] above.	No	No
[A999] Wetlands	As the location of the development is c.4.5km upstream of the SPA it is concluded that the historic development did not pose a significant risk to the water quality of the marine/estuarine SPA	No	No

**Table 5: Qualifying Features of the SAC & SPA potentially impacted.**

Designated Site	Qualifying features of conservation interest potentially impacted
River Shannon SAC (002165)	<b>Habitats</b> [3260] Floating River Vegetation <b>Species</b>

Designated Site	Qualifying features of conservation interest potentially impacted
	[1095] Sea Lamprey ( <i>Petromyzon marinus</i> ) [1096] Brook Lamprey ( <i>Lampetra planeri</i> ) [1106] Atlantic Salmon ( <i>Salmo salar</i> ) [1355] Otter ( <i>Lutra lutra</i> )
River Shannon and River Fergus Estuaries SPA (004077)	<b>Species</b> [A017] Cormorant ( <i>Phalacrocorax carbo</i> ) [A142] Lapwing ( <i>Vanellus vanellus</i> ) [A160] Curlew ( <i>Numenius arquata</i> )

## 4.5 Descriptions of Habitats and Species where Significant Impacts may have Occurred or could Potentially Occur

The following subsections provide descriptions of the one habitat and seven species identified as being potentially impacted by the historic development.

### 4.5.1 Floating River Vegetation

The Joint Nature Conservation Committee UK (JNCC) characterise this habitat by the presence of river water-crowfoot (*Ranunculion fluitantis*) and water-starwort (*Callitricho-Batrachion*). Floating mats of these white-flowered species are characteristic of river channels in early to mid-summer. They may modify water flow, promote fine sediment deposition, and provide shelter and food for fish and invertebrates. The habitat can occur over a wide range of physical conditions, from acid, oligotrophic, flashy upland streams dominated by bryophytes to more eutrophic, slow flowing streams dominated by *Ranunculus* and *Callitriche* species (JNCC, 2021).

The main pressures and threats to this habitat are associated with diffuse pollution to surface water associated with agricultural and forestry activities. This habitat is found within the watercourses of the Lower Shannon SAC (NPWS, 2019a). Many vegetation communities within this habitat type are considered to be tolerant to moderate levels of pollution. The overall conservation status of this habitat is considered “*unfavourable inadequate*” due to pollution from agriculture and peatland drainage (NPWS, 2019a). The main problems for river habitats in Ireland are damage through eutrophication and other processes linked to water pollution, rather than direct habitat loss and destruction.

### 4.5.3 Brook lamprey (*Lampetra planeri*)

The brook lamprey (*Lampetra planeri* Bloch) is the smallest of the three lamprey taxonomic entities recorded in Ireland. The species is non-parasitic and non-migratory as an adult, living its entire life in freshwater. Adults spawn in spring, excavating shallow nests in relatively small sized gravels in areas of reduced flow. After hatching, the young ammocoetes drift or swim



downstream before encountering areas of riverbed with a fine silt composition. They burrow into this bed material and live as filter feeders over a period of years before transforming into young adult fish. The young adults overwinter before migrating short distances upstream to gravelled areas where they spawn. The adult fish die after spawning (King and Linnane, 2004).

Pollution to surface water, from diffuse and point sources, is a constant threat to all aquatic organisms. Both adult and ammocoete life stages for lamprey have been shown to be vulnerable to the effects of pollution in Irish systems. The brook lamprey spends much of its life cycle in river sediments. Changes in siltation patterns can significantly impact on lamprey habitat. Dredging and removal of sediments and allied river engineering works can lead to loss or removal of sediment that may already contain juvenile lamprey (Igoe et al., 2004). Such works can also lead to limited, or large-scale, re-alignment of channel features and are likely to be designed to provide a more laminar or streamlined flow. If lamprey ammocoete habitats are to form or be maintained, a channel must have a capacity to deposit fine sediment along its margins or into 'alcove' niches, frequently in the lee of some obstructing feature that is disturbing the flow (Igoe et al., 2004). Despite some concerns about the potential localised impacts of pollution and dredging, *Lampetra planeri* are widespread, with extensive areas of suitable habitat, and future prospects for this taxon must be seen, overall, as 'favourable' (NPWS, 2019b).

#### **4.5.4 Atlantic salmon (*Salmo salar*)**

The Atlantic salmon is an anadromous species spending its life both in freshwater and at sea. They use rivers to spawn and as nursery areas during their juvenile phase. As adults, they spend one to three years at sea before returning again to spawn. Eggs are deposited during the winter in river gravels where they develop, protected within the substrate and hatch in spring. Atlantic salmon go through a number of juvenile stages; alevins, fry, par and smolt. Smolts migrate to sea and develop into adults in 1 or 2 years before returning to freshwater to spawn (Marine Institute, 2020).

The River Fergus is a designated Salmonid River under the Quality of Salmonid Waters Regulations (S.I. 293/1988). The Atlantic salmon is a host to the larval stage of the Freshwater Pearl Mussel. These larvae, known as glochidia, attach to the gills of the fish and so the presence of sufficient salmonid fish is essential for the survival of the Freshwater Pearl Mussel (Moorkens, 1999). Salmonid spawning grounds may be significantly impacted by the increased growth of plants on the river substrate.

The main pressures and threats to the species are a decline in the number of high-status waters due to pollution with agricultural and municipal pollutants being the main culprits. There are also a number of factors causing mortality including legal and illegal fishing, predation by seals, diseases and parasites, marine pollution and climate change. The overall conservation status is considered “stable” due to an increasing trend in population (NPWS, 2019b).

#### **4.5.5 Otter (*Lutra lutra*)**

The main threats to otters in Ireland are habitat destruction through river and wetland drainage; water pollution particularly organic pollution resulting in fish kill; accidental death and illegal killing; and disturbance from recreational activities. The otter is listed on Annex II and Annex IV of the EU Habitats Directive (92/43/EEC). The species is widespread throughout Ireland and present in a wide variety of habitat types including all fresh-water and most coastal habitats. Overall, the otter is considered to be in a “favourable” conservation status (NPWS, 2019b).

#### **4.5.6 Cormorant (*Phalacrocorax carbo*)**

Cormorant in Ireland belong to a breeding and wintering population resident in north-west Europe. It is thought most of the breeding populations in Ireland are resident, although some have been recorded moving south for the winter. Cormorant wintering numbers have declined in Ireland over the last 40 years (Lewis, Burke and Tierney, 2019). The largest concentrations of wintering Cormorant in Ireland is within coastal bays, although the species is widespread inland too, particularly on the larger lakes and parts of the north midlands and west of the country where there are high densities of waterbodies with fish. Cormorant were recorded at 278 sites during the current period. It should be noted that the Shannon & Fergus Estuary site no longer supports numbers of national importance (Lewis, Burke and Tierney, 2019).

#### **4.5.7 Lapwing (*Vanellus vanellus*)**

Lapwing in Ireland are part of just one population which breeds across Europe and western Asia, and winters across Europe, Asia Minor, north Africa, south-west and central Asia and the Caspian coast. In Ireland and across its habitat Lapwing are in decline. Sites in Ireland which had large populations have seen a significant reduction in populations (Lewis, Burke and Tierney, 2019). The Shannon & Fergus Estuary is identified as a site supporting numbers of national importance.

#### **4.5.8 Curlew (*Numenius arquata*)**

Curlew in Ireland belong to a population which breeds in Europe and winters mainly in Europe and western Africa. However, this population is in decline. It is estimated that in Ireland the

breeding populations have declines by 96% in the last 30 years (Lewis, Burke and Tierney, 2019). Wintering populations have also declined but not at such an alarming rate. The Shannon & Fergus Estuary no longer supports numbers of national importance (Lewis, Burke and Tierney, 2019).

## 4.6 Assessment of Potentially Significant Impacts

Surface water run-off from the infilling of the development site could have been and has the potential to be a source of impact. Surface water run-off can be either direct or indirect. While the application site is not situated within the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA, it is located beside land that is adjacent to the Fort Fergus Stream which forms part of the Lower River Shannon SAC. This watercourse and surface water drain on the site could have potentially acted as a conduit for the transfer of silt, mud and fine sediments, and other potential pollutants from the site to the SAC and SPA.

Silt and sediment-laden surface water run-off has the potential to have had a negative impact on important and sensitive habitats and species that are found within the Shannon Estuary Catchment. There is also potential for material deposited on the site pre-infilling to cause a potentially negative impact in the form of leachate entering the groundwater as the source and make-up of this material is unknown. The potential impact from leachate was investigated by means of a trial hole assessment. The results of which indicate that material on the site is not contributing to a reduction in groundwater quality (see Appendix V for Trial Hole Assessment Report).

Silt and sediment-laden surface water may impact the Fort Fergus Stream which provides a hydrological pathway to the River Fergus and Fergus Estuary further downstream. Atlantic Salmon are an important species within the SAC Natura 2000 site. The main channel of the River Fergus has been designated under the S.I. No. 293/1988 - European Communities (Quality of Salmonid Waters) Regulations, 1988. Suspended sediment and changes in water chemistry could have had and could continue to have a potentially negative effect on internationally important species for which these watercourses are designated.

The streams and rivers of the Lower River Shannon SAC offer ideal habitat for the Otter (*Lutra lutra*). Potential effects on water quality within the SAC would have negatively impacted fish and other aquatic species which were and still are an important food resource for Otter. Maintaining water quality within otter habitats is essential to prevent a population decline.

The Annex II species listed as Qualifying Interests (QI) of the SAC, specifically salmon, lamprey species, and otter are sensitive to water pollution. Reduction in water quality through sedimentation can result in inhibition of respiration in aquatic organisms, particularly salmonids. The accidental release of toxic chemicals (including hydrocarbons) and materials (cement & concrete) into surface waters can directly poison fish and other aquatic organisms. Prolonged deterioration in water quality would impact food sources for the otter, as well as salmon and lamprey.

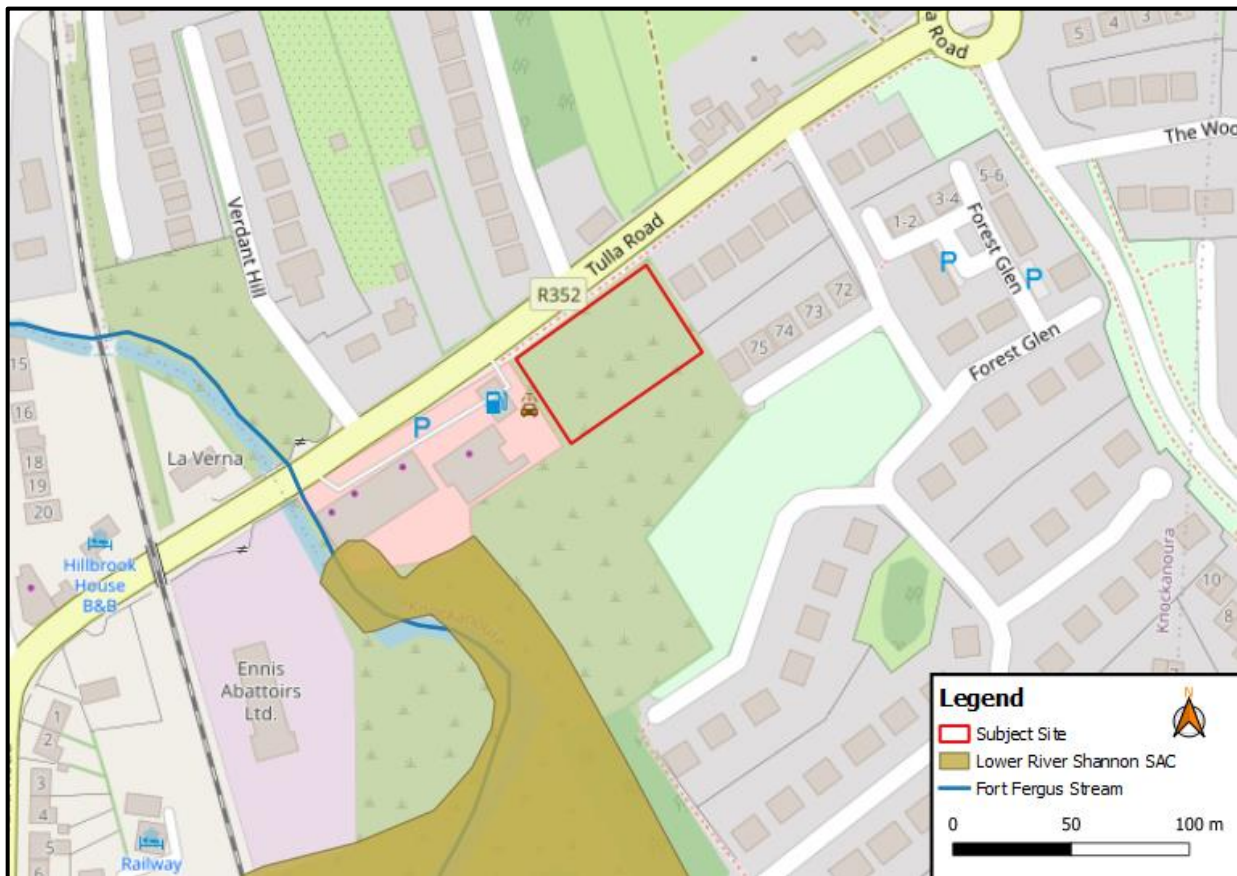


Figure 5. Location of the development site in relation to the Lower River Shannon SAC.

## 4.7 Assessment of Significance

The development site is not located within the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. However, the Fort Fergus Stream, a component part of the SAC is located within 100 metres of the development site. Therefore direct, indirect and cumulative impacts cannot be ruled out. This stream discharges to the River Fergus to the south of the development site. The River Fergus is an important habitat for a number of fish species including Atlantic Salmon (*Salmo salar*), Brook Lamprey (*Lampetra planeri*) and Sea Lamprey

(*Petromyzon marinus*), all Annex II species. The River Fergus flows south where it converges with the River Shannon.

Direct impacts are those which can cause physical impacts and disturbance to the SAC or SPA through on-site development. Indirect impacts are those impacts that are not a direct result but occur away from the original source of impact or as a result of a complex pathway. Cumulative impacts are those which arise from incremental changes caused by other past, present or reasonably foreseeable actions together with the proposed development.

#### **4.7.1 Contaminated surface water run-off**

Potential impacts on the water quality with the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA may occur through run-off of silt and suspended sediment through surface water pathways and potentially via groundwater pathways. The site visit confirmed that there was no surface water run-off.

Direct surface water run-off from the site to the Fort Fergus Stream is considered unlikely to have occurred, is occurring, or likely to occur in the future due to the infilling works due to the separation distance. In addition, the construction of a berm as part of the River Fergus (Ennis) Certified Drainage Scheme separates the infilled site from the SAC and stream.

Indirect impacts on the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA through run-off into the Fort Fergus Stream may have occurred, are occurring or could occur in the future due to previous operations on-site. This is however considered unlikely having regard to the nature of the works which took place and discussed above. Furthermore, there is a lack of evidence of a hydraulic connection between the development site and the Fort Fergus Stream. Therefore, it is considered unlikely that potential indirect impacts occurred, are occurring or could occur in the future, on the SAC and SPA. In addition, the results of groundwater analysis which took place on the proposed development site in January 2022 have indicated that previously infilled material is not negatively impacting on groundwater in the area.

Also, potential impacts on the conservation interests of the SAC and SPA are deemed unlikely to have occurred, are occurring at present or are likely to occur based on the water quality of the associated watercourse during infilling activities, potentially from 1997-2005 and 2013-2015. Water quality appears to have been stable at poor/moderate quality prior to infilling activities occurring (see Table 5).



The conservation objective for Atlantic Salmon in freshwater is Q4 for the Lower River Shannon SAC (NPWS, 2012), this is currently not being met (see Table 5). The 2<sup>nd</sup> River Basin Management Plan, published in 2018, has identified 190 'priority areas for action'. The Shallee sub-catchment, within the wider Fergus catchment in on this list (DHPLG, 2018). This action plan and the upgrade to the Ennis municipal wastewater treatment plant (completed at the end of 2017), could potentially have a positive impact water quality in the Fort Fergus Stream. It can be seen from Table 5 that the Q value of the Fort Fergus Stream in 2019 has increased from Q3 to Q3-4.

**Table 5: Water quality within the Fort Fergus Stream (1990-2019)**

<b>EPA monitoring station Corravarrin Br Station ID RS27F100590</b>	<b>Q value</b>
1991	Q3
1996	Q3
1998	Q2-3
2001	Q3
2005	Q3
2007	Q3
2010	Q3
2013	Q3
2016	Q3
2019	Q3-4

(Source [www.gis.epa.ie/EPAMaps/Water](http://www.gis.epa.ie/EPAMaps/Water))

#### **4.7.2 Impacts due to Importation of Material**

There was potential for impacts on water quality, especially to groundwater due to the importation of unauthorised material onto the site. In addition, the make up of the imported material was not known and this could potentially cause environmental impacts to the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. To investigate these potential impacts a trial hole assessment was carried out on the development site.

During unauthorised infilling activities there was also potential for fuel / oil spills from machinery used onsite during infilling. During the site visit there were no obvious oil spills observed, however due to the time that has passed this would not be uncommon. To investigate the potential for impacts due to hydrocarbons a ground water sample was taken from each trial hole during the assessment.

The results for the Trial Hole Assessment indicate that there is little or no waste of an extraneous nature, no traces of putrescible or degradable waste. Also, Methane was not detected at any level at each trial hole. Furthermore, analysis of the groundwater in each of the trial holes for a wide range of parameters covered by the groundwater regulations were found to be safely below the limit values imposed (see Appendix V for Trial Hole Assessment Report).

It is therefore unlikely that the imported material or related activities had or is having a negative impact on the Qualifying Interests of the SAC or SPA.

### **4.7.3 Cumulative impacts**

EPA datasets for water quality within the Fort Fergus Stream indicate that the water was of 'Poor' or 'Moderate' quality during the period 1991 – 2019. The Q-value assigned to the Fort Fergus Stream over this period remained low (Q2 & predominately Q3), however the last monitoring event has increased the Q-value Q3-4, indicating moderate water quality (see Table 5). Water quality in the Fort Fergus Stream and River Fergus have been impacted by urban wastewater treatment plants, urban run-off and changes to the hydromorphological characteristics of watercourses due to the installation of flood defences (EPA, 2021). There is limited potential for the development site to contribute to cumulative impacts on water quality within the Fort Fergus Stream and further downstream. Infilling activities in combination with wastewater treatment plants, urban run-off in the area have the potential to cumulatively increase sedimentation and pollution within drains and open water courses. However, it is considered unlikely that negative cumulative impacts on water quality due to the development site have occurred for the reasons outlined above in section 4.7.1. Surrounding landuse activities are regulated where appropriate and such regulation should act to control the quality and volume of any discharges from these sites.

## **4.8 Mitigation / Remediation Measures**

This is a remedial Natura Impact Statement; therefore, mitigation measures may not be appropriate as the unauthorised infilling has already been completed. It may therefore be more relevant to recommend monitoring measures to identify if previous unauthorised activities on the site will lead to future impacts which may affect the integrity of the adjacent Natura 2000 sites. These monitoring measures could be used to inform if remediation or future mitigation measures are required.

- A monitoring programme for noxious weeds and invasive species on the site that may be dormant or suppressed by recent weed control.

## 5. Conclusion

The preparation of this remedial Natura Impact Statement as part of the Appropriate Assessment process was based on the information available to Southern Scientific Services Ltd. at the time of drafting. In particular, there was limited information available on the development site or the infilling operations that could be used to inform the assessment of potential impacts of the development on relevant Natura 2000 sites

The development site is not located within a Natura 2000 site. However, it is located within 100m of the Lower River Shannon SAC (002165) and 4.3km north of the River Shannon and River Fergus Estuaries SPA (004077). The most likely impacts were assessed to be on the adjacent SAC. These were considered to arise from the potential for silt, other sediment and pollutants to enter the Fort Fergus Stream, which forms part of the SAC.

Any silt or other sediments potentially released from the infilling of the development site would have been intercepted by the large, infilled area and berm created as part of River Fergus Lower (Ennis) Certified Drainage Scheme. It was therefore concluded that any significant impact on the Natura 2000 sites from inert infilling material in the form of silt or other sediments was unlikely to have taken place, to currently be happening or to arise in the future.

Assessment of EPA water quality monitoring has indicated that surface waters adjacent to the development site are of 'Moderate' status and based on data going back to 1991 have also been of poor/moderate status in the past. Having regard to the current and past water quality status of these surface waters, it would appear that no significant impacts have occurred to affect the quality status of the Fort Fergus River. This evidence suggests that there has not been any significant negative impact arising from the development to date.

It can be reasonably concluded from the assessment that was carried out that the development has not had an adverse impact on relevant adjacent Natura 2000 sites.

Furthermore, results from the Trial Hole Assessment which was undertaken by Southern Scientific Services Ltd, has indicated that there was little or no waste of an extraneous nature, no traces of putrescible or degradable waste deposited on the development site. Methane was

not detected at any level at each trial hole. In addition, regarding groundwater analysis, a wide range of parameters covered by the groundwater regulations were found to be safely below the limit values imposed.

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## Appendix I – Site Photos

Historic site and present-day photographs of development site.



**Plate A: View of eastern end of road frontage of development site from the R352 Tulla Road in March 2011 (Google Maps Street View).**



**Plate B: View of western end of road frontage of development site from R352 Tulla Road in March 2011 (Google Maps Street View).**





**Plate C: Satellite image (c.2011) of development site and area to the southwest, infilled as part of the drainage scheme.**



**Plate D: View of the development site (Facing southwest).**





**Plate E: View of area to the south west of the development site infilled as part of the drainage scheme.**



**Plate F: Flood defense berm constructed in 2013 on southern boundary of the area infilled as part of the drainage scheme adjacent to the Fort Fergus Stream.**





**Plate G: View of area infilled as part of the drainage scheme to the southwest of the development site adjacent to the flood defense berm.**

## Appendix II

### Site Name: Lower River Shannon SAC

### Site Code: 002165

This very large site stretches along the Shannon valley from Killaloe in Co. Clare to Loop Head/Kerry Head, a distance of some 120 km. The site thus encompasses the Shannon, Feale, Mulkear and Fergus estuaries, the freshwater lower reaches of the River Shannon (between Killaloe and Limerick), the freshwater stretches of much of the Feale and Mulkear catchments and the marine area between Loop Head and Kerry Head. Rivers within the sub-catchment of the Feale include the Galey, Smearlagh, Oolagh, Allaughaun, Owveg, Clydagh, Caher, Breanagh and Glenacarne. Rivers within the sub-catchment of the Mulkear include the Killeenagarriff, Annagh, Newport, the Dead River, the Bilboa, Glashacloonaraveela, Gortnageragh and Cahernahallia.

The site is a Special Area of Conservation (SAC) selected for the following habitats and/or species listed on Annex I / II of the E.U. Habitats Directive (\* = priority; numbers in brackets are Natura 2000 codes):

- [1110] Sandbanks
- [1130] Estuaries
- [1140] Tidal Mudflats and Sandflats
- [1150] Coastal Lagoons\*
- [1160] Large Shallow Inlets and Bays
- [1170] Reefs
- [1220] Perennial Vegetation of Stony Banks
- [1230] Vegetated Sea Cliffs
- [1310] Salicornia Mud
- [1330] Atlantic Salt Meadows
- [1410] Mediterranean Salt Meadows
- [3260] Floating River Vegetation
- [6410] Molinia Meadows
- [91E0] Alluvial Forests\*
- [1029] Freshwater Pearl Mussel (*Margaritifera margaritifera*)
- [1095] Sea Lamprey (*Petromyzon marinus*)
- [1096] Brook Lamprey (*Lampetra planeri*)
- [1099] River Lamprey (*Lampetra fluviatilis*)
- [1106] Atlantic Salmon (*Salmo salar*)
- [1349] Bottle-nosed Dolphin (*Tursiops truncatus*)
- [1355] Otter (*Lutra lutra*)

The Shannon and Fergus Rivers flow through Carboniferous limestone as far as Foynes, but west of Foynes Namurian shales and flagstones predominate (except at Kerry Head, which is formed from Old Red Sandstone). The eastern sections of the Feale catchment flow through Namurian rocks and the western stretches through Carboniferous limestone. The Mulkear flows through Lower Palaeozoic rocks in the upper reaches before passing through Namurian rocks, followed by Lower Carboniferous shales and Carboniferous limestone. The Mulkear River itself, immediately north of Pallas Green, passes through an area of Rhyolites, Tuffs and Agglomerates.

The Shannon and Fergus Estuaries form the largest estuarine complex in Ireland. They form a unit stretching from the upper tidal limits of the Shannon and Fergus Rivers to the mouth of the



Shannon Estuary (considered to be a line across the narrow strait between Kilcredaun Point and Kilconly Point). Within this main unit there are several tributaries with their own 'sub-estuaries' e.g. the Deel River, Mulkear River, and Mague River. To the west of Foynes, a number of small estuaries form indentations in the predominantly hard coastline, namely Poulnasherry Bay, Ballylongford Bay, Clonderalaw Bay and the Feale or Cashen River estuary. Both the Fergus and inner Shannon Estuaries feature vast expanses of intertidal mudflats, often fringed with saltmarsh vegetation. The smaller estuaries also feature mudflats, but have their own unique characteristics, e.g. Poulnasherry Bay is stony and unusually rich in species and biotopes. Plant species are typically scarce on the mudflats, although there are some eelgrass (*Zostera* spp.) beds and patches of green algae (e.g. *Ulva* sp. and *Enteromorpha* sp.). The main macro-invertebrate community which has been noted from the inner Shannon and Fergus estuaries is a *MacomaScrobicularia-Nereis* community. In the transition zone between mudflats and saltmarsh, specialised colonisers of mud predominate. For example, swards of Common Cord-grass (*Spartina anglica*) frequently occur in the upper parts of the estuaries. Less common are swards of Glasswort (*Salicornia europaea* agg.). In the innermost parts of the estuaries, the tidal channels or creeks are fringed with species such as Common Reed (*Phragmites australis*) and club-rushes (*Scirpus maritimus*, *S. tabernaemontani* and *S. triquetrus*). In addition to the nationally rare Triangular Club-rush (*Scirpus triquetrus*), two scarce species are found in some of these creeks (e.g. Ballinacurra Creek): Lesser Bulrush (*Typha angustifolia*) and Summer Snowflake (*Leucojum aestivum*). Saltmarsh vegetation frequently fringes the mudflats. Over twenty areas of estuarine saltmarsh have been identified within the site, the most important of which are around the Fergus estuary and at Ringmoyle Quay. The dominant type of saltmarsh present is Atlantic salt meadow occurring over mud. Characteristic species occurring include Common Saltmarsh grass (*Puccinellia maritima*), Sea Aster (*Aster tripolium*), Thrift (*Armeria maritima*), Sea-milkwort (*Glaux maritima*), Sea Plantain (*Plantago maritima*), Red Fescue (*Festuca rubra*), Creeping Bent (*Agrostis stolonifera*), Saltmarsh Rush (*Juncus gerardi*), Long-bracted Sedge (*Carex extensa*), Lesser Sea-spurrey (*Spergularia marina*) and Sea Arrowgrass (*Triglochin maritima*). Areas of Mediterranean salt meadows, characterised by clumps of Sea Rush (*Juncus maritimus*) occur occasionally. Two scarce species are found on saltmarshes in the vicinity of the Fergus estuary: a type of robust saltmarsh-grass (*Puccinellia foucaudii*), sometimes placed within the species Common Saltmarsh grass (*P. maritima*) and Hard-grass (*Parapholis strigosa*).

Saltmarsh vegetation also occurs around a number of lagoons within the site, two of which have been surveyed as part of a National Inventory of Lagoons. Cloonconeen Pool (4-5 ha) is a natural sedimentary lagoon impounded by a low cobble barrier. Seawater enters by percolation through the barrier and by overwash. This lagoon represents a type which may be unique to Ireland since the substrate is composed almost entirely of peat. The adjacent shore features one of the best examples of a drowned forest in Ireland. Aquatic vegetation in the lagoon includes typical species such as Beaked Tasselweed (*Ruppia maritima*) and green algae (*Cladophora* sp.). The fauna is not diverse, but is typical of a high salinity lagoon and includes six lagoon specialists (*Hydrobia ventrosa*, *Cerastoderma glaucum*, *Lekanesphaera hookeri*, *Palaemonetes varians*, *Sigara stagnalis* and *Enochrus bicolor*). In contrast, Shannon Airport Lagoon (2 ha) is an artificial saline lake with an artificial barrier and sluiced outlet. However, it supports two Red Data Book species of stonewort (*Chara canescens* and *Chara cf. connivens*).

Most of the site west of Kilcredaun Point/Kilconly Point is bounded by high rocky sea cliffs. The cliffs in the outer part of the site are sparsely vegetated with lichens, Red Fescue, Sea Beet (*Beta vulgaris* subsp. *maritima*), Sea Campion (*Silene vulgaris* subsp. *maritima*), Thrift and plantains (*Plantago* spp.). A rare endemic type of sealavender, *Limonium recurvum* subsp. *pseudotranswallianum*, occurs on cliffs near Loop Head. Cliff-top vegetation usually consists of either grassland or maritime heath. The boulder clay cliffs further up the estuary tend to be more densely vegetated, with swards of Red Fescue and species such as Kidney Vetch (*Anthyllis vulneraria*) and Common Bird's-foot-trefoil (*Lotus corniculatus*). The site supports an excellent

example of a large shallow inlet and bay. Littoral sediment communities in the mouth of the Shannon Estuary occur in areas that are exposed to wave action and also in areas extremely sheltered from wave action. Characteristically, exposed sediment communities are composed of coarse sand and have a sparse fauna. Species richness increases as conditions become more sheltered. All shores in the site have a zone of sand hoppers at the top, and below this each of the shores has different characteristic species giving a range of different shore types. The intertidal reefs in the Shannon Estuary are exposed or moderately exposed to wave action and subject to moderate tidal streams. Known sites are steeply sloping and show a good zonation down the shore. Well developed lichen zones and littoral reef communities offering a high species richness in the sublittoral fringe and strong populations of the Purple Sea Urchin *Paracentrotus lividus* are found. The communities found are tolerant to sand scour and tidal streams. The infralittoral reefs range from sloping platforms with some vertical steps, to ridged bedrock with gullies of sand between the ridges, to ridged bedrock with boulders or a mixture of cobbles, gravel and sand. Kelp is very common to about 18 m. Below this it becomes rare and the community is characterised by coralline crusts and red foliose algae.

Other coastal habitats that occur within the site include stony beaches and bedrock shores (these support a typical zonation of seaweeds such as *Fucus* spp., *Ascophyllum nodosum* and kelps), shingle beaches (with species such as Sea Beet, Sea Mayweed - *Matricaria maritima*, Sea Campion and Curled Dock - *Rumex crispus*), sandbanks which are slightly covered by sea water at all times (e.g. in the area from Kerry Head to Beal Head) and sand dunes (a small area occurs at Beal Point, where Marram – *Ammophila arenaria* is the dominant species). Freshwater rivers have been included in the site, most notably the Feale and Mulkear catchments, the Shannon from Killaloe to Limerick (along with some of its tributaries, including a short stretch of the Kilmastulla River), the Fergus up as far as Ennis, and the Cloon River. These systems are very different in character: the Shannon is broad, generally slow flowing and naturally eutrophic; the Fergus is smaller and alkaline; while the narrow, fast flowing Cloon is acid in nature. The Feale and Mulkear catchments exhibit all the aspects of a river from source to mouth.

Semi-natural habitats, such as wet grassland, wet woodland and marsh occur by the rivers, but improved grassland is the most common habitat type. One grassland type of particular conservation significance, *Molinia* meadows, occurs in several parts of the site and the examples at Worldsend on the River Shannon are especially noteworthy. Here are found areas of wet meadow dominated by rushes (*Juncus* spp.) and sedges (*Carex* spp.), and supporting a diverse and species-rich vegetation, including such uncommon species as Blue-eyed Grass (*Sisyrinchium bermudiana*) and Pale Sedge (*C. pallescens*). Floating river vegetation characterised by species of water-crowfoot (*Ranunculus* spp.), pondweeds (*Potamogeton* spp.) and the moss *Fontinalis antipyretica* are present throughout the major river systems within the site. The rivers contain an interesting bryoflora with *Schistidium alpicola* var. *alpicola* recorded from in-stream boulders on the Bilboa, new to Co. Limerick. Alluvial woodland occurs on the banks of the Shannon and on islands in the vicinity of the University of Limerick. The woodland is up to 50 m wide on the banks and somewhat wider on the largest island. The most prominent woodland type is gallery woodland where White Willow (*Salix alba*) dominates the tree layer with occasional Alder (*Alnus glutinosa*). The shrub layer consists of various willow species with Rusty Willow (*Salix cinerea* ssp. *oleifolia*) and what appear to be hybrids of *S. alba* x *S. viminalis*. The herbaceous layer consists of tall perennial herbs. A fringe of bulrush (*Typha* sp.) occurs on the river side of the woodland. On slightly higher ground above the wet woodland and on the raised embankment remnants of mixed oak-ash/alders woodland occur. These are poorly developed and contain numerous exotic species but locally there are signs that it is invading open grassland. Alder is the principal tree species, with occasional Pedunculate Oak (*Quercus robur*), elm (*Ulmus glabra* and *U. procera*), Hazel (*Corylus avellana*), Hawthorn (*Crataegus monogyna*) and the shrubs Guelder-rose (*Viburnum opulus*) and willows. The ground flora is species-rich. While woodland is infrequent within the site, however Cahiracon Wood contains a strip of old oak woodland. Sessile Oak (*Q. petraea*) forms the canopy, with an understorey of

Hazel and Holly (*Ilex aquifolium*). Great Wood-rush (*Luzula sylvatica*) dominates the ground flora. Less common species present include Great Horsetail (*Equisetum telmateia*) and Pendulous Sedge (*Carex pendula*).

In the low hills to the south of the Slievefelim Mountains, the Cahernahallia River cuts a valley through the Upper Silurian rocks. For approximately 2 km south of Cappagh Bridge at Knockanavar, the valley sides are wooded. The woodland consists of birch (*Betula* spp.), Hazel, oak, Rowan (*Sorbus aucuparia*), some Ash (*Fraxinus excelsior*) and willow (*Salix* spp.). Most of the valley is not grazed by stock, and as a result the trees are regenerating well. The ground flora features prominent Great wood-rush and Bilberry (*Vaccinium myrtillus*), along with a typical range of

woodland herbs. Bracken (*Pteridium aquilinum*) is a feature in areas where there is more light available. The valley sides of the Bilboa and Gortnageragh Rivers, on higher ground north-east of Cappamore, support patches of semi natural broadleaf woodland dominated by Ash, Hazel, oak and birch. There is a good scrub layer with Hawthorn, willow, Holly and Blackthorn (*Prunus spinosa*) common. The herb layer in these woodlands is often open, with a typically rich mixture of woodland herbs and ferns. Moss species diversity is high. The woodlands are ungrazed. The Hazel is actively coppiced in places. There is a small area of actively regenerating cut-away raised bog at Ballyrroheen. It is situated approximately 5 km north-west of Cappamore in Co. Limerick. The bog contains some wet areas with good cover of bog mosses (*Sphagnum* spp.). Species of particular interest include Cranberry (*Vaccinium oxycoccos*) and White Sedge (*Carex curta*), along with two regionally rare mosses, including the bog moss *S. fimbriatum*. The site is being invaded by Downy Birch (*Betula pubescens*) scrub woodland. Both commercial forestry and the spread of Rhododendron (*Rhododendron ponticum*) has greatly reduced the overall value of the site.

A number of plant species that are listed in the Irish Red Data Book occur within the site, and several of these are protected under the Flora (Protection) Order, 1999. These include Triangular Club-rush (*Scirpus triquetrus*), a species which is only found in Ireland only in the Shannon Estuary, where it borders creeks in the inner estuary.

Opposite-leaved Pondweed (*Groenlandia densa*) is found in the Shannon where it passes through Limerick City, while Meadow Barley (*Hordeum secalinum*) is abundant in saltmarshes at Ringmoylan and Mantlehill. Hairy Violet (*Viola hirta*) occurs in the Askeaton/Foynes area. Golden Dock (*Rumex maritimus*) is noted as occurring in the River Fergus estuary. Finally, Bearded Stonewort (*Chara canescens*), a brackish water specialist, and Convergent Stonewort (*Chara connivens*) are both found in Shannon Airport Lagoon.

Overall, the Shannon and Fergus Estuaries support the largest numbers of wintering waterfowl in Ireland. The highest count in 1995-96 was 51,423 while in 1994-95 it was 62,701. Species listed on Annex I of the E.U. Birds Directive which contributed to these totals include: Great Northern Diver (3; 1994/95), Whooper Swan (201; 1995/96), Pale-bellied Brent Goose (246; 1995/96), Golden Plover (11,067; 1994/95) and Bartailed Godwit (476; 1995/96). In the past, three separate flocks of Greenland Whitefronted Goose were regularly found, but none were seen in 1993/94. Other wintering waders and wildfowl present include Greylag Goose (216; 1995/96), Shelduck (1,060; 1995/96), Wigeon (5,976; 1995/96), Teal (2,319; 1995-96), Mallard (528; 1995/96), Pintail (45; 1995/96), Shoveler (84; 1995/96), Tufted Duck (272; 1995/96), Scaup (121; 1995/96), Ringed Plover (240; 1995/96), Grey Plover (750; 1995/96), Lapwing (24,581; 1995/96), Knot (800; 1995/96), Dunlin (20,100; 1995/96), Snipe (719; 1995/96), Black-tailed Godwit (1,062; 1995/96), Curlew (1,504; 1995/96), Redshank (3,228; 1995/96), Greenshank (36; 1995/96) and Turnstone (107; 1995/96). A number of wintering gulls are also present, including Black-headed Gull (2,216; 1995/96), Common Gull (366; 1995/96) and Lesser Black-backed Gull (100; 1994/95).

This is the most important coastal site in Ireland for a number of the waders including Lapwing, Dunlin, Snipe and Redshank. It also provides an important staging ground for species such as Black-tailed Godwit and Greenshank. A number of species listed on Annex I of the E.U. Birds Directive breed within the site. These include Peregrine Falcon (2-3 pairs), Sandwich Tern (34 pairs on Rat Island, 1995), Common Tern (15 pairs: 2 on Sturamus Island and 13 on Rat Island, 1995), Chough (14-41 pairs, 1992) and Kingfisher. Other breeding birds of note include Kittiwake (690 pairs at Loop Head, 1987) and Guillemot (4,010 individuals at Loop Head, 1987).

There is a resident population of Bottle-nosed Dolphin in the Shannon Estuary. This is the only known resident population of this E.U. Habitats Directive Annex II species in Ireland. The population is estimated (in 2006) to be  $140 \pm 12$  individuals. Otter, a species also listed on Annex II of this Directive, is commonly found on the site. Five species of fish listed on Annex II of the E.U. Habitats Directive are found within the site. These are Sea Lamprey (*Petromyzon marinus*), Brook Lamprey (*Lampetra planeri*), River Lamprey (*Lampetra fluviatilis*), Twaite Shad (*Allosa fallax fallax*) and Salmon (*Salmo salar*). The three lampreys and Salmon have all been observed spawning in the lower Shannon or its tributaries. The Fergus is important in its lower reaches for spring salmon, while the Mulkear catchment excels as a grilse fishery, though spring fish are caught on the actual Mulkear River. The Feale is important for both types. Twaite Shad is not thought to spawn within the site. There are few other river systems in Ireland which contain all three species of lamprey. Two additional fish species of note, listed in the Irish Red Data Book, also occur, namely Smelt (*Osmerus eperlanus*) and Pollan (*Coregonus autumnalis pollan*). Only the former has been observed spawning in the Shannon. Freshwater Pearl Mussel (*Margaritifera margaritifera*), a species listed on Annex II of the E.U. Habitats Directive, occurs abundantly in parts of the Cloon River. There is a wide range of land uses within the site. The most common use of the terrestrial parts is grazing by cattle, and some areas have been damaged through over-grazing and poaching. Much of the land adjacent to the rivers and estuaries has been improved or reclaimed and is protected by embankments (especially along the Fergus estuary). Further, reclamation continues to pose a threat, as do flood relief works (e.g. dredging of rivers). Gravel extraction poses a major threat on the Feale.

In the past, cord-grass (*Spartina* sp.) was planted to assist in land reclamation. This has spread widely, and may oust less vigorous colonisers of mud and may also reduce the area of mudflat available to feeding birds. Domestic and industrial wastes are discharged into the Shannon, but water quality is generally satisfactory, except in the upper estuary where it reflects the sewage load from Limerick City. Analyses for trace metals suggest a relatively clean estuary with no influences of industrial discharges apparent. Further industrial development along the Shannon and water polluting operations are potential threats. Fishing is a main tourist attraction on the Shannon and there are a large number of angler associations, some with a number of beats. Fishing stands and styles have been erected in places. The River Feale is a designated Salmonid Water under the E.U. Freshwater Fish Directive. Other uses of the site include commercial angling, oyster farming, boating (including dolphin-watching trips) and shooting. Some of these may pose threats to the birds and dolphins through disturbance. Specific threats to the dolphins include underwater acoustic disturbance, entanglement in fishing gear and collisions with fast moving craft. This site is of great ecological interest as it contains a high number of habitats and species listed on Annexes I and II of the E.U. Habitats Directive, including the priority habitats lagoon and alluvial woodland, the only known resident population of Bottle-nosed Dolphin in Ireland and all three Irish lamprey species. A good number of Red Data Book species are also present, perhaps most notably the thriving populations of Triangular Club-rush. A number of species listed on Annex I of the E.U. Birds Directive are also present, either wintering or breeding. Indeed, the

Shannon and Fergus Estuaries form the largest estuarine complex in Ireland and support more wintering wildfowl and waders than any other site in the country. Most of the estuarine part of

the site has been designated a Special Protection Area (SPA), under the E.U. Birds Directive, primarily to protect the large numbers of migratory birds present in winter.

## Appendix III

### **SITE NAME: RIVER SHANNON AND RIVER FERGUS ESTUARIES SPA**

#### **SITE CODE: 004077**

The estuaries of the River Shannon and River Fergus form the largest estuarine complex in Ireland. The site comprises the entire estuarine habitat from Limerick City westwards as far as Doonaha in Co. Clare and Dooneen Point in Co. Kerry.

The site has vast expanses of intertidal flats which contain a diverse macroinvertebrate community, e.g. *Macoma-Scrobicularia-Nereis*, which provides a rich food resource for the wintering birds. Salt marsh vegetation frequently fringes the mudflats and this provides important high tide roost areas for the wintering birds.

Elsewhere in the site the shoreline comprises stony or shingle beaches. The site is a Special Protection Area (SPA) under the E.U. Birds Directive, of special conservation interest for the following species: Cormorant, Whooper Swan, Lightbellied Brent Goose, Shelduck, Wigeon, Teal, Pintail, Shoveler, Scaup, Ringed Plover, Golden Plover, Grey Plover, Lapwing, Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit, Curlew, Redshank, Greenshank and Black-headed Gull. It is also of special conservation interest for holding an assemblage of over 20,000 wintering waterbirds.

The E.U. Birds Directive pays particular attention to wetlands and, as these form part of this SPA, the site and its associated waterbirds are of special conservation interest for Wetland & Waterbirds. The site is the most important coastal wetland site in the country and regularly supports in excess of 50,000 wintering waterfowl (57,133 - five year mean for the period 1995/96 to 1999/2000), a concentration easily of international importance. The site has internationally important populations of Light-bellied Brent Goose (494), Dunlin (15,131), Black-tailed Godwit (2,035) and Redshank (2,645). A further 17 species have populations of national importance, i.e. Cormorant (245), Whooper Swan (118), Shelduck (1,025), Wigeon (3,761), Teal (2,260), Pintail (62), Shoveler (107), Scaup (102), Ringed Plover (223), Golden Plover (5,664), Grey Plover (558), Lapwing (15,126), Knot (2,015), Bar-tailed Godwit (460), Curlew (2,396), Greenshank (61) and Black-headed Gull (2,681) - figures are five year mean peak counts for the period 1995/96 to 1999/2000. The site is among the most important in the country for several of these species, notably Dunlin (13 % of national total), Lapwing (6% of national total) and Redshank (9% of national total). The site also supports a nationally important breeding population of Cormorant (93 pairs in 2010). Other species that occur include Mute Swan (103), Mallard (441), Red-breasted Merganser (20), Great Crested Grebe (50), Grey Heron (38), Oystercatcher (551), Turnstone (124) and Common Gull (445) - figures are five year mean peak counts for the period 1995/96 to 1999/2000. Apart from the wintering birds, large numbers of some species also pass through the site whilst on migration in spring and/or autumn. The River Shannon and River Fergus Estuaries SPA is an internationally important site that supports an assemblage of over 20,000 wintering waterbirds. It holds internationally important populations of four species, i.e. Light-bellied Brent Goose, Dunlin, Black-tailed Godwit and Redshank. In addition, there are 17 species that have wintering populations of national importance.

The site also supports a nationally important breeding population of Cormorant. Of particular note is that three of the species which occur regularly are listed on Annex I of the E.U. Birds Directive, i.e. Whooper Swan, Golden Plover and Bar-tailed Godwit. Parts of the River Shannon and River Fergus Estuaries SPA are Wildfowl Sanctuaries.



## Appendix IV - Synopsis of Remedial NIS Report

<p><b>Description of Project</b></p>	<p>HRA Planning Consultants on behalf of Valley Healthcare Fund intend to apply to An Bord Pleanala for Substitute Consent for infilling works carried out at Tulla Road, Knockanoura, Ennis, Co. Clare. The development is situated within 100m of the Lower River Shannon SAC.</p>
<p><b>Description of Natura 2000 site</b></p>	<p>The Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA are sites of great ecological interest. They are of special conservation interest for several Annex listed priority habitats and species of the EU Habitats Directive and EU Birds Directive.</p>
<p><b>Description of Individual Elements of the Project likely to give rise to Impacts on the Natura 2000 Site</b></p>	<p>There are a number of potential elements which may have already, are currently and are likely to give rise to Impacts on the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA during the infilling phase. These include:</p> <ul style="list-style-type: none"> <li>• Runoff of sediment from the development site to adjacent watercourses from unapproved as well as any approved infilling materials;</li> <li>• Runoff of nutrients from the development site to adjacent watercourses from unapproved as well as any approved infilling materials.</li> </ul>
<p><b>Description of Likely Direct, Indirect or Secondary Impacts of the Project on the Natura site</b></p>	<p>The development site is not located within the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. Therefore, there will be no direct impacts to habitats or species for which the SAC or SPA has been designated. However, there was and is potential for indirect impacts (in the absence of mitigation measures) to the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA, in the form of the potential negative impact on the water quality within the Fort Fergus Stream and River Fergus which has, is</p>


	<p>having and in future could have an impact on the Annex II species such as the Otter, Salmon, Brook Lamprey and certain designated habitats.</p>
<p><b>Description of changes to the development site arising as a result of:</b></p> <ul style="list-style-type: none"> <li>• <b>Reduction of habitat area</b></li> <li>• <b>Disturbance to key species</b></li> <li>• <b>Habitat or species fragmentation</b></li> <li>• <b>Reduction in species density</b></li> <li>• <b>Changes in key indicators of conservation value</b></li> </ul>	<p>The following are a description of changes to the development site arising from:</p> <ul style="list-style-type: none"> <li>• <b>Reduction of habitat area</b> – there has been a reduction of habitat area over the footprint of the development site. The development site is now covered with hardcore material and has low ecological value due to infilling with material;</li> <li>• <b>Disturbance to key species</b> – No key species were identified within the development site due to infilling. Prior to infilling the site may have supported key species;</li> <li>• <b>Habitat or species fragmentation</b> – Due to the unauthorised infilling on the development site it is unknown if habitat or species fragmentation resulted from the project, however the development site was not designated for any species;</li> <li>• <b>Reduction in species density</b> – There could potentially have been a reduction in species density due to the infilling of the development site;</li> <li>• <b>Changes in key indicators of conservation value</b> – It is unknown if there was a change to key indicators of conservation value due to the unauthorised infilling of the development site.</li> </ul>
<p><b>Description of impacts on the Natura 2000 site as a whole in terms of:</b></p> <ul style="list-style-type: none"> <li>• <b>Interference with key relationships that define the structure of the site</b></li> <li>• <b>Interferences with key relationships that define the function of the site</b></li> </ul>	<p>In general, the infilling operation associated with the development site had the potential to result in the following impacts:</p> <ul style="list-style-type: none"> <li>• Surface water run-off of sediments/fines to watercourses;</li> <li>• Ingress of fuels or oils to watercourses;</li> <li>• Species disturbance/displacement impacts.</li> </ul> <p>However, the risk of these impacts having occurred, occurring now or in the future is considered limited by virtue of the intervening distances and flood defense berm which occur between the project site and the Lower River Shannon SAC and River Shannon and River Fergus Estuaries SPA. The flood</p>

	<p>defence berm which separates the development site from the SAC would have, continues to and will in future mitigate against the the potential impact of the infilling activities on Natura 2000 site to negligible levels.</p>
<p><b>Indicators of Significance as a result of the identification of effects set out above in terms of:</b></p> <ul style="list-style-type: none"> <li>• <b>Loss</b></li> <li>• <b>Fragmentation</b></li> <li>• <b>Disruption</b></li> <li>• <b>Disturbance</b></li> <li>• <b>Change to Key Elements of the site (e.g. water quality etc)</b></li> </ul>	<p>The following points indicate why significant effects are unlikely to have occurred, are occurring or are unlikely to occur in the future in relation to the project:</p> <ul style="list-style-type: none"> <li>• There is no spatial overlap between the proposed works and any Natura 2000 site.</li> <li>• Significant water quality effects, habitat loss or alteration, species disturbance or displacement or habitat/species fragmentation are unlikely to have occurred, are occurring or are unlikely to occur in the future with mitigation measures in place;</li> <li>• Significant cumulative/in-combination effects through interaction between the proposal and other plans, projects and activities are unlikely to have occurred, are occurring or are unlikely to occur in the future.</li> <li>• It has been objectively concluded that significant effects on any Natura 2000 sites, focused in particular on those within 15km of the development site, arising as a result of the project, either individually or in combination with other plans or projects, are unlikely to have occurred, are occurring or are unlikely to occur in the future.</li> </ul>

## Appendix V – Trial Hole Assessment Report

<p style="text-align: center;"><b>Trial Hole Assessment</b> <b>Application for Substitute Consent for proposed</b> <b>development on Tulla Road, Ennis, Co. Clare</b></p>
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<b>Requested By:</b>	Valley Healthcare Fund - Infrastructure Investment Fund ICAV
<b>Prepared By:</b>	Michael Murphy Southern Scientific Services Ltd
<b>Date Reported:</b>	25/02/2022
<b>Our Reference:</b>	21P-305

<b>Report Prepared By</b>	Michael Murphy	
<b>Issue Date:</b>	25/02/2022	
<b>Comment:</b>	Final Report to Client	
<b>Revision:</b>	00	

## Introduction

The purpose of the trial hole assessment is to determine if waste material is present in the material underground and to give an estimation of proportion and also to categorise the soil component of the waste in one of three categories, inert, stable non-reactive, or hazardous in accordance with the waste acceptance criteria directive 1999/31/EU and accompanying regulations.

## Site description

The site is relatively flat, with a slight elevation 0.75m over the developed ground, a residential area, to the east, but roughly at the same level as the developed lands to the west, along the Tulla Rd. The ground is made up of deposited materials mainly inert material such as soil, stone, gravel and boulders. A surface drain at the eastern edge of the site runs along the circumference of the site towards the Fergus channel. The drain is approximately 0.75m-1m deep, below existing ground level. It was dry on the day of observation 14<sup>th</sup> January 2022. It was populated by mature vegetation of wetland species, predominantly soft rush and some iris. There is no evidence that this surface water drain is connected to the Fort Fergus Stream adjacent to the site.

The site itself is free draining, with no signs of ponding, or saturation. Vegetation types confirm the free draining nature of the soil. Trial hole data confirms this, with much evidence of stone, gravel and boulders rather than heavy clays.

Groundwater was observed at 2.8-3.4metres below existing ground level, within the interface of the made-up ground and the original native ground. Trial hole evidence indicates that the original native ground was not well drained and there is evidence in the level of peat in trial holes 3,4, and 5 to suggest that the virgin ground was saturated for much of the time. Groundwater direction of flow is inevitably towards the Fergus channel. Groundwater flow is slow by virtue of the flat terrain, the proximity to the tidal Fergus channel, and the general topography of the region within and outside the town being prone to long periods of saturation to ground surface in the native terrain.



## **Trial Hole Assessment**

Five trial holes were excavated on-site on the 14<sup>th</sup> January 2022. The location of the trial holes on-site is presented in Figure 1 below. The trial hole locations were selected to best represent the size and shape of the site. Trial holes were excavated to approximately 6 metres, and approximately 2 m x 4 m in surface dimension. During each 1 metre of depth, the excavated material was set aside of the trial hole as a discrete sample pile. See Appendix I for site photographs and Appendix II for Trial Hole Logs. The material was examined visually for evidence of waste materials glass, ceramics, bricks, blocks, asbestos rope or insulation, plastic, metals, fabrics, cardboard, degradable waste, electrical devices, and any other extraneous objects or signs that could be construed as waste in the meaning of the term defined in regulations. A soil description was made using standard procedures, e.g soil structure, texture, colour, compaction, mottling, bedding planes, water ingress etc. All observations and measurements were entered in a trial hole log. The trial hole log is presented in appendix Y. At each 1 metre depth, a methane gas measurement was taken using a methane gas monitoring measuring down to 10ppm. Once the soil observations and characterisations were completed and recorded, the soil piles were mixed initially using the bucket of the excavator. Coning and quartering was used to reduce the size of the pile to a quantity that could be managed with a hand tool. Further coning and quartering was carried out until a 5kg sample was isolated. This sample was transferred to a plastic bag for transport to the laboratory. This procedure was repeated for each of the 5 trial holes. A total of 25 samples were collected at the site.



Figure 1. Location of 5 trial holes on site.

## Laboratory analysis

Further coning and quartering occurred in the laboratory to reduce each sample size to about 2kg. A portion of each sample was placed in large flat trays for air drying over two to three days in a convection oven at 40°C. The remainder of the sample was retained. Dried samples were sieved through a 2mm sieve to exclude gravel. WAC analysis was performed as prescribed directive 1999/31/EU known as the Waste Acceptance Criteria (WAC). The analytical method for analysis of metals in soil/sediment that is best suited to the guide values for the Waste Acceptance Criteria (WAC) is the water based leaching method, BS EN 12457-3.

Methodologies for other test parameters are as follows:

- (a) PAH/PCB/TBT/DBT/Pesticides: adopted from EPA methods 1699,3550 and 8270; GCMSMS
- (b) Pesticides: (MCPA/acid herbicides) UHP LCMSMS adopted from USEPA 8318, 8321A and 8321B.
- (c) Solvents: GCMS Headspace based on USEPA 624

(d) TOC/TN/TIC (i) TOC analysis in liquid samples by Standard Methods for the examination of water and wastewater, APHA, 2021; TC/TIC/ TN analysis by Leco elemental analyser.

(e) Organic matter: Furnace gravimetric method.

## Discussion of Results

All 25 samples were analysed for the 58 tests that make up the WAC criteria (see Appendix III) for deciding on whether to categorise soil as **inert**, **stable non-reactive** or **hazardous**. The limits of the WAC directive are shown in tables 1 and 2 below. For the convenience of viewing, the data at a glance all of the data is presented in Tables 3 to 7 which show test parameters in column 1 on the left-hand side, sample identifications (e.g TR1.1 is trial hole 1 sample depth 0-1m below ground level). Columns on the right-hand side show the WAC limit values, where green shading represents the inert limits, yellow shading represents the stable non-reactive limits, and red represents the non-hazardous limits. The central body of the excel sheet shows the individual data values, where those shaded in green are those within the inert limit, those shaded on yellow within the stable non-reactive limit and those shaded in red represent those within the hazardous limit.

**Table 1 Metal in soil concentration guide values based on WAC Directive and determined by BS EN 12457-parts 1-3.**

**Metals, inorganic elements and ions and organics in Eluate expressed as mg/kg from a 10:1 eluate preparation of the soil/sediment with water as per EN 12457-part 2**

Parameter	Inert waste	Stable Non-reactive hazardous waste	Hazardous Waste
Arsenic,As	0.5	2	25
Barium,Ba	20	100	300
Cadmium,Cd	0.04	1	5
Chromium,Cr	0.5	10	70
Copper,Cu	2	50	100
Mercury,Hg	0.01	0.2	2
Molybdenum,Mo	0.5	10	30
Nickel,Ni	0.4	10	40
Lead,Pb	0.5	10	50
Antimony,Sb	0.06	0.7	5
Selenium,Se	0.1	0.5	7
Zinc, Zn	4	50	200
Chloride,Cl	800	15000	25000
Fluoride,F	10	150	500
Sulphate as SO4	1000	20000	50000
Total dissolved solids (TDS)	4000	60000	100000
Phenol Index	1	-	-

Parameter	Inert waste	Stable Non-reactive hazardous waste	Hazardous Waste
Dissolved Organic Carbon (DOC)	500	800	1000

**Table 2. Substances that characterise soils/sediment/waste as inert or otherwise based on direct analysis. Concentration guide values based on WAC Directive.**

Parameter	Inert as per WAC	Stable non-reactive hazardous as per WAC	Hazardous waste as per WAC	Dutch Intervention value
Total Organic Carbon, w/w %	3	5	6	-
Loss on ignition %	-	-	10	-
Benzene, Xylene, Toluene, Ethylbenzene; BTEX mg/kg	6	-	-	Benzene 1.1 Ethylbenzene 110 Toluene 320 Xylenes 17
Polychlorinated Byphenyls (7 congeners) mg/kg	1	-	-	1
Mineral oils (C10-C40) mg/kg	500	-	-	5000
Polyaromatic hydrocarbons (14-16 congeners) mg/kg	100	-	-	40
pH	-	>6	-	
Acid neutralisation capacity, pH4, mol/kg	-	To be evaluated	To be evaluated	
Acid neutralisation capacity, pH 7, mol/kg	-	To be evaluated	To be evaluated	
Organotin pesticides TBT, DBT mg/kg	-	-	-	2.4
MCPA pesticide, mg/kg	-	-	-	4
Organochlorines mg/kg	-	-	-	Chlordane 4 DDT 1.7 DDE 2.3 DDD 34 Aldrin 0.32 Drins Sum 4 Endosulphan 4 Alpha HCH 17 Beta HCH 1.6 Lindane 1.2 Heptachlor 4

Parameter	Inert as per WAC	Stable non-reactive hazardous as per WAC	Hazardous waste as per WAC	Dutch Intervention value
				Heptachlor epoxide 4
Triazine pesticides,mg/kg	-	-	-	Atrazine 7.1
Carbamate pesticides mg/kg	-	-	-	Carbaryl 0.45 Carbofuran 0.017

**Table 3. Test Parameters for Trial Hole 1**

	Job Number	22-16786									
	Sample ID	53382	53383	53384	53385	53386	53387	53388	53389	53390	53391
	Client Sample Reference	TRH 1.1 - 0.1m	TRH 1.1 - 0.1m	TRH 1.2 - 1-2m	TRH 1.2 - 1-2m	TRH 1.3 - 2-3m	TRH 1.3 - 2-3m	TRH 1.4 - 3.4m	TRH 1.4 - 3.4m	TRH 1.5 - 4-5m	TRH 1.5 - 4-5m
	Matirix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10
Antimony	mg/Kg d.w		< 0.01		< 0.01		0.01		0.02		0.02
Arsenic	mg/Kg d.w		0.02		0.01		0.02		0.04		0.03
Barium (Ba)	mg/Kg d.w		0.66		0.08		0.26		0.20		0.21
Benzene	mg/Kg d.w	< 0.02		< 0.02		< 0.02		< 0.02		< 0.02	
Cadmium	mg/Kg d.w		< 0.005		< 0.005		< 0.005		< 0.005		< 0.005
Chloride	mg/Kg d.w		28.1		25.5		7.8		17.6		30.3
Chromium	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Copper	mg/Kg d.w		0.14		0.04		0.06		0.08		0.17
Dissolved Organic Carbon (DOC)	mg/Kg d.w		114.0		84.8		48.8		94.2		157.4
Ethylbenzene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	
Fluoride	mg/Kg d.w		2.8		2.5		2.1		2.0		2.1
Lead	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Mercury	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Mineral Oil (C10-C40)	mg/Kg d.w	186		91		104		79		< 20	
Molybdenum (Mo)	mg/Kg d.w		0.05		0.02		0.01		0.02		0.07
Nickel	mg/Kg d.w		0.02		< 0.01		< 0.01		0.01		0.02
PCB BZ #101	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #118	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #138	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #153	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #180	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #28	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #52	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
Phenol Index	mg/Kg d.w		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0
Selenium	mg/Kg d.w		0.02		< 0.01		< 0.01		< 0.01		0.02
Sulphate	mg/Kg d.w		117.7		100.7		2441.0		243.6		189.4
Total BTEX	mg/Kg d.w	< 0.13		< 0.13		< 0.13		< 0.13		< 0.13	
Total Dissolved Solids (TDS)	mg/Kg d.w		800.0		630.0		2820.0		730.0		950.0



	Job Number	22-16786									
	Sample ID	53382	53383	53384	53385	53386	53387	53388	53389	53390	53391
	Client Sample Reference	TRH 1.1 - 0.1m	TRH 1.1 - 0.1m	TRH 1.2 - 1-2m	TRH 1.2 - 1-2m	TRH 1.3 - 2-3m	TRH 1.3 - 2-3m	TRH 1.4 - 3.4m	TRH 1.4 - 3.4m	TRH 1.5 - 4-5m	TRH 1.5 - 4-5m
	Matirix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10
Total Organic Carbon (TOC)	% w/w	4.48		2.47		1.27		1.91		4.66	
Total PAH's	mg/Kg d.w	0.66		0.99		< 0.48		< 0.48		< 0.48	
Zinc	mg/Kg d.w		0.22		< 0.01		0.05		0.09		0.11
o-Xylene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	

**Table 4. Test Parameters for Trial Hole 2**

	Job Number	22-16786									
	Sample ID	53392	53393	53394	53395	53396	53397	53398	53399	53400	53401
	Client Sample Reference	TRH 2.1 - 0-1m	TRH 2.1 - 0-1m	TRH 2.2 - 1-2m	TRH 2.2 - 1-2m	TRH 2.3 - 2-3m	TRH 2.3 - 2-3m	TRH 2.4 - 3-4m	TRH 2.4 - 3-4m	TRH 2.5 - 4-5m	TRH 2.5 - 4-5m
	Matirix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10
Antimony	mg/Kg d.w		0.02		< 0.01		< 0.01		0.01		0.01
Arsenic	mg/Kg d.w		0.02		0.03		0.02		0.02		0.02
Barium (Ba)	mg/Kg d.w		0.21		0.19		0.15		0.17		0.13
Benzene	mg/Kg d.w	< 0.02		< 0.02		< 0.02		< 0.02		< 0.02	
Cadmium	mg/Kg d.w		< 0.005		< 0.005		< 0.005		< 0.005		< 0.005
Chloride	mg/Kg d.w		20.3		22.8		22.5		17.1		91.2
Chromium	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		0.01
Copper	mg/Kg d.w		0.07		0.08		0.08		0.06		0.18
Dissolved Organic Carbon (DOC)	mg/Kg d.w		62.7		89.2		98.1		57.8		327.0
Ethylbenzene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	
Fluoride	mg/Kg d.w		2.2		2.1		2.3		2.1		3.9
Lead	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Mercury	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01

	Job Number	22-16786									
	Sample ID	53392	53393	53394	53395	53396	53397	53398	53399	53400	53401
	Client Sample Reference	TRH 2.1 - 0-1m	TRH 2.1 - 0-1m	TRH 2.2 - 1-2m	TRH 2.2 - 1-2m	TRH 2.3 - 2-3m	TRH 2.3 - 2-3m	TRH 2.4 - 3-4m	TRH 2.4 - 3-4m	TRH 2.5 - 4-5m	TRH 2.5 - 4-5m
	Matirix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10
Mineral Oil (C10-C40)	mg/Kg d.w	< 20		139		46		38		< 20	
Molybdenum (Mo)	mg/Kg d.w		0.06		0.03		0.02		0.02		0.05
Nickel	mg/Kg d.w		0.01		0.01		0.01		0.01		0.03
PCB BZ #101	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #118	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #138	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #153	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #180	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #28	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #52	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
Phenol Index	mg/Kg d.w		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0
Selenium	mg/Kg d.w		< 0.01		< 0.01		< 0.01		0.03		0.02
Sulphate	mg/Kg d.w		100.4		118.8		96.6		479.5		185.7
Total BTEX	mg/Kg d.w	< 0.13		< 0.13		< 0.13		< 0.13		< 0.13	
Total Dissolved Solids (TDS)	mg/Kg d.w		760.0		680.0		710.0		710.0		1100.0
Total Organic Carbon (TOC)	% w/w	4.00		4.97		2.10		4.62		9.15	
Total PAH's	mg/Kg d.w	< 0.48		< 0.48		< 0.48		< 0.48		< 0.48	
Zinc	mg/Kg d.w		0.18		0.06		0.06		0.11		0.20
o-Xylene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	

**Table 5. Test Parameters for Trial Hole 3**

	Job Number										
	Sample ID	53402	53403	53404	53405	53406	53407	53408	53409	53410	53411
	Client Sample Reference	TRH 3.1 - 0-1m	TRH 3.1 - 0-1m	TRH 3.2 - 1-2m	TRH 3.2 - 1-2m	TRH 3.3 - 2-3m	TRH 3.3 - 2-3m	TRH 3.4 - 3-4m	TRH 3.4 - 3-4m	TRH 3.5 - 4-5m	TRH 3.5 - 4-5m
	Matirix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10
Antimony	mg/Kg d.w		< 0.01		< 0.01		0.02		0.02		0.01
Arsenic	mg/Kg d.w		0.02		0.02		0.02		0.02		0.02
Barium (Ba)	mg/Kg d.w		0.49		0.13		0.26		0.07		0.33
Benzene	mg/Kg d.w	< 0.02		< 0.02		< 0.02		< 0.02		< 0.02	
Cadmium	mg/Kg d.w		< 0.005		< 0.005		< 0.005		< 0.005		< 0.005
Chloride	mg/Kg d.w		15.8		21.6		23.0		15.8		24.1
Chromium	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Copper	mg/Kg d.w		0.14		0.11		0.08		0.06		0.17
Dissolved Organic Carbon (DOC)	mg/Kg d.w		69.8		92.4		91.4		68.2		101.9
Ethylbenzene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	
Fluoride	mg/Kg d.w		2.1		2.2		2.1		1.8		2.4
Lead	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Mercury	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Mineral Oil (C10-C40)	mg/Kg d.w	37		< 20		< 20		< 20		< 20	
Molybdenum (Mo)	mg/Kg d.w		0.02		0.01		0.02		0.01		0.20
Nickel	mg/Kg d.w		< 0.01		< 0.01		0.02		0.02		0.03
PCB BZ #101	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #118	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #138	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #153	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #180	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #28	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #52	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
Phenol Index	mg/Kg d.w		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0
Selenium	mg/Kg d.w		0.08		0.01		< 0.01		< 0.01		0.01
Sulphate	mg/Kg d.w		977.5		519.1		269.9		54.9		486.5
Total BTEX	mg/Kg d.w	< 0.13		< 0.13		< 0.13		< 0.13		< 0.13	
Total Dissolved Solids (TDS)	mg/Kg d.w		1480.0		1100.0		910.0		520.0		1160.0

	Job Number										
	Sample ID	53402	53403	53404	53405	53406	53407	53408	53409	53410	53411
	Client Sample Reference	TRH 3.1 - 0-1m	TRH 3.1 - 0-1m	TRH 3.2 - 1-2m	TRH 3.2 - 1-2m	TRH 3.3 - 2-3m	TRH 3.3 - 2-3m	TRH 3.4 - 3-4m	TRH 3.4 - 3-4m	TRH 3.5 - 4-5m	TRH 3.5 - 4-5m
	Matirix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10
Total Organic Carbon (TOC)	% w/w	3.15		2.45		4.24		4.32		6.09	
Total PAH's	mg/Kg d.w	0.99		< 0.48		< 0.48		< 0.48		< 0.48	
Zinc	mg/Kg d.w		0.27		0.12		0.10		0.04		0.17
o-Xylene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	

**Table 6. Test Parameters for Trial Hole 4**

	Job Number										
	Sample ID	53412	53413	53414	53415	53416	53417	53418	53419	53420	53421
	Client Sample Reference	TRH 4.1 - 0-1m	TRH 4.1 - 0-1m	TRH 4.2 - 1-2m	TRH 4.2 - 1-2m	TRH 4.3 - 2-3m	TRH 4.3 - 2-3m	TRH 4.4 - 3-4m	TRH 4.4 - 3-4m	TRH 4.5 - 4-5m	TRH 4.5 - 4-5m
	Matirix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10
Antimony	mg/Kg d.w		< 0.01		< 0.01		< 0.01		0.01		0.01
Arsenic	mg/Kg d.w		0.01		0.02		0.01		0.02		0.02
Barium (Ba)	mg/Kg d.w		0.23		0.13		0.16		0.52		0.28
Benzene	mg/Kg d.w	< 0.02		< 0.02		< 0.02		< 0.02		< 0.02	
Cadmium	mg/Kg d.w		< 0.005		< 0.005		< 0.005		< 0.005		< 0.005
Chloride	mg/Kg d.w		48.3		49.2		37.1		66.6		81.4
Chromium	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Copper	mg/Kg d.w		0.14		0.09		0.09		0.12		0.15
Dissolved Organic Carbon (DOC)	mg/Kg d.w		138.1		126.3		82.1		223.1		264.6
Ethylbenzene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	
Fluoride	mg/Kg d.w		2.3		2.2		1.7		2.7		2.9
Lead	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Mercury	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01

	Job Number										
	Sample ID	53412	53413	53414	53415	53416	53417	53418	53419	53420	53421
	Client Sample Reference	TRH 4.1 - 0-1m	TRH 4.1 - 0-1m	TRH 4.2 - 1-2m	TRH 4.2 - 1-2m	TRH 4.3 - 2-3m	TRH 4.3 - 2-3m	TRH 4.4 - 3-4m	TRH 4.4 - 3-4m	TRH 4.5 - 4-5m	TRH 4.5 - 4-5m
	Matrix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10
Mineral Oil (C10-C40)	mg/Kg d.w	51		44		< 20		< 20		< 20	
Molybdenum (Mo)	mg/Kg d.w		0.05		0.03		0.02		0.07		0.10
Nickel	mg/Kg d.w		0.01		< 0.01		0.02		0.03		0.02
PCB BZ #101	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #118	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #138	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #153	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #180	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #28	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #52	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
Phenol Index	mg/Kg d.w		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0
Selenium	mg/Kg d.w		0.01		0.02		< 0.01		0.01		0.01
Sulphate	mg/Kg d.w		149.6		148.7		59.3		311.0		354.7
Total BTEX	mg/Kg d.w	< 0.13		< 0.13		< 0.13		< 0.13		< 0.13	
Total Dissolved Solids (TDS)	mg/Kg d.w		830.0		910.0		710.0		1440.0		1490.0
Total Organic Carbon (TOC)	% w/w	4.59		3.85		5.49		9.09		9.43	
Total PAH's	mg/Kg d.w	< 0.48		< 0.48		< 0.48		< 0.48		< 0.48	
Zinc	mg/Kg d.w		0.25		0.10		0.10		0.48		0.27
o-Xylene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	

**Table 7. Test Parameters for Trial Hole 5**

	Job Number										
	Sample ID	53422	53423	53424	53425	53426	53427	53428	53429	53430	53431
	Client Sample Reference	TRH 5.1 - 0-1m	TRH 5.1 - 0-1m	TRH 5.2 - 1-2m	TRH 5.2 - 1-2m	TRH 5.3 - 2-3m	TRH 5.3 - 2-3m	TRH 5.4 - 3-4m	TRH 5.4 - 3-4m	TRH 5.5 - 4-5m	TRH 5.5 - 4-5m
Matirix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	
Antimony	mg/Kg d.w		0.01		0.02		< 0.01		0.01		0.02
Arsenic	mg/Kg d.w		0.01		0.02		0.01		0.03		0.02
Barium (Ba)	mg/Kg d.w		0.08		0.13		0.14		0.25		0.29
Benzene	mg/Kg d.w	< 0.02		< 0.02		< 0.02		< 0.02		< 0.02	
Cadmium	mg/Kg d.w		< 0.005		< 0.005		< 0.005		< 0.005		< 0.005
Chloride	mg/Kg d.w		38.6		42.8		53.7		62.5		110.8
Chromium	mg/Kg d.w		< 0.01		< 0.01		< 0.01		0.02		0.01
Copper	mg/Kg d.w		0.08		0.10		0.11		0.19		0.18
Dissolved Organic Carbon (DOC)	mg/Kg d.w		123.7		115.1		109.2		221.7		582.6
Ethylbenzene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	
Fluoride	mg/Kg d.w		2.0		1.9		1.6		2.7		3.3
Lead	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Mercury	mg/Kg d.w		< 0.01		< 0.01		< 0.01		< 0.01		< 0.01
Mineral Oil (C10-C40)	mg/Kg d.w	48		58		< 20		< 20		179	
Molybdenum (Mo)	mg/Kg d.w		0.07		0.05		0.02		0.05		0.08
Nickel	mg/Kg d.w		< 0.01		< 0.01		0.02		0.04		0.05
PCB BZ #101	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #118	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #138	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #153	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #180	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #28	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
PCB BZ #52	mg/Kg d.w	< 0.30		< 0.30		< 0.30		< 0.30		< 0.30	
Phenol Index	mg/Kg d.w		< 1.0		< 1.0		< 1.0		< 1.0		< 1.0
Selenium	mg/Kg d.w		0.01		0.01		< 0.01		< 0.01		0.02
Sulphate	mg/Kg d.w		633.3		472.6		151.3		131.3		253.0
Total BTEX	mg/Kg d.w	< 0.13		< 0.13		< 0.13		< 0.13		< 0.13	
Total Dissolved Solids (TDS)	mg/Kg d.w		1150.0		1030.0		800.0		980.0		1700.0



	Job Number										
	Sample ID	53422	53423	53424	53425	53426	53427	53428	53429	53430	53431
	Client Sample Reference	TRH 5.1 - 0-1m	TRH 5.1 - 0-1m	TRH 5.2 - 1-2m	TRH 5.2 - 1-2m	TRH 5.3 - 2-3m	TRH 5.3 - 2-3m	TRH 5.4 - 3-4m	TRH 5.4 - 3-4m	TRH 5.5 - 4-5m	TRH 5.5 - 4-5m
Matrix	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	Soil Contaminated Land	Soil Leachate 1:10	
Total Organic Carbon (TOC)	% w/w	3.68		3.00		5.99		5.46		15.54	
Total PAH's	mg/Kg d.w	< 0.48		< 0.48		< 0.48		< 0.48		< 0.48	
Zinc	mg/Kg d.w		0.02		0.14		0.09		0.29		0.36
o-Xylene	mg/Kg d.w	< 0.04		< 0.04		< 0.04		< 0.04		< 0.04	

As can be seen from the tables above most of the data points for the 25 samples are shaded green and therefore represent inert material and deserve no further comment.

Three related parameters namely dissolved organic carbon, (DOC); Loss on ignition, (LOI) and Total Organic Carbon (TOC), constitute the only sets of parameters that indicate stable non-hazardous or hazardous categorisations. The three parameters are related in that they refer to tests that measure carbon by different techniques. Dissolved organic carbon measures carbon dissolved in water or that can be dissolved in water. Loss on ignition measures carbon in organic matter that is released during incineration of the sample in a furnace at 550° C. Total organic carbon measures the carbon content in the sample. The TOC or Loss on ignition can be used interchangeably or one or other of these tests can be omitted by choice of the analyst. The occurrence of these parameters in this instance is due to either the presence of organic matter from topsoil present in the first 1m of soil which contains carbon from decayed vegetation and accumulated carbon over the last decade or so or the presence of peat and topsoil in the virgin soil at 3-6m BGL. In any case, the DOC result, which represents the soluble organic content, can be selected in preference to the other two tests for carbon and is the guiding parameter in this instance, with a limit value of 500mg/L. All samples bar one TR5.5 are less than 500mg/L (TR 5.5 has 582mg/L which just tips it into the stable non-reactive category. This is understandable as there was quite a large proportion of peat present in this trial hole. It is to be noted that there was no evidence of organic waste of a degradable nature i.e. putrescible waste, paper or cardboard waste observed at any level in any one of the 5 trial holes. Methane was less than 10ppm at all levels in all trial holes. A range of other test parameters e.g. hydrocarbon, pesticides, polyaromatic hydrocarbons, chlorinated solvents, benzene, xylene, toluene, ethyl benzene and other toxic aromatics are safely below the threshold limits for categorisation of the material as inert.

The only other parameter that infers a stable non-reactive categorisation is sulphate in TR 1.3 at 2441.0mg/kg where the limits are 1000mg/kg inert and 20,000 for stable non-reactive. A leaching test may be required to demonstrate inert categorisation. However, TR 1.3 had no evidence of gypsum board present on observation of the excavated material. There was no evidence of sulphate reduction to sulphide in the trial hole. This would be evidenced by discolouration of material to a black colour by reaction with iron. There was no foul odour at this level, demonstrating the absence of production of sulphide by anaerobic biodegradation. It is safe to accept that the material at this level is stable non-reactive and has no potential to degrade to form harmful sulphides.

## Analysis of Ground Water

The water samples taken from each trial hole were analyzed in accordance with the groundwater regulations SI No 9 of 2010 and SI No 366 of 2016. It is to be noted that whilst the Groundwater regulations are used as the barometer of groundwater quality at the site, these regulations are more appropriate for the protection of groundwater as a resource or as a source. The groundwater beneath the site, in an urban environment, cannot be considered as either a resource or a source as it has been the subject of leaching from surface water from a built environment for centuries. Therefore, it cannot be compared strictly to the high standards required to completely satisfy the groundwater regulations.

In all 57 separate tests were carried out on each sample (see Appendix IV for full set of results). The regulations note certain groundwater parameters (see table 8) that can have both natural and anthropogenic origin. If a natural explanation for the source of the exceedance can be ascribed, then the occurrence of the level present is acceptable. As with the WAC analysis above green identifies parameters within the limits of the groundwater regulations SI No 9 of 2010 and SI No 366 of 2016, while red identifies exceedances.

**Table 8. Results of Groundwater Analysis.**

Parameter		Trial Hole 1	Trial Hole 2	Trial Hole 3	Trial Hole 4	Trial Hole 5	Limits as per Groundwater Regulations
1,2-Dichloroethane	µg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	2.25 µg/l
2,4-D	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.075 µg/l
Aluminium	µg/L	1221	2526	3310	5568	5038	150 µg/l
Ammonium	mg/L N	9.11	7.63	9.17	3.48	8.24	0.175 mg/L
Arsenic	µg/L	6	13	7	7	10	7.5 µg/L
Atrazine	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.075 µg/L
Bentazone	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.075 µg/L
Benzene	µg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.75 µg/L
Chloride	mg/L	19.5	21.2	16.9	19.9	18.1	187.5 µg/L
Chromium	µg/L	6	9	13	17	16	37.5 µg/L
Conductivity	µS/cm @ 20 °C	1064	1215	1024	733	1040	1875 µS/cm @ 20 °C
Cypermethrin	µg/L	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012	0.075 µg/L
Diuron	µg/L	0.006	< 0.005	0.006	< 0.005	0.019	0.075 µg/L
Glyphosate	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.075 µg/L
Isoproturon	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.075 µg/L
Lead	µg/L	15	36	15	8	17	18.75 µg/L
MCPA	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.075 µg/L
MCPP (Mecoprop)	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.075 µg/L
Mercury	µg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.75 µg/L
Mol Reactive Phosphorus (MRP)	mg/L P	< 0.01	0.01	0.06	0.01	0.01	0.035 mg/L P
Nitrate	mg/L N	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25	37.5 mg/L N
Nitrite	mg/L N	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.375 mg/L N
Simazine	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	0.075 µg/L

Parameter		Trial Hole 1	Trial Hole 2	Trial Hole 3	Trial Hole 4	Trial Hole 5	Limits as per Groundwater Regulations
Sulphate	mg/L	14.6	248.7	140.5	62.1	147.0	187.5 µg/L
Total PAH	µg/L	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020	0.075 µg/L
Vinyl Chloride	µg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.375 µg/L

The following 5 parameters show exceedances of the limit values recommended in the groundwater regulations

**Aluminium:** Aluminium values ranged from 1221-5568 ug/L, the highest value for trial hole 4. The limit value is 150ug/L. Aluminium occur widely on several geological formation, including the rock types observed at the site, predominantly limestone. The levels found in the samples can be taken as , from natural origin.

**Ammonium:** Ammonium values range from 3.48 -9.17mg/L, the highest value in trial hole 2. The limit value in the directive is 0.175mg/L. Ammonia is accorded a natural as well as an anthropogenic source in groundwater. The lower strata of the trial holes merged into original ground. This original ground possessed considerable quantities of peat, particularly in trial holes 3, 4 and 5. In any case origin of high ammonia is likely to be of natural origin, most likely from the peaty material or the original native topsoil underlying the made-up ground that is now present throughout the site.

**Arsenic:** Elevated levels of arsenic were found in trial hole 2 (13ug/L) and trial 5 (10ug/L). The groundwater limit value is 7.5ug/L. Arsenic, also noted in the groundwater regulations as having possible natural origin. The level is thus acceptable.

**Lead:** Elevated levels of lead occurred in trial hole 2 at 36ug/L. The limit value in the groundwater regulations is 18.75ug/L. Lead does occur naturally in Galena ores. The most likely source of lead in this groundwater in the trial hole is anthropogenic. Most likely caused by leaching into groundwater from the many uses of lead, both modern and traditional (lead pipes, paint, lead flashing, leaded petrol, soldering materials) in an urban setting like Ennis.

**Sulphate:** Elevated levels of sulphate occurred in trial hole 2, (248.7mg/L). The groundwater limit value is 187.5mg/L. Sulphate is of natural origin found in gypsum and baryte minerals and therefore likely to occur from natural origin. The level is therefore acceptable.

## Conclusion

Five separate trial holes representing the site, had excavations made at 1metre levels to a depth of 6 metres. The observations at the trial holes revealed solid made up ground down to more than 3 metres. A water table was observed across the site at 2.8-3.4metres. The site surface has good drainage to groundwater. Virgin ground occurred at 3m and below. The made-up material consisted predominantly of soil, gravel, stone and boulders, mostly limestone in origin. There was little or no waste of an extraneous nature, no traces of putrescible or degradable waste. Methane was not detected at any level at each trial hole.

A WAC suite of analysis was carried out on 25 separate samples for 57 tests per sample. All tests except for those representing carbon and one sulphate test indicated an inert waste categorisation under the WAC Directive. The presence of carbon as TOC and DOC near ground level and below 3m in the virgin soil indicate sources that are topsoil organic matter and native peat. The low DOC values demonstrate that the material represented at these levels is decidedly inert. A single elevated sulphate test result for the middle of trial hole 3 at the centre of the site infers a categorisation of the material as stable non-reactive, however, the absence of gypsum board, the absence of sulphide indicators confirms that no biodegradation has occurred and there is no potential for its occurrence into the future.

With regard to the groundwater analysis, a wide range of parameters covered by the groundwater regulations were found to be safely below the limit values imposed. These parameters include the more toxic organic and persistent organic pollutants including a range of pesticides, polyaromatic hydrocarbons, chlorinated solvents, benzene, xylene, toluene, ethyl benzene and other toxic aromatics, toxic metals such as hexavalent chromium, mercury and cadmium. Eutrophication inducing parameters phosphate and nitrate are also absent. The test parameters that were found to exceed the groundwater limits with the exception of lead have natural as well as anthropogenic sources and therefore can be considered acceptable in the present context. The occurrence of lead at a value twice the groundwater regulation limit, whilst it is not naturally occurring, is acceptable having regard to the multiple sources of lead in the urban environment.

# Appendix I

This appendix contains site photos taken during the excavation of 5off trial holes at the Valley Healthcare Fund site on the Tulla Road Ennis Co Clare. Each trial hole was excavated to a depth of approximately 5 meters. The trail holes were excavated in one-meter sections and segregated into separate piles (as shown below).

## Trial Hole No.1



Figure 1: Trial Hole 1, 1m



Figure 2: Trial Hole 1, 2m





Figure 3: Trial Hole 1, 3m



Figure 4: Trial Hole 1, 4m



Figure 5: Trial Hole 1, 5m



Figure 6: Illustrates trial hole 1 & shows the different horizons within the trial hole.



**Trial Hole No.2**



**Figure 7: Trial Hole 2, 1m**



**Figure 8: Trial Hole 2, 2m**



**Figure 9: Trial Hole 2, 3m**



**Figure 10: Trial Hole 2, 4m**





Figure 11: Trial Hole 2, 5m



Figure 12: Illustrates trial hole 1 & shows the different horizons within the trial hole.

**Trial Hole No.3**



Figure 13: Trial Hole 3, 1m



Figure 14: Trial Hole 3, 2m





Figure 15: Trial Hole 3, 3m



Figure 16: Trial Hole 3, 4m



Figure 17: Trial Hole 3, 5m



Figure 18: Illustrates trial hole 3 & shows the different horizons within the trial hole.



**Trial Hole No.4**



**Figure 19: Trial Hole 4, 1m**



**Figure 20: Trial Hole 4, 2m**



**Figure 21: Trial Hole 4, 3m**



**Figure 22: Trial Hole 4, 4m**





Figure 23: Trial Hole 4, 5m



Figure 24: Illustrates trial hole 4 & shows the different horizons within the trial hole.

### Trial Hole No.5



Figure 25: Trial Hole 5, 1m



Figure 26: Trial Hole 5, 2m





Figure 27: Trial Hole 5, 3m



Figure 28: Trial Hole 5, 4m





Figure 29: Trial Hole 5, 5m

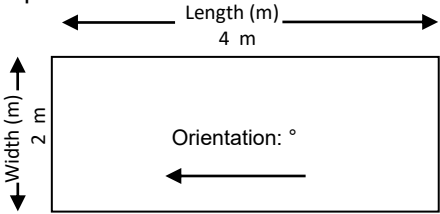



Figure 30: Illustrates trial hole 5 & shows the different horizons within the trial hole.


# Appendix II – Trial Hole Logs

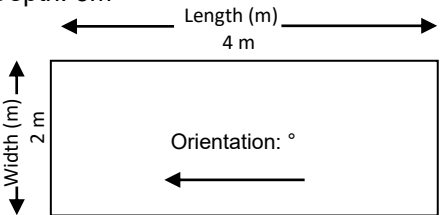
	<b>Contract Name:</b> Tulla Road		<b>Client:</b> HRA Planning Consultants			<b>Trial Hole ID:</b>  <b>TH01</b>
	Proposal no. 21P-305	Date Started: 14/01/22	Logged by: MM & BOC	Logged by: MM & BOC	Checked by:	
<b>Trial Hole Log</b>	Easting: 134764	Northing: 178577	Ground level: 10m OD	Plant Used: Komatsu SAA4D95LE-7	Date Printed:	Scale:
Weather: Dry, mild, light breeze		Hole Termination: 6m		Stability:		

Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) Thickness	Legend	Strata Description		
0-1m	1.1					Topsoil. 10-20% Limestone No glass, metal, plastic waste observed. Small quantities of broken pipe <2% Methane results recorded at this level = less than 10ppm <sup>1</sup> .	 3.4m BGL	
1-2m	1.2					Stone & gravel, predominately limestone (40-50%). Methane results recorded at this level = less than 10ppm <sup>1</sup> . No Waste		
2-3m	1.3					Stone & gravel (30-40%) Waste observed included extraneous quantities of plastic, wire, cloth <2% Methane results recorded at this level = less than 10ppm <sup>1</sup> .		
3-4m	1.4					Topsoil & subsoil. Stone 30%, gravel & limestone Methane results recorded at this level = less than 10ppm <sup>1</sup> . No waste observed		
4-5m	1.5					Stone 30%, gravel & limestone No waste observed Methane results recorded at this level = less than 10ppm <sup>1</sup> .		



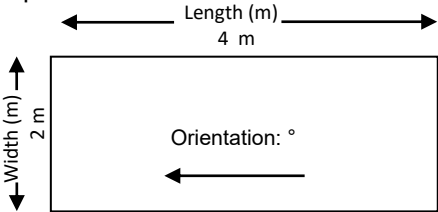
<b>Dimensions:</b> Final Depth: 6m 	<b>General Remarks:</b> See Appendix I for relevant site photos (Figures 1-6) (1) Methane gas monitoring of trial hole: An RSGD38 Methane gas analyser was attached to a telescopic pole and used to monitor methane levels within the trial holes. The objective of the exercise was to detect methane ingress into the open trial arising from open horizontal channels within the profile. The Intake probe of the meter was positioned to the trial hole vertical wall and moved slowly in a horizontal plane around the vertical walls of the trial hole. This is exercise was repeated at each 1 metre level, starting at the top 1-2m level and working downwards. Methane Trigger value = 10,000ppm. The Lower Exposure Limit for Methane = 50,000ppm. Miscellaneous waste <1% and include some brick & plastic, also small quantities of timber in degraded state. No glass, electrical goods, Asbestos, or organic waste observed. Gravel content high in top 3m. No bedrock @ 6m Trial pit backfilled with arisings on completion.
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	<b>Contract Name:</b> Tulla Road		<b>Client:</b> HRA Planning Consultants			<b>Trial Hole ID:</b>  <b>TH02</b>
	Proposal no. 21P-305	Date Started: 14/01/22	Logged by: MM & BOC	Logged by: MM & BOC	Checked by:	
<b>Trial Hole Log</b>	Easting: 134773	Northing: 178559	Ground level: 10m OD	Plant Used:	Date Printed:	Scale:
Weather: Dry, mild, light breeze		Hole Termination: 5m		Stability:		


Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) Thickness	Legend	Strata Description		
0-1m	2.1					Stone (30-40%), Gravel & Soil. No waste observed Grey in colour Methane results recorded at this level = less than 10ppm <sup>1</sup> .	 2.9m BGL	
1-2m	2.2					Stone & gravel (30%), predominately limestone Waste <1% (sewer pipe) Methane results recorded at this level = less than 10ppm <sup>1</sup> .		
2-3m	2.3					Stone & gravel (30-40%) Boulders (size 0.2m-0.3m) Grey in colour Waste: strip of dampcourse (<0.5kgs) Methane results recorded at this level = less than 10ppm <sup>1</sup> .		
3-4m	2.4					Wet stone (30-40%), gravel & soil Boulders (size 0.1m-0.4m) Predominantly limestone No waste observed Methane results recorded at this level = less than 10ppm <sup>1</sup> .		
4-5m	2.5					Soil observed in 3 layers Topsoil above subsoil, with peat observed below these soil layers Large boulder present No waste observed Methane results recorded at this level = less than 10ppm <sup>1</sup> .		

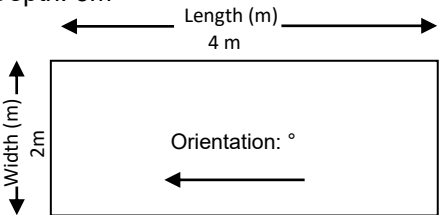
<b>Dimensions:</b> Final Depth: 5m 	<b>General Remarks:</b> See Appendix I for relevant site photos (Figures 7-12) Miscellaneous waste <1% and include some brick & plastic. No glass, Asbestos or organic waste observed. Trial pit backfilled with arisings on completion.
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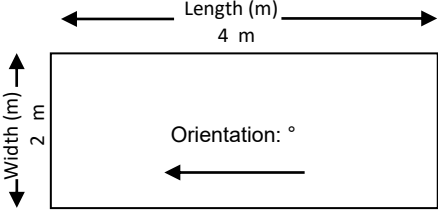


	<b>Contract Name:</b> Tulla Road			<b>Client:</b> HRA Planning Consultants		<b>Trial Hole ID:</b>  <b>TH03</b>		
	Proposal no. 21P-305	Date Started: 14/01/22	Logged by: MM & BOC	Logged by: MM & BOC	Checked by:			
<b>Trial Hole Log</b>	Easting: 134785	Northing: 178578	Ground level: 10m OD	Plant Used:	Date Printed:	Scale:		
Weather: Dry, mild, light breeze		Hole Termination: 5m		Stability:				
Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) Thickness	Legend	Strata Description		
0-1m	3.1					Boulders, gravel, sand & soil. Boulders (size 0.3m-0.4m) No waste observed Grey in colour, no dark discolouration. Methane results recorded at this level = less than 10ppm <sup>1</sup>		
1-2m	3.2					Boulders (10%), gravel, sand & soil. Boulders (size 0.2m-0.4m) Metal pipe observed (1kg) Soil brown & compact. Methane results recorded at this level = less than 10ppm <sup>1</sup>	 2.8m BGL	
2-3m	3.3					Stone ,gravel (30-40%) & sand (30%) Boulders (size 0.2m-0.4m) Grey in colour Waste: rags, no other waste observed. Methane results recorded at this level = less than 10ppm <sup>1</sup>		
3-4m	3.4					Boulders, gravel & sand (30%), wet Boulders (size 0.15m-0.3m) No waste observed Grey in colour Methane results recorded at this level = less than 10ppm <sup>1</sup>		
4-5m	3.5					Boulders (30-40%), gravel & sand, wet Boulders (size 0.2m-0.4m) No waste of any kind observed Grey in colour Methane results recorded at this level = less than 10ppm <sup>1</sup>		
<b>Dimensions:</b>					<b>General Remarks:</b>			
Final Depth: 5m 					See Appendix I for relevant site photos (Figures 13-18) Miscellaneous waste <1% and include some brick & plastic. No glass, domestic appliances, Asbestos or organic waste was observed. Some ingress of water @ 2.4m. No bedding plane. Trial pit backfilled with arisings on completion.			

	<b>Contract Name:</b> Tulla Road		<b>Client:</b> HRA Planning Consultants			<b>Trial Hole ID:</b>  <b>TH04</b>
	Proposal no. 21P-305	Date Started: 14/01/22	Logged by: MM & BOC	Logged by: MM & BOC	Checked by:	
<b>Trial Hole Log</b>	Easting: 134809	Northing: 178583	Ground level: 10m OD	Plant Used:	Date Printed:	Scale:
Weather: Dry, mild, light breeze		Hole Termination: 5m		Stability:		

Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) Thickness	Legend	Strata Description		
0-1m	4.1					Boulders(30-40%), (size 0.5m-0.7m). Waste: Plastic % aluminium pieces (<1%) Dark grey in colour. Methane results recorded at this level = less than 10ppm <sup>1</sup>		
1-2m	4.2					Boulders (20-30%), soil and some clay. Boulder (size 0.5m-0.7m) Waste: Metal rebar & broke pipe (<1%) Grey/brown in colour. Methane results recorded at this level = less than 10ppm <sup>1</sup>	 2.9m BGL	
2-3m	4.3					Gravel (75%), boulders, wet. Boulders (size 0.1m-0.3m) Grey in colour No waste observed. Methane results recorded at this level = less than 10ppm <sup>1</sup>		
3-4m	4.4					Boulders (30-40%), peat & gravel Boulders (size >0.75m) No waste observed Methane results recorded at this level = less than 10ppm <sup>1</sup>		
4-5m	4.5					Boulders (30-50%), gravel (30%) No waste observed Methane results recorded at this level = less than 10ppm <sup>1</sup>		


<b>Dimensions:</b> Final Depth: 5m 	<b>General Remarks:</b> See Appendix I for relevant site photos (Figures 19-24) Grey topsoil to 0.8m. 0.8-2.0m Grey brown soils with stone. 2.0-3.0 soil & stone, >30% boulders >30.0m virgin ground No glass, Asbestos or organic waste observed. Trial pit backfilled with arisings on completion.
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	<b>Contract Name:</b> Tulla Road		<b>Client:</b> HRA Planning Consultants			<b>Trial Hole ID:</b>  <b>TH05</b>		
	Proposal no. 21P-305	Date Started: 14/01/22	Logged by: MM & BOC	Logged by: MM & BOC	Checked by:			
<b>Trial Hole Log</b>	Easting: 134798	Northing: 178602	Ground level: 10m OD	Plant Used:	Date Printed:	Scale:		
Weather: Dry, mild, light breeze		Hole Termination: 5m		Stability:				
Samples & In Situ Testing			Strata Details				Water	Backfill
Depths	Sample ID	Test Result	Reduced Level	Depth (m) Thickness	Legend	Strata Description		
0-1m	5.1					0.3m of red clay. 0.4m of grey clay & some stone. Boulders (30-40%) Boulders (size 0.3m-0.5m) Waste: strips of plastic sheet <1%. Methane results recorded at this level = less than 10ppm <sup>1</sup>		
1-2m	5.2					Stone (30%), soil & some clay. No waste observed Grey in colour Methane results recorded at this level = less than 10ppm <sup>1</sup>	 2.0m BGL	
2-3m	5.3					Stone (30-50%) & gravel No waste observed Grey in colour Methane results recorded at this level = less than 10ppm <sup>1</sup>		
3-4m	5.4					Stone (30-50%) & gravel No waste observed Grey in colour Methane results recorded at this level = less than 10ppm <sup>1</sup>		
4-5m	5.5					Peat & soil No waste observed Methane results recorded at this level = less than 10ppm <sup>1</sup>		
<b>Dimensions:</b>					<b>General Remarks:</b>			
<p>Final Depth: 5m</p>  <p>Length (m) 4 m</p> <p>Width (m) 2 m</p> <p>Orientation: °</p>					<p>See Appendix I for relevant site photos (Figures 25-30) Tree roots observed @ 1.2m No large waste, including domestic appliances, no rages, glass, Asbestos or metal observed. Trial pit backfilled with arisings on completion.</p>			





## Appendix III - Complete WAC Results


Analytical Report	
<b>Project</b>	Trial Hole Analysis - Tulla Rd Ennis
<b>Sampler</b>	M Murphy SSS Ltd
<b>Date Sampled</b>	14/01/2022
<b>Sample Type</b>	Soil


		Acenaphthene	Acenaphthylene	Anthracene	Antimony	Antimony	Arsenic	Arsenic	Barium (Ba)	Barium	Benz(a)anthracene	Benzene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(ghi)perylene	Benzo(k)fluoranthene	Cadmium	Cadmium	Chloride	Chloride	Chromium	Chromium	Chrysene
Client Sample Reference	Matirix	mg/K g d.w	mg/K g d.w	mg/K g d.w	mg/K g d.w	mg/L	mg/K g d.w	mg/L	mg/L	mg/K g d.w	mg/K g d.w	mg/K g d.w	mg/K g d.w	mg/K g d.w	mg/K g d.w	mg/Kg d.w	mg/L	mg/K g d.w	mg/L	mg/K g d.w	mg/L	mg/K g d.w	
TRH 1.1 - 0.1m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							0.04	< 0.02	0.10	0.06	0.06	0.12							0.05
TRH 1.1 - 0.1m	Soil Leachate 1:10				< 0.01	< 0.001	0.02	0.002	0.066	0.66						< 0.005	< 0.0005	28.1	2.8	< 0.01	< 0.001		
TRH 1.2 - 1-2m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							0.07	< 0.02	0.13	0.15	0.07	0.13							0.08
TRH 1.2 - 1-2m	Soil Leachate 1:10				< 0.01	< 0.001	0.01	0.001	0.008	0.08						< 0.005	< 0.0005	25.5	2.6	< 0.01	< 0.001		
TRH 1.3 - 2-3m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							0.03	< 0.02	0.06	0.04	< 0.03	0.07							0.04
TRH 1.3 - 2-3m	Soil Leachate 1:10				0.01	0.001	0.02	0.002	0.026	0.26						< 0.005	< 0.0005	7.8	0.8	< 0.01	< 0.001		
TRH 1.4 - 3.4m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							0.03	< 0.02	0.05	0.06	< 0.03	< 0.03							0.03
TRH 1.4 - 3.4m	Soil Leachate 1:10				0.02	0.002	0.04	0.004	0.020	0.20						< 0.005	< 0.0005	17.6	1.8	< 0.01	< 0.001		
TRH 1.5 - 4-5m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							0.03	< 0.02	0.09	0.10	0.05	0.09							0.04
TRH 1.5 - 4-5m	Soil Leachate 1:10				0.02	0.002	0.03	0.003	0.021	0.21						< 0.005	< 0.0005	30.3	3.0	< 0.01	< 0.001		
TRH 2.1 - 0-1m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 2.1 - 0-1m	Soil Leachate 1:10				0.02	0.002	0.02	0.002	0.021	0.21						< 0.005	< 0.0005	20.3	2.0	< 0.01	< 0.001		


		Acenaphthene	Acenaphthylene	Anthracene	Antimony	Antimony	Arsenic	Arsenic	Barium (Ba)	Barium	Benz(a)anthracene	Benzene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Cadmium	Cadmium	Chloride	Chloride	Chromium	Chromium	Chrysene
TRH 2.2 - 1-2m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 2.2 - 1-2m	Soil Leachate 1:10				< 0.01	< 0.001	0.03	0.003	0.019	0.19							< 0.005	< 0.0005	22.8	2.3	< 0.01	< 0.001	
TRH 2.3 - 2-3m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 2.3 - 2-3m	Soil Leachate 1:10				< 0.01	< 0.001	0.02	0.002	0.015	0.15							< 0.005	< 0.0005	22.5	2.3	< 0.01	< 0.001	
TRH 2.4 - 3-4m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 2.4 - 3-4m	Soil Leachate 1:10				0.01	0.001	0.02	0.002	0.017	0.17							< 0.005	< 0.0005	17.1	1.7	< 0.01	< 0.001	
TRH 2.5 - 4-5m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 2.5 - 4-5m	Soil Leachate 1:10				0.01	0.001	0.02	0.002	0.013	0.13							< 0.005	< 0.0005	91.2	9.1	0.01	0.001	
TRH 3.1 - 0-1m	Soil Contaminated Land	< 0.03	< 0.03	0.04							0.08	< 0.02	0.11	0.06	0.05	0.07							0.08
TRH 3.1 - 0-1m	Soil Leachate 1:10				< 0.01	< 0.001	0.02	0.002	0.049	0.49							< 0.005	< 0.0005	15.8	1.6	< 0.01	< 0.001	
TRH 3.2 - 1-2m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 3.2 - 1-2m	Soil Leachate 1:10				< 0.01	< 0.001	0.02	0.002	0.013	0.13							< 0.005	< 0.0005	21.6	2.2	< 0.01	< 0.001	
TRH 3.3 - 2-3m	Soil Contaminated Land	0.05	< 0.03	0.08							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 3.3 - 2-3m	Soil Leachate 1:10				0.02	0.002	0.02	0.002	0.026	0.26							< 0.005	< 0.0005	23.0	2.3	< 0.01	< 0.001	
TRH 3.4 - 3-4m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 3.4 - 3-4m	Soil Leachate 1:10				0.02	0.002	0.02	0.002	0.07	0.07							< 0.005	< 0.0005	15.8	1.6	< 0.01	< 0.001	
TRH 3.5 - 4-5m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 3.5 - 4-5m	Soil Leachate 1:10				0.01	0.001	0.02	0.002	0.033	0.33							< 0.005	< 0.0005	24.1	2.4	< 0.01	< 0.001	
TRH 4.1 - 0-1m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 4.1 - 0-1m	Soil Leachate 1:10				< 0.01	< 0.001	0.01	0.001	0.023	0.23							< 0.005	< 0.0005	48.3	4.8	< 0.01	< 0.001	
TRH 4.2 - 1-2m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 4.2 - 1-2m	Soil Leachate 1:10				< 0.01	< 0.001	0.02	0.002	0.013	0.13							< 0.005	< 0.0005	49.2	4.9	< 0.01	< 0.001	
TRH 4.3 - 2-3m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 4.3 - 2-3m	Soil Leachate 1:10				< 0.01	< 0.001	0.01	0.001	0.016	0.16							< 0.005	< 0.0005	37.1	3.7	< 0.01	< 0.001	

		Acenaphthene	Acenaphthylene	Anthracene	Antimony	Antimony	Arsenic	Arsenic	Barium (Ba)	Barium	Benz(a)anthracene	Benzene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Cadmium	Cadmium	Chloride	Chloride	Chromium	Chromium	Chrysene
TRH 4.4 - 3-4m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 4.4 - 3-4m	Soil Leachate 1:10				0.01	0.001	0.02	0.002	0.052	0.52							< 0.005	< 0.0005	66.6	6.7	< 0.01	< 0.001	
TRH 4.5 - 4-5m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 4.5 - 4-5m	Soil Leachate 1:10				0.01	0.001	0.02	0.002	0.028	0.28							< 0.005	< 0.0005	81.4	8.1	< 0.01	< 0.001	
TRH 5.1 - 0-1m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 5.1 - 0-1m	Soil Leachate 1:10				0.01	0.001	0.01	0.001	0.008	0.08							< 0.005	< 0.0005	38.6	3.9	< 0.01	< 0.001	
TRH 5.2 - 1-2m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	0.08	0.08	0.05	< 0.03							< 0.03
TRH 5.2 - 1-2m	Soil Leachate 1:10				0.02	0.002	0.02	0.002	0.013	0.13							< 0.005	< 0.0005	42.8	4.3	< 0.01	< 0.001	
TRH 5.3 - 2-3m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 5.3 - 2-3m	Soil Leachate 1:10				< 0.01	< 0.001	0.01	0.001	0.014	0.14							< 0.005	< 0.0005	53.7	5.4	< 0.01	< 0.001	
TRH 5.4 - 3-4m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 5.4 - 3-4m	Soil Leachate 1:10				0.01	0.001	0.03	0.003	0.025	0.25							< 0.005	< 0.0005	62.5	6.3	0.02	0.002	
TRH 5.5 - 4-5m	Soil Contaminated Land	< 0.03	< 0.03	< 0.03							< 0.03	< 0.02	< 0.03	< 0.03	< 0.03	< 0.03							< 0.03
TRH 5.5 - 4-5m	Soil Leachate 1:10				0.02	0.002	0.02	0.002	0.029	0.29							< 0.005	< 0.0005	110.8	11.1	0.01	0.001	


 <b>Southern Scientific Services</b> Consultancy and testing facility		Copper (Cu)	Copper	Dibenz(a,h)anthracene	Dissolved Organic Carbon (DOC)	Dissolved Organic Carbon (DOC)	Dry Matter	Ethylbenzene	Fluoranthene	Fluorene	Fluoride	Fluoride	Indeno(1,2,3-cd)pyrene	Lead (Pb)	Lead	Loss On Ignition (LOI)	Mercury	Mercury	Mineral Oil (C10-C40)	Molybdenum (Mo)	Molybdenum	Naphthalene	Nickel
Client Sample Reference	Matrix	mg/L	mg/K g d.w	mg/K g d.w	mg/K g d.w	mg/L	% dw	mg/K g d.w	mg/K g d.w	mg/K g d.w	mg/K g d.w	mg/L	mg/K g d.w	mg/L	mg/K g d.w	%**	mg/K g d.w	mg/L	mg/K g d.w	mg/L	mg/K g d.w	mg/K g d.w	mg/K g d.w
TRH 1.1 - 0.1m	Soil Contaminated Land			0.04			89.4	< 0.04	0.06	< 0.03			0.07	<	<	2.7	<	<	186		< 0.03		
TRH 1.1 - 0.1m	Soil Leachate 1:10	0.014	0.14		114.0	11.4					2.8	0.3		< 0.001	< 0.01		< 0.01	< 0.001		0.005	0.05		0.02
TRH 1.2 - 1-2m	Soil Contaminated Land			< 0.03			91.5	< 0.04	0.13	< 0.03			0.07			3.1			91		< 0.03		
TRH 1.2 - 1-2m	Soil Leachate 1:10	0.004	0.04		84.8	8.5					2.5	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.002	0.02		< 0.01
TRH 1.3 - 2-3m	Soil Contaminated Land			< 0.03			88.8	< 0.04	0.09	< 0.03			0.04			1.9			104		< 0.03		
TRH 1.3 - 2-3m	Soil Leachate 1:10	0.006	0.06		48.8	4.9					2.1	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.001	0.01		< 0.01
TRH 1.4 - 3.4m	Soil Contaminated Land			< 0.03			90.3	< 0.04	0.09	< 0.03			< 0.03			2.1			79		< 0.03		
TRH 1.4 - 3.4m	Soil Leachate 1:10	0.008	0.08		94.2	9.4					2.0	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.002	0.02		0.01
TRH 1.5 - 4-5m	Soil Contaminated Land			< 0.03			75.3	< 0.04	< 0.03	< 0.03			0.05			5.7			< 20		< 0.03		
TRH 1.5 - 4-5m	Soil Leachate 1:10	0.017	0.17		157.4	15.7					2.1	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.007	0.07		0.02
TRH 2.1 - 0-1m	Soil Contaminated Land			< 0.03			88.8	< 0.04	< 0.03	< 0.03			< 0.03			2.1			< 20		< 0.03		
TRH 2.1 - 0-1m	Soil Leachate 1:10	0.007	0.07		62.7	6.3					2.2	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.006	0.06		0.01
TRH 2.2 - 1-2m	Soil Contaminated Land			< 0.03			90.4	< 0.04	< 0.03	< 0.03			< 0.03			1.9			139		< 0.03		
TRH 2.2 - 1-2m	Soil Leachate 1:10	0.008	0.08		89.2	8.9					2.1	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.003	0.03		0.01
TRH 2.3 - 2-3m	Soil Contaminated Land			< 0.03			92.4	< 0.04	< 0.03	< 0.03			< 0.03			0.9			46		< 0.03		
TRH 2.3 - 2-3m	Soil Leachate 1:10	0.008	0.08		98.1	9.8					2.3	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.002	0.02		0.01
TRH 2.4 - 3-4m	Soil Contaminated Land			< 0.03			88.8	< 0.04	< 0.03	< 0.03			< 0.03			1.1			38		< 0.03		
TRH 2.4 - 3-4m	Soil Leachate 1:10	0.006	0.06		57.8	5.8					2.1	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.002	0.02		0.01
TRH 2.5 - 4-5m	Soil Contaminated Land			< 0.03			61.0	< 0.04	< 0.03	< 0.03			< 0.03			14.1			< 20		< 0.03		
TRH 2.5 - 4-5m	Soil Leachate 1:10	0.018	0.18		327.0	32.7					3.9	0.4		< 0.001	< 0.01		< 0.01	< 0.001		0.005	0.05		0.03
TRH 3.1 - 0-1m	Soil Contaminated Land			< 0.03			89.0	< 0.04	0.19	< 0.03			0.07			2.0			37		< 0.03		
TRH 3.1 - 0-1m	Soil Leachate 1:10	0.014	0.14		69.8	7.0					2.1	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.002	0.02		< 0.01
TRH 3.2 - 1-2m	Soil Contaminated Land			< 0.03			89.9	< 0.04	< 0.03	< 0.03			< 0.03			1.6			< 20		< 0.03		


 <b>Southern Scientific Services</b> <small>Consultancy and testing facility</small>		Copper (Cu)	Copper	Dibenz(a,h)anthracene	Dissolved Organic Carbon (DOC)	Dissolved Organic Carbon (DOC)	Dry Matter	Ethylbenzene	Fluoranthene	Fluorene	Fluoride	Fluoride	Indeno(1,2,3-cd)pyrene	Lead (Pb)	Lead	Loss On Ignition (LOI)	Mercury	Mercury	Mineral Oil (C10-C40)	Molybdenum (Mo)	Molybdenum	Naphthalene	Nickel
TRH 3.2 - 1-2m	Soil Leachate 1:10	0.011	0.11		92.4	9.2					2.2	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.001	0.01		< 0.01
TRH 3.3 - 2-3m	Soil Contaminated Land			< 0.03			91.5	< 0.04	0.04	0.03			< 0.03			1.1			< 20			< 0.03	
TRH 3.3 - 2-3m	Soil Leachate 1:10	0.008	0.08		91.4	9.1					2.1	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.002	0.02		0.02
TRH 3.4 - 3-4m	Soil Contaminated Land			< 0.03			90.9	< 0.04	< 0.03	< 0.03			< 0.03			0.8			< 20			< 0.03	
TRH 3.4 - 3-4m	Soil Leachate 1:10	0.006	0.06		68.2	6.8					1.8	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.001	0.01		0.02
TRH 3.5 - 4-5m	Soil Contaminated Land			< 0.03			70.7	< 0.04	< 0.03	< 0.03			< 0.03			9.1			< 20			< 0.03	
TRH 3.5 - 4-5m	Soil Leachate 1:10	0.017	0.17		101.9	10.2					2.4	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.020	0.20		0.03
TRH 4.1 - 0-1m	Soil Contaminated Land			< 0.03			82.1	< 0.04	0.04	< 0.03			< 0.03			4.5			51			< 0.03	
TRH 4.1 - 0-1m	Soil Leachate 1:10	0.014	0.14		138.1	13.8					2.3	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.005	0.05		0.01
TRH 4.2 - 1-2m	Soil Contaminated Land			< 0.03			87.4	< 0.04	< 0.03	< 0.03			< 0.03			2.1			44			< 0.03	
TRH 4.2 - 1-2m	Soil Leachate 1:10	0.009	0.09		126.3	12.6					2.2	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.003	0.03		< 0.01
TRH 4.3 - 2-3m	Soil Contaminated Land			< 0.03			92.3	< 0.04	< 0.03	< 0.03			< 0.03			1.0			< 20			< 0.03	
TRH 4.3 - 2-3m	Soil Leachate 1:10	0.009	0.09		82.1	8.2					1.7	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.002	0.02		0.02
TRH 4.4 - 3-4m	Soil Contaminated Land			< 0.03			54.7	< 0.04	< 0.03	< 0.03			< 0.03			18.7			< 20			< 0.03	
TRH 4.4 - 3-4m	Soil Leachate 1:10	0.012	0.12		223.1	22.3					2.7	0.3		< 0.001	< 0.01		< 0.01	< 0.001		0.007	0.07		0.03
TRH 4.5 - 4-5m	Soil Contaminated Land			< 0.03			58.5	< 0.04	< 0.03	< 0.03			< 0.03			13.0			< 20			< 0.03	
TRH 4.5 - 4-5m	Soil Leachate 1:10	0.015	0.15		264.6	26.5					2.9	0.3		< 0.001	< 0.01		< 0.01	< 0.001		0.010	0.10		0.02
TRH 5.1 - 0-1m	Soil Contaminated Land			< 0.03			89.5	< 0.04	< 0.03	< 0.03			< 0.03			1.8			48			< 0.03	
TRH 5.1 - 0-1m	Soil Leachate 1:10	0.008	0.08		123.7	12.4					2.0	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.007	0.07		< 0.01
TRH 5.2 - 1-2m	Soil Contaminated Land			< 0.03			86.9	< 0.04	0.03	< 0.03			0.05			1.6			58			< 0.03	
TRH 5.2 - 1-2m	Soil Leachate 1:10	0.010	0.10		115.1	11.5					1.9	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.005	0.05		< 0.01
TRH 5.3 - 2-3m	Soil Contaminated Land			< 0.03			92.5	< 0.04	< 0.03	< 0.03			< 0.03			1.0			< 20			< 0.03	
TRH 5.3 - 2-3m	Soil Leachate 1:10	0.011	0.11		109.2	10.9					1.6	0.2		< 0.001	< 0.01		< 0.01	< 0.001		0.002	0.02		0.02
TRH 5.4 - 3-4m	Soil Contaminated Land			< 0.03			69.2	< 0.04	< 0.03	< 0.03			< 0.03			9.2			< 20			< 0.03	


 Southern Scientific Services Consultancy and testing facility		Copper (Cu)	Copper	Dibenz(a,h)anthracene	Dissolved Organic Carbon (DOC)	Dissolved Organic Carbon (DOC)	Dry Matter	Ethylbenzene	Fluoranthene	Fluorene	Fluoride	Fluoride	Indeno(1,2,3-cd)pyrene	Lead (Pb)	Lead	Loss On Ignition (LOI)	Mercury	Mercury	Mineral Oil (C10-C40)	Molybdenum (Mo)	Molybdenum	Naphthalene	Nickel
TRH 5.4 - 3-4m	Soil Leachate 1:10	0.019	0.19		221.7	22.2					2.7	0.3		< 0.001	< 0.01		< 0.01	< 0.001		0.005	0.05		0.04
TRH 5.5 - 4-5m	Soil Contaminated Land			< 0.03			42.1	< 0.04	< 0.03	< 0.03			< 0.03			35.5			179			< 0.03	
TRH 5.5 - 4-5m	Soil Leachate 1:10	0.018	0.18		582.6	58.3					3.3	0.3		< 0.001	< 0.01		< 0.01	< 0.001		0.008	0.08		0.05


 Southern Scientific Services Consultancy and testing facility		Nickel	PCB BZ #101	PCB BZ #118	PCB BZ #138	PCB BZ #153	PCB BZ #180	PCB BZ #28	PCB BZ #52	Phenanthrene	Phenol Index	Phenols	Pyrene	Selenium	Selenium	Sulphate	Sulphate	Toluene	Total BTEX	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS)	
Client Sample Reference	Matirix	mg/L	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w	mg/L	mg/Kg d.w	mg/Kg d.w	mg/L	mg/Kg d.w	mg/L	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w	mg/L
TRH 1.1 - 0.1m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			0.06					< 0.03	< 0.13			
TRH 1.1 - 0.1m	Soil Leachate 1:10	0.002									< 1.0	0.03		0.02	0.002	117.7	11.8			800.0	80	
TRH 1.2 - 1-2m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	0.04			0.13					< 0.03	< 0.13			
TRH 1.2 - 1-2m	Soil Leachate 1:10	< 0.001									< 1.0	0.03		< 0.01	< 0.001	100.7	10.1			630.0	63	
TRH 1.3 - 2-3m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			0.08					< 0.03	< 0.13			
TRH 1.3 - 2-3m	Soil Leachate 1:10	< 0.001									< 1.0	0.03		< 0.01	< 0.001	2441.0	244.1			2820.0	282	
TRH 1.4 - 3.4m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	0.04			0.07					< 0.03	< 0.13			
TRH 1.4 - 3.4m	Soil Leachate 1:10	0.001									< 1.0	0.03		< 0.01	< 0.001	243.6	24.4			730.0	73	
TRH 1.5 - 4-5m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			0.03					< 0.03	< 0.13			
TRH 1.5 - 4-5m	Soil Leachate 1:10	0.002									< 1.0	0.03		0.02	0.002	189.4	18.9			950.0	95	
TRH 2.1 - 0-1m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13			
TRH 2.1 - 0-1m	Soil Leachate 1:10	0.001									< 1.0	0.03		< 0.01	< 0.001	100.4	10.0			760.0	76	
TRH 2.2 - 1-2m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13			
TRH 2.2 - 1-2m	Soil Leachate 1:10	0.001									< 1.0	0.03		< 0.01	< 0.001	118.8	11.9			680.0	68	
TRH 2.3 - 2-3m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13			




		Nickel	PCB BZ #101	PCB BZ #118	PCB BZ #138	PCB BZ #153	PCB BZ #180	PCB BZ #28	PCB BZ #52	Phenanthrene	Phenol Index	Phenols	Pyrene	Selenium	Selenium	Sulphate	Sulphate	Toluene	Total BTEX	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS)
TRH 2.3 - 2-3m	Soil Leachate 1:10	0.001									< 1.0	0.03		< 0.01	< 0.001	96.6	9.7			710.0	71
TRH 2.4 - 3-4m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 2.4 - 3-4m	Soil Leachate 1:10	0.001									< 1.0	0.05		0.03	0.003	479.5	47.9			710.0	71
TRH 2.5 - 4-5m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 2.5 - 4-5m	Soil Leachate 1:10	0.003									< 1.0	0.05		0.02	0.002	185.7	18.6			1100.0	110
TRH 3.1 - 0-1m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	0.09			0.14					< 0.03	< 0.13		
TRH 3.1 - 0-1m	Soil Leachate 1:10	< 0.001									< 1.0	0.03		0.08	0.008	977.5	97.7			1480.0	148
TRH 3.2 - 1-2m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 3.2 - 1-2m	Soil Leachate 1:10	< 0.001									< 1.0	0.03		0.01	0.001	519.1	51.9			1100.0	110
TRH 3.3 - 2-3m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	0.05			0.04					< 0.03	< 0.13		
TRH 3.3 - 2-3m	Soil Leachate 1:10	0.002									< 1.0	0.02		< 0.01	< 0.001	269.9	27.0			910.0	91
TRH 3.4 - 3-4m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 3.4 - 3-4m	Soil Leachate 1:10	0.002									< 1.0	0.03		< 0.01	< 0.001	54.9	5.5			520.0	52
TRH 3.5 - 4-5m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 3.5 - 4-5m	Soil Leachate 1:10	0.003									< 1.0	0.02		0.01	0.001	486.5	48.6			1160.0	116
TRH 4.1 - 0-1m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			0.03					< 0.03	< 0.13		
TRH 4.1 - 0-1m	Soil Leachate 1:10	0.001									< 1.0	0.06		0.01	0.001	149.6	15.0			830.0	83
TRH 4.2 - 1-2m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 4.2 - 1-2m	Soil Leachate 1:10	< 0.001									< 1.0	0.05		0.02	0.002	148.7	14.9			910.0	91
TRH 4.3 - 2-3m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 4.3 - 2-3m	Soil Leachate 1:10	0.002									< 1.0	0.08		< 0.01	< 0.001	59.3	5.9			710.0	71
TRH 4.4 - 3-4m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 4.4 - 3-4m	Soil Leachate 1:10	0.003									< 1.0	0.06		0.01	0.001	311.0	31.1			1440.0	144
TRH 4.5 - 4-5m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 4.5 - 4-5m	Soil Leachate 1:10	0.002									< 1.0	0.07		0.01	0.001	354.7	35.5			1490.0	149
TRH 5.1 - 0-1m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 5.1 - 0-1m	Soil Leachate 1:10	< 0.001									< 1.0	0.02		0.01	0.001	633.3	63.3			1150.0	115
TRH 5.2 - 1-2m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			0.03					< 0.03	< 0.13		


		Nickel	PCB BZ #101	PCB BZ #118	PCB BZ #138	PCB BZ #153	PCB BZ #180	PCB BZ #28	PCB BZ #52	Phenanthrene	Phenol Index	Phenols	Pyrene	Selenium	Selenium	Sulphate	Sulphate	Toluene	Total BTEX	Total Dissolved Solids (TDS)	Total Dissolved Solids (TDS)
TRH 5.2 - 1-2m	Soil Leachate 1:10	< 0.001									< 1.0	0.03		0.01	0.001	472.6	47.3			1030.0	103
TRH 5.3 - 2-3m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 5.3 - 2-3m	Soil Leachate 1:10	0.002									< 1.0	0.07		< 0.01	< 0.001	151.3	15.1			800.0	80
TRH 5.4 - 3-4m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 5.4 - 3-4m	Soil Leachate 1:10	0.004									< 1.0	0.08		< 0.01	< 0.001	131.3	13.1			980.0	98
TRH 5.5 - 4-5m	Soil Contaminated Land		< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.03			< 0.03					< 0.03	< 0.13		
TRH 5.5 - 4-5m	Soil Leachate 1:10	0.005									< 1.0	0.07		0.02	0.002	253.0	25.3			1700.0	170


		Total Organic Carbon (TOC)	Total PAH's	Total PCBs EC7 congeners	Zinc (Zn)	Zinc	m & p-Xylene	o-Xylene
Client Sample Reference	Matrix	% w/w	mg/Kg d.w	mg/Kg d.w	mg/L	mg/Kg d.w	mg/Kg d.w	mg/Kg d.w
TRH 1.1 - 0.1m	Soil Contaminated Land	4.48	0.66	2.10			< 0.04	< 0.04
TRH 1.1 - 0.1m	Soil Leachate 1:10				0.022	0.22		
TRH 1.2 - 1-2m	Soil Contaminated Land	2.47	0.99	2.10			< 0.04	< 0.04
TRH 1.2 - 1-2m	Soil Leachate 1:10				< 0.001	< 0.01		
TRH 1.3 - 2-3m	Soil Contaminated Land	1.27	< 0.48	2.10			< 0.04	< 0.04
TRH 1.3 - 2-3m	Soil Leachate 1:10				0.005	0.05		
TRH 1.4 - 3.4m	Soil Contaminated Land	1.91	< 0.48	2.10			< 0.04	< 0.04
TRH 1.4 - 3.4m	Soil Leachate 1:10				0.009	0.09		
TRH 1.5 - 4-5m	Soil Contaminated Land	4.66	< 0.48	2.10			< 0.04	< 0.04
TRH 1.5 - 4-5m	Soil Leachate 1:10				0.011	0.11		
TRH 2.1 - 0-1m	Soil Contaminated Land	4.00	< 0.48	2.10			< 0.04	< 0.04

 <b>Southern Scientific Services</b> Consultancy and testing facility		Total Organic Carbon (TOC)	Total PAH's	Total PCBs EC7 congeners	Zinc (Zn)	Zinc	m & p-Xylene	o-Xylene
TRH 2.1 - 0-1m	Soil Leachate 1:10				0.018	0.18		
TRH 2.2 - 1-2m	Soil Contaminated Land	4.97	< 0.48	2.10			< 0.04	< 0.04
TRH 2.2 - 1-2m	Soil Leachate 1:10				0.006	0.06		
TRH 2.3 - 2-3m	Soil Contaminated Land	2.10	< 0.48	2.10			< 0.04	< 0.04
TRH 2.3 - 2-3m	Soil Leachate 1:10				0.006	0.06		
TRH 2.4 - 3-4m	Soil Contaminated Land	4.62	< 0.48	2.10			< 0.04	< 0.04
TRH 2.4 - 3-4m	Soil Leachate 1:10				0.011	0.11		
TRH 2.5 - 4-5m	Soil Contaminated Land	9.15	< 0.48	2.10			< 0.04	< 0.04
TRH 2.5 - 4-5m	Soil Leachate 1:10				0.020	0.20		
TRH 3.1 - 0-1m	Soil Contaminated Land	3.15	0.99	2.10			< 0.04	< 0.04
TRH 3.1 - 0-1m	Soil Leachate 1:10				0.027	0.27		
TRH 3.2 - 1-2m	Soil Contaminated Land	2.45	< 0.48	2.10			< 0.04	< 0.04
TRH 3.2 - 1-2m	Soil Leachate 1:10				0.012	0.12		
TRH 3.3 - 2-3m	Soil Contaminated Land	4.24	< 0.48	2.10			< 0.04	< 0.04
TRH 3.3 - 2-3m	Soil Leachate 1:10				0.010	0.10		
TRH 3.4 - 3-4m	Soil Contaminated Land	4.32	< 0.48	2.10			< 0.04	< 0.04
TRH 3.4 - 3-4m	Soil Leachate 1:10				0.004	0.04		
TRH 3.5 - 4-5m	Soil Contaminated Land	6.09	< 0.48	2.10			< 0.04	< 0.04
TRH 3.5 - 4-5m	Soil Leachate 1:10				0.017	0.17		
TRH 4.1 - 0-1m	Soil Contaminated Land	4.59	< 0.48	2.10			< 0.04	< 0.04
TRH 4.1 - 0-1m	Soil Leachate 1:10				0.025	0.25		
TRH 4.2 - 1-2m	Soil Contaminated Land	3.85	< 0.48	2.10			< 0.04	< 0.04
TRH 4.2 - 1-2m	Soil Leachate 1:10				0.010	0.10		
TRH 4.3 - 2-3m	Soil Contaminated Land	5.49	< 0.48	2.10			< 0.04	< 0.04
TRH 4.3 - 2-3m	Soil Leachate 1:10				0.010	0.10		
TRH 4.4 - 3-4m	Soil Contaminated Land	9.09	< 0.48	2.10			< 0.04	< 0.04
TRH 4.4 - 3-4m	Soil Leachate 1:10				0.048	0.48		
TRH 4.5 - 4-5m	Soil Contaminated Land	9.43	< 0.48	2.10			< 0.04	< 0.04

 <b>Southern Scientific Services</b> Consultancy and testing facility		Total Organic Carbon (TOC)	Total PAH's	Total PCBs EC7 congeners	Zinc (Zn)	Zinc	m & p-Xylene	o-Xylene
TRH 4.5 - 4-5m	Soil Leachate 1:10				0.027	0.27		
TRH 5.1 - 0-1m	Soil Contaminated Land	3.68	< 0.48	2.10			< 0.04	< 0.04
TRH 5.1 - 0-1m	Soil Leachate 1:10				0.002	0.02		
TRH 5.2 - 1-2m	Soil Contaminated Land	3.00	< 0.48	2.10			< 0.04	< 0.04
TRH 5.2 - 1-2m	Soil Leachate 1:10				0.014	0.14		
TRH 5.3 - 2-3m	Soil Contaminated Land	5.99	< 0.48	2.10			< 0.04	< 0.04
TRH 5.3 - 2-3m	Soil Leachate 1:10				0.009	0.09		
TRH 5.4 - 3-4m	Soil Contaminated Land	5.46	< 0.48	2.10			< 0.04	< 0.04
TRH 5.4 - 3-4m	Soil Leachate 1:10				0.029	0.29		
TRH 5.5 - 4-5m	Soil Contaminated Land	15.54	< 0.48	2.10			< 0.04	< 0.04
TRH 5.5 - 4-5m	Soil Leachate 1:10				0.036	0.36		

## Appendix IV - Complete Groundwater Results

 <b>Southern Scientific Services</b> <small>Consultancy and testing facility</small>	<b>Project</b>	Tullow Rd Ennis				
	<b>Sampler</b>	M Murphy				
	<b>Client Sample Reference</b>	<b>Trial Hole 1</b>	<b>Trial Hole 2</b>	<b>Trial Hole 3</b>	<b>Trial Hole 4</b>	<b>Trial Hole 5</b>
<b>1,2-Dichloroethane</b>	µg/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
<b>2,4-D</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>2,6 Dichlorobenzamide</b>	µg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
<b>Acenaphthene</b>	µg/L	0.591	0.069	0.107	0.016	0.161
<b>Acenaphthylene</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Aluminium</b>	µg/L	1221	2526	3310	5568	5038
<b>Ammonium</b>	mg/L N	9.11	7.63	9.17	3.48	8.24
<b>Anthracene</b>	µg/L	0.094	< 0.005	0.027	< 0.005	0.015
<b>Arsenic</b>	µg/L	6	13	7	7	10
<b>Atrazine</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Bentazone</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Benz(a)anthracene</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Benzene</b>	µg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
<b>Benzo(a)pyrene</b>	µg/L	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
<b>Benzo(b)fluoranthene</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Benzo(ghi)perylene</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Benzo(k)fluoranthene</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Bis(2-ethylhexyl)phthalate</b>	µg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
<b>Chloride</b>	mg/L	19.5	21.2	16.9	19.9	18.1
<b>Chromium VI</b>	mg/L	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
<b>Chromium</b>	µg/L	6	9	13	17	16
<b>Chrysene</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Conductivity</b>	µS/cm @ 20 °C	1064	1215	1024	733	1040
<b>Cypermethrin</b>	µg/L	< 0.012	< 0.012	< 0.012	< 0.012	< 0.012
<b>Dibenz(a,h)anthracene</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Dichlobenil</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Dichloromethane</b>	µg/L	< 1	< 1	< 1	< 1	< 1
<b>Diuron</b>	µg/L	0.006	< 0.005	0.006	< 0.005	0.019
<b>Fluoranthene</b>	µg/L	0.100	< 0.005	0.029	0.006	0.032

 <b>Southern Scientific Services</b> <small>Consultancy and testing facility</small>	<b>Project</b>	<b>Tullow Rd Ennis</b>				
	<b>Sampler</b>	<b>M Murphy</b>				
	<b>Client Sample Reference</b>	<b>Trial Hole 1</b>	<b>Trial Hole 2</b>	<b>Trial Hole 3</b>	<b>Trial Hole 4</b>	<b>Trial Hole 5</b>
<b>Fluorene</b>	µg/L	0.190	0.013	0.042	0.005	0.061
<b>Glyphosate</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Indeno(1,2,3-cd)pyrene</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Isoproturon</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Lead</b>	µg/L	15	36	15	8	17
<b>MCPA</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>MCPP (Mecoprop)</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Mercury</b>	µg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
<b>Methyl Tertiary Butyl Esther</b>	µg/L	< 1	< 1	< 1	< 1	< 1
<b>Mol Reactive Phosphorus (MRP)</b>	mg/L P	< 0.01	0.01	0.06	0.01	0.01
<b>Naphthalene</b>	µg/L	0.305	0.005	0.028	< 0.005	0.008
<b>Nitrate</b>	mg/L N	< 0.25	< 0.25	< 0.25	< 0.25	< 0.25
<b>Nitrite</b>	mg/L N	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Phenanthrene</b>	µg/L	0.357	0.011	0.097	0.007	0.047
<b>Pyrene</b>	µg/L	0.064	< 0.005	0.017	0.006	0.026
<b>Simazine</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Sulphate</b>	mg/L	14.6	248.7	140.5	62.1	147.0
<b>Sum Benzo (b)&amp;(k) fluoranthene</b>	µg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
<b>Tetrachloroethene</b>	µg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
<b>Tetrahydrofuran</b>	µg/L	< 1	< 1	< 1	< 1	< 1
<b>Toluene</b>	µg/L	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
<b>Total PAH</b>	µg/L	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
<b>Total Petroleum Hydrocarbons (C10 - C40)</b>	µg/L	235.9	154.1	114.3	101.0	126.3
<b>Trichloroethene</b>	µg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
<b>Vinyl Chloride</b>	µg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
<b>Zinc (Zn)</b>	µg/L	25	47	30	26	39
<b>cis-1,2-Dichloroethene</b>	µg/L	< 1	< 1	< 1	< 1	< 1
<b>trans-1,2-Dichloroethene</b>	µg/L	< 1	< 1	< 1	< 1	< 1