



**FEHILY
TIMONEY**

**CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE & PLANNING**

APPENDIX 1

Tier 1 Study, Kerry County
Council, 2009

Revised Tier 1 Study, Fehily
Timoney and Company,
October 2019

*For inspection purposes only.
Consent of copyright owner required for any other use.*



Comhairle Contae Chiarraí

Kerry County Council

► Tier 1 Review Report – Ardfert ◀

S22 - 02665

November 2013

Prepared by:

*Environmental Services,
Kerry County Council.*

*Seirbhísí Comhshaoil,
Comhairle Contae Chiarraí.*

1.0 Contents.

Section	Description	Page
1.0	Contents	2
2.0	Introduction	3
3.0	Risk Assessment Methodology – Tier 1	3
3.1	Introduction	
3.2	Risk Screening	
3.3	Desk Study (Tier 1 Assessment)	
3.4	Walk Over Survey	
4.0	Site Summary	5
4.1	Location	
4.2	Site Layout and Extent of Waste	
4.3	Available Aerial Photography	
4.4	Designated Sites	
4.5	Water Resources	
4.6	Groundwater vulnerability and Aquifer	
4.7	Surface Water	
4.8	Landfill Gas	
5.0	Conclusions	14
6.0	Attachments	
6.1	Risk Screening, Information Sources and Walk Over Survey	
6.2	Typical Photographs	
6.3	Risk Assessment (2007)	

For inspection purposes only.
Consent of copyright owner required for any other use.

2.0 Introduction.

In 2007 an initial Tier 1 Risk Assessment of all identified unregulated waste disposal sites was undertaken by the Environment Section of Kerry County Council.

The assessment was completed on foot of;

- the Ministerial Direction (WIR 04/05) reminding Local Authorities of their responsibilities under Section 22 of the Waste Management Acts, 1996 to 2005
- the Environmental Protection Agency's Code of Practice (CoP) - Environmental Risk Assessment for Unregulated Waste Disposal Sites.

The site was subsequently registered on the EPA Section 22 Register and given the reference code S22-02665. It was assigned a Moderate Risk (Class B) classification.

A copy of the assessment is included in Attachment No 6.3 for reference.

This report updates the initial assessment taking cognisance of the guidance within the CoP to review sites on an annual basis and in light of SI 524 of 2008, Waste Management (Certification of Historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008.

3.0 Risk Assessment Methodology – Tier 1

3.1 Introduction

Tier 1 of the Risk Assessment Methodology - Conceptual Site Model, Risk Screening and Prioritisation includes a preliminary investigation of the site and also comprises the development of a Conceptual Site Model using information obtained from the desk study and site inspection.

The Conceptual Site Model outlines the different Source-Pathway-Receptor (SPR) linkages and provides information for the risk-screening element. The information gleaned from the desk appraisal and walk over survey is summarised in the Attachment No 6.1.

3.2 Risk Screening

Risk screening represents an assessment of the SPR linkages in the conceptual model. The Conceptual Site Model identifies each of the elements of the linkage present for the site and the associated uncertainty.

The Conceptual Site Model will determine whether a site represents (or potentially represents) an unacceptable intrinsic risk to any receptor.

The risk that is being assessed is the intrinsic risk that the activity poses without any mitigation measures having been put in place. The actual risk posed to the environment will be reduced following remediation measures.

3.3 Desk Study (Tier 1 Risk Assessment)

A desk study of the site has been undertaken. The information has been gathered from various sources including:

- Local authority sources including records and interview,
 - ground water vulnerability maps
 - surface water channels
 - aquifer data
 - sources of public water supplies
 - NHA, SAC, SPA register map
- Section 22 register (existing)
- Waste Plans

- Complaints database
- Permit register
- EPA waste reports (including NWD report)
- EPA IPPC facilities
- EPA waste licenced facilities
- An Foras Forbatha reports
- Aerial photography

3.4 Walk Over Survey.

A walk over survey has been conducted on the identified site.

The results have been recorded in Attachment 6.1 and the allocation of scores to the Risk Prioritisation exercise has been amended accordingly.

Typical photographs of the site are included in Attachment 6.2.

*For inspection purposes only.
Consent of copyright owner required for any other use.*

4.0 Site Summary.

Location.

The unregulated closed site is located in the townland of Ardfert.

The site is bounded to the west by a regional road and on other sides by antiquity sites.

The site is known as Ardfert landfill.

Site Location



Site Layout and extent of waste.

The exact footprint of the waste as placed is as yet unknown pending further investigations.

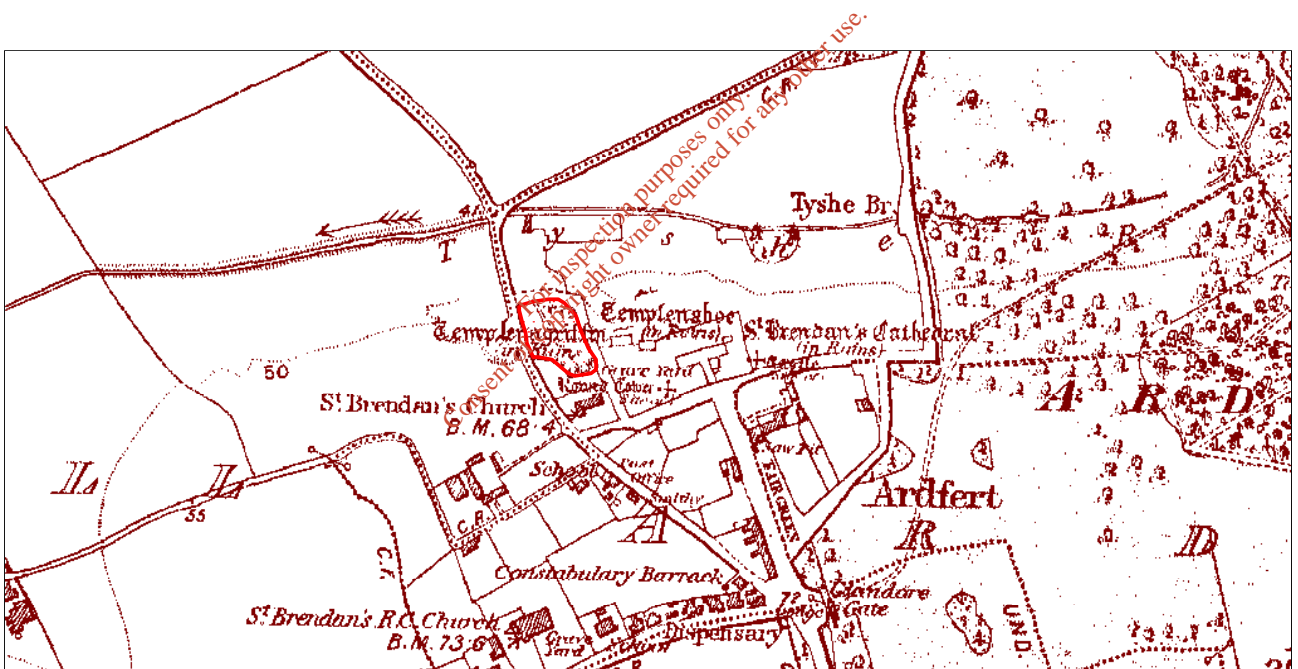
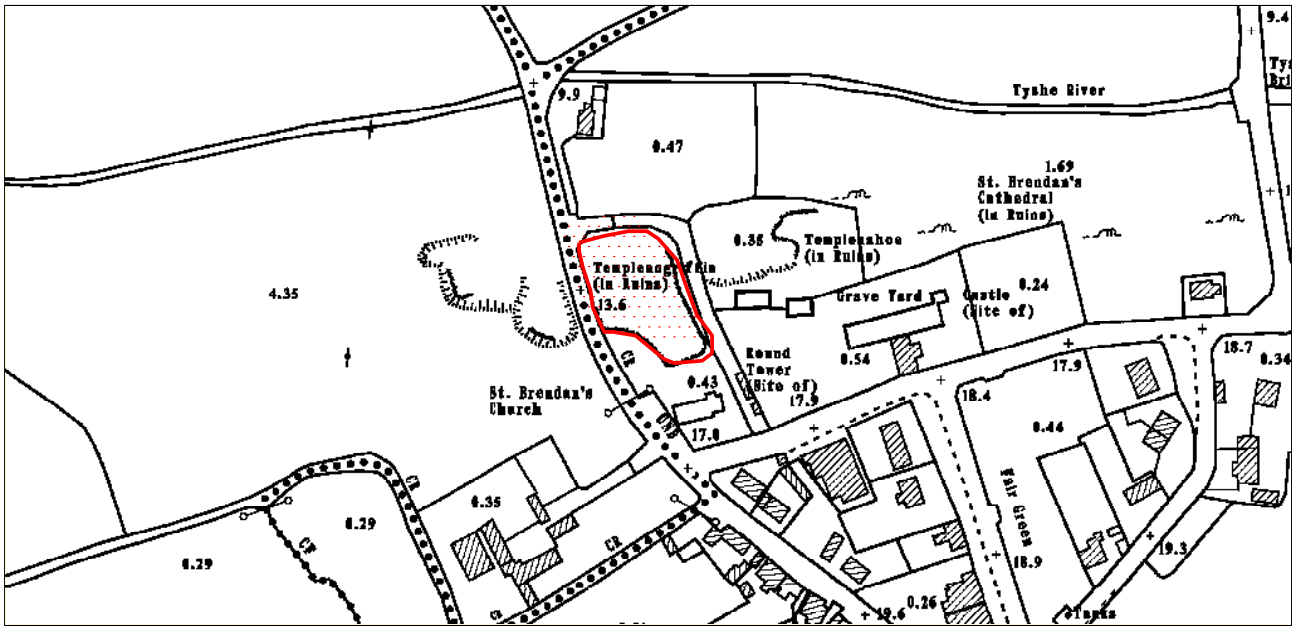
The extent is therefore taken as the full area of the property holding in which the activity took place which is approximately 0.35Ha.

The grid reference to the approximate centre of the property holding is 78,656/120,970.

The following layout map outlines the surrounding land use and geographic features.

The site is unregistered.

Site Layout



Waste activities had ceased before the completion of the 1998 Waste Management Plan for Kerry.

There was no entry in the An Foras Forbartha report on National Database on Waste in 1986. It is assumed that the waste activity ceased prior to this date.

Based on the above this score is used in the Risk Assessment	Table 1A and 1B	Score 5
--	-----------------	---------

Available Aerial photography

There are sets of available aerial photography from 1995 to 2004. These are presented in the following pages

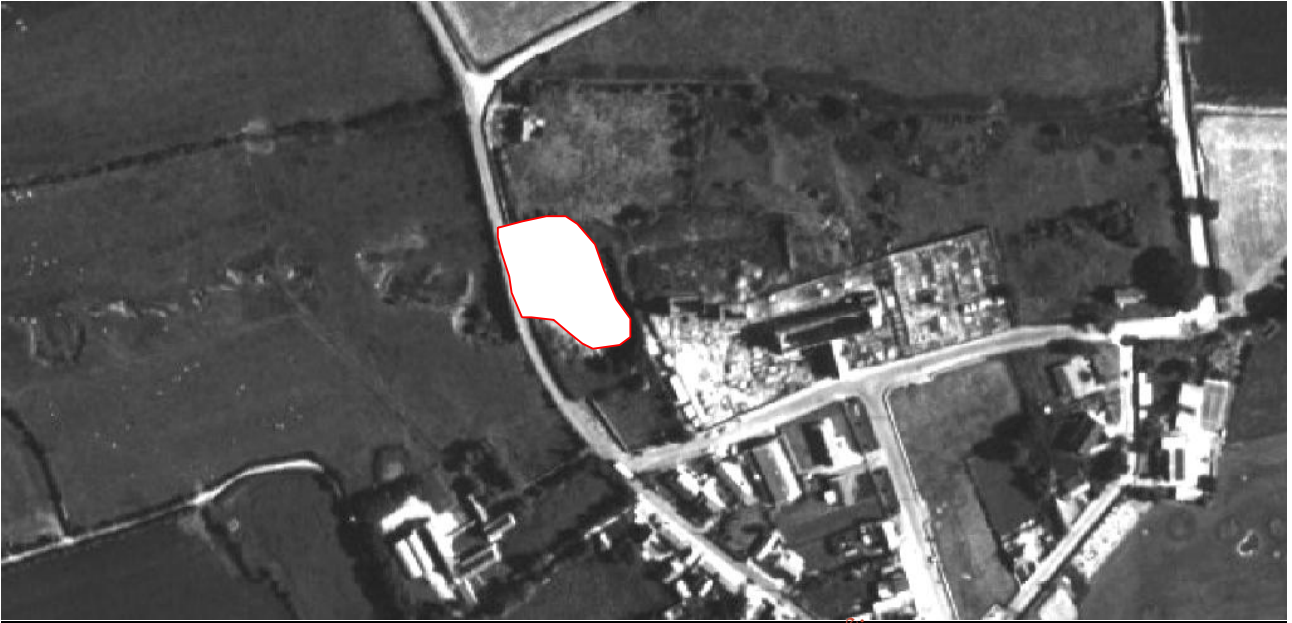
Aerial Photography - 2004



Aerial Photography - 2000



Aerial Photography - 1995



Aerial Photography - Year 2004 (source GSI).

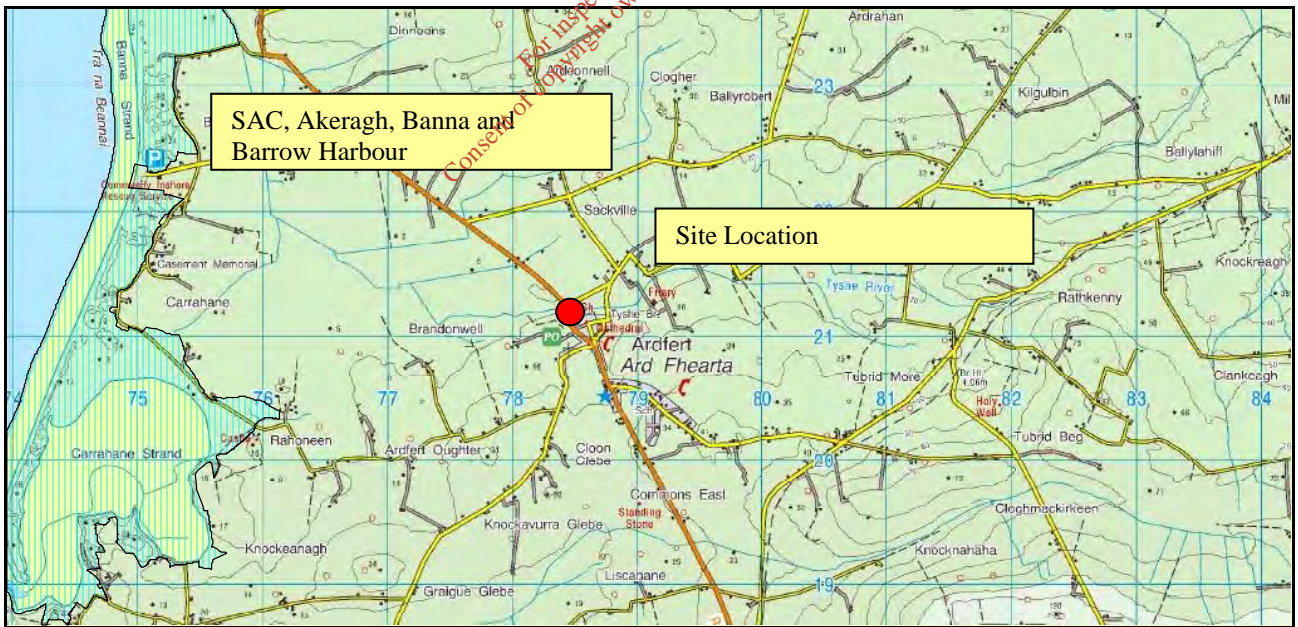


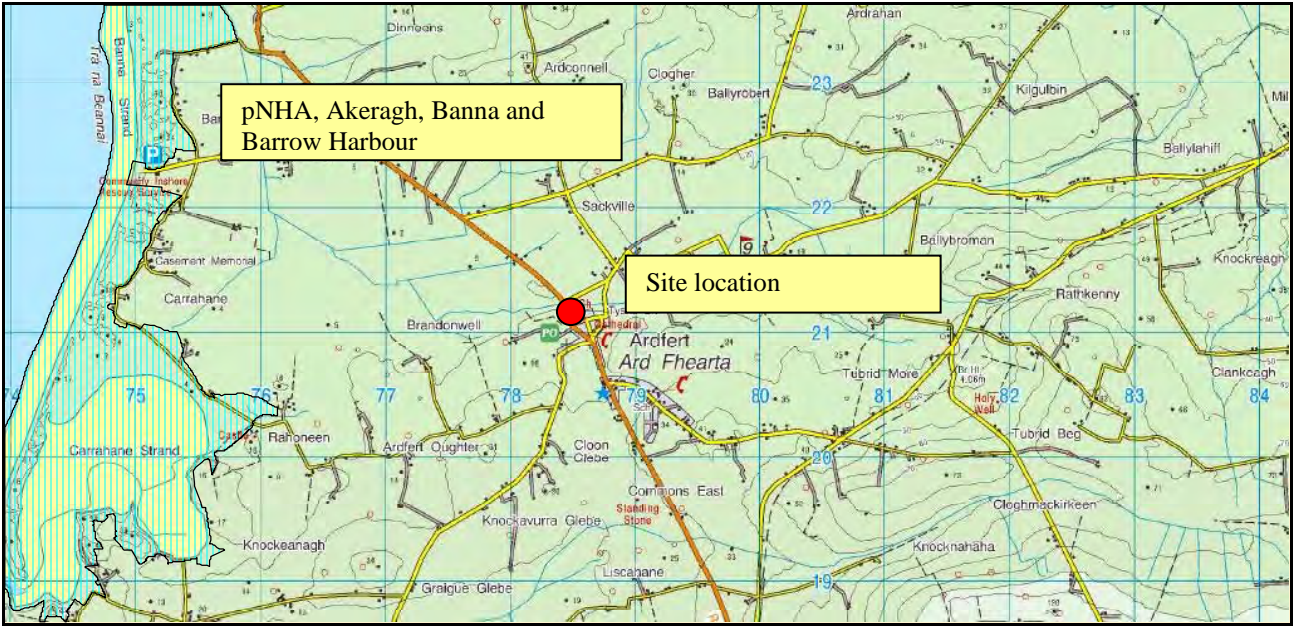
Designated Sites

The site is 2.47 km east of the proposed NHA, SAC. The areas are co-incident.

The designation is current to September 2011.

Designated Sites

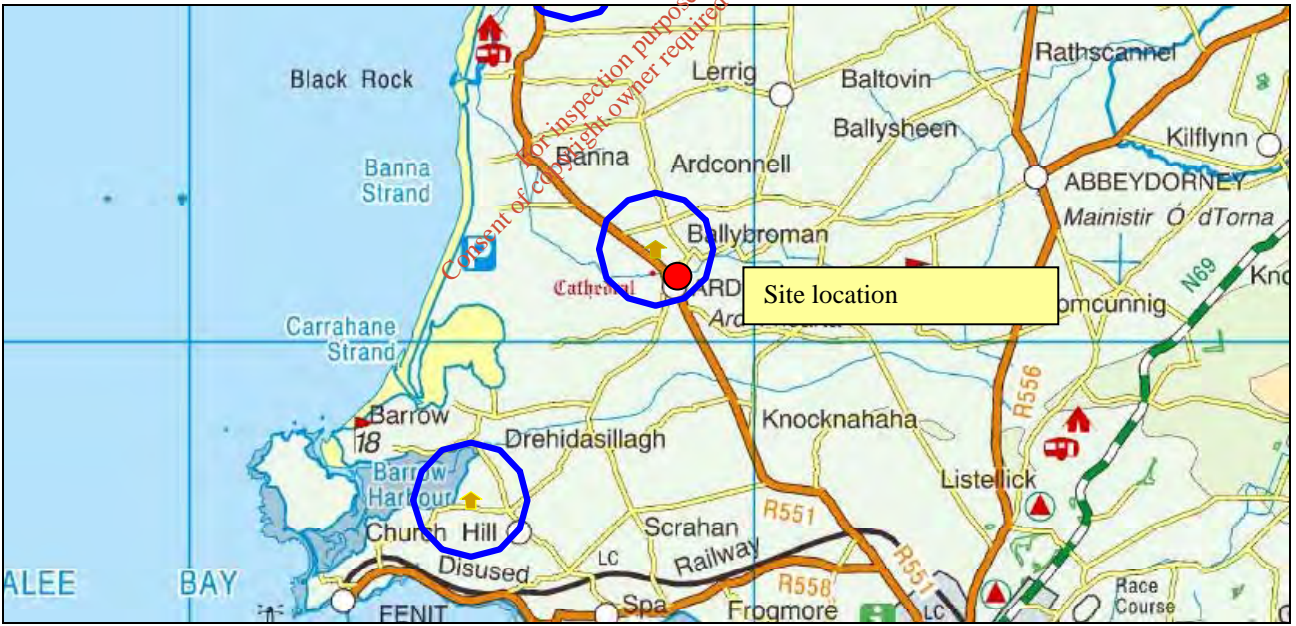




Based on the above this score is used in the Risk Assessment	Table 3B	Score 0
--	----------	---------

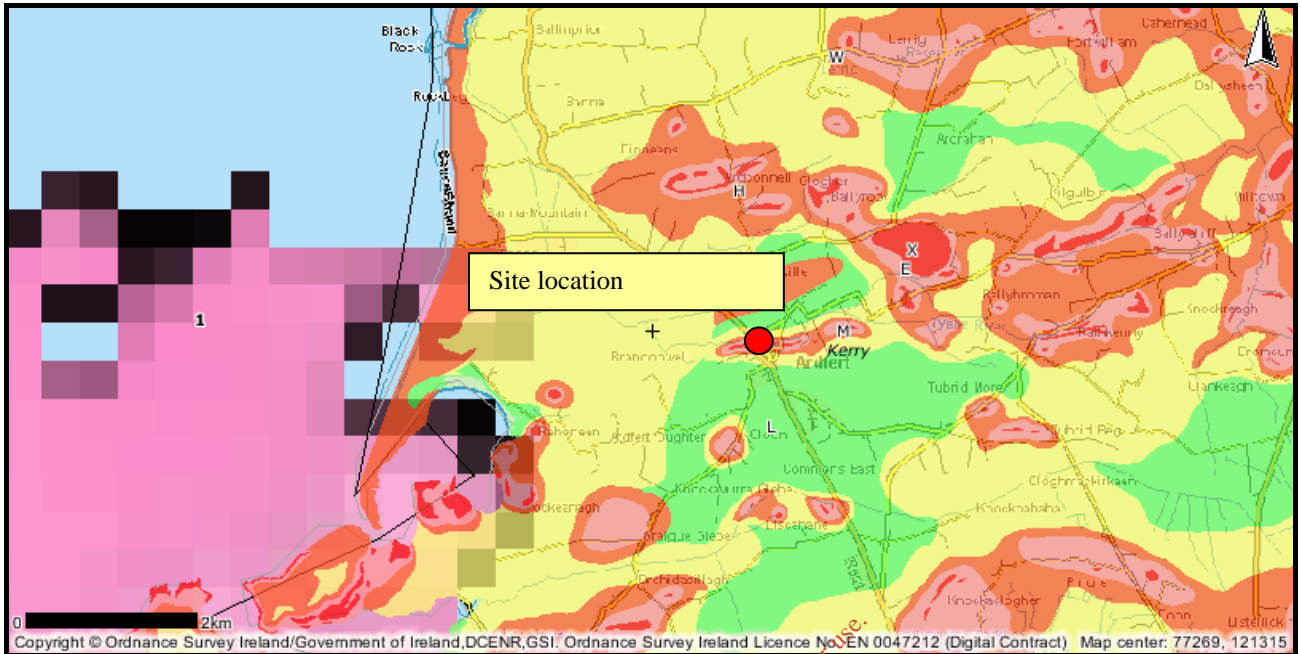
Water Resources

The site is located within a Source Protection Area. It is within the 1 km buffer zone.



Based on the above this score is used in the Risk Assessment	Table 3D	Score 5
--	----------	---------

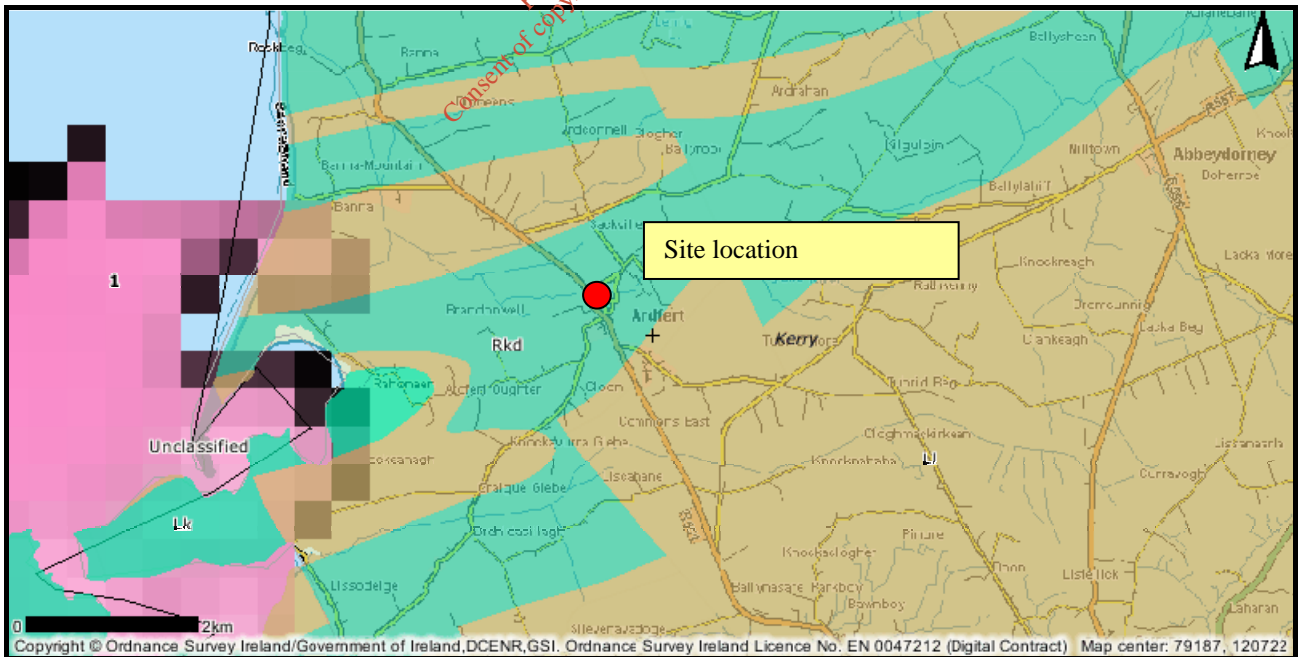
Groundwater Vulnerability



The site is located in an area that is taken as extreme (X).

Based on the above this score is used in the Risk Assessment	Table 2A	Score 3
--	----------	---------

Aquifer Status

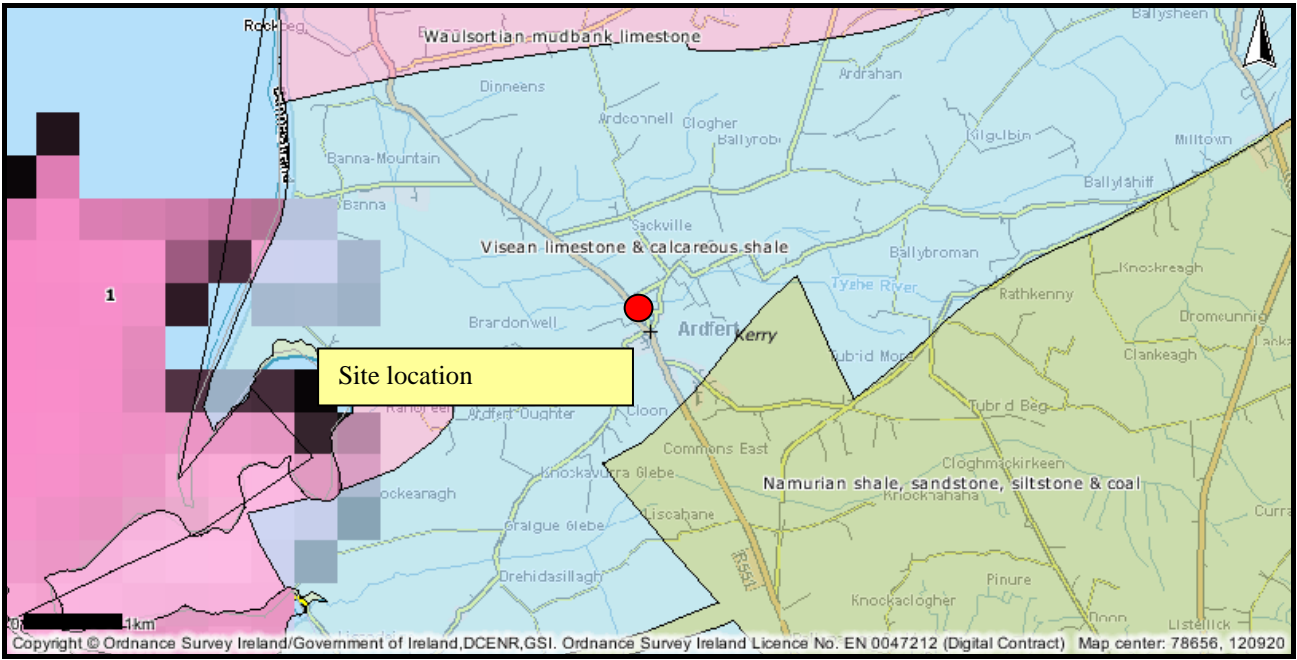


The Rkd status implied that the bedrock aquifer is regionally important.

Based on the above this score is used in the Risk Assessment	Table 3C	Score 5
--	----------	---------

Based on the above this score is used in the Risk Assessment	Table 2B	Score 5
--	----------	---------

Bedrock Geology

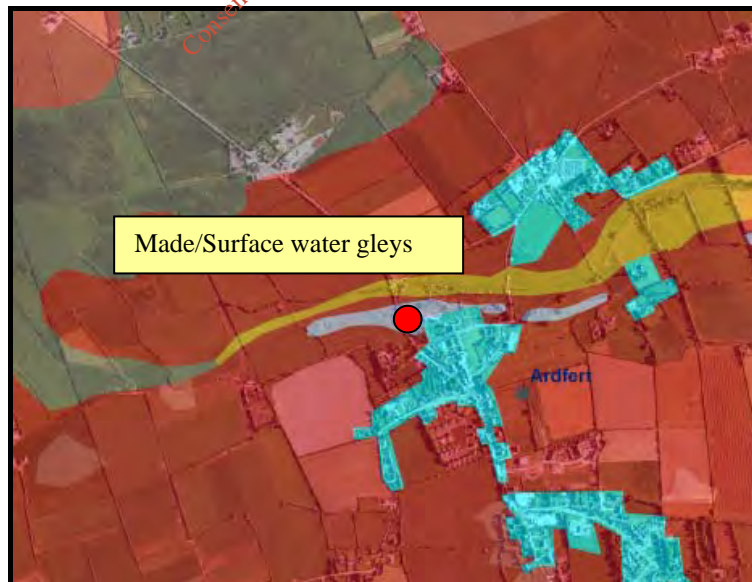


Surface water.

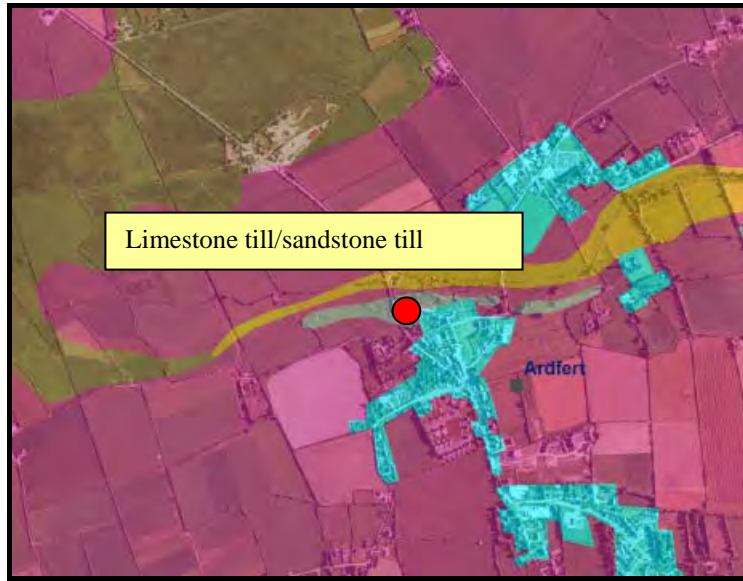
The Tyshe River is to the north of the site – the watercourse bounds the adjacent site, the watercourse is within 100m from the site.

Based on the above this score is used in the Risk Assessment	Table 2C	Score 0
Based on the above this score is used in the Risk Assessment	Table 3E	Score 2

Soil Types



Sub-soil Categorisation



Landfill Gas

Reference to the location map indicates that the closest domestic dwellings is approximately 100 m from the site.

There is no dwelling above the footprint of the waste.

Based on the above this score is used in the Risk Assessment	Table 2D	Score 3
Based on the above this score is used in the Risk Assessment	Table 2E	Score 5
Based on the above this score is used in the Risk Assessment	Table 3A	Score 2
Based on the above this score is used in the Risk Assessment	Table 3F	Score 3

5.0 Conclusions

Summary of Risk Screening.

The following tables set out the scores used in the risk screening exercise and the results of that exercise.

Summary of Risk Screening Scores

Table	Description	Score
Source	1A Leachate; source/hazard scoring matrix	5.0
	1B Landfill gas; source/hazard scoring matrix	5.0
Pathway	2A Leachate migration; pathways (gw vulnerability)	3.0
	2B Leachate migration; pathways (gw flow)	5.0
	2C Leachate migration; pathways (sw pathway)	0.0
	2D Landfill gas; lateral migration	3.0
	2E Landfill gas; upward migration	5.0
Receptor	3A Leachate migration; receptors, human	2.0
	3B Leachate migration; receptors, protected areas	0.0
	3C Leachate migration; receptors, aquifers	5.0
	3D Leachate migration; receptors, public water supply	5.0
	3E Leachate migration; receptors, surface water	2.0
	3F Landfill gas; receptor, human presence	3.0

Summary of SPR Linkages.

		SPR score	Max	Normalised	Risk
SPR 1	1a * (2a + 2b + 2c) * 3e	80	300	27%	LOW
SPR 2	1a * (2a + 2b + 2c) * 3b	0	300	0%	LOW
SPR 3	1a * (2a + 2b) * 3a	80	240	33%	LOW
SPR 4	1a * (2a + 2b) * 3b	0	240	0%	LOW
SPR 5	1a * (2a + 2b) * 3c	200	400	50%	MODERATE
SPR 6	1a * (2a + 2b) * 3d	200	560	36%	LOW
SPR 7	1a * (2a + 2b) * 3e	80	240	33%	LOW
SPR 8	1a * 2c * 3e	0	60	0%	LOW
SPR 9	1a * 2c * 3b	0	60	0%	LOW
SPR 10	1b * 2d * 3f	45	150	30%	LOW
SPR 11	1b * 2e * 3f	75	250	30%	LOW

Based on the above assessment this is a MODERATE RISK CLASS B Site

Based upon the desktop appraisal and walk over survey the calculated risk associated with this site is MODERATE.

6.0 Attachments

- 6.1 Risk Screening, Information Sources and Walk Over Survey
- 6.2 Typical Photographs (walk over survey, 2013)
- 6.3 Risk Assessment 2007

For inspection purposes only.
Consent of copyright owner required for any other use.

Site Reference**S22 - 02665
Ardfert****1. Site Information check list**

Authorisation	None - registered on EPA S22 register as S22-02665
Site Name	Ardfert
Address of townland	
Address 1	Ardfert
County	Kerry
LA functional area	Kerry County Council
Location Map	Yes
Easting	121129
Northing	78553
Source of information	KCC Sources
Owner/occupier	Not registered
Waste activity	Disposal
Estimated tonnage of waste	
Hazardous waste present or unknown	Unknown
Verificatin method	
Known Impacts	
Year opened	
Year closed	Pre 1986 (to be confirmed)
Status	
Containment, total/partial/none	Partial (capping)
Containment, base liner	None
Containment, capping	Partial clay capping
LFG management	None
Leachate collection	None
Vector map reference	

*For inspection purposes only.
Consent of copyright owner required for any other use.*

2. Sources of information check list

Local authority sources	Yes
LA records and knowledge	Yes
Section 22 register (existing)	Yes
Waste Plans	Yes (no entry)
Special Waste Plans	
Section 55 notices	
Section 18 notices	
Complaints database (LA, EPA)	
LA permit register	
Toxic and Dangerous waste register	
Waste oils register	
Derelict buildings register	
Planning files	
LA quarries register	
EPA sources	
EPA waste reports (incl NWD report)	No reference in 1986 report
EPA IPPC facilities	
EPA waste licenced facilities	
IPPC reports	
EPA applicant files	
Other sources	
An Foras Forbatha reports	Yes
Trade directories	
GSI quarries directory	
Aerial photography	Yes
Remote sensing	
Aerial survey	
Newspaper advertisement	

For inspection purposes only.
Consent of copyright owner required for any other use.

<i>Walkover Survey Checklist</i>	<i>Comment</i>
Site	Ardfert
What is current landuse	Unused and overgrown
What are the neighbouring land uses	Residential, antiquity, agricultural
What is the size of the site	0.35 Ha
What is the topography	Concave
Are there potential receptors (if yes - details)	Yes
Houses	Yes
Surface water features (if yes distance and direction of flow)	Yes
Any wetland or protected area	No
Public water supplies	No
Private wells	None visible
Services	None visible
Other buildings	Yes
Other	At the outskirts of the village area
Are there any potential sources of contamination (if yes give details)	
Surface waste (if yes what type)	None visible
Surface ponding of leachate	None visible

Consent of copyright owner required for any other use.
For inspection purposes only.

Leachate seepage	None visible
Landfill gas odours	None
Are there any outfalls to surface water	None visible
Are there any signs of impact on the environment (if yes take photographic evidence)	
Vegetation die off, bare ground	No
Leachate seepage	No
Odours	No
Litter	No
Gas bubbling through water	No
Signs of settlement, subsidence water logged areas	No
Drainage or hydraulic issues	No
Downstream water quality appears poorer than upstream water quality	No visible effects
Are there any indications of remedial measures (provide details)	Yes
Capping	Capped with inert material
Landfill gas collection	None
Leachate collection	None
Describe fences and security features (if any)	Ditch and hedgerow surround
Any other relevant information	Adjacent to antiquity
Site name and reference;	Ardfert S22 - 02665
Date of inspection;	October 25th 2013
Walk over survey by;	Conor Cullo

For inspection purposes only.
Consent of copyright owner required for any other use.

SPR Linkages - Risk Screening

Table	Description	Score		SPR	Max	Normalised	Risk	
1A	Leachate; source/hazard scoring matrix	5.0	SPR 1	1a * (2a + 2b + 2c) *	80	300	27%	LOW
1B	Landfill gas; source/hazard scoring matrix	5.0	SPR 2	1a * (2a + 2b + 2c) *	0	300	0%	LOW
			SPR 3	1a * (2a + 2b) * 3a	80	240	33%	LOW
2A	Leachate migration; pathways (gw vulnerability)	3.0	SPR 4	1a * (2a + 2b) * 3b	0	240	0%	LOW
2B	Leachate migration; pathways (gw flow)	5.0	SPR 5	1a * (2a + 2b) * 3c	200	400	50%	MODERATE
2C	Leachate migration; pathways (sw pathway)	0.0	SPR 6	1a * (2a + 2b) * 3d	200	560	36%	LOW
2D	Landfill gas; lateral migration	3.0	SPR 7	1a * (2a + 2b) * 3e	80	240	33%	LOW
2E	Landfill gas; upward migration	5.0	SPR 8	1a * 2c * 3e	0	60	0%	LOW
			SPR 9	1a * 2c * 3b	0	60	0%	LOW
3A	Leachate migration; receptors, human	2.0	SPR 10	1b * 2d * 3f	45	150	30%	LOW
3B	Leachate migration; receptors, protected areas	0.0	SPR 11	1b * 2e * 3f	75	250	30%	LOW
3C	Leachate migration; receptors, aquifers	5.0						
3D	Leachate migration; receptors, public water supply	5.0						
3E	Leachate migration; receptors, surface water	2.0						
3F	Landfill gas; receptor, human presence	3.0						

For inspection purposes only. Consent of copyright owner required for any other use.

For inspection purposes only.
Consent of copyright owner required for any other use.





For inspection purposes only
Consent of copyright owner required for any other use





For inspection purposes only.
Consent of copyright owner required for any other use.

For inspection purposes only.
Consent of copyright owner required for any other use.

ARDFERT

Environmental risk assessment for unregulated waste disposal sites

<u>Maximum linkage score</u>	<u>Normalised score %</u>
300	26.67
300	0.00
240	50.00
240	0.00
400	50.00
560	21.43
240	33.33
60	0.00
60	0.00
150	33.33
250	0.00

Rationale

Municipal waste <1 ha

Municipal waste <1 ha

Extreme

Regionally important aquifer

no direct contact with SW body

Bedrock outcrops as per Teagasc maps on GSI website

No structures present above waste body

dwelling house within 50m of waste body

Need confirmation from Duchas

Regionally important aquifer as per GSI website

South Ardfert water source 570m from waste body

For inspection purposes only.
Consent of copyright owner required for any other use.

SW body >50m & <250m of site boundary

Human presence <50m

*For inspection purposes only.
Consent of copyright owner required for any other use.*

	SPR linkage score
SPR1	80
SPR2	0
SPR3	120
SPR4	0
SPR5	200
SPR6	120
SPR7	80
SPR8	0
SPR9	0
SPR10	50
SPR11	0

<u>Table no.</u>	<u>Score</u>
Table 1a, Leachate hazard	5
Table 1b, Landfill gas hazard	5
Table 2a, Leachate migration, GW vulnerability	3
Table 2b, Leachate migration, GW flow regime	5
Table 2c, Leachate migration SW drainage	0
Table 2d, Landfill gas Lateral migration	2
Table 2e, Landfill gas Vertical Migration	0
Table 3a, Leachate migration Human presence	3
Table 3b, Leachate migration Protected areas	0
Table 3c, Leachate migration Aquifer category	5
Table 3d, Leachate migration	3

For inspection purposes only.
Consent of copyright owner required for any other use.

Public water supplies

Table 3e, Leachate migration
Surface water bodies

2

Table 3f, Landfill gas
Human presence

5

*For inspection purposes only.
Consent of copyright owner required for any other use.*



28/06/2007

For inspection purposes only.
Consent of copyright owner required for any other use.



28/06/2007



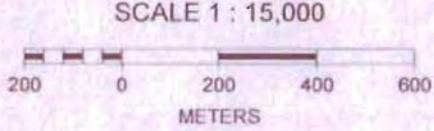
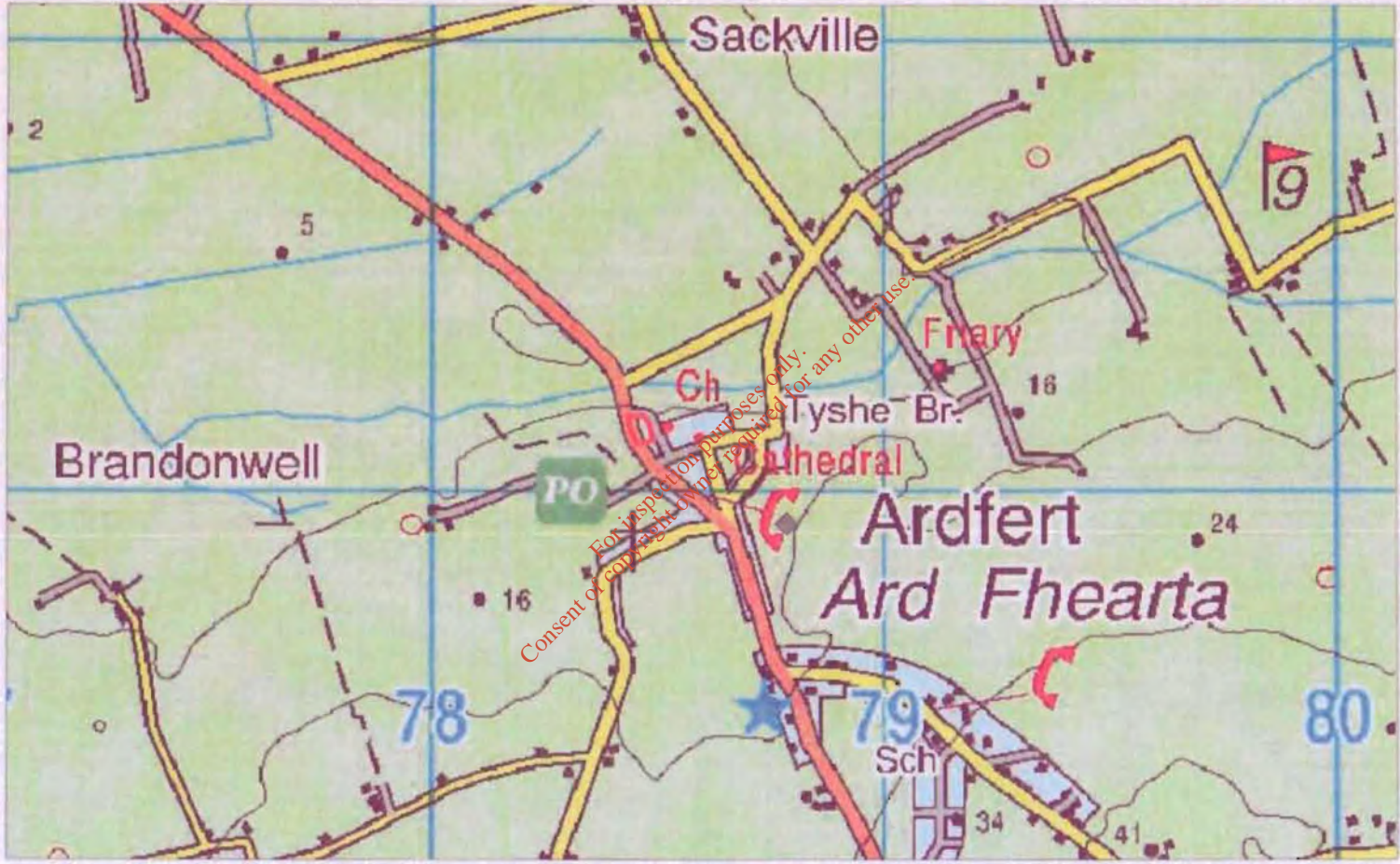
For inspection purposes only.
Consent of copyright owner required for any other use



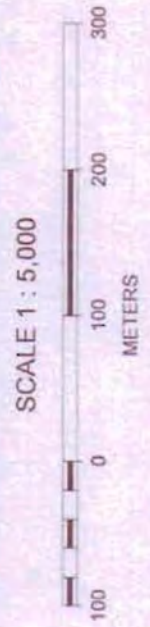


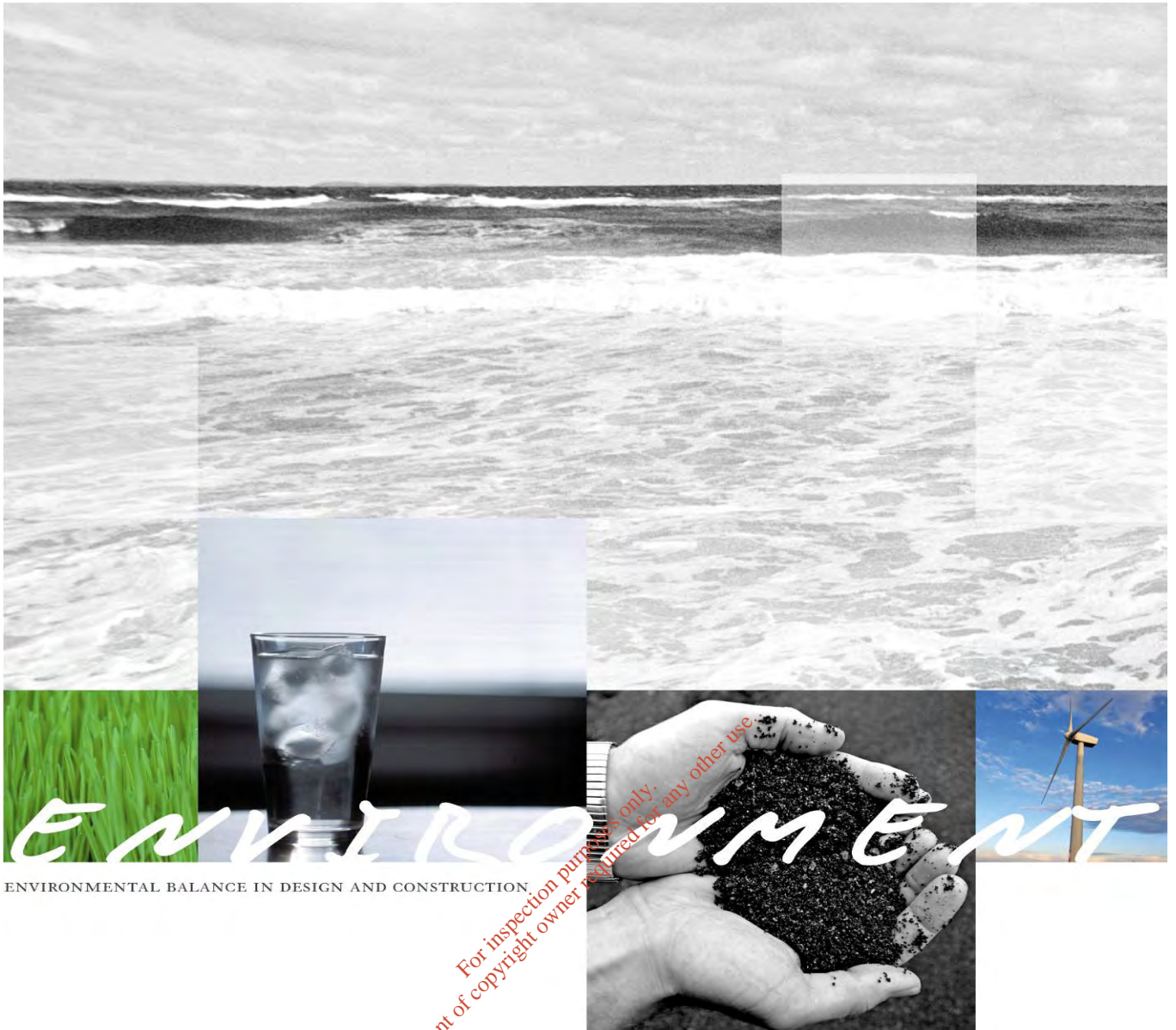
For inspection purposes only.
Consent of copyright owner required for any other use.

Ardfert



Ardfert





TIER 1 RISK ASSESSMENT

HISTORIC LANDFILL AT ARDFERT CO. KERRY

OCTOBER 2019



TIER 1 RISK ASSESSMENT

HISTORIC LANDFILL AT ARDFERT CO. KERRY

User is Responsible for Checking the Revision Status of this Document

Rev. Nr.	Description of Changes	Prepared by:	Checked by:	Approved by:	Date:
0	Draft Issue	EOC/MG	BG	BG	02/10/2019

Client: Kerry County Council

Keywords: Site Investigation, environmental risk assessment, geophysical survey, waste, leachate, soil sampling, groundwater sampling

Abstract: This report represents the findings of a Tier 1 site investigation carried out at Ardfert Historic Landfill, Co. Kerry, and conducted in accordance with the EPA Code of Practice for unregulated landfill sites. The site investigation was undertaken to determine the extent of the historic landfilling at the site.

TABLE OF CONTENTS

Page

PREAMBLE	1
1 INTRODUCTION	2
1.1 BACKGROUND.....	2
1.2 SCOPE OF WORKS	2
2 EXISTING ENVIRONMENT	3
2.1 INTRODUCTION	3
2.2 DESK STUDY.....	3
3 RISK ASSESSMENT	16
3.1 INTRODUCTION	16
3.2 POTENTIAL PATHWAYS AND RECEPTORS	16
3.3 CONCEPTUAL SITE MODEL	17
3.4 RISK PRIORITISATION.....	19
4 CONCLUSIONS & RECOMMENDATIONS	22

LIST OF APPENDICES

APPENDIX 1	SITE WALKOVER CHECKLIST
APPENDIX 2	SITE WALKOVER PHOTOLOG

*For inspection purposes only.
Consent of copyright owner required for any other use.*

LIST OF TABLES

Page

TABLE 2-1:	BOREHOLE AND SPRING DESCRIPTIONS NEAR THE PROJECT SITE.....	8
TABLE 2-2:	GSI GUIDELINES – AQUIFER VULNERABILITY MAPPING.....	11
TABLE 3-1:	RISK CLASSIFICATION CALCULATION.....	19
TABLE 3-2:	NORMALISED SCORE OF S-P-R LINKAGE.....	20

LIST OF FIGURES

FIGURE 2-1:	LOCATION OF SITE.....	4
FIGURE 2-2:	QUATERNARY GEOLOGY.....	6
FIGURE 2-3:	BEDROCK GEOLOGY.....	7
FIGURE 2-4:	AQUIFER CLASSIFICATION.....	9
FIGURE 2-5:	WELLS AND SPRINGS.....	10
FIGURE 2-6:	GROUNDWATER VULNERABILITY.....	12
FIGURE 2-7:	ECOLOGICALLY PROTECTED SITES.....	14
FIGURE 2-8:	OSI HISTORICAL MAPPING.....	15
FIGURE 3-1:	CONCEPTUAL SITE MODEL.....	18
FIGURE 4-1:	EXTRACT FROM SECTION 1.3 OF THE EPA COP.....	22

For inspection purposes only.
Consent of copyright owner required for any other use.

PREAMBLE

Fehily Timoney & Co. (FT) was appointed by Kerry County Council (KCC) to undertake an environmental risk assessment of a historical landfill site located at Ardfert, Co. Kerry. This document presents the Tier 1 environmental risk assessment (ERA) of the historical landfill site. The Tier 1 ERA was carried out in accordance with the EPA Code of Practice (CoP) on ERA for Unregulated Waste Disposal Sites (2007).

The site occupies approximately 0.2 hectares and is located at the northern edge of Ardfert village, immediately north of the Ardfert Cathedral of St. Brendan and south of the River Tyshe.

A Tier 1 assessment was conducted by FT which included a detailed desk study and site walkover. This assessment concluded that the site is **Class B - moderate risk**. The principal risk identified on the site are leachate migration via a groundwater pathway to groundwater receptor.

For such a site, the EPA CoP directs that a Tier 2 ERA including intrusive site investigations is undertaken to confirm the risk classification prior to being allocated to Class B site. Upon confirmation of the risk classification, the site is required to apply for a Certificate of Authorisation.

*For inspection purposes only.
Consent of copyright owner required for any other use.*

1 INTRODUCTION

1.1 Background

Ardfert historic landfill is in a relatively small area of open land located at the northern edge of Ardfert village, immediately north of Ardfert Cathedral of St. Brendan and c. 240m north of centre of Ardfert village. Ardfert village is located approximately 8km north-west of Tralee town. Available evidence suggests that the site closed, and landfilling ceased in 1980. This is stated in the '*Evaluation of the Replacement Waste Management Plan for the Limerick/Clare/Kerry Region 2006-2001*' report published by the Limerick/Clare/Kerry Waste Management Office. Fehily Timoney (FT) understands that since its closure the site has reverted to private ownership, with the lands not presently used for any specific function or activity. The site has been capped with a soil cover, but no other remediation works have been carried out.

KCC is required to complete a tiered risk assessment of unregulated waste disposal sites in accordance with the Environmental Protection Agency (EPA) code of practice for unregulated waste disposal sites.

1.2 Scope of Works

The scope of work was to undertake a Tier 1 ERA of the site based on the risk assessment methodology approach, in accordance with the EPA CoP. This approach requires the carrying out of a:

- Desktop Study
- Site Walkover
- Environmental Risk Assessment (ERA)
- Development of Conceptual Site Model (CSM)

The information gathered from the desk study, intrusive site investigation and geophysical survey were used to inform the development of the CSM and the Environmental Risk Assessment (ERA). This report presents the findings of the assessment.

For inspection purposes only.
Consent of copyright holder required for any other use.

2 EXISTING ENVIRONMENT

2.1 Introduction

The desk top study included the review of the following literature sources and websites:

- Ordnance Survey of Ireland (OSI), www.osi.ie
- Geological Survey of Ireland, Groundwater Web Mapping: www.gsi.ie
- Environmental Protection Agency Maps: www.epa.ie
- National Parks and Wildlife Service Map Viewer: www.npws.ie
- EPA Map-Viewer: <https://gis.epa.ie/EPAMaps/>
- Historic Environment Map Viewer from Department of Culture, Heritage and the Gaeltacht <http://webgis.archaeology.ie/historicenvironment/>

A desktop review of available documentation for the site was conducted and a visit was undertaken to carry out a detailed site walkover on the 14/02/2019.

2.2 Desk Study

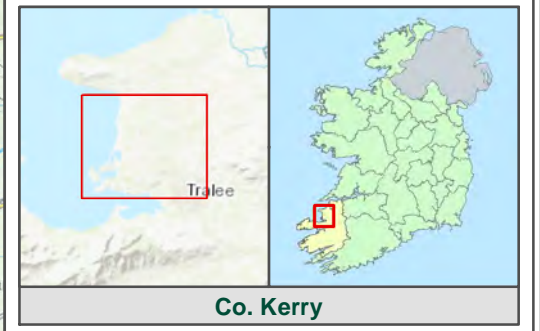
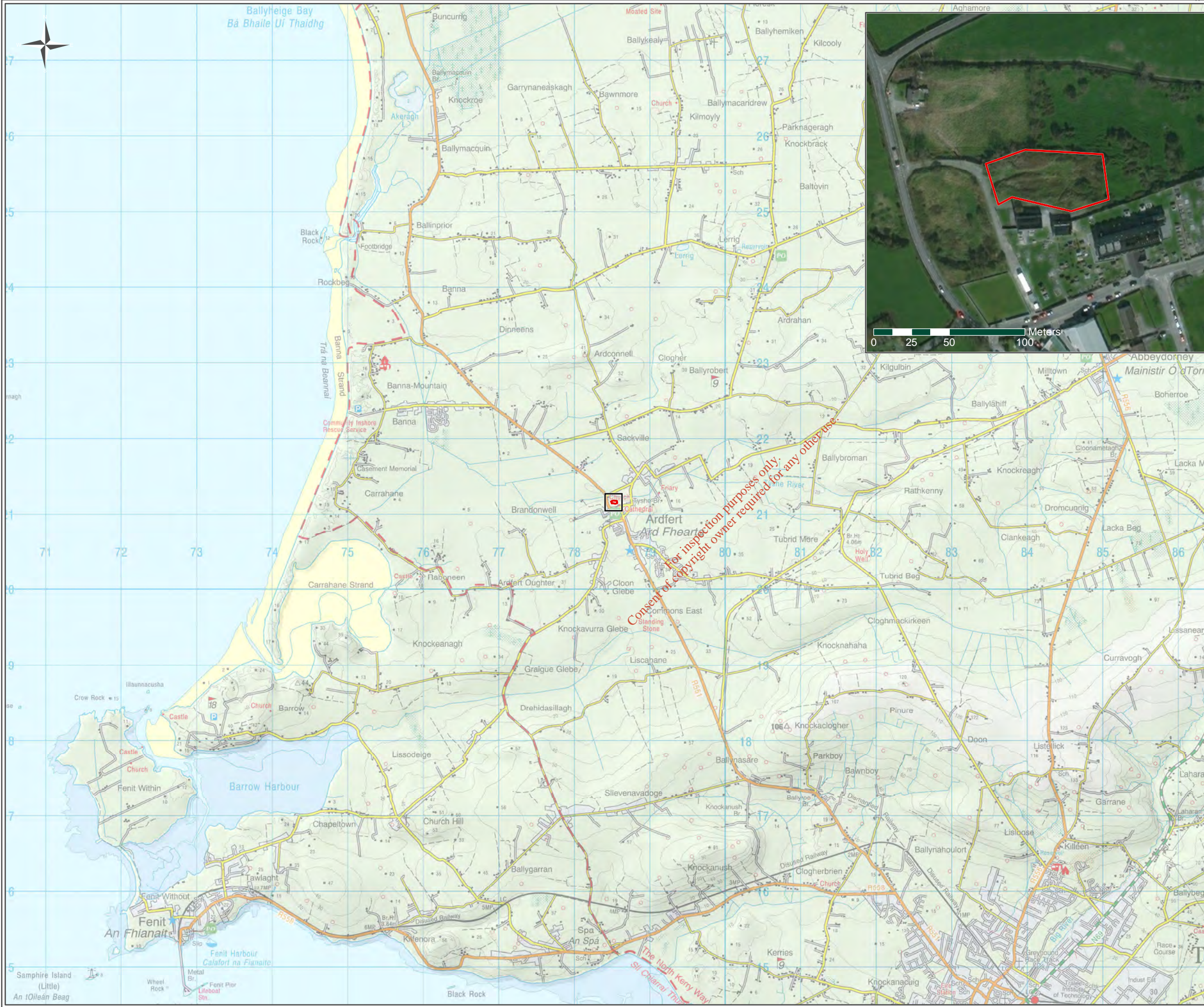
This section of the report presents the findings of the desk study.

2.2.1 Site Description and On-Site Conditions

The site is approximately 0.2 hectares. The site is bounded to the west by a local access road and further west is the R551. To the south, the site is bound by Ardfert Cathedral of St. Brendan. An access road runs along the northern and eastern boundary of the site. The site is bound by agricultural land to the north with a single dwelling located to the north-west.

The location of the site is shown in Figure 2-1.

Consent for copyright material required for any other use.
For internal purposes only.



Legend

 Site Boundary

Figure Title
Site Location

Figure No. 2.1

Project
Environmental Risk Assessment for Ardferd Landfill


Client
Kerry County Council

Scale 1:50,000 **Page Size** A3

Revision A **Date** 02/10/2019

Consultants in Engineering and Environmental Sciences

www.fehilytimoney.ie



2.2.2 Topography

The historic landfill is located within a relatively rural setting on the edge of Ardfert village which is located c.8km north-west of Tralee town. Regional topography is characterised by relatively flat land from the western side of Ardfert town gently slope to the west towards the coast. In contrast, elevations increase further east and south-east from Ardfert with the Stack Mountains located approximately 9 to 10 km east of the village. With respect to local topography except for an earth mound located at the western boundary, the site comprises relatively smooth ground but with elevations decreasing in a south to north direction. Elevations at the site range from approximately 19m to 14m above Ordnance Datum (AOD).

2.2.3 Geology

Drift/Quaternary Geology

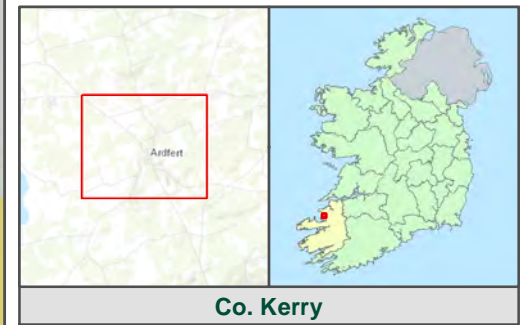
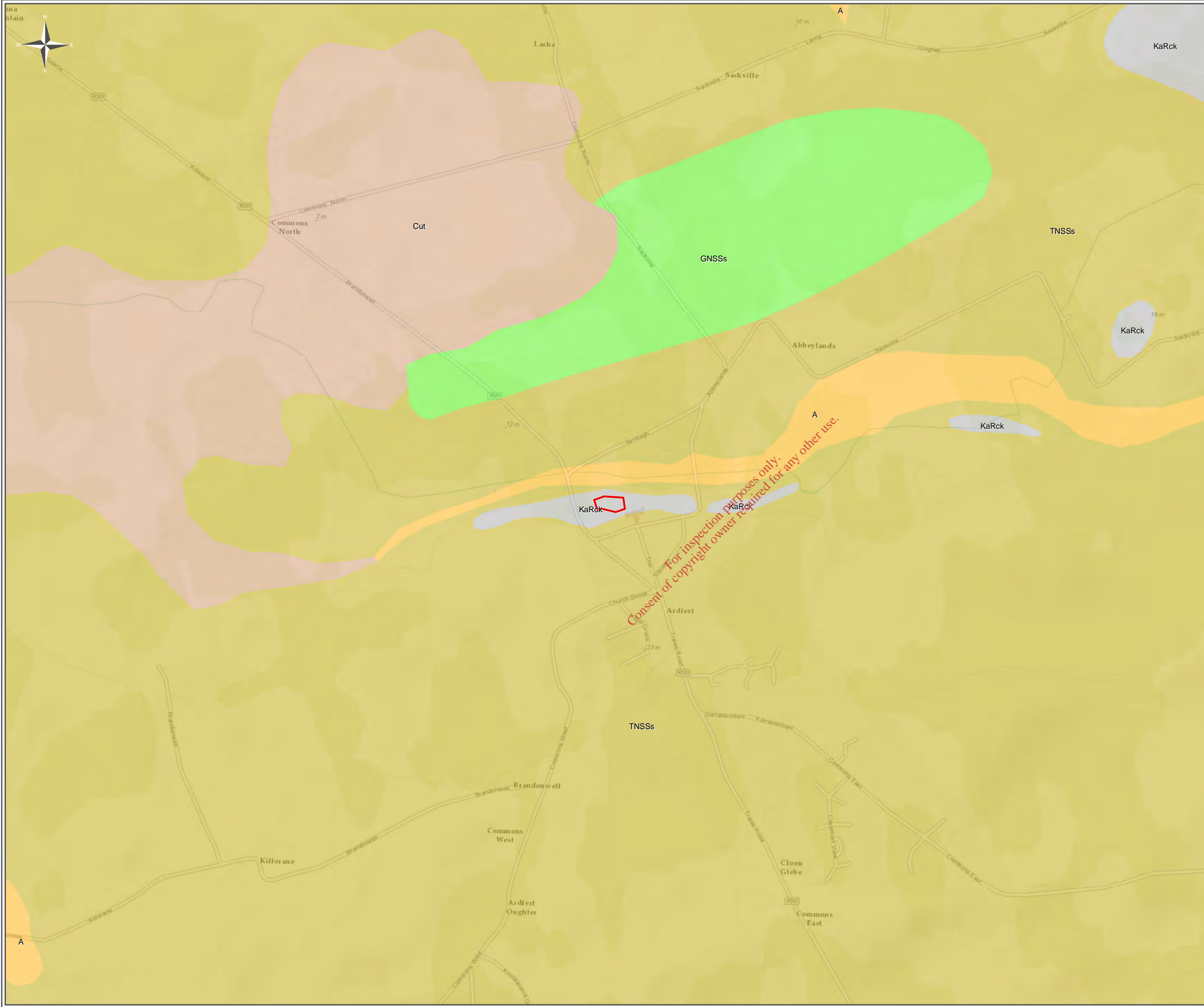
The Quaternary Map provided by GSI Online identifies the quaternary sediments at the site as 'Karstified bedrock outcrop or subcrop (KaRck). To the north and south of this band of rock outcrop quaternary sediments are characterised as 'Till derived from Namurian sandstones and shales'. Further north alluvium deposits are present following the Tyshe River. See Figure 2.2.

Solid or Bedrock Geology

The GSI online 1:100,000 scale bedrock geology map, shows the bedrock beneath to be found on a single formation. The entirety of the site and surrounding area are underlain by the Cloonagh Limestone formation (CDCLNH) which is generally made up of Dinantian '*Bedded bioclastic limestone*'.

GSI mapping indicates that bedrock outcrop is present within a significant portion of the site, at the north-eastern corner. This outcrop extends further east beyond the site boundary. Bedrock outcrops are identified in the wider region. Ardfert quarry, a limestone aggregate and agricultural lime producing quarry is located approximately 2km north-east of the site. A review of the GSI mineral localities mapping identified lead in limestone at Ardfert village, however the exact location is unknown. The bedrock geology is presented in Figure 2.3.

For inspection purposes only
Consent of copyright owner required for any other use



Co. Kerry

Legend

- Site Boundary
- Quaternary Sediments**
- A,
- Cut, Cut over raised peat
- GNSSs, Gravels derived from Namurian sandstones and shales
- KaRck, Kartsified bedrock outcrop or subcrop
- TNSSs, Till derived from Namurian sandstones and shales

Figure Title
Quaternary Geology

Figure No. 2.2


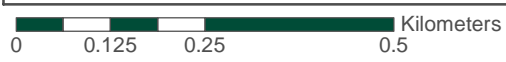
Project
Environmental Risk Assessment for Ardfert Landfill

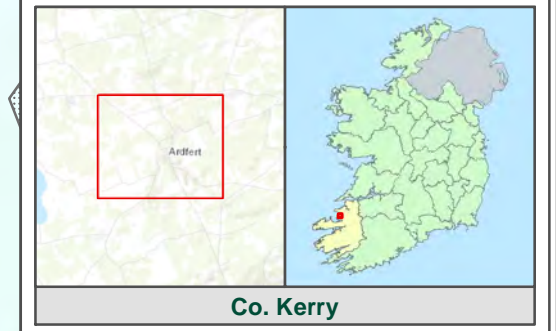
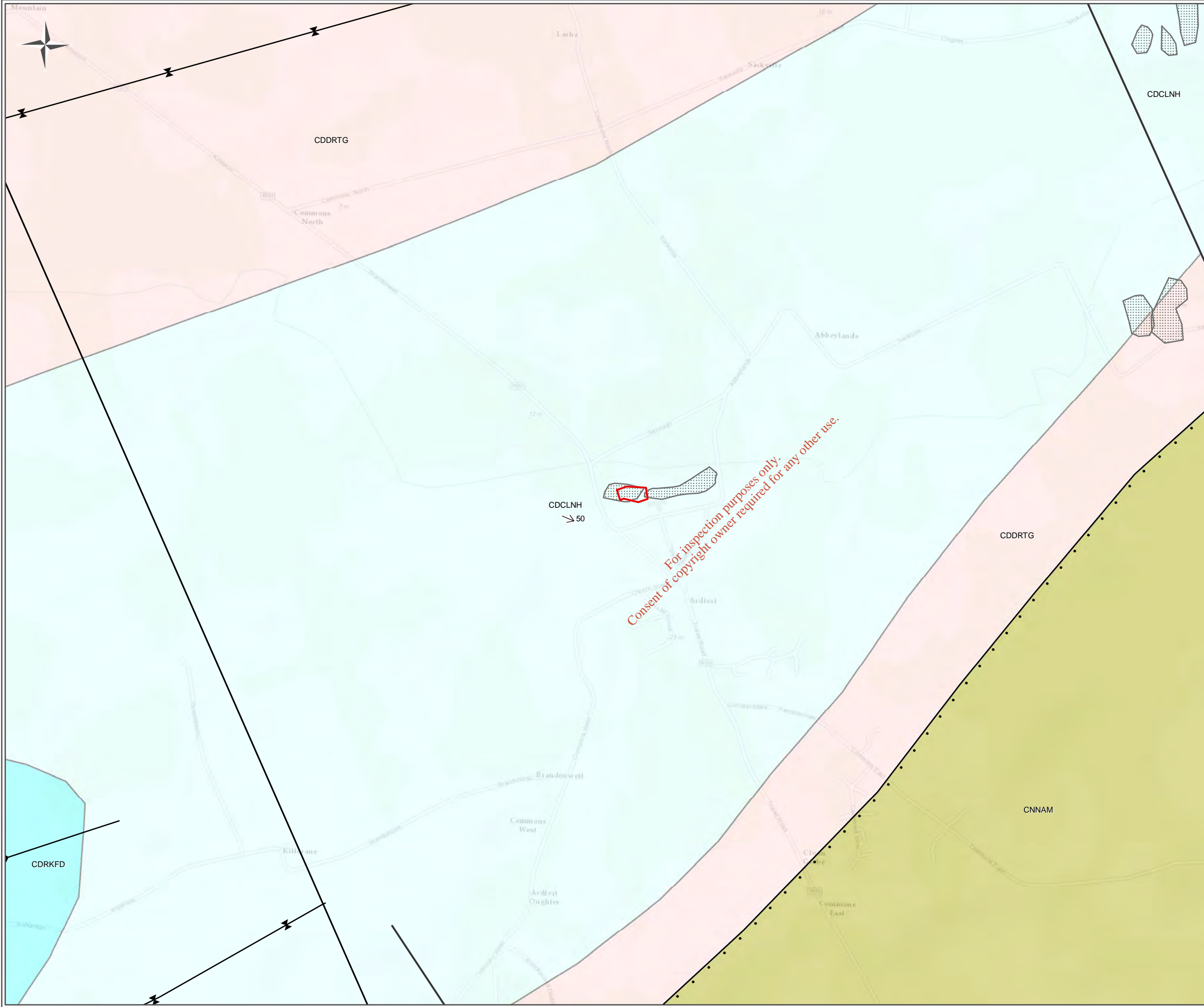
Client
Kerry County Council

Scale 1:10,000 **Page Size** A3

Revision A **Date** 02/10/2019

Consultants in Engineering and Environmental Sciences
www.fehilytimoney.ie



Legend

- Site Boundary
- Bedrock Outcrop
- Dip of bedding or main foliation, old GSI data

Stratigraphic and Structural Linework

- Anticlinal Axis
- Fault
- Synclinal Axis
- Unconformity, dots on younger side
- X-Section

Bedrock Geology

- Clonagh Limestone Formation
- Dirtoge Limestone Formation
- Rockfield Limestone Formation
- Namurian (undifferentiated)

Figure Title	Bedrock Geology
Figure No.	2.3
Project	Environmental Risk Assessment for Ardfert Landfill
Client	Kerry County Council
Scale	1:10,000
Page Size	A3
Revision	A
Date	02/10/2019

Consultants in Engineering and Environmental Sciences

www.fehilytimoney.ie



2.2.4 Hydrogeology

An examination of the national bedrock aquifer map on the GSI online mapping classifies the Clonish formation as a Regionally Important Aquifer – Karstified (Diffuse) Bedrock (Rkd). Ardferf Gravel body is located approximately 340m north of the site and encompasses an area of approximately 520m². The bedrock aquifer mapping is presented in Figure 2.4.

There are no karst landforms within the site boundary. The nearest karst landform is a limestone cave located in Lissodeige approximately 3.8km south-west of the site boundary.

Historical mapping for the area shows no springs in the immediate vicinity of the site or the surrounding area. There are residences within 250m of the site where unregistered private wells may be present.

Table 2.1 presents the details of the registered boreholes and springs within 1km of the site.

Table 2-1: Borehole and Spring Descriptions near the Project Site

BH/Spring	Yield class	Yield (m ³ /day)	Use	Depth (m)	Depth to Rock confidence (m)	Distance from site (km)	Date
0511NEW009	-	-	-	-	17.5	0.24	1969
0511NEW008	-	-	-	-	13.7	0.37	1969
0511NEW027	Excellent	2182	Public Supply	18.6	18.6	0.5	1969

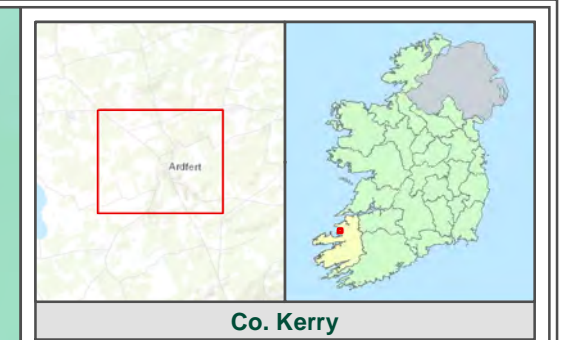
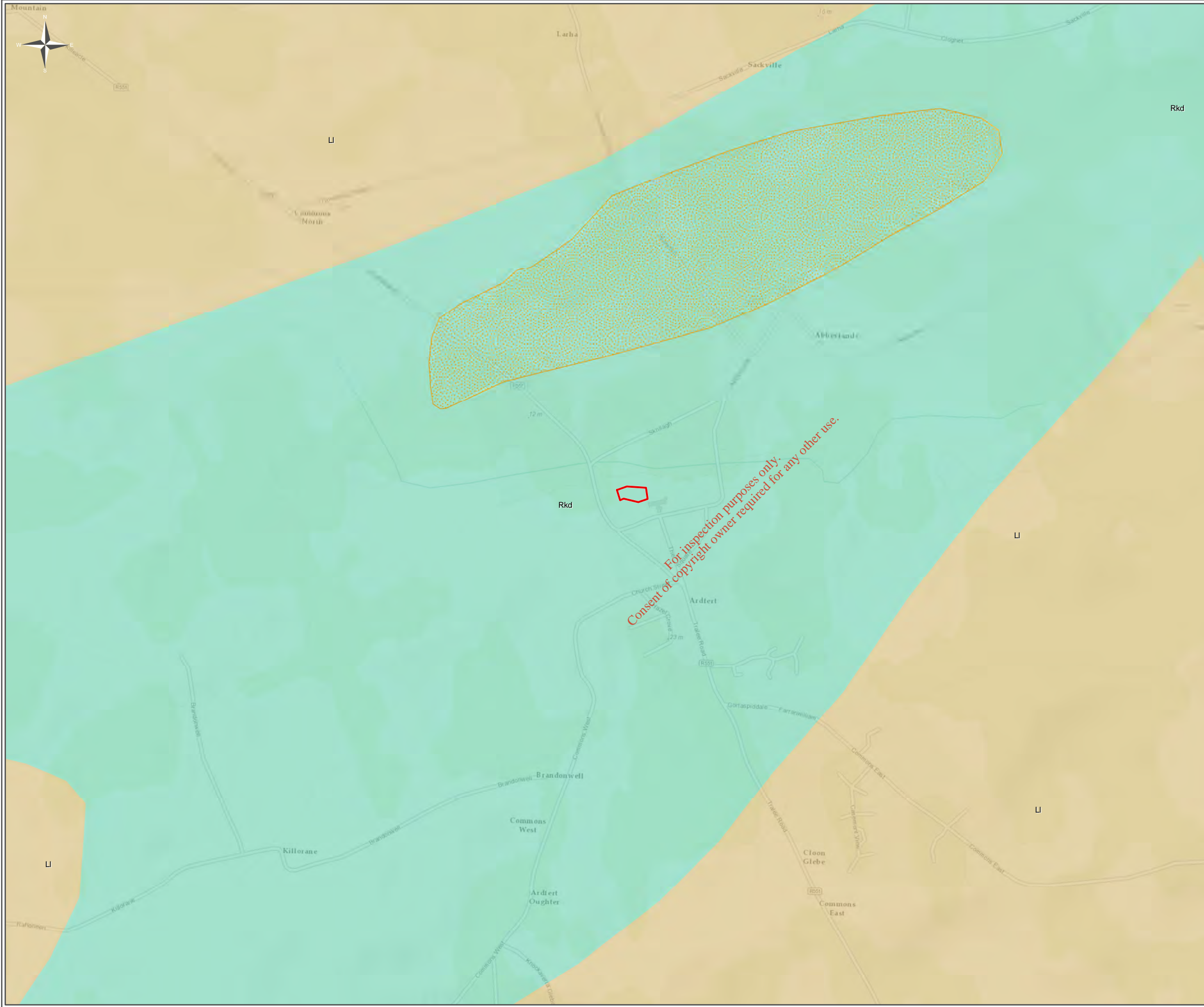
There are no Groundwater Drinking Water Protection Areas within the site boundaries according to GSI. The nearest groundwater protection zone is located approximately 270m north of the site at its closest point. This groundwater protection zone relates to the Ardferf Water Supply Scheme/Ardferf South Boreholes. The wells themselves are located approximately 0.5km from the site and correspond with GSI borehole id 0511NEW027 as shown in Table 2-1 above, which refers to the original well at the site. A sand gravel deposit aquifer is the source of groundwater for this public supply. The total zone of contribution/ source protection zone encompasses 1.5km².

The GSI shows that the groundwater body (GWB) is named Ardferf GWB and has a karstic flow regime and is defined as being at *Good Status* under the Water Framework Directive (WFD). The risk to groundwater quality is currently under review.

There are no recorded groundwater dependent ecosystems in the area.

GSI mapping shows groundwater recharge to be variable in the region. The GSI national recharge map defined the annual recharge for the site as 670 mm/yr. The effective rainfall for the area is 788 mm/yr, returning a recharge coefficient of 85%.

The GSI mapping showing approximate locations of known wells and springs is included in Figure 2.5.



Legend

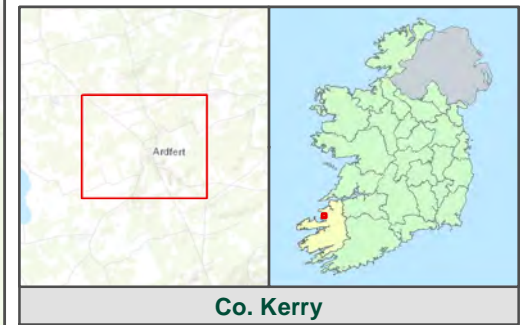
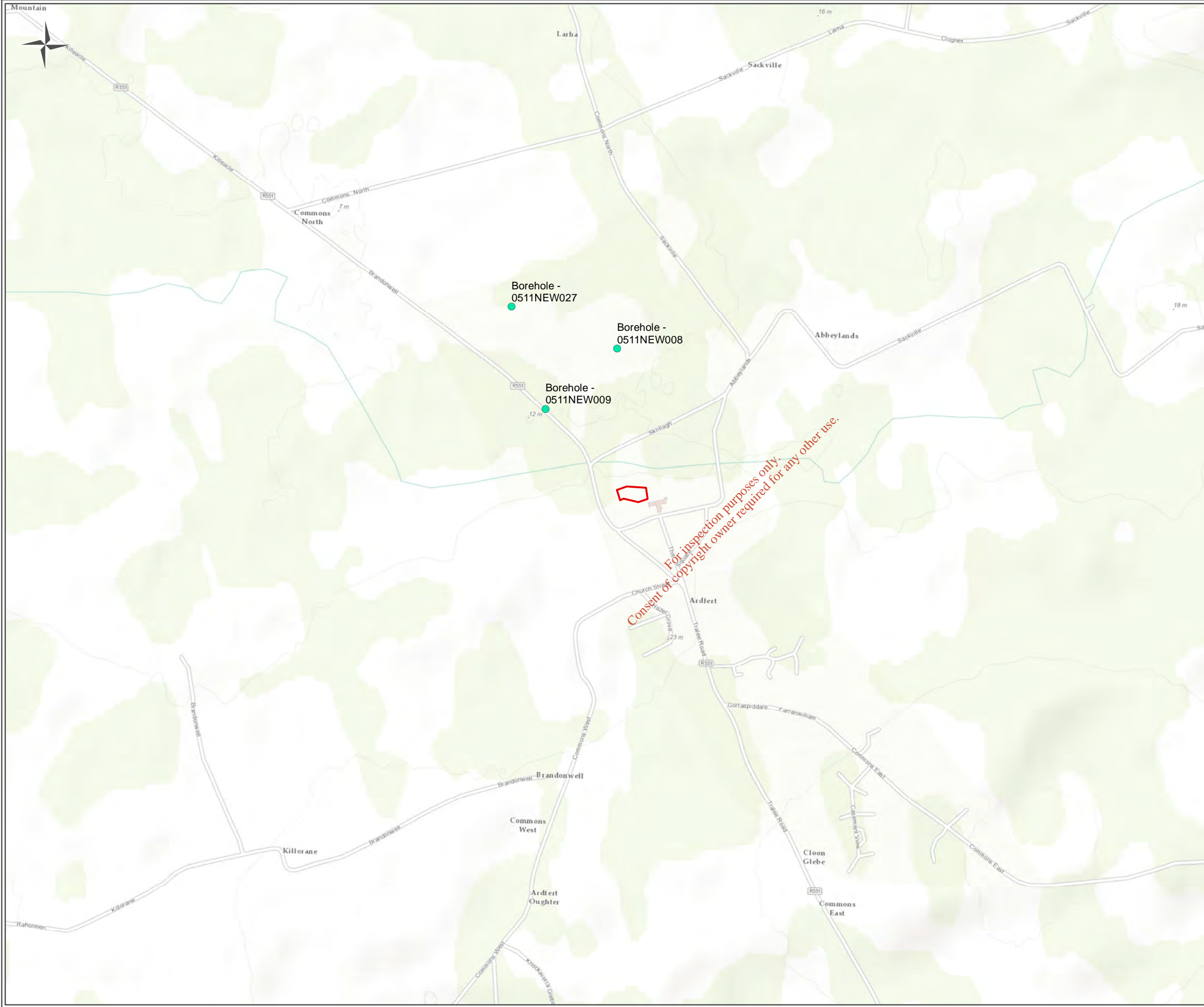
- Site Boundary
- Sand and Gravel Aquifers**
- Locally important gravel aquifer
- Bedrock Aquifers**
- LI: Locally Important Aquifer - Bedrock Mod Productive Locally
- Rkd: Regionally Important Aquifer - Karstified (diffuse)

Figure Title	Aquifer Classification
Figure No.	2.4
Project	Environmental Risk Assessment for Ardfert Landfill
Client	Kerry County Council
Scale	1:10,000
Page Size	A3
Revision	A
Date	02/10/2019

Consultants in Engineering and Environmental Sciences

www.fehilytimoney.ie





Legend

- Site Boundary
- Groundwater Well (10-50m Accuracy)

Figure Title	GIS Wells & Springs	
Figure No.	2.5	
Project	Environmental Risk Assessment for Ardfert Landfill	
Client	Kerry County Council	
Scale	1:10,000	Page Size A3
Revision	A	Date 02/10/2019

Consultants in Engineering and Environmental Sciences
www.fehilytimoney.ie



2.2.5 Groundwater Vulnerability

Groundwater vulnerability, as defined by the GSI, is the term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease with which groundwater may be contaminated by human activities.

The factors used in assessing groundwater vulnerability include subsoil type and thickness and recharge type as indicated in Table 2.2. The GSI procedure whereby groundwater protection is assessed is outlined in the EPA-GSI publication *Groundwater Protection Schemes* (DELG/EPA/GSI, 1999).

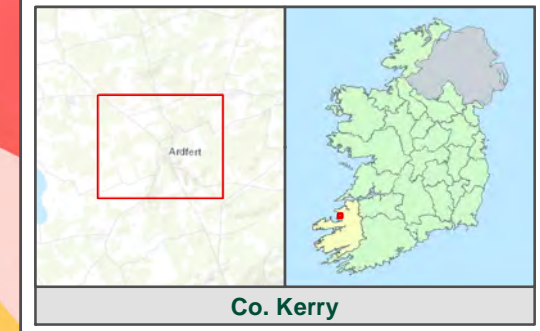
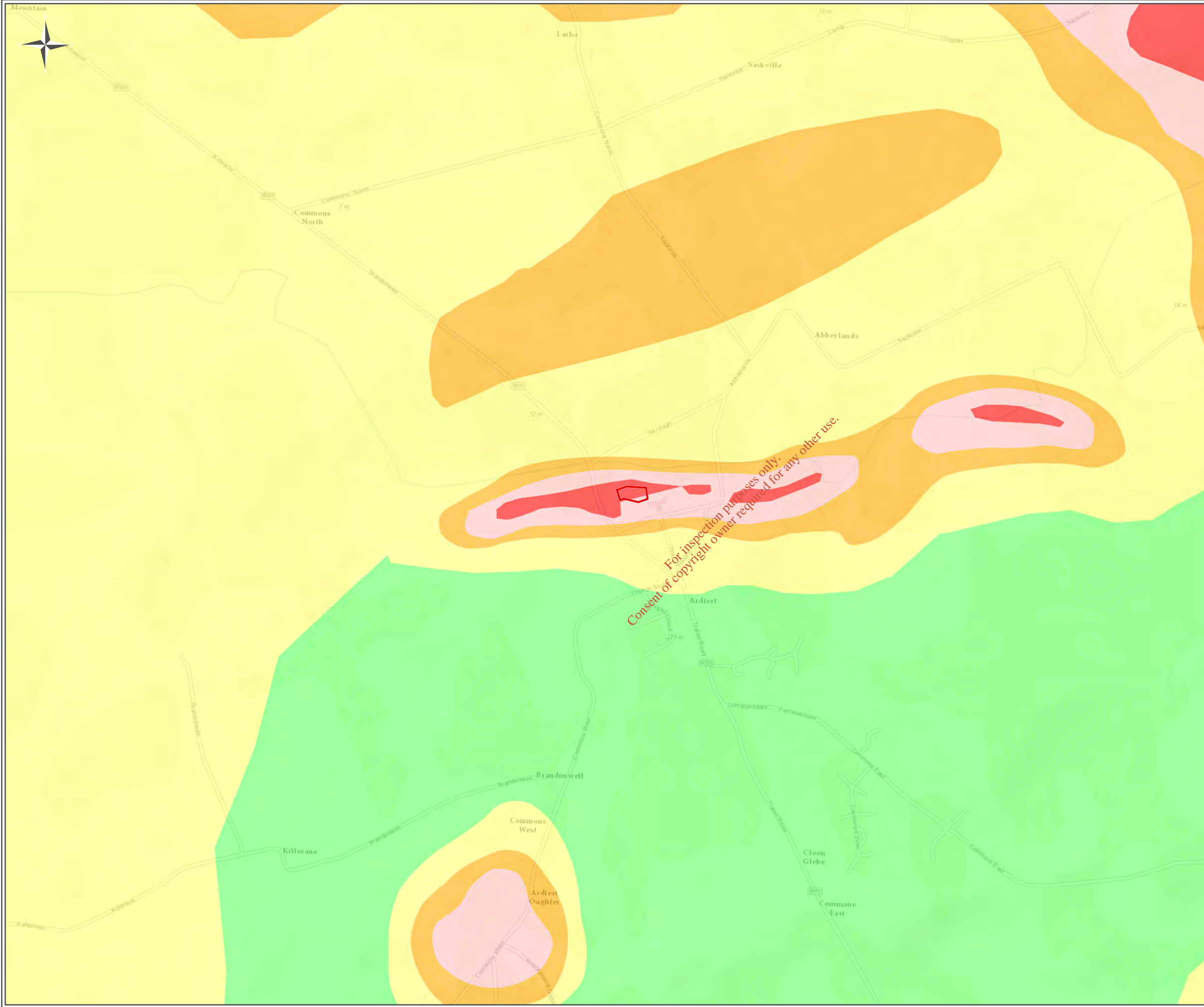
The GSI Online mapping data set identifies the vulnerability of groundwater to contamination is classified as rock at or near surface or karst and extreme vulnerability, given the presence of bedrock outcrop at the site and thin overburden cover. The Groundwater Vulnerability mapping is presented in Figure 2.6.

The recharge coefficient associated with the western section of the site is 85% and the recharge rate is 670 mm/year.

Table 2-2: GSI Guidelines – Aquifer Vulnerability Mapping

Vulnerability Rating	Hydrogeological Conditions		
	<i>Subsoil Permeability (Type) and Thickness</i>		
	High Permeability (Shallow Bedrock)	Moderate Permeability (e.g. Sandy soil)	Low Permeability (e.g. Clayey subsoil, clay, peat)
Extreme (E)	0 - 3.0 m	0 - 3.0 m	0 - 3.0 m
High (H)	>3.0 m	3.0 - 10.0 m	3.0 - 5.0 m
Moderate (M)	N/A	>10.0 m	5.0 - 10.0 m
Low (L)	N/A	N/A	>10 m

Notes:
N/A = Not Applicable
Precise permeability values cannot be given at present



Legend

- Site Boundary
- Groundwater Vulnerability**
- E - Extreme
- H - High
- M - Moderate
- L - Low
- X - Rock Near Surface or Karst

Figure Title
Groundwater Vulnerability

Figure No. 2.6


Project
Environmental Risk Assessment for Ardfert Landfill

Client
Kerry County Council

Scale 1:10,000 **Page Size** A3

Revision A **Date** 02/10/2019

Consultants in Engineering and Environmental Sciences
www.fehilytimoney.ie




2.2.6 Hydrology

The site is located within the catchment of the Tralee Bay-Feale, Sub-catchment Ardfert-Oughter and river sub-basin Tyshe_020. The River Tyshe is located approximately 70m north of the site and flows in a westerly direction before turning north-west and north eventually meeting the west coast approximately 5km north-west of the site.

2.2.7 Ecology

The site is not within or directly adjacent to any Natural Heritage Area (NHA), proposed NHA (pNHA), Special Area of Conservation (SAC) or Special Protection Area (SPA). The nearest SAC is Akeragh, Banna and Barrow Harbour SAC (Site Code:000332) located approximately 2.4km west of the site. This SAC is also classified as a proposed Natural Heritage Area (pNHA). The nearest SPA is Tralee Bay Complex (Site Code: 004188), located approximately 2.4km west of the site.

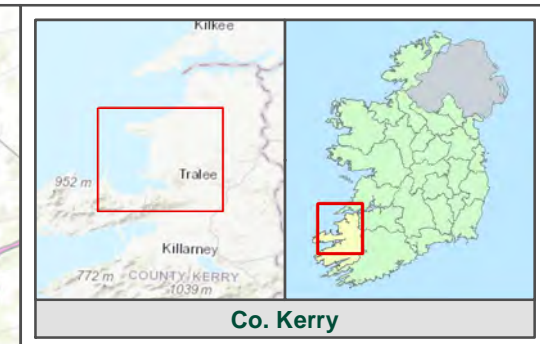
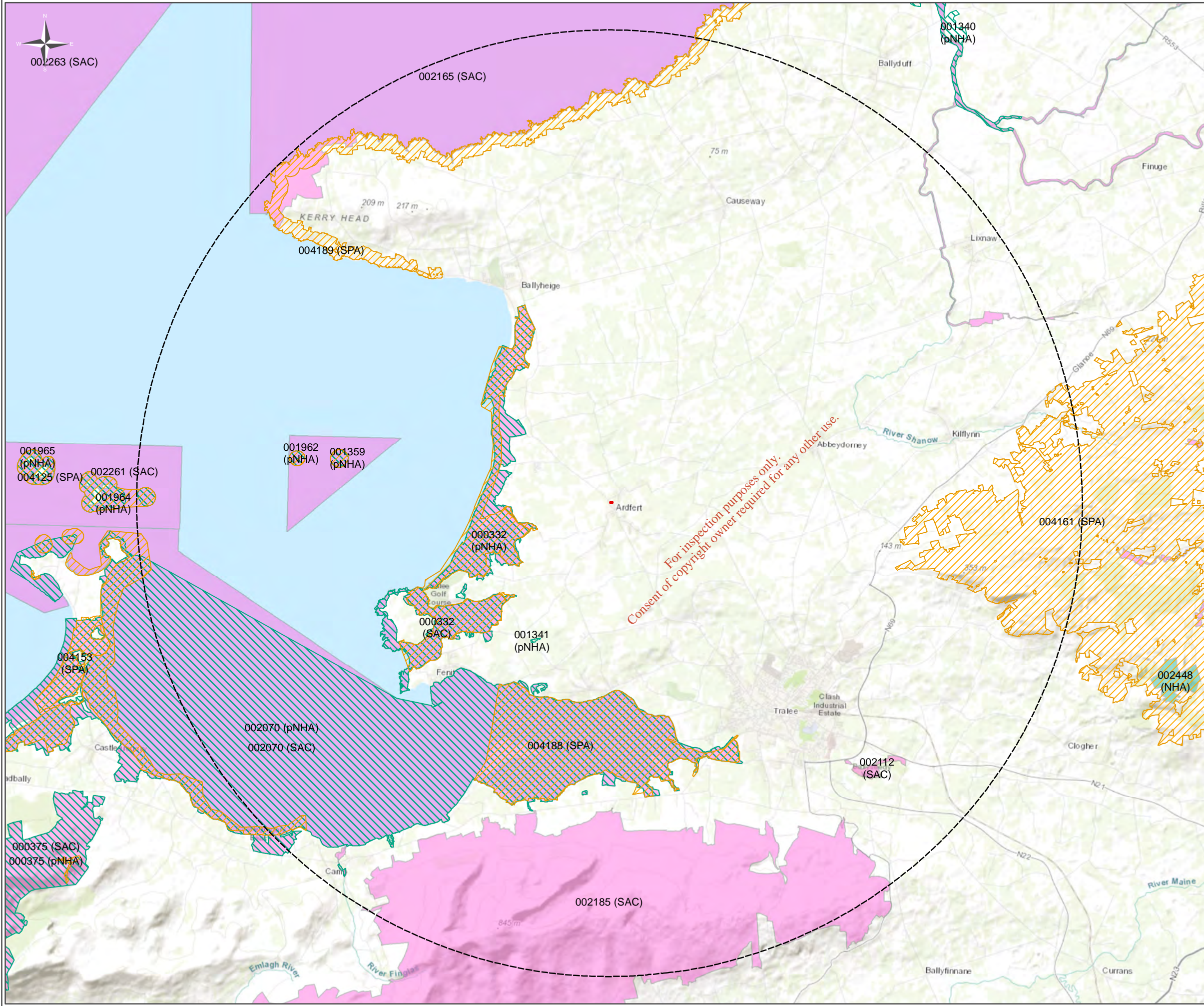
The ecology protected areas mapping is presented in Figure 2.7.

2.2.8 Site History

The earliest historical map available on the OSI website dates from 1837-1842. The OSI identifies that a portion land close to the western boundary of the site was used for quarrying activities. Review of the 1888 – 1913 historical map also indicates that significant portion of the site along its western extent was used as a quarry. It is noted that quarrying activity also historically took place further outside the site immediately west, and further within lands to the west of the R551 road.

The OSI Historical Mapping is presented in Figure 2.8.

For inspection purposes only.
Consent of copyright owner required for any other use.



Legend

- Site Boundary
- 15km Distance from Site Boundary
- Special Protection Area (SPA)
- Proposed Natural Heritage Area (pNHA)
- Special Area of Conservation (SAC)
- Natural Heritage Area (NHA)

For inspection purposes only.
Consent of copyright owner required for any other use.

Figure Title
Ecologically Protected Areas

Figure No. 2.7


Project
Environmental Risk Assessment for Ardfert Landfill

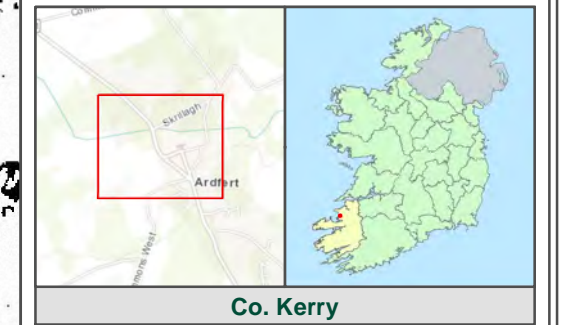
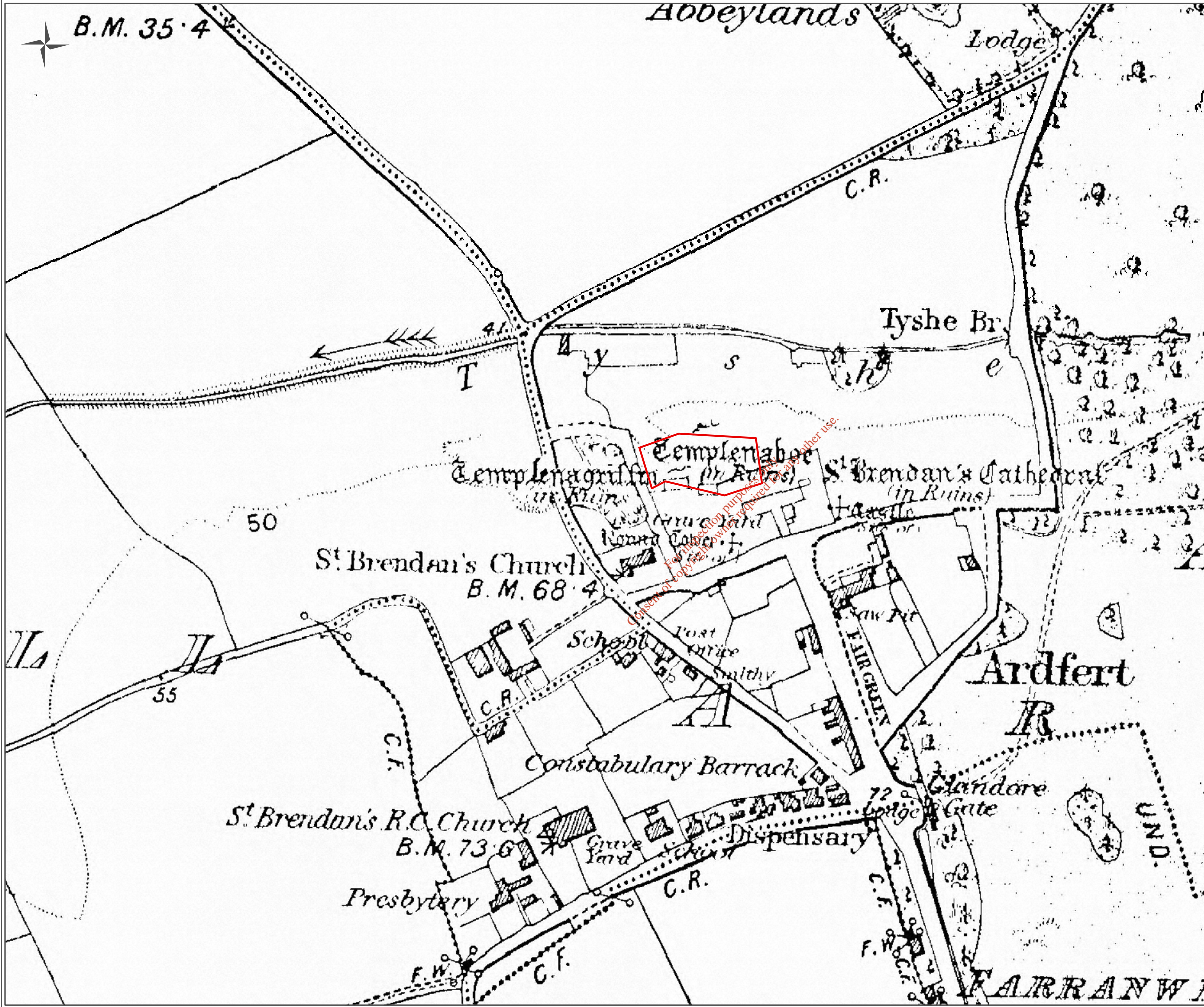
Client
Kerry County Council

Scale 1:120,000 **Page Size** A3

Revision A **Date** 02/10/2019

Consultants in Engineering and Environmental Sciences
www.fehilytimoney.ie

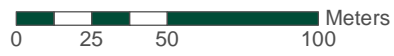


Legend
 Site Boundary

Figure Title	OSi Historical Mapping
Figure No.	2.8
Project	Environmental Risk Assessment for Ardert Landfill
Client	Kerry County Council
Scale	1:2,500
Page Size	A3
Revision	A
Date	02/10/2019

Consultants in Engineering and Environmental Sciences
 www.fehilytimoney.ie



3 RISK ASSESSMENT

3.1 Introduction

Risk assessment considers the likelihood of occurrence and the consequence of occurrence of an event (Royal Society, 1992¹). ERA is based on the development of a Conceptual Site Model (CSM) which is used to determine the potential exposure of a vulnerable receptor to a contaminant. The CSM is used as the basis for the risk assessment. It is used to identify all possible sources (S), pathways (P) and receptors (R) as well as the processes that are likely to occur along each of the source-pathway-receptor (S-P-R) linkages and uncertainties.

Based on the desktop investigation and site walkover undertaken, this CSM takes the source of the contamination to be the waste material, the pathway to involve the surface water and groundwater and the ultimate receptors to be the River Tyshe, underlying groundwater, potential water supplies from both surface water and ground water and all human presence nearby the historical landfill.

3.2 Potential Pathways and Receptors

A pathway is a mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor. Contaminants associated with deposited waste may include leachate generated from groundwater/rainwater infiltration into the waste material and/or the generation of landfill gas from the degradation of the biodegradable fraction of deposited waste.

The potential pathways associated with the site are:

- Groundwater/leachate migration
- Landfill gas migration

3.2.1 Groundwater/Leachate Migration

According to the EPA CoP, there are three main pathways for leachate migration. These are:

- Vertically to the water table or top of an aquifer, where groundwater is the receptor
- Vertically to an aquifer and then horizontally in the aquifer to a receptor such as a well, spring, stream
- Horizontally at the ground surface or at shallow depth to a surface receptor

The migration and attenuation of leachate from the site depends on the permeability and thickness of subsoil and on both the bedrock permeability value and type. These elements are encompassed in groundwater vulnerability, groundwater flow regime and surface water drainage. The main receptors to leachate migration from this site are:

- Aquifer
- Surface water bodies
- Nearby public water supply
- Human presence nearby the site

3.2.2 Landfill Gas Migration

According to the EPA CoP, there are two main pathways for landfill gas migration. These are

- Lateral migration via subsoil
- Vertical migration via subsoil

¹ Royal Society 1992, Risk: Analysis, Perception and Management. The Royal Society, London (ISBN 0-85403-467-6).

The migration of landfill gas from the site depends on the nature of the material deposited and the nature, permeability and thickness of the surrounding subsoil or bedrock. The main receptors to potential landfill gas migration from this site are:

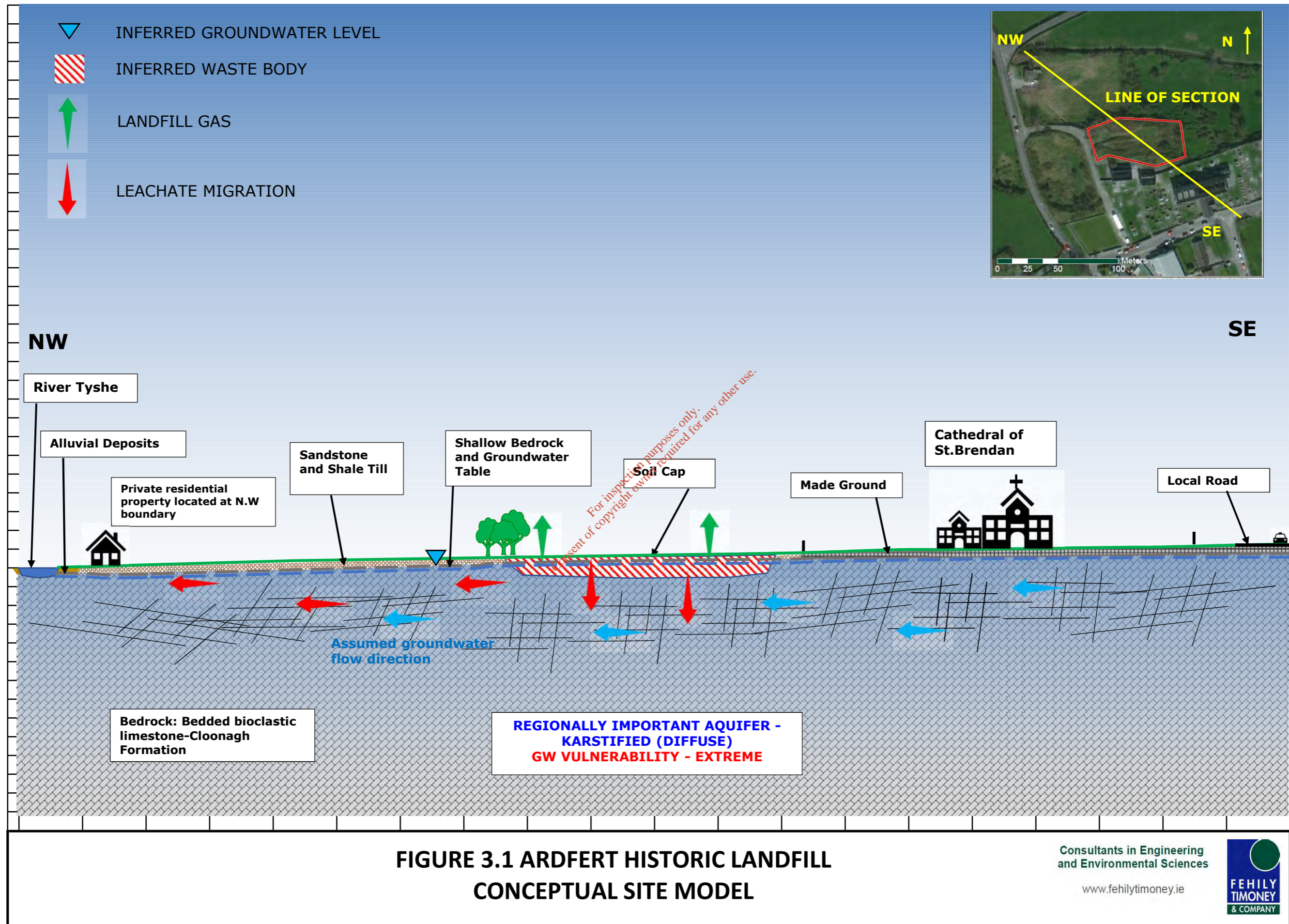
- Human Presence/Buildings nearby the waste body

Landfill gas has the potential to collect in confined spaces such as ducts, chambers, and manholes. Given the relatively shallow soil cap present on site it is more likely that vertical migration of landfill gas would be the preferable pathway.

3.3 Conceptual Site Model

Based on the desktop investigation and site walkover undertaken, an assessment of the risk is made to confirm the source – pathway – receptor (S-P-R) linkages identified in the preliminary investigation. The results and analysis of the investigation has enabled a basic conceptual model to be produced, which is presented in Figure 3.1.

*For inspection purposes only.
Consent of copyright owner required for any other use.*



3.4 Risk Prioritisation

Risk prioritisation enables resources to be prioritised on the highest risk facilities and on the highest source – pathway – receptor linkage potential.

The risk prioritisation process assigns a score to each linkage and the overall score is the maximum of the individual linkages for the site. The higher the score a site/linkage receives the higher the risk.

In order to classify the risk, scores will be applied to the information obtained during the site investigation. Where there is insufficient information available (i.e. where there is a high degree of uncertainty) the highest score is assumed.

In accordance with the EPA CoP (2007) the scoring matrixes are as follows:

- Leachate; Source/hazard scoring matrix, based on waste footprint
- Landfill gas: Source/hazard scoring matrix based on waste footprint
- Leachate migration: Pathway (Vertical)
- Leachate migration: Pathway (Horizontal)
- Leachate migration: Pathway (Surface water drainage)
- Landfill gas: Pathway (Lateral migration potential)
- Landfill gas: Pathway (Upwards migration potential)
- Leachate migration: Receptor (Surface water drainage)
- Leachate migration: Receptor (Human presence)
- Leachate migration: Receptor (Protected areas – SWDTE or GWDTE) (Surface water/groundwater dependent terrestrial ecosystems)
- Leachate migration: Receptor (Aquifer category – Resource potential)
- Leachate migration: Receptor (Public water supplies – other than private wells)
- Leachate migration: Receptor (Surface water bodies)
- Landfill gas: Receptor (Human presence)

Table 3.1 calculates the points awarded to each of the headings listed above.

Table 3-1: Risk Classification Calculation

EPA Ref	Risk	Points	Rationale
1a	Leachate; source/hazard scoring matrix, based on waste footprint.	5	Based on the potential waste footprint of <1ha and a site that accepted municipal and domestic waste
1b	Landfill gas; source/hazard scoring matrix, based on waste footprint.	5	Based on the potential waste footprint of <1ha and a site that accepted municipal and domestic waste
2a	Leachate migration: Pathway (Vertical)	3	GSI describes the groundwater vulnerability as extreme across the entire site.
2b	Leachate migration: Pathway (Horizontal)	5	A significant portion of the site is underlain by Regionally Important Aquifer – Karstified (Rkd)
2c	Leachate migration: Pathway (Surface water drainage)	0	There are no drains present at the site with a direct pathway to the River Tyshe

EPA Ref	Risk	Points	Rationale
2d	Landfill gas: Pathway (Lateral migration potential)	3	Identified soil type was karstified bedrock outcrop
2e	Landfill gas: Pathway (Upwards migration potential)	0	No buildings located directly above estimated waste footprint area.
3a	Leachate migration: Receptor (Human presence)	2	Residential dwelling located between 50m and 250m of site boundary. Nearest dwelling is located to the north-west of the site
3b	Leachate migration: Receptor (Protected areas – SWDTE or GWDTE) (Surface water/ groundwater dependent terrestrial ecosystems)	0	No registered protected areas located within 1km of the site
3c	Leachate migration: Receptor (Aquifer category – Resource potential)	5	Regionally Important Aquifers (Rkd)
3d	Leachate migration: Receptor (Public water supplies – other than private wells)	5	Public water supply and groundwater protection zone located within 300m of the site
3e	Leachate migration: Receptor (Surface water bodies)	2	Surface water body (River Tyshe) within 50m of the site.
3f	Landfill Gas: Receptor (Human presence)	3	Residential dwelling located between 50m and 150m from the site.

Table 3-2: Normalised Score of S-P-R Linkage

Calculator	S-P-R Values	Maximum Score	Linkage	Normalised Score	
Leachate migration through combined groundwater and surface water pathways					
SPR1	$1a \times (2a + 2b + 2c) \times 3e$	$5 \times (3+5+0) \times 2 = \mathbf{80}$	300	Leachate => surface water	27%
SPR2	$1a \times (2a + 2b + 2c) \times 3b$	$5 \times (3+5+0) \times 0 = \mathbf{0}$	300	Leachate => SWDTE	0%
Leachate migration through groundwater pathway					
SPR3	$1a \times (2a + 2b) \times 3a$	$5 \times (3+5) \times 3 = \mathbf{120}$	240	Leachate => human presence	33%
SPR4	$1a \times (2a + 2b) \times 3b$	$5 \times (3+5) \times 0 = \mathbf{0}$	240	Leachate => GWDTE	0%
SPR5	$1a \times (2a + 2b) \times 3c$	$5 \times (3+5) \times 5 = \mathbf{200}$	400	Leachate => Aquifer	50%
SPR6	$1a \times (2a + 2b) \times 3d$	$5 \times (3+5) \times 5 = \mathbf{200}$	560	Leachate => Public Supply	36%

Calculator		S-P-R Values	Maximum Score	Linkage	Normalised Score
SPR7	$1a \times (2a + 2b) \times 3e$	$5 \times (3+5) \times 2 = \mathbf{80}$	240	Leachate => Surface Water	33%
Leachate migration through surface water pathway					
SPR8	$1a \times 2c \times 3e$	$5 \times 0 \times 2 = \mathbf{0}$	60	Leachate => Surface Water	0%
SPR9	$1a \times 2c \times 3b$	$5 \times 0 \times 0 = \mathbf{0}$	60	Leachate => SWDTE	0%
Landfill gas migration pathway (lateral & vertical)					
SPR10	$1b \times 2d \times 3f$	$5 \times 3 \times 3 = \mathbf{45}$	150	Landfill Gas => Human Presence	30%
SPR11	$1b \times 2e \times 3f$	$5 \times 0 \times 5 = \mathbf{0}$	250	Landfill Gas => Human Presence	0%
Site maximum S-P-R Score					50%
Risk Classification					B - Moderate

Table 3.2 shows the maximum S-P-R scoring for the site is **50%**.

The following are the risk classifications applied:

- Highest Risk (Class A) Greater than 70 for any individual SPR linkage
- Moderate Risk (Class B) 41-69 for any individual SPR linkage
- Lowest Risk (Class C) Less than 40 for any individual SPR linkage

Based on this, the site can be classified as a moderate-risk classification (Class B). The principal risk identified on the site, with a normalised score of 50% was:

- Leachate migrations to the underlying groundwater aquifer via groundwater pathway.

4 CONCLUSIONS & RECOMMENDATIONS

KCC requested that a Tier 1 ERA be carried out for the site in accordance with the EPA CoP on ERA for Unregulated Waste Disposal Sites.

A Tier 1 study was conducted by FT in accordance with the CoP. The study consisted of a desktop study and a detailed site walkover. These works informed the development of the CSM and risk screening model.

The results of the Tier 1 assessment and risk model indicate that the site is a **Class B - moderate risk**. The principal risk identified on the site is leachate migration through groundwater pathways to groundwater receptor. The EPA CoP states that, for Class B sites, 'site investigations are required to verify the risk status'. FT

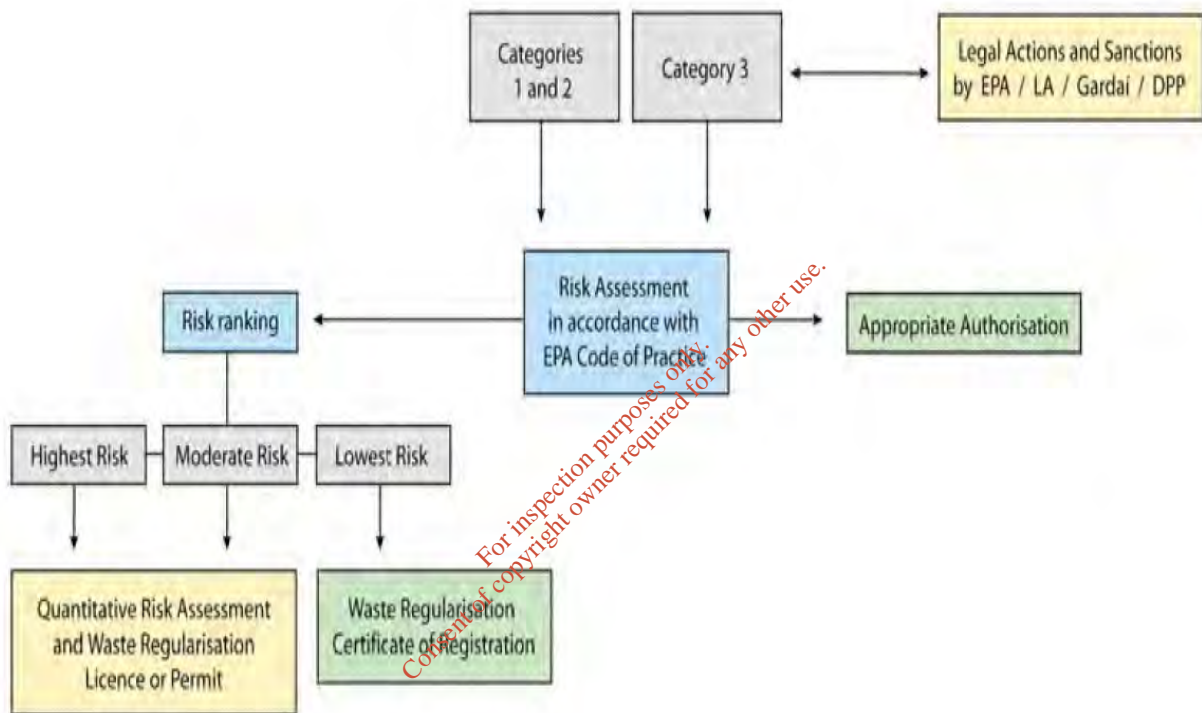


Figure 4-1: Extract from Section 1.3 of the EPA CoP

Appendix 1

Site Walkover Checklist

*For inspection purposes only.
Consent of copyright owner required for any other use.*



Ardfert, Kerry Walkover Survey Checklist – 14th February 2019

Information	Checked	Comment (include distances from site boundary)
1. What is the current land use?	✓	Site is not currently used for specific purpose
2. What are the neighbouring land uses?	✓	North: Open field and river further north, identified as River Tyshe. South: Ardfert Cathedral of St.Brendan East: Open field, grassland West: Local access road immediately west, open field and R551 road
3. What is the size of the site?	✓	Total subject site/survey area c. 0.2 ha. Exact waste footprint area is unconfirmed.
4. What is the topography?	✓	Decreasing elevations in south to north direction.
5. Are there potential receptors (if yes, give details)?	✓	Yes
Houses	✓	None on site. Nearest residential property is located to c.60m to the north-west of the site.
Surface water features (if yes, distance and direction of flow)	✓	No significant water features within or immediately adjacent to the site. The River Tyshe is located c. 70m north of the site.
Any wetland or protected areas	✓	No designated protected areas within site or in the immediate vicinity of the site.
Public water supplies	✓	None observed within site
Private wells	✓	None observed within site
Services	✓	No services or utilities observed on site
Other buildings	✓	No buildings present on site
Other		n/a
6. Are there any potential sources of contamination (if yes, give details)?	✓	None observed
Surface waste (if yes, what type?)	✓	Non observed
Surface ponding of leachate	✓	None observed
Leachate seepage	✓	None observed
Landfill gas odours	✓	None

Information	Checked	Comment (include distances from site boundary)
7. Are there any outfalls to surface water? (If yes, are there discharges and what is the nature of discharge?)	✓	No
8. Are there any signs of impact on the environment? (If yes, take photographic evidence)		Non observed
Vegetation die off, bare ground	✓	None noted
Leachate seepages	✓	None noted
Odours	✓	None noted
Litter		See photographic log
Gas bubbling through water	✓	None noted
Signs of settlement	✓	None noted
Subsidence, water logged areas	✓	No
Drainage or hydraulic issues	✓	No
Downstream water quality appears poorer than upstream water quality	✓	No
9. Are there any indications of remedial measures? (Provide details)	✓	None observed with the exception of soil cap
Capping	✓	Exact capping details are unconfirmed. It is assumed the site is capped with soil as a minimum.
Landfill gas collection	✓	None
Leachate collection	✓	None
10. Describe fences and security features (if any)	✓	See photographic log
Any other relevant information?		

Appendix 2

Site Walkover Photo Log

*For inspection purposes only.
Consent of copyright owner required for any other use.*



PHOTOGRAPHIC LOG

Consultants in Engineering
and Environmental Sciences

www.fehilytimoney.ie



Client Name:
Kerry County Council

Site Location: Ardfert Landfill

Project Number: P1766

Photo No.	Date:
1	14-02-19

Description:
Entrance gate – access to site



For information purposes only.
Consent of copyright owner required for any other use.

Photo No.	Date:
2	14-02-19

Description:
View towards cathedral from site



PHOTOGRAPHIC LOG

Consultants in Engineering
and Environmental Sciences

www.fehilytimoney.ie



Client Name:
kerry Co. Co.

Site Location: Ardferf Landfill

Project Number: P1766

Photo No.

Date:

3

14-02-19

Description:

View of site looking towards
River Tyshe



Photo No.

Date:

4

14-02-19

Description:

Photo from river culvert of
River Tyshe

