Comhairle Contae Chorcaí
Cork County Council

An Stiúrthóireacht Comhshaoil,
Inis Cara, Co. Corcaigh.
Fón: (021) 4532700 • Faics: (021) 4532727
Suíomh Gréasáin: www.corkcoco.ie
Environmental Directorate,
Inniscarra, Co. Cork.
Tel. No. (021) 4532700 • Fax No. (021) 4532727
Web: www.corkcoco.ie

Office of Licensing and Resources
Environmental Protection Agency
PO Box 3000
Johnstown Castle
Co.Wexford

10 th October 2012

Re: Application for the Certification of an Unregulated Landfill Site (namely Dunmanway Landfill) as per S.I. No 524 of 2008 Waste Management (Certification of historic Unlicensed Waste Disposal and Recovery Activity) Regulations 2008.

Dear Sir/Madam,

Cork County Council would like to apply to have Dunmanway Landfill site Certified as per the Waste Management regulations 2008.

A Tier I study was completed on this site in January 2008 as part of Cork County Councils statutory obligation under Section 22 of the Waste Management Act to investigate old landfill sites within the county.

In October 2009 the Council commenced a Tier II investigation on the site and this was complete in November 2009. Following the completion of this report the site was classed as a "Moderate Risk" Site. This classification required a QRA to be undertaken following the findings of the Tier II investigation.

Please find attached copy of the Tier I, Tier II and QRA c / w a cheque in the amount of €5000 – please note that the EPA recently refunded Cork County Council in the amount of €500 from the fee submitted for the Certificate of Authorisation for Dunmanway Landfill Site and I herby request that the agency refund a similar amount in respect of this application.

Yours Faithfully,

Nicholas Bond
Head of Waste Enforcement
Environment Directorate
Cork County Council

Table of Contents

I. Certificate of Authorisation Application Form

II. Attachment A.1

III. Attachment B.1

IV. Attachment E.1

V. Dunmanway Report

Environmental Protection Agency
An Ghníomhaireacht um Chaomhnú Comhshaoil

Certificate of Authorisation Application Form

Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations, 2008

EPA Ref. Nº: *(Office use only)*	

Environmental Protection Agency
PO Box 3000, Johnstown Castle Estate, Co. Wexford
Lo Call: 1890 335599 Telephone: 053-9160600 Fax: 053-9160699
Web: www.epa.ie Email: info@epa.ie

CONTENTS

CONTENTS 2

APPLICATION GUIDANCE NOTES 3

SECTION A: NON-TECHNICAL SUMMARY 5

SECTION B: GENERAL 6

SECTION C: SITE DETAILS 9

SECTION D: RISK ASSESSMENT 12

SECTION E: APPROPRIATE ASSESSMENT 13

SECTION F: DECLARATION 15

SECTION G: JOINT DECLARATION 16

APPENDICES: LOCATION OF ATTACHEMENTS 17

APPLICATION GUIDANCE NOTES

This application must be completed in accordance the guidance notes below and the instructions accompanying each section of the application form.

This form is for the purpose of making an application for a Certificate of Authorisation in accordance with Regulation 7 (1) of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations, 2008 (hereinafter referred to as 'the Regulations'). A valid application must, as a minimum, contain the information prescribed in Regulation 7(2) of the Regulations.

The applicant must conform to the format set out in this application form and accompanying instructions. Each page of the completed application form must be numbered, e.g. *page 5 of 20,* etc. The basic information should be supplied in the spaces given in the application form, with supporting documentation supplied as attachments, as specified. All sections of the form must be completed. Where a section is not relevant to the application, the words "not applicable" should be clearly written. The abbreviation "N/A" should not be used.

The Risk Assessment (required under Regulation 6(1) of the Regulations) shall be submitted in full as Attachment D.1 to this application form. Risk Assessments are to be carried out in accordance with the *'Code of Practice - Environmental Risk Assessment for Unregulated Waste Disposal Sites'* (hereinafter referred to as the Code of Practice).

All maps/drawings/plans must be no larger than A3 size and scaled appropriately such that they are clearly legible. In exceptional circumstances, where A3 is considered inadequate, a larger size may be requested by the Agency.

All drawings should

- be titled and dated;
- have a unique reference number and be signed by a clearly identifiable person; and
- indicate a scale and the direction of north.

Information supplied on this application, including supporting documentation, will be put on public display and open to inspection by any person. Should the applicant consider information to be confidential, this information should be submitted in a separate enclosure bearing the legend "In the event that this information is deemed not to be held as confidential, it must be returned to.....". In the event that information is considered to be of a confidential nature, then the nature of this information, and the reasons why it is considered confidential (with reference to the "Access to Information on the Environment" Regulations) should be stated in the Application Form, where relevant.

An original signed application shall be submitted together with 1 copy. A copy of the application (and risk assessment) shall also be provided on 2 CD-ROMs in searchable PDF format.

It should be noted that it will not be possible to process or determine the application until the required documents have been provided in sufficient detail and to a satisfactory standard.

This document does not purport to be and should not be considered a legal interpretation of the provisions and requirements of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations 2008 (S.I. No. 524 of 2008).

SECTION A: NON-TECHNICAL SUMMARY

A non-technical summary of the application is to be included here. The summary should identify all environmental impacts of significance associated with the site.

The following information must be included in the non-technical summary:

A description of:

- The site location.
- A brief history of the site, types and volumes of waste deposited, duration of disposal activities and date of cessation.
- The hydrogeology and ecology of the site and surrounding area, to include protected areas.
- Risk category of the site
- Actual and potential environmental impacts.
- Proposed remediation including timescale.

Supporting information should form **Attachment A.1.**

SECTION B: GENERAL

B.1. Applicant's Details

Only application documentation submitted by the applicant and by the nominated person will be deemed to have come from the applicant.

Name*:	Cork County Council
Address:	Environment Directorate
	Inniscarra
	Co. Cork
Tel:	021-4532700
Fax:	021-4532727
e-mail:	

*Full name and address of the local authority making the application.

Name and Address for Correspondence

Name*:	Mr. Nicholas Bond
Address:	Environment Directorate
	Inniscarra
	Co. Cork
Tel:	021-4532701
Fax:	021-4532727
e-mail:	nicholas.bond@corkcoco.ie

*This should be the name of the person nominated by the local authority for the purposes of this application.

Name of Qualified Person

Site investigations must be supervised by a suitably qualified, trained and experienced person. Section 2.3 of the Code of Practice sets out the requirements in this regard, which should be observed by local authorities. The Code of Practice states that, notwithstanding the fact that a local authority will be in position to carry out much of the risk assessment using in-house resources, "a suitably qualified, trained and experienced person, who is a registered professional with chartered status (or equivalent) awarded by a relevant professional body, and who has successfully conducted risk assessments at other sites, should supervise the Site Investigations ... and be used to carry out the risk assessment." Please provide the name of the qualified person, in-house or external, used for this risk assessment.

Name:	Mr. Nicholas Bond
Qualification:	Bachelor in Engineering, Civil Engineering, NUIG, Post Grad Dip Environmental Engineering.
Professional Body:	Chartered Engineer
Address:	Environment Directorate
	Inniscarra
	Co.Cork
Tel:	021-4532701
Fax:	021-4532727
e-mail:	nicholas.bond@corkcoco.ie

Name:	Mr. Daniel O' Shea
Qualification:	Bachelor in Engineering, Civil Engineering, Cork IT, Bachelor of Science, Construction Management Cork IT.
Professional Body:	
Address:	Environment Directorate
	Inniscarra
	Co. Cork
Tel:	021-4532728
Fax:	021-4532727
e-mail:	daniel.oshea@corkcoco.ie

Interest in Site

State whether the applicant(s) is the registered owner of the land (please check):

Landowner	X
Landowner (part)	☐
Not Landowner	☐

Provide the name and address of the current owner(s) and lessees of the land. An appropriately scaled drawing (≤A3) outlining the land ownership should be included in **Attachment B.1.**

Name:	Cork County Council
Address:	County Hall
	Co. Cork
Tel:	021-4276891
Fax:	021-4276321
e-mail:	

B.2. Fees

Appropriate Fee (€5,000) Included	**Yes**	**No**
	Yes	

SECTION C: SITE DETAILS

C.1. Site Location

Name:	Kilbarry (Dumanway) Landfill
Address*:	Dunmanway
	Co.Cork
Tel:	
Fax:	
e-mail:	

* Include any townland

Attachment C.1. should contain appropriately scaled drawings or maps (≤A3) showing the site location in the context of its surroundings and clearly highlighting the site boundary.

C.2. Unauthorised Waste Sites Register (Section 22) – Site Boundary and Site Code

State that the site has been recorded on the online Section 22 Register at www.epa.ie/uwsr and that the boundary drawn of the site represents the full extent of the site.

Following the Tier 2 and Tier 3 site investigations, if the extent of the site is determined to be greater or less than that initially recorded in the Section 22 Register, then the boundary must be amended accordingly.

Finalised boundary entered in Section 22 Register?	X

Provide the unique code assigned to the site in the Section 22 Register

Site Code	S22-02304

Provide a six-digit National Grid Reference for the site location

Grid Reference	122,853	**E**	52,345	**N**

Confirm the following waste details entered on the Section 22 Register:

- State which type of waste activity was carried out at the site (please check):

Disposal	X
Recovery	☐

- State the principal waste type at the site (please check):

C&D	☐
Industrial	☐
Municipal	X
Pre 1977	☐
Unknown	☐

- State any additional waste types at the site (please check):

Agriculture	☐
C&D	X
Dredged Soil	☐
ELV/Scrap Metal	☐
Hazardous	☐
Industrial	X
Mining	☐
Municipal	☐
Municipal Sludge	☐
Other	☐

- State whether or not hazardous waste is present at the site (please check):

Present on site	☐
Not present on site	X

- Estimate the total quantity of waste at the site (tonnes):

Total waste quantity at the site:	54,000 tonnes

- Provide the start date and end date of waste activities at the site:

Start date	01/01/1950
End date	01/06/1998

C.3. Risk Category

State which Risk Category* the site belongs to (please check):

Class A (High)	☐
Class B (Moderate)	X
Class C (Low)	☐

*See Chapter 4, Code of Practice (as required under Section 6(2) of the Regulations)

C.4. Land Use

Provide details of the current use of the land on which the closed landfill is situated.

Attachment C.4. should detail this information or refer to the specific section of the risk assessment documentation where this information is contained.

C.5. Types and quantities of waste deposited

Provide details of the types and estimated quantities of waste deposited at the site.

Attachment C.5. should detail this information or refer to the specific section of the risk assessment documentation where this information is contained.

In addition, state whether the types and quantities of waste which have been recorded on the online Section 22 Register at www.epa.ie/uwsr represent the final estimated quantities at the site.

Following the Tier 2 and Tier 3 site investigations, if the type and quantities of waste are determined to be greater or less than that initially recorded in the Section 22 Register, then these quantities must be amended accordingly.

Finalised estimate of waste types and quantities entered in Section 22 Register	X

SECTION D: RISK ASSESSMENT

For sites which have been assigned risk category Class A (High Risk) or Class B (Moderate Risk) during the Tier 1 assessment, a full risk assessment (Tier 1, 2 and 3) must be carried out. Class C (Low Risk) sites must have, as a minimum, Tier 1 and exploratory Tier 2 assessments. All sections of the risk assessment must be included as part of this application, including any part of the Tier 1 assessment carried out using the EPA Section 22 Register risk assessment tool at www.epa.ie/uwsr.

For all sites, a proposal detailing necessary measures for remediation, risk attenuation and site restoration must be provided, and must as a minimum contain the following information:

- Details of all necessary measures proposed, including a statement of the impact of the remediation measures. Proposed measures must clearly address all risks identified in the revised Conceptual Site Model for the site. This should also include details of alternative measures considered and reasons for rejection of same, where applicable.

- Schedule for completion of the proposed necessary measures, including a timeframe for the submission of a validation report.

- Details of any ongoing or long-term monitoring or assessment programme which may be required to evaluate and ensure the effectiveness of the necessary measures as carried out.

Two copies of the risk assessment shall be submitted. The risk assessment shall also be provided on two CD-ROMs in searchable PDF format.

The Risk Assessment should be submitted as **Attachment D.1.**

SECTION E: APPROPRIATE ASSESSMENT

In addition to the foregoing, all sites (whether low, moderate or high risk) should be subject to screening for Appropriate Assessment in accordance with the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477 of 2011). The results of any such screening should be submitted as part of this application. The screening should demonstrate whether the project is/is not likely, whether individually or in combination with other plans or projects, to have significant effects on any European Site or sites as defined in Regulation 2(1) of the Habitats Regulations (S.I. No. 477 of 2011) having regard to best scientific knowledge and its conservation objectives. Where, based on the Stage 1 screening, it is considered that an appropriate assessment *is not* required, a reasoned response should be provided.

Where screening has determined that an appropriate assessment *is* required, an appropriate assessment in accordance with Article 6(3) of the Habitats Directive (92/43/EEC) should be completed and a copy of the Natura Impact Statement submitted as part of this application. The assessment should consider the following impacts on any European Site(s):

1. The impact of the existing landfill on European sites;
2. The cumulative effects of the project combined with other plans or projects that might impact on the European site or sites;
3. An assessment of the implications of the project for the European site in view of the European site's conservation objectives;
4. The objectives of proposed remediation measures with regard to existing impacts identified in item 1;
5. The impact on the European site of any physical works carried out at the closed landfill as part of the remediation plan;
6. Details of any mitigation measures proposed at or in relation to the European site, including timeframes for the implementation and monitoring of the measures; and
7. Natura Impact Statement conclusion statement. The statement should conclude whether the project will or will not adversely affect the integrity of the European site(s) having regard to its conservation objectives.

While the appropriate assessment is subject to a separate report (the Natura Impact Statement), it should be carried out in tandem with the overall risk assessment. This is to ensure that a holistic approach is undertaken, whereby all relevant appropriate assessment and risk assessment parameters are addressed and to ensure that the remediation measures proposed address all risks identified.

Please refer to the guidance document *'Appropriate Assessment of Plans and Projects in Ireland – Guidance for Planning Authorities', issued in 2009 by the Department of the Environment, Heritage and Local Government, and revised in 2010 with regard to this assessment. This document is available at: http://www.npws.ie/publications/archive/NPWS_2009_AA_Guidance.pdf.*

Three copies of the screening report and, where relevant, the Natura Impact Statement shall be submitted. The screening report/Natura

Impact Statement shall also be provided on two CD-ROMs in searchable PDF format.

The Appropriate Assessment (screening and, where relevant, Natura Impact Statement should be submitted as **Attachment E.1.**

SECTION F: DECLARATION

Declaration

I hereby make application for a Certificate of Authorisation pursuant to the provisions of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations, 2008 (S.I. No. 524 of 2008).

I certify that the information given in this application is truthful, accurate and complete and the enclosed Risk Assessment is a full and complete representation of all relevant work carried out in relation to the site in question.

I give consent to the EPA to copy this application for its own use and to make it available for inspection and copying by the public, both in the form of paper files available for inspection at EPA offices and via the EPA's website.

This consent relates to this application itself and to any further information or submission, whether provided by me as Applicant, any person acting on the Applicant's behalf, or any other person.

Signed by :_____ **Date :**_____
(on behalf of the organisation)

Print signature name: _____

Position in organisation:_____

SECTION G: JOINT DECLARATION

Joint Declaration [Note1]

I hereby make application for a Certificate of Authorisation pursuant to the provisions of the Waste Management (Certification of Historic Unlicenced Waste Disposal and Recovery Activity) Regulations, 2008 (S.I. No. 524 of 2008).

I certify that the information given in this application is truthful, accurate and complete and the enclosed Risk Assessment is a full and complete representation of all relevant work carried out in relation to the site in question.

I give consent to the EPA to copy this application for its own use and to make it available for inspection and copying by the public, both in the form of paper files available for inspection at EPA offices and via the EPA's website.

This consent relates to this application itself and to any further information or submission whether provided by me as Applicant, any person acting on the Applicant's behalf, or any other person.

Lead Authority

Signed by :_____ **Date :**_____
(on behalf of the organisation)

Print signature name: N/A

Position in organisation:_____

Co-Applicants

Signed by :_____ **Date :**_____
(on behalf of the organisation)

Print signature name: N/A

Position in organisation:_____

Signed by :_____ **Date :**_____
(on behalf of the organisation)

Print signature name: N/A

Position in organisation:_____

Note 1: In the case of an application being lodged on behalf of more than one local authority the above declaration must be signed by all applicants.

APPENDICES: LOCATION OF ATTACHMENTS

The list below sets out the various attachments required under the under the Historic Landfill Application Form and there location within the attached documents.

- **Attachment C.1:** The appropriate scaled drawings and maps showing the site location can be viewed in the document Dunmanway Tier I report.

- **Attachment C.4:** Information in relation to the current use of the land can be found in the Dunmanway Tier II report under the section "Site Introduction" – "Surrounding Land Use".

- **Attachment C.5:** The information relating to the types and quantities of waste deposited can be viewed in the Dunmanway Tier II report under "On Site Investigations" – "Waste Characterisation". It is estimated that approximately 54,000 tonnes of waste have been deposited on this site.

- **Attachment D.1:** This can be found within the Dunmanway Tier II and Tier III Reports.

- The Schedule for completion of the proposed necessary measures is dependent on agreement of the EPA to proposed measures.

Attachment A.1

Landfill Site: **Dunmanway**
Site Reference: **08/W**
Division: **West Cork**
Area Office**: Dunmanway**

TABLE OF CONTENTS

INTRODUCTION **3**

The Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites *3*
Circular WPRR: 09/08 ..... *4*
Site Description *4*
Tier I Study *4*
Tier II Assessment *5*
Tier III Assessment – Cork County Council *6*
QRA Conclusions & Recommendations *6*

Introduction

The European Court of Justice ruled on the 26th April 2005 that Ireland was non compliant with the Waste Framework Directive (75/442/EEC) between 1977 and 1997.

A proper and sufficient permitting system for private and local authority landfills had not been in place for the above years in accordance with the Directive.

The EPA prepared the "Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites" in response to the ECJ ruling.

The code came into effect in April 2007 and provided Local Authorities with guidance on:

- The Identification of Unregulated Landfill Sites
- Risk Screening & Prioritisation (Tier I)
- Site Investigations & Verification (Tier II)
- Quantitative Risk Assessment (Tier III)
- Remediation Techniques
- Reporting Requirements

The Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites

The Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites required All Local Authorities to

1. Identify all landfills within functional area (including public & private).
2. Place all sites on a register in accordance with section 22 of the Waste Management Act (WMA).
3. Carry out risk assessments on each site in accordance with COP.
4. Carry out a quantitative risk assessment on all Medium and High risk sites
5. Prepare remediation plans in line with risk assessments.
6. Apply to EPA to certify these sites in accordance with SI 524 of 2008
7. Provide verification reports showing successful outcome of remediation works.

Circular WPRR: 09/08

- Circular WPRR: 09/08 along with S.I. 524 of 2008 were issued on the 22nd December 2008 and required that all Category 1 Landfills (LA operated landfills) be identified and placed on the EPA section 22 register by the 30th June 2009.
    - This has been completed by Cork County Council.
- All Tier I Investigations were also required to be completed by 31st December 2009.
    - Cork County Council has completed this task and placed the findings on the EPA Section 22 register.

Site Description

The Dunmanway Landfill 08/W is situated approximately 300m South West of the local town centre. The Dirty River which flows through Dunmanway town is 40m away from the site. The landfill covers an approximate area of 1.60Ha and it is believed the site is almost 6-7m deep. To protect against waste being washed away during periods of flood an earth bank was constructed on the northern area of the site.

It is understood the site began operating in the 1950s or maybe even in the late 1940s. The material deposited on the site varied from Municipal, C&D Waste, Commercial and possibly some Food waste. The Landfill ceased activity in 1997/1998 and was capped with topsoil, stone and chips.

Tier I Study

Cork County Council completed a Tier 1 study on the landfill in Dunmanway in January 2008 in accordance with the "Code of Practice Environment Risk Assessment for Unregulated Waste Disposal Sites (COP)" published by the Environmental Protection Agency (EPA).

The Assessment concluded that the site was a Class B – Moderate Risk Site. This was due to the potential for leachate migration from the site to local waterways, while confirming that there is no methane gas risk to the surrounding housing.

Tier II Assessment

1. In November 2009, the Council commenced with a Tier II Assessment. This consisted of an Exploratory Phase and an ensuing Detailed Phase Investigation.

2. The Exploratory Phase included:-
   a) A trial pitting programme to determine the lateral and vertical extent of the fill, the nature of the waste and to establish the nature of the underlying subsoil;

3. The Detailed Phase included:-
   a) The collection and analysis of samples of the waste for waste characterisation; collection and chemical analysis of surface water, leachate and soil samples and collection and geotechnical testing of soil samples.

4. The Report Found that

   - The site was underlain by material varying in depth from 3.4m near the earth bund in the northern side to 5-6m in the middle and south facing area. The depth of soil cover ranged from 0.5-2m on the site and the footprint of the site could be downsized from 1.6Ha to 0.9Ha. Brown firm clay was found beneath the waste material and this is providing an effective barrier between leachate and groundwater.

   - The makeup of the waste consisted of domestic waste, wiring, steel and concrete fragments. From the surface water samples it was found that the landfill may be having some impact on the water quality of the local river. There is no significant risk to the local residents from landfill gas, while it can be concluded that Dunmanway landfill is likely to be in late stage IV or in stage V of the degradation process.

   - An environmental survey was carried out by Doherty Environmental and they found the site to be of moderate ecological value.

Tier III Assessment – Cork County Council

1. The Tier III Assessment involves the review of the Conceptual Site Model (COP) put forward in the Tier I investigation as well as the findings of the Tier II Assessment.

2. The risk posed was found to be a Moderate Risk (Class B) and therefore a Quantitative Risk Assessment (QRA) was required. A Quantitative Risk Assessment is required should the risk be deemed to intrinsically pose a high or moderate risk to the environment or human health. It uses an efficient and progressive approach to identify the risks with the aim of establishing a pollutant linkage from a source (S) via a pathway (P) to a receptor (R). Should a pathway not exist there is no risk.

3. The main Source – Pathway – Receptor risk is from leachate migration to surface water. The remediation plans should focus on breaking this link.

QRA Conclusions & Recommendations

1. In order to eliminate the risk posed by the leachate migration to surface water, some remedial works are necessary to reduce the infiltration of rainwater into the waste mass.

2. The likely solution on hand would be to place a low permeability layer over the landfill. This could be achieved by either installing a geo membrane over the landfill mass or else placing a layer of low permeability soil over the existing soil cover. Both of these options would greatly reduce the infiltration into the waste body.

3. There is a however a possibility of landfill gas build up during the remedial works. Therefore further gas monitoring maybe required on the site.

4. Ammonia levels were found to have increased downstream from the landfill when compared with the upstream levels. Since the levels were found to be high in the samples of leachate taken from the landfill, it can be assumed that the increase in Ammonia levels in the river is down to leachate migration from the waste mass. Additional sampling maybe necessary after the CoA is granted to confirm the break in the linkage.

Attachment B.1

Land Registry

County Cork — Folio 38260F

Register of Ownership of Freehold Land

Part 1(A) - The Property

Note: Unless a note to the contrary appears, neither the description of land in the register nor its identification by reference to the Registry Map is conclusive as to boundaries or extent

For parts transferred see Part 1(B)

No.	Description	Official Notes
1	A plot of ground being part of the Townland of DERREENY and Barony of Bear containing .0880 Hectares shown as Plan(s) 11, 10 edged RED on the Registry Map (OS MAP Ref(s) 116/6).	From Folio CK27748
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	
2	A plot of ground being part of the Townland of CARRIGROHANE and Barony of Cork containing .1570 Hectares shown as Plan(s) 1289 edged RED on the Registry Map (OS MAP Ref(s) 6381/C).	From Folio CK51726 Instrument S 5473/85
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	
3	A plot of ground being part of the Townland of BALLYHOOLY SOUTH and Barony of Fermoy containing .8420 Hectares shown as Plan(s) 75 edged RED on the Registry Map (OS MAP Ref(s) 34/4).	From Folio CK32961F Instrument S 8530/85
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	
4	A plot of ground being part of the Townland of KNOCKNAMADDEREE and Barony of Imokilly containing .2790 Hectares shown as Plan(s) 26 edged RED on the Registry Map (OS MAP Ref(s) 88/4).	From Folio CK30099 Instrument S 1372/86
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	
5	A plot of ground being part of the Townland of BALLINSPITTLE and Barony of Courceys containing .0930 Hectares shown as Plan(s) 2 edged RED on the Registry Map (OS MAP Ref(s) 124/11).	Instrument S 6707/85
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	

Land Registry

County Cork — Folio 38260F

6	A plot of ground being part of the Townland of BOHERASH and Barony of Fermoy containing .4590 Hectares shown as Plan(s) 65A edged RED on the Registry Map (OS MAP Ref(s) 27/6). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK38275F Instrument S 1373/86
7	A plot of ground situate to the West of the Road leading from Dunmanway to Bantry in the Town of Bantry being part of the Townland of ABBEY and Barony of Bantry containing 1.3220 Hectares shown as Plan(s) 1 edged RED on the Registry Map (OS MAP Ref(s) 118/6). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 4907/85
8	A plot of ground being part of the Townland of GLEBE and Barony of Carbery West (East Division) containing .1190 Hectares shown as Plan(s) 9 edged RED on the Registry Map (OS MAP Ref(s) 141/13). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 8290/85
9	A plot of ground situate on the Northside of the road from Liscarroll to Buttevant being part of the Townland of CREGGANE and Barony of Orrery and Kilmore shown as Plan(s) 228 edged RED on the Registry Map (OS MAP Ref(s) 17/9). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 8291/85
10	A plot of ground situate on the Northside of Main Street in the Town of Millstreet in the Parish of Millstreet and in the Non-Municipal Town of Millstreet containing .0020 Hectares shown as Plan(s) 150 edged RED on the Registry Map (OS MAP Ref(s) 39/10). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 8292/85

Land Registry

County Cork — Folio 38260F

11	A plot of ground in the village of Ballyclogh being part of the Townland of BALLYCLOGH and Barony of Orrery and Kilmore containing .0260 Hectares shown as Plan(s) 61 edged RED on the Registry Map (OS MAP Ref(s) 24/15). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 8293/85
12	A plot of ground being part of the Townland of BALLYCOSKERY and Barony of Orrery and Kilmore containing 1.7060 Hectares shown as Plan(s) 65 edged RED on the Registry Map (OS MAP Ref(s) 8/5). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK3473 Instrument S 8564/85
13	Eight undivided 276th parts of a plot of ground being part of the Townland of GERAHIES and Barony of Carbery West (West Division) containing .0080 Hectares shown as Plan(s) 105 edged RED on the Registry Map (OS MAP Ref(s) 117/15). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK45405 Instrument S 8311/85
14	A plot of ground being part of the Townland of COOLAWALEEN and Barony of Duhallow containing 1.6310 Hectares shown as Plan(s) 32 edged RED on the Registry Map (OS MAP Ref(s) 24/13). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK34402 Instrument S 247/86
15	A plot of ground being part of the Townland of CARRIGTOHILL and Barony of Barrymore containing 1.9500 Hectares shown as Plan(s) 380, 381 edged RED on the Registry Map (OS MAP Ref(s) 75/8). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK49809 Instrument S 8326/84

16	A plot of ground being part of the Townland of CARRIGTOHILL and Barony of Barrymore containing .7820 Hectares shown as Plan(s) 1D edged RED on the Registry Map (OS MAP Ref(s) 6341-C, 6386-A). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK49809 Instrument S 9928/84
17	A plot of ground being part of the Townland of CASTLEREDMOND and Barony of Imokilly containing .0880 Hectares shown as Plan(s) 349 edged RED on the Registry Map (OS MAP Ref(s) 6388/1). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK46956 Instrument S 733/86
18	A plot of ground being part of the Townland of GLINNY and Barony of Kinalea containing .5860 Hectares shown as Plan(s) 38, 40, 41 edged RED on the Registry Map (OS MAP Ref(s) 98/6). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK7272F Instrument S 1982/88
19	A plot of ground being part of the Townland of BALLYTRASNA (ED CAHERLAG) and Barony of Barrymore containing .0010 Hectares shown as Plan(s) 10 edged RED on the Registry Map (OS MAP Ref(s) 65/2). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1976 or in any superior grant affecting the property	From Folio CK26996F Instrument S 1093A/86
20	A plot of ground being part of the Townland of DOUGLAS and Barony of Cork containing .0150 Hectares shown as Plan(s) 300, 301 edged RED on the Registry Map (OS MAP Ref(s) 6428/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK41859, CK8825F Instrument S 1436/86

21	A plot of ground being part of the Townland of COURTSTOWN and Barony of Barrymore containing .4330 Hectares shown as Plan(s) 114 edged RED on the Registry Map (OS MAP Ref(s) 75/7). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK35620 Instrument S 3144/86
22	A plot of ground being part of the Townland of GORTDONAGHMORE and Barony of Muskerry East containing .4810 Hectares shown as Plan(s) 45, 46, 48, 49 edged RED on the Registry Map (OS MAP Ref(s) 6288/A, 6288/C). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK15229, CK15230 Instrument S 5447/86
23	A plot of ground being part of the Townland of GARRYDUFF and Barony of Barrymore shown as Plan(s) 28 edged RED on the Registry Map (OS MAP Ref(s) 6387/5, 6342/25). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK54813 Instrument S 6742/85
24	A plot of ground being part of the Townland of CHURCHTOWN and Barony of Barrymore containing .0680 Hectares shown as Plan(s) 4 edged RED on the Registry Map (OS MAP Ref(s) 76/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK23787 Instrument S 937/86
25	A plot of ground being part of the Townland of FARNANES and Barony of Muskerry East containing .0780 Hectares shown as Plan(s) 53 edged RED on the Registry Map (OS MAP Ref(s) 84/1). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK52808 Instrument S 941/86

26	A plot of ground being part of the Townland of CARRIGALINE EAST and Barony of Kerrycurrihy containing .4800 Hectares shown as Plan(s) 130 edged RED on the Registry Map (OS MAP Ref(s) 6510/B). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK3014 Instrument S 1070/86
27	A plot of ground being part of the Townland of CLOUSTOGE and Barony of Fermoy containing .1130 Hectares shown as Plan(s) 21 edged RED on the Registry Map (OS MAP Ref(s) 18/9). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK20907 Instrument S 9108/84
28	A plot of ground situate to the East of River Street in the Town of Cloyne being part of the Townland of TOWNPARKS and Barony of Imokilly containing .3350 Hectares shown as Plan(s) 369 edged RED on the Registry Map (OS MAP Ref(s) 6433/D). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 1265/86
29	A plot of ground being part of the Townland of ROCHFORDSTOWN and Barony of Cork containing .0270 Hectares shown as Plan(s) 218, 219 edged RED on the Registry Map (OS MAP Ref(s) 86/1). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 1263/86
30	A plot of ground situate to the North of Mary Street and West of West Street being part of the Townland of DUNMANWAY SOUTH and Barony of Carbery East (West Division) containing 2.2410 Hectares shown as Plan(s) 55 edged RED on the Registry Map (OS MAP Ref(s) 107/12). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 1264/86

31	A plot of ground being part of the Townland of BALLYGARVAN and Barony of Kerrycurrihy containing .6800 Hectares shown as Plan(s) 147 edged RED on the Registry Map (OS MAP Ref(s) 86/10). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK29602 Instrument S 1324/86
32	The property shown coloured Red as plan(s) 259, 99, 100, 98 on the Registry Map, situate in the Parish of KINSALE, in the Townland of TOWN-PLOTS, in the Barony of KINSALE, in the Electoral Division of KINSALE URBAN. The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property Description Revised Instrument Q2011LR017874W 1-Nov-2011.	Instrument S 1410/86
33	A plot of ground being part of the Townland of KEALE SOUTH and Barony of Duhallow containing .0320 Hectares shown as Plan(s) 13 edged RED on the Registry Map (OS MAP Ref(s) 39/3). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 1412/86
34	A plot of ground situate to the North of the road leading from Crosshaven to Cork in the Urban District of Passage West being part of the Townland of MONKSTOWN and Barony of Kerrycurrihy shown as Plan(s) 68 edged RED on the Registry Map (OS MAP Ref(s) 87/10). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 1413/86

35	A plot of ground being part of the Townland of BALLYFOULOO and Barony of Kerrycurrihy shown as Plan(s) 71, 72 edged RED on the Registry Map (OS MAP Ref(s) 87/10). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 1413/86
36	A plot of ground in the Village of Ladysbridge being part of the Townland of KNOCKGLASS and Barony of Imokilly containing .9360 Hectares shown as Plan(s) 82 edged RED on the Registry Map (OS MAP Ref(s) 77/6, 77/7). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 1414/86
37	A plot of ground situate on the South side of the road leading from Glengarriff to Bantry being part of the Townland of REENMEEN EAST and Barony of Bear containing .0060 Hectares shown as Plan(s) 18 edged RED on the Registry Map (OS MAP Ref(s) 104/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 1230/86
38	A plot of ground being part of the Townland of ROCHFORDSTOWN and Barony of Cork containing .1130 Hectares shown as Plan(s) 217 edged RED on the Registry Map (OS MAP Ref(s) 86/1). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 255/86
39	A plot of ground being part of the Townland of GURTEENROE and Barony of Muskerry West shown as Plan(s) 247 edged RED on the Registry Map (OS MAP Ref(s) 6329/C). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK56523 Instrument S 1648/86

40	A plot of ground being part of the Townland of BALLYDUHIG SOUTH and Barony of Kerrycurrihy containing .0160 Hectares shown as Plan(s) 103 edged RED on the Registry Map (OS MAP Ref(s) 6509/A). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK33230F Instrument S 1965/86
41	A plot of ground being part of the Townland of DOUGLAS and Barony of Cork containing .0350 Hectares shown as Plan(s) 305, 306 edged RED on the Registry Map (OS MAP Ref(s) 6428/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK58766 Instrument S 1988/86
42	A plot of ground being part of the Townland of CLASHDUFF and Barony of Barrymore containing .5590 Hectares shown as Plan(s) 47, 48 edged RED on the Registry Map (OS MAP Ref(s) 76/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK1839 Instrument S 2014/86
43	A plot of ground being part of the Townland of COOLMAIN and Barony of Carbery East (East Division) containing .4240 Hectares shown as Plan(s) 30 edged RED on the Registry Map (OS MAP Ref(s) 124/13). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK22184 Instrument S 2098/86
44	A plot of ground on the South side of Mill Street in the Town of Mallow being part of the Townland of BALLYDAHIN and Barony of Fermoy shown as Plan(s) 2 edged RED on the Registry Map Book 29, Division 1. The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 2103/86

45	A plot of ground being part of the Townland of BALLYHENNICK and Barony of Barrymore containing .3240 Hectares shown as Plan(s) 21 edged RED on the Registry Map (OS MAP Ref(s) 75/2). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK32206 Instrument S 936/86
46	A plot of ground being part of the Townland of LISBEALAD EAST and Barony of Carbery East (West Division) containing .6470 Hectares shown as Plan(s) 27 edged RED on the Registry Map (OS MAP Ref(s) 121/1). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK13518 Instrument S 943/86
47	A plot of ground being part of the Townland of BALLYNAGRUMOOLIA and Barony of Kerrycurrihy shown as Plan(s) 74 edged RED on the Registry Map (OS MAP Ref(s) 86/9). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK22804 Instrument S 2669/86
48	A plot of ground being part of the Townland of TEADIES LOWER and Barony of Carbery East (West Division) containing .0240 Hectares shown as Plan(s) 79 edged RED on the Registry Map (OS MAP Ref(s) 109/6). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK11222 Instrument S 2698/86
49	A plot of ground being part of the Townland of RIVERSTOWN and Barony of Barrymore containing 4.2850 Hectares shown as Plan(s) 487 edged RED on the Registry Map (OS MAP Ref(s) 64/9). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK34759 Instrument S 3143/86

50	A plot of ground being part of the Townland of MONEYGURNEY and Barony of Cork containing 2.2610 Hectares shown as Plan(s) 220A edged RED on the Registry Map (OS MAP Ref(s) 86/8). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK12811 Instrument S 3322/86
51	A plot of ground being part of the Townland of PIERCETOWN and Barony of Cork containing .0480 Hectares shown as Plan(s) 34 edged RED on the Registry Map (OS MAP Ref(s) 63/11). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK35523F Instrument S 7121/85
52	A plot of ground being part of the Townland of CARRIGTOHILL and Barony of Barrymore containing .6960 Hectares shown as Plan(s) 383, 422, 423 edged RED on the Registry Map (OS MAP Ref(s) 75/8, 76/5). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK31663 Instrument S 3444/86
53	A plot of ground being part of the Townland of GARRYHANKARD and Barony of Kinalea containing .2780 Hectares shown as Plan(s) 29, 30 edged RED on the Registry Map (OS MAP Ref(s) 96/8, 97/5). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK21245F Instrument S 3706/86
54	A plot of ground being part of the Townland of KILBARRY and Barony of Cork containing .0760 Hectares shown as Plan(s) 116, 117 edged RED on the Registry Map (OS MAP Ref(s) 24/3). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK17273F Instrument S 5581/86

55	A plot of ground being part of the Townland of ARDURA BEG and Barony of Carbery West (West Division) containing .0580 Hectares shown as Plan(s) 21, 22 edged RED on the Registry Map (OS MAP Ref(s) 140/8). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK42932 Instrument S 4165/86
56	A plot of ground being part of the Townland of CASTLEREDMOND and Barony of Imokilly containing .0180 Hectares shown as Plan(s) 353 edged RED on the Registry Map (OS MAP Ref(s) 6388/1). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	Instrument S 4217/86
57	A plot of ground being part of the Townland of SHANDRUM and Barony of Carbery East (West Division) containing .1080 Hectares shown as Plan(s) 13 edged RED on the Registry Map (OS MAP Ref(s) 120/11). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK12635 Instrument S 7943/86
58	A plot of ground being part of the Townland of BARRYSCOURT and Barony of Barrymore containing .1500 Hectares shown as Plan(s) 155 edged RED on the Registry Map (OS MAP Ref(s) 76/5). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK19297F Instrument S 5077/86
59	A plot of ground being part of the Townland of MONFIELDSTOWN and Barony of Cork containing .0050 Hectares shown as Plan(s) 355 edged RED on the Registry Map (OS MAP Ref(s) 6428/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK4450 Instrument S 5648/86

60	A plot of ground situate on the South side of Baltimore Road in the Urban District of Skibbereen being part of the Townland of CARRIGFADDA and Barony of Carbery East (West Division) shown as Plan(s) 94 edged RED on the Registry Map (OS MAP Ref(s) 141/12). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK38642 Instrument S 8744/86
61	A plot of ground being part of the Townland of CARRIGROHANE and Barony of Cork shown as Plan(s) 1601 edged RED on the Registry Map (OS MAP Ref(s) 73/12). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK37827F Instrument S 7074/86
62	A plot of ground being part of the Townland of CURRAGHBINNY and Barony of Kerrycurrihy shown as Plan(s) 91, 92, 93 edged RED on the Registry Map (OS MAP Ref(s) 87/14, 87/15). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK36428 Instrument S 5205/86
63	A plot of ground being part of the Townland of AGHARINAGH and Barony of Muskerry East containing .0500 Hectares shown as Plan(s) 250, 251 edged RED on the Registry Map (OS MAP Ref(s) 72/3). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK22580 Instrument S 5100/86
64	A plot of ground being part of the Townland of BALLYEDKIN and Barony of Imokilly shown as Plan(s) 31 edged RED on the Registry Map (OS MAP Ref(s) 76/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK49548 Instrument S 1066/87

65	A plot of ground being part of the Townland of BAURNAHULLA and Barony of Carbery West (East Division) containing .0500 Hectares shown as Plan(s) 139 edged RED on the Registry Map (OS MAP Ref(s) 119/12).	Instrument S 5949/86
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	
66	A plot of ground being part of the Townland of DARKWOOD and Barony of Carbery East (West Division) containing .1520 Hectares shown as Plan(s) 18 edged RED on the Registry Map (OS MAP Ref(s) 107/8).	From Folio CK48940 Instrument S 6920/86
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	
67	A plot of ground being part of the Townland of BALLYDAHIN and Barony of Fermoy containing .1090 Hectares shown as Plan(s) 613 edged RED on the Registry Map (OS MAP Ref(s) 33/9).	From Folio CK35373 Instrument S 5742/86
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	
68	A plot of ground being part of the Townland of ROCKSPRING and Barony of Orrery and Kilmore containing .2800 Hectares shown as Plan(s) 62 edged RED on the Registry Map (OS MAP Ref(s) 16/1).	From Folio CK17900 Instrument S 2567/87
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	
69	A plot of ground being part of the Townland of CLASHDUFF and Barony of Barrymore containing .0440 Hectares shown as Plan(s) 49 edged RED on the Registry Map (OS MAP Ref(s) 76/4).	From Folio CK56247 Instrument S 6364/86
	The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	

70	A plot of ground being part of the Townland of KNOCKNABOHILLY and Barony of Kinsale containing .0270 Hectares shown as Plan(s) 18 edged RED on the Registry Map (OS MAP Ref(s) 112/13). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK22890F Instrument S 5957/86
71	A plot of ground being part of the Townland of KILLOUGH EAST and Barony of Bear containing .2020 Hectares shown as Plan(s) 26 edged RED on the Registry Map (OS MAP Ref(s) 127/9). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK2240F Instrument S 6485/86
72	A plot of ground being part of the Townland of KANTURK and Barony of Duhallow containing .1640 Hectares shown as Plan(s) 647 edged RED on the Registry Map (OS MAP Ref(s) 23/14). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK2850 Instrument S 326/87
73	A plot of ground being part of the Townland of CLOGHMACSIMON and Barony of Carbery East (East Division) containing 3.5910 Hectares shown as Plan(s) 20 edged RED on the Registry Map (OS MAP Ref(s) 6607/2, 6607/3). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK34509 Instrument S 7110/86
	Description Revised Instrument No.D2005CK019039T.	

74	A plot of ground situate to the East of Casement Road in the Town of Bandon being part of the Townland of CLOGHMACSIMON and Barony of Carbery East (East Division) shown as Plan(s) 279 edged RED on the Registry Map (OS MAP Ref(s) 6607/2, 6607/3). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK34504 Instrument S 7110/86
75	A plot of ground being part of the Townland of BALLYCRENANE (ED BALLINTEMPLE) and Barony of Imokilly containing .0160 Hectares shown as Plan(s) 26 edged RED on the Registry Map (OS MAP Ref(s) 89/10). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK19351 Instrument S 7555/86
76	A plot of ground being part of the Townland of BALLYCRENANE (ED BALLINTEMPLE) and Barony of Imokilly containing .0050 Hectares shown as Plan(s) 25 edged RED on the Registry Map (OS MAP Ref(s) 89/10). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK37725F Instrument S 7555/86
77	A plot of ground being part of the Townland of DUNBULLOGE and Barony of Barrymore containing .4090 Hectares shown as Plan(s) 30 edged RED on the Registry Map (OS MAP Ref(s) 63/3). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK5705 Instrument S 7746/86
78	A plot of ground being part of the Townland of KILLAHORA and Barony of Barrymore containing .0300 Hectares shown as Plan(s) 129 edged RED on the Registry Map (OS MAP Ref(s) 75/3). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK17021F Instrument S 7994/86

79	A plot of ground being part of the Townland of BALLINCROKIG (ED ST. MARYS) and Barony of Cork containing .1940 Hectares shown as Plan(s) 36, 40 edged RED on the Registry Map (OS MAP Ref(s) 63/15). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK24433F Instrument S 8097/86
80	A plot of ground being part of the Townland of BALLYMACOWEN and Barony of Carbery East (East Division) containing .0310 Hectares shown as Plan(s) 62 edged RED on the Registry Map (OS MAP Ref(s) 135/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK34326F Instrument S 9351/86
81	A plot of ground being part of the Townland of CLODAH and Barony of Muskerry West containing .0760 Hectares shown as Plan(s) 84 edged RED on the Registry Map (OS MAP Ref(s) 83/8). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK60139 Instrument S 7389/86
82	A plot of ground being part of the Townland of CURRAGHCONWAY and Barony of Cork shown as Plan(s) 76 edged RED on the Registry Map (OS MAP Ref(s) 86/3). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK3478F Instrument S 7408/86
83	A plot of ground being part of the Townland of CURRAGHCONWAY and Barony of Cork shown as Plan(s) 75 edged RED on the Registry Map (OS MAP Ref(s) 86/3). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK3478F Instrument S 7408/86

84	A plot of ground situate to the South of the road leading from Baltimore to Skibbereen in the Urban District of Skibbereen being part of the Townland of CARRIGFADDA and Barony of Carbery West (East Division) containing .0250 Hectares shown as Plan(s) 93 edged RED on the Registry Map (OS MAP Ref(s) 141/12). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK30162 Instrument S 7589/86
85	A plot of ground being part of the Townland of CURRABWEE and Barony of Carbery East (West Division) shown as Plan(s) 19 edged RED on the Registry Map (OS MAP Ref(s) 120/12). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK49157 Instrument S 7638/86
86	A plot of ground being part of the Townland of CAHERNACRIN and Barony of Bantry containing 7.2560 Hectares shown as Plan(s) 29 edged RED on the Registry Map (OS MAP Ref(s) 118/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK25249 Instrument S 7823/86
87	A plot of ground being part of the Townland of KILPHELAN and Barony of Condons and Clangibbon containing .0160 Hectares shown as Plan(s) 9 edged RED on the Registry Map (OS MAP Ref(s) 19/11). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK33584 Instrument S 7901/86
88	A plot of ground being part of the Townland of CASTLETREASURE and Barony of Cork containing .2630 Hectares shown as Plan(s) 197 edged RED on the Registry Map (OS MAP Ref(s) 86/4). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK32707 Instrument S 1584/87

89	A plot of ground being part of the Townland of KILLEENDANIEL and Barony of Cork containing .3860 Hectares shown as Plan(s) 9, 10 edged RED on the Registry Map (OS MAP Ref(s) 63/14). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK5322 Instrument S 1620/87
90	A plot of ground being part of the Townland of GLANLOUGH and Barony of Carbery West (West Division) containing .3640 Hectares shown as Plan(s) 68 edged RED on the Registry Map (OS MAP Ref(s) 130/2). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK60666 (Lands No. 1) Instrument S 1652/87
91	A plot of ground being part of the Townland of TOORMORE and Barony of Carbery West (West Division) containing .2500 Hectares shown as Plan(s) 155 edged RED on the Registry Map (OS MAP Ref(s) 148/1). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK45526 Instrument S 1679/87
92	A plot of ground being part of the Townland of CURRAHEVERN EAST and Barony of Ibane and Barryroe containing .4800 Hectares shown as Plan(s) 37 edged RED on the Registry Map (OS MAP Ref(s) 136/6). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK38920F Instrument S 1958/87
93	A plot of ground being part of the Townland of GARRANE and Barony of Carbery West (West Division) shown as Plan(s) 15 edged RED on the Registry Map (OS MAP Ref(s) 148/2). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK5411F Instrument S 2010/87

Land Registry

County Cork Folio 38260F

94	A plot of ground being part of the Townland of GLEBE (ED GORTNATUBBRID) and Barony of Muskerry West containing .2220 Hectares shown as Plan(s) 12 edged RED on the Registry Map (OS MAP Ref(s) 58/12). The Registration does extend to the mines and minerals reserved in a Fee Farm Grant dated 24-Jan-1876 or in any superior grant affecting the property	From Folio CK10123 Instrument 2130/87

Land Registry

County Cork Folio 38260F

Part 1(B) - Property
Parts Transferred

No.	Prop No:	Instrument:	Date:	Area(Hectares):	Plan:	Folio No:
4	74	D2003CK010919D	28-MAY-2003	1.1500	A47MP	CK103326F
5	90	D2001CK014067C	08-NOV-2001	0.3500	A5C42	CK103877F
6	16	D2004CK000204Y	08-JAN-2004		A5NPJ	CK104467F
7	68	D2003CK026171Q	09-DEC-2003		A6AK7	CK106097F
8	16	D2004CK007302K	29-MAR-2004		A6GMU	CK106544F
9	74	D2000CK013790B	12-OCT-2000		512	CK93874F
10	73	D2005CK011274P	10-MAY-2005		513 A87PX	CK113498F
11	12	D2005CK024859J	30-SEP-2005		225V	CK114924F
12	12	D2005CK027865W	04-NOV-2005		28HD	CK115682F
13	28	D2006CK007220G	26-NOV-2003		2RNU	CK118255F
14	16	D2005CK031462D	15-NOV-2005		2X2A	CK119032F
15	12	D2006CK016704B	20-JUN-2006		BCP3G	CK120174F
16	16	D2005CK021773N	25-MAY-2005		BHE28	CK125374F
17	5	D2006CK007708E	16-MAR-2006	0.0060	BKRD8	CK127845F
18	16	D2008CK039062N	15-DEC-2008		BYCQ4	CK129688F
19	16	D2006CK015938R	13-JUN-2006		B0K13	CK130917F
20	39	D2006CK025813H	21-SEP-2006	0.6730	B07TK	CK131346F
21	3	D2009LR078276K	20-APR-2009		B4NTT	CK135340F
22	39	D2006CK001014W	16-JAN-2006		B8M18	CK137820F
23	16	D2006CK010764M	19-APR-2006		B8N91	CK138124F
24	6	D2009LR203661N	28-MAY-2008		CHVM1	CK143227F
26	3	D2008CK034996J	05-NOV-2008	0.2530	C4DD5	CK150520F

Transfer Notes

Entry No. 10 The area of Plans 513 and A87PX is 2.7150 Hectares.

Land Registry

County Cork Folio 38260F

Part 2 - Ownership

Title of property no. 13, 55, 91 POSSESSORY
Title of property no. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 92, 93, 94 ABSOLUTE

No.	The devolution of the property is subject to the provisions of Part II of the Succession Act, 1965
1	01-NOV-1984 THE COUNTY COUNCIL OF THE COUNTY OF CORK is full owner.

Land Registry

County Cork Folio 38260F

Part 3 - Burdens and Notices of Burdens

No.		Particulars
~~1~~		~~The property Nos. 7, 10, 23, 32, 34, 60, 62, 63, 64, 65, 66, 69, 73, 74, 75, 76, 77, 78, 80, 81, 82, 83, 84, 86, 87, 88, 89, 90, 91, 92, 93 and 94 are subject to the provisions prohibiting letting, subletting or subdivision specified in Section 12 of the Land Act, 1965, and to the provisions restricting the vesting of interests specified in Section 45 of the said Act in so far as the said provisions affect same.~~ ~~NOTE: Section 12 consent lodged under D2005CK011274P.~~ Cancelled D2005CK027865W 04-NOV-2005
2		The property herein having been acquired by the registered owner thereof for its statutory purposes is subject to such restrictions against alienation or letting as may be contained in the statutory enactments relating to such property.
3	L.R. 12/52102	The property No. 2 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
4	L.R. 70/67314	The property No. 13 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
5	L.R. 380/46618	The property No. 14 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
6	L.R. 1/66229	The property No. 15 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
7	L.R. 1/66229	The property No. 16 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
		The property No. 20 is subject to the fishing rights and

8	L.R. 1F/63491 L.R. 10F/63491	fisheries (if any) excepted by Order of the Land Commission
9	L.R. 3/44613	The property No. 21 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
10	L.R. 10F/63491	The property No. 41 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
11	L.R. 4/45560	The property No. 49 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
12	L.R. 226/65585	The property No. 54 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
13	L.R. 68/65540	The property No. 55 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
14	L.R. 5/44700	The property No. 62 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
15	L.R. 1025/74464	The property No. 90 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
16	L.R. 47/67490	The property No. 91 is subject to the fishing rights and fisheries (if any) excepted by Order of the Land Commission
17	L.R. 14998	The property No. 3 is subject to the sporting rights reserved in a Fee Farm Grant dated the 29th of August 1853 or in any

		superior grant affecting the property.
18		The property No. 15 is subject to the sporting rights within the meaning of the Irish Land Act 1903 to which Joseph H. Gubbins was entitled previously to the sale under the said Act.
19	L.R. 6817	The property No. 18 is subject to the sporting rights within the meaning of the Irish Land Act, 1903, reserved by Fiat of the Land Commission.
20	L.R. 16426	The property No. 27 is subject to the sporting rights within the meaning of the Irish Land Act, 1903.
21	L.R. 4408	The property No. 40 is subject to the sporting rights reserved in a Fee Farm Grant dated the 24th of January 1876 or in any superior grant or lease affecting the property.
22		The property No. 47 is subject to the sporting rights reserved in a Fee Farm Grant dated the 30th of July 1859 or in any superior grant affecting the property.
23		The property No. 48 is subject to the sporting rights within the meaning of the Irish Land Act, 1903, reserved by Fiat of the Land Commission.
24	SCH NO. 7425	The property No. 57 is subject to the sporting rights excepted and reserved in a Fee Farm Grant dated the 25th of March 1861 or in any superior grant affecting the property.
25	L.R. 2/18844	The property No. 63 is subject to the concurrent sporting rights reserved in a Fee Farm Grant dated the 24th of December 1859 or in any superior grant affecting the property.
26		The property No. 66 is subject to the sporting rights within the meaning of the Irish Land Act 1903 to which Georgiana Dorothea

		Harriett, Countess of Bandon was entitiled previously to the sale under the said Act.
27	L.R. 12283	The property No. 68 is subject to the concurrent sporting rights reserved in a Fee Farm Grant dated the 28th of April 1864 or in any superior grant affecting the property.
28		The property No. 80 is subject to the sporting rights within the meaning of the Irish Land Act, 1903, reserved by Fiat of the Land Commission.
29	L.R. 4464	The sporting rights for Entry No. 94 within the meaning of the said Act to which the Vendor Sir George St. John Colhurst Baronet was entitled exclusive of the tenant previously to the sale under the said Act are reserved to the said Vendor his heirs and assigns.
30	27-AUG-1964 307/9/64	Full right and liberty for Jeremiah Wallace his heirs and assigns the owners of the property comprised in Folio 46955 and his and their licencees at all times and for all purposes on foot and with or without animals or vehicles to pass and repass over the property No. 17 herein by the way coloured yellow and lettered GF on the Plan thereof.
31	25-JAN-1979 S 698/79	The right of William Finbarr Rose and Marina Rose the registered owners of Folio 14568F their transferees, invitees, licencees, servants and agents with or without animals or vehicles to pass and repass over the property No. 41 herein by the way shown coloured yellow on Plan 306.
32	26-NOV-1985 S 251/86	The right of Norman Callinan the registered owner of Folio 38734F at all times and for all purposes to pass and repass over the property No. 79 herein along the way shown coloured yellow on Plan 36 such right to be exercised during the period specified in Instrument No. S 251/86.

33	26-AUG-1996 D96CK09765N	The right of way specified in Instrument No. D96CK09765N in favour of Maurice McCarthy and Rosemary McCarthy the registered owners of Folio 71382F their heirs and assigns and others as specified therein affecting the part of the property No. 39 shown coloured yellow and lettered E-B on the Plan 247 thereof on the Registry Map (O. S. 6329-C). Altered 16.01.06 D2006CK001014W
34		The property No. 74 is subject to the right of way and other easements specified in the following Instruments: D1999CK011617K, D2000CK013790B, D2001CK006591A, D2001CK012656M, D2003CK010919D.
35	18-OCT-1999 D1999CK011617K	The right of way and other easements specified in Instrument No. D1999CK011617K in favour of Tobins Bakery Limited the registered owner of Folio 83068F their heirs and assigns and others as specified therein affecting the part of the property No. 74 herein shown coloured yellow on Plan 279 of the Registry Map (O. S. 6607/2, 6607/3).
36	21-FEB-2002 D2002CK003126V	The right of way specified in Instrument No. D2002CK003126V in favour of Maurice McCarthy and Rosemary McCarthy the registered owners of Folio 94720F their heirs and assigns and others as specified therein affecting the part of the property No. 39 shown coloured yellow and lettered A-B on the Plan 247 thereof on the Registry Map (O. S. 6329-C). Altered 16.01.06 D2006CK001014W
37	11-FEB-2002 D2002CK002443C	The property No. 39 is subject to the right of way relating to the use and enjoyment of the property specified in Instrument No. D2002CK002443C.
38	26-JUL-2002 D2002CK012016Q	The right of way as specified in Instrument No. D2002CK012016Q in favour of Guardwell Sheltered Housing Limited the registered

		owner of Folio 99215F its successors and assigns affecting the part of the property No. 32 herein shown coloured yellow on the Plan 100 thereof on the Registry Map (O. S. 6640/15).
39	15-DEC-2003 D2003CK026360U	Shared Ownership Lease dated the 19-SEP-2003 from THE COUNTY COUNCIL OF THE COUNTY OF CORK to PAUL NAUGHTON, HELEN NAUGHTON of the part of the property no.16 edged GREEN and numbered A5K84 on the plan thereof on the Registry Map together with the rights specified therein. Term: 99 years from 19-SEP-2003 rent as specified in Instrument No.D2003CK026360U Note: The title to this Shared Ownership Lease is registered on Folio CK16052L.
40	18-JUN-2004 D2004CK013522J	Shared Ownership Lease dated the 28-JAN-2004 from THE County Council of the County of Cork to SARAH GRIMES of the property no.16 edged GREEN and numbered A6XAN on the Registry MapOS REF (6341/C, 6386/A). Term: 99 years from 28-JAN-2004 rent as specified in Instrument No. D2004CK013522J. Note: The title to this Shared Ownership Lease is registered on Folio CK16349L.
41	06-MAR-2003 D2003CK005110G	The right of way and such other easements as specified in Instrument no. D2003CK005110G in favour of Watercourse Properties Limited the registered owner(s) of the property comprised in folio 51371F, their heirs and assigns and others as specified therein affecting the part of the property no.28 shown coloured yellow on Plan 369 of the Registry Map.
~~42~~	~~18-JUN-2004 D2004CK013490V~~	~~Shared Ownership Lease dated the 29-AUG-2003 from THE COUNTY COUNCIL OF THE COUNTY OF CORK to ANTHONY MANLEY, ERIN MANLEY of the property no.16 edged GREEN and numbered A6XCB on the plan thereof (edged red) on the Registry Map (O.S. 6341-C, 6386-A).~~

		~~Term: 99 years from 29 AUG 2003 rent rent payable as specified in Instrument No. D2004CK013490V~~ ~~Note: The title to this Shared Ownership Lease is registered on Folio CK16354L.~~ Cancelled D2006CK015938R 13-JUN-2006
43	30-JUL-2004 D2004CK016829U	Shared Ownership Lease dated the 29-AUG-2003 from The County Council of The County of Cork to PAUL O'ROURKE, SIMONE VAUGHAN of the property no.16. edged GREEN and numbered A67UT on the Registry Map 6341/C together with the rights (if any) as specified in instrument No. D2004CK016829U. Term: 99 years from 29-AUG-2003 rent payable as specified in instrument no. D2004CK016829U. Note: The title to this Shared Ownership Lease is registered on Folio CK16498L.
44	21-JUL-2004 D2004CK016154U	Shared Ownership Lease dated the 07-JUL-2004 from CORK COUNTY COUNCIL to BRENDAN NESTOR of the part of the property no.16 edged GREEN and numbered A7DXV on the plan thereof on the Registry Map together with the rights specified therein. Term: 99 years from 07-JUL-2004 at the yearly rent as specified in Instrument No.D2004CK016154U Note: The title to this Shared Ownership Lease is registered on Folio CK16564L.
45	12-OCT-2000 D2000CK013790B	The right of way as specified in Instrument no. D2000CK013790B in favour of Valley View Free Range Eggs Limited the registered owner of the property comprised in folio CK93874F, it's heirs and others as specified therein affecting the part of the property no.74 herein shown coloured yellow on Plan 279 of the Registry Map(O.S. 6607/2). Shared Ownership Lease dated the 08-APR-2005 from THE COUNTY

Land Registry

County Cork — Folio 38260F

46	06-MAY-2005 D2005CK010880D	COUNCIL OF THE COUNTY OF CORK, to JAMES FITZGERALD, MICHELLE HEGARTY of the part of the property herein edged GREEN and numbered A8P5R edged red and numbered 1D on the Registry Map 6341/C . Term: 99 years from 08-APR-2005 at the yearly rent as specified in Instrument No. D2005CK010880D. Note: The title to this Shared Ownership Lease is registered on Folio CK16913L.
47	23-FEB-2004 D2004CK004454P	Shared Ownership Lease dated the 29-AUG-2003 from CORK COUNTY COUNCIL to DENIS DINEEN of the part of the property No.16 herein edged GREEN and numbered 1R3U on the Registry Map (O.S. 6341/D) together with the rights specified therein. Term: 99 years from 29-AUG-2003 at the rent as specified in the lease. Note: The title to this Shared Ownership Lease is registered on Folio CK17032L.
48	16-JAN-2006 D2006CK001014W	The right of way and such other easements as specified in Instrument no. D2006CK001014W in favour of Maurice McCarthy and Rosemary McCarthy the registered owner(s) of the property comprised in folio CK137820F, their heirs and assigns and others as specified therein affecting the part of the property no.39 shown coloured yellow and lettered A-B on Plan 247 of the Registry Map(O.S.)

landdirect.ie An online service from the Property Registration Authority

main menu | form 17 | owner search | app search | view folio | request certified copy | map search | account | help | logout

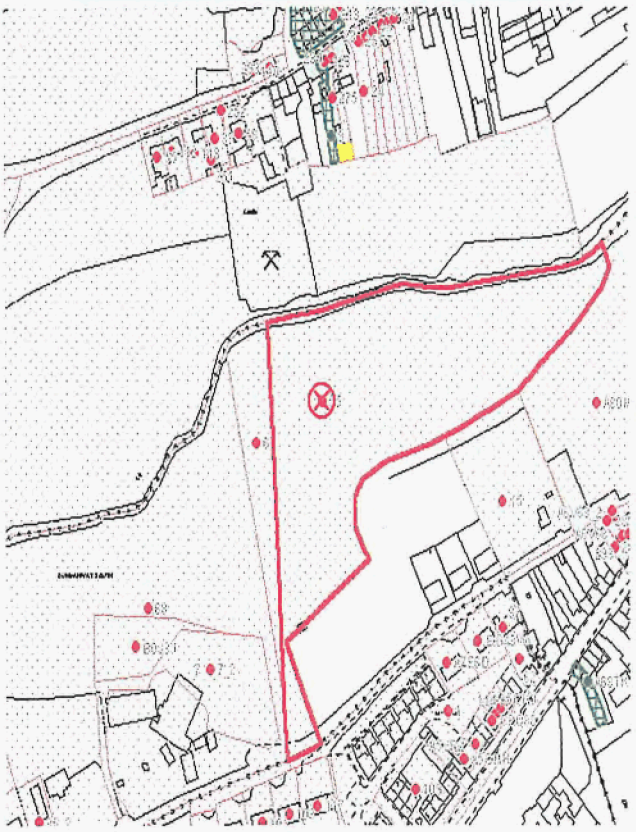
Identify Features

Folio **CK38260F (130 Plan(s))**

Zoom/Highlight | View Folio | Request Copy

Pending Applications:	Status:
D2009LR186393U	For Further Attention
D2010LR000986R	For Further Attention
D2008CK034738P	Queried
D2011LR118233P	For Further Attention
Q2012LR006078W	Awaiting Attention
D2009LR118002A	Queried

Folio Search | Go | Set Map Width



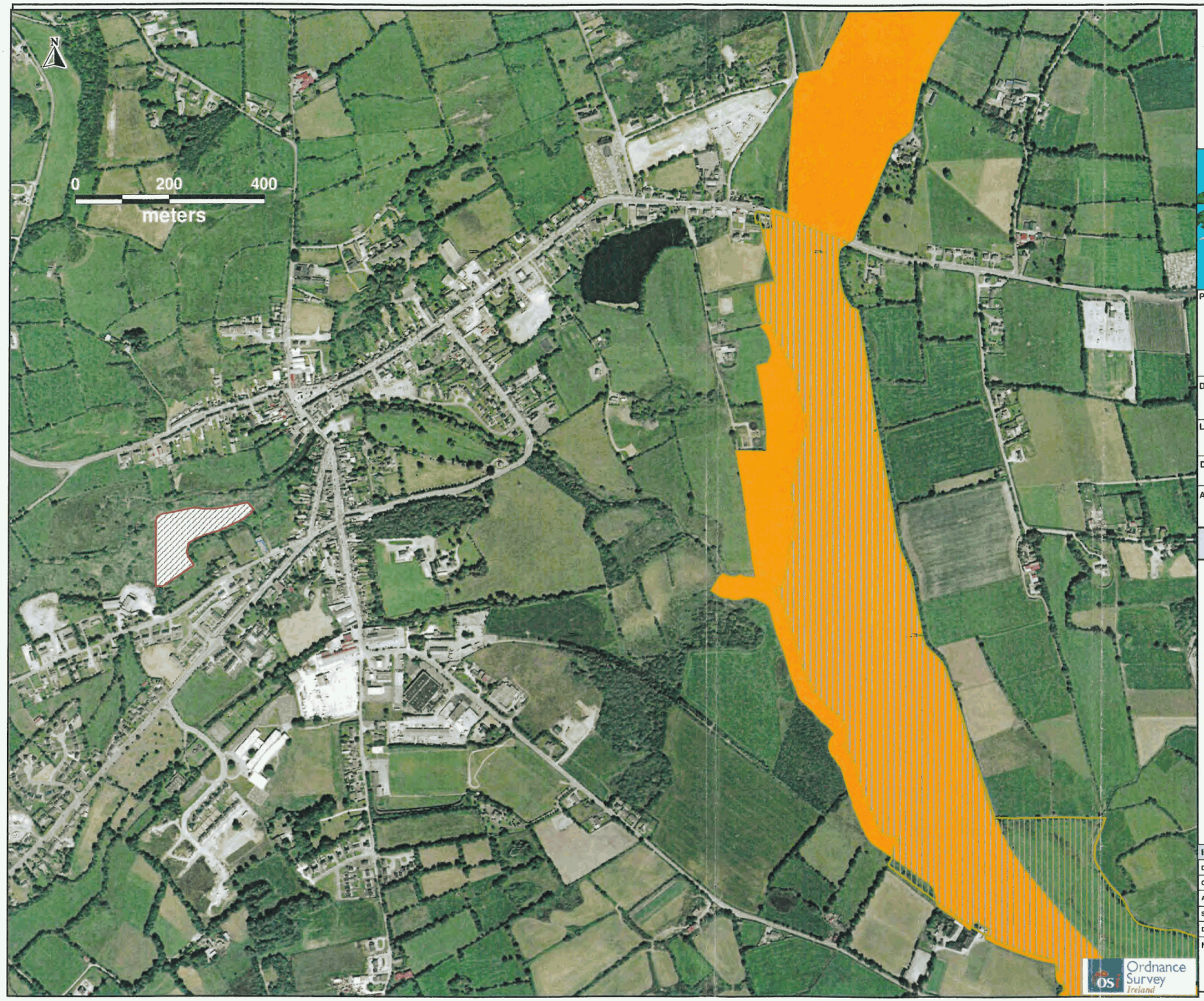
Current mode is: Select

Map Detail | Addresses | Bookmarks | Area Search | Home

Special Registration Map | Official Map Search

Information:Based on centre point
Easting:**522,758** Northing:**552,452**
Map Width:**458.63M**

Townland:	**DUNMANWAY SOUTH**
E.D:	**DUNMANWAY SOUTH**
Barony:	**CARBERY EAST (West Division)**
County:	**Cork**

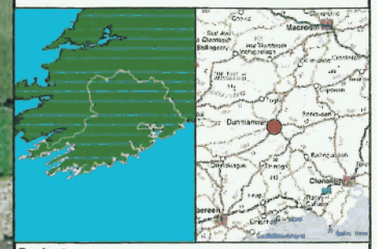


Cork County Council

Environment Directorate
Cork County Council
Inniscarra
Co Cork

1899 ~ 1999

Environment Directorate



Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:
Protected Areas Map

Landfill Name & Reference No:
Clonakilty Landfill - 02/W

Division: **West Cork**

Area Office:
Clonakilty

Legend

- Landfilled Area
- SPA
- NHA
- SAC

Issue Details

Drawn: KC		File Ref. 08/W_PA_Rev1	
Checked: -			
Approved:			
Scale:		Drawing No. 08/W_PA	Rev. 1
Date: Jan 08			

Notes

1. This drawing is the property of CCC. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. NOT TO SCALE, use figured dimensions only, if in doubt ask.
4. Ordnance Survey Ireland Licence No. ****** Copyright Government of Ireland.

Ordnance Survey Ireland

Attachment E.1

Habitat Assessment of Dunmanway Landfill Site

Habitat assessment and biological water quality analysis of Dunmanway Landfill

Doherty Environmental

December, 2009

Table of Contents

Introduction 2
1 Section 1 2
1.1 Methodology 2
1.1.1 Ecological Evaluation 2
1.2 Receiving Environment 4
1.3 Field Survey Results 5
1.3.1 Grassland 5
1.3.2 Woodland and Scrub 5
1.3.3 Exposed Rock and Bare Ground 6
1.4 Site Evaluation 6
2 Section 2 7
2.1 Dirty River Water Quality 7
3 Conclusions 9

Introduction

Doherty Environmental has been commissioned by Cork County Council to undertake a habitat assessment and a review of biological water quality analysis of the disused Dunmanway Landfill and the Dirty River, Co. Cork. The purpose of this assessment is to provide baseline information on the habitats supported by the former landfill site and evaluate the water quality of the Dirty River.

This report is presented in two sections. Section 1 presents the results of the baseline phase 1 habitat survey undertaken on site, while Section 2 outlines the results of the water quality analysis.

1 Section 1

The purpose of the habitat survey was to:

- review the site history and summarise the results of previous ecological studies/records undertaken at the site;
- identify the habitats supported by the site; and
- identify the existing fauna of the site.

The scope of the following assessment follows the guidance outlined in Appendix 4 of *Environmental Protection Agency's* (EPA) *Code of Practice for Environmental Risk Assessment for Unregulated Waste Disposal.*

1.1 Methodology

The basis for this assessment was a Phase 1 Habitat Survey, undertaken in accordance with the *Heritage Council's "A Guide to Habitats in Ireland"* (Fossit, 2000) and the *"Draft Habitat Survey Guidelines"* (Hertiage Council, 2002). The *Guide to Habitats in Ireland* classifies habitats according to a hierarchical framework with Level 1 habitats representing broad habitat groups, Level 2 representing habitat sub-groups and Level 3 representing individual habitats. The field survey focused on identifying Level 3 habitats. The DAFOR scale was also used to characterise the vegetation within each habitat. This scale refers to plant species in terms of dominance, abundance, frequency, occasional and rare (DAFOR). In addition any evidence or records of fauna activity within or adjacent to the site were also noted during the survey, which was undertaken in December, 2009. It is noted that the timing of the field survey was undertaken outside the optimal season for undertaking habitat surveys.

1.1.1 Ecological Evaluation

The evaluation of the ecological resource was assessed according to the National Roads Authority's *Site Evaluation Scheme* (outlined in *Table 1* below) as described in the NRA's *Guidelines for the Assessment of Ecological Impacts of National Road Schemes.* These criteria evaluate the significance of an ecological resource within a defined geographical context. The Institute of Ecology and Environmental Management's (IEEM) *Guidelines for Ecological Impact Assessment* and the *Ratcliffe Criteria*, which also evaluate ecological resources according to a

defined geographical context were also taken in account during the baseline ecological evaluation.

Table 1 *Site Evaluation Scheme*

Rating	Qualifying Criteria
A	**Internationally Important** Site designated (or qualifying for designation) as Special Area of Conservation (SAC) or Special Protection Area (SPA) under the EU Habitats or Birds Directives. Undesignated sites containing good examples of Annex I priority habitats under the EU Habitats Directive. Major salmon river fisheries. Major salmonid (salmon, trout or char) lake fisheries.
B	**Nationally Important** Sites or waters designated or proposed as an Natural Heritage Area (NHA) or statutory Nature Reserves. Undesignated sites containing good examples of Annex I habitats (under EU Habitats Directive). Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive or species protected under the Wildlife (Amendment) Act 2000. Major trout river fisheries. Water bodies with major amenity fishery value. Commercially important coarse fisheries.
C	**High Value, locally important** Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or significant populations of locally rare species.

Rating	Qualifying Criteria
	Small water bodies with known salmonid populations or with good potential salmonid habitat. Sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive. Large water bodies with some coarse fisheries value.
D	**Moderate Value, locally important** Sites containing some semi-natural habitat or locally important for wildlife. Small water bodies with some coarse fisheries value or some potential salmonid habitat. Any water body with unpolluted water (Q-value rating 4-5).
E	**Low Value, locally important** Artificial or highly modified habitats with low species diversity and low wildlife value. Water bodies with no current fisheries value and no significant potential fisheries value

1.2 Receiving Environment

The disused landfill site is located to the southwest of the centre of Dunmanway town (G.R. V12285 52345). The site is located at approximately 70m OD Malin and is located approximately 40m to the south of the Dirty River. The land cover to the north of the site is characterised by wet grassland and marsh habitats. These habitats are located along the riparian zone of the Dirty River and are characterised by a high water table. The land cover the east and south of the site is characterised by built urban land. The soils are characterised by peaty podzols and mineral alluvium. The sub-soils are characterised by Devonian sandstone and undifferentiated alluvium.

The land cover within the site is dominated by spreading scrub habitats and semi-natural grassland habitats. The previous deposition of landfill within the site has changed the topography of the site with a steep embankment present towards the north of the site. This

embankment is a bund which separates the site from the wetland habitats occurring further to the north of the site.

1.3 Field Survey Results

The terrestrial habitats recorded within the survey area are presented in the Habitat Map, *Figure 1*. Three broad (Level 1) habitat groups were identified within the site area:

1. Grassland
2. Woodland & Scrub; and
3. Exposed Rock and Disturbed Ground.

Each of the broad habitats and the individual habitats (Level 3 habitats) making up these broad groups are described below. Habitats that represent a transition between two individual habitats will be described in the text below under the Level 3 habitat that they most resemble and details of such transitions will be outlined.

1.3.1 Grassland

The grassland habitats identified within the site have been classified as:

- Dry meadow and grassy verges (GS2)
- Wet grassland (GS4)

The dry meadow habitat occurs to the south of the site. The absence of ongoing management of this habitat has led to the establishment of a high sward characterised by tussock grass species such as Yorkshire fog (*Holcus lanatus*), Cock' foot (*Dactylis glomerata*) and false oat-grass (*Arrhenatherum elatius*).

The wet grassland habitat occurs to the north of the site. This habitat was inundated during the habitat survey. A dominance of soft rush (*Juncus effusus*) was noted within this habitat.

1.3.2 Woodland and Scrub

The woodland and scrub habitats identified within the site have been classified as:

- Scrub (WS1)
- Treeline

Immature scrub is the dominant habitat occurring within northern and section of the site. This scrub is characterised by spreading gorse (*Ulex europeaus*) and willow (*Salix sp.*) species. Recent vegetation clearance has reduced the overall cover of this habitat. An area of established scrub dominated by willow species occurs to the east of the site entrance. A mature stand of conifers occurs to the west of this site while a stand of immature birch (*Betula sp.*) is located to the south of the site.

A coniferous treeline consisting of Leyland cypress (*Cupressocyparis leylandii*) occurs along the southern boundary of the site. A second birch treeline also occurs within the centre of the site.

1.3.3 Exposed Rock and Bare Ground

The exposed rock and bare ground habitats identified within the site have been classified as:

- Spoil and bare ground (ED2)

Recent disturbance to the site has resulted in the removal of much of the site's vegetation, with resultant bare ground dominating areas of the site. No vegetation is associated with this habitat.

1.4 Fauna

1.4.1 Mammals

No records or evidence of mammal activity was recorded on site. The mature trees and the shed occurring within the site were assessed for their potential to support roosting bats. The trees were examined for features used by bats for roosting. These features include crevices, hollows, ivy cover and limb fractures. The trees occurring within the site boundaries did not display such features and it is considered that these trees are unlikely to support roosting bat species.

The shed occurring within the site does not display features typically associated with a bat roost structure. This shed is of limited potential for supporting roosting bats and is likely to support at most day roosting bat species.

While no evidence of otters (*Lutra lutra*) was recorded during the field survey, the Bandon River system is known to support populations of otter. It is considered likely that otters foraging along the Dirty River adjacent to the site.

The site was surveyed for field signs indicating the presence of badgers. These field signs, as described by Neal & Cheeseman (1996) include prints, pathways, setts, latrines, hairs and scratch marks. No evidence was noted during the field survey.

The area surrounding the site has the potential to support a range of small mammal species such as hedgehog and pygmy shrew.

The following bird species were recorded on site: hooded crow (*Corvus corone cornix*), jackdaw (*Corvus monedula*), robin (*Erithacus rubecula*), wren (*Troglodytes troglodytes*), pigeon (*Columbus palumba*), stonechat (*Saxicola torquata*), chaffinch (*Tringella coelebs*) and blackbird (*Turdus merula*).

No amphibians or signs indicating the presence of amphibian species were recorded on site. However the presence of wet grassland within and adjacent to the site and the presence of marsh habitats to the north of the site increases the likelihood for amphibians to occur within and adjacent to the site.

1.5 Site Evaluation

The site supports a mosaic of habitats that provide support for a range of fauna species. The high sward associated with the dry meadow to the south of the site is likely to support a range of invertebrate species and also offers shelter for foraging small mammals such as hedgehog and pygmy shrew. The wet grassland to the north of the site is dominated by soft rush. This habitat

is likely to support a diverse range of floral and invertebrate species. However, the timing of the survey and the high water levels prevented the survey from recording the range of species associated with this habitat.

The immature scrub, stand of immature birch and coniferous treelines provides ideal habitat for nesting bird species.

The bare ground habitats are of low ecological value and is of limited value for supporting faunal species.

Overall, due to the presence of established and immature scrub, the occurrence of wetland habitats such as wet grassland and the potential for these habitats to support a range of fauna species the site is considered to be of moderate ecological value.

2 Section 2

2.1 Dirty River Water Quality

The Dirty River is located 40m to the north of the Dunmanway Landfill site. The Dirty River is a tributary of the Bandon River.

No biological sampling of the Dirty River was undertaken during the Habitat Assessment as spate conditions preventing such sampling from being undertaken.

The remainder of this Section provides a review of the biological status of the Dirty River. This review has been compiled from a number of published and unpublished documents which provide information on the biological status of the Dirty River. The following key sources were consulted during the compilation of this review:

- Dunmanway Wastewater Treatment Plant Discharge License Application;
- Dunmanway Wastewater Treatment Plant EIS;
- Freshwater Pearl Mussel Draft Bandon Sub-Basin Management Plan; and
- EPA reports on Biological Water Quality.

The Environmental Protection Agency undertakes regular biological water monitoring at three sampling stations along the Dirty River. Two of these station (at Sillahertane Bridge and the bridge northwest of Tonafona) are located upstream of the Dunmanway Landfill site. The third station is located downstream of the landfill site at a bridge upstream of the confluence with the Bandon River. *Table 2.1* below provides the results of EPA biological water quality assessments at these stations from 1978 to 2006.

Table 2-1: Q-values at EPA Monitoring Stations along the Dirty river 1978 - 2006

Site Name	EPA Station Code	1978	1982	1986	1989	1994	1997	2000	2003	2006
Sillahertane Bridge	20DO010005	-	-	-	4	4	4	4	4	4

Bridge NW of Tonafona	20DO010050	-	3 – 4	3 – 4	3	4	4	4	3 – 4	4
Bridge upstream of Bandon River	20DO010100	3 – 4	3 – 4	3 – 4	3 – 4	4	4	3 – 4	4	4

Previous decreases in water quality at the downstream site (i.e. Q 3 – 4 in 2000) were considered to be related to overflows at a discharge outfall from the Quarry Road Pumping Station. Other influences, such as road run-off and small direct discharges from point sources were noted for their potential to adverse affect the water quality of the Dirty River. In 2003 the results of water quality analysis were reversed with a Q-value of 3 – 4 being assigned at the Tonafona monitoring station, while a Q-value of 4 was assigned at the downstream site. However, following the latest Q-value analysis of the river, undertaken in 2006, the EPA assessments concluded that the status of the Dirty River was satisfactory throughout following improvements at the second monitoring station i.e. at the Bridge northwest of Tonafona.

The results of recent physico-chemical surface water analysis recorded increases in ammonia downstream of the landfill site (see Cork County Council's Tier II Exploratory Investigation Report). Under the Freshwater Fish Directive (78/659/EEC) the maximum admissible concentrations (I/MAC value) for ammonia (mg/l N) is 0.02. The concentrations recorded at SW1 and SW2 were 0.064 and 0.032 mg/l N respectively. Both of these sampling points where were located downstream of the landfill site. The results of the analysis for the upstream monitoring site recorded levels of ammonia within the EQSs for Surface Waters.

In aqueous solutions ammonia comprises two discrete aqueous species: free ammonia or unionised ammonia (NH_3) and ionised ammonia or ammonium (NH_4). The relative concentrations of ionised and unionised ammonia in a given solution are a function mainly of pH, temperature and ionic strength of the aqueous solution. As pH increases, the equilibrium is shifted towards the un-ionised species and the concentration of NH_3 increases while that of NH_4 decreases. For example a pH increase from 7.0 to 8.0 in the temperature range 0°C to 30°C results in a nearly tenfold increase in the concentration of NH_3. It has been shown that the un-ionised species of ammonia is most harmful to freshwater aquatic life and to fish in particular (EPA, 1999). Acute exposure to elevated levels of NH_3 can cause gill ventilation, hyper-excitability and death to fish species. Chronic exposure can cause a decrease in growth, a decrease in reproductive capacity and an increased susceptibility to disease. Research data has indicated that ammonia can have adverse effects on aquatic life at relatively low concentrations. Chronic effects on the growth rate of Atlantic salmon were recorded when un-ionised ammonia exceeded 0.06 mg/NH_3 (Samylin, 1969).

The partitioning of NH_3 and NH_4 is critical for defining the ecotoxicological impact of any given ammonia concentration and, as such, a total ammonia reading in isolation provides only a generalised indicator of potential ecotoxicological risk. The partial contribution of un-ionised ammonia increases with increasing pH and temperature. The partitioning between the unionised ammonia and ammonium can be calculated once the pH and temperature values are known. However, as no values for temperature were provided for SW1 and SW2 at the time of writing, the level of un-ionised ammonia for these samples could not be calculated.

All other parameters recorded at the three sampling points were within the relevant EQSs for Surface Waters.

3 Conclusions & Recommendations

Due to the lack of information with regard to key physico-chemical parameters the potential impact of slightly elevated ammonia levels could not be quantified. Also as conditions were unsuitable for undertaking instream sampling during the field assessment no biological water quality analysis was undertaken at the three sampling points along the river. Due to a lack of first hand biological quality analysis only a review of existing water quality information could be undertaken at this time.

It is recommended that a habitat restoration and management plan be undertaken for the site. Opportunities for habitat enhancement exist particularly in areas now dominated by spoils and bare ground. Active habitat management of these areas will facilitate an increase in biodiversity on site. The establishment of the following habitats should be considered within the site:

- Woodland;
- Wildflower meadows; and
- Wetlands.

Habitat enhancement measures should be undertaken with reference to the EPA's Landfill Restoration and Aftercare Manual (1999). The planting of woodland tree species on landfills was previously not recommended due to uncertainty over tree survival and performance and fears that tree roots may damage clay caps or other types of impermeable covers (Rawlinson *et al.*, 2004). However it is now accepted that woodland habitats can be safely established on landfill sites as part of the restoration process. The results of research has concluded that tree planting on restored landfill sites can be undertaken where:

- a 1m deep clay cap compacted to a bulk density of 1.8 to 1.9 tonnes/m^3 achieving a hydraulic conductivity of 1 X 10^{-9} m/s is capable of preventing root penetration. It is noted that the clay cap at the Dunmanway landfill site is generally greater than 1m in depth.
- Suitable tree species are selected as part of the woodland habitat on the restored landfill. The following tree species are deemed to be unsuitable for woodland restoration of landfill sites: poplar (*Populus sp.*), crack willow (*Salix fragillis*) and white willow (*S. alba*). Research undertaken the UK by Rawlinson *et al* (2004) concluded that the following species of trees are suitable for woodland creation on landfill sites: ash (*Fraxinus excelsior*); oak (*Quercus petraea*); apple (*Malus sylvestris*); rowan (*Sorbus aucuparia*); sycamore (*Acer pseudoplatanus*); hawthorn (*Crategus monogyna*); alder (*Alnus glutinosa*); and blackthorn (*Prunus spinosa*).
- A 1m thick soil cover layer is established.

It is recommended that a detailed habitat survey of the site be undertaken during the summer months to catalogue the plant species occurring within and adjacent to the site. During this

survey specific areas should be identified for the establishment, where appropriate, of the above listed habitats.

Consideration should also be given to the establishment of habitat enhancement features for fauna such as the erection of bird boxes and bat boxes in suitable location. Also locally occurring plants which provide foraging resources for butterflies and other invertebrates should be included within any proposed planting lists.

Any planting associated with the establishment of these habitats should be sourced from native seed stocks and should replicate the local flora occurring within and adjacent to the site.

It is recommended that a biological water quality assessment is undertaken at the three survey points along the Dirty River as outlined in the Tier II Exploratory Investigation Report. Ideally this analysis should be undertaken during the optimal time period for undertaking aquatic macroinvertebrate surveys which is between June to September. Macroinvertebrate analysis at these locations will provide additional information on the potential impacts of any pollution arising from the landfill site.

References

Cork County Council (2009). *Tier II exploratory investigation report for Dunmanway Landfill.*

Environmental Protection Agency (EPA) (2002). *Landfill Manuals: Landfill Restoration and Aftercare.* Environmental Protection Agency.

Environmental Protection Agency (EPA) (2002). *Guidelines on the information to be contained in Environmental Impact Statements.* Environmental Protection Agency.

Environmental Protection Agency (EPA) (2003). *Advice notes on current practice in the preparation of Environmental Impact Statements.* Environmental Protection Agency.

Environmental Protection Agency (EPA) (2007). *Guidance Manual* for *Waste Facility Permit and Registration Regulations.*

Environmental Protection Agency (2006). 2005 River Water Quality Report: Annual report on biological quality of Irish Rivers. http://www.epa.ie/downloads/pubs/water/rivers

Fossitt J. A. (2000). *A Guide to Habitats in Ireland.* Heritage Council.

Heritage Council (2002). *Draft Habitat Survey Guidelines.* Hertiage Council.

McGarrigle, M.L. *et al* (2002). Water Quality in Ireland 1998 – 2000. Environmental Protection Agency.

National Roads Authority (NRA) (2006). Guidelines for the Assessment of Ecological Impacts of National Road Schemes.

Neal E. & Cheeseman C. (1996). *Badgers*. Poyser Natural History. London.

NS 2 (2009). *Draft Bandon sub-basin management plan*. DEHLG.

Rawlinson, H, Dickinson, N., Nolan, P. & Putwain, P. (2004). *Woodland establishment on old-style closed landfills in Northwest England*. Forest Ecology and Management. **202:** 265 – 280.

Samylin, A.F. (1969). *Effect of ammonium carbonate on the early stages of development of salmon. (*English translation). Uch. Zap. Leningr. Gos. Pedagog. Inst. Im. A.I. Gertsena 422: 47 – 62.

US Environmental Protection Agency. *Update of ambient water quality criteria for ammonia.* Washington, DC: EPA; 1999. 822/R-99-014.

Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites

DUNMANWAY
TIER II SITE INVESTIGATION REPORT

Landfill Site:	**Dunmanway Landfill**
Site Reference:	**08/W**
Division:	**West Cork**
Area Office:	**Dunmanway**

Report by: Kieran Coffey
Environment Directorate
Cork County Council
November 2009

Table of Contents

1.0 SITE SUMMARY 3
2.0 SITE INTRODUCTION 3
2.2 Site History 4
2.3 Tier I SPR Linkage Score 4
2.4 Tier I Conceptual Site Model 5
3.0 TIER II SITE INVESTIGATION 5
3.1 OBJECTIVES 5
3.2 SITE INVESTIGATION METHODOLOGY 5
3.3 ON SITE INVESTIGATIONS 6
3.4 ON-SITE OBSERVATIONS 6
3.4.1 Waste Characterisation 6
3.4.2 Lateral and Vertical Extent of the Waste 11
3.5 SAMPLING AND ANALYSIS 11
3.5.1 Surface Water 11
3.5.2 Surface Water Samples 13
3.5.3 Interpretation of Surface Water Results 14
3.5.4 Leachate Sample Results 15
3.5.5 Interpretation of Leachate Results 15
3.6 CONCLUSIONS AND RECOMMENDATIONS FOLLOWING EXPLORATORY INVESTIGATION 16
4.0 TIER II MAIN INVESTIGATION 16
4.1 Tier II Main Investigation Scope 16
4.2 Gas Monitoring Results 18
4.3 Analysis of Bund and Landfill Cover Material 18
4.4 Ecology Study 18
5.0 RE-ASSESSMENT OF TIER I CSM 19
6.0 CONCLUSIONS AND RECOMMENDATIONS FOR TIER II MAIN INVESTIGATION 20
6.1 Conclusions 20
6.2 Recommendations 20

APPENDIX 1 - DUNMANWAY TIER I REPORT

APPENDIX 2 - EPA MATRICES FOR DUNMANWAY

APPENDIX 3 - TRIAL PIT & GAS WELL LOGS

APPENDIX 4 - FULL LABORATORY REPORTS

APPENDIX 5 - SITE SURVEY

APPENDIX 6 - ECOLOGY SURVEY

APPENDIX 7 - RE-RUN OF SPR LINKAGES

1.0 SITE SUMMARY

Cork County Councils Environment Directorate completed a Tier I report and risk assessment on Dunmanway Landfill in January 2008. The Tier I assessment was completed in accordance with the EPA CODE OF PRACTICE Environmental Risk Assessment for Unregulated Waste Disposal Sites. The Tier I Report showed Dunmanway Landfill to be a "**Moderate Risk**" site.

A Tier II Exploratory Investigation was organised for this site in October 2009. The purpose of the Exploratory Investigation was to confirm the initial conceptual site model (CSM) prior to the designing of the Main Investigation programme (in accordance with 5.3.2 of the Code of Practice). Following the Exploratory investigation a main investigation was designed and completed in accordance with the EPA Matrix (see Appendix 2) in November 2009.

2.0 SITE INTRODUCTION

Dunmanway Landfill is located approximately 300m South West of the Dunmanway town centre (GIS Coordinates E122,853, N52,345). The Landfill is within 40m of Dirty River which flows through the town.

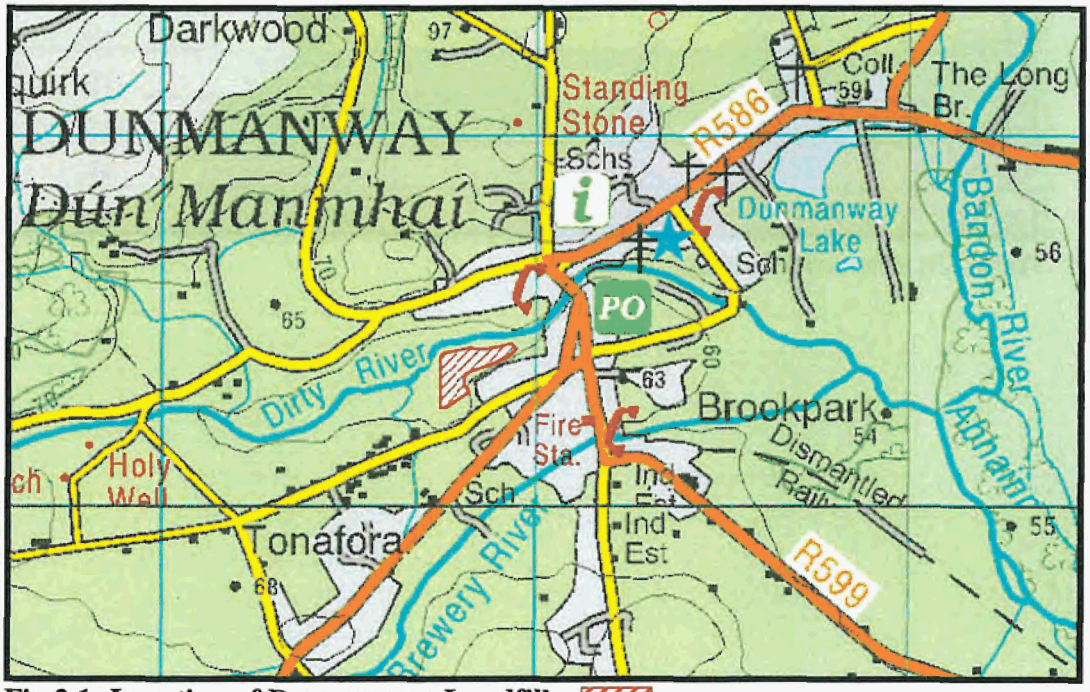


Fig 2.1: Location of Dunmanway Landfill

2.1 Surrounding Land Use

The areas to the west and north of the landfill are on the flood plain of Dirty River. The area to the south and east is beside scrub land. There are a number of houses approximately 75m to the south of the site.

2.2 Site History

This site was operating since the 1950's and possibly the 1940's. The landfill closed in 1997/98 and was capped with topsoil, stone and chips.

2.3 Tier I SPR Linkage Score

The table below shows the Tier I linkage scores for Dunmanway.

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
SPR 1 =	70	300	Leachate => surface water	23%
SPR 2 =	70	300	Leachate => SWDTE	23%
SPR 3 =	42	240	Leachate => human presence	18%
SPR 4 =	42	240	Leachate => GWDTE	18%
SPR 5 =	63	400	Leachate => Aquifer	16%
SPR 6 =	0	960	Leachate => Surface Water	0%
SPR 7 =	42	240	Leachate => SWDTE	18%
SPR 8 =	28	60	Leachate => Surface Water	47%
SPR 9 =	28	60	Leachate => SWDTE	47%
SPR 10 =	63	150	Landfill Gas => Human Presence	42%
SPR 11 =	105	250	Landfill Gas => Human Presence	42%

Table 2.1: Tier I SPR Linkage Scores

2.4 Tier I Conceptual Site Model

The diagram below shows the Tier I Conceptual Site Model for Dunmanway.

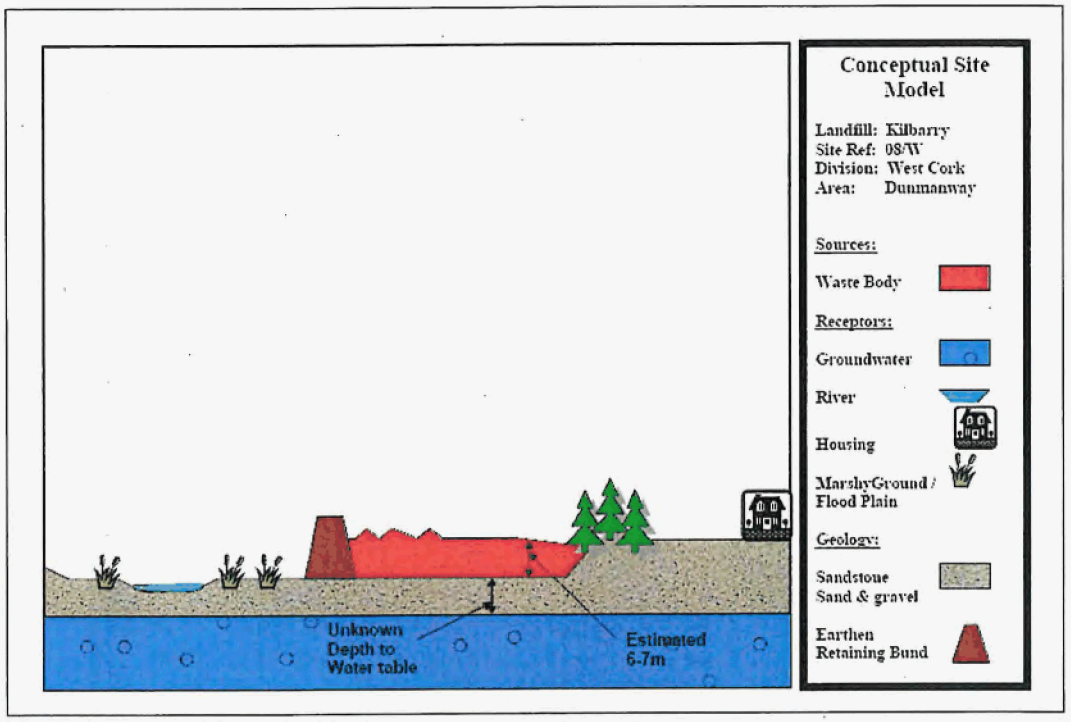


Fig 2.2: Dunmanway Tier I Conceptual Site Model

3.0 TIER II SITE INVESTIGATION

3.1 OBJECTIVES

The main objective of the investigation was to collect sufficient information to confirm the Tier I conceptual site model.

The objectives are summarised as follows:

- Characterise the waste on site
- Delineate the lateral and vertical extent of the waste
- Determine the depth and composition of any capping layer
- Determine the subsoil type, thickness and permeability
- Confirm if the Tier I Conceptual Site Model is valid (and adjust if required)
- Show if there is evidence of the landfill causing any environmental impacts
- Use the information gathered to design the Main Tier II Investigation

3.2 SITE INVESTIGATION METHODOLOGY

The site investigation included the following elements:

- Excavation of Slit Trenches around the waste mass
- Excavation of Trial Pits throughout the site
- Collection and Analysis of Surface Water Samples
- Collection and Analysis of Leachate Samples
- Collection and Analysis of the Waste Samples

- Completion of a Site Survey
- Landfill Gas Monitoring
- Ecology Survey

3.3 ON SITE INVESTIGATIONS

A clay bund surrounds the waste on the northern and western sides of the site (as outlined in the Tier I Risk Assessment Report) The site investigation comprised the use of 13Tonne Tracked Excavator to dig 11No. Slit Trenches in this bund as well as the excavation of 16No. Trial Pits throughout the site. The excavations were supervised by an O'Callaghan Moran Geologist and a Cork County Council Engineer. Each Trial Pit was logged in accordance with BS5930. Trial Pit and Slit Trench locations can be seen below.

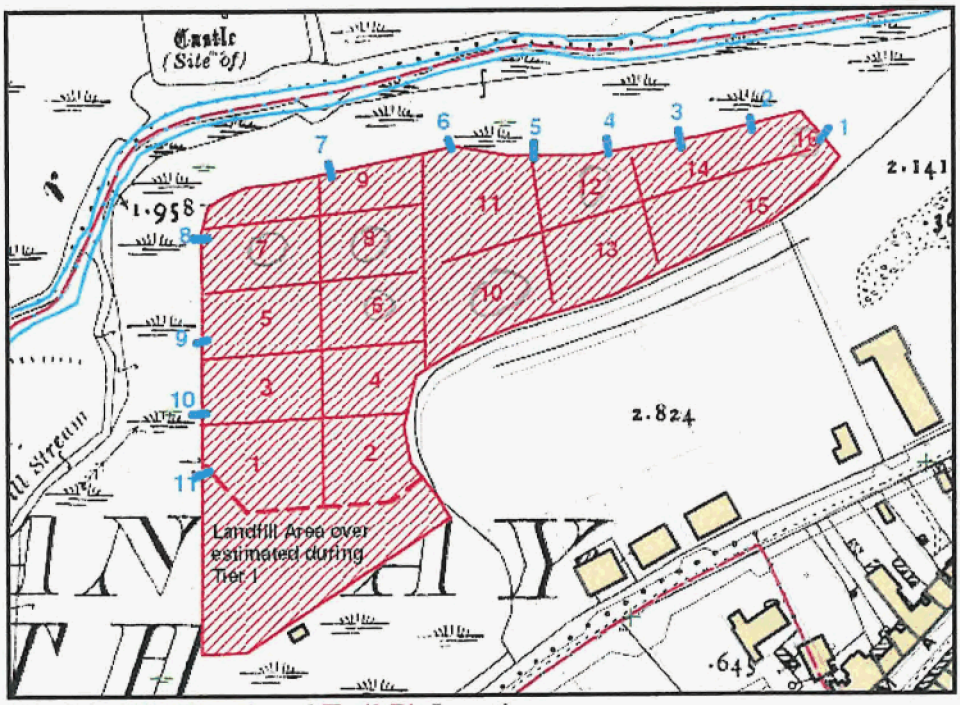


Fig. 3.1 - Slit Trench and Trail Pit Locations

3.4 ON-SITE OBSERVATIONS

3.4.1 Waste Characterisation

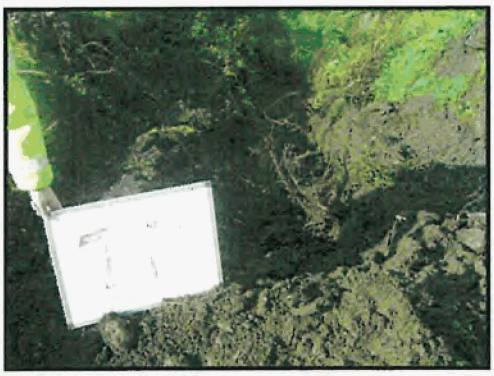
Waste was found in all excavated areas of the site. The majority of the waste comprised of domestic waste including papers, plastics, glass, wiring, steel fragments, concrete fragments and timber. The waste was supported in most areas by a sandy gravely clay matrix. Waste was sampled for VOC's with a hand held Photo Ionisation Detector. No significant VOC readings were recorded (Highest reading of 19ppm in TP-3). Water / Leachate was found at between 2.1m and 4.5m below ground level in all Trial Pits (See Appendix 3). A Brown firm Clay with a high proportion of rootlets and organic material was found below most Trial Pits (13No. of 16No. Trial Pits, 3No. Trial Collapsed before the base was reached). This Organic Clay layer was found to be dry in all cases and appeared to be forming an effective barrier between the landfill and the groundwater.

Photos of Trenches and Trial Pits can be seen below:

Slit Trench 1

Slit Trench 4

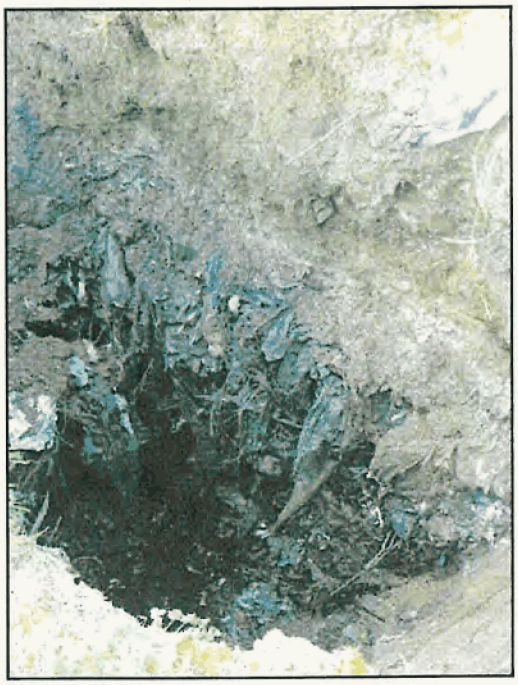
Slit Trench 7



Slit Trench 10

Trial Pit 2

Trial Pit 2



Trial Pit No.4

Trial Pit No.4

Organic Layer under TP4

Close-Up of Organic layer under TP4

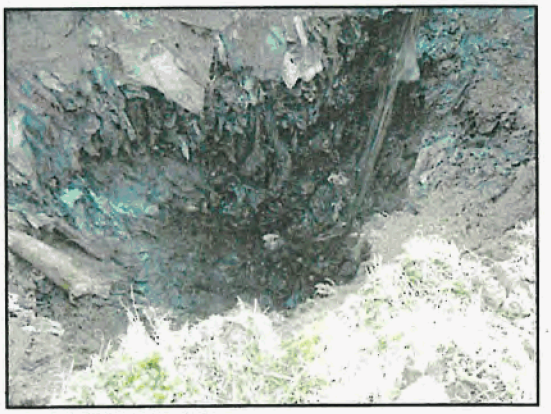
Trial Pit No. 6

Trial Pit No.6

Trial Pit No.10

Trial Pit No.10

Trial Pit No.16



Trial Pit No.16

3.4.2 Lateral and Vertical Extent of the Waste

Lateral: The trial pitting confirmed that the waste was located up to the clay bund around the west and north of the site and as far as the drain to the south of the site. Slit Trenches that were excavated around the north and west of the site showed the Clay Bund to be approximately 4-6m in depth. Following the exploratory investigation the extent of the waste area was reduced from the Tier I report (see site survey in Appendix 5)

Vertical: The depth of the waste varied from 3.4m near the clay bund at the western and northern boundaries to 5m and > 6m at the southern boundary and around the middle of the site respectively. The soil cover over the site varied in depth from ½ m to 2m. The average soil cover was approximately 1m. A firm brown clay with a high proportion of organic material was found at the base of all trial pits. This material was noted to be dry under the waste mass and appeared to be providing an effective barrier between the leachate and the groundwater. Water was encountered in the Trial Pits between 2 and 4m below ground level.

3.5 SAMPLING AND ANALYSIS

3.5.1 Surface Water

Dirty River flows in an easterly direction past Dunmanway Landfill. The river is between 20 and 30m from the northern boundary of the landfill and during heavy rains the river floods right up to the boundary/bund around the landfill. The EPA river quality status for Dirty river is Q 3-4 river and is rated as being at risk of not achieving good status. There is no hydrometric station on the Dirty River so the river flow could not be accurately predicted. The EPA 2007 95 Percentile flow at hydrometric station 20008 (similar catchment area) is 0.14m3/s.

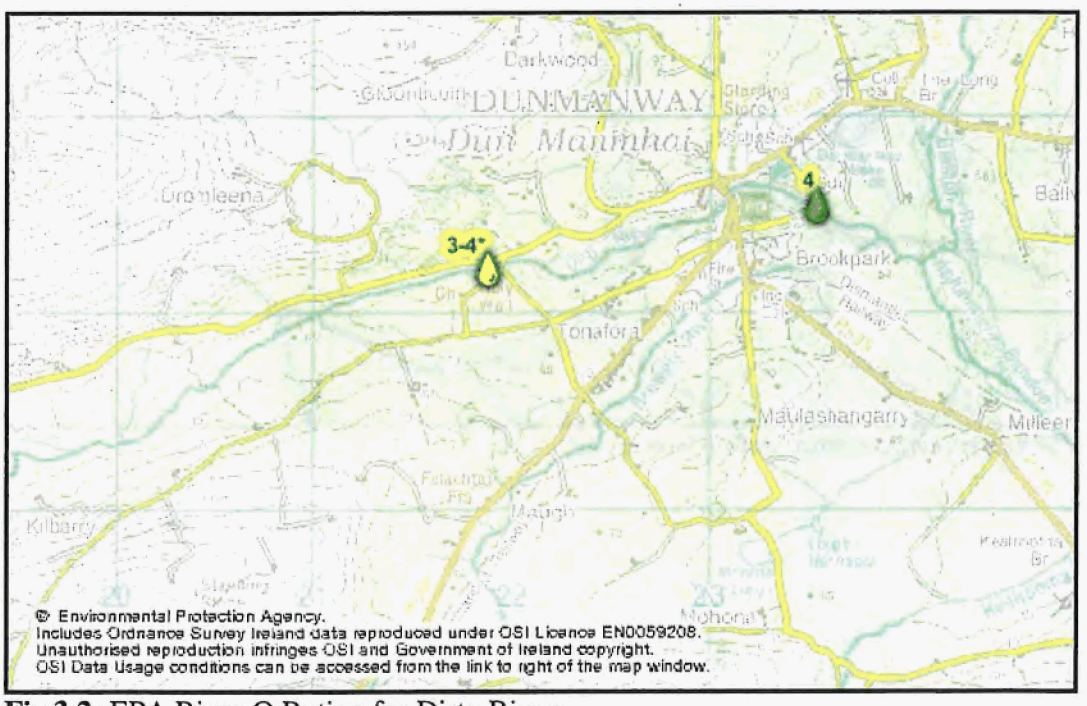


Fig 3.2: EPA River Q Rating for Dirty River

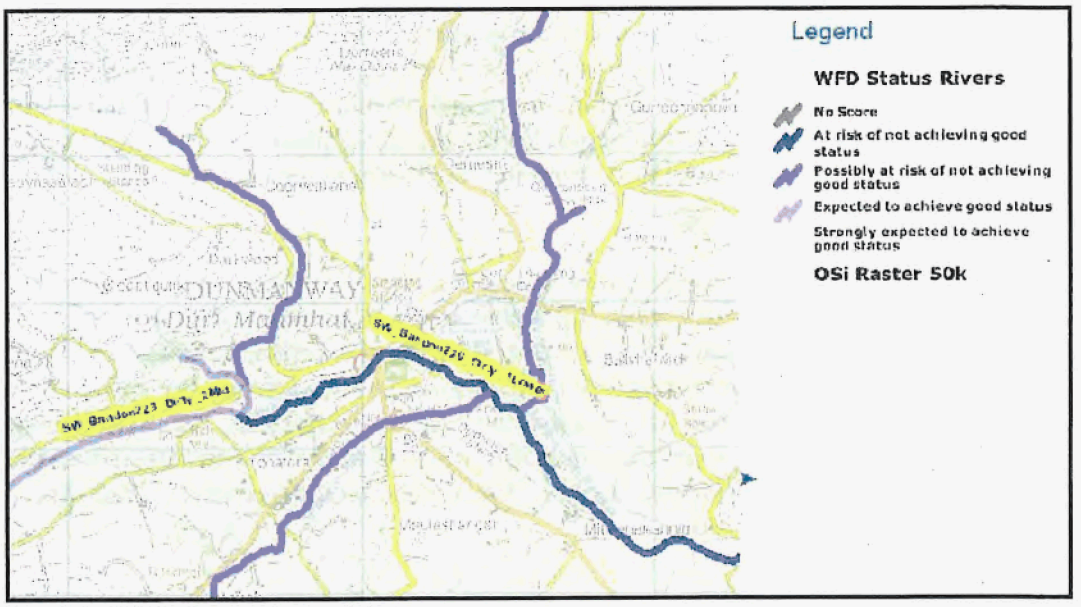


Fig 3.3: WFD River Status Map

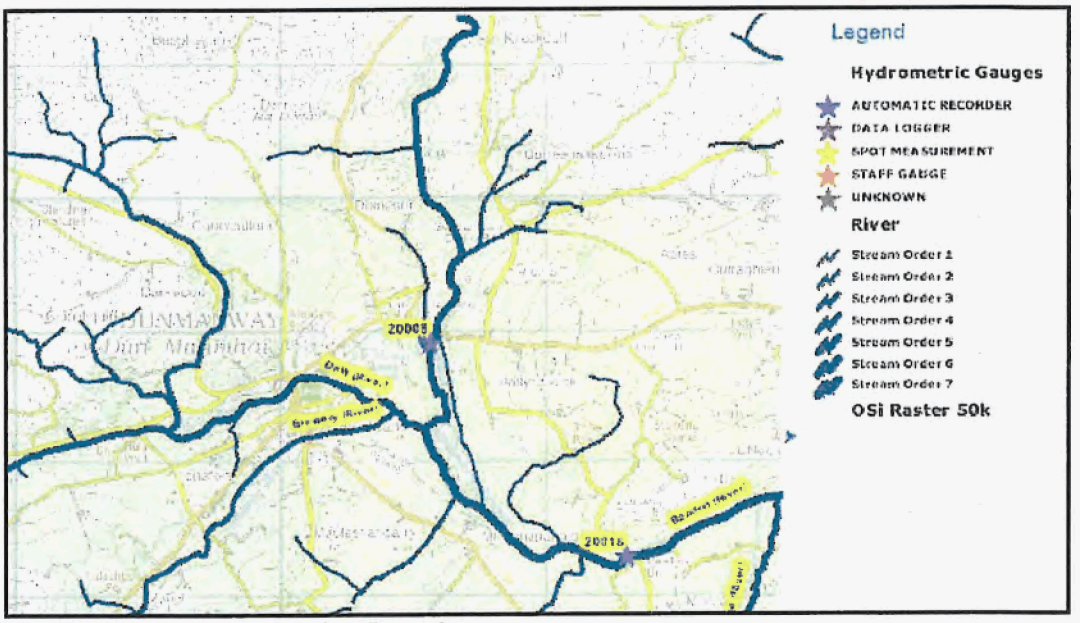


Fig 3.4: Hydrometric Station Locations

3.5.2 Surface Water Samples

3No. Surface Water samples were taken from dirty river on 22nd October 2009. Samples were collected and stored in accordance with BS 6068 – 6.6 Guidance on sampling of rivers and streams. Full laboratory chain of custody documentation was completed and samples dispatched to the chosen laboratory (Certificates of Analysis can be seen in Appendix 4). The river was in flood at the time of sampling and sample No.2 was taken from the flood waters beside the landfill (Note: It is recommended that further sampling in times of low flow will be required to get a complete picture of the impact the landfill is having on the surface water).

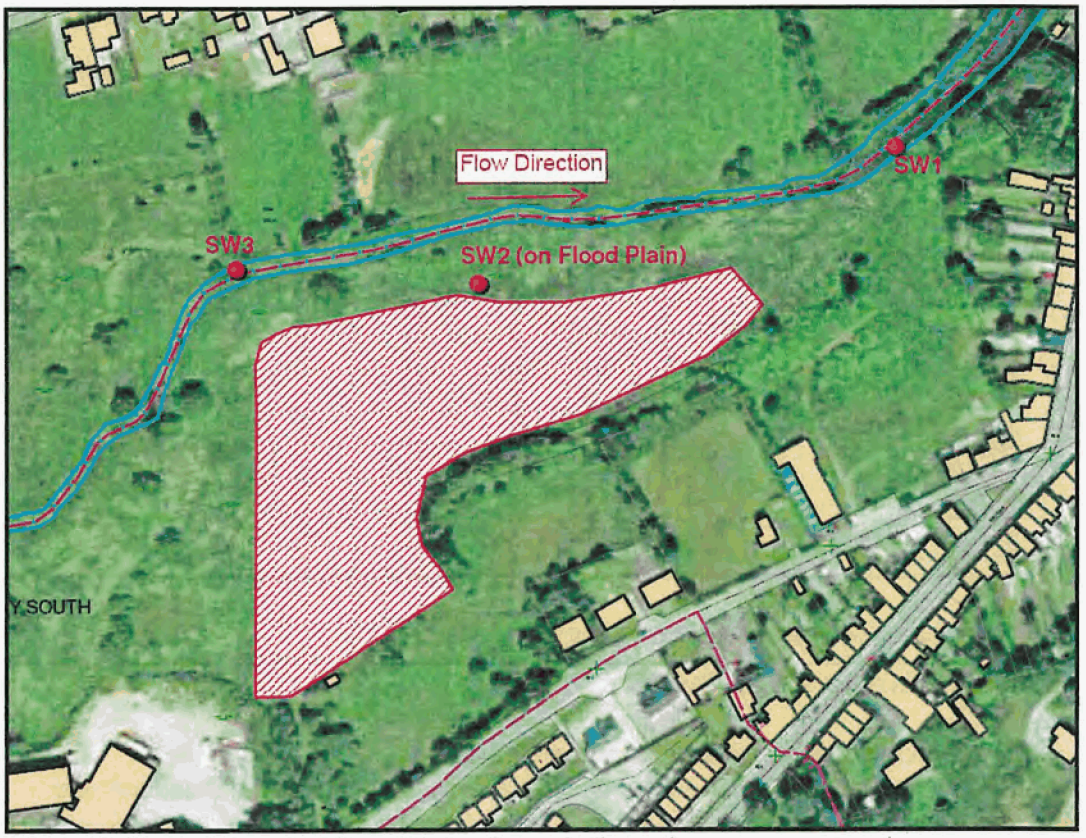


Fig 3.5: Dunmanway Surface Water Sample Locations

Surface water samples for Dunmanway Landfill					
Parameter	Units	SW3	SW2	SW1	EQS Values
pH (Surface Water)	pH Units	6.6	6.5	7	6.5 - 9.5
Conductivity (Surface Water)	uscm -1@25C	80	99	85	1000
Solids (Total Suspended)	mg/L			5	~
Solids (Total Dissolved)	mg/L			<5	~
Ammonia (Surface Water)	mg/L as N	<0.01	0.032	0.064	0.02 mg/L
Nitrogen (Total Oxidised) (Surface Water)	mg/L as N			0.53	~
Total Organic Carbon	mg/L			6.57	~
BOD (Surface Water)	mg/L	<2	<2	<2	~
COD (Surface Water)	mg/L			9	~
Calcium	mg/L			10.80	~
Magnesium	mg/L			1.30	0.3 mg/L
Sodium	mg/L	6.40	5.30	10.60	~
Potassium	mg/L	1.60	1.30	1.60	~
Iron (Surfacewater)	ug/L			448	1000 ug/L
Manganese (Surface Water)	ug/L			58.7	~
Cadmium (Surface Water)	ug/L			<0.01	5 ug/L
Chromium (Surface Water)	ug/L			0.8	30 ug/L
Copper (Surface Water)	ug/L			3.1	30 ug/L
Nickel (Surface Water)	ug/L			0.9	50 ug/L
Lead (Surface Water)	ug/L			1.4	10 ug/L *
Zinc (Surface Water)	ug/L			1	100 ug/L *
Arsenic (Surface Water)	ug/L			0.4	25 ug/L *
Boron (Surface Water)	ug/L			157.7	2000 ug/L *
Mercury	ug/L			<0.02	1 ug/L *
Alkalinity (Surface Water)	mg/L CaCO3			14	~
Sulphate	mg/L as SO4	1.61	2.06	1.64	200 mg/L
Chloride (Surface Water)	mg/L	11.37	14.49	11.62	250 mg/L
Phosphate (Ortho) Surface Water	mg/L as P			0.018	~
Cyanide	ug/L			<5	10 ug/L #
Fluoride (Surface Water)	mg/L			0.08	5 mg/L #
Atrazine	ug/L			<0.01	1 ug/L
Dichloromethane	ug/L			<1	10 ug/L
Simazine	ug/L			<0.01	1.0 ug/L
Toluene	ug/L			<0.28	10 ug/L
Tributyltin*	ug/L as Sn			<0.02	~
Xylene (Total)	ug/L			<1	10 ug/L
Coliforms (Faecal)	no/ 100ml			110	~
Coliforms (Total)	no/ 100ml			400	~

Note:
Standard where hardness of water is > 100mg/L $CaCO_3$

Table 3.1: Surface Water Results

3.5.3 Interpretation of Surface Water Results

Noticeable increases in Ammonia above the Environmental Quality Standards are indicated in the above table. There was a minor increases in Sodium levels after the landfill also. It is apparent from the above results that the landfill is having some impact on the water quality of the local river.

3.5.4 Leachate Sample Results

5No. Leachate samples were taken from trial pits on the 22nd and 27th October. Leachate samples were taken from the following locations:

Leachate 1	Trial Pit No.7
Leachate 2	Trial Pit No.11
Leachate 3	Trial Pit No.12
Leachate 4	Trial Pit No.13
Leachate 5	Trial Pit No.15

Leachate was tested as per table C2 of the EPA Landfill Monitoring Manual 2003 for Leachate 1 and a minor suite for all other locations (as per EPA Matrix, Appendix 2)

Parameter	Leachate 1	Leachate 2	Leachate 3	Leachate 4	Leachate 5	Units
pH	6.8	6.7	6.7	6.7	6.8	pH Units
Conductivity	4160.0	1863.0	1850	2280	1404	uscm -1@25C
Ammonia	47.93	65.78	77.18	92.02	19.68	mg/L as N
Nitrogen (Total Oxidised)	<0.03					mg/L as N
BOD	11	18	22	75	22	mg/L
COD	121					mg/L
Sulphate	3.16	<1.39	<1.39	3.25	4.48	mg/L as SO4
Chloride	904.61	67.17	63.20	61.52	24.04	mg/L
Phosphate (Ortho)	<0.005					mg/L as P
Cyanide	<5					ug/L
Fluoride	0.51					mg/L
Atrazine	<0.01					ug/L
Dichloromethane	<1					ug/L
Simazine	<0.01					ug/L
Toluene	<0.28					ug/L
Tributyltin*						ug/L as Sn
Xylene (Total)	<1					ug/L
Calcium	136.00		146			mg/L
Magnesium	21.30		28			mg/L
Sodium	652.00	33.20	41.4	51.1	15.6	mg/L
Potassium	37.80	29.20	42.9	64.5	16.9	mg/L
Iron (Total)	32.9		94.6			mg/L
Manganese	1.82		4.7			mg/L
Cadmium	<0.09		<0.1			ug/L
Chromium	2.5		<1			ug/L
Copper	4.1		0			ug/L
Nickel	5.4		6			ug/L
Lead	5.5		15			ug/L
Zinc	35.7		14			ug/L
Arsenic	2.2		8			ug/L
Boron	309.3		500			ug/L
Mercury	0.04		0.03			ug/L

Table 3.2 Leachate Results

3.5.5 Interpretation of Leachate Results

Ammonia concentrations averaged 60mg/L over the 5No. locations tested. Leachate 1 showed up much higher values of Chloride and Sodium compared to other locations. It is possible that some salt was deposited at this location in the landfill.

When comparing the above Leachate results to leachates sampled from other landfills (i.e. Table 7.1 & 7.2 EPA Landfill Site Design, 2000) 95% of the values are below Median values for the landfills that are in Stage III and Stage IV of the degradation process (Iron and Manganese showed up as being higher) It is concluded that Dunmanway landfill is likely to be in late stages of Stage IV or in Stage V (Aerobic Stage) of the biodegradation process. The low recorded ratio between BOD and COD (0.01) as well as the low levels of Carbon Dioxide detected (and no methane) supports the above view.

3.6 CONCLUSIONS AND RECOMMENDATIONS FOLLOWING EXPLORATORY INVESTIGATION

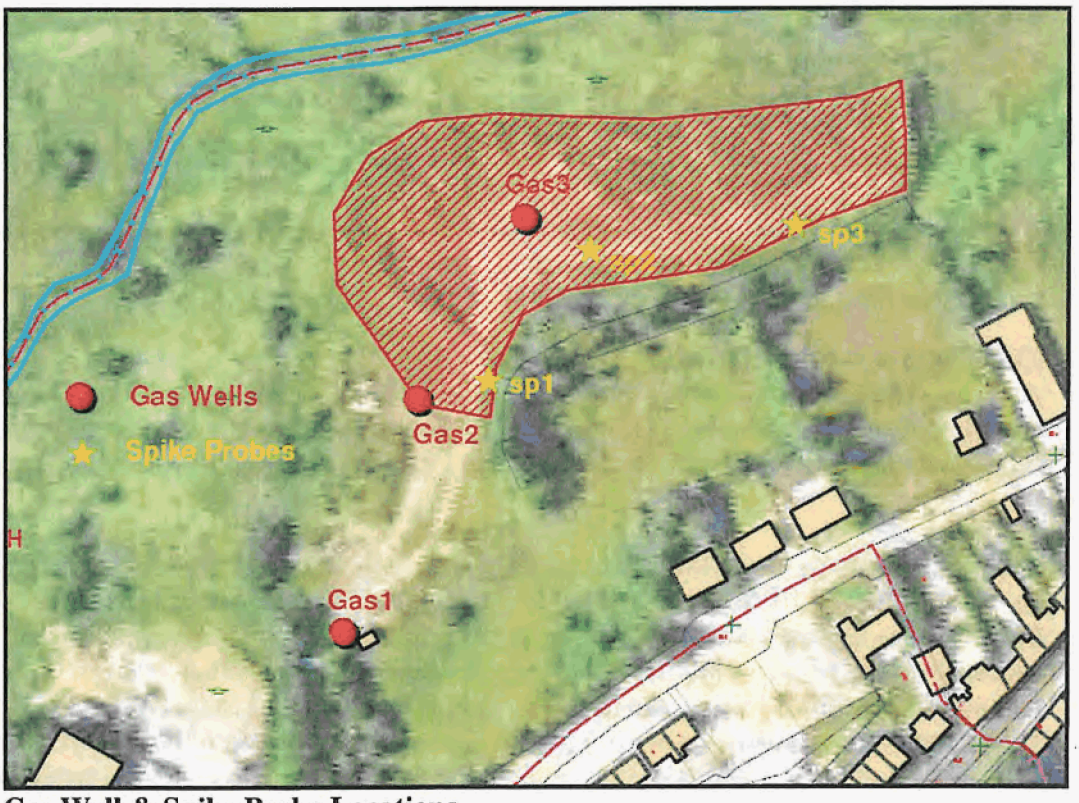
Waste throughout the site was consistent in nature and was mainly composed of mixed domestic waste. The waste footprint of the site has been reduced from the Tier I estimate of 1.6 hectares to 0.9 Hectares (the southern area of the site and around the site was overestimated). An organic layer was found at the base of the waste. This layer was seen to provide an effective barrier between the waste and the groundwater. Based on the observations and knowledge obtained in the exploratory investigation it was concluded that the SPR linkages in the Tier I were valid and the focus of the main investigations was on these SPR linkages (i.e. Leachate to surface water as well as Gas risk).

No Geophysical Survey of the site was taken because the excavator was able to reach the base of the waste in the majority of the trial holes (13No. out of 16No.). No Groundwater wells were installed as this linkage route was seen to be of low risk (Using EPA matrix guidance, Appendix 2).

4.0 TIER II MAIN INVESTIGATION

4.1 Tier II Main Investigation Scope

3No. Gas wells were installed on the 24th November 2009.. 1No. outside the waste mass, 1No. adjacent to the waste mass and 1No. within the waste mass. 3No. Gas Spike Probes were later installed also along the perimeter of the site (see explanation for this below). See drawing below for wells and probe locations.



Gas Well & Spike Probe Locations

Installation of Gas Well No.2

Gas wells were constructed using high density polyethylene 50mm diameter standpipes. A gravel filter pack was inserted between the borehole and the standpipe.

While visiting the site for the first gas monitoring period on the 1st December it was noticed that the gas wells had been vandalised (Well heads hammered off their concrete mounts and polyethylene standpipes pulled out and thrown into the under growth). Due to adverse weather conditions and the danger of repeated vandalism it was decided to install Gas Spike Probes instead of re-installing the wells.

Spike probes were constructed using 2m long 60mm Galvanise Piping. The end of the probes were pointed and multiple holes were bored in the side of the probes near the base. The probes were pushed into place using the back bucket of a JCB. See monitoring results below:

4.2 Gas Monitoring Results

Location	Methane %			Carbon Dioxide %			Barometric Pressure (mb)		
TEST DATE	11/12/09	15/12/09	30/12/09	11/12/09	15/12/09	30/12/09	11/12/09	15/12/09	30/12/09
SP 1	0	0	0	0	0	2.3	1016	1009	976
SP 2	0	0	0	0	0	0.2	1016	1009	976
SP 3	0	0	0	0	0.5	0.4	1016	1009	976

Table 4.1: Gas Monitoring results

4.2.1 Gas Monitoring Methodology

A GFM 430 Gas Monitoring Unit was used for taking gas samples. This unit is calibrated on a regular basis. The gas intake tube to the unit was placed on the well head gas tap and the gas tap opened. The gas readings were allowed to stabilise for 1 minute before readings were taken.

4.2.1 Interpretation of Gas Results

No Methane was detected in any of the Spike Probes over the monitoring period. Low levels of Carbon Dioxide were detected in all probes on the 30th December 2009 and in SP3 on the 15th December 2009. This indicates that the landfill in likely to be in Stage V of the degradation process (i..e Aerobic Stage). It also shows that there is a very low risk to the local residents from methane gas.

4.3 Analysis of Bund and Landfill Cover Material

The landfill cover material and bund was categorised in accordance with BS 5930. The samples were logged as being *"sandy very gravely SILT/CLAY"*. Gravel was generally small to medium with occasional large clasts and was of mixed type and sub-angular. There was also some organic content which was influencing the plasticity tests and thus skewing the result to the right (of the GSI handchart).

4.4 Ecology Study

An Ecology Survey was conducted by Mr Patrick Doherty MSc, MIEEM of Doherty Environmental. A copy of the completed report can be found in Appendix 6.

The summary findings of the Ecology Survey are as follows:

Overall, due to the presence of established and immature scrub, the occurrence of wetland habitats such as wet grassland and the potential for these habitats to support a range of fauna species the site is considered to be of moderate ecological value.

No records of mammal activity was recorded on site.

The possible effects of Ammonia on fish was outlined. The un-ionised form of NH_3 was outlined as being more toxic to fish. Further sampling (including measurement of Temperature and pH) was recommended so a more complete picture of un-ionised ammonia concentrations could be determined.

A habitat restoration and management plan is recommended which might include woodland, wildflower meadows and wetlands.

Due to flooding on the river it was not possible to make a biological assessment of the adjacent river. It is recommended that a biological water quality assessment be undertaken, ideally between June and September.

5.0 RE-ASSESSMENT OF TIER I CSM

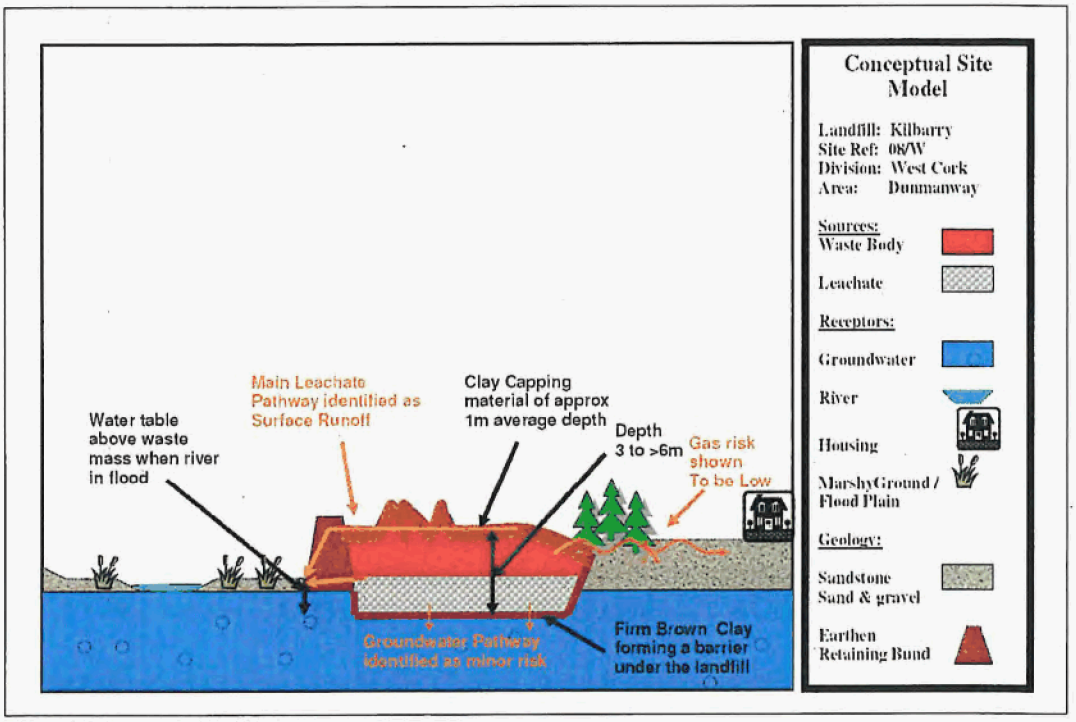


Fig. 6.1 Revised CSM

The CSM was revised following the Tier II Exploratory and Main Investigations. The trial pits showed a low permeability organic clay layer under the landfill confirming the low risk to groundwater. Where this layer was encountered it was dry in all cases.

There is a large clay bund that is between 4-6m thick which surrounds the waste on the northern and western boundaries of the site. Significant depths of clay cover the whole site (generally greater than 1m deep).

Surface water testing showed that there may be some minor increases in Ammonia to the adjacent river. Limited or only very minor levels of VOCs were detected (indicating no significant hydrocarbon contamination). The extent of the waste has been reduced from the Tier I Report.

No methane gas was detected during the gas monitoring period.

6.0 CONCLUSIONS AND RECOMMENDATIONS FOR TIER II MAIN INVESTIGATION

6.1 Conclusions

Landfill Gas – There is no or very limited landfill gas risk to the local residents.

Groundwater – The risk to the groundwater is confirmed as being low. The dry organic layer under the waste mass is providing a barrier between the waste and the groundwater.

SAC, NHA - The local protected areas are approximately 1Km from the landfill site and the risk from the landfill is low (as outlined in the re-running the SPR risk rating).

Surface Water - The adjacent surface water is being impacted slightly by the landfill. The impact levels are to be determined in the Quantitative Risk Assessment.

Following the Tier II Investigation SPR 8 (Leachate to Surface Water) is the only linkage of concern. Any future remediation plan should focus on breaking this linkage.

6.2 Recommendations

- Prevent leachate migration off site by breaking the main *"Source Pathway Receptor"* Linkage (i.e. SPR No. 8 Leachate to Surface Water).
- Prevent as far as possible the Leachate Generation on site.
- Complete a Tier III Quantitative Risk Assessment (QRA) on the Site

All surface water sampling during the site investigations was undertaken when the river was in flood. In order to gain a better understanding of the effect the landfill is having on the surface water, further sampling should be taken in times of low flow and during the hotter summer months. Temperature and pH should also be recorded to confirm the level of un-ionised ammonia in the surface water.

Biological water quality assessment should be undertaken on the adjacent river between June and September.

To reduce the surface water seepage into the landfill (and consequent leachate generation) a remediation strategy plan/report should be prepared (as part of the Tier III QRA). The report should use guidance provided in EPA Landfill Manuals: Landfill Site Design (EPA 2000) and restoration and Aftercare (EPA, 1999). The likely solutions available will be to place a low permeability layer (geo-membrane or low permeability soil) over the landfill with appropriate surface water drainage installed (to limit leachate volumes).

A Quantitative Risk Assessment should be completed on the site to quantify the pollution risk to the local river.

Dunmanway QRA

1.0 Quantitative Risk Assessment

Risk Assessment is a scientific mechanism that allows the various hazards, pathways and receptors present at a site to be evaluated. It uses a systematic and progressive approach to identify the risks with the aim of establishing a pollutant linkage from a source (S) via a pathway (P) to a receptor (R). If a pathway does not exist there is no risk.

The CSM (Conceptual Site Model) completed in the Tier 1 Assessment identified leachate and landfill gas as the sources; surface water, groundwater, air and soil as potential pathways; and surface water courses, the bedrock aquifer and humans as the potential receptors. The highest potential linkage scores were identified as being:
SPR 8 (47%), SPR 9 (47%), SPR 10 (42%) and SPR 11 (42%). The site classification was one of "Moderate Risk".

The objective of the Tier II assessment was to establish if the SPR linkages identified in the Tier I investigation actually existed. The Assessment identified that the only SPR of concern was SPR 8 => Leachate to Surface Water. (Appendix 7 – Re-run of SPR Linkages).

1.1 Potential Sources

1.1.1 Waste Body

The Tier II site investigations identified the presence of a waste body consisting of approximately 0.9ha with an average thickness of 4m. There is approximately 54,000 tonnes of waste intermingled with sand and clay. The waste mainly consists of domestic waste such as glass, plastics, and papers. A brown firm clay was found below 81% of the Trial Pits (13No. of 16.No). In three of the Trial Pits the base was not proven due to side wall collapse.From the remaining trial pits the base can be found between 6m and 7m below ground level. The base Clay layer was found to be dry in all cases and appeared to be forming an effective barrier between the landfill and the underlying aquifer. (Tier II report pg 6 – "Waste Characterisation".)

The waste generally was comprised of domestic waste for example; glass, plastics, papers, wiring, concrete and steel fragments and timber. The waste was incorporated in a sandy gravely clay matrix. No significantly contaminated material was observed, while no evidence of staining or odours consistent with the presence of such material identified during field screening activities. The screening of the waste with a Photo Ionisation detector did not detect any elevated VOC readings. From these findings one can conclude that the waste could be considered to be typical non –hazardous municipal solid waste. (Tier II report pg 6 – "Waste Characterisation".)

1.1.2 Subsoils

Following the completion of the Tier II Exploratory and Main Investigations the CSM was revised. The trial pits highlighted a brown firm clay layer under the landfill. The low permeability layer has been found to be naturally occurring and goes further beneath the landfill to the south and south east and also toward the river to the north and north west. This layer was found to be dry on all occasions when encountered.

A large clay bund is located on the northern and western boundaries of the site. The earthen bank was constructed by the council over a number of years to avert the risk of waste being washed away during times of flood. It was constructed on the river side of the site and is between 4-6m thick. Given the nature of the subsurface it is envisaged that beneath the landfill the groundwater in the bedrock is confined.

1.1.3 Leachate

Five leachate samples were collected and tested from various trial pits (TP- 7, 11, 12, 13, and 15). The leachate was tested for the parameters specified in Table C2 of the EPA Landfill Monitoring Manual 2003 for the sample TP-7 and for a minor suite of parameters for all other locations (as recommended in the EPA 2009 Matrix Guidance which is included in Appendix 2. The results were presented in Table 3.2).

Dunmanway landfill is assumed to be in late Stage IV or in early Stage V of the biodegradation process based on the findings from the leachate samples taken.

1.1.4 Landfill Gas

Gas monitoring on the site was carried out in three separate locations using a GFM 430 Gas Monitoring Unit. The results are presented in Table 4.1.

1.3 Potential Pathways

To establish the pollutant linkage, a pathway or pathways to the receptor must be identified. This is the route by which a hazard can move towards the receptor. The pathways may allow the passage of a hazard in any of its three basic phrases or in a combination, i.e. as a liquid as a solid or as a gas. Potential pathways for the can be seen in Table 7.1.

Table 7.1 Potential Pathways

Potential Pathway	***Route***
Surface Water	Leachate migration from the landfill discharging into the Dirty River.
Groundwater	Contaminant migration to the water table through the base of the landfill into the subsoil and underlying sandstone bedrock.
Air/Soil	Landfill gas migration to buildings along subsurface or surface pathway.

Table 7.2 Potential Receptors

Potential Receptor	***Type***
Surface Water	The Dirty River and Bandon river SAC 1 km downstream.
Ground Water	Bedrock Aquifer beneath the site.
Human Beings/ Animals	Private wells and public supply downstream in he catchment animal water supply from stream, inhalation of gases or gas explosion in confined spaces.

1.4 Pollution Linkage

Potential hazards, pathways, and receptors have been identified at the site. For a risk to pose a significant threat to a receptor linkage via a pathway must be established.

1.5 Surface Water

Leachate generated in the waste mass has the potential to migrate laterally from the landfill into the Dirty River. Monitoring was undertaken at three locations. SW-1 is down stream of the landfill, SW-2 is standing water location between the landfill and the river and SW-3 is upstream of the landfill. The results have been compared to the EPA Environmental Quality Standard Limits.

The results indicate that the only parameter that was detected at increasing concentrations between upstream and downstream of the site was ammonia. The levels detected in SW-2 and SW-3 exceeds the EQS limit. No ammonia was detected in the upstream sample. A slightly elevated level was recorded in SW-2 and an even greater value was recorded in SW-3. Given the elevated ammonia detected in the leachate samples within the landfill it is highly likely that the source of the ammonia is leachate escaping from the landfill site.

While the ammonia levels are slightly elevated down stream of the landfill at SW-1 it is not possible to conclude on the significance of the potential impact on surface water quality based on a single monitoring event, particularly at a time when the river was in flood. Further monitoring of the river particularly during low flood periods would be required to establish if leachate discharges to the surface water are having a significant impact on surface water quality. The Bandon River SAC area is located approximately 1km downstream and further monitoring downstream of SW-1 in the river may be undertaken to asses the possible impact on that area. If a significant risk/impact is detected in the surface water system then remedial action maybe required to minimise leachate generation at the site.

1.6 Groundwater

The bedrock aquifer is characterised by the GSI as a locally important (LI) being productive in local zones. This means groundwater flow paths are generally short 10s to 100s of metres at most and that shallow groundwater discharges to the river. There are no groundwater abstraction wells within 500m of the landfill site. The trial pitting programme has identified the presence of a clay layer beneath the waste. The clay layer was dry despite the presence of leachate in the overlying waste. This indicates that the clay layer has a very low permeability.

Based on the trial pit and trench excavation results the clay appears to extend beyond the landfill to the south and the south east and also toward the river to the north and north west. This layer more than likely represents a natural confining layer separating the leachate from the underlying bedrock aquifer. In the event of the clay being breached it is more likely that groundwater would migrate upward into the leachate rather than for the leachate to migrate vertically to the water table, because of the upward pressure being exerted by the confined groundwater. For this reason it is likely that the preferential pathway for leachate migration is not via ground water but via overland flow to the surface water.

1.7 Landfill Gas

No methane was detected in any of the Spike probes over the monitoring period. Low levels of Carbon Dioxide were detected in all probes on the 30th December 2009 and in SP3 on the 15th December 2009.Given the low landfill gas levels detected the risk posed by landfill gas to off-site receptors is currently considered to be negligible. However, it is expected that as part of remedial action required for this site that the landfill may require some remedial works to reduce the infiltration of rainwater into the waste mass. Such remedial action may result in a build up in landfill gas and increased levels of production of carbon dioxide and even methane. Post remediation monitoring of landfill gas between the landfill and the buildings located to the southeast would therefore be recommended. The monitoring could be undertaken using spike probes as previously if there is a risk of damage to permanent gas monitoring well installations.

1.8 QRA Conclusions

The only potential source-pathway-receptor risk that may be present at the site is that for leahate discharge to surface water. Surface water monitoring has indicated elevated levels of ammonia in the Dirty River. Samples taken from both upstream and downstream of the landfill site have shown raised levels of ammonia downstream. In addition, leachate samples taken from the landfill, show enhanced levels of ammonia present. Therefore it can be assumed that the source of the increased ammonia levels in the Dirty River is via the lateral migration of leachate to surface water.

1.9 QRA Recommendations

The Risk Rating for this site should remain at a Moderate Risk. To minimise the infiltration of rainfall through the waste, it is recommended that the existing soil cover be re-worked and evenly distributed over the site. Further soil cover may be necessary to further enhance the cover and compaction of the soil layer cover. In doing so, this would reduce the overall permeability of the layer.

The Ammonia levels in the Dirty River were found to have varied when samples were taken from both upstream and downstream of the waste mass. The Ammonia levels were found to have increased downstream of the waste mass and this would correspond with the high levels of Ammonia found in the leachate samples taken from the landfill. One can assume that the high levels found downstream are related to possible leachate migration from the waste mass. Additional sampling maybe necessary after the CoA is granted to confirm the break in the linkage.

Appendix 1

Dunmanway Tier I Risk Assessment

Code of Practice Environmental Risk Assessment for Unregulated Waste Disposal Sites

Tier 1 Study

Conceptual Site Model, Risk Screening & Prioritisation

For

Landfill Site:	**Kilbarry (Dunmanway)**
Site Reference:	**08/W**
Division:	**West Cork**
Area Office:	**Dunmanway**

OVERALL RISK RATING	MODERATE

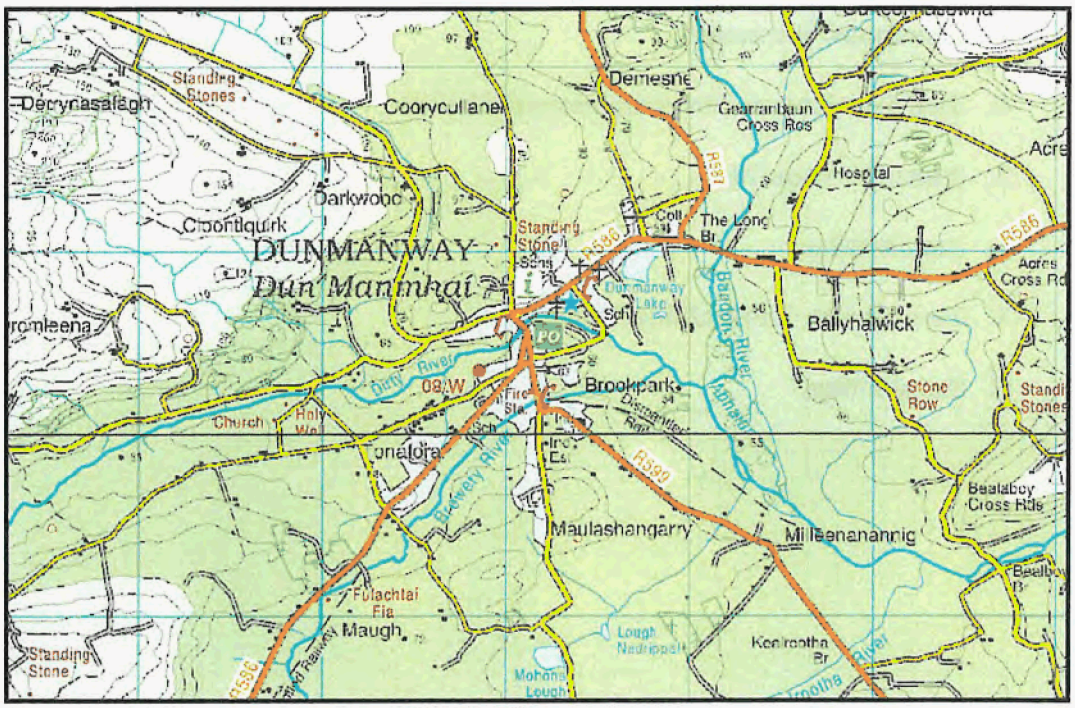
Report by: Kieran Coffey
Environment Directorate
Cork County Council
January 2008

Contents

1. Site Summary
2. Site Photos
3. Conceptual Site model
4. Risk Screening and Prioritisation calculations
5. Protected Areas Map
6. Aquifer Map
7. Groundwater Vulnerability Map
8. Subsoil Map

Site Summary

Dunmanway Landfill is located approximately 300m South West of the Dunmanway town centre (GIS Coordinates E122,853, N52,345). The Landfill is within 40m of Dirty River which flows through the town. This landfill covers an area of approximately 1.6 Ha. It is estimated that the site is approximately 6-7 m deep.



Location of Dunmanway Landfill (08/W)

This site was operating since the 1950's and possibly the 1940's. It was originally leased to the council but was purchased in the mid to late 60's. It was reported that approximately 1000 tonnes of waste were deposited at this site in 1983[1]. Burning of rubbish was common at this site. The landfill closed in 1997/98[2] and was capped with topsoil, stone and chips. A variety of waste was thought to have been disposed here including municipal, construction and demolition, commercial and possibly food waste (from Carbery Milk Products). The landfill is located on marshy ground and close to a river. To prevent waste being washed away during flooding an earthen bank was built up over the years on the northern edge of the site. It was reported that a *"dozer was used to level off the waste approximately every three weeks"*[1].

Walkover Survey

The site is now capped and is covered in scrub. The site is bordered to the south by two fields. There are two houses and a commercial building approximately 50m from the site. The site is adjacent to marshy ground to the north (also a flood plain) and the river is approximately 40m away. The site itself is undulating in parts. There was some surface waste evident on parts of the site as well as mounds of construction and

demolition waste (see attached photos). No leachate or smells noticed during the walkover survey.

Geology:

The site is shown in subsoil maps to be on an area of sandstone sands and gravels. It is on top of a Locally Important aquifer and is in an area of High-Low groundwater vulnerability. During the Tier 1 risk screening this site has been identified as having a 47% risk rating for leachate migration to the local waterway.

Risk Rating: MODERATE

Recommendations:

Proceed to Tier 2 – Site Investigation and Testing. Confirm that no leachate risk remains from this site and check water quality data that may be available for the river both up stream and downstream to see if there is any evidence of pollution from this site impacting on river water quality. Confirm that there is no methane gas risk from this site to the local housing.

References:

1. Summary of waste services in West Cork by Jerome O'Sullivan SEO (1984)
2. Extract from Managers Estimates (1998)

3. Site Photos & Layout Map

Layout map of positions from where photos were taken

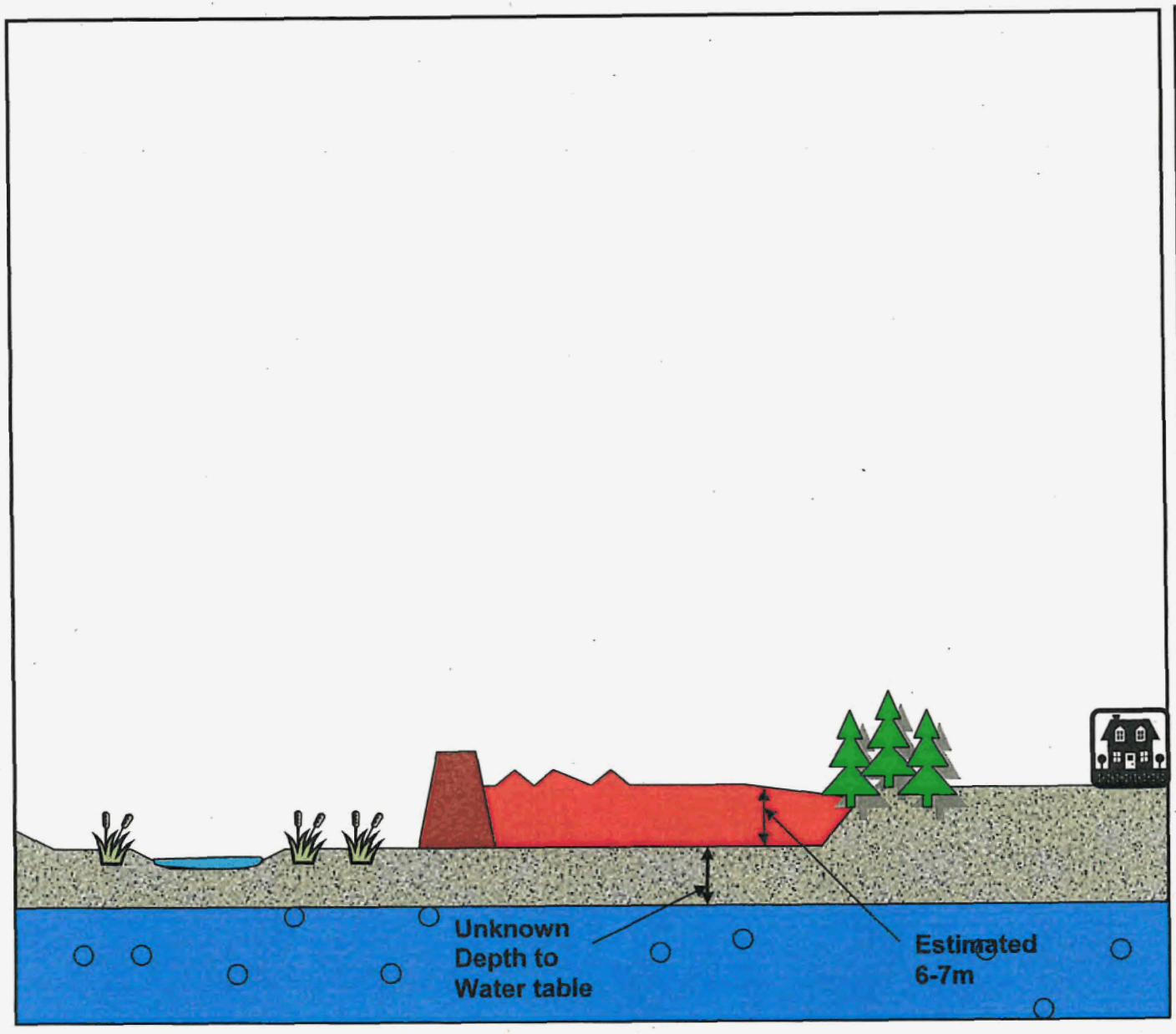
1. **Entrance (facing North)**

2. Mounds of C&D waste

3. C&D waste (facing West)

4. Surface waste

5. Photo towards the town with the river on the left (facing East)



Conceptual Site Model

Landfill: Kilbarry
Site Ref: 08/W
Division: West Cork
Area: Dunmanway

Sources:

Waste Body

Receptors:

Groundwater

River

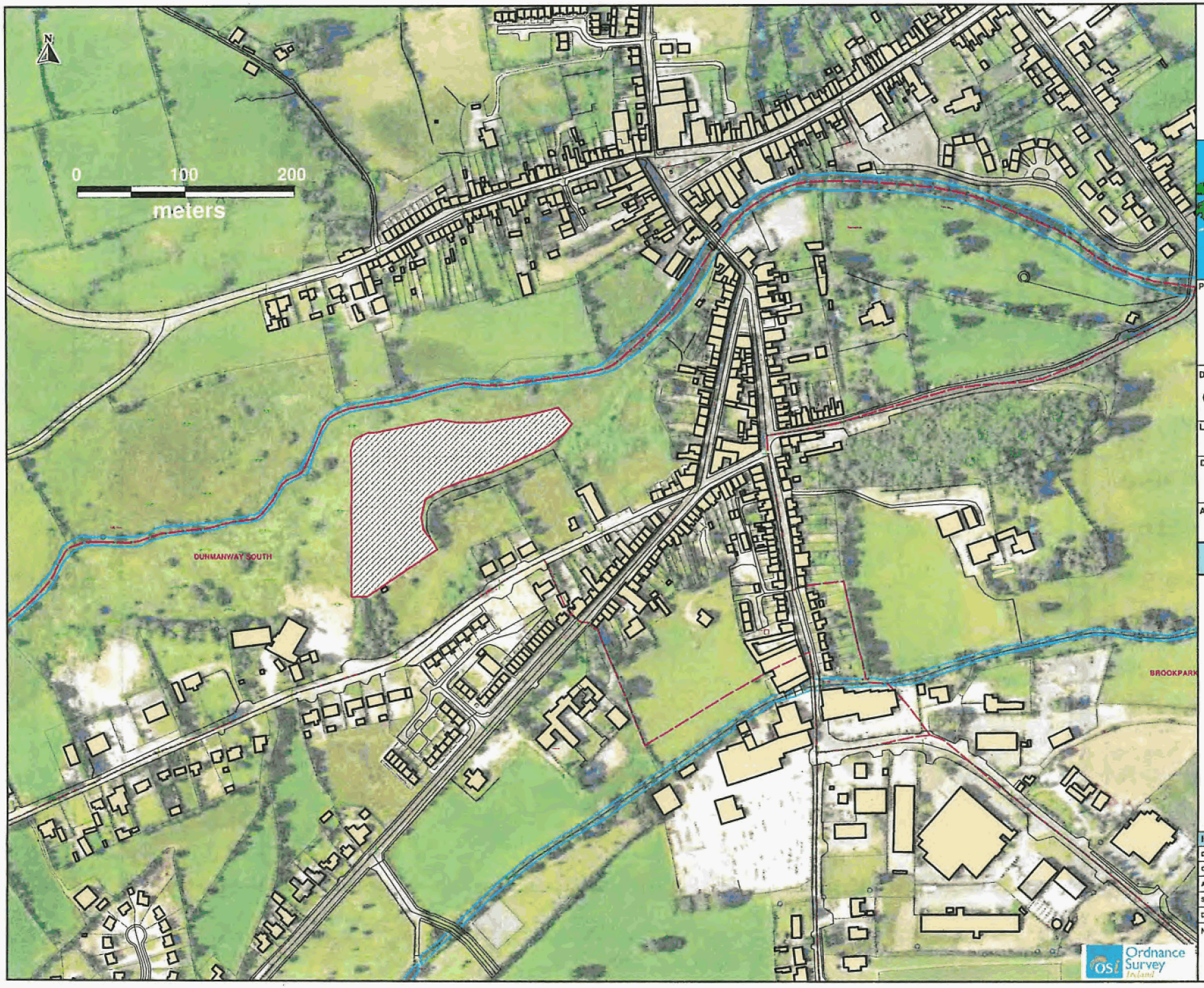
Housing

MarshyGround / Flood Plain

Geology:

Sandstone
Sand & gravel

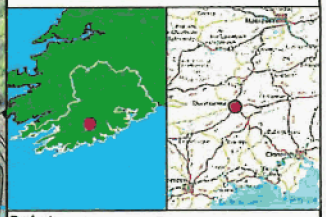
Earthen
Retaining Bund



Cork County Council

Environment Directorate
Cork County Council
Inniscarra
Co Cork

Environment Directorate



Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:

Conceptual Site Model - Plan

Landfill Name & Reference No:

Kilbarry - 08/W

Division:

West Cork

Area Office:

Dunmanway

Legend

Buildings

Landfilled Area

Issue Details

Drawn: KC		File Ref.	
Checked: -		08-W_GVM_rev1	
Approved:			
Scale:		Drawing No.	Rev. 1
Date: Jan 2008		08-W_CSM plan	

Notes
1. This drawing is the property of CCC. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. NOT TO SCALE, use figured dimensions only, if in doubt ask.
4. Ordnance Survey Ireland Licence No. ****** Copyright Government of Ireland.

4. Risk Screening & Prioritisation Calculations

Landfill SiteName: Kilbarry,Dunmanway
Landfill Ref. No. : 08/W

Tier 1 Study

Risk Screening/ Prioritisation

Table 1a LEACHATE: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	1	1.5
Municipal	5	7	10
Industrial	5	7	10
Pre 1977 sites	1	2	3

1a =	7

Table 1b LANDFILL GAS: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	0.75	1
Municipal	5	7	10
Industrial	3	5	7
Pre 1977 sites	0.5	0.75	1

1b =	7

Table 2a : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER VULNERABILITY (Vertical Pathway)	Points
Extreme Vulnerability	3
High Vulnerability	2
Moderate Vulnerability	1
Low Vulnerability	0.5
High - Low Vulnerability (use where vulnerability not on GIS)	2

2a =	2

Table 2b : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER FLOW REGIME (Horizontal Pathway)	Points
Karstified Groundwater Bodies (Rk)	5
Productive Fissured Bedrock Groundwater Bodies (Rf & Lm)	3
Gravel Groundwater Bodies (Rg and Lg)	2
Poorly Productive Bedrock Groundwater Bodies (Ll, Pl, Pu)	1

2b =	1

Risk Screening/ Prioritisation

Table 2c : LEACHATE MIGRATION: PATHWAYS	
SURFACE WATER DRAINAGE (Surface water pathway)	Points
Is there a direct connection between drainage ditches associated with the waste body and adjacent surface water body? Yes	2
If no direct connection	0

2c =	2

Table 2d : LANDFILL GAS: PATHWAY	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	Points
Sand and Gravel, Made ground, urban, karst	3
Bedrock	2
All other Tills (including limestone, sandstone etc - moderate permabi	1.5
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2d =	3

Table 2e : LANDFILL GAS: PATHWAY (assuming receptor located above source)	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	Points
Sand and Gravel, Made ground, urban, karst	5
Bedrock	3
All other Tills (including limestone, standstone etc - moderate permab	2
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2e =	5

Table 3a : LEACHAGE MIGRATION: *RECEPTORS*	
HUMAN PRESENCE (presence of a house indicaates potential private wells)	Points
On or within 50m of the waste body	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0

3a =	2

Risk Screening/ Prioritisation

Table 3b : LEACHAGE MIGRATION: RECEPTORS PROTECTED AREAS (SWDTE or GWDTE)	Points
Within 50m of waste body	3
Greater than 50m but less than 250m of the waste body	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0
Undesignated sites within 50m of waste body	1
Undesignated sites greater than 50m but less than 250m	0.5
Undesignated sites greater than 250m of the waste body	0
3b =	**2**

Table 3c : LEACHAGE MIGRATION: *RECEPTORS*	
AQUIFER CATEGORY (resource potential)	Points
Regionally Important Aquifers (Rk, Rf, Rg)	5
Locally Important Aquifers (Ll, Lm, Lg)	3
Poor Aquifers (Pl, Pu)	1

3c =	**3**

Table 3d : LEACHAGE MIGRATION: *RECEPTORS*	
PUBLIC WATER SUPPLIES (Other than private wells)	Points
Within 100m of site boundary	7
Greater than 100m but less than 300m or with in Inner SPA for GW supplies	5
Greater than 300m but less than 1km or within Outer SPA (SO) for GW supplies	3
Greater than 1km (karst aquifer)	3
Greater than 1km (no karst aquifer)	0
3d =	**0**

Table 3e : LEACHAGE MIGRATION: *RECEPTORS*	
SURFACE WATER BODIES	Points
Within 50m of site boundary	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km	1
Greater than 1km	0
3e =	**2**

Landfill SiteName: Kilbarry,Dunmanway
Landfill Ref. No. : 08/W

Tier 1 Study

Risk Screening/ Prioritisation

Table 3f : LEACHAGE MIGRATION: *RECEPTORS*	
HUMAN PRESENCE	**Points**
On site or within 50m of site boundary	5
Greater than 50m but less than 150m	3
Greater than 150m but less than 250m	1
Greater than 250m	0.5

3f =	**3**

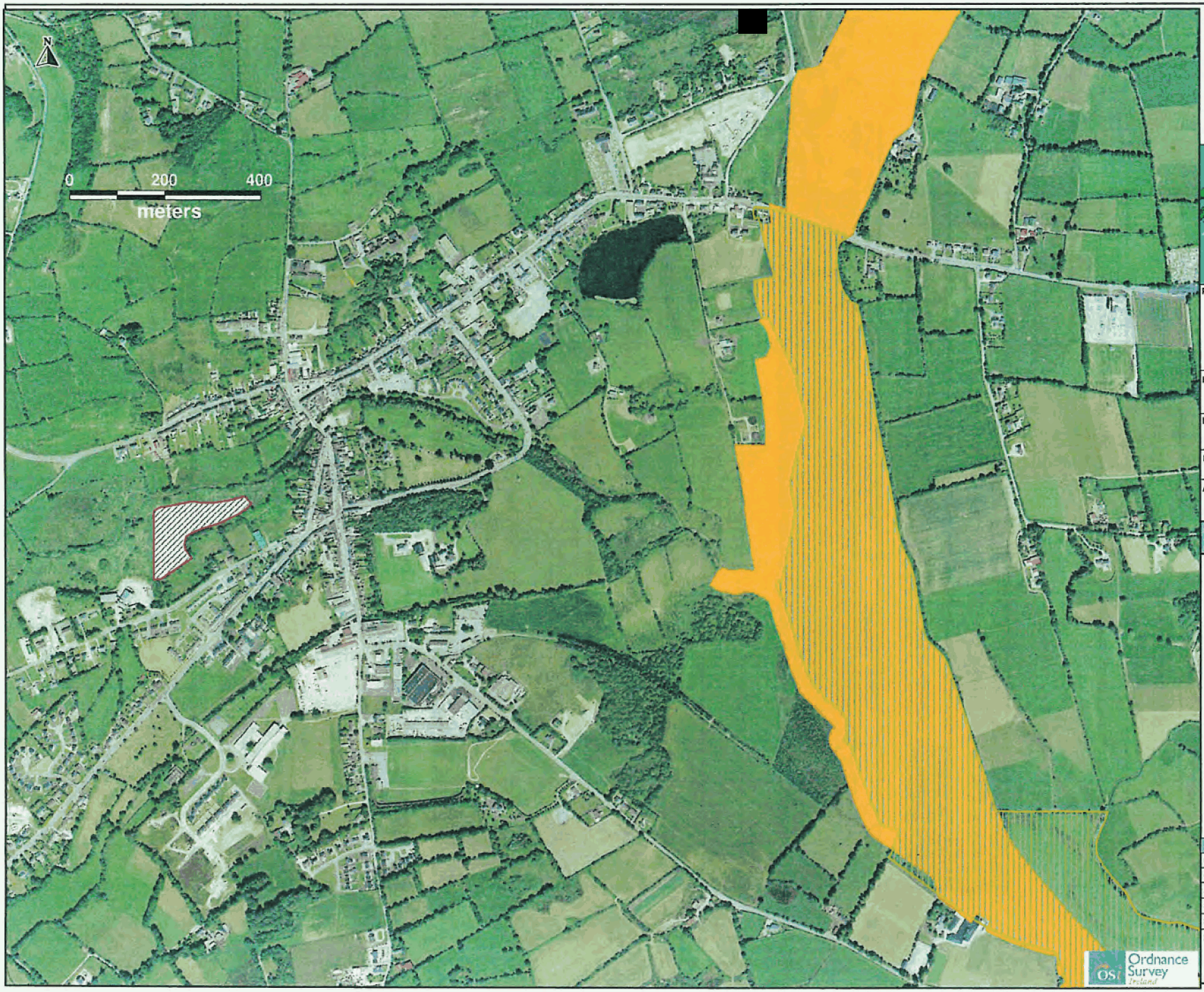
Note: The table below represents the Tier 1 risk rating for this site. SPR 1 to 9 represent the leachate risk scores. SPR 10 & 11 represent Landfill Gas risks. The migration pathways are colour coded as follows:

Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
SPR 1 =	70	300	Leachate => surface water	23%
SPR 2 =	70	300	Leachate => SWDTE	23%
SPR 3 =	42	240	Leachate => human presence	18%
SPR 4 =	42	240	Leachate => GWDTE	18%
SPR 5 =	63	400	Leachate => Aquifer	16%
SPR 6 =	0	560	Leachate => Surface Water	0%
SPR 7 =	42	240	Leachate => SWDTE	18%
SPR 8 =	28	60	Leachate => Surface Water	47%
SPR 9 =	28	60	Leachate => SWDTE	47%
SPR 10 =	63	150	Landfill Gas => Human Presence	42%
SPR 11 =	105	250	Landfill Gas => Human Presence	42%

Risk Classification	Range of Risk Scores
Highest Risk (Class A)	Greater than or equal to 70% for any individual SPR lingage
Moderate Risk (Class B)	Between 40-70% for any individual SPR linkage
Lowest Risk (Class C)	Less than or equal to 40% for any individual SPR linkage

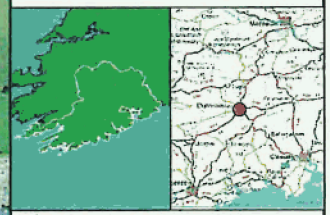
OVERALL RISK RATING	MODERATE



Cork County Council

Environment Directorate
Cork County Council
Inniscarra
Co Cork

Environment Directorate



Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:

Protected Areas Map

Landfill Name & Reference No:

Clonakilty Landfill - 02/W

Division: West Cork

Area Office:

Clonakilty

Legend

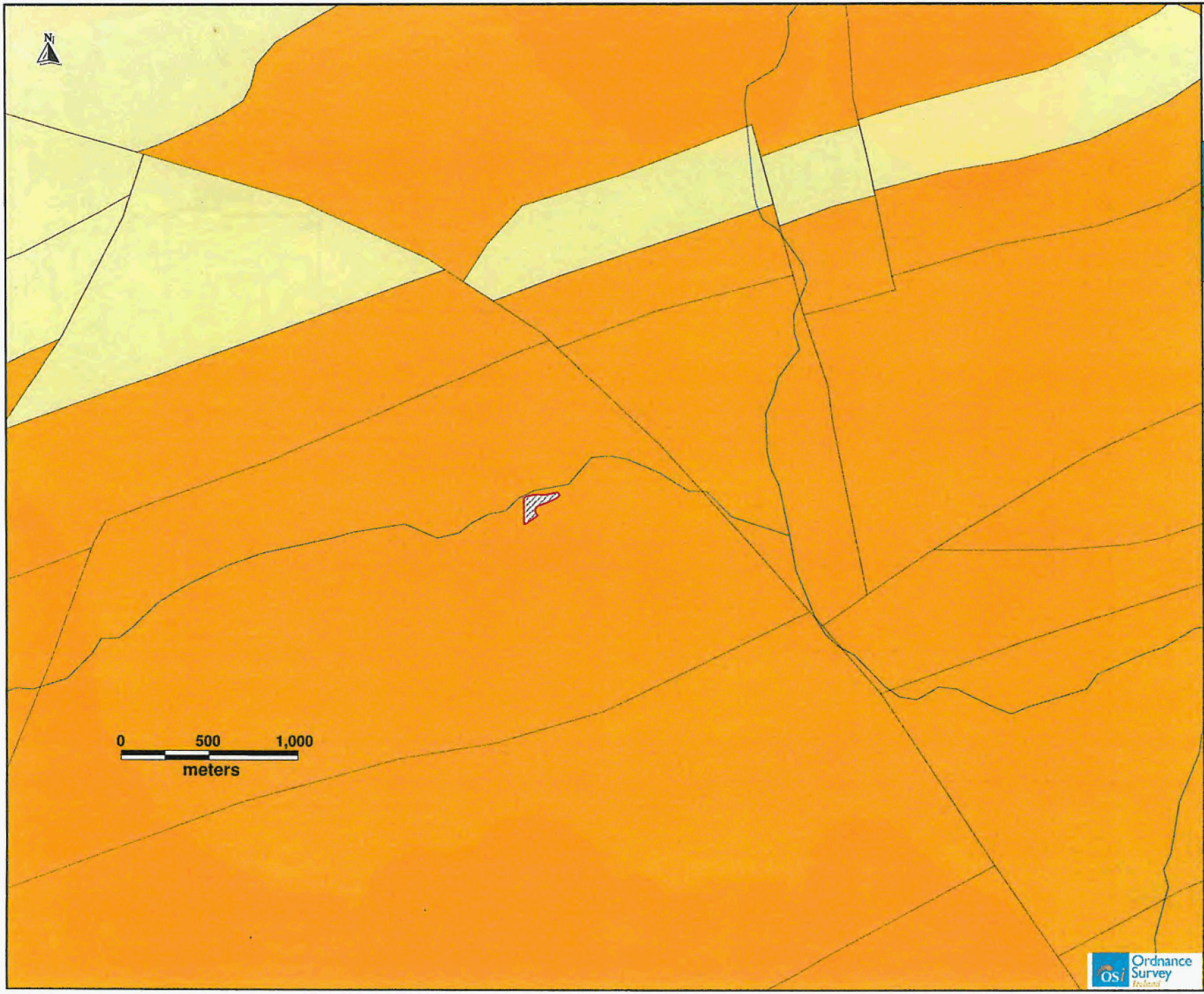
- Landfilled Area
- SPA
- NHA
- SAC

Issue Details

Drawn: KC		File Ref. 08/W_PA_Rev1	
Checked: -			
Approved:			
Scale:		Drawing No. 08/W_PA	Rev. 1
Date: Jan 08			

Notes

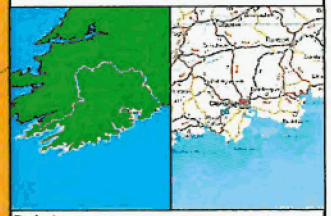
1. This drawing is the property of CCC. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. NOT TO SCALE, use figured dimensions only, if in doubt ask.
4. Ordnance Survey Ireland Licence No. ***** Copyright Government of Ireland



Cork County Council

Environment Directorate
Cork County Council
Inniscarra
Co Cork

Environment Directorate



Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:

Aquifer Map

Landfill Name & Reference No:

Kilbarry - 08/W

Division:

West Cork

Area Office:

Dunmanway

Legend

Landfilled Area

AQUIFER CATEGORY

- Ll - Locally Important Aquifer
- Pending Classification
- Pl - Poor Bedrock Aquifer
- Pu - Poor Bedrock Aquifer
- Rf - Regionally Important Fissured Aqu.
- Rkd - Regionally Important Karst Aquifer

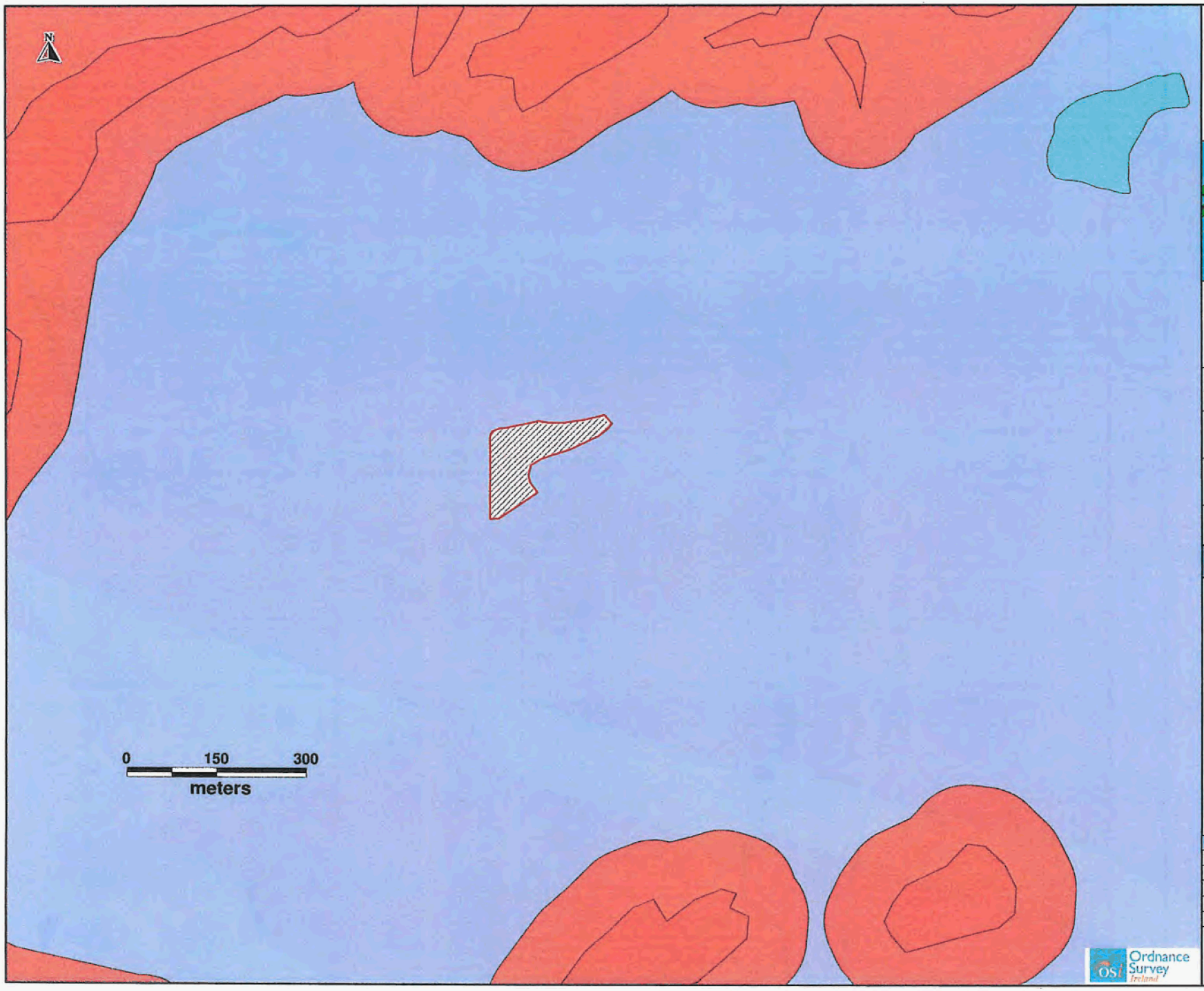
River

Issue Details

Drawn: KC		File Ref.	08/W_AC_rev0
Checked: -			
Approved:			
Scale:		Drawing No. 08/W_AQ_1	Rev. 1
Date: Jan 2008			

Notes

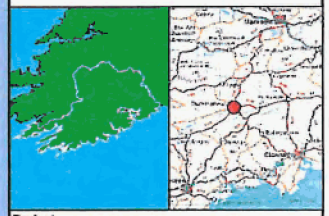
1. This drawing is the property of CCC, it is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. NOT TO SCALE, use figured dimensions only, if in doubt ask.
4. Ordnance Survey Ireland Licence No. ***** Copyright Government of Ireland.



Cork County Council

Environment Directorate
Cork County Council
Inniscarra
Co Cork

Environment Directorate



Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:

Groundwater Vulnerability Map

Landfill Name & Reference No:

Kilbarry - 08/W

Division:

West Cork

Area Office:

Dunmanway

Legend

Landfilled Area

SWRBD Groundwater Vulnerability

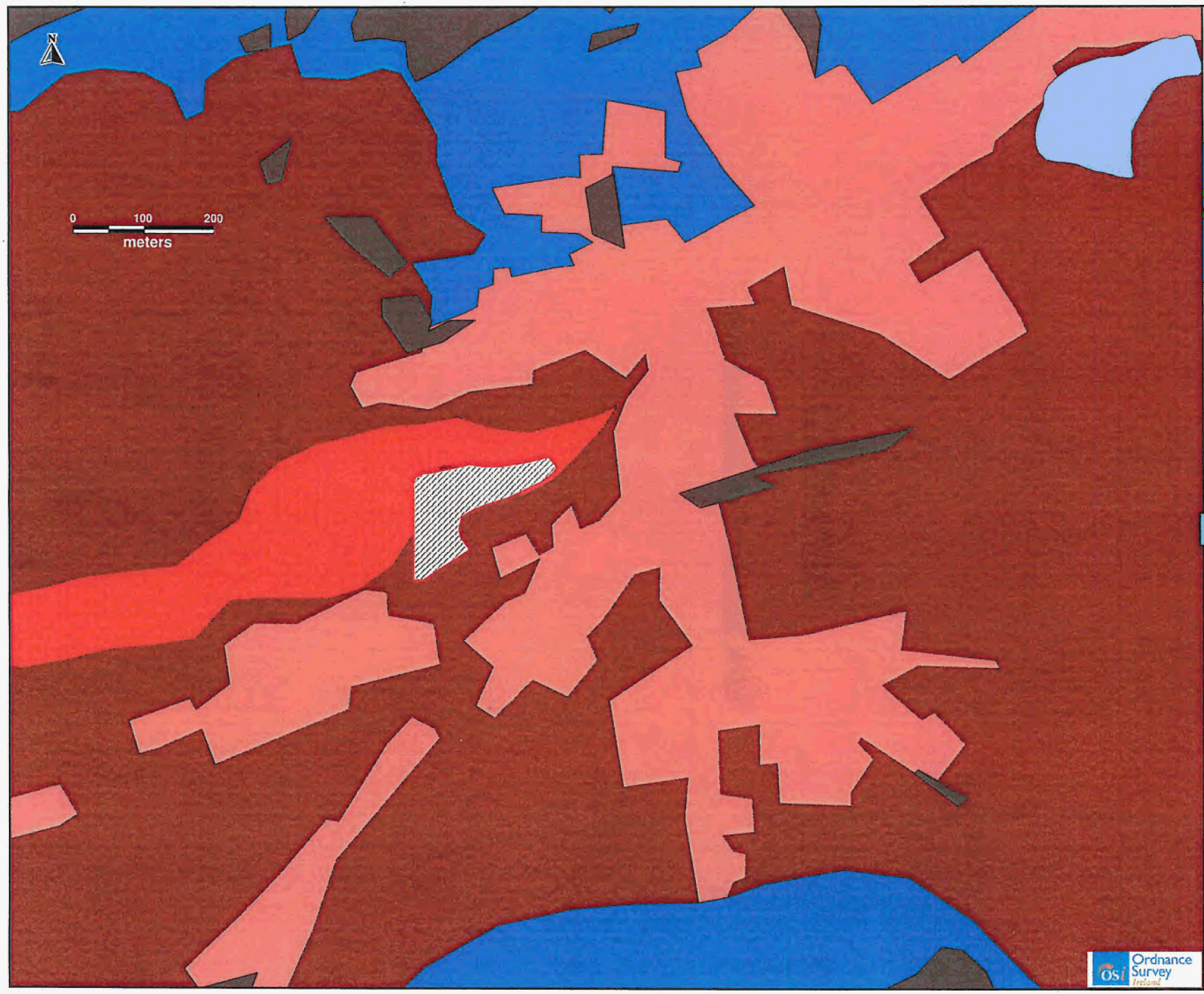
- X - Extreme (rock <1m from surface)
- E - Extreme (rock close to surface)
- H - High
- M - Moderate
- L - Low
- HL - High-Low
- Water

Issue Details

Drawn: KC		File Ref.	08-W_GVM_rev1
Checked: -			
Approved:			
Scale:		Drawing No.	Rev.
Date: Jan 2008		08-W_GVM	1

Notes
1. This drawing is the property of CCC. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. NOT TO SCALE. use figured dimensions only. If in doubt ask.
4. Ordnance Survey Ireland Licence No. ****** Copyright Government of Ireland.

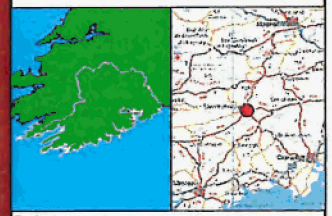
Ordnance Survey Ireland



Cork County Council

Environment Directorate
Cork County Council
Inniscarra
Co Cork

Environment Directorate



Project

Environmental Risk Assessment for Unregulated Waste disposal Sites

Tier 1 Investigation

Drawing Description:
Subsoils Map

Landfill Name & Reference No:
Kilbarry - 08/W

Division: **West Cork**

Area Office:
Dunmanway

Legend

Subsoil Type

Alluvium*	Mbs
AcEsk	Mesc
BktPt	MGs
Cut	Msi
FenPt	Rck *
GDCSs	Scree
GDSs*	TDCSsS *
GLs	TdlMr
GNSSs	TDSs
IrSTDSs	TLPSsS
KaRck	TLs
L	TNSSs
Made *	Water
Marsh	Ws

Issue Details

Drawn:	KC	File Ref.	08/W_SS_1
Checked:	-		
Approved:			
Scale:		Drawing No.	Rev.
Date:	Jan 2008	08-W_SSM_1	1

Notes
1. This drawing is the property of CCC. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. NOT TO SCALE, use figured dimensions only, If in doubt ask.
4. Ordnance Survey Ireland Licence No. ****** Copyright Government of Ireland.

Appendix 2

EPA Matrices for Dunmanway

EPA COP MAIN SITE INVESTIGATION REQUIREMENTS FOR MODERATE RISK (CLASS B 40% TO 69%) AND HIGH RISK (CLASS A > 70%) FOR UNREGULATED WASTE DISPOSAL SITES.

IMPORTANT NOTE: THIS IS A GENERAL GUIDE TO INDENTIFY SUITABLE SITE INVESTIGATION (SI) METHODS FOR MODERATE & HIGH RISK WASTE SITES, AS IDENTIFIED BY THE EPA COP RISK CLASSIFICATION FROM THE COMPLETED TIER 1 & INETIAL TIER 2 EXPLORATORY INVESTIGATIONS. EACH PHASE OF INVESTIGATION WILL DEVELOP THE CONCEPTUAL SITE MODEL (CSM) AND SHOULD GUIDE THE DESIGN OF THE NEXT PHASE OF INVESTIGATION & ULTIMATELY THE REMEDIATION . THE APPLICATION OF THE INVESTIGATION PROCESS AND METHODOLOGIES SHOULD BE COMPLETED IN ACCORDANCE WITH THE RELEVANT GUIDANCE DOCUMENTS AND STANDARDS AND BE UNDERTAKEN BY EXPERIENCED PRACTITIONERS.

				TIER 2: MAIN INVESTIGATION					TIER 2 PROBE AND/OR BOREHOLE SAMPLING						TIER 2 SPECIALIST SURVEYS			AFTER TIER 2 MAIN INVESTIGATION, REFINE CONCEPTUAL SITE MODEL, CONFIRM RISK CLASSIFICATION & PROGRESS TO QRA & REMEDIATION PHASE
				The selection of site investigation techniques should be focused on what SPR Linkage is being examined & the site/ground conditions - in some cases a combination of techniques may be required and/or additional trial pitting considered necessary														
SPR LINKAGE	SOURCE	PATHWAY	RECEPTOR	SHALLOW PROBES/HAND *AUGERS*	GEOPHYSICS/ INFRA *RED SURVEYS*	*WINDOW SAMPLING*	CABLE PERCUSSION BORING	AIR ROTARY OPEN OR CORED HOLE	GAS SAMPLING	LEACHATE SAMPLING	SOIL SAMPLING	SURFACE WATER SAMPLING	GROUNDWATER SAMPLING	PUMPING TEST	ECOLOGICAL SURVEYS	SURFACE WATER SURVEYS	ODOUR/DUST or ASBESTOS SURVEYS	
				Manual or mechanical installation of temporary probes for gas monitoring to typically 2mBGL & use of landfill gas analyser and/or PID to determine concentrations - may give limited soil profile and strength information.	Range of techniques for waste extent, depth, plumes & anomalies; can be influenced by power cables, unsuitable ground conditions, poor interpretation. Needs ground proofing.	Competitor/terrier rig shallow soil sampling, permeability testing & standpipe installation for GW monitoring & gas taps: Ground conditions can limit depth.	Also called Shell & Auger (S&A) drilling - deeper soil sampling, permeability testing & standpipe installation for GW monitoring & gas taps. Can be limited by boulders/ obstructions. No bedrock penetration.	Bedrock drilling, chip sampling & standpipe installation for GW monitoring permeability testing & gas taps. Very limited subsoil or waste sampling. Coring used for geotech logging, rock quality/fracture logging.	Gas Sampling using bags, Gresham Tubes etc.	Sampling from boreholes in waste area giving data on List 1 & List 2 substances contamination - Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	Soil sampling to assess permeability potential of surrounding materials (leachate or gas pathway assessment). Soil contamination assessment may be required and assessment potential for local material to be used for remediation/capping. Detailed borehole logs should be completed.	List 1 & List 2 substances contamination assessment in SW & seepage locations. Sampling applied for surface water abstractions from shallow dug wells and surface water sources, (SPR 6). Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	List 1 & List 2 substances contamination assessment GW flow direction. Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	Enables GW sampling for List 1 & List 2 substances contamination assessment, relevant water standards & GW flow regime & direction	habitat assessment, surface water Q quality rating, ecological significance - surveys should be risk specific.	water levels, flow rates, assimilative capacity, hydrology studies	Only required if odours, dust and asbestos are identified as potential problem during Tier 1 and Tier 2 works	
SPR 1	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body	N	S	R/S	R/S	R/S	N	R	R	R	R/S	S	S	R	N	
SPR 2	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	N	S	R/S	R/S	R/S	N	R	R	R	R/S	S	R/S	R	N	
SPR 3	LEACHATE	Vertical & Horizontal Groundwater Migration	Human Presence (Private Well)	N	S	N	S	R	N	S	S	N	R	S	N	N	N	
SPR 4	LEACHATE	Vertical & Horizontal Groundwater Migration	Groundwater Protected area (GWDTE)	N	S	N	S	R	N	S	S	S	R	S	R	N	N	
SPR 5	LEACHATE	Vertical & Horizontal Groundwater Migration	Aquifer Category	N	S	N	S	R	N	R	R	N	R	R/S	N	N	N	
SPR 6	LEACHATE	Vertical & Horizontal Groundwater Migration	Public Supply (Well) (Includes Group Water Schemes)	N	S	N	S	R	N	R	R	S	R	R/S	N	S	N	
SPR 7	LEACHATE	Vertical & Horizontal Groundwater Migration	Surface Water Body	N	S	S	S	R	N	R	R	R	R	S	S	R	N	
SPR 8	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body	N	S	R/S	R/S	N	N	R	R	R	N	N	S	R	N	
SPR 9	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	N	S	R/S	R/S	N	N	R	R	R	N	N	R	R	N	
SPR 10	LANDFILL GAS	Lateral Migration (Subsoil)	Human Presence	R	S	S	S	S	R/S	N	N	N	N	N	N	N	S	
SPR 11	LANDFILL GAS	Vertical Migration (Subsoil)	Human Presence	R	S	S	S	S	R/S	N	N	N	N	N	N	N	S	
Source & Pathway & Receptor Parameters Targeted for CSM & Risk Screening & Remediation.				waste type, footprint, soil type, thickness, strength. Suitable for gas monitoring and gas migration potential.	waste type/volume, waste footprint, depth to bedrock, groundwater vulnerability, horizontal pathway - plume migration,	waste type, groundwater vulnerability/level, gas migration potential,	waste type, groundwater vulnerability/level, flow direction & resource potential, horizontal pathway, gas migration potential.	groundwater vulnerability/level & flow direction & resource potential, horizontal pathway, gas migration potential.	waste type, gas migration potential	waste type, leachate potential and gas migration potential.	soil type, permeability, leachate & gas migration potential, ground vulnerability, horizontal pathway. May also assist in assessing re-use of material for remediation.	surface water receptor and pathway information.	groundwater receptor and horizontal pathway information.	groundwater resource potential, flow direction, horizontal pathway	surface water pathway, groundwater vulnerability, horizontal pathway,	surface water pathway	Air Pathway	
General comments regarding techniques & COP Section Reference - Note: the development of the CSM and design of the site investigation should involve an experienced SI practitioner.				Gas monitoring should be considered if trial pit phase identifies gas potential, thin/no capping and human presence exists. Section 5.5.2 of COP.	Geophysics should be considered for areas where extent of waste is unclear and where shallow plumes may be impacting on surface waters. Advantage of covering large areas and is not intrusive. Needs ground proofing. Section 5.5.1.2 of COP.	Window sampling option should be considered for shallow boreholes in ground without obstructions (as identified from Trial Pit Survey). Use boreholes for sampling, water/leachate & gas monitoring.	S&A drilling can be completed after or instead of window sampling phase especially if deeper depth required. Use boreholes for sampling, water/leachate & gas monitoring. Section 5.5.2 of COP.	Aquifer category work based on GSI well survey data & rotary drilling. Recommend minimum of three GW level locations are available for flow direction calculation - use of data loggers to confirm levels and/or possible linkage. Core drilling rarely used unless RQD needed. Design and proper grouting of wells is important. Use boreholes for sampling, water/leachate & gas monitoring. Section 5.5.2 of COP.	Should be considered once landfill gas identified as risk to receptors. Compete as per best practice and relevant guidelines. Refer to EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Section 7.	characterises waste type and leachate source/contamination potential, Compete as per best practice and relevant guidelines. Section 5.5.3 of COP. Refer to EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Section 6.	Characterises soil type and if contamination present, characterises geology and permeability. Refer to relevant guidelines and Standards. Section 5.5.3 of COP.	should be completed as per best practice and relevant guidelines. Refer to EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Section 4.	should be completed as per best practice and relevant guidelines. Refer to EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Section 5.	generally step test should be followed by longer CRT test to determine aquifer characteristics and potential linkages. Level loggers should be used.	should be considered for SACs/SPA, wetlands and surface waters - if surface water body is part of salmonoid (Q Index) or marine catchment then ecology survey's should be considered. Consultation with NPWS may be required. Where applicable use existing data from EPA/OPW or local authority sources. Refer to Section 5.5.1.3 and Appendix 4 of COP.	catchment surveys, V-Notch weirs, flow studies should all be considered Consultation with fisheries may be beneficial.	Standard dust jars or specific odour surveys should be considered. Compete as per best practice and relevant guidelines. Refer to EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Sections 8 and 10.	
Provisional Guidance on Minimum Extent of Testing/Sampling - (sampling totals will depend on the type of risk identified, size of site, extent & volume of waste, ground conditions, variability of the waste material, etc..)				Number of probes will depend on extent of survey and depth of probe. I	Will depend on the nature and extent of the waste and type of survey being undertaken. Needs to be site specific assessment scoped and completed by experienced and qualified contractors.	Number of probes will depend on survey area, ground conditions and depth of completion. If suitable ground exists typically three five metre boreholes are possible per day.	Number of boreholes will depend on survey area, ground conditions and depth of completion. Rough average 10m of drilling typically completed per day.	Number of boreholes will depend on extent of waste and location of receptors. Completion rate will be impacted by installations and grouting. Approximately 75m of drilling and casing can be completed per day.	Will depend on extent and nature of gases and receptors. Should be decided on a site specific basis.	Will depend on nature and composition of the waste and number of investigation points. Full screen testing as per Table C.2 of EPA Landfill Monitoring Manual 2003, indicator parameters include ph, Conductivity, Temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium.	Will depend on the variability of site and geology. Ground variability will require more sampling. In-situ permeability and strength (SPT) tests and soil assessment for remediation use should be considered.	Sample upstream and down stream locations as per Table C.2 of EPA Landfill Monitoring Manual 2003. Basic indicator parameters include ph, Conductivity, Temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium.	Sample at all borehole locations. Full screen as per Table C.2 of EPA Landfill Monitoring Manual 2003. Basic indicator parameters include ph, Conductivity, Temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium.	Pumping tests are important for assessing pathways and confirming linkages and should be completed if possible.	Quantified on a site specific basis. For high risk sites functional values for the habitat may need to be assessed.	Quantified on a site specific basis.	Quantified on a site specific basis.	
MODERATE RISK SITES				initial one day probe survey should be considered for moderate gas risk sites.	Less coverage and survey densities would be expected for moderate risk sites when compared to high risk sites.	Minimum of one days should be considered.	Minimum three to five locations should be considered.	Minimum of one down gradient borehole required for moderate risk sites.	Less gas monitoring locations would be expected to be monitored for moderate risk sites when compared to high risk sites.	One full suite and indicator parameters at a minimum of three locations.	Number of samples should be determined by the site specific requirements.	Full suite on down stream locations and indicator parameters at up stream locations.	Full suite on nearest down gradient borehole and indicator parameters at all other relevant groundwater locations.	Step test and minimum of 72 hour test should be initially considered.	Surveys should be determined by the site specific requirements. In general moderate risk sites would be expected to require a less extensive scope of works to be completed.	Quantified on a site specific basis. In general moderate risk sites would be expected to require a less extensive scope of works to be completed.	Quantified on a site specific basis. In general moderate risk sites would be expected to require a less extensive scope of works to be completed.	
HIGH RISK SITES				initial two day probe survey should be considered for moderate gas risk sites.		Minimum of two days should be considered.	Minimum three to five locations should be considered.	Minimum of three boreholes are required for high risk sites.		Minimum of two full suite and indicator parameters at all other suitable locations.		Full suite on up and down stream locations and indicator parameters at any other relevant surface locations.	Full suite on up gradient and down gradient boreholes and indicator parameters at all other relevant groundwater locations.	Step test and five to seven day test should be initially be completed.				

R = Recommended technique assuming site conditions allow.

S = Should be considered but is dependent on site suitability for that methodology.

N = Not recommended, but may occasionally be suitable.

RQD = Rock Quality Designation

BGL = Below Ground Level

GSI = Geological Survey Of Ireland

CSM = Conceptual Site Model

SI = Site Investigation

CRT = Constant Rate Test

NPWS = National Parks and Wildlife Service

GW - Groundwater

QRA = Quantitative Risk Assessment

ISSUED WORKING DRAFT

DATE:17 Sept 09

COMPILED BY WYG

EPA COP MINIMUM REQUIRED PRELIMINARY & EXPLORATORY INVESTIGATIONS FOR ALL UNREGULATED WASTE DISPOSAL SITES

IMPORTANT NOTE: THIS IS THE INITIAL PHASE OF WORK IS CONSIDERED MANDATORY FOR ALL SITES IDENTIFIED AND SHOULD AIM TO COMPLETE A COMPREHENSIVE TIER 1 THE FINDING OF WHICH WILL BE CONFIRMED BY THE INITIAL TIER 2 WORKS. EACH PHASE OF ASSESSMENT WILL DEVELOP THE CONCEPTUAL SITE MODEL (CSM) AND SHOULD GUIDE THE DESIGN OF THE NEXT PHASE OF SI . THE APPLICATION OF THE SI PROCESS AND METHODOLOGIES SHOULD BE COMPLETED IN ACCORDANCE WITH THE RELEVANT STANDARDS/EPA GUIDANCE DOCUMENTS AND UNDERTAKEN BY EXPERIENCED PRACTITIONERS.

					TIER 1: PRELIMINARY INVESTIGATION				TIER 2: EXPLORATORY INVESTIGATION & SAMPLING							
					DESK STUDY	WALKOVER SURVEY	CONCEPTUAL SITE MODEL (CSM)		TRIAL PITS & TRENCHES	WASTE TYPE	WASTE SAMPLING	LEACHATE TESTING	SOIL SAMPLING	Surface or Groundwater Sampling	TOPOGRAPHIC & GPS SURVEY	
SPR LINKAGE	Clountreem Linkage Scores	SOURCE	PATHWAY	RECEPTOR	Critical mandatory element of the SI process - includes gathering baseline site and local area data, history of landfill, waste types, volumes, age, presence and distance to potential receptors, etc	Very important element of the SI process. Confirms physical conditions on site, desk study findings and examines access issues, visual assessment of pathways/receptors allows initial SPR linkage potential to be considered.	The development of the CSM is a critical aspect of the risk assessment and defining SPR linkages and therefore SI requirements	AFTER TIER 1 INVESTIGATION, DEVELOP CONCEPTUAL SITE MODEL, DETERMINE RISK CLASSIFICATION & SCOPE EXPLORATORY INVESTIGATION	JCB or tracked excavator - waste type assessment & classification - leachate/gas potential, limited depth, good bulk samples & visual assessment. Allows for sampling and possibly temporary standpipes (not best practice). Accurate logs and photographs important.	Assessment of waste type in terms of content and determining composition of C&D, Municipal, Industrial, Pre 1977 sites. Should confirm reported waste types deposited as identified in Tier 1.	Waste Sampling is primarily to enable leachability testing if risk of leachate emanating from waste exists.	List 1 & List 2 substances contamination - Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	Principle purpose of soil sampling at this stage is to assess permeability potential of surrounding materials (pathway assessment), composition of any cap and potential for local materia to be used for remediation/capping. In some cases contamination assessment may be required.	Any obvious receptors should be considered for initial indicator parameter screening. Surface waters and/or existing boreholes can be sampled at this stage. Gas monitoring with hand held equipment can be completed. Parameters to be considered as per Table C.2 of EPA Landfill Monitoring Manual 2003.	Topographic modelling will enable waste extent & volume calculations, location of sampling points, surface drains/features. Topographic data & Well datum for flow direction mapping. GPS system will determine grid ref for SI works, Can be important for remediation/capping design.	AFTER TIER 2 EXPLORATORY INVESTIGATION, REFINE CONCEPTUAL SITE MODEL, CONFIRM RISK CLASSIFICATION & SCOPE MAIN SITE INVESTIGATION AS REQUIRED
									2 Days Trial Pitting	2 Days Site Engineer (See CCC staff costs)	Waste Sampling	Leachate samping , 1No. Full Suite, 2 No. minor suite	Soil Sample	1No. Down Stream Sample	Topographic Survey	
SPR 1	23%	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 2	23%	LEACHATE	Vertical & Horizontal Groundwater to Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 3	18	LEACHATE	Vertical & Horizontal Groundwater Migration	Human Presence (Private Well)	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 4	18	LEACHATE	Vertical & Horizontal Groundwater Migration	Groundwater Protected area (GWDTE)	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 5	16	LEACHATE	Vertical & Horizontal Groundwater Migration	Aquifer Category	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 6	0	LEACHATE	Vertical & Horizontal Groundwater Migration	Public Supply (Well) (includes Group Water Schemes)	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 7	18	LEACHATE	Vertical & Horizontal Groundwater Migration	Surface Water Body	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 8	47	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 9	47	LEACHATE	Surface Water Drainage/Runoff	Surface Water Body Protected Area (SWDTE)	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 10	42	LANDFILL GAS	Lateral Migration (Subsoil)	Human Presence	M	M	M		M	M	R	R	R	R/S	R/S	
SPR 11	42	LANDFILL GAS	Vertical Migration (Subsoil)	Human Presence	M	M	M		M	M	R	R	R	R/S	R/S	
Source & Pathway & Receptor Parameters Targeted for CSM & Risk Screening					Research of all available published site information - Site history, waste type, extent and volumes, possible historic sources, local receptors, infrastructure etc. Interviews with previous site staff should be considered.	Walkover should confirm desk study data and investigate Source Pathway Receptor regimes being considered.	The CSM should graphically represent the relationship's) and receptor's) developed on the basis of hazard identification and refined during subsequent phases of assessment.		Waste type/composition, footprint, volume, depth & groundwater vulnerability, leachate & gas source & migration potential. Should assess nature and depth of any cap or undersoils, if encountered.	waste type, general composition and extent within the landfill area, leachate and gas source & migration potential.	waste type, leachate potential	waste type, leachate potential	ground vulnerability, horizontal or vertical pathway assessment & material use in remediation of site.	surface water or groundwater receptor and potential horizontal pathway information.	waste area & volume, site topography, layout/setting, access roads, surface features, accurate SI points, levels for groundwater flow direction, etc	
General comments & COP Section Reference - Note: the development of the CSM and design of the site investigation should involve an experienced SI practitioner.					Critical first step in site and waste characterisation, all potential data sources should be considered. Note Section 3.2 of COP	allows visual assessment of site and local environs, important that walkover confirms findings of desk study and allows accurate CSM to be developed. Note Section 3.4 of COP	This is a fundamental part of the Risk Assessment exercise - the CSM information should be clearly documented and accessible in the form of text, figures and tables. Note section 3 of COP and reporting requirements in Chapter 8.		Trial pits and trenching is a very important phase of work to enable the potential sources and types of leachate & gas to be determined. Detailed logs and photographic records important. Note Section 5.5.2 of COP.	characterises waste type and contamination potential. Note Section 4.3.1 of COP & Table 1a & Table 1b of Scoring Matrix.	characterises waste type and contamination potential. Note Section 4.3.1 of COP & Table 1a & Table 1b of Scoring Matrix.	characterises waste type and contamination potential, samples can be acquired during trial pitting or from existing borehole infrastructure, if present.	Characterises geology type and material strength, permeability	should be completed as per best practice and relevant guidelines. Refer to COP 5.3.2 and EPA Landfill Monitoring Guidelines, 2nd Edition 2003, especially Sections 4 and 5.	topographic surveys give base map for site layout, investigation points, sample and water level depths, groundwater flow direction etc. recommended.	
Provisional Guidance on Extent of Testing/Sampling - This will ultimately depend on the type of risk identified, size of site, extent & volume of waste, ground conditions, variability of the waste material, etc..					Office based assessment using all available existing site data that is vital in assessing the initial risk level and conceptual model for the site. Sites may have GIS data available.	Locations and access issues for sampling and site suitability should be assessed at this stage.	A good conceptual site model will facilitate an initial risk classification for the site and guide future works.		Typically 7 to 10 trial pits are completed to 3 to 5m per day. Initial two days of trial pitting should be undertaken on and around the waste body to confirm extent and composition. Initial gas monitoring can be by hand held gas and volatile monitors & based on physical observations. Further Trial Pits & Trenching can be completed as part of the Main SI if required.	Each trial pit should be logged as per BS 5930:1999 and nature of waste and composition recorded. Photographic records important. Potential to cause source of contamination to be assessed.	Leachability testing of waste should be completed once is not C&D type - minimum of two samples should be acquired for the NRA Leachability test and comparison to the relevant guidelines such as, EPA groundwater Interim Guideline Values (IGVs).	Will depend on nature and composition of the waste and number of investigation points. Initially one to three samples should be taken with one full screen as per Table C.2 of EPA Landfill Monitoring Manual 2003, and at other locations to do indicator parameters such as ph Conductivity, temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium.	Will depend on nature and variability of soil material around waste body and number of investigation points. Initially three disturbed samples should be taken and tested for soil type, particle size, permeability and strength, refer to BS 5930 standard.	Nearest or local downgradient locations should be considered for exploratory sampling. Basic indicator parameters such as ph Conductivity, temp, BOD, Ammonia, Chloride, sulphate, sodium and potassium should be completed as a minimum.	A topographical survey should be considered for the site area and immediate environs of low risk sites and is recommended for all moderate and high risk sites. GPS survey locations as required.	

M = Mandatory and should be completed as thoroughly as possible for each site.

R = Recommended technique assuming site conditions allow.

S = Should be considered but is dependent on site suitability for that methodology.

ISSUED WORKING DRAFT

DATE:17th September 2009

COMPILED BY WYG

Appendix 3

Trial Pit and Gas Well Logs

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-1

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 4.2m

Groundwater entry: 2.15m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1				
	Waste Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix. Water entry in hole noted at 2.15m.		Composite Sample	0ppm
2				
3				
4	***Clay*** Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 21/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-2

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 3.4m

Groundwater entry: 2.9m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1				
	Waste Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
2	Water entry in hole noted at 2.9m.		Composite Sample	0ppm
3				
	Clay Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			
4				

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 21/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-3

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 4.7m

Groundwater entry: 2.4m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix. Water entry in hole noted at 2.4m.		Composite Sample	19ppm
2				
3				
4				
	Clay Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			
5				

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 21/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-4

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 4.6m

Groundwater entry: 3.2m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
	Water entry in hole noted at 3.2m.		Composite Sample	1ppm
2				
3				
4				
	Clay Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			
5				

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 21/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-5

Project: 09-039-01 | Completion Depth: 5.7m

Client: Cork County Council | Groundwater entry: 4.5m

Location: Dunmanway | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.		Composite Sample	0ppm
1				
2				
3	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
	Water entry in hole noted at 4.5m.			
4	Base of waste not reached due to collapse of pit walls.			
5				
6				

Excavation Method: 13 Tonne Track Mounted Excavator | Geologist: B. Sexton

Excavation Date: 21/10/2009 | Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-6

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 6.3m

Groundwater entry: 3.6m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
2	Water entry in hole noted at 3.6m.		Composite Sample	2ppm
3				
4				
5				
6				
	Clay Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			
7				

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 21/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-7

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 4.4m

Groundwater entry: 2.6m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix. Water entry in hole noted at 2.6m.		Composite Sample	0ppm
2				
3				
4	***Clay*** Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			
5				

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 22/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-8

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 6.1m

Groundwater entry: 3.5m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
	Water entry in hole noted at 3.5m.		Composite Sample	1ppm
2				
3				
4				
5				
6	***Clay*** Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			
7				

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 22/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-9

Project: 09-039-01 | Completion Depth: 5.1m

Client: Cork County Council | Groundwater entry: 2.1m

Location: Dunmanway | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1				
2	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix. Water entry in hole noted at 2.1m.		Composite Sample	0ppm
3				
4				
5	***Clay*** Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			

Excavation Method: 13 Tonne Track Mounted Excavator | Geologist: B. Sexton

Excavation Date: 22/10/2009 | Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-10

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 6.1m

Groundwater entry: 2.1m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
	Water entry in hole noted at 2.1m.			
2	Base of waste not reached due to collapse of hole.		Composite Sample	5ppm
3				
4				
5				
6				

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 22/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-11

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 5.4m

Groundwater entry: 2.1m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.		Composite Sample	0ppm
2	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix. Water entry in hole noted at 2.1m.			
5	***Clay*** Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			
6				

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 22/10/2009

Sheet: 1 of 1

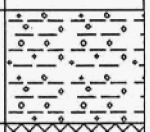
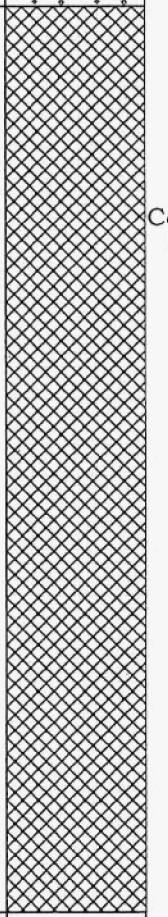
O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-12

Project: 09-039-01 | Completion Depth: 6.3m

Client: Cork County Council | Groundwater entry: 3.3m

Location: Dunmanway | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface		Composite Sample	6ppm
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
2	Water entry in hole noted at 3.3m.			
	Base of waste not reached due to collapse of hole.			
3				
4				
5				
6				

Excavation Method: 13 Tonne Track Mounted Excavator | Geologist: B. Sexton

Excavation Date: 22/10/2009 | Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-13

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 6.1m

Groundwater entry: 3.6m

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
2	Water entry in hole noted at 3.6m.		Composite Sample	0ppm
3				
4				
5				
6	***Clay*** Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 22/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-14

Project: 09-039-01 | Completion Depth: 6m

Client: Cork County Council | Groundwater entry: 2.6m

Location: Dunmanway | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
2	Water entry in hole noted at 2.6m.		Composite Sample	0ppm
3				
4				
5				
6	***Clay*** Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			
7				

Excavation Method: 13 Tonne Track Mounted Excavator | Geologist: B. Sexton

Excavation Date: 22/10/2009 | Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-15

Project: 09-039-01

Client: Cork County Council

Location: Dunmanway

Completion Depth: 5.7m

Groundwater entry: -

SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1				
2	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.		Composite Sample	0ppm
3				
4				
5				
6	***Clay*** Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			

Excavation Method: 13 Tonne Track Mounted Excavator

Geologist: B. Sexton

Excavation Date: 22/10/2009

Sheet: 1 of 1

O'Callaghan Moran & Associates
Phone: 021-4321521 Fax: 021-4321522

Trial Pit Number: TP-16

Project: 09-039-01 | Completion Depth: 5m

Client: Cork County Council | Groundwater entry: 3.1m

Location: Dunmanway | SWL (m):

Depth (m)	Lithology Description	Lithology	Soil Sample Depth (m)	PID Readings (ppm)
0	Ground Surface			
	Soil and Stones Brown and grey sandy gravelly Clay. Cobbles throughout.			
1	***Waste*** Domestic waste including papers, plastics, glass, wiring, concrete fragments, steel fragments, timber supported in a sandy gravely clay matrix.			
2	Water entry in hole noted at 3.1m.		Composite Sample	7ppm
3				
4				
5	***Clay*** Brown firm Clay. Clay has a high portion of rootlets and organic material. Original ground. This layer was noted to be dry.			
6				
7				

Excavation Method: 13 Tonne Track Mounted Excavator | Geologist: B. Sexton

Excavation Date: 22/10/2009 | Sheet: 1 of 1

PRELIMINARY

Borehole Log

GEOTECH

Drilled MN Logged Checked	Start 24/11/2009 End 24/11/2009	Equipment, Methods and Remarks Casagrande C6 Rotary Open Hole 175mm diameter from 0.00m to 3.00m. 50mm standpipe installed.	Depth from 0.00m to 3.00m Diameter 175mm Casing Depth 2.00m	Ground Level - Coordinates - National Grid - Chainage

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
			24/11/2009 2.00	1800 0.00

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Driller Reports: MADE GROUND - Fill.	(0.50)		
Driller Reports: MADE GROUND - Waste landfill.	0.50		1
	(2.30)		SP
Driller Reports: PEAT.	2.80		
EXPLORATORY HOLE ENDS AT 3.00 m	3.00		

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	0.50	-	-

Depth Related Remarks *

From	to (m)	
0.00	3.00	Flush type: Air.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

AGS

Project: Landfill SI at Dunmanway & Clonakilty

Project No.: KC9075

Carried out for: Cork County Council

Borehole

BH01 - D

Sheet 1 of 1

PRELIMINARY

Borehole Log

GEOTECH

Drilled MN Logged Checked	Start 24/11/2009 End 24/11/2009	Equipment, Methods and Remarks Casagrande C6 Rotary Open Hole 175mm diameter from 0.00m to 3.00m. 50mm standpipe installed.	Depth from 0.00m to 3.00m Diameter 175mm Casing Depth 3.00m	Ground Level - Coordinates - National Grid - Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
			24/11/2009 3.00	1800 0.20

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Driller Reports: MADE GROUND - Fill.	(0.60)		
Driller Reports: MADE GROUND - Waste landfill.	0.60		1
	(2.40)		
EXPLORATORY HOLE ENDS AT 3.00 m	3.00		SP

Depth	Type & No	Records	Date Casing	Time Water

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	0.70	-	-

Depth Related Remarks *

From	to (m)	
0.00	3.00	Flush type: Air.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

AGS

Project	Landfill SI at Dunmanway & Clonakilty
Project No.	KC9075
Carried out for	Cork County Council

Borehole

BH02 - D

Sheet 1 of 1

PRELIMINARY

Borehole Log

GEOTECH

Drilled MN Logged Checked	Start 24/11/2009 End 24/11/2009	Equipment, Methods and Remarks Casagrande C6 Rotary Open Hole 175mm diameter from 0.00m to 2.00m. 50mm standpipe installed.	Depth from 0.00m to 2.00m Diameter 175mm Casing Depth 2.00m	Ground Level - Coordinates - National Grid - Chainage	

Samples and Tests

Depth	Type & No	Records	Date Casing	Time Water
2.00			24/11/2009	1600 0.00

Strata

Description	Depth, Level (Thickness)	Legend	Backfill/ Instruments
Driller Reports: MADE GROUND - Fill.	(0.70)		
Driller Reports: MADE GROUND - Ash, CLAY and GRAVEL.	0.70 (1.30)		
EXPLORATORY HOLE ENDS AT 2.00 m	2.00		SP

Groundwater Entries

No.	Struck (m)	Post strike behaviour	Depth sealed (m)
1	0.00	-	-

Depth Related Remarks *

From	to (m)	
0.00	2.00	Flush type: Air.

Chiselling

Depths (m)	Time	Tools used

Notes: For explanation of symbols and abbreviations see key sheet. All depths and reduced levels in metres. Stratum thickness given in brackets in depth column.

Scale 1:50

AGS

Project: Landfill SI at Dunmanway & Clonakilty

Project No.: KC9075

Carried out for: Cork County Council

Borehole

BH03 - D

Sheet 1 of 1

Appendix 4

Full Laboratory Reports

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/023/03
		Date of Receipt	23/10/2009
		Date Testing Commenced	23/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway Leachate 1 22/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia	114	Colorimetry	47.93	mg/L as N	
Arsenic	177	ICPMS	2.2	ug/L	
Atrazine	191	HPLC	<0.01	ug/L	
BOD	113	Electrometry	11	mg/L	
Boron	177	ICPMS	309.3	ug/L	
Cadmium	177	ICPMS	<0.09	ug/L	
Calcium	184	ICPMS	136.00	mg/L	
Chloride	100	Colorimetry	904.61	mg/L	
Chromium	177	ICPMS	2.5	ug/L	
COD	107	Colorimetry	121	mg/L	
Conductivity	112	Electrometry	4160.0	uscm -1@25C	
Copper	177	ICPMS	4.1	ug/L	
Cyanide	138	Colorimetry	<5	ug/L	
Dichloromethane	154	GCMS	<1	ug/L	
Fluoride	115	Colorimetry	0.51	mg/L	
Iron (Total)	177	ICPMS	32890.0	ug/L	
Lead	177	ICPMS	5.5	ug/L	
Magnesium	184	ICPMS	21.30	mg/L	
Manganese	177	ICPMS	1827.0	ug/L	
Mercury	178	ICPMS	0.04	ug/L	
Nickel	177	ICPMS	5.4	ug/L	
Nitrogen (Total Oxidised)	151	Colorimetry	<0.03	mg/L as N	
pH	110	Electrometry	6.8	pH Units	
Phosphate (Ortho)	117	Colorimetry	<0.005	mg/L as P	
Potassium	184	ICPMS	37.80	mg/L	

Signed : DHeslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C

Results contained in this report relate only to the samples tested

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/023/03
		Date of Receipt	23/10/2009
		Date Testing Commenced	23/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway Leachate 1 22/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Simazine	191	HPLC	<0.01	ug/L	
Sodium	184	ICPMS	652.00	mg/L	
Sulphate	119	Colorimetry	3.16	mg/L as SO4	
Toluene	179	GCMS	<0.28	ug/L	
Tributyltin	0	GCMS	<1.5	ug/L as Sn	
Xylene (Total)	179	GCMS	<1	ug/L	
Zinc	177	ICPMS	35.7	ug/L	

Signed : Donna Heslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C

Results contained in this report relate only to the samples tested

• Subcontracted

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/023/04
		Date of Receipt	23/10/2009
		Date Testing Commenced	23/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway Leachate 2 22/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia	114	Colorimetry	65.78	mg/L as N	
BOD	113	Electrometry	18	mg/L	
Chloride	100	Colorimetry	67.17	mg/L	
Conductivity	112	Electrometry	1863.0	uscm -1@25C	
pH	110	Electrometry	6.7	pH Units	
Potassium	184	ICPMS	29.20	mg/L	
Sodium	184	ICPMS	33.20	mg/L	
Sulphate	119	Colorimetry	<1.39	mg/L as SO4	

Signed : D Heslin

Donna Heslin - Laboratory Manager

Date : 12/11/09

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C

Results contained in this report relate only to the samples tested

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland

Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/023/05
		Date of Receipt	23/10/2009
		Date Testing Commenced	23/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway SW1 22/10/09	*Sample Type*	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Alkalinity (Surface Water)	102	Colorimetry	14	mg/L CaCO3	UKAS
Ammonia (Surface Water)	114	Colorimetry	0.064	mg/L as N	UKAS
Arsenic (Surface Water)	177	ICPMS	0.4	ug/L	UKAS
Atrazine	191	HPLC	<0.01	ug/L	
BOD (Surface Water)	113	Electrometry	<2	mg/L	UKAS
Boron (Surface Water)	177	ICPMS	157.7	ug/L	UKAS
Cadmium (Surface Water)	177	ICPMS	<0.01	ug/L	UKAS
Calcium	184	ICPMS	10.80	mg/L	
Chloride (Surface Water)	100	Colorimetry	11.62	mg/L	UKAS
Chromium (Surface Water)	177	ICPMS	0.8	ug/L	UKAS
COD (Surface Water)	107	Colorimetry	9	mg/L	UKAS
Coliforms (Faecal)	140	Filtration/ Incubation 44C/ 24	110	no/ 100ml	
Coliforms (Total)	140	Filtration/ Incubation 37C/ 24	400	no/ 100ml	
Conductivity (Surface Water)	112	Electrometry	85	uscm -1@25C	UKAS
Copper (Surface Water)	177	ICPMS	3.1	ug/L	UKAS
Cyanide	138	Colorimetry	<5	ug/L	
Dichloromethane	154	GCMS	<1	ug/L	
Fluoride (Surface Water)	115	Colorimetry	0.08	mg/L	UKAS
Iron (Surfacewater)	177	ICPMS	448	ug/L	UKAS
Lead (Surface Water)	177	ICPMS	1.4	ug/L	UKAS
Magnesium	184	ICPMS	1.30	mg/L	
Manganese (Surface Water)	177	ICPMS	58.7	ug/L	UKAS
Mercury	178	ICPMS	<0.02	ug/L	
Nickel (Surface Water)	177	ICPMS	0.9	ug/L	UKAS
Nitrogen (Total Oxidised) (Surface	151	Colorimetry	0.53	mg/L as N	UKAS

Signed : DHeslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C

Results contained in this report relate only to the samples tested

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/023/05
		Date of Receipt	23/10/2009
		Date Testing Commenced	23/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway SW1 22/10/09	*Sample Type*	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
pH (Surface Water)	110	Electrometry	7	pH Units	UKAS
Phosphate (Ortho) Surface Water	117	Colorimetry	0.018	mg/L as P	UKAS
Potassium	184	ICPMS	1.60	mg/L	
Simazine	191	HPLC	<0.01	ug/L	
Sodium	184	ICPMS	10.60	mg/L	
Solids (Total Dissolved)	105	Filtration/ Evaporation @ 180	<5	mg/L	
Solids (Total Suspended)	106	Filtration/ Drying @ 104C	5	mg/L	
Sulphate	119	Colorimetry	1.64	mg/L as SO4	
Toluene	179	GCMS	<0.28	ug/L	
Total Organic Carbon	316	TOC analyser (NPOC)	6.57	mg/L	
Tributyltin*	0	GCMS	<0.02	ug/L as Sn	
Xylene (Total)	179	GCMS	<1	ug/L	
Zinc (Surface Water)	177	ICPMS	1	ug/L	UKAS

Signed : D Heslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C

Results contained in this report relate only to the samples tested

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland

Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/023/06
		Date of Receipt	23/10/2009
		Date Testing Commenced	23/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway SW2 22/10/09	*Sample Type*	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia (Surface Water)	114	Colorimetry	0.032	mg/L as N	UKAS
BOD (Surface Water)	113	Electrometry	<2	mg/L	UKAS
Chloride (Surface Water)	100	Colorimetry	14.49	mg/L	UKAS
Conductivity (Surface Water)	112	Electrometry	99	uscm -1@25C	UKAS
pH (Surface Water)	110	Electrometry	6.5	pH Units	UKAS
Potassium	184	ICPMS	1.30	mg/L	
Sodium	184	ICPMS	5.30	mg/L	
Sulphate	119	Colorimetry	2.06	mg/L as SO4	

Signed : DHeslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/023/07
		Date of Receipt	23/10/2009
		Date Testing Commenced	23/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway SW3 22/10/09	*Sample Type*	Surface Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia (Surface Water)	114	Colorimetry	<0.01	mg/L as N	UKAS
BOD (Surface Water)	113	Electrometry	<2	mg/L	UKAS
Chloride (Surface Water)	100	Colorimetry	11.37	mg/L	UKAS
Conductivity (Surface Water)	112	Electrometry	80	uscm -1@25C	UKAS
pH (Surface Water)	110	Electrometry	6.6	pH Units	UKAS
Potassium	184	ICPMS	1.60	mg/L	
Sodium	184	ICPMS	6.40	mg/L	
Sulphate	119	Colorimetry	1.61	mg/L as SO4	

Signed : D Heslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C
Results shall not be reproduced, except in full, without the approval of EURO environmental services
Results contained in this report relate only to the samples tested

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/024/01
		Date of Receipt	28/10/2009
		Date Testing Commenced	28/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway Leachate 3 22/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia	114	Colorimetry	77.18	mg/L as N	
Arsenic	177	ICPMS	8	ug/L	
BOD	113	Electrometry	22	mg/L	
Boron	177	ICPMS	500	ug/L	
Cadmium	177	ICPMS	<0.1	ug/L	
Calcium	184	ICPMS	146	mg/L	
Chloride	100	Colorimetry	63.20	mg/L	
Chromium	177	ICPMS	<1	ug/L	
Conductivity	112	Electrometry	1850	uscm -1@25C	
Copper	177	ICPMS	0	ug/L	
Iron (Total)	177	ICPMS	94570	ug/L	
Lead	177	ICPMS	15	ug/L	
Magnesium	184	ICPMS	28	mg/L	
Manganese	177	ICPMS	4754	ug/L	
Mercury	178	ICPMS	0.03	ug/L	
Nickel	177	ICPMS	6	ug/L	
pH	110	Electrometry	6.7	pH Units	
Potassium	184	ICPMS	42.9	mg/L	
Sodium	184	ICPMS	41.4	mg/L	
Sulphate	119	Colorimetry	<1.39	mg/L as SO4	
Zinc	177	ICPMS	14	ug/L	

Signed : DHeslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C

Results contained in this report relate only to the samples tested

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/024/02
		Date of Receipt	28/10/2009
		Date Testing Commenced	28/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway Leachate 4 22/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia	114	Colorimetry	92.02	mg/L as N	
BOD	113	Electrometry	75	mg/L	
Chloride	100	Colorimetry	61.52	mg/L	
Conductivity	112	Electrometry	2280	uscm -1@25C	
pH	110	Electrometry	6.7	pH Units	
Potassium	184	ICPMS	64.5	mg/L	
Sodium	184	ICPMS	51.1	mg/L	
Sulphate	119	Colorimetry	3.25	mg/L as SO4	

Signed : DHeslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C

Results contained in this report relate only to the samples tested

EURO
environmental
services

Environmental Science & Management
Water,Soil & Air Testing

Unit 35,
Boyne Business Park,
Drogheda,
Co. Louth
Ireland
Tel: +353 41 9845440
Fax: +353 41 9846171
Web: www.euroenv.ie
email info@euroenv.ie

A copy of this certificate is available on www.euroenv.ie

Customer	Kieran Coffey Cork County Council Inniscarra Waterworks Iniscarra Co Cork	*Lab Report Ref. No.*	1128/024/03
		Date of Receipt	28/10/2009
		Date Testing Commenced	28/10/2009
		Received or Collected	Courier: Brefni
		Condition on Receipt	Acceptable
Customer PO	430521	*Date of Report*	12/11/2009
Customer Ref	Dunmanway Leachate 5 22/10/09	*Sample Type*	Water

CERTIFICATE OF ANALYSIS

Test Parameter	SOP	Analytical Technique	Result	Units	Acc.
Ammonia	114	Colorimetry	19.68	mg/L as N	
BOD	113	Electrometry	22	mg/L	
Chloride	100	Colorimetry	24.04	mg/L	
Conductivity	112	Electrometry	1404	uscm -1@25C	
pH	110	Electrometry	6.8	pH Units	
Potassium	184	ICPMS	16.9	mg/L	
Sodium	184	ICPMS	15.6	mg/L	
Sulphate	119	Colorimetry	4.48	mg/L as SO4	

Signed : DHeslin *Date :* 12/11/09

Donna Heslin - Laboratory Manager

Acc. : Accredited Parameters by ISO 17025:2005

All organic results are analysed as received and all results are corrected for dry weight at 104 C
Results shall not be reproduced, except in full, without the approval of EURO environmental services
Results contained in this report relate only to the samples tested

Appendix 5

DUNMANWAY SITE SURVEY


I. N. G.
NORTH
NOTES
LEGEND
FOCUS
TOPOGRAPHICAL SITE SURVEY.
DUNMANWAY LANDFILL SITE
DUNMANWAY, Co. CORK.
ENVIRONMENT DIRECTORATE
CORK COUNTY COUNCIL.
SCALE
SURVEYED BY
DATE
DRAWN BY
DATE
CHECKED BY

Appendix 6

DUNMANWAY ECOLOGY SURVEY

Habitat Assessment of Dunmanway Landfill Site

Habitat assessment and biological water quality analysis of Dunmanway Landfill

Doherty Environmental

December, 2009

Table of Contents

Introduction 2
1 Section 1 2
1.1 Methodology 2
1.1.1 Ecological Evaluation 2
1.2 Receiving Environment 4
1.3 Field Survey Results 5
1.3.1 Grassland 5
1.3.2 Woodland and Scrub 5
1.3.3 Exposed Rock and Bare Ground 6
1.4 Site Evaluation 6
2 Section 2 7
2.1 Dirty River Water Quality 7
3 Conclusions 9

Introduction

Doherty Environmental has been commissioned by Cork County Council to undertake a habitat assessment and a review of biological water quality analysis of the disused Dunmanway Landfill and the Dirty River, Co. Cork. The purpose of this assessment is to provide baseline information on the habitats supported by the former landfill site and evaluate the water quality of the Dirty River.

This report is presented in two sections. Section 1 presents the results of the baseline phase 1 habitat survey undertaken on site, while Section 2 outlines the results of the water quality analysis.

1 Section 1

The purpose of the habitat survey was to:

- review the site history and summarise the results of previous ecological studies/records undertaken at the site;
- identify the habitats supported by the site; and
- identify the existing fauna of the site.

The scope of the following assessment follows the guidance outlined in Appendix 4 of *Environmental Protection Agency's* (EPA) *Code of Practice for Environmental Risk Assessment for Unregulated Waste Disposal.*

1.1 Methodology

The basis for this assessment was a Phase 1 Habitat Survey, undertaken in accordance with the *Heritage Council's "A Guide to Habitats in Ireland"* (Fossit, 2000) and the *"Draft Habitat Survey Guidelines"* (Hertiage Council, 2002). The *Guide to Habitats in Ireland* classifies habitats according to a hierarchical framework with Level 1 habitats representing broad habitat groups, Level 2 representing habitat sub-groups and Level 3 representing individual habitats. The field survey focused on identifying Level 3 habitats. The DAFOR scale was also used to characterise the vegetation within each habitat. This scale refers to plant species in terms of dominance, abundance, frequency, occasional and rare (DAFOR). In addition any evidence or records of fauna activity within or adjacent to the site were also noted during the survey, which was undertaken in December, 2009. It is noted that the timing of the field survey was undertaken outside the optimal season for undertaking habitat surveys.

1.1.1 Ecological Evaluation

The evaluation of the ecological resource was assessed according to the National Roads Authority's *Site Evaluation Scheme* (outlined in *Table 1* below) as described in the NRA's *Guidelines for the Assessment of Ecological Impacts of National Road Schemes.* These criteria evaluate the significance of an ecological resource within a defined geographical context. The Institute of Ecology and Environmental Management's (IEEM) *Guidelines for Ecological Impact Assessment* and the *Ratcliffe Criteria*, which also evaluate ecological resources according to a

defined geographical context were also taken in account during the baseline ecological evaluation.

Table 1 *Site Evaluation Scheme*

Rating	Qualifying Criteria
A	**Internationally Important** Site designated (or qualifying for designation) as Special Area of Conservation (SAC) or Special Protection Area (SPA) under the EU Habitats or Birds Directives. Undesignated sites containing good examples of Annex I priority habitats under the EU Habitats Directive. Major salmon river fisheries. Major salmonid (salmon, trout or char) lake fisheries.
B	**Nationally Important** Sites or waters designated or proposed as an Natural Heritage Area (NHA) or statutory Nature Reserves. Undesignated sites containing good examples of Annex I habitats (under EU Habitats Directive). Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive or species protected under the Wildlife (Amendment) Act 2000. Major trout river fisheries. Water bodies with major amenity fishery value. Commercially important coarse fisheries.
C	**High Value, locally important** Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or significant populations of locally rare species.

Rating	Qualifying Criteria
	Small water bodies with known salmonid populations or with good potential salmonid habitat. Sites containing any resident or regularly occurring populations of Annex II species under the EU Habitats Directive or Annex I species under the EU Birds Directive. Large water bodies with some coarse fisheries value.
D	**Moderate Value, locally important** Sites containing some semi-natural habitat or locally important for wildlife. Small water bodies with some coarse fisheries value or some potential salmonid habitat. Any water body with unpolluted water (Q-value rating 4-5).
E	**Low Value, locally important** Artificial or highly modified habitats with low species diversity and low wildlife value. Water bodies with no current fisheries value and no significant potential fisheries value

1.2 Receiving Environment

The disused landfill site is located to the southwest of the centre of Dunmanway town (G.R. V12285 52345). The site is located at approximately 70m OD Malin and is located approximately 40m to the south of the Dirty River. The land cover to the north of the site is characterised by wet grassland and marsh habitats. These habitats are located along the riparian zone of the Dirty River and are characterised by a high water table. The land cover the east and south of the site is characterised by built urban land. The soils are characterised by peaty podzols and mineral alluvium. The sub-soils are characterised by Devonian sandstone and undifferentiated alluvium.

The land cover within the site is dominated by spreading scrub habitats and semi-natural grassland habitats. The previous deposition of landfill within the site has changed the topography of the site with a steep embankment present towards the north of the site. This

embankment is a bund which separates the site from the wetland habitats occurring further to the north of the site.

1.3 Field Survey Results

The terrestrial habitats recorded within the survey area are presented in the Habitat Map, *Figure 1.* Three broad (Level 1) habitat groups were identified within the site area:

1. Grassland
2. Woodland & Scrub; and
3. Exposed Rock and Disturbed Ground.

Each of the broad habitats and the individual habitats (Level 3 habitats) making up these broad groups are described below. Habitats that represent a transition between two individual habitats will be described in the text below under the Level 3 habitat that they most resemble and details of such transitions will be outlined.

1.3.1 Grassland

The grassland habitats identified within the site have been classified as:

- Dry meadow and grassy verges (GS2)
- Wet grassland (GS4)

The dry meadow habitat occurs to the south of the site. The absence of ongoing management of this habitat has led to the establishment of a high sward characterised by tussock grass species such as Yorkshire fog (*Holcus lanatus*), Cock' foot (*Dactylis glomerata*) and false oat-grass (*Arrhenatherum elatius*).

The wet grassland habitat occurs to the north of the site. This habitat was inundated during the habitat survey. A dominance of soft rush (*Juncus effusus*) was noted within this habitat.

1.3.2 Woodland and Scrub

The woodland and scrub habitats identified within the site have been classified as:

- Scrub (WS1)
- Treeline

Immature scrub is the dominant habitat occurring within northern and section of the site. This scrub is characterised by spreading gorse (*Ulex europeaus*) and willow (*Salix sp.*) species. Recent vegetation clearance has reduced the overall cover of this habitat. An area of established scrub dominated by willow species occurs to the east of the site entrance. A mature stand of conifers occurs to the west of this site while a stand of immature birch (*Betula sp.*) is located to the south of the site.

A coniferous treeline consisting of Leyland cypress (*Cupressocyparis leylandii*) occurs along the southern boundary of the site. A second birch treeline also occurs within the centre of the site.

1.3.3 Exposed Rock and Bare Ground

The exposed rock and bare ground habitats identified within the site have been classified as:

- Spoil and bare ground (ED2)

Recent disturbance to the site has resulted in the removal of much of the site's vegetation, with resultant bare ground dominating areas of the site. No vegetation is associated with this habitat.

1.4 Fauna

1.4.1 Mammals

No records or evidence of mammal activity was recorded on site. The mature trees and the shed occurring within the site were assessed for their potential to support roosting bats. The trees were examined for features used by bats for roosting. These features include crevices, hollows, ivy cover and limb fractures. The trees occurring within the site boundaries did not display such features and it is considered that these trees are unlikely to support roosting bat species.

The shed occurring within the site does not display features typically associated with a bat roost structure. This shed is of limited potential for supporting roosting bats and is likely to support at most day roosting bat species.

While no evidence of otters (*Lutra lutra*) was recorded during the field survey, the Bandon River system is known to support populations of otter. It is considered likely that otters foraging along the Dirty River adjacent to the site.

The site was surveyed for field signs indicating the presence of badgers. These field signs, as described by Neal & Cheeseman (1996) include prints, pathways, setts, latrines, hairs and scratch marks. No evidence was noted during the field survey.

The area surrounding the site has the potential to support a range of small mammal species such as hedgehog and pygmy shrew.

The following bird species were recorded on site: hooded crow (*Corvus corone cornix*), jackdaw (*Corvus monedula*), robin (*Erithacus rubecula*), wren (*Troglodytes troglodytes*), pigeon (*Columbus palumba*), stonechat (*Saxicola torquata*), chaffinch (*Tringella coelebs*) and blackbird (*Turdus merula*).

No amphibians or signs indicating the presence of amphibian species were recorded on site. However the presence of wet grassland within and adjacent to the site and the presence of marsh habitats to the north of the site increases the likelihood for amphibians to occur within and adjacent to the site.

1.5 Site Evaluation

The site supports a mosaic of habitats that provide support for a range of fauna species. The high sward associated with the dry meadow to the south of the site is likely to support a range of invertebrate species and also offers shelter for foraging small mammals such as hedgehog and pygmy shrew. The wet grassland to the north of the site is dominated by soft rush. This habitat

is likely to support a diverse range of floral and invertebrate species. However, the timing of the survey and the high water levels prevented the survey from recording the range of species associated with this habitat.

The immature scrub, stand of immature birch and coniferous treelines provides ideal habitat for nesting bird species.

The bare ground habitats are of low ecological value and is of limited value for supporting faunal species.

Overall, due to the presence of established and immature scrub, the occurrence of wetland habitats such as wet grassland and the potential for these habitats to support a range of fauna species the site is considered to be of moderate ecological value.

2 Section 2

2.1 Dirty River Water Quality

The Dirty River is located 40m to the north of the Dunmanway Landfill site. The Dirty River is a tributary of the Bandon River.

No biological sampling of the Dirty River was undertaken during the Habitat Assessment as spate conditions preventing such sampling from being undertaken.

The remainder of this Section provides a review of the biological status of the Dirty River. This review has been compiled from a number of published and unpublished documents which provide information on the biological status of the Dirty River. The following key sources were consulted during the compilation of this review:

- Dunmanway Wastewater Treatment Plant Discharge License Application;
- Dunmanway Wastewater Treatment Plant EIS;
- Freshwater Pearl Mussel Draft Bandon Sub-Basin Management Plan; and
- EPA reports on Biological Water Quality.

The Environmental Protection Agency undertakes regular biological water monitoring at three sampling stations along the Dirty River. Two of these station (at Sillahertane Bridge and the bridge northwest of Tonafona) are located upstream of the Dunmanway Landfill site. The third station is located downstream of the landfill site at a bridge upstream of the confluence with the Bandon River. *Table 2.1* below provides the results of EPA biological water quality assessments at these stations from 1978 to 2006.

Table 2-1: Q-values at EPA Monitoring Stations along the Dirty river 1978 - 2006

Site Name	EPA Station Code	1978	1982	1986	1989	1994	1997	2000	2003	2006
Sillahertane Bridge	20DO010005	-	-	-	4	4	4	4	4	4

Bridge NW of Tonafona	20DO010050	-	3 – 4	3 – 4	3	4	4	4	3 – 4	4
Bridge upstream of Bandon River	20DO010100	3 – 4	3 – 4	3 – 4	3 – 4	4	4	3 – 4	4	4

Previous decreases in water quality at the downstream site (i.e. Q 3 – 4 in 2000) were considered to be related to overflows at a discharge outfall from the Quarry Road Pumping Station. Other influences, such as road run-off and small direct discharges from point sources were noted for their potential to adverse affect the water quality of the Dirty River. In 2003 the results of water quality analysis were reversed with a Q-value of 3 – 4 being assigned at the Tonafona monitoring station, while a Q-value of 4 was assigned at the downstream site. However, following the latest Q-value analysis of the river, undertaken in 2006, the EPA assessments concluded that the status of the Dirty River was satisfactory throughout following improvements at the second monitoring station i.e. at the Bridge northwest of Tonafona.

The results of recent physico-chemical surface water analysis recorded increases in ammonia downstream of the landfill site (see Cork County Council's Tier II Exploratory Investigation Report). Under the Freshwater Fish Directive (78/659/EEC) the maximum admissible concentrations (I/MAC value) for ammonia (mg/l N) is 0.02. The concentrations recorded at SW1 and SW2 were 0.064 and 0.032 mg/l N respectively. Both of these sampling points where were located downstream of the landfill site. The results of the analysis for the upstream monitoring site recorded levels of ammonia within the EQSs for Surface Waters.

In aqueous solutions ammonia comprises two discrete aqueous species: free ammonia or unionised ammonia (NH_3) and ionised ammonia or ammonium (NH_4). The relative concentrations of ionised and unionised ammonia in a given solution are a function mainly of pH, temperature and ionic strength of the aqueous solution. As pH increases, the equilibrium is shifted towards the un-ionised species and the concentration of NH_3 increases while that of NH_4 decreases. For example a pH increase from 7.0 to 8.0 in the temperature range 0°C to 30°C results in a nearly tenfold increase in the concentration of NH_3. It has been shown that the un-ionised species of ammonia is most harmful to freshwater aquatic life and to fish in particular (EPA, 1999). Acute exposure to elevated levels of NH_3 can cause gill ventilation, hyper-excitability and death to fish species. Chronic exposure can cause a decrease in growth, a decrease in reproductive capacity and an increased susceptibility to disease. Research data has indicated that ammonia can have adverse effects on aquatic life at relatively low concentrations. Chronic effects on the growth rate of Atlantic salmon were recorded when un-ionised ammonia exceeded 0.06 mg/NH_3 (Samylin, 1969).

The partitioning of NH_3 and NH_4 is critical for defining the ecotoxicological impact of any given ammonia concentration and, as such, a total ammonia reading in isolation provides only a generalised indicator of potential ecotoxicological risk. The partial contribution of un-ionised ammonia increases with increasing pH and temperature. The partitioning between the unionised ammonia and ammonium can be calculated once the pH and temperature values are known. However, as no values for temperature were provided for SW1 and SW2 at the time of writing, the level of un-ionised ammonia for these samples could not be calculated.

All other parameters recorded at the three sampling points were within the relevant EQSs for Surface Waters.

3 Conclusions & Recommendations

Due to the lack of information with regard to key physico-chemical parameters the potential impact of slightly elevated ammonia levels could not be quantified. Also as conditions were unsuitable for undertaking instream sampling during the field assessment no biological water quality analysis was undertaken at the three sampling points along the river. Due to a lack of first hand biological quality analysis only a review of existing water quality information could be undertaken at this time.

It is recommended that a habitat restoration and management plan be undertaken for the site. Opportunities for habitat enhancement exist particularly in areas now dominated by spoils and bare ground. Active habitat management of these areas will facilitate an increase in biodiversity on site. The establishment of the following habitats should be considered within the site:

- Woodland;
- Wildflower meadows; and
- Wetlands.

Habitat enhancement measures should be undertaken with reference to the EPA's Landfill Restoration and Aftercare Manual (1999). The planting of woodland tree species on landfills was previously not recommended due to uncertainty over tree survival and performance and fears that tree roots may damage clay caps or other types of impermeable covers (Rawlinson *et al.*, 2004). However it is now accepted that woodland habitats can be safely established on landfill sites as part of the restoration process. The results of research has concluded that tree planting on restored landfill sites can be undertaken where:

- a 1m deep clay cap compacted to a bulk density of 1.8 to 1.9 tonnes/m^3 achieving a hydraulic conductivity of 1 X 10^{-9} m/s is capable of preventing root penetration. It is noted that the clay cap at the Dunmanway landfill site is generally greater than 1m in depth.
- Suitable tree species are selected as part of the woodland habitat on the restored landfill. The following tree species are deemed to be unsuitable for woodland restoration of landfill sites: poplar (*Populus sp.*), crack willow (*Salix fragillis*) and white willow (*S. alba*). Research undertaken the UK by Rawlinson *et al* (2004) concluded that the following species of trees are suitable for woodland creation on landfill sites: ash (*Fraxinus excelsior*); oak (*Quercus petraea*); apple (*Malus sylvestris*); rowan (*Sorbus aucuparia*); sycamore (*Acer pseudoplatanus*); hawthorn (*Crategus monogyna*); alder (*Alnus glutinosa*); and blackthorn (*Prunus spinosa*).
- A 1m thick soil cover layer is established.

It is recommended that a detailed habitat survey of the site be undertaken during the summer months to catalogue the plant species occurring within and adjacent to the site. During this

survey specific areas should be identified for the establishment, where appropriate, of the above listed habitats.

Consideration should also be given to the establishment of habitat enhancement features for fauna such as the erection of bird boxes and bat boxes in suitable location. Also locally occurring plants which provide foraging resources for butterflies and other invertebrates should be included within any proposed planting lists.

Any planting associated with the establishment of these habitats should be sourced from native seed stocks and should replicate the local flora occurring within and adjacent to the site.

It is recommended that a biological water quality assessment is undertaken at the three survey points along the Dirty River as outlined in the Tier II Exploratory Investigation Report. Ideally this analysis should be undertaken during the optimal time period for undertaking aquatic macroinvertebrate surveys which is between June to September. Macroinvertebrate analysis at these locations will provide additional information on the potential impacts of any pollution arising from the landfill site.

References

Cork County Council (2009). *Tier II exploratory investigation report for Dunmanway Landfill.*

Environmental Protection Agency (EPA) (2002). *Landfill Manuals: Landfill Restoration and Aftercare.* Environmental Protection Agency.

Environmental Protection Agency (EPA) (2002). *Guidelines on the information to be contained in Environmental Impact Statements.* Environmental Protection Agency.

Environmental Protection Agency (EPA) (2003). *Advice notes on current practice in the preparation of Environmental Impact Statements.* Environmental Protection Agency.

Environmental Protection Agency (EPA) (2007). *Guidance Manual* for *Waste Facility Permit and Registration Regulations.*

Environmental Protection Agency (2006). 2005 River Water Quality Report: Annual report on biological quality of Irish Rivers. http://www.epa.ie/downloads/pubs/water/rivers

Fossitt J. A. (2000). *A Guide to Habitats in Ireland.* Heritage Council.

Heritage Council (2002). *Draft Habitat Survey Guidelines.* Hertiage Council.

McGarrigle, M.L. *et al* (2002). Water Quality in Ireland 1998 – 2000. Environmental Protection Agency.

National Roads Authority (NRA) (2006). Guidelines for the Assessment of Ecological Impacts of National Road Schemes.

Neal E. & Cheeseman C. (1996). *Badgers*. Poyser Natural History. London.

NS 2 (2009). *Draft Bandon sub-basin management plan.* DEHLG.

Rawlinson, H, Dickinson, N., Nolan, P. & Putwain, P. (2004). *Woodland establishment on old-style closed landfills in Northwest England.* Forest Ecology and Management. **202:** 265 – 280.

Samylin, A.F. (1969). *Effect of ammonium carbonate on the early stages of development of salmon. (*English translation). Uch. Zap. Leningr. Gos. Pedagog. Inst. Im. A.I. Gertsena 422: 47 – 62.

US Environmental Protection Agency. *Update of ambient water quality criteria for ammonia.* Washington, DC: EPA; 1999. 822/R-99-014.

Appendix 7

DUNMANWAY RE-RUN OF TIER I SPR LINKAGES

Risk Screening/ Prioritisation

Table 1a LEACHATE: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	1	1.5
Municipal	5	7	10
Industrial	5	7	10
Pre 1977 sites	1	2	3

1a =	5

Reduced from 7

Table 1b LANDFILL GAS: SOURC/HAZARD SCORING MATRIX			
	Waste FOOTPRINT (ha)		
WASTE TYPE	≤ 1ha	> 1 ≤ 5 ha	> 5ha
C&D	0.5	0.75	1
Municipal	5	7	10
Industrial	3	5	7
Pre 1977 sites	0.5	0.75	1

1b =	5

Reduced from 7

Table 2a : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER VULNERABILITY (Vertical Pathway)	Points
Extreme Vulnerability	3
High Vulnerability	2
Moderate Vulnerability	1
Low Vulnerability	0.5
High - Low Vulnerability (use where vulnerability not on GIS)	2

2a =	2

Table 2b : LEACHATE MIGRATION: PATHWAYS	
GROUNDWATER FLOW REGIME (Horizontal Pathway)	Points
Karstified Groundwater Bodies (Rk)	5
Productive Fissured Bedrock Groundwater Bodies (Rf & Lm)	3
Gravel Groundwater Bodies (Rg and Lg)	2
Poorly Productive Bedrock Groundwater Bodies (Ll, Pl, Pu)	1

2b =	1

Risk Screening/ Prioritisation

Table 2c : LEACHATE MIGRATION: PATHWAYS	
SURFACE WATER DRAINAGE (Surface water pathway)	**Points**
Is there a direct connection between drainage ditches associated with the waste body and adjacent surface water body? Yes	2
If no direct connection	0

2c =	**2**

Table 2d : LANDFILL GAS: PATHWAY	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	**Points**
Sand and Gravel, Made ground, urban, karst	3
Bedrock	2
All other Tills (including limestone, sandstone etc - moderate permabi	1.5
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2d =	**3**

Table 2e : LANDFILL GAS: PATHWAY (assuming receptor located above source)	
LANDFILL GAS LATERAL MIGRATION POTENTIAL	**Points**
Sand and Gravel, Made ground, urban, karst	5
Bedrock	3
All other Tills (including limestone, standstone etc - moderate permab	2
All Namurian or Irish Sea Tills (low permability)	1
Clay, Alluvium, Peat	1

2e =	**5**

Table 3a : LEACHAGE MIGRATION: *RECEPTORS*	
HUMAN PRESENCE (presence of a house indicaates potential private wells)	**Points**
On or within 50m of the waste body	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0

3a =	**2**

Risk Screening/ Prioritisation

Table 3b : LEACHAGE MIGRATION: RECEPTORS PROTECTED AREAS (SWDTE or GWDTE)	Points
Within 50m of waste body	3
Greater than 50m but less than 250m of the waste body	2
Greater than 250m but less than 1km from waste body	1
Greater than 1km of the waste body	0
Undesignated sites within 50m of waste body	1
Undesignated sites greater than 50m but less than 250m	0.5
Undesignated sites greater than 250m of the waste body	0

3b ⊟	1

Table 3c : LEACHAGE MIGRATION: *RECEPTORS*	
AQUIFER CATEGORY (resource potential)	Points
Regionally Important Aquifers (Rk, Rf, Rg)	5
Locally Important Aquifers (Ll, Lm, Lg)	3
Poor Aquifers (Pl, Pu)	1

3c ⊟	3

Table 3d : LEACHAGE MIGRATION: *RECEPTORS*	
PUBLIC WATER SUPPLIES (Other than private wells)	Points
Within 100m of site boundary	7
Greater than 100m but less than 300m or with in Inner SPA for GW supplies	5
Greater than 300m but less than 1km or within Outer SPA (SO) for GW supplies	3
Greater than 1km (karst aquifer)	3
Greater than 1km (no karst aquifer)	0

3d =	0

Table 3e : LEACHAGE MIGRATION: *RECEPTORS*	
SURFACE WATER BODIES	Points
Within 50m of site boundary	3
Greater than 50m but less than 250m	2
Greater than 250m but less than 1km	1
Greater than 1km	0

3e =	3

Increased from 2 due to floodplain

Risk Screening/ Prioritisation

Table 3f : LEACHAGE MIGRATION: *RECEPTORS*	
HUMAN PRESENCE	Points
On site or within 50m of site boundary	5
Greater than 50m but less than 150m	3
Greater than 150m but less than 250m	1
Greater than 250m	0.5

3f =	3

Note: The table below represents the Tier 1 risk rating for this site. SPR 1 to 9 represent the leachate risk scores. SPR 10 & 11 represent Landfill Gas risks. The migration pathways are colour coded as follows:

Groundwater & Surface Water	Groundwater only	Surface water only	Lateral & Vertical

Calculator	SPR Values	Maximum Score	Linkages	Normalised Score
SPR 1 =	75	300	Leachate => surface water	25%
SPR 2 =	25	300	Leachate => SWDTE	8%
SPR 3 =	30	240	Leachate => human presence	13%
SPR 4 =	15	240	Leachate => GWDTE	6%
SPR 5 =	45	400	Leachate => Aquifer	11%
SPR 6 =	0	560	Leachate => Surface Water	0%
SPR 7 =	45	240	Leachate => SWDTE	19%
SPR 8 =	30	60	Leachate => Surface Water	50%
SPR 9 =	10	60	Leachate => SWDTE	17%
SPR 10 =	45	150	Landfill Gas => Human Presence	30%
SPR 11 =	75	250	Landfill Gas => Human Presence	30%

Risk Classification	Range of Risk Scores
Highest Risk (Class A)	Greater than or equal to 70% for any individual SPR lingage
Moderate Risk (Class B)	Between 40-70% for any individual SPR linkage
Lowest Risk (Class C)	Less than or equal to 40% for any individual SPR linkage

OVERALL RISK RATING	MODERATE