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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

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:	Clountreem Landfill
Address*:	Castletownbere
	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	S22-02310

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

Grid Reference	68,880	**E**	47,310	**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	☐
Dredged Soil	☐
ELV/Scrap Metal	X
Hazardous	☐
Industrial	☐
Mining	☐
Municipal	☐
Municipal Sludge	X
Other	☐

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

Present on site	X
Not present on site	☐

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

Total waste quantity at the site:	116,000 tonnes

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

Start date	01/06/1975
End date	26/02/1999

C.3. Risk Category

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

Class A (High)	X
Class B (Moderate)	☐
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 situate.

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: _____

Position in organisation:_____

Co-Applicants

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

Print signature name: _____

Position in organisation:_____

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

Print signature name: _____

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 Clountreem Tier I report.

- **Attachment C.4:** Information in relation to the current use of the land can be found in the Clountreem 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 Clountreem Tier II report under – "On Site Investigations" – "Waste Characterisation". It is estimated that approximately 116,000 tonnes of waste have been deposited on this site.

- **Attachment D.1:** This can be found within the Clountreem 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: **Clountreem**
Site Reference: **07/W**
Division: **West Cork**
Area Office**: Castletownbere**

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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

Clountreem Landfill is situated nearly 1km North North East of Castletownbere. The landfill covers an area of almost 1.16ha. It is estimated the dept of waste could range between 6-8m.the site was purchased by Cork County Council in 1975. It operated as the main dump in the area for more than twenty years.

The site closed on 26th Feb 1999. The majority of waste deposited here is municipal. Some End of Life Vehicles (ELV), wastewater sludge's and sum quantities of asbestos roofing. Waste from the fish processing industry was disposed of here until it was banned in the early eighties. Following the incident at Whiddy Island 1979, material from the clean up was also deposited at the landfill.

It is believed that in the region of 1,330 tonnes of waste was deposited annually at the site. The waste was regularly levelled and a light soil capping applied. Once a year the waste was fully levelled and a soil capping placed on top of the waste. A stream flows beneath this landfill.

Tier I Study

Cork County Council completed a Tier I study on the landfill at Clountreem Landfill in February 2008 in accordance with the "Code of Practice Environmental risk Assessment for Unregulated Waste Disposal Sites (COP)" published by the Environmental Protection Agency (EPA).

The Assessment concluded that the site was a Class A – High Risk site, due to the potential for leachate migration to the local stream. As a result a Tier II Assessment was required.

Tier II Assessment

1. In October 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:

    - Waste was deposited throughout the whole site. The depth of the waste varied depending on areas where the rock was close to the surface. The depth ranged between 1m – 6.5m. A brown sandy gravel overlay the waste material (200-300mm). Beneath the waste a peaty material was found. This material was found not to be saturated, which suggests that it's providing an effective barrier between the waste and groundwater. In some parts of the landfill the waste is lying directly on weathered rock.

    - The stream flows beneath the landfill via a 600mm concrete pipe in a North East to South West direction. Following the testing of surface water samples it is evident that the landfill is having an adverse effect on water quality in the stream. Increases were found in Ammonia, Magnesium and Iron as well as Calcium, Sodium and Manganese. These increases were most evident upon the stream exiting the landfill.

    - The leachate results construe that the landfill is in late Stage IV or in Stage V of the bio- degradation process. Further testing off the water samples indicated that Iron and Manganese are naturally occurring in the Castletownbere area. The ecological survey undertaken by Doherty Environmental found the habitats on the site to be of low ecological value and low conservation importance.

- The major leachate pathway can be identified as being through the concrete pipe to the stream. An investigation of the pipes found cracks and leakages in the section above the manhole in the pipes joints. This is how the majority of the leachate is migrating into the stream.

Tier III Assessment – WYG

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 report concluded that:

The risk posed was high 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.

The Council appointed WYG Environmental (Ireland) Ltd, to carry out a Tier III Assessment and propose a remediation plan for Clountreem Landfill. Following a review of the findings from the Tier I & II carried out by the Council, WYG carried at a (DQRA) Detailed Quantitative Risk Assessment of the site.

- This allowed for a more site specific assessment of the risks posed to the nearby surface water receptors. The dilution factors of the three main contaminants were calculated based on the flow in the stream.

- All three were found to exceed the EPA EQS, therefore confirming that there is insufficient dilution capacity in the stream which flows beneath the waste mass.

- Downstream of the waste body, the water was found to display a rust coloured staining along with an odour. The Q rating for the stream was deemed to be 2-3 (poor status).

Site Remediation Plans

Remediation measures are necessary to prevent leachate entering the surface water and the potential for leachate generation on site. These measures are necessary to break the already identified Source-Pathway-Receptor linkages.

The remediation plan proposed by WYG includes:

1. Water Course Management
2. Capping
3. Leachate Collection & Treatment

Water Course Management

Since the stream currently travels beneath the waste body, one option would be to divert the stream around the waste mass. This would help eliminate the current high levels of contaminants entering the stream. Repairing or realignment of the existing drainage pipes was not considered due to access difficulties and the possibility of repairs failing in future years.

Capping

At present rainwater can easily percolate down through the waste body at Clountreem. This is contributing significantly to the high levels of leachate runoff from the landfill. Therefore a properly engineered cap is required to reduce the amount of rainfall seeping into the waste mass and eventually into the stream. Through installing an impermeable geo-membrane liner in concurrence with subsoil and topsoil a low permeable barrier would be formed reducing the leachate volumes currently being generated. However, given the topography of the site, some re-grading work may be necessary along with some surface water drainage works to prevent ponding. Some gas venting systems may also need to be incorporated into the remediation works.

Leachate Collection & Treatment

Leachate Collection and treatment would only become necessary should the capping and stream diversion works be already complete. The existing drainage pipe could be blocked at the downward end and act as a collection pipe. This would allow the leachate being generated to be either drained off into a containment area or maybe for removal and further treatment.

Attachment B.1

CK060515 O : Folio

Land Registry

County **CORK** **Folio** **60515**

Registered Owner:

THE COUNTY COUNCIL OF THE COUNTY OF CORK
COUNTY HALL
CORK

This is a reference sheet only in respect of the above-mentioned Folio.

The above-mentioned Folio is not available currently in electronic or imaged format. This Folio comprises a large number of entries of distinct or unrelated properties and it is available in paper format only.

You or your agent may inspect this Folio for free at the Public Counter in the Land Registry, on production of a printout of this page. Please see the location of the Land Registry public counters on the Website.

The specific number of the property of interest on the Folio should be quoted in applications for copy Folios or Filed Plans.

END

SEQ56

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landdirect.ie Maps

Welcome to our online Map that supports the spatial element of landdirect.ie. Using the available functions, you can go directly to a location on the Land Registry digital map in a number of ways and perform a variety of spatial/map queries.

If you are new to this part of the site click here for help on Using the online Map.

Zoom To:

- Folio: Go
- County: Zoom to ..... Go
- Co-ordinates: X: 468858 Y: 547377 Go
- OSi Sheet: Go
- Plan Search: Go

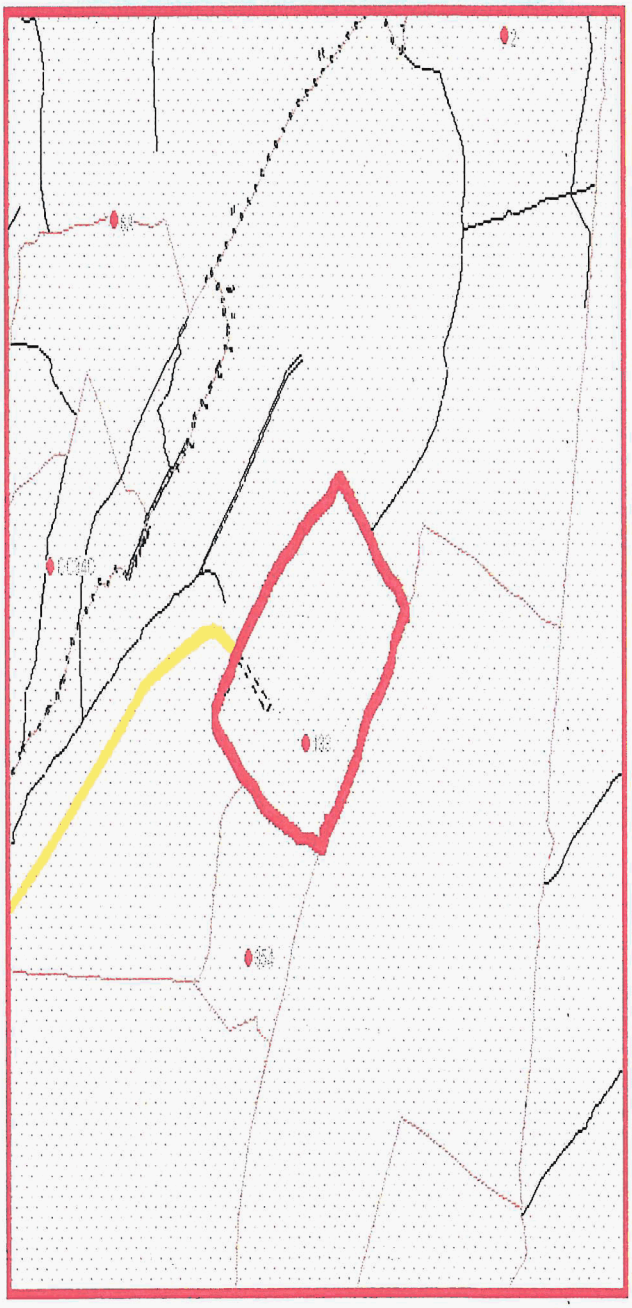
Map Detail | Addresses | Bookmarks | Area Search | Home

Special Registration Map | Official Map Search

Information:Based on centre point
Easting:468,858 Northing:547,377
Map Width:500M

Townland:	DERRYMIHIN WEST
E.D:	KILLACONENAGH
Barony:	BEAR
County:	Cork

Folio Search Go | Set Map Width

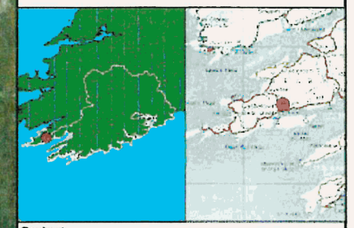


Current mode is: Zoom Window

Cork County Council

Environment Directorate
Cork County Council
Bantry
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:

Clountreem - 07/W

Division: **West Cork**

Area Office: **Bantry**

Legend

- Landfilled Area
- SPA
- NHA
- SAC

Issue Details

Drawn: KC	File Ref.		
Checked: -	07/W_PA_Rev1		
Approved:			
Scale:	Drawing No. 07/W_PA	Rev. 1	
Date: Feb 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

Attachment E.1

Habitat Assessment of Clountreem Landfill Site

Habitat assessment and biological water quality analysis of Clountream Landfill and Stream.

Doherty Environmental

December 2009

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Introduction

Doherty Environmental has been commissioned by Cork County Council to undertake a habitat assessment and biological water quality analysis of the Clountreem Landfill and Clountreem Stream at Clountream, 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 Clountream Stream with a view to identifying any potential adverse effects to the water quality arising from the disused landfill.

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.

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.

Rating	Qualifying Criteria
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. 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.
E	Any water body with unpolluted water (Q-value rating 4-5). **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 within the rural townland of Clountreem, approximately 1km to the north-northeast of Castletownbere, West Cork (G.R. V68880 47310). The site is located at approximately 70m OD Malin and is situated at the south western base of the Slieve Miskish Mountain. The majority of the land cover surrounding the site is characterised by low-activity land management regimes. Low intensity sheep grazing was noted in places. Recent planting of coniferous seedlings was noted to the west and north of the site. In general the land cover

consists of heath land and associated habitats with extensive areas of exposed surface bedrock. The soils are characterised by peaty podzols with peatlands occurring in more elevated areas to the northeast of the site. The bedrock is characterised by old red sandstone (ORS) and sandstone and siltstone conglomerate, much of which is outcropping at the surface surrounding the site.

The land cover within the site is dominated by spreading scrub habitats. An upland stream flowing east to west is culverted through the site. The previous deposition of waste within the site has changed the topography of the site with a steep embankment present towards the south of the site. To the south of the site the land cover is dominated by acid grassland and heath mosaics. Discrete areas characterised by Molinia meadows, which are a habitat listed on Annex 1 of the EU Habitats Directive were also noted to the south of the site. The land rises naturally 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. Freshwater;
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 Freshwater

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

- Upland eroding stream (FW1)

The Clountreem stream which is culverted through the site is classified as an upland eroding stream. The baseline conditions of this stream with regard to habitats and fauna are outlined in *Section 2* of this report.

1.3.2 Woodland and Scrub

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

- Scrub (WS1)

Immature scrub formerly dominated this site. Recent vegetation clearance has reduced the overall cover of this habitat. The remaining scrub is characterised by dense stands of gorse (*ulex europeaus*) and bramble (*Rubus fruticosa* agg.). A discrete area of willow (*Salix cinerea*) scrub is established along the south-facing slope towards the south 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.

1.3.4 Grassland

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

- Wet grassland

The wet grassland habitat occurring within the site is dominated by soft rush (*juncus effusus*). Other herbaceous species occurring in association within this habitat include creeping buttercup (*Ranunculus repens*), foxglove (*Digitalis purpurea*), broad leaved dock (*Rumex obtusifolius*), great willowherb (*Epilobium hirsutum*) and floating sweet-grass (*Glyceria fluitans*).

The site is surrounded to the south and west by wet grassland and wet heath mosaics. An area of wet grassland occurs in association with the willow scrub along the southern boundary of the site. The herb layer of this wet grassland habitat is dominated by nutrient-loving plant species such as nettles (*Urtica dioica*), creeping buttercup; meadow buttercup (*R. acris*); bulbous buttercup (*R. bulbosus*); broad-leaved dock; dandelion (*Taraxacum officinalis* agg.); soft rush; floating sweet grass; and bracken (*Pteridium aquilinum*). The presence of a nutrient-loving plant community at this location is indicative of eutrophic conditions. Further south from the boundary of the site the vegetation grades from a Glyceria and soft rush dominated herb layer to a typically nutrient-poor purple moor-grass meadow. This vegetation zonation may be related to excessive nutrient inputs derived from the landfill waste along the southern boundary of the site. The purple moor-grass dominated grassland to the south of the site corresponds with the EU Habitats Directive Annex I listed habitat *Molinia meadows on calcareous, peaty or clayey-silt laden soils (molinion caerulae)* (6410). A further example of this habitat type occurs to the west of the site adjacent to the Clountream Stream.

1.4 Site Evaluation

The habitats occurring within the site are considered to be of low ecological value (E). The bare ground supports little vegetation cover and does not function as a habitat for faunal species such as mammals and birds. The remaining scrub habitat occurring within the site is degraded and provides limited shelter for fauna species. The willow scrub along the southern boundary of the site has the potential to support a limited population of bird species. The wet grassland occurring within the site is dominated by soft rush and is not representative of the naturally occurring wet grassland habitats in this area.

Overall the site is considered to be of low ecological value and low conservation importance.

2 Section 2

2.1 Biological Water Quality Assessment

The biological water quality survey was based on the Biotic Index or Q-value system as outlined by the EPA (McGarrigle, 2002). The EPA Q-Value system is a listed criteria for calculating surface water ecological status as outlined in Schedule 5 of the Surface Water Regulations 2009 (SI No. 272 of 2009). A five minute kick sample was undertaken at each sample location using a kick-net (mesh size: 1mm). Each sample was transferred to a plastic bag at the sampling site. Sample processing was undertaken within 24 hours of sampling. Each sample was sieved using a 500µm sieve to remove mud while stones and other organic detritus (such as leaves, wood fragments etc.) were removed. Animals clinging to stones and leaves were washed into a white sorting tray along with the sieved sample. Each sample was sorted for one hour. Macroinvertebrates were identified to the level required by the EPA Q-rating system using both low and high powered microscopes where necessary. Based on the relative abundance of indicator taxa a biotic index (Q-value) was determined for each site. As different taxa show different levels of tolerance and sensitivity to pollution, the presence or absence of specific organisms in the water indicates the level of water quality in a watercourse. The Q-value system is base on a five-point biotic index as outlined in *Table 2.1.* The intermediate values i.e. Q1 -2, Q3 – 4 etc. denote transitional conditions. The Q-values listed in *Table 2.1* are assigned according to the abundance of different invertebrate groups.

For the purposes of assigning Q-values the EPA has divided macroinvertebrates into five arbitrary Indicator Groups. *Table 2.2* outlines the taxa associated with each group.

As mentioned above the abundance of each indicator group will determine the Q-value assigned. The abundance categories that apply when assigning Q-values are outlined in *Figure 2.3.*

Table 2-1: Q-Value system with Five Point Biotic Index and Intermediate Values (Source: EPA, 2006).

Biotic Index	Water Quality	Pollution Status
Q5	Good	Unpolluted
Q4 – 5	Fair – Good	
Q4	Fair	
Q3 – 4	Doubtful – Fair	Slight to moderate pollution
Q3	Doubtful	
Q2 – 3	Poor	
Q2	Poor	Serious pollution
Q1 – 2	Bad – Poor	
Q1	Bad	

Table 2-2: Macroinvertebrates grouped according to their sensitivity to organic pollution (Source: EPA, 2006).

Macroinvertebrates grouped according to their sensitivity to organic pollution					
Taxa	Group A	Group B	Group C	Group D	Group E

	Sensitive	Less Sensitive	Tolerant	Very Tolerant	Most Tolerant
Plecoptera	All except Leutra spp.	*Leutra spp.*			
Emphemeroptera	Heptageniidae Siphlonuriidae Emphemera danica	Baetidae (excl. *Baetis rhodani*) Leptophilebidae	*Baetis rhodani* Caeniddae Emphemerellidae		
Trichoptera		Cased spp.	Uncased spp		
Odonata		All taxa			
Megaloptera				Sialidae	
Hemiptera		*Aphelocheirus aestivalis*	All except *A. Aestivalis*)		
Coleoptera			Coleoptera		
Dipteral			Chironomidae (excl. *Chironomus* spp.) Simuliidae Tipulidae		*Chironomus* spp. *Eristalis* sp.
Hydracarina			Hydracarina		
Crustacea			*Gammurus* spp. *Austropotamobius pallipes*	*Asellus* spp. *Crangonyx* spp.	
Gastropoda			Gastropoda (excl.	*Lymnaea peregra* *Physa* sp.	
Lamellibranchiata	Margaritifera mrgaritifera				
Hirudinea					
Oligochaeta					Tubificidae

Platyhelminthes			All		

Figure 2-3: Abundance Values and Frequency of Occurrence for assigning Q-Values (Source: EPA, 2006)

Abundance Category	Approximate Percentage frequency of Occurrence
Present	1 or 2 individuals
Scarce/Few	<1%
Small numbers	<5%
Fair numbers	5 – 10%
Common	10 – 20%
Numerous	25 – 50%
Dominant	50 – 75%
Excessive	>75%

2.2 Clountreem Stream Habitat Assessment

A habitat assessment was undertaken at each sampling site. The habitats associated with each site were assessed in terms of:

- Stream width and depth;
- Instream habitats;
- Substrate type;
- Flow;
- Riparian vegetation, including a list of species noted and percentage bank side cover and degree of shading;
- Instream vegetation, including a list of species noted and percentage cover;
- General rating of habitat (fisheries perspective).

3 Results

3.1 Biological Water Quality Assessment

3.1.1 Site 1

Site 1 was located at GR V 68936 47365, upstream of the landfill site. The Clountreem Stream at this point is characterised by an upland eroding stream. The stream is approximately 30 to 50cm wide and 20cm deep. The stream is banked on both sides by wet grassland and wet heath habitat and no riparian vegetation occurs along the stream at this site. These habitats are characterised by low growing shrub species such as heathers and herbaceous vegetation, dominated by purple moor-grass. As no trees or shrubs border the stream at the location the degree of riparian cover and shading is low.

No instream vegetation was recorded at this survey site.

The river substrate along this site is characterised by 60% boulders, 30% stones and 10% gravel material. The instream habitats were characterised by 100% riffle.

The potential for this site to support fish species was considered to be low.

The results of the macroinvertebrate survey are provided in *Table 3.1*. The abundance of indicator taxa is also given in this table. The macroinvertebrate community recorded at this site is indicative of a Q-value of 4 - 5. This Q-value has been assigned at this site due to the dominance of Group A and B taxa, the numerous status of Group C taxa and the absence of Group D and E taxa. The high number of stoneflies (Plecoptera spp.) associated with this site is typical of an upland eroding stream.

Table 3-1: Results of Site 1 of Macroinvertebrate Survey

Indicator Group	Pollution Sensitivity/tolerance	Taxon	No. Recorded
A	Pollution Sensitive	Plecoptera	16
B	Less Pollution Sensitive	Emphemeroptera	3
		Cased Trichoptera	3
C	Pollution Tolerant	Hydrophilidae	2
		Simuliidae	5
		Tipulidae	3
		Baetis rhodani	2

		Gammurus duebeni Uncased Trichoptera Chironomidae (excluding Chironomus sp.)	4 2 3
D	Very Pollution tolerant	None present	
E	Most Pollution Tolerant	None present	

3.1.2 Site 2

Site 2 is located at GR V 68805 47339, immediately downstream of the landfill site. The Cloutreem Stream at this point is approximately 30 – 50cm in width and 15cm deep. Immediately upstream of the sample site the stream opens out into a pool. The riparian vegetation at the site is dominated by wet grassland habitats and no riparian cover was noted during the survey. Immediately upstream from the point a treeline dominates both bank sides.

No instream vegetation was noted during the survey.

The river substrate at this site was made up of 50% boulders, 40% stones and 10% gravel. Excessive yellow-ocre staining was noted on the stream bed. Noxious odours were noted during the kick samplings.

The instream habitats were characterised by 100% riffle. Immediately upstream of the site pools were noted. A waterfall is located upstream from the pools, adjacent to the stream outfall from the disused landfill site.

The potential for this site to support fish species was considered to be low.

The results of the macroinvertebrate survey for this site are provided in *Table 3.2*. The abundance of indicator taxa is also given in this table. The macroinvertebrate community recorded at this site is indicative of a Q-value of 2 - 3. This Q-value has been assigned at this site due to the absence of Group A the presence of one individual Group B taxon, the scarcity of Group C taxa and the low numbers of Group D and E taxa. Overall the occurrence of macroinvertebrates at this site was notably reduced when compared to the numbers recorded at Site 1.

Table 3-2: Results of Site 2 Macroinvertebrate Survey

Indicator Group	Pollution Sensitivity/tolerance	Taxon	No. Recorded
A	Pollution Sensitive	None present	

B	Less Pollution Sensitive	Leuctra spp.	1
C	Pollution Tolerant	Uncased trichoptera Chironomidae (excluding Chironomus sp.)	3 1
D	Very Pollution tolerant	None present	
E	Most Pollution Tolerant	Tubificidae	2

3.1.3 Site 3

Site 3 is located at V 68629 47224, approximately 200m southwest of the landfill site. The Cloutreem Stream at this point is approximately 60 – 70cm in width and 20 – 30cm deep. The riparian vegetation along the stream is dominated by purple moor-grass dominated wet grassland. Two willow trees were noted along the western side of the bank at the survey location. The riparian cover was estimated to be less than 10% at the survey site.

No instream vegetation was recorded at this site. The river substrate was made up of 40% boulders, 50% stones and 10% gravel. Yellow-ocre staining was also noted at this survey site but odours were not immediately noted during the kick sampling.

The instream habitats at the site were characterised by 100% riffle.

The potential for this site to support fish species was considered to be low.

The results of the macroinvertebrate survey for this site are provided in *Table 3.3*. The abundance of indicator species is also given in this table. The invertebrate community recorded at this site is indicative of a Q-value of 4. This Q-value has been assigned at this site due to the presence of Group A taxa; the dominance of Group B taxa; the presence of individual Group C taxon along with the common occurrence of Group D and E taxa. It is noted that, while the number of macroinvertebrates recorded at this sample location increased in comparison to the results of sampling at Site 2, they were still reduced when compared to Site 1.

Table 3-3: Results of Site 3 Macroinvertebrate Survey

Indicator Group	Pollution Sensitivity/tolerance	Taxon	No. Recorded
A	Pollution Sensitive	Plecoptera	2

B	Less Pollution Sensitive	Leutridae Cased trichoptera	6 1
C	Pollution Tolerant	Uncased trichoptera	1
D	Very Pollution tolerant	Glossiphonidae	2
E	Most Pollution Tolerant	Tubificidae	2

3.1.4 **Site 4**

Site 4 is located at V 68629 47224. The survey point was located on the Aghakista River to the south of the disused landfill site. At the survey point the Aghakista River is approximately 5m width and 20 – 25cm deep. Immediately upstream of the survey point the riparian vegetation is dominated by mature broadleaved tree species. The eastern river bank at the survey point does not support riparian vegetation. The riparian cover was estimated to be approximately 60% at the survey site.

No instream vegetation was recorded at this site. The river substrate was made up of 40% stones, 15% boulders and 45% sand and gravel.

The instream habitats at the site were characterised by 100% riffle.

The potential for this site to support fish species was considered to be high.

No macroinvertebrates were recorded from the samples taken at this site. The high sand content and excessive rainfall in the weeks preceding the survey are likely to have influenced the results of sampling at this site. The heavy rainfall is likely to have washed macroinvertebrates from the stream bed.

3.2 Physico-chemcial Analysis

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 SW2 and SW3 were 2.74 and 1.3 mg/l N respectively. The pH of both samples are 6.9 and 7.5 respectively. SW2 is located immediately downstream of the landfill site and the outfall of the Clountreem Stream from the culvert crossing the landfill site. SW3 is located approximately 200m to the southwest of the landfill site. The results of the analysis for (SW1) which is located upstream of the landfill 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 SW2 and SW3 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.

4 Conclusions and Recommendations

The results of the biological water quality analysis and the elevated levels of ammonia recorded from the physico-chemcial analysis indicates that the disused landfill site is adversely affecting the water quality of the Clountreem Stream and is the source of point source pollution to the stream.

The elevated ammonia levels, yellow-ocre staining on the stream-bed and the reduction in macroinvertebrate numbers are a likely result of leachate infiltrating the culverted section of the Clountreem Stream under the landfill site.

It is recommended that measures are taken to ensure that the integrity of the stream culvert under the landfill is fully sealed and impermeable to potential leachate infiltration.

It is also recommended that a habitat restoration and management plan be undertaken for the site. The restoration plan should aim to reinstate habitats in keeping with the heathland habitats occurring adjacent to the site.

5 Limitations

It is noted that the field assessment was undertaken in December. The optimal period for undertaking freshwater macroinvertebrate assessments is from June to September inclusive

(NRA, 2006). Therefore, the results of the field assessment may be limited by seasonal effects. Also it is likely that excessively high rates of precipitation prior to the field surveys influenced the results of the biological water quality assessment.

References

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

Croft, P.S. (1986). Freshwater Invertebrates: *A Key to the Major Groups of British Freshwater Invertebrates.* Field Studies: Vol. 6: pp. 531 – 579. Field Studies Council.

Edington, I. & Hildrew, A.G. (1981). *A key to the cases caddis larvae of the British Isles.* Scientific Publication of the Freshwater Biological Association 43.

Elliot, J.M., Humpesch, U.H. and Macan, T.T. (1988). *Larvae of the British species of Emphemeroptera.* Scientific Publication of the Freshwater Biological Association 13.

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.