

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

Crawberry Hill Wellsite Waste Management Plan Exploratory Operations

This document contains proprietary information belonging to Rathlin Energy (UK) Limited and shall be used only for the purpose for which it was supplied. It shall not be copied, reproduced, disclosed or otherwise used, nor shall such information be furnished in whole or in part to third parties, except in accordance with the terms of any agreement under which it was supplied or with the prior consent of Rathlin Energy (UK) Limited and shall be returned upon request.

© Copyright of Rathlin Energy (UK) Limited

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

*** Page Left Blank Intentionally ***

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

TABLE OF CONTENTS

1	INTRODUCTION	7
1.1	Site Details	7
2	SCOPE	8
3	DEFINITIONS.....	9
4	ENVIRONMENTAL LEGISLATION AND APPLICABILITY	10
4.1	Water Resources Act 1991 (as amended by the Water Act 2003)	10
4.2	Environmental Permitting (England and Wales) Regulations 2010.....	10
4.2.1	A Groundwater Activity.....	10
4.2.2	A Mining Waste Activity.....	11
4.2.3	Industrial Emissions Activity.....	11
4.2.4	A Radioactive Substances Activity	11
5	DESCRIPTION OF THE FACILITY.....	12
5.1	Site Location.....	12
5.2	Site Description and Current Status.....	12
5.3	Waste Generating Activities	13
5.3.1	Well Maintenance	14
5.3.2	Well Testing.....	14
5.3.3	Drilling Operations	18
5.3.4	Well Abandonment and Partial Well Abandonment	21
5.4	Classification of the operations	22
5.4.1	Mining Waste Operation.....	22
5.4.2	Installation	22
6	EXTRACTIVE AND NON EXTRACTIVE WASTE MANAGEMENT	22
6.1	Operator Waste Objectives.....	22

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

6.2	Waste Prevention and Minimisation	23
6.3	Waste Description and Management Arrangements	24
6.3.1	Extractive Waste	24
6.3.2	Non Extractive Waste.....	38
7	ENVIRONMENTAL RISK ASSESSMENT.....	38
8	MEASURES TO MINIMISE ENVIRONMENTAL IMPACT	39
9	CONTROL AND MONITORING OF WASTE	40
9.1	Release to Ground Water	40
9.1.1	Surface Release	40
9.1.2	Subsurface Release	40
9.2	Air Emissions	41
9.3	Noise	41
9.4	Lighting.....	41
9.5	Traffic	41
9.6	Contractor Performance	42
9.7	Security	42
9.8	Complaints	42
10	ENVIRONMENTAL INCIDENT MANAGEMENT	42
10.1	Containment within the Wellbore	42
10.2	Wellsite Containment	43
10.3	Fire Response	43
10.4	Incident Reporting and Investigation.....	43
11	ALTERATIONS TO THE PLAN	44
12	PLAN FOR CLOSURE	44
	APPENDIX 1 – RATHLIN ENERGY CORPORATE INFORMATION	45

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

APPENDIX 2 – RATHLIN ENERGY ENVIRONMENTAL POLICY MANUAL	49
APPENDIX 3 – ROLES AND RESPONSIBILITIES	51
APPENDIX 4 – CHEMICAL INVENTORY DURING EXPLORATORY OPERATIONS	57
APPENDIX 5 – AIR DISPERSION MODELLING AND REPORT	59
APPENDIX 6 – MANAGEMENT OF RADIOACTIVE WASTE.....	61
APPENDIX 7 – LIGHTING PLAN.....	63
APPENDIX 8 – TRAFFIC MANAGEMENT PLAN.....	65

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

*** Page Left Blank Intentionally ***

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

1 INTRODUCTION

Rathlin Energy (UK) Limited (Rathlin Energy) is a wholly owned subsidiary of Connaught Oil & Gas Ltd, a private company with its head office in Calgary, Canada. Connaught Oil & Gas Ltd is an international petroleum exploration, development and production company with operations in Western Canada and the United Kingdom. The experienced senior management team has an average of 30 years of direct operating experience in Canada and internationally. The United Kingdom operations are conducted through Rathlin Energy (UK) Limited and are directed from the Rathlin office in London.

Rathlin Energy is engaged in the exploration and production of petroleum onshore United Kingdom and holds 100% interest in Petroleum Exploration and Development Licence (PEDL) 183, within which it has drilled two exploration boreholes, Crawberry Hill 1 and West Newton 1.

The Crawberry Hill exploration wellsite was granted planning permission by East Riding of Yorkshire Council in September 2012. A copy of the planning decision notice DC/12/02945/STPLF/STRAT is included within 'Crawberry Hill Wellsite Planning Decision Notice' (RE-05-EPRA-CH-PDN-009) provided in support the environmental permit application. The site was constructed in 4th quarter 2012 and the drilling of the Crawberry Hill 1 well was completed in 2nd quarter 2013. The well has subsequently been suspended pending analysis of the data gathered during the drilling operation.

The purpose of this document is to outline the waste management arrangements to be implemented at the Crawberry Hill wellsite during exploratory operations, which for clarity includes the testing of the existing CH1 well, the drilling and testing of CH2 well and wellsite restoration operations, permitted under the existing planning consent.

1.1 Site Details

The proposed Crawberry Hill exploratory operations are being undertaken at the following location:

Crawberry Hill Wellsite
Rathlin Energy (UK) Limited
Land Southwest of Crawberry Hill
Walkington Heads
Beverley
East Riding of Yorkshire
HU17 8RU

National Grid Ref: SE 97669 37720

Site Area: 0.99 hectares

Waste Registration Number: OGA961

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

The site surface boundary is detailed in green on the site plans included within document RE-05-EPRA-CH-SP-004.

2 SCOPE

This Waste Management Plan is applicable to the Crawberry Hill wellsite and all exploratory operations permitted therein, in accordance with the existing planning consent. It is applicable to Rathlin Energy, its contractors and subcontractors and can be used in support of applications to the Environment Agency under the Environmental Permitting (England and Wales) Regulations 2010, where there is a requirement to provide a Waste Management Plan.

The Waste Management Plan is the principle document for the management of all activities permitted at the wellsite under applicable environmental legislation.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

3 DEFINITIONS

BAT:	Best Available Technique
CH1:	Crawberry Hill 1 Well
EA:	Environment Agency
EMS:	Environmental Management System
EPR 2010:	Environmental Permitting (England and Wales) Regulations 2010
Hazardous Waste:	As defined by Article 3(2), 7 and Annex III of the Waste Framework Directive
HCl:	Hydrochloric Acid
HDPE:	High-Density Polyethylene
HSE:	Health, Safety and Environment
Inert Waste:	A waste that does not undergo any significant physical, chemical or biological transformations. Does not give rise to environmental pollution or harmful to health
LCM:	Lost Circulation Material
MMSCF:	Million Standard Cubic Feet
Non Hazardous Waste:	A waste which is not classified as inert or hazardous waste
Pollutant:	Any substance liable to cause pollution
Pollution:	A direct or indirect introduction, as a result of human activity, of substances or heat into the air, water land which may; a) Be harmful to human health or the quality of aquatic ecosystems or terrestrial ecosystems directly depending on aquatic ecosystems b) Result in damage to material property c) Impair or interfere with amenities or other legitimate uses of the environment
SMS:	Safety Management System;
Spent Acid:	Calcium chloride, carbon dioxide and water

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

4 ENVIRONMENTAL LEGISLATION AND APPLICABILITY

Activities associated with the exploration for oil and gas onshore in England fall to be considered within the scope of a number of pieces of environmental legislation. A review of the proposed Crawberry Hill exploratory operations against environmental legislation has identified the following legislation as being applicable to the Crawberry Hill exploratory operations.

4.1 Water Resources Act 1991 (as amended by the Water Act 2003)

Under Section 199 of the Water Resources Act 1991 (as amended by the Water Act 2003), a notice of the intention to construct or extend a boring for the purpose of searching for or extracting minerals must be submitted to the Environment Agency using form WR11. A method statement, including drilling and casing designs, together with storage and use of chemicals and drilling muds, shall accompany the WR11 application form.

The Crawberry Hill 1 well was the subject of a WR11 application, subsequently approved by the Environment Agency in December 2012. A copy of the CH1 WR11 is included within Appendix 2 of 'Crawberry Hill Wellsite Site Condition Report (RE-05-EPRA-CH-006) provided in support the environmental permit application.

The second borehole will be subject to a separate WR11 application, to be submitted to the Environment Agency for approval once final design is confirmed. For clarity, the waste arising from the drilling of the second exploratory borehole has been included within this waste management plan.

4.2 Environmental Permitting (England and Wales) Regulations 2010

A number of activities to be undertaken during the Crawberry Hill exploratory operations may require permitting under the Environmental Permitting (England and Wales) Regulations 2010 (EPR 2010).

4.2.1 A Groundwater Activity

Under Schedule 22 of EPR 2010, an activity that could involve the discharge of pollutants into groundwater must be notified to the Environment Agency, together with the nature of these pollutants. The Environment Agency will then determine whether the groundwater activity needs to be permitted.

The Crawberry Hill exploratory operations include a Mini Fall-Off Test within the Upper Viséan/Lower Namurian interval and an acid wash and acid squeeze within the Permian interval, which fall within the meaning of a 'Groundwater Activity' under Schedule 22 of EPR.

Schedule 22 3 (3) of EPR 2010 provides that the *'The regulator may determine that a discharge, or an activity that might lead to a discharge, is not a groundwater activity if the input of the pollutant...*

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

(b) is or would be of a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater.

To enable the regulator to deviate from the requirement for a groundwater activity permit, a description of the operations, together with a technical justification to exclude these operations under Schedule 22 paragraph 3 (3) of EPR 2010, is included within Section 5 of this waste management plan. In addition, a conceptual model derived from a true representation of the subsurface geology encountered during the drilling of CH1 is included within Section 5.2.

4.2.2 A Mining Waste Activity

The Mining Waste Directive 2006/21/EC requires that extractive wastes are managed in such a way that it minimises harm to human health and the impact on the environment. It applies to the management of waste resulting from the prospecting, extracting, treatment and storage of mineral resources and working quarries, which the Mining Waste Directive refers to as extractive waste. The waste can take the form of a solid, liquid or gas.

Schedule 20 of EPR 2010 defines a mining waste operation as being *the management of extractive waste, whether or not it involves a waste facility*. Under EPR 2010, an environment permit is required to authorise a mining waste operation.

The Crawberry Hill exploratory operations at this stage will involve the management of extractive waste not involving a waste facility.

4.2.3 Industrial Emissions Activity

The Industrial Emissions Directive 2010/75/EU requires a facility within which the incineration of hazardous wastes in plant such as a flare is carried out and where such incineration exceeds 10 tonnes per day, to be classified as an installation.

Regulation 35 of the Environmental Permitting (England and Wales) (Amended) Regulations 2013, which transposes the requirements of the Industrial Emissions Directive, requires an environmental permit to authorise an installation operation.

The Crawberry Hill exploratory operations will involve the incineration of natural gas exceeding 10 tonnes per day and, therefore, a permit to authorise an installation operation is required.

4.2.4 A Radioactive Substances Activity

Schedule 23 of EPR 2010 provides for the control of Naturally Occurring Radioactive Material (NORM). Schedule 23 defines the production of oil and gas as a NORM industrial activity and therefore any accumulation of radioactive waste, which exceeds concentrations set out in Table 1 of Schedule 23 of EPR 2010 (as amended in 2011) and its subsequent disposal requires an environmental permit to authorise a radioactive substances activity.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

The Crawberry Hill exploratory operations will involve the circulating to surface of fluids exposed to the formation during drilling and/or well testing, which may or may not contain NORM in concentrations exceeding those set out in Table 1 of Schedule 23 of EPR 2010. Until such time as the concentration of NORM can be established, an environmental permit is required to authorise the management and disposal of NORM.

5 DESCRIPTION OF THE FACILITY

5.1 Site Location

The Crawberry Hill wellsite is located immediately north of Walkington Heads, Beverley within the East Riding of Yorkshire.

5.2 Site Description and Current Status

The Crawberry Hill wellsite was constructed in 4th quarter 2012 in preparation for the drilling of a petroleum exploratory borehole. The site was constructed by means of removing the topsoil and storing it on the northern boundary of the site. The exposed chalk was then cut to level creating a level plateau. A perimeter ditch was then excavated around the perimeter of the site to aid environmental containment. A 2.75m deep drilling cellar was then constructed using precast concrete rings, each ring individually sealed and cemented to ensure integrity. A 1mm fully welded HDPE membrane was then laid across the site and perimeter containment ditches, protected above and below by a layer of non-needle punch geotextile. Above the impermeable membrane and geotextile was laid geogrid overlaid by a 300mm layer of MOT Type 1 stone.

Following site construction a small water well drilling rig was mobilised to site and drilled a 36" hole through the boulder clay at surface into the top section of the Chalk at 100m depth. 28" welded casing was then ran into the borehole and cemented back to surface. A 26" hole was drilled to 203m depth and 20" welded casing was then ran into the borehole and cemented back to surface. On completion of this operation the small drilling rig was demobilised from site.

A larger oilfield drilling rig was then mobilised to site to drill the remaining sections of the borehole. Following the drilling of each hole section, threaded steel casing was installed, cemented into position and pressure tested to confirm pressure integrity. A schematic of the well construction is provided in Figure 1, together with a lithology log showing the formations encountered.

On completion of the drilling operation the well was suspended pending analysis of the data gathered during the drilling operation.

The CH1 well is currently suspended pending a programme of well testing, which is the subject of this waste management plan and scheduled to be undertaken once all relevant environmental permits have been issued.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

Rathlin Energy	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

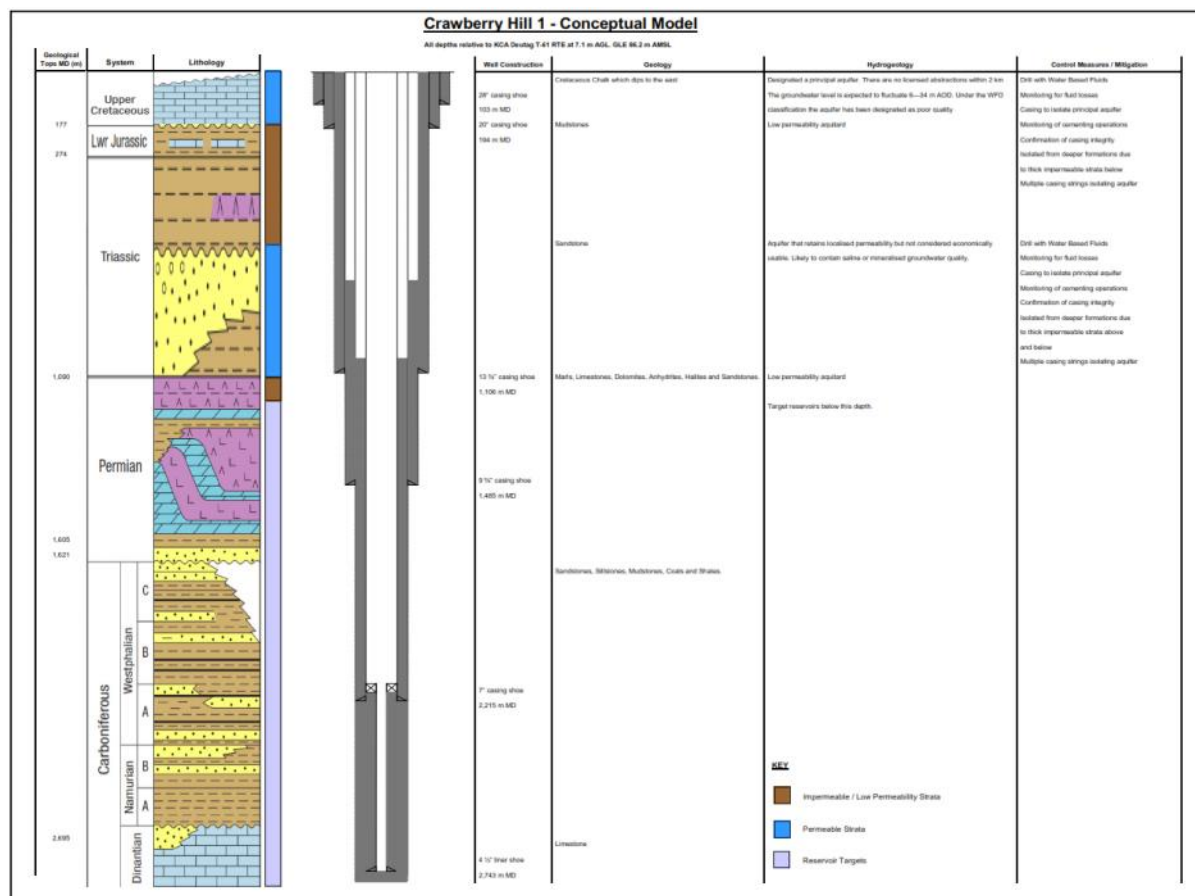


Figure 1. CH1 Construction Schematic (Conceptual Model)

A larger scale copy of the CH1 conceptual model is provided within Crawberry Hill site condition report (RE-05-EPRA-CH-SCR-006).

5.3 Waste Generating Activities

A summary of the proposed CH1 well maintenance and testing operations is detailed below in chronological order, with a more detailed description of each activity provided within each subsection. The summary also includes the drilling of the second well from the wellsite, which is permitted under the existing planning permission. The following drilling, well maintenance and testing programme is as follows:

- Well maintenance
- Upper Visean/Lower Namurian (subset within the Dinantian) mini fall-off test
- Lower Namurian pressure monitor and flow test
- Permian carbonate acid wash/squeeze and flow test
- Drilling of second permitted well
- Well abandonment

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

5.3.1 Well Maintenance

Following drilling operations, during the maintenance cycle of an exploration well, the potential to generate waste is limited and is likely to be associated with cementing operations to ensure integrity and formation isolation.

Borehole logging undertaken during well construction may identify areas where the cement bond between the formation and the casing does not meet the self-imposed standard set by Rathlin Energy, which exist to meet and exceed industry best practice. In the event such areas are identified, an operation to undertake further logging of the wellbore and perform cement remediation works will be undertaken.

The operation consists of electric logging of the wellbore to accurately determine where the existing cement does not meet the Rathlin standard.

Across areas where cement remediation is required, perforating guns will be run into the wellbore and fired, creating a direct pathway through the wellbore casing to the external formation. If practicable, a fluid circulation is established through two sets of perforations, enabling any cement debris to be circulated into the wellbore and returned to surface.

Once cement debris has been removed, new cement will then be squeezed through the perforations into any voids behind the casing, improving the bond between the casing and the formation.

The operation may be completed a number of times until the required cement bond standard is achieved.

5.3.2 Well Testing

Geological logging is undertaken during well construction to determine whether formations encountered during drilling contain petroleum. The borehole logs assist Rathlin Energy in determining specific zones, which justify subsequent testing.

Well testing may involve various different processes, all of which are intended to obtain a greater understanding of the formation properties and ultimately determine whether the formations are capable of producing commercial quantities of petroleum. Well testing process does vary, depending on the formation being tested. An overview of the various well testing processes to be undertaken is detailed below:

5.3.2.1 Mini Fall-Off Test within Carboniferous Shale

A mini fall-off test is a short duration formation test designed to gather reservoir engineering data (characteristics and properties of the reservoir rock formation). The test is carried out to establish the pressure at which injectivity of fluid occurs into the formation and analyses how the pressure permeates through the formation over a given period of time (usually 14 days). For clarity, the intention of the mini fall-off test is not to fracture the formation but to establish if and at what pressure the formation becomes permeable. The information gathered during the mini fall-off test will help determine whether the formation is capable of being hydraulically fractured. For clarity,

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

hydraulic fracturing is not being considered as part of this waste management plan or any permit application this plan is being submitted to support.

The mini fall-off test is being performed within the Upper Visean/Lower Namurian interval at a depth of 2,677m - 2,682mMD. The Upper Visean/Lower Namurian is a subset within the Dinantian.

In order to establish communication between the formation and the wellbore, perforating guns will be run into the wellbore and fired, providing a direct pathway from the formation to the wellbore. A retrievable packer will then be lowered into the wellbore, immediately above the perforations.

Fluid, which in the case of the Crawberry Hill well is Potassium Chloride (KCl) water, is then be pumped into the wellbore until injectivity occurs. Fluid is pumped for 5 – 10 minutes, during which 5m³ to 10m³ of fluid is injected. When pumping is complete, the residual pressure within the tubing is shut in and monitored for 14 days to analyse how the residual pressure permeates through the formation.

On completion of the mini fall-off test, any pressure within the tubing will be released and any remaining KCl water circulated to surface. KCl water injected into the formation during the mini fall-off test is unlikely to return (no flow back) due to the naturally impermeable characteristics of the formation. It will be absorbed by the formation and mixed with the naturally occurring formation water, held within the micro pore spaces. A small quantity of KCl water remaining within the formation will have no discernable effect on the formation or groundwater therein.

Potassium chloride water is not a hazardous substance and must therefore be considered as a non-hazardous pollutant.

The Upper Visean/Lower Namurian interval lies at a depth of some 2450m BGL and is isolated from near surface aquifers, groundwater and those users and the environment dependent on them by some 2,000m of overlying low permeable formations.

The formation has extremely low permeability and requires mechanical intervention to enhance its permeability. The quantity and concentration of potassium chloride water introduced to the formation must be considered in the context of the naturally occurring concentrations in the receiving water. Introducing potassium chloride water to the formation will obviate any present of future danger of deterioration in the quality of the receiving groundwater.

Whilst the injection of potassium chloride within deep impermeable formations is considered a 'groundwater activity', the activity is considered de minimus and can be excluded under Schedule 22 3 (3) of EPR 2010. The mini fall-off test within the Upper Visean/Lower Namurian interval does not, therefore require a groundwater permit.

5.3.2.2 Flow Test within Carboniferous Sands

Pressure monitoring and flow test is being performed within the Lower Namurian interval at a depth of 2,582m – 2587mMD.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

In order to establish communication between the formation and the wellbore, perforating guns will be run into the wellbore and fired, providing a direct connection between the formation and the wellbore. A retrievable packer will then be lowered into the wellbore, immediately above the perforations.

Pressure gauges will be run and set in the wellbore across the formation to monitor formation pressure. In the event that permeability in the formation is suitable, a flow tested may be undertaken, as described in Section 5.3.2.4.

5.3.2.3 Acid Wash/Squeeze and Flow Test within Permian Carbonate

Carbonate formations are heterogeneous with significant variations in porosity and permeability. To improve the flow of petroleum within a carbonate formation, an acid, most commonly hydrochloric acid (HCl) at 15% concentration with water (i.e. 150L of HCl with 850L of water), is applied to the formation through the wellbore. The operation is very much akin to acidisation of boreholes in the water well industry and results in high permeability channels through which water or petroleum can flow.

An acid wash is applied using low pressure and can be used to clean out the natural fractures, having potentially been blocked as a result of the initial drilling operation. An acid squeeze is applying the acid to the formation under pressure not exceeding the fracture pressure of the formation, resulting in the acid being squeezed through the natural fractures within the formation and increasing the near hole permeability.

The proposed dilution of hydrochloric acid is 15%, which is circulated across the perforations using 1m³ of HCl solution per single stage wash. The process of washing the perforations is repeated a further four times. Following the washing of the perforations, HCl is then selectively squeezed into the formation at 1m³ of HCl per metre of perforation.

It is anticipated that between 6m³ to 11m³ of HCl will be pumped into the formation during the operation, with all spent acid being recovered to surface.

If more than one interval within the Permian interval is to be tested, the operation will be repeated.

The acid wash and squeeze is being performed within the Permian interval at a depth of 1,310m.

The HCl reacts with the calcite or dolomite through dissolution to produce carbon dioxide (CO₂), water (H₂O) and chloride ions (Cl⁻). The chloride ions exist in the water and pair to form calcium chloride (CaCl₂). The chemical equation is as follows:



Calcium chloride is not a hazardous substance and must therefore be considered as a non-hazardous pollutant.

Formation water produced in petroleum production wells in North Yorkshire from the Permian interval is considered representative of the formation water anticipated within the Permian interval at Crawberry Hill, East Riding of Yorkshire with a natural salinity of some 349,000mg/l. The Permian

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

interval lies at a depth of some 1200m BGL and is isolated from near surface aquifers, groundwater and those users and the environment dependent on them by some 1000m of overlying low permeability formations.

Deeper aquifers within the Jurassic, Triassic and Permian are not considered to be important receptors due to their depth and likely high salinity or mineralised groundwater quality and, as such, can be considered ‘permanently unsuitable’. Whilst at shallow depths these aquifers are highly productive aquifers of national importance, at great depths beneath the Crawberry Hill wellsite where these aquifers have been encountered the aquifers are unlikely to be exploited or provide base flow to surface water features.

The quantity and concentration of acid introduced to the formation must be considered in the context of the naturally occurring concentrations in the receiving water. In this case, given the natural salinity levels of the Permian interval in the North Yorkshire wells and this being considered representative of the same formation at Crawberry Hill, the receiving water is hyper-saline and the addition of the calcium carbonate as a result of introducing acid to the formation will obviate any present or future danger of deterioration in the quality of the receiving groundwater.

Whilst the injection of hydrochloric acid within deep saline water bearing formations is a ‘groundwater activity’, the activity is considered de minimus and can be excluded under Schedule 22 3 (3) of EPR 2010. The acid wash/squeeze within the Permian Carbonate does not, therefore, require a groundwater permit.

5.3.2.4 Flow Test (Carboniferous Sands and Permian Carbonate)

A flow test is a short to medium duration test to analyse the flow characteristics of a formation, which may contain petroleum.

In order to establish communication between the formation and the wellbore, perforating guns will be run into the wellbore and fired, providing a direct pathway from the formation to the wellbore, through which petroleum can flow. Petroleum is flowed to surface through the wellbore into temporary fluid separation equipment located on site. Natural gas is separated from produced fluids (expected to be a mixture of formation water, oil and condensate) and diverted via temporary pipework to an enclosed single point flare located on site for incineration. At the point of incineration the natural gas is considered a waste. The flare is equipped with a propane fuelled always on pilot, which ensures that ignition takes place as soon as natural gas is present and reignites if there is a break in flow. Air dispersion modelling and assessment of the two flare options, together with the indicated BAT in Environment Agency Technical Guidance Note for Onshore Oil and Gas Exploratory Operations has led to the selection of the single point enclosed flare (referred to as Configuration B within the Crawberry Hill Air Dispersion and Modelling Report).

Produced fluids are transferred via temporary pipework to cylindrical storage tanks located on site where they are held for subsequent offsite disposal. Oil and condensate, which for clarity is not considered a waste, will be transported by a licenced haulier to a permitted refinery for sale and produced water, which is considered a waste, will be transported by a licenced haulier to an

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Environment Agency permitted water treatment facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.

Should the formation contain petroleum and the formation being capable of flowing such volumes, a suitable flow rate for well testing would be 95.74 tonnes (5mmscf) of gas per day, which for clarity exceeds the threshold values of 10 tonnes per day set out in Regulation 35 of EPR 2010, albeit for a short duration. Sufficient storage for produced fluids will be provided in the form of cylindrical tanks, which will be sufficient for a number of days well testing. A minimum of 210m³ of produced fluids storage will be available on site, supported by 24 hour tanker haulage to remove oil/condensate or produced water for sale or disposal respectively.

As produced water has the potential to contain low levels of Naturally Occurring Radioactive Material (NORM). Samples of produced water shall be sent to a laboratory holding the appropriate accreditations for radionuclide analysis by gamma spectrum. The maximum volume of aqueous liquid is anticipated during the testing operation is 210m³. Available storage of aqueous liquid will be 210m³ and takes into account turnaround times associated with the analytical techniques required.

To aid the initial flow of petroleum, nitrogen may be injected into the wellbore to displace wellbore fluids, reduce its hydrostatic weight. Nitrogen is classified as an inert waste and venting of such considered a closed loop system, insofar as nitrogen is extracted from the atmosphere and is vented back atmosphere. No nitrogen would remain in the formation.

5.3.3 Drilling Operations

The Crawberry Hill wellsite planning permission provides for the drilling of a second well from the wellsite. The well may be required to investigate and test the extents of any potential petroleum reservoir encountered during the drilling and testing of the first well or to investigate and test a formation that may not have been encountered in the first well, the trajectory of the first well having potentially missed a particular formation.

For the purpose of this Waste Management Plan, the design and construction of the second exploratory borehole will be similar to that of the first borehole, insofar as its depths, borehole diameter and produced wastes. The trajectory of the second exploratory borehole will, however, differ slightly from that of the first borehole due to it targeting either the extent of the petroleum reservoir or other formations. The second borehole will be subject to a separate WR11 application, to be submitted to the Environment Agency for approval once final design is confirmed. For clarity, the waste arising from the drilling of the second exploratory borehole has been included within this waste management plan.

5.3.3.1 Surface Conductor

A conventional water well drilling rig would be mobilised to the wellsite to drill the surface conductor to +/- 194m TVD GL.

The drilling of the surface conductor will start with the drilling of a 36" hole, to a depth of +/- 103m TVD GL. This initial section will be drilled conventionally using fresh water. Once this section has

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

been drilled, 28" steel casing will be run into the hole and cemented back to surface. A second hole section will be drilled from 103m to +/- 194m TVD GL. Once this section has been drilled, 20" casing will be run and cemented back to surface. These initial sections of hole will be drilled conventionally with water.

Once this section of the borehole is completed, the waterwell drilling rig will be demobilised from the site.

5.3.3.2 Main Drilling Operation

Once the surface conductor has been set, a conventional oilfield drilling rig will be mobilised to the wellsite, rigged up and commissioned. Drilling of the borehole would then be undertaken in the following sequence. The composition of the drilling fluid used is detailed within each hole section.

Hole Section 17 ½"

A 17 ½" hole will be drilled from +/- 194m TVD GL to 1,106m MD GL using a bentonite polymer water based mud system. Once this section has been drilled, 13 ⅝" casing will be run and cemented back to surface. The casing will be pressure tested to 1,800 psi. A Formation Integrity Test will also be completed.

Drilling Fluid Composition:					
17 ½" Hole Section – Gel/Polymer				Volume:	6730 bbl
Product:	Unit Size:	Quantity:	Total Quantity :	Quantity (lbs):	Concentration (ppb)
CAUSTIC SODA	13 KG	37	481	1,060	0.44
DRILLING STARCH	25 KG	138	3,450	7,606	3.15
M-I BAR	25 KG	80	2,000	4,409	1.83
BENTONITE OCMA	25 KG	455	11,375	1,003	0.42
POLYPAC UL	25 KG	120	3,000	265	0.11
SAFE-CARB 40	25 KG	225	5,625	496	0.21
SODA ASH	25 KG	7	175	386	0.16

Hole Section 12 ¼"

The 12 ¼" well will continue to be drilled with a salt saturated water based mud drilling fluid. It will be drilled from 1,106m MD GL to 1,485m MD GL. Once this section has been drilled, 9 ⅝" casing will be run into the hole, cemented up to 700m MD GL and then pressure tested to 2,200 psi to confirm its integrity.

Drilling Fluid Composition:					
12 ¼" Hole Section – NaCL Salt-Saturated Polymer				Volume:	1664 bbl
Product:	Unit Size:	Quantity:	Total Quantity :	Quantity (lbs):	Concentration (ppb)
CAUSTIC SODA	13 KG	4	52	115	0.03
CITRIC ACID	25 KG	31	775	1709	0.46
DRILLING STARCH	25 KG	192	4800	10582	2.87

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE

MANAGEMENT

DUOVIS	25 KG	80	2000	4409	1.19
DYNARED FINE	25 LBS	80	2000	4409	1.19
EMI-2224	25 LTR	9	225	496	0.13
KWIK SEAL MEDIUM	40 LBS	55	2200	4850	1.31
POTASSIUM CHLORIDE	25 KG	48	1200	2646	0.72
SAFE-CARB 40	25 KG	35	875	1929	0.52
SAFE-CARB 250	25 KG	140	3500	7716	2.09
SAFE-CARB 500	25 KG	100	2500	5512	1.49
PVD SALT	MT	17	17	37479	10.16
PVD SALT	25 KG	52	1300	2866	0.78
CONQOR 404 NS	200 LTR	4	800	1764	0.48
SAFE-CIDE	25 LTR	11	275	606	0.16
LIME	25 KG	30	750	1653	0.45
SODIUM CHLORIDE BRINE	BBL	625	625	1378	0.37
KWIK SEAL COURSE	40 LBS	35	1400	3086	0.84
DYNARED COURSE	25 LBS	84	2100	4630	1.25
POTASSIUM CHLORIDE	MT	7	7	15432	4.18

Hole Section 8 ½"

Prior to drilling the next section, a Formation Integrity Test will be completed to confirm the formation and casing shoe. The 8 ½" borehole will be drilled from 1,485m MD GL to a total depth of 2,750m MD GL. A salt saturated water based mud drilling fluid will be used in this section. Once drilled, 7" casing will be run into the hole to a depth of 2,215m from surface and cemented up to 1,065m MD. It will then be pressure tested to 4,400 psi.

Drilling Fluid Composition:					
8 ½" Hole Section – Salt Polymer					
Product:	Unit Size:	Quantity:	Total Quantity:	Volume: Quantity (lbs):	1814 bbl Concentration (ppb)
CAUSTIC SODA	12.5 KG	24	300	661	0.23
CITRIC ACID	25 KG	14	350	772	0.27
DRILLING STARCH	25 KG	100	2500	5512	1.93
DUOVIS	25 KG	24	600	1323	0.46
EMI-2224	25 LTR	4	100	220	0.08
MI-BAR	25 KG	80	2000	4409	1.54
POLYPAC UL	25 KG	70	1750	3858	1.35
SAFE-CARB 40	25 KG	100	2500	5512	1.93
SAFE-CARB 250	25 KG	100	2500	5512	1.93
SAFE-CARB 500	25 KG	100	2500	5512	1.93
PVD SALT	MT	6	6	13228	4.63
CONQOR 404 NS	200 LTR	2	400	882	0.31
SAFE-CIDE	25 LTR	13	325	717	0.25
LIME	25 KG	9	225	496	0.17
SODIUM CHLORIDE BRINE	BBL	500	500	500	0.17
POTASSIUM CHLORIDE	MT	8	8	17637	6.17
SAFE COR EN	200 LTR	3	600	1323	0.46
SAFE-SCAV NA	25 LTR	1	25	55	0.02

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Following logging of the 8 1/2" hole section below the 7" casing shoe, a 4 1/2" liner will be run 50m into the Lower Carboniferous Limestone, with the liner hanger to be set 150m inside the 7" casing. The liner will be tested to 4,400 psi.

A 3 1/2" completion and tubing will be run for the upper zone and a 2 7/8" completion and tubing for the lower zone. The various targets identified will be perforated to allow any hydrocarbons to flow into the annulus. Hydraulic packers will be set in the well to isolate the petroleum reservoirs. The selective completions will be designed to allow production from either the upper target (the Permian interval) only, the Lower Namurian secondary targets only, or both perforated zones combined. The completion and tubing will provide a conduit for the petroleum to flow to surface.

5.3.4 Well Abandonment and Partial Well Abandonment

In the event that the well(s) is not successful in establishing commercially producible petroleum, the well(s) will be abandoned in accordance with Oil & Gas UK *Guidelines for the suspension and abandonment of wells*, which requires all distinct permeable zones penetrated by the well to be isolated from each other and from surface by a minimum of one permanent barrier. If any permeable zone penetrated by the well is hydrocarbon-bearing or over-pressured and water-bearing then the requirement is for two permanent barriers from surface, the second barrier being a back-up to the first.

In addition to the Oil & Gas UK *Guidelines for the suspension and abandonment of wells*, the well abandonment(s) will be undertaken in accordance with the following regulations:

- The Borehole Sites and Operations Regulations 1995, and
- Offshore Installations and Wells (Design & Construction Regulations 1996)

The initial design and construction of the well(s) takes into consideration the permeable zones encountered during the drilling operation and whether any of these zones are hydrocarbon-bearing or over-pressured and water-bearing. Construction of the boreholes will therefore provide adequate sealing of these zones when cementing in the various steel casing strings, ensuring compliance with the Oil & Gas UK guidance.

Based on a borehole construction, which complies with Oil & Gas UK guidance for the suspension and abandonment of wells, the internal section of last cemented casing string will be subject to well abandonment. The operation involves the setting of cement barriers, extended above and below the permeable zone(s). Rubber cement retainers are positioned within the internal casing string immediately below the required cement depth, which prevents the cement from moving or slumping during setting.

Once the well(s) is abandoned, the casing strings will be mechanically cut off at 1.5m below original ground level and a steel plate welded over the top. The pre-cast concrete drilling cellar would then be removed and the site restored to its former use.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

5.4 Classification of the operations

A review of the proposed Crawberry Hill exploratory operations against applicable environmental legislation has identified the following classifications as being applicable to the wellsite.

5.4.1 Mining Waste Operation

The Environmental Permitting (England and Wales) Regulations 2010, which transposes the requirements of the Mining Waste Directive 2006/21/EC, requires mining waste operations to be authorised. A mining waste operation is defined in Schedule 20 paragraph 2 (1) of EPR 2010 as *‘the management of extractive waste, whether or not involving a mining waste facility’*.

For the purpose of this waste management plan, the Crawberry Hill exploratory operations are classified as a mining waste operation, namely, the management of extractive waste not involving a waste facility.

5.4.2 Installation

Regulation 35 of the Environmental Permitting (England and Wales) (Amendments) Regulations 2013, which amends EPR 2010, transposes the requirements of the Industrial Emissions Directive 2010/75/EU, defines an ‘installation’ as an activity specified within Part 2 of Schedule 1 of EPR 2010, disposal or recovery of waste in waste incineration plants or in waste co-incineration plants for hazardous waste with a capacity exceeding 10 tonnes per day.

As the exploratory operations proposed within the Crawberry Hill wellsite anticipate the incineration of hazardous waste (natural gas) with a capacity exceeding 10 tonnes per day, albeit for a short duration, the Crawberry Hill wellsite is classified as an installation under the Environmental Permitting (England and Wales) Regulations 2010.

6 EXTRACTIVE AND NON EXTRACTIVE WASTE MANAGEMENT

The following section describes the various extractive and non-extractives wastes arising from the Crawberry Hill exploratory operation, their classification and anticipated quantities. This section also describes the objectives of Rathlin Energy to appropriately manage waste and how these objectives are achieved through waste minimisation, methods of treatment and disposal.

6.1 Operator Waste Objectives

The Rathlin Energy policy on waste Duty of Care, waste segregation, waste handling and waste transfer are set out in the Rathlin Energy Environmental Policy Manual (RE-02-002).

The site waste champion for the Crawberry Hill wellsite is the Rathlin Energy HSE Adviser. He will:

- Promote awareness of the Waste Management Plan;
- Monitor and report on waste generation;
- Monitor and enforce waste segregation;
- Monitor the effectiveness of the Waste Management Plan;

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

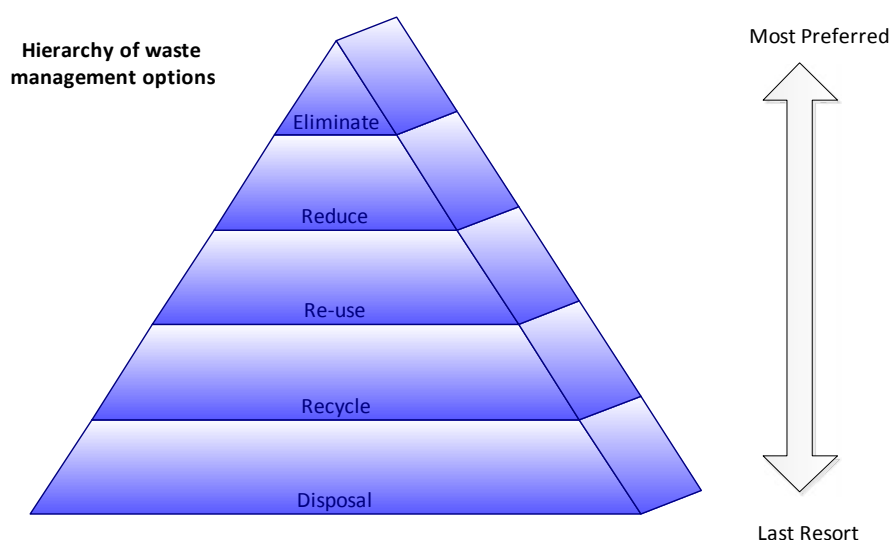
<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

- Form a good working relationship with the waste management contractor; and
- Encourage suggestions for better waste management on site.

6.2 Waste Prevention and Minimisation

The following is an extract from the Rathlin Energy Environmental Policy Manual (RE-02-002), which details the hierarchy of waste management. This hierarchy of waste management has been used when assessing the appropriate waste management arrangements for extractive and non-extractive wastes arising from the Crawberry Hill exploratory operations. Specific waste prevention and minimisation arrangements, together with treatment and disposal methods are provided within Section 6.3.



Eliminate the waste

Every effort will be made to eliminate the waste produced at source. Control measures will include:

- Avoiding packaged material where practicable;
- Ordering correct quantities;
- Avoiding damage by handling and storing correctly.

Reduce the amount of waste produced

This includes planning to reduce over ordering of materials, providing suppliers with sufficient information to supply correctly, avoiding damage or deterioration from poor handling or storage.

Re-use

Only dispose of waste which cannot economically or practically be re-used or recycled. Materials such as drilling fluids can be readily re-used.

Recycle

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Waste will be segregated onsite to allow for recycling off site. Additionally, materials that are recycled shall be procured for use on site where practicable and where specification permits.

Dispose

Waste that cannot be reused or recycled practicably shall be disposed of responsibly and in compliance with Rathlin Energy's duty of care obligations. All waste shall be removed from site by a licenced waste carrier to a licenced waste site.

6.3 Waste Description and Management Arrangements

An assessment of the potential waste arising from the Crawberry Hill exploratory operations has been undertaken. The potential waste, together with its classification, anticipated quantities, prevention, minimisation, treatment and disposal is provided overleaf.

6.3.1 Extractive Waste

Well Suspension Brine		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	01 05 08
	Estimated Quantity	25m ³
	On Site Storage	1 x 60m ³ Horizontal Cylindrical Closed Tank
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	The Crawberry Hill 1 well is currently suspended using a suspension brine and mechanical plugs. The brine is measured at 988g/ltr and is used to fill the wellbore to prevent the ingress of natural gas to the wellbore. During any well intervention work and/or flow testing the suspension brine will be circulated out of the well to an onsite storage tank via temporary surface pipework.	
Waste Prevention and Minimisation	The suspension brine will be stored onsite for subsequent reuse as a suspension brine within the well operation or considered for use at one of Rathlin Energy's other wellsite operations. If it cannot be reused then the suspension brine will become a waste.	
Waste Treatment and Disposal	Once the suspension fluid has fully served its purpose at the wellsite or one of Rathlin Energy's other wellsite operations, the suspension brine will be removed from site via a licenced haulier to an environmental agency permitted waste water treatment works facility where it is processed, treated and discharged in accordance with the permitted	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

	controls of the water treatment facility.
Waste Remaining in the Formation	None. Suspension brine circulated out prior to well intervention and/or flow testing.
Monitoring	An inspection of the fluid tanks that contain the suspension fluid shall be carried out prior to being used and will be subject to visual weekly inspections and annual thickness checks.

Cement (Well Maintenance and Abandonment)		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	17 01 01
	Estimated Quantity	25m ³
	On Site Storage	5 x 6m ³ Plastic lined Open Top Builder's Skip
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	Any cement work that does not meet Rathlin Energy's self-imposed well construction standards (based on industry practice) will undergo cement remediation work. The cement will be used to seal the wellbore annulus completely or in the case of well abandonment a number of cement plugs will be set inside the 7" casing. During either of the potential operations / activity there is the possibility for excess cement returns to surface.	
Waste Prevention and Minimisation	Careful planning will be taken prior to any cement operation being undertaking allowing Rathlin Energy to calculate the amount of cement required thus preventing or minimising cement waste. The cement will be batched mixed to allow control of quantities being used, which further prevents and/or minimises cement waste. The cement operation will be undertaken by a competent contractor to reduce the amount of potential wastes produced from the returns to surface. The cement that is to be used will be batched mixed on site to allow control over quantities and preventing unnecessary waste being produced. It is to be noted that the amount of waste cement expected is to be minimal.	
Waste Treatment and Disposal	Excess returns to surface will be transferred to a number of open top builders skips onsite for subsequent removal and disposal to an	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

Rathlin Energy	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

	environmental agency permitted waste facility where it recycled as building rubble for use within the building industry. Each skip will be filled individually until full then begin filling the next one and so on. The operation is of short duration (4 hours).
Waste Remaining in the Formation	None. Cement remaining within the formation is a critical component of the well construction and remains so throughout the life cycle of the well. It is not considered a waste.
Monitoring	Rathlin Energy provide competent supervisor to review the cement calculations to prevent and / or minimise cement waste. The building skips will be inspected prior to use to ensure they are suitable for holding cement.

Spent Hydrochloric Acid (Calcium Chloride)		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	16 10 02
	Estimated Quantity	11m ³ per squeeze
	On Site Storage	11 x 1m ³ IBC Containers (Bunded)
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	Hydrochloric acid is used to wash and clean out natural fractures within carbonate formations, having potentially being blocked as a result of the initial drilling operations. In addition, hydrochloric acid is squeezed into the natural fractures of the carbonate formation under pressure, increasing the near hole permeability. The reaction of the hydrochloric acid with the calcite or dolomite produces calcium chloride and is unavoidable, which is classified as non-hazardous. The calcium chloride, a result of the reaction with the carbonate formation ($2\text{HCl} + \text{CaCO}_3 \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$), will be reversed circulated out of the wellbore into 1m³ IBC containers and stored onsite for subsequent removal via a licenced haulier to an environmental agency permitted waste water treatment works facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.	
Waste Prevention and Minimisation	The hydrochloric acid will be used in stages to ensure its use is minimised the reaction of the hydrochloric acid with the calcite or dolomite produces calcium chloride. This reaction, and in turn the waste generated, is unavoidable.	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

Rathlin Energy	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

	Careful planning will be taking prior to any acid wash or squeeze being undertaking to ensure Rathlin Energy minimises the amount of acid used which in turn reduces the amount of waste generated as a result of the operation hydrochloric acid required.
Waste Treatment and Disposal	The calcium chloride will be reversed circulated out of the wellbore into a number of 1m ³ IBC containers and stored onsite for subsequent removal via a licenced haulier to an environmental agency permitted waste water treatment works facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.
Waste Remaining in the Formation	None. The reaction of the hydrochloric acid with the calcite or dolomite produces calcium chloride, which is classified as non-hazardous. The calcium chloride will be reverse circulated out of the formation and collected at surface.
Monitoring	Rathlin Energy provides competent supervisors to oversee the operation ensuring the correct volumes of hydrochloric acid are used. The IBC containers will be inspected prior to use to ensure they are suitable for holding calcium chloride.

Formation Water		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	16 10 02
	Estimated Quantity	16m ³ per test
	On Site Storage	4 x 60m ³ Horizontal Cylindrical Closed Tank
	Storage Duration	3 Months to Allow for Radionuclide Analysis
	Odour Potential	No Odour Anticipated
Operation / Activity	During flow testing operations there is a possibility of formation water being produced together with petroleum. Formation water is separated from the petroleum on surface using temporary fluid separation equipment and transferred via temporary pipework to cylindrical storage tanks located onsite for offsite removal. The formation water has the potential to contain low levels of Naturally Occurring Radioactive Material (NORM) samples of formation water will be sent to a laboratory holding the appropriate accreditations for radionuclides analysis by gamma spectrum.	
Waste Prevention and	The ability to prevent or minimise formation water is extremely limited. Given that the operation is exploratory, no consideration has been	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Minimisation	given at this stage for reinjection of produced formation water.
Waste Treatment and Disposal	Depending on the outcome of radionuclides analysis formation water will be transported via a licenced haulier to either an environmental agency permitted waste water treatment works facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility, or to a bespoke RSR permitted waste treatment facility for treatment and disposal in accordance with the Best Available Technique (BAT) produced by Studsvik UK Limited.
Waste Remaining in the Formation	None. Formation water naturally occurs within the formation and is only considered as a waste when produced from the well.
Monitoring	A contamination monitoring programme will be devised and include the wellhead temporary separator equipment and storage tanks. Consignment of formation water will be screened externally for contamination prior to leaving site. An inspection of the fluid tanks that contain the formation water shall be carried out prior to being used and will be subject to visual weekly inspections and annual thickness checks.

Natural Gas		
Waste Classification, Quantity and Storage	Classification	Hazardous
	LOW Code	Not Applicable
	Estimated Quantity	141,584m ³ per day (10 days)
	On Site Storage	None – Incineration by Ground Flare
	Storage Duration	Not Applicable
	Odour Potential	No odour anticipated
Operation / Activity	During flow testing operations there is a likelihood of natural gas being produced from the formation and flowed at different rates to determine the characteristics of the formation, allowing Rathlin Energy to determine whether or not the reservoir is sufficient enough to produce commercial quantities of natural gas. A period of flowing the natural gas is followed by a period of shutting in the well to monitor pressure build up. At the point of incineration the natural gas is considered a waste.	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

Rathlin Energy	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Waste Prevention and Minimisation	The ability to prevent or minimise natural gas is extremely limited during this operation as it is required to allow Rathlin Energy to determine the condition and state of the reservoir. Given that the operation is exploratory, no consideration has been given at this stage to capture the gas for sale and transportation for reuse as a fuel or other means of generating energy.
Waste Treatment and Disposal	Natural gas is separated from produced fluids at surface and diverted via temporary pipework to a ground flare located onsite for incineration. The ground flare will be fitted with a pilot and an electrical ignition system. The flare will also be continuously propane fed to allow for a continuous flame. The incineration of natural gas is subject to a separate air modelling and dispersion report included within this waste management plan.
Waste Remaining in the Formation	None. Natural gas naturally occurs within certain hydrocarbon bearing formations and is only considered as a waste when produced from the well.
Monitoring	During flaring operating the flare will be supervised 24 hours a day to monitor the flare ensuring its effectiveness to incinerate the natural gas. In addition, air emissions monitoring will be carried out and includes: • H₂S • BTEX / VOCs • Methane • Sulphur dioxide • Nitrogen oxide • Ozone

Nitrogen		
Waste Classification, Quantity and Storage	Classification	Inert
	LOW Code	Not Applicable
	Estimated Quantity	Not Known at this Time
	On Site Storage	None – Vented to Atmosphere
	Storage Duration	Not Applicable
	Odour Potential	No Odour Anticipated

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Operation / Activity	Nitrogen is injected into the well to aid the initial lifting of wellbore fluids, thus reducing the hydrostatic pressure and allowing natural gas to flow to surface.
Waste Prevention and Minimisation	The use of nitrogen can be classified as a closed loop system due to the nitrogen having been first taken from the atmosphere during its manufacture process and then vented back into the atmosphere as the well is flowed. The quantities of nitrogen required are small and a detailed measurement cannot be provided at this stage.
Waste Treatment and Disposal	As an inert gas, nitrogen that has been extracted from the atmosphere will be vented back into the atmosphere without any treatment being necessary.
Waste Remaining in the Formation	None. Nitrogen injected into the well to aid the initial lifting of wellbore fluids will flow to surface.
Monitoring	The volumes of nitrogen will be monitored both in and out of the well.

Chalk cuttings (Second Exploratory Well)		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	01 04 09
	Estimated Quantity	184m ³
	On Site Storage	1 x 31m ³ Open Square Tank
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	The drilling of the secondary exploratory borehole will commence with drilling and installation of a casing string known as a surface conductor. The drilling operation will be carried out using a waterwell drilling rig which will use fresh water to conventionally drill the near surface chalk within which the surface conductor casing will be set and cemented into position. The chalk will be circulated out of the well using fresh water and return to the surface where it is transferred to an open square tank.	
Waste Prevention and Minimisation	The ability to prevent or minimise chalk arisings is limited given that the formation needs to be removed to allow the conductor casing to be installed. The selection of the drilling bit will be such that it minimises	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

	the hole size required to install the conductor casing which in turn keeps the chalk arising's to a minimum.
Waste Treatment and Disposal	The chalk will be transported offsite via a licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.
Waste Remaining in the Formation	None. Naturally occurring formation.
Monitoring	Rathlin Energy provides competent supervision to ensure the operation is carried out in accordance with an approved drilling programme. An inspection of the open square tank that contain the clay and sand shall be carried out prior to being used and will be subject to visual weekly inspections and annual thickness checks.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Fresh Water Drilling Muds and Waste (Second Exploratory Well)		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	01 05 04
	Estimated Quantity	455m ³
	On Site Storage	Minimum 95m ³ Open Top Active Tank System on Rig. 1 x 31m ³ Open Top Tank (Drill Cuttings) and 1 x 20m ³ Open Top Tank (Centrifuge)
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	Drilling muds are used to aid in the drilling process by lubricating the drill bit, circulating to surface the rock cuttings from the drilling process and for well control by maintaining a prescribed hydrostatic pressure within the well to prevent the uncontrolled release of natural gas or formation pressure. Drilling muds are used in a closed loop system, within which the rock cuttings are circulated to surface and removed by vibrating screens (shakers). Finer particles of rock cuttings are then extracted from the drilling mud by a centrifuge and the drilling mud is circulated back down the well.	
Waste Prevention and Minimisation	Drilling mud waste is minimised by continually reusing the mud in a closed loop system and sustained by way filtering out rock cuttings and finer particles of rock. The rock cuttings tank is a fluid separator tank (perforated false floor), which allows drilling muds coated to the rock cuttings to percolate down through the false floor where it is collected and pumped back into the closed loop mud system. When the drilling mud weight exceeds the prescribed mud weight, having been utilised all means to remove the finer particles, will the drilling mud need to be diluted. Dilution required the removal of a prescribed volume of active drilling mud and diluting the remaining volume with new drilling mud. Periodically, the drilling mud system will be completely changed and will depend on the formation being drilled.	
Waste Treatment and Disposal	Drilling muds are used in a closed loop system and become a waste when no longer required for use in the operation. In such an event the drilling mud will be transferred from the active mud system on the drilling rig to a vacuum tanker for removal offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Waste Remaining in the Formation	None. Any drilling muds remaining within the formation exist as a filter cake on borehole wall and forms part of the well construction. It is not considered a waste.
Monitoring	Rathlin Energy provides competent supervision to ensure the operation is carried out in accordance with an approved drilling programme. An inspection of the mud tank system, including transfer lines, hoses etc. shall be carried out prior to being used and will be subject to visual weekly inspections and annual thickness checks.

Chloride Containing Drilling Muds and Waste (Second Exploratory Well)		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	01 05 08
	Estimated Quantity	666m ³
	On Site Storage	Minimum 95m ³ Open Top Active Tank System on Rig. 1 x 31m ³ Open Top Tank (Drill Cuttings) and 1 x 20m ³ Open Top Tank (Centrifuge)
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	Drilling muds are used to aid in the drilling process by lubricating the drill head, circulating to surface the rock cuttings from the drilling process and for well control by maintaining a prescribed hydrostatic pressure within the well to prevent the uncontrolled release of natural gas or formation pressure. Drilling muds are used in a closed loop system, within which the rock cuttings are circulated to surface and removed by vibrating screens (shakers). Finer particles of rock cuttings are then extracted from the drilling mud by a centrifuge and the drilling mud is circulated back down the well.	
Waste Prevention and Minimisation	Drilling mud waste is minimised by continually reusing the mud in a closed loop system and sustained by way filtering out rock cuttings and finer particles of rock. The rock cuttings tank is a fluid separator tank (perforated false floor), which allows drilling muds coated to the rock cuttings to percolate down through the false floor where it is collected and pumped back into the closed loop mud system. When the drilling mud weight exceeds the prescribed mud weight, having been utilised all means to remove the finer particles, will the drilling	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

	mud need to be diluted. Dilution required the removal of a prescribed volume of active drilling mud and diluting the remaining volume with new drilling mud. Periodically, the drilling mud system will be completely changed and will depend on the formation being drilled.
Waste Treatment and Disposal	Drilling muds are used in a closed loop system and become a waste when no longer required for use in the operation. In such an event the drilling mud will be transferred from the active mud system on the drilling rig to a vacuum tanker for removal offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.
Waste Remaining in the Formation	None. Any drilling muds remaining within the formation exist as a filter cake on borehole wall and forms part of the well construction. It is not considered a waste.
Monitoring	Rathlin Energy provides competent supervision to ensure the operation is carried out in accordance with an approved drilling programme. An inspection of the mud tank system, including transfer lines, hoses etc. shall be carried out prior to being used and will be subject to visual weekly inspections and annual thickness checks.

Water Based Rock Cuttings (Second Exploratory Well)		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	01 04 08
	Estimated Quantity	355m ³
	On Site Storage	1 x 31m ³ Open Top Fluid Separator Tank (Drill Cuttings) and 1 x 20m ³ Open Top Tank (Centrifuge)
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	Drilling muds are used in a closed loop system, within which the rock cuttings are circulated to surface and removed by vibrating screens (shakers) into an open top tank, which is also a fluid separator tank. Finer particles of rock cuttings are then extracted from the drilling mud by a centrifuge and the drilling mud is circulated back down the well.	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Waste Prevention and Minimisation	The ability to prevent or minimise rock cuttings arisings is limited given that the formation needs to be removed to allow the casing to be installed. The selection of the drilling bit will be such that it minimises the hole size required to install each string of casing which in turn keeps the arisings to a minimum. The rock cuttings tank is a fluid separator tank (perforated false floor), which allows drilling muds coated to the rock cuttings to percolate down through the false floor where it is collected and pumped back into the closed loop mud system.
Waste Treatment and Disposal	Rock cuttings will be transferred from the rock cuttings tank to a sealed road bulker by a hydraulic grab arm fitted to the rock cuttings tank and transported offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.
Waste Remaining in the Formation	None. Naturally occurring formation.
Monitoring	Rathlin Energy provides competent supervision to ensure the operation is carried out in accordance with an approved drilling programme. An inspection of the rock cuttings tanks shall be carried out prior to being used and will be subject to visual weekly inspections and annual thickness checks.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

Rathlin Energy	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

Salt Saturated and KCL Rock Cuttings (Second Exploratory Well)		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	01 05 08
	Estimated Quantity	223m ³
	On Site Storage	1 x 31m ³ Open Top Fluid Separator Tank (Drill Cuttings) and 1 x 20m ³ Open Top Tank (Centrifuge)
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	Drilling muds are used in a closed loop system, within which the rock cuttings are circulated to surface and removed by vibrating screens (shakers) into an open top tank, which is also a fluid separator tank. Finer particles of rock cuttings are then extracted from the drilling mud by a centrifuge and the drilling mud is circulated back down the well.	
Waste Prevention and Minimisation	The ability to prevent or minimise rock cuttings arisings is limited given that the formation needs to be removed to allow the casing to be installed. The selection of the drilling bit will be such that it minimises hole size required to install each string of casing which in turn keeps the waste arisings to a minimum. The rock cuttings tank is a fluid separator tank (perforated false floor), which allows drilling muds coated to the rock cuttings to percolate down through the false floor where it is collected and pumped back into the closed loop mud system.	
Waste Treatment and Disposal	Rock cuttings will be transferred from the rock cuttings tank to a sealed road bulker by a hydraulic grab arm fitted to the rock cuttings tank and transported offsite via licenced haulier to a permitted composting facility where it is blended into compost after compost has been sanitised.	
Waste Remaining in the Formation	None. Naturally occurring formation.	
Monitoring	Rathlin Energy provides competent supervision to ensure the operation is carried out in accordance with an approved drilling programme. An inspection of the rock cuttings tanks shall be carried out prior to being used and will be subject to visual weekly inspections and annual	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

	thickness checks.	
Cement (Casing Cementation)		
Waste Classification, Quantity and Storage	Classification	Non Hazardous
	LOW Code	17 01 01
	Estimated Quantity	25m ³
	On Site Storage	5 x 6m ³ Open Top Builder's Skip
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	On completion of the drilling of every hole section, steel casing is installed and cemented into position. Cemented is batch mixed on site and pumped through and out of the steel casing filling the void (annulus) between the borehole wall and the outside of the steel casing. In the shallow sections of the well, cement volumes are designed and required to return to surface and therefore cement as a waste is anticipated.	
Waste Prevention and Minimisation	Careful planning will be taken prior to any cement operation being undertaken allowing Rathlin Energy to calculate the amount of cement required thus preventing or minimising cement waste. The cement will be batched mixed to allow control of quantities being used, which further prevents and/or minimises cement waste. The cement operation will be undertaken by a competent contractor to reduce the amount of potential wastes produced from the returns to surface. The cement that is to be used will be batched mixed on site to allow control over quantities and preventing unnecessary waste being produced. It is to be noted that the amount of waste cement expected is to be minimal.	
Waste Treatment and Disposal	Excess returns to surface will be transferred to a number of open top builders skips onsite for subsequent removal and disposal to an environmental agency permitted waste facility where it recycled as building rubble for use within the building industry.	
Waste Remaining in the Formation	None. Cement remaining within the formation is a critical component of the well construction and remains so throughout the life cycle of the well. It is not considered a waste.	
Monitoring	Rathlin Energy provide competent supervisor to review the cement calculations to prevent and / or minimise cement waste. The building	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

	skips will be inspected prior to use to ensure they are suitable for holding cement.
--	--

6.3.2 Non Extractive Waste

During the Crawberry Hill exploratory operations there will be non extractive wastes generated on site:

- Surface run-off water
- Waste water and sewage
- Potential minor fuel oil spills
- Waste engine, gear and lubricating oils
- Waste hydraulic oils
- Oil rags and absorbents
- Waste oil filters
- Paper and cardboard
- Canteen waste
- Wood
- Metal

There will be no treatment or disposal of non extractive waste on site and any storage will be limited to temporary storage, pending collection. No temporary storage of non-extractive waste will exceed 12 months.

7 ENVIRONMENTAL RISK ASSESSMENT

An environmental risk assessment has been carried out in support of a permit application and is based on a conceptual model derived from a true representation of the subsurface geology encountered during the drilling of CH1 using the Horizontal Guidance Note H1 Environmental Risk Assessment for permits. (Version 2.1, December 2011) and the EPR6 14: How to comply with your environmental permit: Additional guidance for: mining waste operations, Version 2, February 2011.

The environmental risk assessment follows the following H1 structure:

- Identify the risk from the activity
- Assess risks and check they are acceptable
- Justify appropriate measures to control the risk (if needed)
- Present the risk assessment

In assessing the risk the appropriate H1 annexes have been referenced:

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

- Annex (a) Amenity and accident risks from installations and waste operations
- Annex (d) Surface Water (basic)
- Annex (f) Air emissions
- Annex (g) Disposal and recovery of waste produced on site
- Annex (h) Global warming potential
- Annex (j) Groundwater
- Annex (k) Justifying and cost-benefit analysis of control measures

A copy of the environmental risk assessment, together with a supporting statement and conventional model is included within 'Crawberry Hill Wellsite Environmental Risk Assessment' (RE-05-EPRA-CH-007) provided in support the environmental permit application.

8 MEASURES TO MINIMISE ENVIRONMENTAL IMPACT

Measures to minimise the environmental impact of the operation have been incorporated as part of the initial site selection process, site design and construction through to subsequent exploration operations. The measures to mitigate long term environmental impact are:

- Site located suitable distance from residential properties
- Site located away from any statutory designated areas
- Baseline monitoring of ecology, noise, water
- Hydrogeological risk assessment
- Site design to include impermeable membrane and containment ditches
- Wellbore lifecycle design to protect groundwater
- Hierarchy of waste management
- Operating procedures and inductions
- Waste handling, storage and disposal regime
- Continuous Training and development
- Environmental monitoring
- Restoration and aftercare

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

9 CONTROL AND MONITORING OF WASTE

The environmental risk assessment has identified the requirement to control and monitor waste generated from the exploratory operation. The following waste shall be monitored:

9.1 Release to Ground Water

The potential for a release to ground water exists both at surface and within the subsurface.

9.1.1 Surface Release

Incorporated into the design of the wellsite is an impermeable membrane constructed using fully welded 1mm HDPE, protected above and below with non-needle punch geotextile. The impermeable membrane prevents surface fluids (mainly rainwater) penetrating the underlying subsoils. Surface fluids migrate along the surface of the impermeable membrane to a perimeter ditch, where it is contained for subsequent reuse in the operation.

Daily inspections of the drainage ditch are undertaken to ensure the level does not exceed the maximum containment of the ditch. If the level is close to reaching the maximum containment of the ditch, the surface fluids are removed by road tanker for subsequent disposal at an approved waste facility.

A daily inspection of all tanks and other waste storage containers shall be undertaken to ensure they remain fit for purpose. The inspections will aid early identification of any potential release to site from equipment which deteriorates over time.

9.1.2 Subsurface Release

Drilling muds and other fluids used in well operations are strictly monitored to ensure an accurate understanding of fluid volumes lost, gained or, in the case of cement, placed in the subsurface. During drilling operations, the volumes of fluids pumped, together with the volumes of fluid within the tanks are continually monitored by a geological logging company (mud loggers). Such monitoring can identify loss of drilling muds to the formation. In the event that losses occur, loss circulation material (LCM) is provided on site to stem the losses.

A scheme of groundwater monitoring was implemented prior to the well being constructed, which provided a baseline for groundwater quality. The scheme was implemented during well construction and will be implemented during subsequent exploratory operations. The monitoring scheme includes an analysis of:

- Turbidity
- pH
- Total suspended solids
- Alkalinity
- Hardness

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE

MANAGEMENT

- Sulphate
- Chloride
- Nitrate
- Calcium
- Magnesium
- Potassium
- BTEX
- TPH

9.2 Air Emissions

A scheme of air emissions monitoring was implemented prior to the well being constructed, which provided a baseline for air quality. The scheme was implemented during well construction and will be implemented during the subsequent exploratory operations. The monitoring scheme includes:

- H₂S
- BTEX/VOCs
- Methane
- Sulphur Dioxide
- Nitrogen Oxide
- Ozone

No significant emissions to air are expected from the waste streams.

9.3 Noise

A noise monitoring scheme has been implemented to ensure compliance with planning permission.

9.4 Lighting

Planning permission required the submission of a lighting plan, included as Appendix 7. The lighting plan has been implemented to ensure compliance with planning permission and periodic monitoring of the lighting is undertaken to ensure light overspill is reduced to a minimum.

9.5 Traffic

Planning permission required the submission of a traffic management plan and wheel washing facilities to prevent mud being brought out of site onto public highway. The traffic management plan and wheel washing facilities is included as Appendix 8. The traffic management plan has been implemented to ensure compliance with planning permission and periodic monitoring of the plan and wheel washing facilities is undertaken.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

9.6 Contractor Performance

Rathlin Energy is ultimately responsible for any waste generated on site during the Crawberry Hill exploratory operations. Rathlin Energy will not delegate its responsibilities or accountabilities as Operator to a contractor.

Contractors, who are involved in the generating of waste and subsequent reuse, recycle or disposal will first have been selected in accordance with Rathlin Energy's Management of Contractor's Safety and Performance Standard (RE-03-002) and, under that standard, are then subject to periodic monitoring of their performance.

9.7 Security

Security of the wellsite is provided in the form of fencing and lockable gates. Additional fencing is provided around the wellhead when the site is unmanned. A CCTV camera is also active when the site is unmanned and a roaming security detail is provided, carrying out routine visits to the wellsite.

During well operations, 24 hours onsite security is provided. Security control access and egress to the wellsite and play a key role in the control of personnel in the event of an emergency situation, in accordance with the Site Safety Document, a requirement of the Borehole Sites and Operations Regulations 1995.

9.8 Complaints

In the event that a complaint is received from stakeholders, including neighbours, the complaint shall be recorded and investigated in accordance with Rathlin Energy's safety and environmental management system.

Complaints relating to the environment will be reported to the Environment Agency, actions to prevent reoccurrence will be agreed, together with a programme for implementation. Implementation of the actions will be monitored and the Environment Agency informed.

10 ENVIRONMENTAL INCIDENT MANAGEMENT

The potential for an environmental incident to occur during the operation is minimal. The source of such incident is contained within the wellbore and contained within the wellsite.

10.1 Containment within the Wellbore

Well control equipment is deployed on the well in accordance with API RP53 'Recommended Practice for Blowout Prevention Equipment Systems for Drilling Wells'. Well control equipment is considered secondary well control in the event that the primary well control, hydrostatic fluid weight, is compromised. Well control equipment is subject to a schedule of certification and testing, together with a requirement for those operating well control equipment to be certified competent.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

10.2 Wellsite Containment

Incorporated into the design of the wellsite is an impermeable membrane constructed using fully welded 1mm HDPE, which prevents any environmental spillages on site penetrating the underlying subsoils and contains the spill within a containment ditch for subsequent reuse, recycle or disposal.

In addition to general spill containment and clean up equipment provided on site, a substantial environmental incident response trailer is provided. The trailer contains equipment necessary to minimise and if possible contain an environmental incident in the unlikely event that the impermeable membrane or containment ditch is compromised. The equipment provides for damming of any nearby water course and subsequent clean up, including temporary bunding of spent clean-up equipment.

In the very unlikely event of an environmental incident occurring beyond the capabilities of the equipment or personnel on site then a specialist contractor, Veolia Environmental Services, based in Hull will be called to assist Rathlin Energy in dealing with the incident.

10.3 Fire Response

Whilst a fire is associated more so with the health and safety of the personnel on site, a fire does have the potential to lead to an environmental incident. It is imperative, therefore, that any potential for a fire and subsequent emergency response is identified and included in the operational planning. The Site Safety Document, which is a requirement under Regulation 7 of the Boreholes Sites and Operations Regulations 1995, specifies the arrangements for identification and mitigation in the event of a fire, including consultation with the local Fire & Rescue Service.

Containment of any firefighting fluid is provided by the impermeable membrane incorporated in to the design of the wellsite. In the event that such requirements were to be necessary, continued monitoring of the containment ditch shall be implemented to ensure it does not exceed its containment capacity.

Additional water is available on site and should be used to keep the areas adjacent to the fire cool to avoid any damage being sustained to the impermeable membrane.

10.4 Incident Reporting and Investigation

All incidents, no matter how minor, are reported in accordance with Rathlin Energy's Incident Accident Reporting and Investigation Standard (RE-03-008). The standard provides for the investigation of all incidents to ensure lessons are captured and actions implemented to avoid reoccurrence.

In addition, the standard provides for the notification to the relevant Regulatory Authority in the event of an incident which extends beyond the containment of the wellsite.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

11 ALTERATIONS TO THE PLAN

Any required changes or deviations from this plan are to be referred to the Rathlin Energy HSE & Planning Manager or to the site HSE Adviser in the first instance. No changes to or deviations from this plan are to be implemented until the required changes or deviations have been reviewed and approved by Rathlin Energy and the relevant approvals obtained in writing from the Environment Agency for any changes to the plans and operating techniques approved under the environmental permit to be issued.

12 PLAN FOR CLOSURE

The wellsite is currently being used for petroleum exploration activities to determine whether petroleum is present in the substrata and, if so, in commercial quantities.

In the event that the well(s) is deemed not capable of producing commercial quantities of petroleum a decision will be made to abandon the well in accordance with Oil & Gas UK Guidelines for the *suspension and abandonment of wells* and restore the site. In such an event, a closure plan will be created in accordance with section 3.4 of the Environment Agency's guidance "How to comply with your environmental permit, additional guidance for: mining waste operations" as part of any application to surrender the environmental permit. Wellsite restoration will be the subject of a separate waste management plan.

Other regulations relevant to the closure plan include:

- The Borehole Sites and Operations Regulations 1995, and
- Offshore Installations and Wells (Design & Construction Regulations 1996
- Petroleum Act 1998 (Petroleum Exploration and Development Licence)

In the event that the well is deemed capable of producing commercial quantities of petroleum then applications to vary existing permits and/or acquire new permits to permit the subsequent production of petroleum will be submitted to the Environment Agency.

Until such time as the new permits are obtained, which for clarity will include a new planning permission to produce petroleum, the well will be suspended using a well suspension brine and mechanical plugs set within the borehole to safely isolate the well from the surface. All equipment associated with the exploratory operations will be removed and wellsite made secure. The wellsite will then be inspected and monitored daily by Rathlin Energy.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

APPENDIX 1 – RATHLIN ENERGY CORPORATE INFORMATION

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

*** Page Left Blank Intentionally ***

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

RATHLIN ENERGY CORPORATE INFORMATION

Register Office:

Rathlin Energy (UK) Limited
20-22 Bedford Row
London
WC1R 4JS

Company Registration No: 06478035

Principal Office:

Rathlin Energy (UK) Limited
8 Wimpole Street
London
W1G 9SP

Tel: 020 7269 9861

Web: www.rathlin-energy.co.uk

Field Office:

Rathlin Energy (UK) Limited
Suite 4, Albion House
Albion Lane
Willerby
East Riding of Yorkshire
HU10 6TS

Tel: 01482 363630

24 Hour Emergency Number:

0800 1959154

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

*** Page Left Blank Intentionally ***

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

APPENDIX 2 – RATHLIN ENERGY ENVIRONMENTAL POLICY MANUAL

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

*** Page Left Blank Intentionally ***

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014



Environmental Management System POLICY MANUAL

Rathlin Energy

David Montagu-Smith
Chairman of the Board
January 2013

This document sets out Rathlin Energy's Environmental Management System (EMS). It highlights the systematic approach in the way Rathlin Energy manages its business activities and the belief that our performance can always be improved over time. The management system integrates environmental performance into our day to day business activities and is the key to successful environmental management.

Rathlin Energy	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

CIRCULATION LIST

This Policy Manual is a controlled document. The Rathlin Energy Health, Safety and Environmental Advisor must ensure that all amendments are circulated and obsolete copies are removed and filed.

This Policy Manual is distributed to the following personnel by the Rathlin Energy Health, Safety and Environmental Advisor.

Copy No:	Recipient:	Position:	Location:
Master	Jonathan Foster	Health, Safety and Environmental Manager	London Office, UK
1	David Montagu-Smith	Chairman	London Office, UK
2	Tom Selkirk	Operations Manager	London Office, UK
3	Caroline Foster	Operations Engineer	Willerby Office, UK
4	Richard Sands	Consultant Drilling Manager	MDC Bridlington Office, UK
5			
6			
7			
8			
9			
10			

All employees shall have access to this Policy Manual held in the London office under the control of the Rathlin Energy Health, Safety and Environmental Advisor.

Printed copies of this document, other than those listed above, will not be revised. As a result, such copies are considered “*Uncontrolled Copies*” and shall be marked accordingly.

AMENDMENT HISTORY

This document is amended by the distribution of new revisions of all or part of Policy Manual to the personnel detailed within the Circulation List. The history of amendments is recorded below.

Date:	Revision No:	Section / Page No. Revised:	Reason for Revision:	New Revision No:	Authorised By:
01/01/2012	0	All	First Issue	1	JFo
09/01/2013	1	All	Annual Review	2	JFo

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

FOREWARD

Rathlin Energy recognises the importance of an effective Environmental Management System (EMS) which contributes significantly to the company's long-term business strategy.

This document sets out Rathlin Energy's Environmental Management System (EMS). It highlights the systematic approach in the way Rathlin Energy manages its business activities and the belief that our performance can always be improved over time. The management system integrates environmental performance into day to day business activities and is the key to successful environmental management.

The application of its processes, interactions and implementations, requires participation and commitment from personnel throughout the organisation and contractors at all levels.

It is imperative that everyone involved in the business of Rathlin Energy familiarise themselves fully with their roles and responsibilities within the document to ensure there is a unified joint effort and commitment. Only by total commitment by everyone can we ensure a positive organisational culture and the best possible protection of our employees, contractors, the public, our assets and the environment.

Rathlin Energy Corporate Health, Safety and Environmental Policy is contained in (RE-01-001) and the Environmental Protection Policy is contained in (RE-01-002).

David Montagu-Smith
Chairman of the Board
Rathlin Energy

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Contents

1. TERMINOLOGY	5
2. PURPOSE	5
3. SCOPE.....	5
3.1 DEFINITIONS	6
4. ENVIRONMENTAL MANAGEMENT SYSTEM REQUIREMENTS.....	7
4.1 GENERAL REQUIREMENTS	7
4.2 ENVIRONMENTAL POLICY	7
4.3 PLANNING.....	8
4.3.1 ENVIRONMENTAL ASPECTS	8
4.3.2 LEGAL AND OTHER REQUIREMENTS	12
4.3.3 OBJECTIVES, TARGETS AND PROGRAMMES	14
4.4 IMPLEMENTATION AND OPERATION	14
4.4.1 RESOURCES, ROLES, RESPONSIBILITY AND AUTHORITY.....	14
4.4.2 COMPETENCE, TRAINING AND AWARENESS.....	18
4.4.3 COMMUNICATION	19
4.4.4 DOCUMENTATION AND RECORDS.....	21
4.4.5 ENVIRONMENTAL OPERATIONAL CONTROL	22
4.4.6 ENVIRONMENTAL CONTROL ARRANGEMENTS.....	23
4.4.7 EMERGENCY PREPAREDNESS AND RESPONSE	28
4.5 CHECKING	29
4.5.1 MONITORING AND MEASUREMENT	29
4.5.2 NON-CONFORMITY AND CORRECTIVE AND PREVENTATIVE ACTION	30
4.5.3 INTERNAL AUDIT.....	31
4.6 MANAGEMENT REVIEW	33

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

1. Terminology

Term	Use of Term Implies	Dispensation for Area Covered by Term All dispensations are to be recorded and retained in the Management of Change Form (RE-05-FO-001)
<u>Must</u>	Legislative Requirement.	No dispensation can be granted. Inform Chairman of the Board.
<u>Shall</u>	Minimum requirement stipulated across assets/sites.	Approval by Operations Manager
<u>Should</u>	UK Best Practice or Recommended/Preferred option	Approval by Operations Manager and/or Health, Safety and Environmental Advisor.

2. Purpose

The purpose of this document is to enable Rathlin Energy to develop and implement a policy and objectives that take account of legal requirements and other requirements to which Rathlin Energy subscribes. This is in line with the requirements of the International Standards Organisation (ISO) 14001 Environmental Management System (EMS).

The 'other requirements' to which Rathlin Energy subscribes include the Safety Management System (SMS), other Rathlin Energy practices, Environmental Agency (EA) obligations, commitments to partners in joint ventures and corporate obligations such as annual environmental reporting.

This document should be read in conjunction with the site specific Environmental Plan (RE-04-006) and the site specific Health and Safety Plan as required under the Borehole Sites and Operations Regulations (BSOR) 1995.

3. Scope

This document applies to all Rathlin Energy's operated sites and facilities in the United Kingdom involved in exploration, production, transportation, processing and storage of hydrocarbons and all contractors who work on these sites. It also includes all aspects within British Standard (BS European Norm (EN) ISO 14001 that are deemed to be applicable.

Contractors-operated facilities will be managed in accordance with contractor management processes.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

3.1 Definitions

Environment

Surrounding in which Rathlin Energy operates, including air, water, land, subsoil, natural resources, flora, fauna, humans, and their interrelation.

Environmental Aspect

Elements of Rathlin Energy activities, products or services that can interact with the environment. A significant environmental aspect can, or has the potential to, have a significant environmental impact.

Environmental Impact

Any change to the environment, whether adverse or beneficial, that is wholly or partially resulting from Rathlin Energy environmental aspects.

Environmental Management System

Environmental Management System used to develop and implement its environmental policy and manage its environmental aspects.

Environmental Objective

Overall environmental goal, consistent with the environmental policy, that Rathlin Energy sets itself to achieve.

Environmental Performance

Measurable results of the management of Rathlin Energy environmental aspects.

Health, Safety and Environmental Policy

Overall intentions and direction of Rathlin Energy related to its environmental performance, as formally expressed by the Chairman of the Board.

Environmental Target

Detailed performance requirements, applicable to Rathlin Energy arising from the environmental objectives and that needs to be set and met in order to achieve those objectives.

Internal Audit

Systematic, independent of the site and documented process for obtaining audit evidence and evaluating it objectively to determine the extent to which the EMS audit criteria set by Rathlin Energy are fulfilled.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

4. Environmental Management System Requirements

4.1 General Requirements

Rathlin Energy **shall** establish, document, implement, maintain and continually improve an EMS in accordance with the requirements of ISO 14001 and **shall** determine how it will fulfil these requirements.

4.2 Environmental Policy

Aim

The environmental policy directs Rathlin Energy in its overall goal of meeting ‘no damage to the environment’ and also meets ISO 14001 Requirement 4.2 Environmental Policy, through committing to:

- Preventing pollution;
- Continual improvement of environmental performance;
- Compliance with applicable legal requirements and with other requirements to which Rathlin Energy subscribes;
- Rathlin Energy Health, Safety and Environmental Policy (RE-01-001);
- Rathlin Energy Environmental Protection Policy (RE-01-002).

Process

The following sub-heading describes the responsibilities for the development and review of the policy, with details of how it is communicated both internally and externally.

Policy Development

The policy is developed by the Chairman of the Board, on behalf of the Rathlin Energy Board, incorporating best industry practices and to be applicable to all assets/sites.

Policy Review and Publication

The annual management review considers whether policy needs updating to support the outputs of the review. The policy will also be reviewed whenever a significant change occurs including:

- A change in senior management;
- A change in the structure of the organisation;
- A change in the scope of Rathlin Energy activities or key environmental issues.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

The policy will not typically require changes in light of legislative changes, environmental incidents or particularly good or bad environmental performance, as the policy statement is necessarily a high level document. The policy is published in the annual environmental statement and will also be made available on request from any member of the public. The process for communicating the policy and making it publicly available are described further in Paragraph 4.4.3.

4.3 Planning

4.3.1 Environmental Aspects

Aim

This paragraph details and process that enables the initial identification of the relevant environmental aspects and the level of significance of identified aspects to be evaluated. It comprises a basic environmental risk assessment methodology:

Environmental Significance = Severity x Likelihood

The process is designed to enable management to make an informed decision regarding the importance of environmental issues and objective professional judgement **should** be used. This ensures that the outcome reflects the importance to the business of the issues concerned.

Each Asset/Site will maintain a site-specific register.

Risk Management

The first step towards achieving the Rathlin Energy aim of ‘no damage to the environment’ is to understand what effects our activities have, or might have, on the environment. This is achieved through identification and significance testing of the aspects of Rathlin Energy operations that can or could result in environmental impacts. This enables us to identify those environmental aspects that need to be managed within the EMS and need to be considered when setting environmental objectives and targets.

A requirement of this Paragraph 4.3 is to comply with:

- ISO 14001 Requirements 4.3.1 Environmental Aspects

Process

Identification

Prior to operations beginning on a new asset/site, a workshop/brainstorm session involving key representatives from across the business must identify areas where operations and activities can

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

interact with the environment. This is sometimes referred to as an Environmental Impact Identification (ENVID).

All sources of actual and potential environmental impact **shall** be comprehensively identified, including potential non-routine and emergency situations. The review **shall** include, but not be limited to, the following considerations.

Global climate change and air quality	Cumulative impacts
Water and sediment quality	Habitats and species conservation
Waste disposal	Operations
Physical presence of facility	Liability management
Oil spill and emergency planning	Resource use

Evaluation of Significance

Once the aspects have been identified, they are then evaluated for their significance using the process outline below:

(1) Environmental issues will be reviewed, with the severity of the potential associated impacts assessed using Table 1 as a balance between the following;

(a) Environmental Consequence

For a risk assessment, this can be broadly summarised from scientific evidence, for example, laboratory studies indicating toxic effects which are demonstrated in the field etc.

(b) Non-financial Impact

Policy drivers may be driven by current legislation, operating licences, operational permits and consents, and company practices, procedures and targets etc.

(2) Consider the likelihood of the impact occurring, using Table 2.

(3) Use the simple matrix of severity and probability (refer to Table 3) to determine the significance of the overall impact.

Aspects Register

The outcome from the identification and evaluation process shall be recorded in the aspects register(s) (RE-04-007).

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

Rathlin Energy	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Rating	Environmental Consequence	Stakeholder Factors	Regulatory/Policy Driver
Major	Actions/operations result in the quantifiable degradation or loss of habitats of flora and fauna, ecological systems, and property, where the recovery would not be achieved until several years following the cessation of the activity. Impact on the status and health of internationally or nationally protected sites, habitats or human beings.	Documented and widely held concerns in society and the scientific community, including perception of threats to the global environment. Decrease, or perceived decrease, in the availability or the quality of resources to the extent of affecting the long-term wellbeing of the persons utilising or benefiting from the resource. Will have an effect on human health.	Actions/operations result in the breach of UK/EU legislation that results in a fine or court proceedings.
Moderate	Actions/operations result in the quantifiable degradation or loss of habitats of flora and fauna, ecological systems and property where the recovery would clearly be underway within 1 to 2 years following the cessation of the activity. Impact on locally protected or important sites, habitats or health of human beings.	Local concerns at the community or broad interest group level. Decrease, or perceived decrease, in the availability or the quality or a resource to the extent of affecting the short-term wellbeing of the persons utilising or benefiting from the resource. Possible, but unlikely effects on human health.	Actions/operations result in the breach of Rathlin Energy performance contracts. Impact on corporate goals and targets on specific activities, beyond regulatory requirements.
Minor	Actions/operations result in the potential degradation of habitats of flora and fauna, ecological systems and property where total recovery would be achieved within 1 year following the cessation of the activity. Impact on individual organisms within specific ecosystems.	Issues that may affect individuals, single businesses and single interest groups at a local level. A temporary decrease, or perceived, in the availability or the quality or a resource affecting the wellbeing of local person utilising or benefiting from the resource.	Actions/operations result in the breach of individual performance contracts.
Negligible	Effects on actions/operations	A slight decrease in the	Actions/operations

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

Rathlin Energy	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

	are not measurable from background variation .	availability or the quality of a resource that is unlikely to be noticed by the persons utilising it	result in slight impairment of corporate environmental image or policy
Positive	An enhancement in some ecosystem or population parameters.	An enhancement in the availability or the quality of a resource(s) benefiting persons utilising it.	Enhancement of corporate environmental image or policy

Table 1 Severity Matrix

Probability Rating	Routine (Planned) Operation Frequency	Probability
5	Continuous, over several years	Likely > one per year
4	Regular, intermittent over each year; typical one per year	Possible > one in 10 years
3	Regular, intermittent, every 2 to 5 years	Unlikely > one in 100 years
2	One-off event, over several days	Remote > one in 1000 years
1	One-off event, up to 1 day in duration	Extremely remote > one in 10,000 years

Table 2 Categories for Assessing Likelihood

Probability Rating	Consequence Rating			
	Major	Moderate	Minor	Negligible
5				
4				
3				
2				
1				

Final Significance Rating		
High	Medium	Low

Table 3 Categories for Assessing Environmental Probability

Review

On an annual basis, or as required through the Management of Change Standard (RE-03-003), a review of the relevant aspect register will take place. The review **should** be attended by a representation of the personnel from the Asset/Site. The review will identify any changes to the operations, or impacts that **should** be captured in the aspects register.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

For major changes to the aspects or additions to the scope, such as new projects, this environmental aspects process **should** be used. This will identify the aspects and then assess their significance. Where appropriate, the findings will be fed into the operational control procedures.

4.3.2 Legal and Other Requirements

Aim

This paragraph sets out how Rathlin Energy identifies applicable legal and other requirements, in relation to our environmental aspects. It also details how Rathlin Energy ensures compliance, particularly with legal requirements.

The Rathlin Energy Legal Register (RE-05-LEG-001) sets out regulatory health, safety and environmental compliance.

A requirement of this Paragraph 4.3.2 is to comply with ISO 14001 Requirements 4.3.2 Legal and Other Requirements.

Process

The process comprises the identification of legislation, and other requirements, the management of permits and consents and the evaluation of compliance.

Identification of Legislation

The primary method for identifying legal and other requirements is a quarterly review of information provided by the Regulatory Compliance and Environmental Manager and Health, Safety and Environmental Advisor. In addition, to this primary method, the following is used:

- Consultation with regulators;
- Environmental/Project HSSE/other functions network meetings;
- Attendance at conferences and workshops;
- Membership of professional bodies, e.g. the institute of Environmental Management and Assessment (IEMA) and Institute of Occupational Safety and Health (IOSH).

Environmental Legislation Register

The Rathlin Energy Legal Register (RE-05-LEG-001) is reviewed, updated and audited on a regular basis.

Additional sources of legislation can be found in Additional Sources of Legislation and Guidance (RE-05-LEG-002).

Legal Compliance

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Within each asset/site, processes **shall** be in place to identify the regulatory permits required and to ensure that permit applications are submitted in a timely manner.

Consents and Permits Register

The asset/site Consents and Permits Register (RE-05-LOG-003) will be reviewed and updated periodically and will be used to identify when renewals are required. The register contains the following information, as a minimum:

- Type of consent/permit
- Valid from date
- Expiration date
- Consent/permit owner
- Conditions and limitations of permit/consent

In addition to the register, each asset/site **shall** retain hardcopies of the consents and permits, display hardcopies of the relevant consents/permits on site and, provide electronic copies for the asset/site server if necessary.

Obtaining Consents and Permits

The Health, Safety and Environmental Advisor is responsible for obtaining environmental consents and permits and will seek the Operations Manager (or their delegate's) assistance with site specific content.

On receipt of any permit or consent, the Operations Manager, with input from the Health, Safety and Environmental Adviser, **shall** ensure that the permit accurately reflects the application. It is the Operations Manager responsibility to ensure that the new consent/permit is communicated within the asset/site and that all permit conditions are met. The Health, Safety and Environmental Advisor **should** provide support and advice as required.

Conformance with Other Requirements

Where 'other requirements' (refer to Paragraph 2) have been identified, these are incorporated into annual objectives and targets, asset plans and monitoring schedules in accordance with the processes described in Paragraphs 4.3.3 and 4.5.1.

Evaluation of Compliance

Compliance with permit/consent limits will be checked at an appropriate frequency by the Health, Safety and Environmental Advisor, as he submits environmental data and reports on asset/site performance.

Checks on compliance are also included in Paragraph 4.5.3.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

4.3.3 Objectives, Targets and Programmes

Aim

This paragraph details how Rathlin Energy sets objectives, targets and environmental programmes to deliver continual improvements in environmental performance. This is to ensure that the Rathlin Energy goal of ‘no damage to the environment’ is pursued.

A requirement of this paragraph is to comply with ISO 14001 Requirements 4.3.3 Objectives, Targets and Programme(s).

Process

Define Rathlin Energy Environmental Activities

The Rathlin Energy environmental activities are set in line with the business planning process.

When establishing and reviewing the environmental activities, the following will be taken into consideration:

- Current and future legal and regulatory requirements and ‘other’ requirements;
- Individual site’s environmental performance;
- All significant environmental aspects and impacts, including any changes due to new or altered procedures or plant;
- Opinions, concerns and requirements of interested parties;
- Financial, operational and other matters, as appropriate;
- Likely new projects, which might occur inside the next planning cycle;
- Behavioural safety programmes and Hazard Report Form (HRF) cards.

4.4 Implementation and Operation

4.4.1 Resources, Roles, Responsibility and Authority

Aim

This paragraph defines the organisational structure that allows Rathlin Energy to establish, implement, maintain and improve the Environmental Management System (EMS).

A requirement of this paragraph is to comply with ISO 1400 Requirement 4.4.2 Resources, Roles, Responsibility and Authority.

Role and Responsibilities

The following matrix shows roles and responsibilities relating to the EMS.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Role	Clause													
	4.2 Policy	4.3.1 Aspects	4.3.2 Legal and Other Requirements	4.3.3 Objectives, Targets and Programmes	4.4.1 Resources, Roles, Responsibilities and Authority	4.4.2 Competence Training and Awareness	4.4.3 Communication	4.4 Documentation, 4.4.5 Control of Document, 4.5.4 Control of Records	4.4.6 Operational Control	4.4.7 Emergency Preparedness and Response	4.5.1 Monitoring and Measurement, 4.5.2 Evaluation of Compliance	4.5.3 Non-conformity and Corrective and Preventative Action	4.5.5 Internal Audit	4.6 Management Review
Chairman of the Board	• Endorsement of the policy • Development and review of policy • Scheduling policy annual/other reviews • Implementing changes to policy				Ensure sufficient resources are available to implement, maintain and improve the EMS.			Ownership of environmental documents.						Attend and provide input at the annual management review.
Operations Manager			Ensure assets/sites are in compliance with relevant legislation through the provision of adequate competent resources.	Accountable for: Ensuring that Rathlin Energy environmental requirements are included in asset specific objectives and targets within the asset plan.			Ensure polices and environmental requirements are communicated to all employees and contractors.		Ensure implementation of operational control.			Encourage all personnel to identify and communicate non-conformances		Hold a management review of the EMS annually.
Divisional Managers		Review aspects register with cross-section of asset team. Ensure aspects register is filed appropriately and is readily available	• Maintain consents and permits register • Provide the Operations Manager with support required for the environmental elements of consent/permit preparation and submission.	Provide support to the Operations Manager in delivering the environmental requirements of the plan.	Implement and maintain asset/site level processes and documentation.	Responsible for promoting training and seeking assurance that it is being undertaken for the asset/site.	Communicate: • Relevant legal and other requirements to the site • Key EMS structure and responsibilities to the site • Site environmental performance, findings from audits/inspections, non-conformances in relation to Rathlin Energy performance and management review outcomes	Ensure that all EMS asset/site specific documentation: • Is held within the asset/site document control system • Has an identified owner and a defined periodicity date	Drive implementation of, and conformance with, operating control procedures related to key environmental systems.	Ensure that: The emergency plans are kept up to date for operations, drilling and new projects.	• Identify which aspects will be monitored and measured and communicate to the site. • Seek assurance that monitoring and reporting that is related to regulatory compliance is carried out • Seek assurance that consent and permit conditions are complied with at all times.	Ensure all environmental non-conformances are recorded in the action tracker (RE-05-LOG-001)	Ensure that: • Logistics have been arranged for the audits • Actions are entered into the action tracker (RE-05-LOG-001) and closed out.	• Organise and minute the asset/site level management review • Track progress against actions resulting from the asset/site level management review • Provide the minutes, including actions to the EMS Single Point of Accountability (SPA) • Review and update asset level objectives and targets.
HSE Advisor			Maintain the legislative register and ensure periodic reviews are undertaken according to the reviewed procedures.				Liaise with national and international government departments and non-government organisation, pressure groups, the public and the media.			• Identify potential risks associated with emergency conditions, including release of hydrocarbons • Make the Site Supervisor			• Carry out audits in line with procedures • Communicate the scope of the audit to the site • Review previous audits	

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

										aware of these risks, to ensure that they are incorporated in relevant emergency response plans.			conducted at the site prior to the audit • Ensuring the report is entered into the server by sites and actions distributed. • Approving action close-out and providing challenge where close-out is insufficient. • Ensuring the final report is filled in with the corresponding report number (see RE-03-001).	
Regulatory Compliance and Environmental Manager		Ensure annual review of aspects register		Responsible for ensuring the site specific environmental plan adequately covers environmental activities.	EMS focal point and responsible for establishing, implementing and maintaining the EMS across the sites/assets.		Communicate the following: • Rathlin Energy environmental requirements and plan • Rathlin Energy environmental performance, significant findings from audits or inspections and environmental non-conformances • Rathlin Energy annual environmental statement • Key EMS structure and responsibilities to the Site Supervisor	Responsible for: • Allocation of document owners • Ensuring that reviews are undertaken within each document's defined periodically	Ensure that the defined Rathlin Energy practices and processes are communicated to all sites/assets.	Provide assistance and guidance in update and approval of Emergency Plans, co-ordinating this process if required.			• Ownership and maintenance of the internal auditing schedule • Facilitation of audit teams for all internal audits • Advising auditor of areas of focus for the year • Ensuring audits reports are kept and available for sharing • Analysing audit data and communicating system risks • Facilitation of external audits	• Attend and support the Chairman of the Board at the annual management review • Consolidate asset/site level management reviews for the Corporate annual management review • Track progress from the management reviews • Keep records of all management review for minimum 5 years
Site Supervisor			Ensure that the following are undertaken: • Populate consents and permits register • Retain on file hard copy of consents/permits and if necessary, provide electronic copies • Notify the Operations Manager when expiration is due and seek assistance in a	Responsible for: Delivering the environmental activities contained within the plan.					Ensure implementation of site specific operational controls.	• Test the response plans on a regular basis. • Record learning's from the exercises on the server. • Ensure the appropriate level of environmental		Manage non-conformances in their area of responsibility.	Ensure that sufficient priority is placed on undertaking environmental audits.	Attend the asset/site level annual management reviews.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

			timely manner • Apply to the relevant authority in a timely manner for consents/permits, to ensure an adequate consultation period can be undertaken • Issue consents/permits to ensure awareness of the conditions across the site							training across the site is up to date.				
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Process

Organisational Structure

The overall responsibility for the Rathlin Energy EMS is held within the Rathlin Energy Management Team. This team comprises the Chairman of the Board, Operations Manager and their delegates.

Under the Rathlin Energy Management Team, the responsibilities for establishing, implementing and maintaining the EMS lies with the Rathlin Energy Compliance and Environment Team made up by the Regulatory Compliance and Environmental Manager and Health, Safety and Environmental Advisor.

In addition, Rathlin Energy expects the participation, commitment and involvement of personnel within Rathlin Energy. All staff are responsible in ensuring that environmental matters are satisfactorily managed within Rathlin Energy.

Organisational Capability

It is the responsibility of senior management to ensure that resources are available to establish, implement, maintain and improve the EMS. This is achieved by the annual organisational capability review, which identifies future resources and actions that are required.

The Environmental Manager is the Rathlin Energy EMS Single Point of Accountability (SPA). The Rathlin Energy selection process will ensure that this position is filled by a competent person,

4.4.2 Competence, Training and Awareness

Aim

This paragraph outlines how Rathlin Energy is assured that it has the necessary competence, training and awareness to deliver the commitments in the environmental policy and to achieve the annual objectives and targets.

A requirement of this paragraph is to comply with ISO 14001 Requirement 4.4.2 Competence, Training and Awareness.

Process

The process involves:

- Identification of training needs to develop the appropriate environmental competency;
- Delivery and evaluation of training;

Identification of Training

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

The training matrix in Health, Safety and Environmental Training Standards (RE-05-FO-023) defines roles against training modules, based upon the responsibility and importance of the role with regards to the potential to cause environmental harm.

Training Delivery

These are standard classroom based and site based training courses listed below. In addition to these, and to address specific training needs, other forms of training may be used for example:

- Inductions for Turnarounds (TARs)/Projects/Drilling Campaigns;
- Toolbox Talks;
- Safe System of Works;
- Environmental Hazard Identification and Reporting Training.

Environmental Classroom-based Training (CBT) and Site-based Training

These include, but not limited to the following:

- Control of Substances Hazardous to Health (COSHH) Training;
- Environmental Awareness Training;
- Emergency Response Training;
- H₂S Training;
- Environmental spills and clean up Training;
- Confined Space Entry Training;
- Environmental legislation Training;
- EMS auditing Training;
- Waste Management Training.

Training Evaluation

The evaluation of individual training is undertaken through the following processes:

- Competence management will identify the training requirements of individuals managed by the Health, Safety and Environmental Advisor.
- Excellence programme will provide a roadmap of expected qualifications and competencies for environmental professionals.

4.4.3 Communication

Aim

This paragraph sets out how the Rathlin Energy communicates on environmental management issues, both internally and externally. A requirement of this paragraph is to comply with ISO 14001 Requirement 4.4.3 Communication.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Process

Internal Communication

Internal communication will be circulated to Rathlin Energy employees in writing or via e-mails.

The formal process for internally communicating legislation, compliance and performance is through the annual management review at Paragraph 4.6, which takes place at Asset/Site and Corporate Leadership Team Levels.

In addition to the annual management reviews the following tools are used for internal communication and data management:

- Regular Health, Safety, and Environment (HSE) meetings at an asset/site level;
- Total Environmental Reporting Toll (TERTL) for site emission reporting;
- Internal updates on changes in legislation;
- Daily morning meetings;
- Annual environmental forum for communications with site representatives;
- Email and other forms of internal correspondence;
- Annual environmental statement prepared for Rathlin Energy;
- Records of internal communications can be stored on the server and other storage facilities;
- Tracker used to report and monitor data relating to environmental incidents such as spills and material releases.

External Communication

Communications directly between Rathlin Energy Asset/Site and external groups occur with:

- Statutory and regulatory bodies;
- Vendors and contractors;
- Emergency organisations.

Statutory and Regulatory Bodies

Communication with regulators generally occurs at two levels:

- (1) Strategic and policy issues
- (2) Operational issues

Strategic and policy issues are communicated externally by the Health, Safety and Environmental Advisor in liaison with the Chairman of the Board. Operational issues may be communicated by appropriate site personnel directly with the applicable external party, with the support of the Health, Safety and Environmental Advisor as required.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Performance information is communicated to regulators by the asset against specific legislation as detailed in the asset/site Consents and Permits Register. In addition, annual environmental performance review meetings are held with government agencies as required.

Communication that has a realistic potential for being used in legal proceedings **shall** be approved by the Rathlin Energy Regulatory Compliance and Environmental Manager before issued.

Vendors and Contractors

Communications with a range of external organisations is required in environmental emergency situations. These arrangements are detailed in the relevant site Health and Safety Plan, Emergency Response Plan Offsite (RE-04-004) and Emergency Response Plan Onsite (RE-04-005).

Emergency Organisations

Communication with a range of external organisations is required in environmental emergency situations. These arrangements are detailed in relevant procedures and in line with site specific operations.

Other External Communication

Liaison with National and International Government departments and Non-Government Organisations (NGOs), pressure groups and the public is typically carried out by the Operations Manager and Regulatory Compliance and Environmental Manager. Prior to communicating with media (including statements, interviews and press releases) the site/manager seeks advice from the Health, Safety and Environmental Advisor.

External communications such as those from government departments, NGOs or other parties with concerns are directed to, and managed at, a Managerial level. All environmental complaints are acknowledged and investigated, and an appropriate response made in a timely fashion. Complaints are initially assessed by the appropriate Site/Manager representative, who then liaises with the Operations Manager, as required, in determining an appropriate response. All responses **shall** be endorsed by the relevant Site Supervisor and Divisional Manager.

Following a complaint from an external party, details **must** be recorded along with any required actions entered into the Action Tracker (RE-05-LOG-001). Once entered, actions are tracked until they are closed by the responsible party.

4.4.4 Documentation and Records

Aim

The purpose of this paragraph is to define what documentation needs to be available and to whom, processes for storing and maintaining documentation relating to Rathlin Energy EMS. It also shows

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

how Rathlin Energy controls environmental records to ensure sufficient information is obtained to assess compliance with its EMS and to continue to learn lessons from past experiences.

A requirement of this paragraph is to comply with:

- ISO 14001 Requirements 4.4.4 Documentation, 4.4.5 Document of documents and 4.5.4 Control of Records

Process

Document Control

The Document Control Procedure (RE-03-001) describes how the EMS documents are maintained, reviewed and updated. Each document will clearly state the document owner and the revision date.

Consents, Permits and Other Requirements

Copies of all consents and licences **shall** be held in a central location for a minimum of 3 years. Electronic copies can also be held on servers at the discretion of the site/manager.

Other regulatory correspondence will be held in accordance with the Document Control Procedure (RE-03-001).

Environmental Aspects Register

An electronic copy of the Asset Environmental Aspects Register (RE-04-007) **shall** be held in a central location that is accessible by all relevant personnel as per Paragraph 4.3.1.

Training Records

Records of environmental training **shall** be recorded within the Rathlin Energy Training Matrix (RE-05-FO-023)

When training is provided, paper certificates or letters **should** be held by the individual.

4.4.5 Environmental Operational Control

Aim

This paragraph details the processes in place for ensuring that operations are conducted in such a way as to minimise environmental impact and to facilitate continuous improvement.

Good Practice

A requirement of this paragraph is to comply with:

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

Rathlin Energy	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

- ISO 14001 Requirement 4.4.6 Operational Control
- Operational control of the environmental management system is managed through a number of Level 3 Standard and Procedures and Level 4 Site Specific Documentation other guidance documents.

These documents include:

- Site Specific Environmental Plan (RE-04-006);
- Site Rules (RE-04-001);
- Site Induction (RE-04-003);
- Emergency Response Plan Onsite (RE-04-004);
- Emergency Response Plan Offsite (RE-04-005);
- Legal Register (RE-05-LEG-001);
- Additional Sources of Legislation and Guidance (RE-05-LEG-002);
- Environmental Aspects (RE-04-007);
- Site Specific Health and Safety Plan (RE-05-BSOR-001);
- Site Specific Bridging Document (RE-05-BRG-001);
- Well Design and Operations Standard (RE-03-009);
- Written Scheme For Independent Well Examination (RE-05-WES-001);
- Consents and Permits Register (RE-05-LOG-003);
- Action Tracker (RE-05-LOG-001);
- Audit Scope Checklist (RE-05-CHK-006);
- Housekeeping Checklist (RE-05-CHK-007);
- Audit Report Form (RE-05-FO-019);
- Training Matrix (RE-05-FO-023);
- Health, Safety and Environmental Objectives and Targets (RE-05-FO-024).

4.4.6 Environmental Control Arrangements

During induction to the asset/site and as part of task specific risk assessments, all personnel **shall** be made aware of 'spill kit' locations and how to check and replace these items if used. Drip trays **shall** be used and spill kits present at all times when plant is being used, such as portable generators. All fuels **shall** be stored in such a way to contain any spills.

This will be within an impermeable bund, or mobile fuel bowser with a secondary containment system (double skin bund). All mobile bowzers **shall** also be sited on an impermeable barrier such as "visqueen" sheeting.

In the event of an environmental spill the procedure **shall** be:

- STOP NORMAL WORK immediately;
- If spillage is flammable, remove or extinguish all possible sources of ignition;
- Identity the sources of pollution and if possible isolate the source;

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

Rathlin Energy	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

- Contain the spillage using earth/sand to construct a bund around the spill to stop it spreading or where available use the spill kit;
- Contact the Project Manager immediately;
- Put on appropriate PPE;
- Protect sensitive areas (e.g. watercourses or surface water drains, use drain covers or use earth/sand to construct a bund);
- Clean up the spill. Use absorbent granules/pads to soak up the spill. Large pools of oil or spills which cannot be absorbed should be removed using a gulper;
- Dispose of all contaminated material (soil/absorbent material) correctly, those containing substances such as oil, diesel or paint will be hazardous waste;
- Never wash or hose a spill into the drainage system. Always use absorbent materials.

The Site Supervisor **shall** take all reasonable measures to ensure that:

- Any release is contained and that harm to human health and the environment is minimised, both within and beyond the site boundary;
- Once the release has been contained, any environmental damage is appropriately remediated (with advice from the Environmental Agency if required);
- Contaminated clean up materials are handled, stored and disposed of as hazardous waste in accordance with the Hazardous Waste Regulations;
- Environmental incidents are fully investigated. Such investigation with help from the Health, Safety and Environmental Advisor and Operations Manager **shall** determine:
 - (i) Whether the incident is of a 'major' or 'minor' nature. Note: all incidents requiring action beyond site boundaries **shall** be classified as 'major'
 - (ii) The cause of the incident
 - (iii) If existing emergency procedures are adequate or requires revising;
- An environmental complaints/incident reports are completed and issued to the Operations Manager;
- Any pollution incident classified as 'major' is reported to the relevant regulatory authority (Environmental Agency), as soon as possible;
- Contractors working on behalf of Rathlin Energy are made aware of the contents of this procedure and that they are required to comply with its provisions.

Pollution Hazard Schedule

POLLUTION HAZARDS	POLLUTION CONTROL MEASURES
Fuel leaks from plant and work equipment	Drip trays to be placed beneath static plant. Plant/work equipment regularly inspected for defect and records of such inspections to be recorded in the appropriate register.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

Rathlin Energy	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Fuel spillage during refueling operations	Designated refueling area to be established onsite. Fuel tanks to be fitted with locks and delivery hose to be kept within bunded tank area when not in use. Spill kit to be provided and kept close to fuel tank. Drip bund to be formed below filler hose. Protective barrier or bund to be installed to prevent impact damage to fuel tank.
Pollution from delivery wagons or washout process	Bespoke washout area to be established on site with suitable containment system in place
Pollution from accidental release of hazardous substances	All hazardous substances to be properly stored in appropriate containers in such a manner as to prevent damage or accidental spillage.
Dust and Noise from operational activities	See below

Potential pollutants include:

Gas Oil (plant fuel) – estimated weekly consumption unknown at this point.

Silted water (surface water run-off and pumped groundwater) quantities unknown at this point.

Other hazardous substances (various) estimated quantities unknown at this point.

Waste Management & Housekeeping

A high standard of housekeeping **shall** be maintained at all times. The Operations Manager and Site Supervisor will monitor performance throughout the project (RE-05-CHK-007). All waste and packaging will be disposed of as it is generated. Litter is unacceptable and all personnel will be reminded of the requirements to dispose of waste during induction.

Segregated walking routes and roadways **shall** be maintained effectively by road sweeping as necessary.

It is Rathlin Energy's target to reduce the amount of waste being sent to landfill by implementing a hierarchy of control and by segregating waste onsite. The Operations Manager and/or Site Supervisor **shall** consolidate all transfer and consignment notes and record the information within the Site Environmental Plan (RE-04-006). Rathlin Energy **shall** endeavor to recycle whatever cannot be re-used and when ordering materials, recycled products will be purchased wherever practicable.

Tools and equipment **shall** not be left unattended and **shall** be stored in the designated areas.

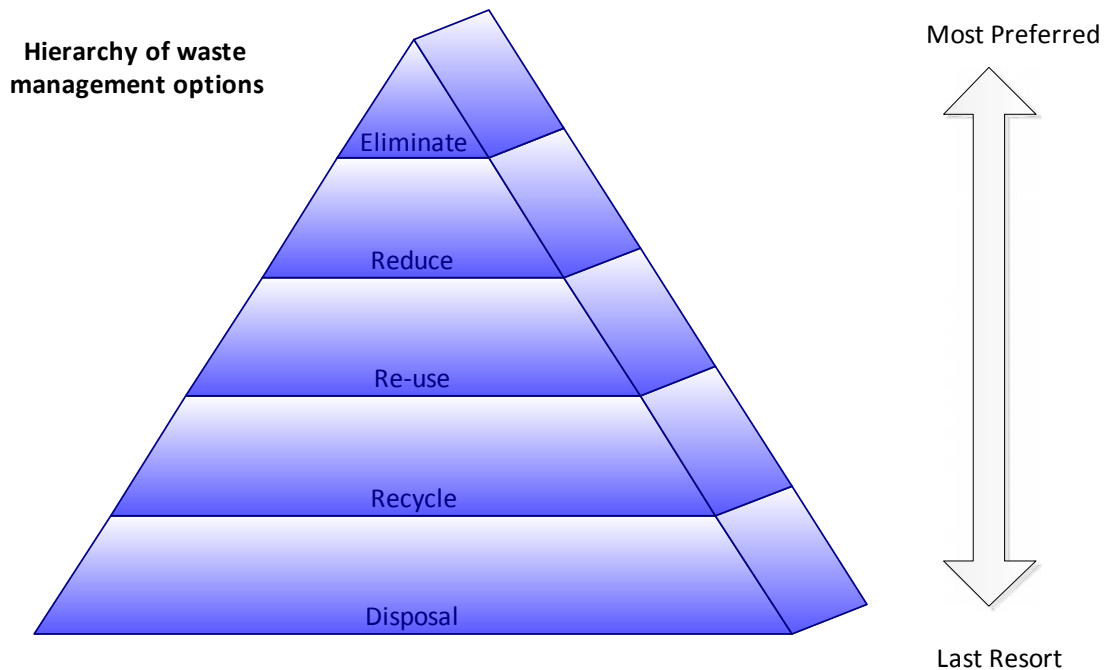
All waste skips, bins and segregating areas **shall** be sited away from temporary site offices. In the event of an accidental fire or fire caused deliberately, this may reduce the risk of fire spreading to other cabins and creating nuisance smoke to the atmosphere.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

The Site Supervisor is responsible for the implementation of the Site Environmental Plan on a day to day basis.

The options for waste on site are illustrated as follows:



Eliminate the waste

Every effort will be made to eliminate the waste produced at source. Control measures will include:

- Avoiding packaged materials where practicable;
- Ordering correct quantities;
- Avoiding damage by handling and storing correctly.

Reduce the amount of waste produced

This includes planning to reduce over ordering of materials, providing suppliers with sufficient information to supply correctly, avoiding damage or deterioration from poor handling or storage methods.

Re-use

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Only dispose of waste which cannot economically or practically be re-used or recycled. Materials such as drilling fluids can be readily reused.

Recycle

Waste will be segregated onsite to allow for recycling off site. Additionally, materials that are recycled **shall** be procured for use onsite where practicable and where the specification permits.

Dispose

Waste that cannot be reused or recycled practicably **shall** be disposed of responsibly and in compliance with Rathlin Energy duty of care obligations. All waste **shall** be removed from site by a licensed waste carrier to a licensed waste site.

Control of Substances Hazardous to Health (COSHH) & Storage of Materials

COSHH assessments will be produced for any hazardous materials used onsite. COSHH assessments **shall** be appended to the relevant risk assessment and communicated to those people involved with or affected by the tasks, by the Site Supervisor. All fuels or materials with the potential to cause an environmental incident **shall** be stored where any spills can be contained. This will be within an impermeable bund, or mobile bowser with a secondary containment system (double skin bund).

Wherever possible substances will be substituted with nonhazardous alternatives. Where this is not possible Rathlin Energy **shall** apply the hierarchy of control measures as outlined in the Control of Substances Hazardous to Health Regulations 2002.

The quantity of any flammable material stored onsite **shall** be kept to a minimum to reduce the potential for fire hazard. No fuels **shall** be stored in any area where surface run-off migrates directly into water drains. All materials **shall** be stored in stockpiles of reasonable gradient to prevent collapse. The storage area **shall** be fenced off and secured to exclude trespassers when not in use. All waste materials **shall** be stored in suitable skips/containers etc. All flammable waste skips **shall** be stored at least ten metres from any adjacent cabin. The storage area **shall** be fenced off and secured to prevent unauthorised access. Recovered and waste materials awaiting transport **shall** only be stored within the site or the site compound. Stored materials **shall** not obstruct access to any other part of the asset/site.

Dust & Noise Mitigation

Airborne dust generated by operations will, in general, be controlled by damping down with water. Various techniques will be adopted across the site to reduce the production of dust. Each specific task carried out onsite will have its own standard operating procedure and will detail measures to be taken to reduce the production of dust. It may be that one measure alone will be sufficient for a task

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

Rathlin Energy	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

or it may require a series of measures to ensure that dust is kept to an acceptable level. All dust suppression methods using water will be done in a controlled manner in order that sufficient water is used to suppress the dust but not excessive quantities that causes run off.

All Site personnel will be aware of the care required to minimise the production of dust and will be informed of this in various forms including, site inductions, risk assessment instruction, tool box talks, time out for safety, and general supervision instruction onsite.

The associated COSHH assessments **shall** be available to all personnel involved with or affected by the work. Appropriate Personal Protection Equipment (PPE) **shall** be worn in accordance with the task specific risk assessment.

Appropriate plant and equipment **shall** be utilised to ensure that site noise is kept to a minimum. All work equipment **shall** be adequately maintained to avoid unnecessary noise and be fitted with appropriate working silencers and noise insulation where available. No plant **shall** be left idling. Plant **shall** be sited in such a position so as to reduce noise pollution.

Site personnel **shall** be reminded of the requirement to keep noise down to an acceptable level during their site induction. Due to the tasks involved in the operation, Rathlin Energy **shall** choose methods of work and equipment which **shall** reduce the potential exposure to Site personnel. PPE **shall** be provided and enforced should the noise levels exceeds 80 and 85 dba respectively. The Health, Safety and Environmental Advisor will monitor noise levels during the works at various locations across the asset/site.

4.4.7 Emergency Preparedness and Response

Aim

This paragraph specifies the arrangements for key personnel, operating procedures and supporting information necessary for an effective response to potential environmental emergency situations.

Risk Management

A requirement of this paragraph is to comply with:

- ISO 14001 Requirement 4.4.7 Emergency Preparedness and Response

Emergency response plans set out the procedures for managing responses to environmental incidents. Emergency Response Plan Offsite (RE-04-004) and Emergency Response Plan Onsite (RE-04-005) are the two principle plans for Rathlin Energy.

Process

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

The responses to most major emergency scenarios in the upstream and business are covered by legal obligations and Rathlin Energy policy, as provided for, for example, in Borehole Sites and Operations Regulations, Incident Investigation and Reporting (RE-03-008), Identification of Health and Safety Risks (RE-03-005), reports and emergency management plans.

Emergency Plans

This contains information on the resources available during spill response, the procedures for contacting external agencies and data on the environmental sensitivities.

Emergency Exercises

The emergency preparedness of the assets/sites **shall** be regularly tested at all levels of response. All assets/sites **shall** periodically undertake emergency exercises to test the emergency response plans at the site. Outcomes from these exercised **must** be recorded and any specific actions taken to improve the response **shall** be tracked.

Arrangements for responding promptly and effectively to potential emergency situations **should** be tested with sufficient frequency to ensure their continued appropriateness and the competence of personnel regarding their particular responsibilities. Lessons learned from tests or actual incidents **should** be reflected through amendment of relevant procedures and plans.

4.5 Checking

4.5.1 Monitoring and Measurement

Aim

This paragraph details how Rathlin Energy monitors and measures those environmental impacts that have been deemed of medium or high significance. It also details how Rathlin Energy evaluates and tests the compliance with legal and other requirements to which it subscribes.

A requirement of this paragraph is to comply with:

- ISO 14001 Requirements 4.5.1 Monitoring and Measurement and 4.5.2 Evaluation of Compliance

Process

Area of Performance for Monitoring

It is impractical to monitor and measure all of Rathlin Energy potential and actual environmental impacts; therefore, the focus is on those that qualify by either of these points:

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

- Have been identified by Paragraph 4.3.1 as being of medium or high significance
- Are specified for measurement through consents and permits, or by other regulatory bodies

Assets/sites **shall** identify their own specific monitoring and measurement requirements. All monitoring data for reporting **shall** be held within the server and be populated by the asset/site.

Monitoring and Measurement Records

Records of internal audits, external audits, inspections and management reviews **shall** be retained electronically, where all relevant personnel have access.

All monitoring and measurement reports that are submitted to regulators **shall** be held by the asset/site for the duration required under specific legislation of Rathlin Energy retention requirements.

4.5.2 Non-conformity and Corrective and Preventative Action

Aim

This paragraph sets out how Rathlin Energy manages non-conformity, in addition to corrective and preventative action.

A requirement of this paragraph is to comply with:

- ISO 14001 Requirement 4.5.3 Non-conformity, Corrective Action and Preventive Action

Process

This process describes the methods used for identifying and addressing actual and potential non-conformities within Rathlin Energy.

Identifying Non-conformity

A number of tools are used to identify non-conformities, including:

- EMS audits;
- Safety and Environmental Observations and Conversation;
- Hazard Report Form (HRF) cards;
- External audits and inspections, including regulatory checks.

Some of these tools are explained in more detail below.

Addressing Non-conformity

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Following initial identification of the non-conformity, the necessary actions required to prevent recurrence are agreed with the actionees and, where appropriate, entered into the action tracker (RE-05-LOG-001), in accordance with Incident/Accident Reporting and Investigation (RE-03-008).

Regulatory Non-conformity

Managing regulatory non-conformity is specified in the Correction and Preventative Action Standard (RE-03-010)

Monitoring Progress

Where actions have been entered into the Action Tracker (RE-05-LOG-001), the actions are tracked to closure by the responsible party. Once the action is closed out, the originator is informed and is given the opportunity to verify that the action has been closed out to his/her satisfaction.

Management of Change

If any identified non-conformity requires a change of personnel, process or procedure, the relevant management of change process will be applied. Changes to the EMS documentation **shall** be carried out through the Document Control and Data Records Standard (RE-03-001).

4.5.3 Internal Audit

Aim

This paragraph explains what steps are needed to determine whether the EMS is functioning as intended and is supporting a path towards continuous improvement in environmental performance.

Sites will be expected to complete one internal EMS audit per annum and, additionally, a combination of waste, pollution and external EMS audits as required by the Health, Safety and Environmental Advisor. If this is not practicable, dispensation **shall** be sought from the Regulatory Compliance and Environmental Manager.

The audit scope and additional checklist can be found in (RE-05-CHK-006) and (RE-05-CHK-007).

A template for close out reports can be found in (RE-05-FO-019).

A requirement of this paragraph is to comply with:

- ISO 14001 Requirement 4.5.5 Internal Audit

All EMS Auditors are required to undergo Institute of Environmental Management and Assessment (IEMA) accredited audit training (3-day course) before undertaking internal audits or seeks dispensation from the Regulatory Compliance and Environmental Manager, if they have equivalent experience or training.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

A Lead Auditor **should** be someone who has done 10 to 12 audits over a reasonably short time i.e. 3 to 4 years. They **should** have completed an EMS auditor course. Prior to becoming a Lead Auditor they **should** be observed by an existing Lead Auditor to ensure they have the necessary skills.

Process

Planning

The EMS Single Point of Accountability (SPA) **shall** provide leadership and direction of the process to:

- Select a Lead Auditor and, if required, additional members of the audit team;
- Highlight any specific areas for the audit to focus on, as appropriate (see Internal Audit RE-03-004).

When determining the frequency and effort of audit activity, or suggesting amendments to existing internal audit schedule, the following **should** be taken into account:

- Changes in the organisation;
- Changes in activities, products and services;
- Changes in risk;
- Environmental performance;
- History of non-compliance/conformance.

Conducting the Audit

The Lead Auditor **should** convene an opening meeting with the appropriate member of the management team to explain the scope and purpose of the audit, and the roles and responsibilities. During the audit, the Audit Scope Checklist (RE-05-CHK-006) **should** be used as an auditing guide. It is not anticipated that all subject areas are audited. The Lead Auditor **should**, be make reference to the agreed scope of the audit for the asset/site.

After the audit is concluded, a meeting **shall** be held between the audit team and appropriate members of the management team to review findings, identify corrective and preventative action and, based on the roles and responsibilities the next steps to be taken.

Actions arising from the audit **shall** be entered into the Action Tracker (RE-05-LOG-001) as individual actions. The audit itself is to be recorded on the server as an EMS audit.

The Lead Auditor **shall** reach a verbal agreement on actions that are appropriate for the facility, regarding each finding from the audit. The site representative or a nominated individual **shall** enter and distribute actions arising from this discussion into the Action Tracker (RE-05-LOG-001). The approver of these actions **shall** be the Lead Auditor.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

Rathlin Energy	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

Closure of these actions will be monitored and overdue actions highlighted by the Regulatory Compliance and Environmental Manager. Actions for closure **should** be attached to the Action Tracker (RE-05-LOG-001) records.

Records of internal audits, external audits, inspections and management reviews **shall** be retained electronically, where all relevant personnel have access.

Shared Learning

Every 3 months the EMS SPA **shall** review all internal audit findings and provide a summary to the Regulatory Compliance and Environment Manager and Health, Safety and Environmental Advisor.

4.6 Management Review

Aim

This paragraph sets out how management reviews are conducted. The aim of management reviews is to provide visibility to senior leadership of the performance of the EMS. It also provides an opportunity to improve performance through amendment of the health, safety and environmental policy and objectives and targets.

A requirement of this paragraph is to comply with:

- ISO 14001 Requirement 4.6 Management Review

Process

Two levels of management review **shall** be conducted annually, one at asset/site level and one at managerial level.

Asset/Site Management Review

The purpose of this management review is to consider asset environmental performance. As a minimum, the review will cover items (a) to (h) of ISO 14001 Requirement 4.6.

The site/asset senior leadership and the Health, Safety and Environmental Advisor, in addition to asset team member, **shall** attend the review.

The outcomes of the asset management review are fed into the managerial management review, through the EMS SPA.

Managerial Management Review

This management review looks at overall Rathlin Energy environmental performance, taking into account the outcomes of asset management reviews.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-02-002
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 2.00

As a minimum, the review will cover items (a) to (h) of ISO 14001 Requirement 4.6.

These can be reviewed under the framework of the Management Review Standard (RE-03-006).

Review Outputs

A nominated person will take minutes of the reviews (these can be incorporated into the slides used). Actions will be entered into the Action Tracker (RE-05-LOG-001) and the action numbers sent to the EMS SPA. These are retained for a period of 3 years. The Health, Safety and Environmental Advisor will track the progress of actions highlighted at the management review meetings.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	09/01/2013

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

APPENDIX 3 – ROLES AND RESPONSIBILITIES

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

*** Page Left Blank Intentionally ***

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

ROLES AND RESPONSIBILITIES

Organisation	Site Representative	Responsibilities
Rathlin Energy	Chairman	Establish and maintain Environmental Policies, ensuring sufficient resources available for implementation. Attend and provide input at Annual Management reviews.
Rathlin Energy	Divisional Managers	Establish clear leadership and promote a high degree of HSE awareness through communication of HSE Policies and responsibilities. Development and review of HSE objectives and targets in their respective area and develop the organisation and controls to meet the goals and achieve KPI indicators. Maintain, communicate and test emergency response procedures for effectiveness. Ensure legislative compliance through the provision of adequate competent resources. Provide support for the preparation and submission of consents and permits, including waste management plans. Ensure that monitoring and reporting relating to regulatory compliance is carried out. Encourage identification and reporting of non-conformances and track actions to close out. Review aspects register with cross section of asset team and make readily available. Developing and training staff so that they are capable of carrying out their work to the required standards. Contractor review and selection. Briefing all staff so that they fully understand their individual responsibilities for Health, Safety and Environment as part of the performance appraisal. Investigate all incidents, involving, or having the potential to cause, injury or harm to personnel, damage to infrastructure or the environment. Communicate performance and findings from audits, inspections and non-conformances. Hold a management review of SMS/EMS annually and track progress of actions identified to close out.
Rathlin Energy	Field Operations Engineer	Duty of care for waste produced from operations. Registration of sites as a hazardous waste producer. Implementation of the Waste Management Plan. Training of those involved in the work on the plan.
Rathlin Energy	HSE Adviser	Provide HSE advice and support as the competent person in compliance with Regulation 7 of the Management at Work Regulations 1999. Provide HSE support to the Drilling Supervisor and the

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

		Drilling contractor. Lead site investigations and audits to ensure that operations are conducted in accordance with SMS/EMS. Maintain and review legislative register. Liaise with government departments, non-government organisations, pressure groups, the public and media. Identify potential risks associated with emergency conditions. Inform Site Supervisor of potential risks to ensure they are incorporated into the Emergency Response Plan and Waste Management Plan. Review previous audits. Ensure reports are produced and communicated. Approving action close out and provide challenges where close out is insufficient. Site Waste Champion.
Rathlin Energy	Regulatory Compliance and Environmental Manager (Rathlin HSE & Planning Manager)	Annual review of Aspects Register. Site specific environmental plan. EMS focal point for establishing, implementing and maintaining the EMS. Communicate environmental requirements and plan. Communicate environmental performance, significant findings and non-conformances. Communicate environmental statement. Key EMS structure and responsibilities to Site Supervisor. Ensure defined practices and processes are communicated to site/assets. Provide assistance and guidance in update and approval of Emergency Response Plans and Waste Management Plans. Ownership and maintenance of internal auditing schedule. Facilitation of internal and external audit teams and advise auditors of areas of focus. Ensure audit reports are documented and communicated. Analysing audit data and communicating system risks. Attend and support Chairman of the Board at annual management review. Consolidate asset/site level management reviews for annual management review. Track progress from the management reviews. Keep records of management review for minimum 5 years.
Rathlin Energy	Drilling Manager	Provide technical assistance for operations. Provide technical risk assessments. Ensure operational programmes are approved by an independent well examiner. Duty of care for waste produced from drilling and workover operations.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE MANAGEMENT

		Implementation of the Waste Management Plan. Segregation of waste on site. Training of those involved in the work on the plan.
Rathlin Energy	Site Supervisor	Populate consents and permit register. Retain hard copy of consents/permits and provide electronic copies if required. Notify Operations Manager when expiration is due and seek assistance in timely manner. Issue consents/permits to ensure awareness of the conditions across the site Implementation of the environmental activities and mitigation in accordance with the Waste Management Plan. Test response plans on a regular basis and record learning's. Ensure appropriate level of training across the site is up to date. Manage non-conformances in their area of responsibility. Ensure sufficient priority is placed on undertaking audits. Attend annual management reviews. Monitor compliance with the Waste Management Plan. Compile waste transfer notices.
Rathlin Energy	Logistics Manager	Provision of waste segregation and waste disposal, including skips and transport to and from the wellsite.
Principal Contractor	Supervisor	Compliance with the Waste Management Plan. Cooperation with the Operator. Assisting with training of sub-contractors. Monitoring the effectiveness of the Waste Management Plan.
Sub-Contractors	Supervisor	Compliance with the Waste Management Plan. Conduct operations responsibly and in compliance with work instructions, procedures and standards. Participate with line management and supervisors in the implementation of, compliance with, and improvement of the requirements of the SMS and EMS.
Principal Waste Contractor	Supervisor	Compliance with the Waste Management Plan. Issue waste transfer notices. Coordinate waste disposal notices. Conduct operations responsibly and in compliance with work instructions, procedures and standards. Participate with line management and supervisors in the implementation of, compliance with, and improvement of the requirements of the SMS and EMS. Notify the Rathlin HSE & Planning Manager in the event of any changes or additional requirements associated with the recycling or disposal of waste at the various waste disposal facilities.

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

*** Page Left Blank Intentionally ***

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

APPENDIX 4 – CHEMICAL INVENTORY DURING EXPLORATORY OPERATIONS

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

*** Page Left Blank Intentionally ***

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

CHEMICAL INVENTORY - EXPLORATORY OPERATIONS

Page 1 of 3

PRODUCT NAME	UNIT SIZE	QTY	TOTAL VOLUME	MAX TONNES	UN NO	CLASSIFICATIONS	HAZARD	Composition/Formation of Ingredients
FLUID ADDITIVES - DRILLING MUDS								
Bentonite Ocma	25 kg Sack	500	12,500 kg	12.5	N/A	Xn;R20	Inhalation	Bentonite 80-95%. Quartz, Crystalline Silica 2-15%.
Caustic Soda	13 kg Can	75	975 kg	1	1823	C;R35. S26. S45. S37/39	Corrosive	Sodium Hydroxide Solid 60-100%
Citric Acid	25 kg Sack	80	2,000 kg	2	N/A	Xi;R36.	Irritant	Citric Acid 60-100%
Conqor 404NS	200 kg Drum	8	1,600 kg	1.6	N/A	Not Classified		Salts of Phosphate esters in water 60-100%
Drilling Starch	25 kg Sack	360	9,000 kg	9	N/A	Not Classified		Potato starch (no% given)
Duo-Vis	25 kg Sack	100	2,500 kg	2.5	N/A	Not Classified		Xanthan gum 99-99.9%. Glyoxal 0.1-1%
Dynared Coarse	25 lb Sack	200	5,000 lbs	2.5	N/A	Not Classified		Proprietary 100% weight.
Dynared Fine	25 lb Sack	200	5,000 lbs	2.5	N/A	Not Classified		Proprietary 100% weight.
EMI-2224	25 ltr Can	40	1,000 ltr	0.96	N/A	Not Classified		Glycol Derivatives 60-100%
Kwikseal Coarse	40 lb Sack	80	3,200 lbs	1.45	N/A	Not Classified		Blend of Vegetable Fibres 60-100%
Kwikseal Medium	40 lb Sack	80	3,200 lbs	1.45	N/A	Not Classified		Blend of Vegetable Fibres 60-100%
Lime	25 kg Sack	120	3,000 kg	3	N/A	Xi;R36/38	Irritant	Calcium Hydroxide (Lime) 60-100%
M-I Barite	25 kg Sack	600	15,000 kg	15	N/A	R20 R48	Inhalation	Barite 91-93%. Silica, crystalline, quartz 1-11%. Mica 1-5%
M-I NaCl brine	Bulk Tanker	2000	2,000 bbl	381.6	N/A	Not Classified		Sodium Chloride 10-30%, Water 60-100%
Polypac UL	25 kg Sack	200	5,000 kg	5	N/A	Not Classified		Poly Anionic Cellulose 60-100%
Pot Chl KCL Big Bag	1 MT Bag	30	30 MT	30	N/A	Not Classified		Potassium Chloride 10-30%, Water 60-100%
Potassium Chloride	25 kg Sack	300	7,500 kg	7.5	N/A	Not Classified		Potassium Chloride 90-100%
Safe-Carb 40	25 kg Sack	400	10,000 kg	10	N/A	Xn;R20	Inhal	

CHEMICAL INVENTORY - EXPLORATORY OPERATIONS

Page 2 of 3

PRODUCT NAME	UNIT SIZE	QTY	TOTAL VOLUME	MAX TONNES	UN NO	CLASSIFICATIONS	HAZARD	Composition/Formation of Ingredients
Hydraulic Oil Shell Tullus 32	System	1	3,275 ltr	2.866	N/A	Not Classified		Highly refined mineral oil contains <3% (w/w) DMSO-extract, according to IP 346
Shell Omala 220 Gear Lub	System	1	606.6 ltr	0.545	N/A	NC R22,R41,R43,R51,R53	FI Tox Aq	Amine Phosphate 0,10-0,50%
Shell Omala S2 G 100 Gear Lub	System	1	425 ltr	0.379	N/A	NC R22,R41,R43,R51,R53	FI, Ac Tox	Amine Phosphate 0,10-0,50%
OILS - DRILLING RIG REPLENISHMENT STOCK								
Engine Oil 15W40	200 ltr Drum	6	1,200 ltr	1.06	1268	Not Classified R38,R41, R51/53	Tox Aq	Zinc alkyl dithiophosphate 1-2.4% Interchangeable low viscosity base oil 0-90%
Hydraulic Oil Shell Tullus 32	200 ltr Drum	5	1,000 ltr	0.875	N/A	Not Classified		Highly refined mineral oil contains <3% (w/w) DMSO-extract, according to IP 346
Shell Omala 220 Gear Lub	200 ltr Drum	3	600 ltr	0.539	N/A	NC R22,R41,R43,R51,R53	FI, Ac Tox	Amine Phosphate 0,10-0,50%
Shell Omala S2 G 100 Gear Lub	200 ltr Drum	3	600 ltr	0.6	N/A	NC R22,R41,R43,R51,R53	FI, Ac Tox	Amine Phosphate 0,10-0,50%
PERFORATING GUNS - ON SITE AD HOC - IF TUBING CONVEYED								
Cord, detonating - XHV,HMX, 80gr Det cord	5.2g	301	1560g	0.0016	0065	1.1D	Explosive	CAS no 78-11-5
Components, Explosive Train, N.O.S.	0.7g	30	21g	0.000021	0384	1.4S	Explosive	CAS no 78-11-5
Detonators, Non-Electric, for blasting	0.48g	13	6.3g	0.000006	0455	1.4S	Explosive	CAS no 78-11-5, 121-8-24, 13424-46-9, 15245-44-0, 1314-41-6, 7722-64-7
PERFORATING GUNS - ON SITE AD HOC - IF WIRELINE CONVEYED								
Detonators, electric for blasting - RP800 EBW								
Detonator	0.2g	5	1g	0.000001	0456	1.4S	Explosive	CAS no 78-11-5, 121-8-24, 13424-46-9, 15245-44-0, 1314-41-6, 7722-

CHEMICAL INVENTORY - EXPLORATORY OPERATIONS

Page 3 of 3

PRODUCT NAME	UNIT SIZE	QTY	TOTAL VOLUME	MAX TONNES	UN NO	CLASSIFICATIONS	HAZARD	Composition/Formation of Ingredients
CFR-8L	ltrs	168.35	168.35 ltrs	0.162	N/A	Not Classified		Sulfonated organic polymer 30-60%
Halad-300L NS	ltrs	4,500	4,500 ltrs	3.866	N/A	Not Classified		Mixture 60-100%
HR-4L	ltrs	1,370	1,370 ltrs	1.349	N/A	Not Classified		Modified Lignosulfonate 30-60%
Silicalite Liquid	ltrs	37,974	37,974 ltrs	44.209	N/A	Not Classified		Silica, amorphous-fumed, 30-60%
Tuned Spacer E+	ltrs	19,793	19793 ltrs	1.973	N/A	Not Classified		Bentonite 60-100%, Crystalline silica, tridymite 0-1%, Crystalline silica, cristobalite 0-1%. Crystalline silica quartz 1-5%
Gasstop-L	ltrs	7,562	7,562 ltrs	6.414	N/A	Xi R36/38 S26 S45 S37/39	Irritant	Sodium hydroxide 1-5%
CEMENT ADDITIVES - WELL MAINTENANCE								
MF-1				0.218	N/A	Not Classified		Sodium acid pyrophosphate 60-100%
Tuned Spacer E+	ltrs	5,457	5457 ltrs	0.544	N/A	Not Classified		Bentonite 60-100%, Crystalline silica, tridymite 0-1%, Crystalline silica, cristobalite 0-1%. Crystalline silica quartz 1-5%
SCR-100L				0.184	N/A	Not Classified		Acrylic copolymer 10-30%
Microcem 650SR				17	N/A	Xi R37 R38 R 41 R43	Irritant	Portland Cement Clinker 5-100%
NF-6	ltrs	60	60 ltrs	0.046	N/A	Not Classified		Vegetable oil 60-100%. Aluminum stearate 1-5%
HR-4L	ltrs	228	228 ltrs	0.224	N/A	Not Classified		Modified Lignosulfonate 30-60%
CFR-8L	ltrs	820	820 ltrs	0.789	N/A	Not Classified		Sulfonated organic polymer 30-60%
Gasstop-L	ltrs	3,413	3,413 ltrs	2.895	N/A	Xi R36/38 S26 S45 S37/39	Irritant	Sodium hydroxide 1-5%
Microbond HT				1.202	N/A	Xi R36/37/38 S2 S22		Calcium sulphate dihydrate 60-100%. Calcium aluminate 10-30%.
Silicalite Liquid	ltrs	717	717 ltrs	0.848	N/A	Not Classified		Silica, amorphous-fumed, 30-60%
Lafarge G	Bulker MT	25	25 MT	25	N/A	Xi R43 R35/38	Irritant	Portland cement 60-100%, Crystalline silica, quartz < 3%

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

APPENDIX 5 – AIR DISPERSION MODELLING AND REPORT

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014

<i>Rathlin Energy</i>	Applies To: Rathlin Energy	RE-05-EPRA-CH-005
Prepared By: Jonathan Foster	Uncontrolled, If Printed	Rev: 1.00

**EMS WORK INSTRUCTIONS – EPRA – CRAWBERRY HILL EXPLORATORY OPERATIONS – WASTE
MANAGEMENT**

*** Page Left Blank Intentionally ***

Rev:	Prepared By:	Checked By:	Approved By:	Issued:
1.00	Jonathan Foster	Tom Selkirk	D Montagu-Smith	16/01/2014



DISPERSION MODELLING ASSESSMENT OF THE IMPACT OF GAS FLARING AT CRAWBERRY HILL WELL SITE ON LOCAL AIR QUALITY

RATHLIN ENERGY (UK) LIMITED

Report prepared for

Rathlin Energy (UK) Limited
8 Wimpole Street
London
W1G 9SP

Report prepared by

Environmental Scientifics Group Limited
Unit D, Acacia Building
Vantage Point Business Village
Mitcheldean
Gloucestershire
GL17 0DD

Contract No. RE-EPR-CH-ESG-01

Author Dr N Ford

N Ford

CONTENTS

		Page No.
	COVER	1
	CONTENTS	2
0	SUMMARY	3
1	INTRODUCTION	4
	1.1 Scope of study	4
	1.2 General approach	4
	1.3 Structure of report	4
2	POLICY CONTEXT AND ASSESSMENT CRITERIA	5
	2.1 Context of assessment	5
	2.2 Pollutants from gas flaring	5
	2.3 Air Quality Standards	5
	2.4 Background air quality in Walkington	6
3	MODELLING METHODOLOGY	8
	3.1 Assessment area	8
	3.2 Buildings	9
	3.3 Meteorology	9
	3.4 Terrain	9
	3.5 Flare arrangement	10
	3.6 Flare gas properties	11
	3.7 Flare discharge conditions	12
	3.8 Pollutant discharge rates	12
	3.9 Modelling scenarios	13
4	MODELLING RESULTS	14
	4.1 Impact of flare releases	14
	4.2 Overall ambient concentrations of pollutants	15
	4.3 Process contribution at sensitive receptors	16
5	CONCLUSIONS	17
6	REFERENCES	18
Annex A	Dispersion model contour plots	19

0 SUMMARY

A dispersion modelling assessment using the ADMS 5 model was employed to predict the impact on local air quality of discharges of nitrogen oxides and carbon monoxide from a proposed natural gas flaring operation at Crawberry Hill well site. Based on full time flaring at the maximum gas disposal rate, the process contributions to local ambient concentrations of nitrogen dioxide and carbon monoxide have been predicted.

Rathlin Energy UK Limited are currently proposing to undertake exploration at the Crawberry Hill well site which will include the flaring of natural gas. The current assessment is undertaken to determine the likely impact of flaring operations on local air quality, in particular sensitive areas of habitation, and attainment of applicable air quality standards.

Two flare configurations were considered; a three tip ground flare and a single tip shrouded flare. The assessment indicates that in general the ground flare will have a greater impact on ground level pollutant concentrations than the shrouded flare. The ground flare can operate with several arrangements. Each has been considered and the configuration providing the highest environmental impact is reported.

For the ground flare maximum process contributions to ground level concentrations were equivalent to 27% and 30% respectively of the short term and long term air quality limit for nitrogen dioxide and 10% of the limit for carbon monoxide. When combined with the existing background concentrations all maximum predicted environmental concentrations were well within the applicable air quality standards ranging between 24 and 54% of the standard.

For the single tip shrouded flare maximum process contributions to ground level concentrations were equivalent to 1% and 3% respectively of the long term and short term air quality limit for nitrogen dioxide and 1% of the limit for carbon monoxide. When combined with the existing background concentrations all maximum predicted environmental concentrations were well within the applicable air quality standards ranging between 13 and 25% of the standard.

Maximum process contributions are generally predicted to occur relatively close to the well site within around 200 m. Process contributions fall rapidly with distance from the site and are typically around 20% or less of the highest values at a distance of 400 m. The general plume dispersion is in the direction of the prevailing wind towards the north west.

Maximum process contributions to ambient concentrations at locations of human habitation closest to the well site are equivalent to a very small part of the applicable air quality standard (at or less than 1 % of the standard). The worst case operation with the ground flare indicated a process contribution at locations of habitation at or below the level at which it would be considered insignificant. For the single tip shrouded flare all predicted process contributions at these locations are considered insignificant.

The modelling assessment methodology and necessary assumptions provide an conservative assessment of impact on air quality. The overall results and conclusions reached therefore incorporate a reasonable margin of comfort in spite of the inevitable uncertainty of such modelling studies.

It is concluded that the flaring operations proposed during well exploration will not affect the attainment of air quality standards within the local area. For the nearest locations of human habitation the impact of flaring on air quality is at or below the level at which it would be considered insignificant.

1 INTRODUCTION

Rathlin Energy (UK) Limited placed a contract with Environmental Scientifics Group Limited (ESG) to undertake an assessment of the impact on local air quality of discharges of important pollutants from a proposed gas flaring process at their Crawberry Hill well site near Walkington, East Riding of Yorkshire.

1.1 Scope of study

The purpose of this study is to assess the impact of releases from the proposed flaring operations at the Crawberry Hill well site on local air quality in the context of applicable air quality standards. It is necessary, as part of the application for a permit to operate, to demonstrate that the proposed development will not have a significant adverse impact on the ambient concentrations of important pollutants, in particular for this case nitrogen dioxide and carbon monoxide.

1.2 General approach

The approach taken in this assessment comprised the following main stages:

- Determine a suitable modelling tool for the assessment.
- Collate available process design data for input to the model.
- Establish the location of the proposed development relative to any existing or proposed buildings.
- Obtain information on local background concentrations of important pollutants.
- Obtain the most recent 5 years' meteorological data from a measurement station appropriate to the location.
- Model the dispersion of releases of important pollutants the flare operations to determine the process contribution to ambient concentrations over the local area with particular attention to locations of human exposure and statutory designated areas.
- Assess the predicted process contributions and established background concentrations with reference to applicable air quality standards to determine compliance.
- Comment on the predicted impact of discharges of important pollutants on local air quality.

Further details of the approach taken and model input information are provided in the following sections.

1.3 Structure of the report

This report provides an assessment of the impact of discharges from the proposed flare operations at Rathlin Energy (UK) Limited's Crawberry Hill well site on air quality in the vicinity. The approach to the assessment has been described above. The following sections provide a detailed commentary on the assessment and conclusions:

Section 2	Air quality standards and assessment criteria
Section 3	The model methodology employed and important input data
Section 4	The results of the assessment
Section 5	Conclusions of the assessment

2 POLICY CONTEXT AND ASSESSMENT CRITERIA

The Strawberry Hill well site is located in a relatively flat area with the town of Walkington some 2 km to the south east and the town of Bishops Burton around 3km to the north east (see Figure 3.1).

The proposed flaring operation at the Strawberry Hill site is part of a mineral exploration (oil and natural gas) programme. It is understood that initially, during exploration operations, there will be a need to dispose of up to 5MM scfd (million standard cubic feet per day) of gas by flaring.

2.1 Context of assessment

Local Authorities are required to assess compliance with applicable air quality objectives. Where the objectives are unlikely to be met the Local Authority is required to declare an Air Quality Management Area (AQMA) and prepare proposals for remedial action to achieve the required objective.

This operation will be under the control of the Environment Agency and will require a permit to operate. As part of the permit application it is necessary to demonstrate the likely impact of operations on local ambient concentrations of important pollutants. It is in this context that the proposed flaring operations are being examined to determine their additional contribution to existing concentrations of important pollutants and therefore determine compliance with applicable air quality limit values.

2.2 Pollutants from gas flaring

The main pollutants from the flaring of natural gas, which is predominantly composed of methane are oxides of nitrogen (NO_x) and carbon monoxide (CO). Oxides of nitrogen are generally considered to comprise nitrogen monoxide (NO) and nitrogen dioxide (NO_2). Emissions from combustion primarily consist of nitrogen monoxide, although reaction in the atmosphere results in conversion to nitrogen dioxide, which is the primary nitrogen oxide of interest with respect to ambient pollution. Carbon monoxide is formed from incomplete combustion of fuel and its presence will therefore be related to efficiency of combustion.

It is understood that there is negligible sulphur content in the natural gas and as such discharges of sulphur dioxide (SO_2) are not considered in this assessment. In some cases flaring can give rise to the production of fine particulate matter or soot, particularly where combustion is poor and there is a smoky flame. In view of the flare and fuel characteristics in this case, it is not expected that there will be any significant discharge of fine particulate matter and as such this is not considered in the assessment.

Air quality standards for England consider limit values for nitrogen dioxide and carbon monoxide. The standards specified are in the form of concentrations and are determined to be levels below which effects are unlikely even in sensitive population groups or below which the risk to public health would be very small.

2.3 Air Quality Standards

The UK's air quality strategy is based on meeting obligations within the European Union (EU) Ambient Air Quality Directive (2008/50/EC, 21 May 2008)¹ and the Fourth Daughter Directive (relating to metals and hydrocarbons). Table 2.1 summarises the applicable limit values for the pollutants considered in this assessment as at 2013.

It may be seen that standards are generally provided on the basis of short term and long term means. The limit values are considered to apply where members of the public are likely to be regularly exposed over the monitoring period. For the longer averaging periods the standards are considered to apply around the frontage of premises such as residential properties, schools and hospitals. The shorter term limit value (1 hour or 1 day means) applies at these locations and other areas where exposure is likely to be of one hour or more on a regular basis.

Table 2.1 UK Air Quality Standards

Pollutant	Basis	Concentration
Carbon monoxide (CO)	running 8 hour mean	10 mg/m ³
Nitrogen dioxide (NO ₂)	1 hour mean (99.79 percentile – 18 exceedences per year)	200 µg/m ³
	annual mean	40 µg/m ³

In some cases air quality standards (AQS) discuss standards (concentrations recorded over a specified time period which are considered to be acceptable in terms of current knowledge of the impact on health and the environment), objectives (target date by which the standard is expected to be met) and limit values (a legally binding time averaged limit which must not be exceeded). In the case of pollutants considered above the values specified are limit values which the UK is obliged to meet.

2.4 Background air quality in Walkington

In considering the overall impact of an operation, such as this herein, on local air quality and compliance with limit values, it is necessary not only to consider the contribution from the source of interest, but also the existing levels of pollutants of interest. Background air quality data for the Walkington area are available from DEFRA's air quality archive (<http://uk-air.defra.gov.uk/data/pcm-data>). The archive provides estimated background concentrations of important pollutants for 1km² areas for the UK. The latest background levels of nitrogen dioxide and carbon monoxide for the area considered (497500, 437500) were used for this assessment. Table 2.2 summarises the estimated background concentration for NO₂ and CO as obtained from the air quality archive.

Table 2.2 Background concentrations for Walkington

Pollutant	Concentration (µg/m ³)
Nitrogen dioxide (2011)	9.6
Carbon monoxide (2010)	1447

When considering the combination of estimated process contributions and background concentrations it should be noted that background concentrations are generally available as annual mean values and as such simple addition when considering short term air quality standards may not be appropriate. Guidance from the Environment Agency² suggests a simplified method for combining estimated process contributions and background concentrations. For comparison with long term standards the overall concentration is the sum of the process contribution (annual mean) and background concentration (annual mean). For comparison with short term standards the Environment Agency suggest the sum of the process contribution (hourly or daily mean) and twice the background concentration (annual mean). This methodology has been employed in this assessment.

When considering the impact of a process contribution, the existing background concentration and the headroom that this allows are significant. Figure 2.1 illustrates existing background concentrations around Walkington in the context of the current air quality limit values.

The Environment Agency's guidance note H1³ provides a methodology for assessing the impact and determining the acceptability of emissions to atmosphere on ambient air quality. H1 provides Environmental Assessment Levels (EALs) for each pollutant such that impact may be assessed.

The EALs relevant to this development are summarised in Table 2.2. The EALs employed are based on the more stringent of the EAL, where specified, and the corresponding air quality standard.

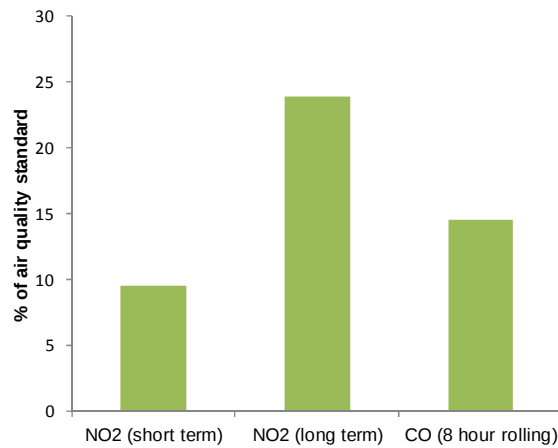
Table 2.2 Environmental Assessment Levels

Pollutant	Long term EAL (annual mean)	Short term EAL (hourly mean)
	µg/m ³	
CO	-	

The contribution of the process (PC) to the ambient concentration of a given pollutant is considered insignificant if:

- the long term PC is less than 1% of the long term environmental standard
- the short term PC is less than 10% of the short term environmental standard

Figure 2.1 Background pollutant concentrations and limit values – Walkington



3 MODELLING METHODOLOGY

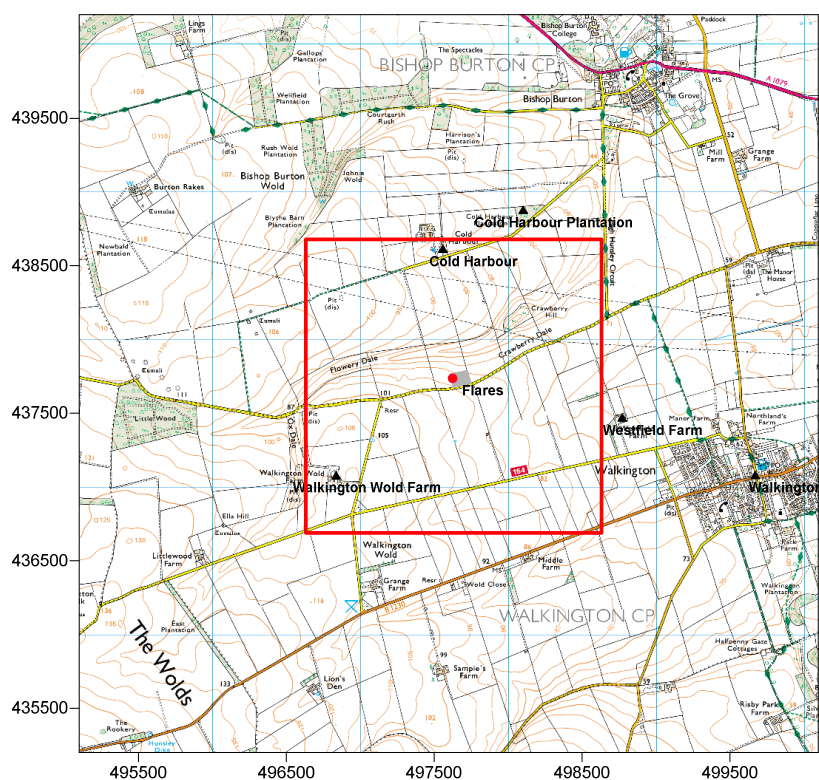
The contributions to ambient concentrations of nitrogen dioxide and carbon monoxide from the proposed flaring operations at Rathlin Energy (UK) Limited's Crawberry Hill well site have been modelled using the Atmospheric Dispersion Modelling System (ADMS) version 5. The use of this modelling tool is widely accepted by the Environment Agency and UK Local Authorities.

ADMS 5 requires a range of information in order to perform the modelling. The primary information used to perform the modelling is discussed below.

3.1 Assessment area

The area over which the assessment was undertaken is a 2000m x 2000m area with the flare location (497625, 437737) located approximately at the centre (see Figure 3.1).

Figure 3.1 Assessment area for modelling



A general grid with receptors spaced at 40 m intervals (i.e. 2601 points for a 51 x 51 grid) was used to assess the process contribution to ground level concentrations over the area. The grid was considered at ground level (i.e. 0m).

Some special receptors, as identified in Figure 3.1, were considered at the locations of human habitation closest to the well site. There are no statutory designated sites within the assessment area.

The coordinates of the special receptors are summarised in Table 3.1. All special receptors are considered at an elevation of 1.5 m above ground level.

Table 3.1 Locations of special receptors

Site	Easting	Northing
Westfield Farm	498773	437471
Walkington Wold Farm	496837	437079
Cold Harbour	497559	438615
Cold Harbour Plantation	498103	438879
Walkington	499672	437081

3.2 Buildings

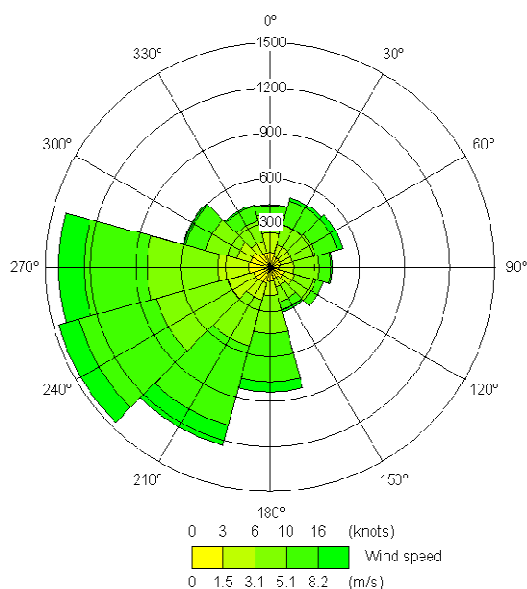
The presence of buildings close to a stack can have a significant impact on the dispersion of releases. The most significant impact can be the downwash of a plume around a building causing increased concentrations in the immediate area around the building. Buildings can also disturb the wind flow causing turbulent wake downwind which can also affect dispersion. It is normally considered that buildings within 5 times the height of release should be considered in any modelling.

It is not considered that the temporary buildings intended for this site will have any significant impact on dispersion of flare discharges and as such the presence of buildings has not been considered in this assessment.

3.3 Meteorology

For this modelling assessment hourly sequential meteorological data from the nearest suitable meteorological station to the Crawberry Hill site was obtained. The data, provided by the UK Met Office, was from the Leconfield station and covered the 5-year period 2008 to 2012.

The data included, among other parameters, hourly measurements of wind speed and direction. A typical annual windrose (2008) for the Leconfield station is shown in Figure 3.2.

Figure 3.2 Windrose for Leconfield (2008)

The prevailing wind is from the south east and east.

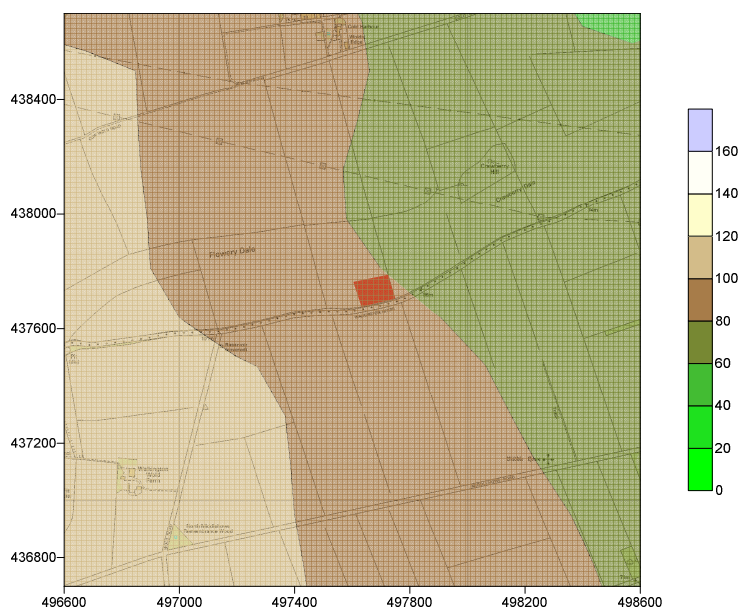
3.4 Terrain

The area of the assessment around the Crawberry Hill well site is relatively flat. The well site is around 1km from the nearest residence and around 2 km from the village of Walkington.

The general area is considered to fall into the category of an agricultural area and as such a surface roughness of 0.2, as defined in ADMS 5, has been assigned. A sensitivity analysis indicated no significant change in predicted contributions to ground level concentrations of nitrogen dioxide between surface roughness values of 0.1 (root crops) to 1.0 (woodland).

Terrain data was obtained for the assessment area from the Ordnance Survey Land-form Panorama DTM data base. The complex terrain option was employed such that modelling considered ground elevation as illustrated in Figure 3.3.

Figure 3.3 Ground elevation within the assessment area



3.5 Flare arrangement

The arrangement of the flaring system has yet to be decided. Currently Rathlin Energy (UK) Limited are considering two flare configurations (A and B). Configuration A features a three tip ground flare arrangement, whilst Configuration B is a single tip shrouded flare as shown in Figure 3.4. When installed Configuration A will incorporate a temporary enclosure with thermal sheeting which will act to reduce both noise and thermal radiation.

Figure 3.4 Flare configurations



A - 3 tip ground flare



B – single tip shrouded flare

The significant properties of the two flare configurations are summarised in Table 3.2.

Table 3.2 Main properties of flare configurations

Configuration	A	B
Flare tip height above ground	1.22 m	3.05 m
Flare tip diameter	2 off 2" (internal 31 mm) 1 off 3" (internal 51 mm)	1 off 12" (305 mm) (shroud 2.44 m diameter, 9.14m high)

In this assessment both flare configurations have been considered. It has also been necessary for Configuration A, to consider the pattern of operation. Assessments have been undertaken for the following operating patterns:

- 1 off 2" (all gas to single 2" flare tip)
- 2 off 2" (50% of gas to each 2" flare tip)
- 1 of 3" (all gas to 3" flare tip)
- 1 off 2" and 1 off 3" (73% of gas to 3" flare tip and remainder to 2" flare tip – in proportion to tip area)

3.6 Flare gas properties

The composition of the natural gas to be flared was provided by Rathlin Energy (UK) Limited and is summarised in Table 3.3.

Table 3.3 Composition of natural gas

Component	% by volume
CO ₂	0.03
CO	0.01
H ₂	1.18
C ₁	87.04
C ₂	4.65
C ₃	1.03
C ₄	0.22
C ₅	0.07

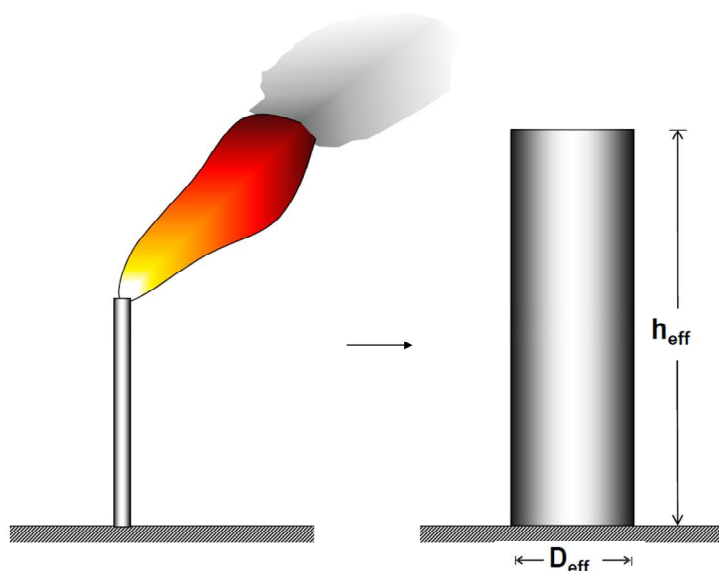
Rathlin Energy (UK) Limited has indicated that the expected natural gas disposal rate is 5 MMscfd. Based on the composition in Table 3.3 and the specified disposal rate, assumed to be uniform over each daily operating period, the natural gas characteristics in Table 3.4 have been calculated.

Table 3.4 Natural gas flaring characteristics

Parameter		Value
Total flow rate of natural gas	kg/h	3989
	kmol/h	249
	MMscfd	5000000
	Nm ³ /s	1.55
Natural gas molecular weight	g/gmol	16.02
Net heat of combustion	MJ/kmol	765
	Btu/scf	867
	kJ/kg	47767
Gross heat of combustion	MJ/mol	851
	Btu/scf	965
	kJ/kg	53158
Net heat release rate*	Btu/s	49166
	MW	51.87
Gross heat release rate*	Btu/s	54715

3.7 Flare discharge conditions

Dispersion modelling of flare discharges is generally based on United States Environmental Protection Agency (US EPA) guidelines. These require flares to be considered as point sources (i.e. similar to a stack), although it is necessary to consider the effective height and diameter of the plume which are determined based on heat release, flame temperature and the radiative heat loss.



There are a range of methodologies for undertaking the calculations necessary to determine these parameters. Generally the guidance provided by the US EPA is followed. For use with ADMS the methodology described within Ontario State guidelines⁵ is generally recommended and has been used herein. US EPA recommended default values for stack temperature and exit velocity⁴ have also been employed. Based on this methodology the pertinent release parameters for each configuration of flare are summarised in Table 3.5.

Table 3.5 Flare discharge conditions

Flare Configuration		A					B		
		1 x 2"	2 x 2"	1 x 3"	2" & 3"				
					2"	3"			
Flare temperature	°C	1000 ³							
Radiation loss	%	25 ¹					10 ²		
Effective release height	m	12.4	9.3	12.4	7.2	10.9	14.3		
Effective diameter	m	0.29	0.29	0.48	0.29	0.48	2.25		
Gas velocity	m/s	20 ³							

1. a radiation loss of 25% is the default value for an unshrouded flare in Ontario State guidance⁵

2. a radiation loss of 10% is assumed based on a previous assessment of this shrouded flare

3. values for flare temperature and velocity are based on US EPA default values⁴

3.8 Pollutant discharge rates

In the absence of measurements, it is general practice to employ emission factors to estimate the pollutant discharge rates from flare operations. US EPA AP-42⁶ emission factors are accepted widely and have been used in this assessment. The total pollutant discharges from the flare operations are summar

to each tip is assumed to be in proportion to the tip area and such the pollutant rate from each tip will be correspondingly shared.

Table 3.6 Pollutant discharge rates

Parameter		Nitrogen oxides	Carbon monoxide
Emission factor	lb/10 ⁶ Btu ¹	0.068	0.37
Total discharge rate	g/s	1.69	9.18

1. based on gross heating value

Whilst the emission of nitrogen oxides is mostly in the form of nitrogen monoxide, subsequent reactions in the atmosphere produce nitrogen dioxide. As nitrogen dioxide (NO₂) is of considerably more importance to air quality than nitrogen monoxide (NO), it is essential that a representative measure of the conversion from NO to NO₂ is employed. Guidance⁷ suggests that a worst case scenario is to assume:

- 35% conversion of NO to NO₂ for short term averaging
- 70% conversion of NO to NO₂ for long term averaging

The conversion factors above have been employed within this assessment.

3.9 Modelling scenarios

ADMS 5 has been employed to estimate process contributions to ambient concentrations of NO₂ and CO based on the general conditions specified above. The flare operating patterns discussed in section 3.5 have been considered. For all modelling scenarios considered the model has been run using meteorological data for each of five years (2008 to 2012).

4 MODELLING RESULTS

ADMS 5 has been run for the operating scenarios described in Section 3.5. The results of the modelling are discussed below. In this section results are presented in tabular form generally considering the location of maximum impact, whilst in Annex A contour plots are provided which illustrate the estimated process contribution to ambient pollutant concentrations over the entire assessment area.

4.1 Impact of flare releases

Table 4.1 summarises the maximum process contributions to ground level concentrations of nitrogen dioxide and carbon monoxide for the operating arrangements considered.

Table 4.1 Predicted maximum process contributions

Pollutant	Averaging basis	Maximum process contribution to ground level concentration ($\mu\text{g}/\text{m}^3$)					
		Flare arrangement				B	
		A					
		1 x 2"	2 x 2"	1 x 3"	1 x 2" & 1 x 3"		
NO ₂	Short term	40	54	24	39	6.3	
NO ₂	Long term	7.2	11.8	4.7	8.5	0.5	
CO	8 hours	786	978	447	627	109	

The assessment indicates that the maximum process contribution to ground level concentrations of both nitrogen dioxide and carbon monoxide is seen when the flare Configuration A is employed. This is not unexpected since these are ground flares with a lower elevation than Configuration B and as such the plume rise is lower and dispersion less efficient. In particular, the scenario where both 2" flares each operate with half of the total Natural gas provides the maximum predicted process contribution. Configuration B, with a higher discharge height by virtue of the higher flare tip and reduced heat radiation provides a much lower process contribution to ground level concentrations than any of the Configuration A arrangements.

It should be noted that the values in Table 4.1 are the predicted maximum contributions one location. For the remainder of the assessment area predicted maximum contributions are lower and in most cases significantly lower. The contour plots in Annex A illustrate the predicted pattern of dispersion for discharges. For Configuration A, with the lower release height, maximum process contributions are predicted to occur relatively close to the well site within around 200 m. Process contributions fall rapidly with distance from the site and are typically around 20% or less of the highest values at a distance of 400 m. As might be expected when viewed over a longer term (Figure A3) the general plume dispersion is in the direction of the prevailing wind towards the north west. The pattern of dispersion for Configuration B is similar although distances to the location of maximum are somewhat higher.

In Table 4.2 the predicted maximum process contributions are summarised as a proportion of the applicable air quality standards.

Table 4.2 Predicted maximum process contributions – relative to air quality standards

Pollutant	Averaging basis	Maximum process contribution to ground level concentration
-----------	-----------------	--

monoxide the corresponding values are 4-10% for Configuration A and 1% for Configuration B. In all cases maximum process contributions are well below the applicable air quality standards.

4.2 Overall ambient concentrations of pollutants

Whilst the assessment has concentrated on the process contribution to ground level concentrations it should also be recognised that there will be an existing background concentration of each pollutant. As indicated in section 2.4 background concentrations for the Walkington area are available.

In this case the background concentration needs to be added to the process contribution to determine the total pollutant concentration. Based on the maximum predicted contributions in Table 4.1, and background concentrations in Table 2.2, the total maximum predicted environmental concentration (PEC) for each pollutant has been determined and is summarised in Table 4.3.

Table 4.3 Maximum predicted environmental concentrations of pollutants

Pollutant	Averaging basis	Maximum predicted environmental concentration (%AQS)				
		Flare arrangement				
		A				B
		1 x 2"	2 x 2"	1 x 3"	1 x 2" & 1 x 3"	
NO ₂	Short term	30	37	22	29	13
NO ₂	Long term	42	54	36	45	25
CO	8 hours	22	24	18	20	15

In all cases the maximum predicted environmental concentrations of nitrogen dioxide and carbon monoxide are well below the applicable air quality standards. Figure 4.1 illustrates the relative contributions of the process contribution and background for the worst case Configuration A arrangement and Configuration B in the same format as Figure 2.1.

Figure 4.1 Maximum predicted environmental concentrations of pollutants

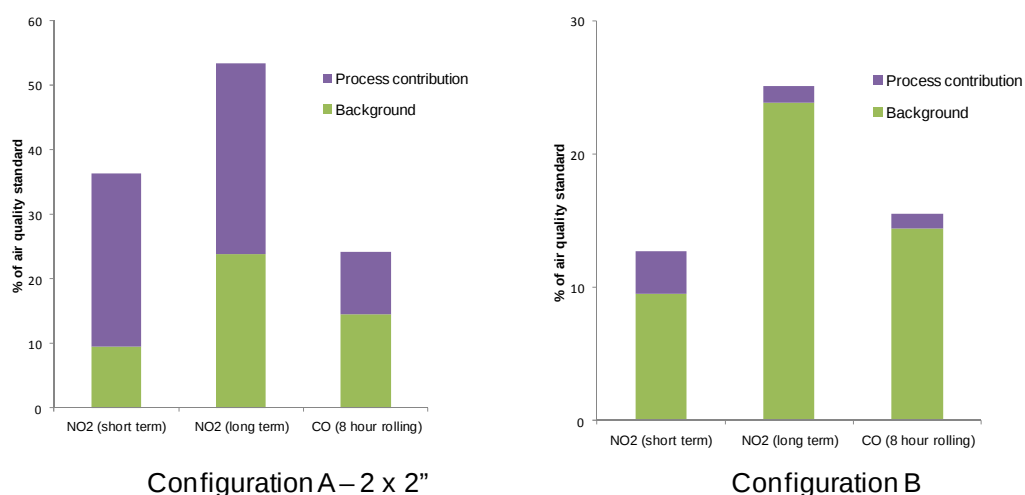


Table 4.4 Comparison of PC and EAL at sensitive receptors

Location	Maximum process contribution (%PC/EAL)					
	Configuration A (2 x 2")			Configuration B		
	NO ₂ Annual mean	NO ₂ 99.79 percentile of hourly means	CO Running 8 hour mean	NO ₂ Annual mean	NO ₂ 99.79 percentile of hourly means	CO Running 8 hour mean
Westfield Farm	2.7	0.8	0.5	0.4	2.1	0.1
Walkington Wold Farm	1.9	0.5	0.5	0.5	1.3	0.1
Cold Harbour	3.2	1.0	0.6	0.5	2.6	0.2
Cold Harbour Plantation	2.4	1.0	0.5	0.4	2.5	0.1
Walkington	1.6	0.3	0.3	0.2	0.7	0.0

There are no statutory designated sites within the assessment area.

5 CONCLUSIONS

A dispersion modelling assessment using the ADMS 5 model was employed to predict the impact on local air quality of discharges of nitrogen oxides and carbon monoxide from a proposed natural gas flaring operation at Crawberry Hill well site. Based on full time flaring at the maximum gas disposal rate, the process contributions to local ambient concentrations of nitrogen dioxide and carbon monoxide have been predicted.

Rathlin Energy (UK) Limited are currently proposing to undertake exploration at the Crawberry Hill well site which will include the flaring of natural gas. The current assessment is undertaken to determine the likely impact of flaring operations on local air quality, in particular sensitive areas of habitation, and attainment of applicable air quality standards.

Two flare configurations were considered; a three tip ground flare and a single tip shrouded flare. The assessment indicates that in general the ground flare will have a greater impact on ground level pollutant concentrations than the shrouded flare. The ground flare can operate with several arrangements. Each has been considered and the configuration providing the highest environmental impact is reported.

Ground flare maximum process contributions to ground level concentrations were equivalent to 27% and 30% respectively of both the short term and long term air quality limit for nitrogen dioxide and 10% of the limit for carbon monoxide. When combined with the existing background concentrations all maximum predicted environmental concentrations were well within the applicable air quality standards ranging between 24 and 54% of the standard.

For the single tip shrouded flare maximum process contributions to ground level concentrations were equivalent to 1% and 3% respectively of the long term and short term air quality limit for nitrogen dioxide and 1% of the limit for carbon monoxide. When combined with the existing background concentrations all maximum predicted environmental concentrations were well within the applicable air quality standards ranging between 13 and 25% of the standard.

Maximum process contributions are generally predicted to occur relatively close to the well site within around 200 m. Process contributions fall rapidly with distance from the site and are typically around 20% or less of the highest values at a distance of 400 m. The general plume dispersion is in the direction of the prevailing wind towards the north west.

Maximum process contributions to ambient concentrations at locations of human habitation closest to the well site are equivalent to a very small part of the applicable air quality standard (at or less than 1 % of the standard). The worst case operation with the ground flare indicated a process contribution at locations of habitation at or below the level at which it would be considered insignificant. For the single tip shrouded flare all predicted process contributions at these locations are considered insignificant.

The modelling assessment methodology and necessary assumptions provide an conservative assessment of impact on air quality. The overall results and conclusion reached therefore incorporate a reasonable margin of comfort in spite of the inevitable uncertainty of such modelling studies.

It is concluded that the flaring operations proposed during well exploration will not affect the attainment of air quality standards within the local area. For the nearest locations of human habitation the impact of flaring on air quality is at or below the level at which it would be considered insignificant.

6 REFERENCES

1. Directive 2008/50/EC – Ambient air quality and cleaner air for Europe, 21 May 2008.
2. Environment Agency, 'Review of background air quality data and methods to combine these with process contributions: technical modelling aspects', Science report SC030174/1SR2, October 2006.
3. Environment Agency, "Horizontal guidance note H1 – Annex (f) Air Emissions", version 2.2, December 2011.
4. 'Comparison of Flare Dispersion Modeling Methodologies and Current Flare Technologies', W L Boger et al.
5. 'Air dispersion modelling guideline for Ontario, Version 2.0', Ontario Ministry of the Environment, March 2009.
6. 'Compilation of Air Pollutant Emission Factors', Volume 1, 5th Edition, January 1995, United States Environmental Protection Agency.

ANNEX A Dispersion model contour plots

The results of the modelling of the impact of the flaring operations on local ambient concentrations of nitrogen dioxide and carbon monoxide are presented in tabular form in Section 4. In Annex A these results are presented as contour plots of the process contribution to ambient concentrations. All results are presented as the maximum contribution of the process (excluding existing background concentrations) in $\mu\text{g}/\text{m}^3$ for nitrogen dioxide and mg/m^3 for carbon monoxide.

The following figures are presented:

- | | |
|----------|---|
| Figure 1 | Predicted concentrations of nitrogen dioxide (99.8 percentile of 1 hour means)
Flare Configuration A – 2 x 2" |
| Figure 2 | Predicted concentrations of nitrogen dioxide (annual mean)
Flare Configuration A – 2 x 2" |
| Figure 3 | Predicted maximum process contributions of carbon monoxide (short term – rolling 8
hour mean) - Flare Configuration A – 2 x 2" |
| Figure 4 | Predicted concentrations of nitrogen dioxide (99.8 percentile of 1 hour means)
Flare Configuration B |
| Figure 5 | Predicted concentrations of nitrogen dioxide (annual mean)
Flare Configuration B |
| Figure 6 | Predicted maximum process contributions of carbon monoxide (short term – rolling 8
hour mean) - Flare Configuration B |

**Figure A.1 Predicted concentrations of nitrogen dioxide (99.8 percentile of 1 hour means)
Flare Configuration A – 2 x 2"**

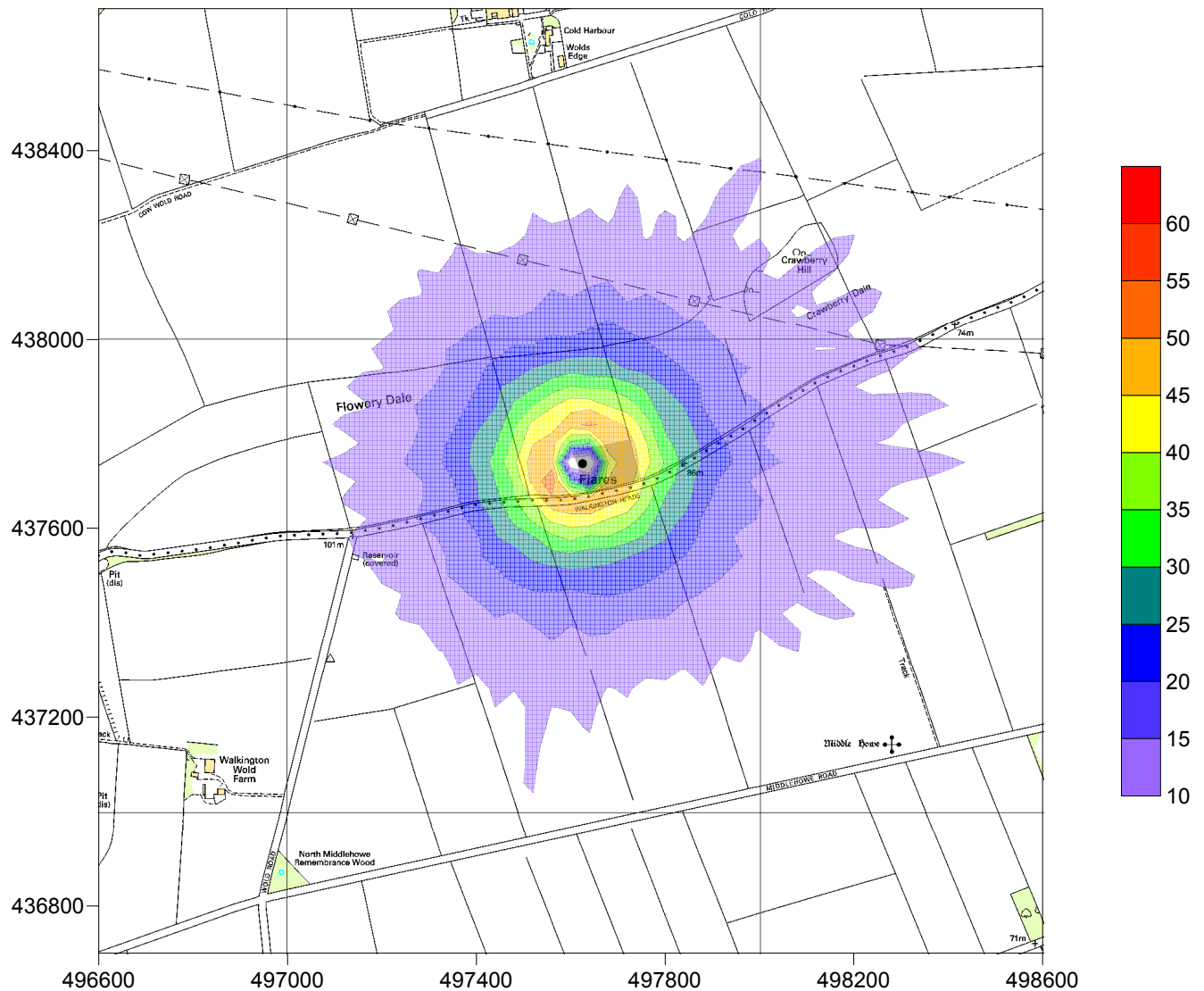


Figure A.2 Predicted concentrations of nitrogen dioxide (annual mean)
Flare Configuration A – 2 x 2"

