Ballinlea 2
Waste Management Plan
Exploratory Operations

*** Page Left Blank Intentionally ***

TABLE OF CONTENTS

1. INTRODUCTION

Rathlin Energy 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 Northern Ireland operations are conducted through Rathlin Energy and are directed from the Rathlin Energy office in London.

Rathlin Energy is engaged in the exploration and production of petroleum onshore United Kingdom and holds 100% interest in Department of Enterprise, Trade and Investment (DETI) Petroleum Licence (PL) PL3/10, within which it has drilled one exploration borehole at Ballinlea, County Antrim, Northern Ireland.

An application for planning permission for the proposed Ballinlea 2 exploration wellsite has been submitted to the Planning Service within the Department of the Environment Northern Ireland (DOENI). The application is for the construction of a wellsite and the drilling and testing of a petroleum exploratory borehole.

The purpose of this document is to outline the waste management arrangements to be implemented at the Ballinlea 2 wellsite during exploratory operations, which for clarity includes site construction, drilling, testing and wellsite restoration operations, permitted under a future planning consent.

1.1 Site Details

The proposed Ballinlea 2 exploratory operations are to be undertaken at the following location:

Ballinlea 2 Wellsite
Rathlin Energy Limited
49 Ballinlea Road
Ballinlea Upper
Ballycastle
County Antrim
Northern Ireland
BT54 6NN

National Grid Ref: NW 22182 97672

Site Area: 1.17 hectares

Waste Registration Number: To be applied for following receipt of planning consent

The site surface boundary is detailed in green on the site plans included within the document RE-05-WMP-B2-SP-001, Included as Appendix 1.

2. SCOPE

This Waste Management Plan is applicable to the Ballinlea 2 wellsite and all exploratory operations permitted therein, in accordance with future planning consent. It is applicable to Rathlin Energy, its contractors and subcontractors and can be used in support of applications to the Planning Service within the Department of the Environment (DOENI) and the Northern Ireland Environment Agency (DOENI) under the Pollution Prevention and Control (Northern Ireland) Regulations 2003, 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 waste legislation.

3. DEFINITIONS

API:	American Petroleum Institute
B2:	Ballinlea 2 Well
BAT:	Best Available Technique
BTEX:	Benzene, Toluene, Ethylbenzene and Xylenes
DEFRA:	Department for Environment, Food and Rural Affairs
DETI:	Department of Enterprise, Trade and Industry
DOENI:	Department of Environment Northern Ireland
EMS:	Environmental Management System
H2S:	Hydrogen Sulphide
Hazardous Waste:	As defined by Article 3(2),7 and Annex III of the Waste Framework Directive
HCI:	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
MAFF:	Ministry of Agriculture, Fisheries and Food

MD GL:	Measured Depth Ground Level
MMSCF:	Million Standard Cubic Feet
NIEA:	Northern Ireland Environment Agency
Non Hazardous Waste:	A waste which is not classified as inert or hazardous waste
NORM:	Naturally Occurring Radioactive Material
pH:	Measure of hydrogen ion concentration
PL:	Petroleum Licence
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
PPG:	Pounds per Gallon
SMS:	Safety Management System;
Spent Acid:	Calcium chloride, carbon dioxide and water
TD:	Total Depth
TVD GL:	True Vertical Depth Ground Level
VOCs:	Volatile Organic Compounds

4. PLANNING AND ENVIRONMENTAL LEGISLATION AND APPLICABILITY

Activities associated with the exploration for oil and gas onshore Northern Ireland fall to be considered within the scope of a number of pieces of planning and environmental legislation. A review of the proposed Ballinlea 2 exploratory operations against planning and environmental legislation associated with waste has identified the following legislation as being applicable to the Ballinlea 2 exploratory operations.

4.1 Pollution Prevention and Control Regulations (Northern Ireland) 2003

Regulation 10 of the Pollution Prevention and Control Regulations (Northern Ireland) 2003 requires an application for a permit to operate an installation or mobile plant if the installation or mobile plant is classified as a Part A, B or C installation or mobile plant under the definitions of Schedule 1 Part 1.

The Ballinlea 2 exploratory operations do not involve any activities listed within Schedule 1 of the Pollution Prevention and Control Regulations (Northern Ireland) 2003. A permit to operate an installation is, therefore, not applicable to this Waste Management Plan.

However, during the testing of the well, the incineration of natural gas, classified as a hazardous waste, will be conducted to determine whether the formations are capable of producing commercial quantities of petroleum. The incineration may exceed 10 tonnes per day and therefore will be regulated under the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2003 (see section 4.4).

4.2 Groundwater Regulations (Northern Ireland) 2009

The Groundwater Regulations (Northern Ireland) 2009 define that an activity that could involve the discharge of pollutants into groundwater must be notified to the Northern Ireland Environment Agency, together with the nature of these pollutants. The Northern Ireland Environment Agency will then determine whether the groundwater activity needs to be authorised or is exempt under Regulation 6 of the Groundwater Regulations (Northern Ireland) 2009.

The Ballinlea 2 exploratory operations will involve minor discharge of drilling fluids, cement and acids to groundwater, although for clarity, the fluids used, together with the depths at which they are used, does not present a risk of pollution and therefore can be considered by the Northern Ireland Environment Agency an Exempt Groundwater Activity in accordance with Regulation 6 of the Groundwater Regulations (Northern Ireland) 2009.

4.3 Planning (Management of Waste from Extractive Industries) Regulations (Northern Ireland) 2010

The Planning (Management of Waste from Extractive Industries) Regulations 2010 transposes the Mining Waste Directive 2006/21/EC, which 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.

The Ballinlea 2 exploratory operations will involve the extraction of waste, as defined in the Mining Waste Directive.

4.4 The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2003

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.

The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013, which transposes the requirements of the Industrial Emissions Directive, requires an environmental permit to authorise an installation operation.

The Ballinlea 2 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.

4.5 Radioactive Substances Act 1993

Activities involving radioactive materials are regulated under the Radioactive Substances Act 1993 and the Radioactive Substances Act 1993 (Amendment) Regulations (Northern Ireland) 2011.

Table 1 of Schedule 1A of the Radioactive Substances Act 1993 (Amendment) Regulations (Northern Ireland) 2011 defines the production and use of thorium or uranium as a Naturally Occurring Radioactive Material (NORM) industrial activity.

Table 2 of Schedule 1A of the Radioactive Substances Act 1993 (Amendment) Regulations (Northern Ireland) 2011 requires an accumulation of radioactive waste and its subsequent disposal, exceeding concentrations set out in Table 2, to be authorised.

The Ballinlea 2 exploratory operations may 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 2 of Schedule 1A. Until such time as the concentration of NORM can be established, an authorisation is required to authorise the management and disposal of NORM.

4.6 Water Discharge Activity

Surface water discharge of clean surface water run-off does not require consent to discharge. If, however, surface water run-off does become contaminated then the Northern Ireland Environment Agency must be contacted and consent to authorise the discharge sought, having first exhausted all feasible means to stop contamination at source and such discharge not giving raise to pollution of the receiving water. If it is not feasible to issue consent for water discharge due to the potential for polluting the receiving water, the Northern Ireland Environment Agency will require an alternative means to discharge, such as offsite disposal at a licenced facility or onsite treatment.

The Ballinlea 2 exploratory operations do anticipate surface water discharge of clean water, having constructed the site to include an impermeable membrane, containment ditch and interceptor. Wherever possible surface water is reused in the exploratory operations with any excess being

discharged from the interceptor (clean runoff water only) or removed from site to an offsite licensed facility for treatment if dirty or contaminated. A water discharge consent may be required if contaminated water is discharged to surface, land or groundwater, however, this is not anticipated nor is a permit being sought.

5 DESCRIPTION OF THE FACILITY

5.1 Site Location

The Ballinlea 2 wellsite is located on the B147 Ballinlea Road approximately 6.3km west of Ballycastle and 9.3km east of Bushmills, within Moyle District Council, County Antrim.

5.2 Site Description and Current Status

Rathlin Energy applied for planning permission in June 2013 from the Planning Service, Department of the Environment Northern Ireland (DOENI) to construct a temporary drilling site with associated access and drill a borehole for the purpose of minerals exploration (petroleum). The application, awaiting approval, provides for the construction of the wellsite and the drilling and testing of one exploratory borehole followed by well abandonment and wellsite restoration.

The proposed site location is currently an agricultural field laid to grass, surrounded by mature hedge and scattered hedgerow trees.

The Ballinlea 2 (B2) petroleum exploration borehole is to be drilled following receipt of planning permission and subsequent site construction. Upon completion of the drilling operation the well will be suspended pending a programme of testing to determine whether or not the B2 well has encountered commercially producible petroleum. In the event that the B2 well is not successful in determining the presence of commercially producible petroleum, the well will be abandoned and the site restored to its former use.

5.3 Waste Generating Activities

A summary of the proposed B2 site construction, drilling, well maintenance and testing operations is detailed below, with a more detailed description of each activity provided within each subsections. Site construction, drilling, well maintenance and testing programme is as follows:

- Wellsite construction
- Drilling operations
    - Surface Conductor
    - Main Drilling Operation
- Well testing
    - Lower Carboniferous shale mini fall-off test and abandonment
    - Lower Carboniferous sand flow test
    - Lower Carboniferous sand acid stimulation
    - Lower Carboniferous sand conventional hydraulic fracture stimulation

- Well maintenance
- Well abandonment
- Site Restoration

5.3.1 Wellsite Construction

5.3.1.1 Highway Improvements

There is an existing access point to the site location immediately adjacent to the public highway. To allow the safe movement of vehicles access and egress, the current access point and wellsite access will require upgrading. The upgraded entrance will consist of precast concrete kerbs and channels, tarmac at surface and surface water drainage. Verges along the access route will require protection and these works will be completed under relevant agreement with the Highways Authority.

5.3.1.2 Wellsite Entrance

Topsoil will be excavated within the entrance and stored in the earth bunds on the western boundary of the site. The entrance will be constructed from tarmac with a fall into the wellsite, ensuring that it does not drain onto the public highway. By using tarmac, this will minimise debris being carried onto the public highway. Wheel washing facilities will be available to ensure that site debris is not transmitted onto the public highway.

5.3.1.3 Site Preparation

In preparing the site to ensure it is suitable for the proposed operations, the top soil will be removed. Soil handling will be carried out with reference to guidelines set out by DEFRA "Construction Code of Practice for the Sustainable Use of Soils on Construction Sites" (2009) and MAFF "Good Practice Guide for Handling Soils" (2000). In accordance with this guidance, the handling of soils will be minimised as far as reasonably practicable.

The topsoil will be removed from the development area and stored in an earth bund along the western boundary of the site. This is the most suitable area to form additional visual screening of the site and provide noise attenuation during operations. A topographical survey of the site has confirmed that the site has a cross fall of approximately five metres, therefore, in order to ensure a level working platform the subsoil will need to be cut and filled to an approximate depth of two and a half metres.

5.3.1.4 Liner, Drainage and Working Surface

Once the topsoil has been removed and the cut to fill completed, an impermeable membrane will be laid across the site and heat welded to ensure integrity. The membrane is similar to the liners used for landfills and is typically made from High Density Polyethylene (HDPE). The membrane will cover the footprint of the site and is protected above and below by a non-woven geotextile. Once laid, the liner is tested to confirm it has a containment area. Rathlin Energy will be issued a certificate confirming its integrity by the specialist contractor.

A drainage ditch will be constructed around the perimeter of the site and any surface water directed to the ditch prior to collection. The ditch will be lined with the membrane to ensure containment of

fluids and connected to an interceptor. In order to access and egress the wellsite, the ditch to the north will have a twin wall perforated plastic pipe placed within it before being covered with clean aggregates back to surface. Any surface water captured in the drainage ditch will be reused on site or either discharged through an interceptor to soak away if clean run-off water or, if dirty or contaminated, collected by a licenced carrier for disposal at a licenced waste water facility.

5.3.1.5 Drilling cellar

A cellar will be constructed within the centre of the site. This forms a containment area from which the well can be drilled, whilst also housing the wellhead. The cellar is constructed using precast concrete rings approximately 2700mm nominal diameter. The impermeable membrane is incorporated into the cellar construction to maintain the integrity of the site. Once the cellar has been constructed, an integrity test is carried out to confirm that it provides suitable containment.

5.3.1.6 Utilities and Security

A fence will be erected around the perimeter of the wellsite and a set of gates erected across the wellsite entrance. The perimeter fencing and access gates will be constructed from wood and will ensure no unauthorised access to the site.

All utilities required for the site will be provided by mobile facilities. This will include the use of acoustically clad generators and storage tanks for potable and non-potable water.

5.4 Drilling Operations

The Ballinlea 2 wellsite planning permission provides for the drilling of an exploratory 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 well.

The waste arising from the drilling of the exploratory borehole has been included within this waste management plan.

5.4.1 Surface Conductor

A conventional waterwell drilling rig would be mobilised to the wellsite to drill the surface conductor to approximately 200m TVD GL.

The drilling of the surface conductor consists of drilling a 17 ½" hole, to a depth of +/- 200m. This initial section of the borehole will be drilled conventionally using air. Once this section has been drilled, 13 $^{3}/_{8}$" steel casing will be run into the hole and cemented back to surface.

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

5.4.2 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 12¼"

A 12 ¼" drill bit will drill from 200m to 800m TVD GL with water based KCl and polymer mud system. Once this section has reached its TD, 9 ⅝" casing will be run and cemented back to surface.

Drilling Fluid Composition:					
12¼" Hole Section – KCL Polymer Mud System				Volume:	752 bbl
Product:	Unit Size:	Quantity:	Total Quantity:	Quantity (lbs):	Concentration (ppb)
BARITE	25 KG	144	3,600	7937	10.55
CAUSTIC SODA	25 KG	4	100	220	0.29
SODA ASH	25 KG	20	500	1102	1.47
SODIUM BICARBONATE	25 KG	2	50	110	0.15
CITRIC ACID	25 KG	8	200	441	0.59
KCL, MR2, PO BAL 026	25 KG	80	2,000	4409	5.86
KCL, Bb, PO BAL 026	1MT	17	17,000	33479	44.52
DUOVIS	25 KG	41	4,025	8874	11.80
SAFECIDE	25 KG	3	75	165	0.22
DEFOAM NS	25 KG	6	150	331	0.44
DRILLING STARCH	25 KG	98	2,450	5401	7.18

Hole Section 8 ½"

A 8 ½" hole will be drilled from 800m TVD GL to 1,690m MD GL using a water based KCl and polymer mud system. 7" casing will be set immediately below the Triassic section in the Permian. The casing will be run and cemented back to surface.

Drilling Fluid Composition:					
8½" Hole Section – KCL Polymer Mud System				Volume:	2027 bbl
Product:	Unit Size:	Quantity:	Total Quantity:	Quantity (lbs):	Concentration (ppb)
BARITE	25 KG	740	18500	40786	20.12
BENTONITE	25 KG	10	250	551	0.27
CAUSTIC SODA	25 KG	73	1825	4023	1.98
SODA ASH	25 KG	46	1150	2535	1.25
SODIUM BICARBONATE	25 KG	9	225	496	0.24
KCL, MR2, PO BAL 026	25 KG	160	4000	8818	4.35
KCL, MR7, PO BAL 026	25 KG	280	7000	15432	7.61
KCL, MR8, PO BAL 026	25 KG	112	2800	6173	3.05
KCL, MR10, PO BAL 029	25 KG	86	2150	4740	2.34
KCL, BB, PO BAL 026	1mt	9	9000	19842	9.79
DUOVIS	25 KG	95	2375	5236	2.58
DEFOAM NS	25 KG	15	375	827	0.41
SAFECIDE	25 KG	7	175	386	0.19
DRILLING STARCH	25 KG	204	5100	11244	5.55
POLYPAC UL	25 KG	66	1650	3638	1.79
CITRIC ACID	25 KG	11	275	606	0.30

Hole Section 6”

Prior to drilling the next section, a Formation Integrity Test will be completed to confirm the formation and casing shoe. The 6” hole will be drilled from 1,690m MD GL to a total depth of 2,700m MD GL, with a water based KCI polymer mud system.

If the 6” hole is successful in encountering petroleum and following some initial tests, a 4 ½” casing will be run and cemented to 100m above the 7” casing shoe.

A 3 ½” completion and tubing will be run for the upper zone and a 2 ⅞” 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 the primary and secondary targets within the lower Carboniferous or both perforated zones combined. The completion and tubing will provide a conduit for the petroleum to flow to surface.

Drilling Fluid Composition:					
6” Hole Section – KCL Polymer Mud System				Volume:	1502 bbl
Product:	Unit Size:	Quantity:	Total Quantity:	Quantity (lbs):	Concentration (ppb)
BARITE	25 KG	498	12450	27448	18.27
CAUSTIC SODA	12.5 KG	13	162.5	358	0.24
SODA ASH	25 KG	13	325	717	0.48
SODIUM BICARBONATE	25 KG	19	475	1047	0.70
DUOVIS	25 KG	23	575	1268	0.84
DEFOAM NS	25 KG	11	275	606	0.40
KCL, MR10, PO BAL 029	25 KG	34	850	1874	1.25
KCL, MR11, PO BAL 031	25 KG	120	3000	6614	4.40
KCL, MR12, PO BAL 032	25 KG	280	7000	15432	10.27
KCL, MR14, PO BAL 038	25 KG	40	1000	2205	1.47
SAFECIDE	25 KG	23	575	1268	0.84
DRILLING STARCH	25 KG	106	2650	5842	3.89
POLYPAC UL	25 KG	52	1300	2866	1.91
CITRIC ACID	25 KG	12	300	661	0.44
SAFE-CARB 20	25 KG	10	250	551	0.37
SAFE-CARB 40	25 KG	10	250	551	0.37

5.5 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 Energy 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.

5.6 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:

5.6.1 Mini Fall-Off Test within Upper Visean/Lower Namurian

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 intention, following completion of the mini fall-off test, is to abandon this section of the wellbore.

The mini fall-off test is being performed within the Upper Visean/Lower Namurian interval at a depth of 2,490m.

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 Ballinlea 2 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 $5m^3$ to $10m^3$ 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 this section of the borehole will be plugged and abandoned using cement. Any pressure within the tubing will be released and any remaining KCl water circulated to surface. KCI 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 KCI 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 is isolated from near surface aquifers, groundwater and those users and the environment dependent on them by some 2,000m of overlying low permeably 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 or 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 Regulation 6 of the Groundwater Regulations (Northern Ireland) 2009. The mini fall-off test within the Upper Visean/Lower Namurian interval does not, therefore require a groundwater permit.

5.6.2 Flow Test within Carboniferous Sands

Pressure monitoring and flow test is being performed within the Lower Namurian interval at a depth of 2,365m to 2,480m.

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 test may be undertaken, as described in Section 5.6.5.

5.6.3 Acid Wash/Squeeze within Carboniferous Sands

To improve the flow of petroleum within a carboniferous sandstone formation, an acid, most commonly hydrochloric acid (HCI) at 15% concentration with water (i.e. 150L of HCI with 850L of water), or a combination of hydrochloric acid (HCI) at 15% concentration and hydrofluoric acid (HF) at 3% concentration with water (i.e. 120L of HCI, 30L of HF 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.

Hydrochloric acid does not react easily with minerals that reduce sandstone permeability but hydrofluoric acid does. Early attempts within the industry using HF in sandstones failed due to plugging from secondary reactions. This problem was resolved with a treatment combining both HCl and HF. The HF within the acid combination dissolves mineral deposits within the sandstones that hinder production whilst the HCl controls the precipitates that may build up within the formations.

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 15%, or the combination of hydrochloric acid (15%) and hydrofluoric acid (3%) is circulated across the perforations using $1m^3$ of solution per single stage wash. The process of washing the perforations is repeated a further four times. Following the washing of the perforations, the HCI or HCl/HF combination is then selectively squeezed into the formation at $0.5m^3$ per metre of perforation.

It is anticipated that between $6m^3$ to $11m^3$ of HCI or HCl/HF will be pumped into the formation during the operation, with all spent acid being recovered to surface.

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

The acid wash and squeeze is being performed within the Carboniferous interval at a depth between 2,365m and 2,480m.

Sandstones are composed of grains of quartz sand. Some sandstones (sometimes called orthoquartzites) are cemented together with quartz cement while others will have a calcite cement. The calcite cement will react with hydrochloric acid and those sandstones with calcite cement will display effervescence.

The HCI reacts with the calcite through dissolution to produce carbon dioxide (CO2), water (H2O) and chloride ions (CI). The chloride ions exist in the water and pair to form calcium chloride (CaCI2). The chemical equation is as follows:

$2HCI + CaCO3 \rightarrow CaCI2 + H2O + CO2$

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

The Carboniferous interval lies at a depth of some 2,300m BGL and is isolated from near surface aquifers, groundwater and those users and the environment dependent on them by some 2,1000m 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. Whilst at shallow depths these aquifers are highly productive aquifers of national importance, at great depths beneath the proposed Ballinlea 2 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. 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 of future danger of deterioration in the quality of the receiving groundwater.

Whilst the injection of hydrochloric acid and hydrofluoric acid within deep saline water bearing formations is a 'groundwater activity', the activity is considered de mimimus and can be excluded under Regulation 6 of the Groundwater Regulations (Northern Ireland) 2009. The acid wash/squeeze within the Carboniferous Sandstone does not, therefore, require a groundwater permit.

5.6.4 Conventional Hydraulic Fracture Stimulation within Carboniferous Sands

If the well encounters petroleum, which due to the permeability of the formation, does not flow into the wellbore and subsequent attempts to clean out the formation using acid wash or acid stimulation has proven unsuccessful, a conventional hydraulic fracture stimulation treatment will be carried out.

Approximately 41 tonnes of sand (proppant) is mixed with a 115m^3 solution consisting of 98% water and 2% additives, including gelling agent, surfactant, breaker, crosslinker and pH control. The gelled fluid is pumped into the formation under pressure using approximately 9,600m^3 of nitrogen. Pressure will be increased to a level which exceeds the fracture gradient of the formation, resulting in localised fracturing of the formation. As the pressure is being applied, the sand suspended within the gelled fluid, migrates into the fractures. When the pressure is subsequently released the sand remains in situ propping open the fractures. The technique used creates permeability within the formation.

It is anticipated that very little of the sand proppant will be flowed back to surface. The gelled fluid recovered at surface is anticipated to be 50% of the total fluid pumped and between 50% and 100% of the nitrogen recovered.

As flow back fluid has the potential to contain low levels of Naturally Occurring Radioactive Material (NORM), samples of the fluid shall be sent to a laboratory holding the appropriate accreditations for radionuclide analysis by gamma spectrum. The maximum volume of aqueous liquid anticipated during the testing operation, including flow back fluid, is 275m^3, which for clarity includes 100% contingency. Available storage of aqueous liquid will be 240m^3 and takes into account turnaround times associated with the analytical techniques required.

5.6.5 Flow Test (Carboniferous Sands (Oil))

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.

If the well flows oil at a moderate or good rate the well will be shut in and pressure gauges will be run in the well and landed near the perforations. A flow test will be undertaken with flow from the well kept at a constant back pressure for 5-10 days. If the well swabs oil at a good rate, swabbing will continue for 5-10 days with careful measuring of the oil, water and gas rates undertaken by a competent person.

If the well flows at a poor rate, or if the formation appears to be blocked due to the initial drilling operation, an acid stimulation or conventional hydraulic fracture stimulation treatment will be undertaken, as detailed in Section 5.6.3 and 5.6.4 respectively.

Produced fluids from the flow test 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 transported by a licenced haulier to an Environment Agency permitted water treatment facility where it is processed, treated and discharged in accordance with the permitted controls of the water treatment facility.

Any natural gas associated with flowing oil to surface will be 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 Ballinlea 2 Air Dispersion and Modelling Report).

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 anticipated during the testing operation, including produced water, is 275m^3, which for clarity includes 100% contingency. Available storage of aqueous liquid will be 240m^3 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 to atmosphere. No nitrogen would remain in the formation.

5.6.6 Flow Test (Carboniferous Sands (Gas))

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 Ballinlea 2 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 transported by a licenced haulier to an 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 Schedule 1 of The Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013, 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 240m^3 of produced fluids storage will be available on site, supported by 24 hour tanker haulage to remove oil/condensate or produced water to 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 anticipated during the testing operation, including produced water, is 275m^3, which for clarity includes 100% contingency. Available storage of aqueous liquid will be 240m^3 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 to atmosphere. No nitrogen would remain in the formation.

5.7 Well Abandonment and Partial Well Abandonment

In the event that the well is not successful in establishing commercially producible petroleum, the well 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 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 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 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.

5.8 Classification of the Operations

A review of the proposed Ballinlea 2 exploratory operations against applicable environmental legislation has identified the following classifications as being applicable to the wellsite.

5.81 Mining Waste Operation

The Planning (Management of Waste from Extractive Industries) Regulations 2010 which transposes the requirements of the Mining Waste Directive 2006/21/EC, requires mining waste operations to be authorised.

For the purpose of this waste management plan, the Ballinlea 2 exploratory operations are classified as a mining waste operation, namely, the management of extractive waste not involving a waste facility.

5.8.2 Installation

Part 1 of the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013, transposes the requirements of the Industrial Emissions Directive 2010/75/EU, defines an "installation" as an activity specified within Part 1 of Schedule 1 of the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013, incineration of hazardous waste in a waste incineration plant with a capacity of 10 tonnes or more per day.

As the exploratory operations proposed within the Ballinlea 2 wellsite anticipate the incineration of hazardous waste (natural gas) with a capacity exceeding 10 tonnes per day, albeit for a short duration, the Ballinlea wellsite is classified as an installation under the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013.

6 EXTRACTIVE AND NON EXTRACTIVE WASTE MANAGEMENT

The following section describes the various extractive and non-extractives wastes arising from the Ballinlea 2 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

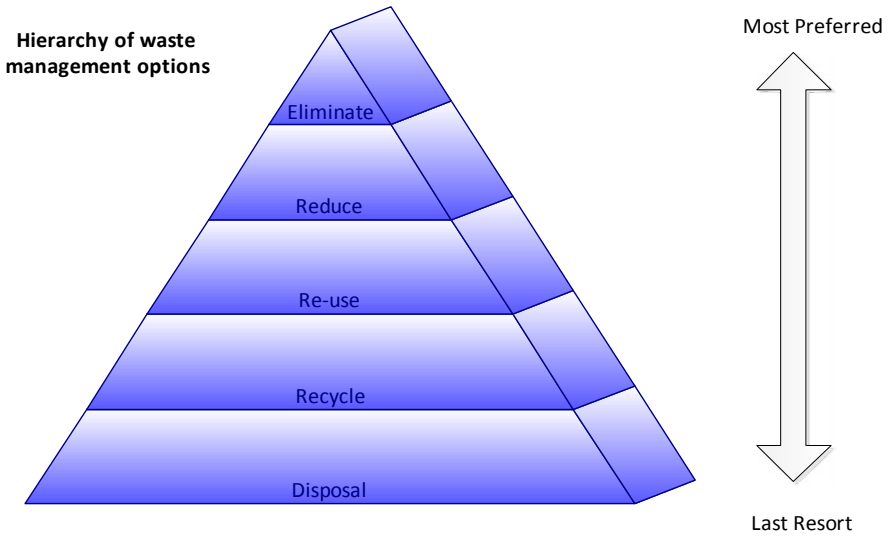
The Rathlin Energy policy on waste Duty of Care, waste segregation, waste handling and waste transfer are set out in the Rathlin Energy Environmental Policy Manual (RE-02-002).

The site waste champion for the Ballinlea 2 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;
- 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 Ballinlea 2 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

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 generated as a result of the Ballinlea 2 exploratory operations has been undertaken. The potential waste, together with its classification and anticipated quantities, prevention, minimisation, treatment and disposal is provided below.

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 Ballinlea 2 well will be 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 be 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 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 4½" 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 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.	

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 Minimisation	The ability to prevent or minimise formation water is extremely limited. Given that the operation is exploratory, no consideration has been 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 Rathlin Energy Management of Radioactive Waste document.	
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.	

Spent Hydrochloric/Hydrofluoric 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/hydrofluoric acid is used to wash and clean out natural fractures within sandstone 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 sandstone formation under pressure, increasing the near hole permeability. The reaction of the hydrochloric/hydrofluoric acid with the calcite produces calcium chloride and is unavoidable, which is classified as non-hazardous. The calcium chloride, a result of the reaction with the sandstone formation ($2HCl + CaCO_3 \rightarrow CaCl_2 + H_2O + CO_2$), will be reversed circulated out of the wellbore into1m^3 IBC containers and stored onsite for subsequent removal via a licenced haulier to an environment 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 and hydrofluoric acid will be used in stages to ensure its use is minimised. The reaction of the hydrochloric acid with the calcite produces calcium chloride. This reaction, and in turn the waste generated, is unavoidable. Careful planning will be taken prior to any acid wash or squeeze being undertaken to ensure Rathlin Energy minimises the amount of acid used which in turn reduces the amount of waste generated as a result of the operational 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 environment 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 and hydrofluoric acid with the calcite 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 and hydrofluoric acid are used. The IBC containers will be inspected prior to use to ensure they are suitable for holding calcium chloride.

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. If oil is encountered the gas associated with the oil will be incinerated but at a much lesser volume of flare rate.	
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 curtain 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: • H_2S • BTEX / VOCs • Methane • Sulphur dioxide • Nitrogen oxide • Ozone

Nitrogen		
Waste Classification, Quantity and Storage	**Classification**	Inert
	LOW Code	Not Applicable
	Estimated Quantity	9,600m^3
	On Site Storage	None – Vented to Atmosphere
	Storage Duration	Not Applicable
	Odour Potential	No Odour Anticipated
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.

Waste Clays and Sand (Conductor Setting)		
Waste Classification, Quantity and Storage	**Classification**	Non Hazardous
	LOW Code	01 04 09
	Estimated Quantity	48m^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 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 auger or conventionally drill the near surface clays and sands within which the surface conductor casing will be set and cemented into position. The clay and sand will be circulated out of the well using either an auger or water based drilling fluids and return to the surface where it is transferred to an open square tank.	
Waste Prevention and Minimisation	The ability to prevent or minimise clay and sand 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 the hole size required to install the conductor casing which in turn keeps the clay and sand arising's to a minimum.	
Waste Treatment and Disposal	The clay and sand 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.

Rock Cuttings (Conductor Setting)		
Waste Classification, Quantity and Storage	**Classification**	Non Hazardous
	LOW Code	01 04 08
	Estimated Quantity	138m^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 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 auger or conventionally drill the near surface formation within which the surface conductor casing will be set and cemented into position. The rock cuttings will be circulated out of the well using either an auger or water based drilling fluids and return to the surface where it is transferred to an open square tank.	
Waste Prevention and Minimisation	The ability to prevent or minimise rock cutting 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 the hole size required to install the conductor casing which in turn keeps the clay and sand arising's to a minimum.	
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.	

Chloride Containing Drilling Muds and Waste		
Waste Classification, Quantity and Storage	**Classification**	Non Hazardous
	LOW Code	01 05 08
	Estimated Quantity	1223m^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 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.

Salt Saturated and KCL Rock Cuttings		
Waste Classification, Quantity and Storage	**Classification**	Non Hazardous
	LOW Code	01 05 08
	Estimated Quantity	1691m^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 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 sallow 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 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 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 skips will be inspected prior to use to ensure they are suitable for holding cement.

Stimulation Flow Back Fluid		
Waste Classification, Quantity and Storage	**Classification**	Hazardous
	LOW Code	01 05 06*
	Estimated Quantity	57.5m^3
	On Site Storage	1 x 60m^3 Horizontal Cylindrical Closed Tank
	Storage Duration	Maximum 7 Days
	Odour Potential	No Odour Anticipated
Operation / Activity	Stimulation flow back fluid is used to conventionally hydraulically fracture and prop open fractures within the formations during well testing. Approximately 41 tonnes of sand (proppant) is mixed with a 115m^3 solution consisting of 98% water and 2% additives, including gelling agent surfactant, breaker, crosslinker and pH control. The gelled fluid is pumped into the formation under pressure using approximately 9,600m^3 of nitrogen. Pressure will be increased to a level which exceeds the fracture gradient of the formation, resulting in localised fracturing of the formation. As the pressure is being applied the sand, suspended within the gelled fluid, migrates into the fractures. When the pressure is subsequently released the sand remains in situ propping open the fractures. The technique used creates permeability within the formation.	

Waste Prevention and Minimisation	The stimulation flow back fluid will be used in stages to ensure its use is minimised. The sand proppant remaining within the formation fractures will be classified as waste generated and is unavoidable. Careful planning will be taken prior to any conventional hydraulic fracture stimulation operation being undertaking to ensure Rathlin Energy minimises the amount of stimulation fluid used which in turn reduces the amount of waste generated as a result of the operation required.
Waste Treatment and Disposal	The gelled fluid will be reversed circulated out of the wellbore into a 60m^3 horizontal cylindrical closed tank and stored onsite for subsequent removal via a licenced haulier to an environmental agency permitted waste treatment facility.
Waste Remaining in the Formation	It is anticipated that very little of the sand proppant will be flowed back to surface. The gelled fluid recovered at surface is anticipated to be 50% of the total fluid pumped and between 50% and 100% of the nitrogen recovered.
Monitoring	Rathlin Energy provide competent supervisor to review the stimulation fluid calculations to prevent and / or minimise stimulation fluid waste. The horizontal cylindrical closed tank will be inspected prior to use to ensure it is suitable for holding stimulation fluid.

6.3.2 Non Extractive Waste

During the Ballinlea 2 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 will be carried out in advance of the operation commencing and in support of permit applications. The environmental risk assessment will be developed in accordance with the H1 Environmental Risk Assessment for permits. (Version 2.1, December 2011).

The H5 - Site Report Guidance and Template for Applicants and Operators requires that for all new and existing installations a site report is produced. The site report describes and records the condition of the land and groundwater which establishes a baseline prior to operations commencing and subsequently demonstrates that the environment has been protected during operations and is in a satisfactory state when the site is restored.

Section 3 of the H5 Site Report Guidance and Template for Applicants and Operators (Version 1, January 2012) requires that an environmental risk assessment is produced to support the site report application. The environmental risk assessment will identify the hazards and everything that can be affected by the hazards from the Ballinlea 2 operations.

The environmental risk assessment will be carried out in accordance with the following 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:

- 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

It is not always possible to eliminate the risk entirely, so the aim is to reduce the risk to a suitably low level so for as reasonably practicable.

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

9 CONTROL AND MONITORING OF WASTE

The environmental risk assessment will identify 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 will be implemented prior to the well being constructed, which provides a baseline for groundwater quality. The scheme will be implemented during well construction and subsequent well testing operations. The monitoring scheme will include an analysis of:

- Turbidity
- pH
- Total suspended solids
- Alkalinity
- Hardness
- Sulphate
- Chloride
- Nitrate
- Calcium
- Magnesium
- Potassium
- BTEX
- TPH

9.2 Air Emissions

A scheme of air emissions monitoring will be implemented prior to the well being constructed, which provide a baseline for air quality. The scheme will be 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

9.3 Noise

A noise management plan will be implemented during the exploratory operations to ensure compliance with any associated planning permission conditions.

9.4 Lighting

A lighting plan will be implemented during the exploratory operations to ensure compliance with any associated planning permission conditions. Periodic monitoring of the lighting will be undertaken to ensure light overspill is reduced to a minimum.

9.5 Traffic

A traffic management plan, including the provision of and wheel washing facilities to prevent mud being brought out of site onto public highway, will be implement during the exploratory operations.

The traffic management plan will be implemented to ensure compliance with planning permission conditions and periodic monitoring of the plan and wheel washing facilities will be undertaken.

9.6 Contractor Performance

Rathlin Energy is ultimately responsible for any waste generated on site during the Ballinlea 2 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.

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 Northern Ireland Environment Agency, actions to prevent reoccurrence will be agreed, together with a programme for implementation. Implementation of the actions will be monitored and the Northern Ireland 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.

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 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.

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 will be 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 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 and will form part of any application to surrender the environmental permit.

The permit will be surrendered in accordance with Regulation 19 and 20 of the Pollution Prevention and Control Regulations (Northern Ireland) 2003. 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)

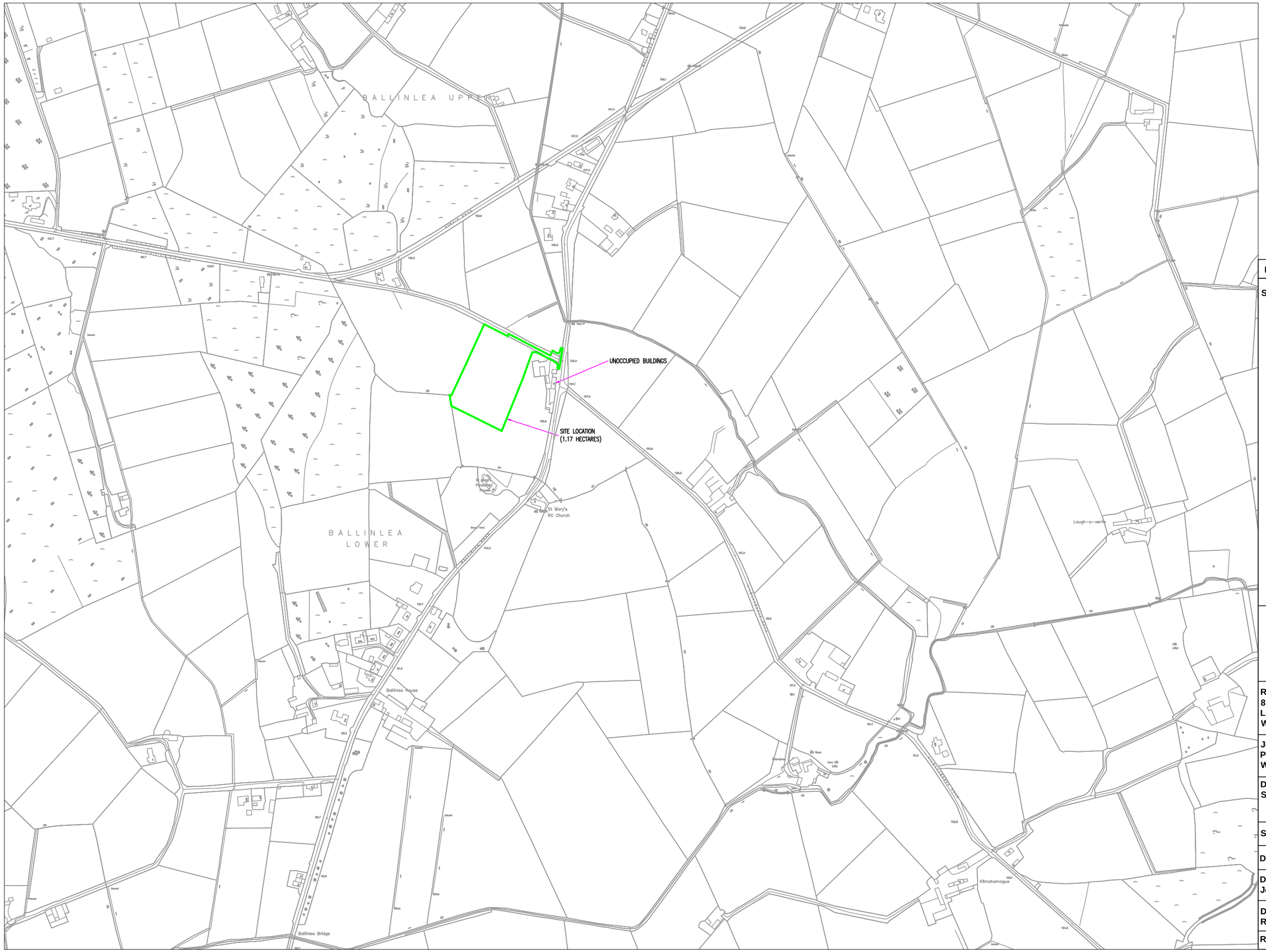
In the event that the well is deemed capable of producing commercial quantities of petroleum then applications to vary existing permits and/or acquire new permits to permit the subsequent production of petroleum will be submitted to the Northern Ireland Environment Agency.

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.

*** Page Left Blank Intentionally ***

APPENDIX 1 – BALLINLEA 2 SITE PLAN

*** Page Left Blank Intentionally ***



Key:

Site Boundary

Rathlin Energy

Rathlin Energy Limited
8 Wimpole Street
London
W1G 9SP

Job Title:
Proposed Ballinlea 2 Wellsite

Drawing Title:
Site Plan

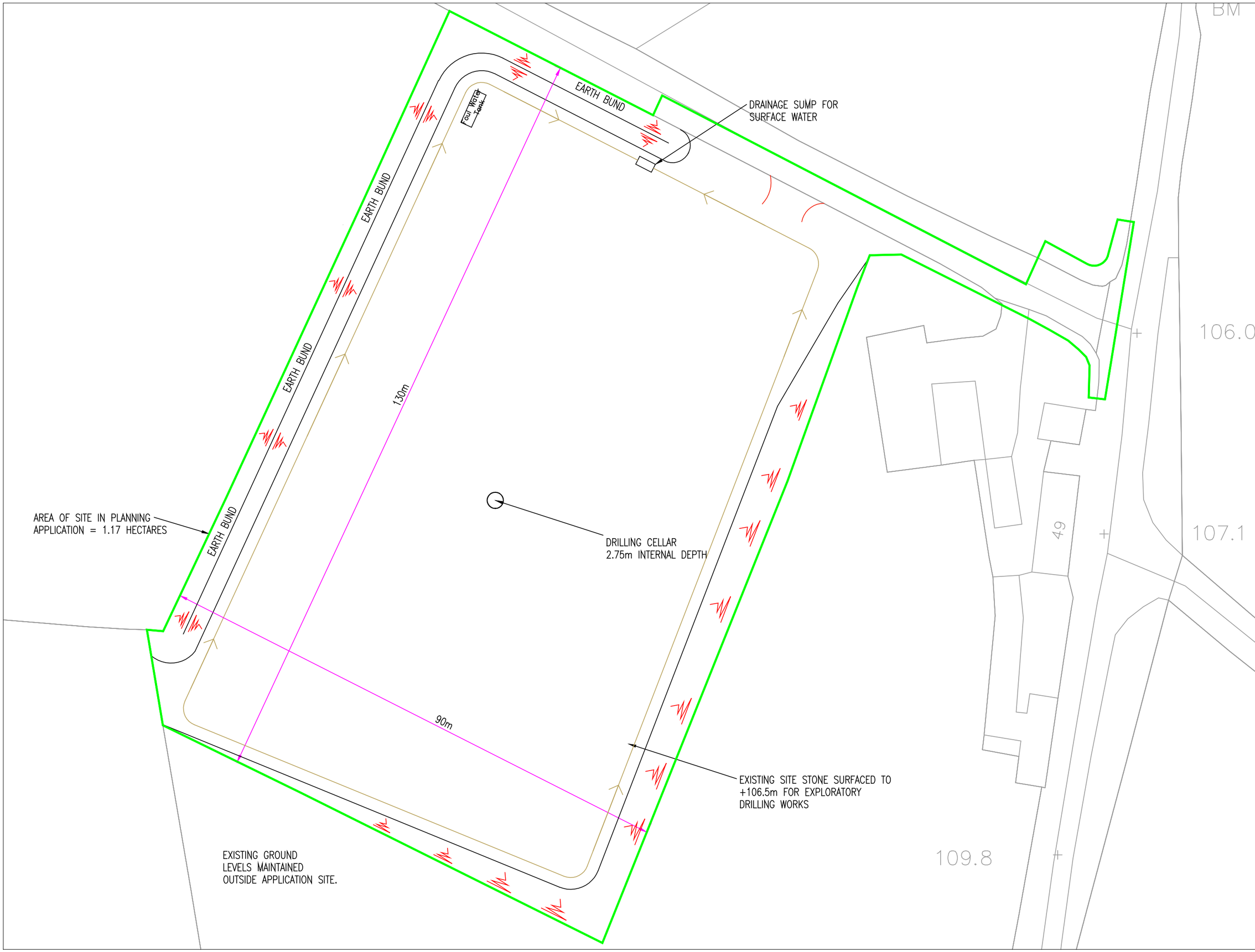
Scale: 1:5,000 (Print A3)

Date: 4th March 2014

Drawn By:
Jonathan Foster

Drawing No:
RE-05-WMP-B2-SP-01

Rev: 0



Key:

Site Boundary

Rathlin Energy

Rathlin Energy Limited
8 Wimpole Street
London
W1G 9SP

Job Title:
Proposed Ballinlea 2 Wellsite

Drawing Title:
Propsed Site Construction Plan

Scale: Not to Scale

Date: 4th March 2014

Drawn By:
Jonathan Foster

Drawing No:
RE-05-WMP-B2-SP-02

Rev: 0

APPENDIX 2 – RATHLIN ENERGY CORPORATE INFORMATION

*** Page Left Blank Intentionally ***

RATHLIN ENERGY CORPORATE INFORMATION

Register Office:
Rathlin Energy Limited
50 Bedford Street
Belfast
BT2 7FW

Company Registration No: NI 062216

Principal Office:
Rathlin Energy Limited
8 Wimpole Street
London
W1G 9SP

Tel: 020 7269 9861
Web: www.rathlin-energy.co.uk

24 Hour Emergency Number:
0800 1959154

*** Page Left Blank Intentionally ***

APPENDIX 3 – RATHLIN ENERGY ENVIRONMENTAL POLICY MANUAL

*** Page Left Blank Intentionally ***

Environmental Management System POLICY MANUAL

Rathlin Energy (UK) Limited
Rathlin Energy Limited

David Montagu-Smith
Chairman of the Board
February 2014

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.

*** Page Left Blank Intentionally ***

CIRCULATION LIST

This Policy Manual is a controlled document. The Rathlin Energy Health, Safety and Environmental Manager 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 Manager.

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	Willlerby Office, UK
4	Tony Fildes	Health, Safety and Environmental Adviser	Willlerby 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
26/02/1014	2	All	Annual Review	3	JFo

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 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

Contents

*** Page Left Blank Intentionally ***

1. Terminology

Term	Use of Term Infers	Dispensation for Area Covered by Term All dispensations are to be recorded and retained in the Management of Change Form (RE-05-FO-001)
Must	Legislative Requirement.	No dispensation can be granted. Inform Chairman of the Board.
Shall	Minimum requirement stipulated across assets/sites.	Approval by Operations Manager
Should	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.

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

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.

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.

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 the 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 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).

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 affective 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 are not measurable from **background variation**.	A **slight** decrease in the availability or the quality of a **resource** that is unlikely to be noticed by the persons	Actions/operations result in slight impairment of corporate

		utilising it	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.

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, particularity 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 HSE/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

Within each asset/site, processes **shall** be in place to identity 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.

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.

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 aware of these			• Carry out audits in line with procedures • Communicate the scope of the audit to the site • Review previous audits conducted at	

										risks, to ensure that they are incorporated in relevant emergency response plans.			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 timely manner • Apply to the relevant	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 training across the site is up to date.		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.

			• 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											

*** Page Left Blank Intentionally ***

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

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;
- H_2S 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.

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.

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 issue.

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 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:

- ISO 14001 Requirement 4.4.6 Operational Control
- Operational control of the environmental management system is managed through a number of Level 3 Standards and Procedures and Level 4 Site Specific Documentation and 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 bowsers **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;

- 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 require 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.
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.

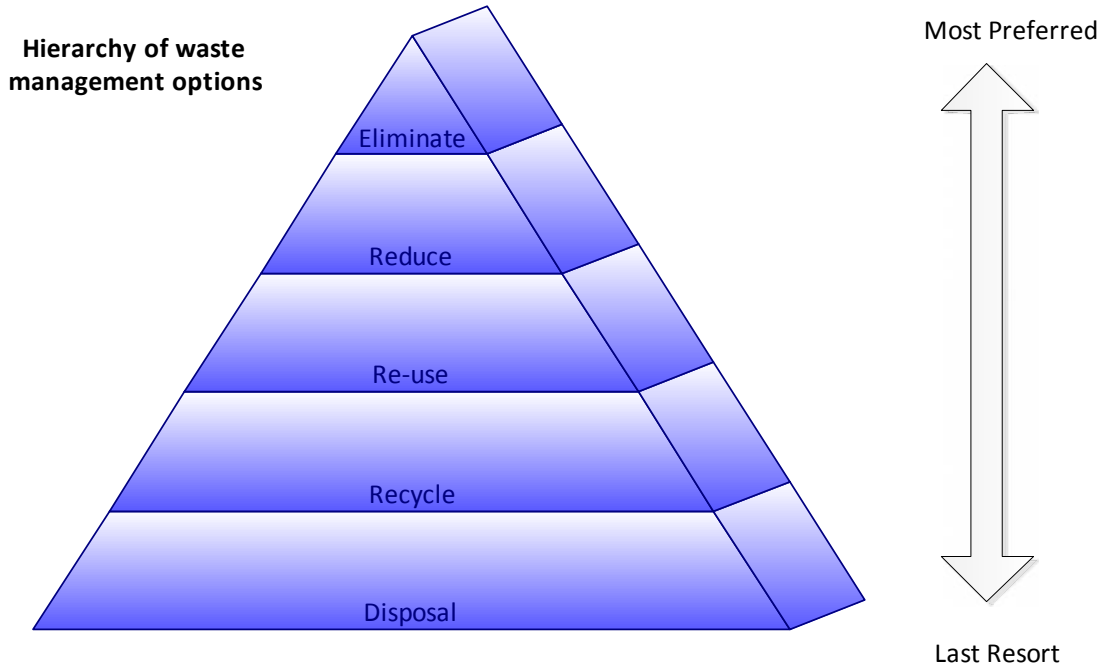
Segregated walking routes and roadways **shall** be maintained effectively by road sweeping as necessary.
It is Rathlin Energy's target to reduce the amount of waste being sent to landfill by implementing a hierarchy of control and by segregating waste onsite. The Operations Manager and/or Site Supervisor **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.

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

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 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

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 exercises **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:

- 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

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.

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.

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 moths 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 1SO 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.

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.

APPENDIX 4 – ROLES AND RESPONSIBILITIES

*** Page Left Blank Intentionally ***

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 of Health and Safety at Work Regulations (NI) 2000. Provide HSE support to the Drilling Supervisor and the 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. 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.

*** Page Left Blank Intentionally ***

APPENDIX 5 – CHEMICAL INVENTORY DURING EXPLORATORY OPERATIONS

*** Page Left Blank Intentionally ***

CHEMICAL INVENTORY - EXPLORATORY OPERATIONS

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	Inhalation	Calcium Carbonate 60-100%, Quartz, Crystalline silica < 1%
Safe-Carb 250	25 kg Sack	160	4,000 kg	4	N/A	Xn;R20	Inhalation	Calcium Carbonate 60-100%, Quartz, Crystalline silica < 1%
Safe-Carb 500	25 kg Sack	160	4,000 kg	4	N/A	Xn;R20	Inhalation	Calcium Carbonate 60-100%, Quartz, Crystalline silica < 1%
Safe-Carb1000	25 kg Sack	120	3,000 kg	3	N/A	Xn;R20	Inhalation	Calcium Carbonate 60-100%, Quartz, Crystalline silica < 1%
Safe-Cide	25 kg Can	24	600 kg	0.6	2810	Cat 6.1 T;R23. Xn;R20/21/22/23 R34.R36/37 R43	Toxic	Triazine(2H,4H,6H)-triethanol 50-100%. Glycine 1-5%
Safe-Core	200 ltr Drum	8	1,600 ltr	1.664	N/A	Xi;R36/38. R43. Xn;R22. R43,R52.	Irritant	Formaldehyde, Reaction products with Ethanolamine 10-30%
Safe-Scav HSB	25 ltr Can	32	800 ltr	0.88	2810	T;R23. Xn;R22. R43.	Toxic	TRIETHANOL 30-60%. Water 30-60%. Aminoethanol 1-5%
Safe-Scav NA	25 ltr Can	6	150 ltr	0.2085	N/A	Cat 6.1 T;R23. Xn;R20/21/22. R34.R36/37 R43.	Toxic	Ammonium Bisulphate 30-60%. Water 30-60%
Salt PVD - Sodium Chloride	1 MT Bag	40	40 MT	40	N/A	Not Classified		CAS no 7647-14-5
Salt PVD - Sodium Chloride	25 kg Sack	500	12,500 kg	12.5	N/A	Not Classified		CAS no 7647-14-5
SAPP	25 kg Sack	80	2,000 kg	2	N/A	Not Classified		Sodium Acid Pyrophosphate 60-100%
Soda Ash	25 kg Sack	40	1,000 kg	1	N/A	Xi;R36.	Irritant	Sodium Carbonate 60-100%
Sodium Bicarbonate	25 kg Sack	42	1,050 kg	1.05	N/A	Not Classified		CAS no 144-55-8
Sugar	25 kg Sack	60	1,500 kg	1.5	N/A	Not Classified		Sugar 100%
DIESEL FUEL - DRILLING RIG								
Portable Fuel Caddy	107 Litres	1	107 ltr	0.1	1202	Cat3 Xn, N R40, R65, R66, R51/53	Harmful En	Petroleum Hydrocarbons >99%
Rig Fuel Tank 1	30000 litres	1	30,000 ltr	26	1202	Cat3 Xn, N R40, R65, R66, R51/53	Harmful En	Petroleum Hydrocarbons >99%
Rig Fuel Tank 2	20000 litres	1	20,000 ltr	17.4	1202	Cat3 Xn, N R40, R65, R66, R51/53	Harmful En	Petroleum Hydrocarbons >99%
GASES - DRILLING RIG STOCK								
Acetylene	97 kg Bottle	3	291 kg	0.291	1001	Cat2.2 F+;R12, R5, R6	Ex Fl Exp	CAS no 74-86-2
Argon	50 ltr Bottle	7	350 ltr	0.49	1006	Cat2.2	Asphyxiant	CAS no 7440-37-1
Hydrogen	50 ltr Bottle	2	100 ltr	0.009	1049	Cat2.2	Ex Fl Exp	CAS no 1333-74-0
Nitrogen	85 kg Bottle	4	425 kg	0.425	1066	Cat2.2	Asphyxiant	CAS no 7727-37-9
BOP Accumulator (Pre Charged Nitrogen)	24 x Bottle	1	1600 kg	1.6	1066	Cat2.2	Asphyxiant	CAS no 7727-37-9
Oxygen	80 kg Bottle	3	240 kg	0.24	1072	Cat2.2 O; R8	Oxidising	CAS no 7782-44-7
OILS - DRILLING RIG ACTIVE SYSTEM								
Engine Oil 15W40	System	1	440.5 ltr	0.389	1268	Not Classified R38,R41, R51/53	Tox Aq	Zinc alkyl dithiophosphate 1-2.4% Interchangeable low viscosity base oil 0-90%

CHEMICAL INVENTORY - EXPLORATORY OPERATIONS

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	Fl 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	Fl, 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	Fl, 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	Fl, 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, 7722-64-7
Detonators, electric for blasting - RP880 EBW Fluid Des Detonator	0.66g	5	3.3g	0.000003	0255	1.4B	Explosive	CAS no 78-11-5, 121-8-24, 13424-46-9, 15245-44-0, 1314-41-6, 7722-64-7
Cord, detonating - XHV,HMX, 80gr Det cord	5.2g	500	2,600g	0.0026	0065	1.1D	Explosive	CAS no 78-11-5
Cord, detonating - HMX 40gr Det cord	2.6g	500	1,300g	0.0013	0065	1.1D	Explosive	CAS no 78-11-5
Detonators, electric for blasting - SQ-80 Igniter	0.5g	5	2.5g	0.000003	0456	1.4S	Explosive	CAS no 78-11-5, 121-8-24, 13424-46-9, 15245-44-0, 1314-41-6, 7722-64-7
Articles, explosives, nos - Booster	0.6g	20	12g	0.000012	0349	1.4S	Explosive	CAS no 00121-82-4, 026914-41-0, 20062-22-0, 38082-89-2, 07429-90-5, 07439-89-6, 07782-42-5, 07440-50-8, 07439-92-1, 07440-33-7, 07440-66-6
Igniters - Baker Secondary	10g	5	50g	0.00005	0454	1.4S	Explosive	CAS no 10294-40-3, 7439-95-4
Cartridge, power device - #20 Baker power charge slow burn	570g	5	2,850g	0.00285	0323	1.4S	Explosive	CAS no 7439-89-6, 7440-50-8, 7440-66-6, 9004-70-0, 55-63-0, 84-74-2, 15245-44-0
Charges, shaped - 2-00" Tubing Punch Charge	6.5	50	325g	0.000325	0441	1.4S	Explosive	CAS no 00121-82-4, 026914-41-0, 20062-22-0, 38082-89-2, 07429-90-5, 07439-89-6, 07782-42-5, 07440-50-8, 07439-92-1, 07440-33-7, 07440-66-6
LUBRICANTS								
OKS 611	500 ml	10	5 ltr	0.0035	1950	R12, R53-66 Xn R65	F+	Naphtha (petroleum) heavy alkylate 25-50%. Propane liquefied 10-25%. Isobutene 10-25%. Butane, pure 2.5-5% 2-butoxyethanol ≤ 2.5%
RADIOACTIVE SOURCES - ON SITE AD HOC								
Cesium 137	63.0GBq	1	63.0GBq		3332	Class 7 R10. S2	Radioactive	Cesium Chloride
Americium 241 Beryllium	592GBq	1	592GBq		3332	Class 7 R10. S2	Radioactive	Americium oxide with Beryllium metal
CEMENT ADDITIVES - DRILLING								
Tuned Light XLE	Bulker MT	150	150 MT	150	N/A	Xi R37/38 R41, R43	Irritant	Portland cement 60-100%, Crystalline silica, quartz 1-5%
Calcium Chloride Liquid	ltrs	4,341	4,341 ltrs	4,902	N/A	Xi R36 S2 S22 S24	Irritant	Calcium Chloride 30-60%
NF-6	ltrs	250	250	0.193	N/A	Not Classified		Vegetable oil 60-100%. Aluminum stearate 1-5%
Lafarge G	Bulker MT	50	50 MT	50	N/A	Xi R43 R35/38	Irritant	Portland cement 60-100%, Crystalline silica, quartz < 3%
Bentonite (Included in Fluid Additives - Drilling Muds)					N/A	Not Classified		Bentonite 60-100%, Crystalline silica, tridymite 0-1%, Crystalline silica, cristobalite 0-1%. Crystalline silica quartz < 3%.

CHEMICAL INVENTORY - EXPLORATORY OPERATIONS

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%
DIESEL FUEL - WORKOVER RIG								
Rig Fuel Tank	563 litres	1	563 ltr	0.49	1202	Cat3 Xn, N R40, R65, R66, R51/53	Harmful En	Petroleum Hydrocarbons >99%
Bunded Fuel Tank	1000 litres	1	1,000 ltr	0.87	1202	Cat3 Xn, N R40, R65, R66, R51/53	Harmful En	Petroleum Hydrocarbons >99%
OILS - WORKOVER RIG								
Engine Oil 15W40	200 ltr Drum	1	200 ltr	0.18	1268	Not Classified R38,R41, R51/53	Tox Aq	Zinc alkyl dithiophosphate 1-2.4% Interchangeable low viscosity base
Hydraulic Oil Shell Tullus 32	200 ltr Drum	1	1200 ltr	0.18	N/A	Not Classified		Highly refined mineral oil contains <3% (w/w) DMSO-extract,
FLUID ADDITIVES - WELL TESTING								
15% Hydrochloric Acid	1m3 IBC	10	10m3	9.1	1789	Cat8 Xi R34, R37	Irritant	HCL 15% Water 85%
3% Hydroflouric Acid	1m3 IBC	2	2m3	2	1790	Cat8 R7/9, R26, R36/37/39 R45	Toxic	HF 3% Water 97%
Potassium Chloride	25 kg Sack	100	2,500 kg	2.5	N/A	Not Classified		Potassium Chloride 90-100%
Nitrogen	16 x Bottle	1	613kg	0.613	1066	Cat2.2	Asphyxiant	CAS no 7727-37-9

APPENDIX 6 – AIR DISPERSION MODELLING AND REPORT

*** Page Left Blank Intentionally ***

Air Quality Impact Assessment – Rathlin Energy Ballinlea Petroleum Exploration

DOCUMENT CONTROL SHEET

Client	Rathlin Energy Ltd
Document Title	Air Quality Impact Assessment
Document No.	NI1444.10_03_2014_V03

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
D02	*Draft for Comment*	SMcA	DOL	DOL	Belfast	10 March 2014
F01	*FINAL*	SMcA	DoL	DoL	Belfast	13 March 2014

CONTENTS

1.0 INTRODUCTION

Rathlin Energy Ltd (Rathlin) is an oil and gas exploration company that has been engaged for over a decade in the study of the geology of Co. Antrim and Co. Londonderry. In 2008, Rathlin drilled an exploratory well at its Ballinlea site, known as Ballinlea 1, and encountered oil. Consequently, in 2011, Rathlin Energy Ltd applied for a renewal licence from the Department of Enterprise Trade and Investment (DETI) and was successful, enabling it to continue exploration. The licence covers an area of 216,000 acres and is known geologically as the Rathlin Basin.

Rathlin have submitted a planning application for the development of a second exploratory well. This new well location is based on the interpretation of the results of the original Ballinlea 1 well, combined with other geological and geophysical surveys conducted by Rathlin over the last few years. Rathlin is planning to drill a vertical wellbore to approximately 2700 metres depth to evaluate the oil and gas potential and investigate the stratigraphy. This second well (Ballinlea 2) will help determine if sufficient oil or gas reserves are present to contemplate commercial production.

An assessment of the air quality has been completed for the Ballinlea petroleum drilling exploration; a dispersion modelling assessment using the ADMS 3.2 model was employed to predict the impact on local air quality of discharges of nitrogen oxides, carbon monoxide and volatile organic compounds from a proposed natural gas flaring operation at the well site. Based on full time flaring at the maximum gas disposal rate, the process contributions to local ambient concentrations of nitrogen dioxide, carbon monoxide and volatile organic compounds have been predicted.

For the proposed 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 14 and 29% of the standard.

Maximum process contributions are generally predicted to occur relatively close to the well site within around 100-200 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 east.

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 (between less than 1 and 5% of the standard). The predicted process contributions at these locations are considered insignificant.

The modelling assessment methodology and necessary assumptions provide a 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 and statutory designed sites, the impact of flaring on air quality is around or below the level at which it would be considered insignificant.

1.1 Proposed 4 Phase Development

The assessment covers the four proposed phases of the development, those being:

1. Site Construction (Construction Phase);
2. Drilling (Operational Phase);
3. Testing (Flare) (Operational Phase);
4. Reinstatement (Essentially a Construction Phase).

The assessment of air quality discusses the development in terms of construction phase and operational phase and specifically details model output reflective of Phase 3 - Gas Flaring.

2.0 POLICY CONTEXT AND ASSESSMENT CRITERIA

The site for exploration is located near the junction of the Ballinlea Road and the Kilmahamogue Road approximately 4 miles west of Ballycastle with a proposed entrance from the north on the Kilmahamogue Road.

The surrounding landscape is predominantly agricultural with residential properties scattered throughout. Appendix A, Figure 1.1 shows the location of the proposed development. The figure also highlights sensitive receptors and distance bandings from the proposed well site extent. Appendix C contains a site specific air quality assessment recommended by The London Councils and the Greater London Authority which developed the London Best Practice Guide (used as a template document throughout the UK) as part of its Air Quality and Planning Guidance.

The report assesses potential impact on sensitive receptors from the development in terms of vehicular transport, on-site drilling exhaust fumes and airborne particulates (dust) during the preparation phase. In addition, the report examines the activity of flaring gas at the site.

2.1 Context of the Assessment & Gas Flaring

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 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 the existing concentrations of important pollutants and therefore determine compliance with applicable air quality limit values.

Well test flaring is recognised as standard practice during well exploration activities and is used to gain awareness of the types of fluids contained in the reservoir formations in addition to the pressure and flow rates of those fluids. Flaring is performed on site to remove the gas that is brought to the surface and allows for safe incineration of natural gas.

2.2 Legislation and Standards

2.2.1 Air Quality Standards Regulations (Northern Ireland) 2010

The Air Quality Standard Regulations (Northern Ireland) 2010 came into force on 11th June 2010. These regulations transpose the following European Union Directives into National Law in Northern Ireland:

- Directive 2008/50/EC on Ambient Air Quality and Cleaner Air For Europe (the Air Quality Directive); and,
- Directive 2004/107/EC (the Fourth Daughter Directive) relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.

The Regulations set out requirements for ambient air quality monitoring, including the number of sampling points, suitable locations, and acceptable methodology. They identify the duties of Northern Ireland's Departments in relation to achieving limit and target values, and the responsibility of Departments to inform the public about air quality in Northern Ireland, particularly with regard to warning the public when information and alert thresholds are reached.

The Air Quality Standards Regulations set air quality standards for a range of air pollutants, including NO_2 and PM_{10}. The UK Government has published an Air Quality Strategy which sets out how the Government proposes to fulfil the UK's obligations under the European Community (EC) Air Quality Directive. The Air Quality Strategy (AQS) for England, Scotland, Wales and Northern Ireland sets out the policy, targets and objectives for air pollutants up to 2010.

Air quality standards represent concentrations that are considered acceptable in terms of health and the environment. They can also be used as an indicator to see if the air pollution is getting better or worse. An exceedence of a standard occurs where the concentration of a pollutant exceeds that set down by the standard over a period of time. The number of days on which an exceedence has been recorded is often reported to make useful comparison between pollutants. The air quality objectives for the UK are presented in Table 2.1 & Table 2.2 and show the UK air quality objectives for the protection of vegetation and ecosystems.

Table 2.1: UK Air Quality Objectives

Pollutant	Air Quality Objective		To be achieved by
	Concentration	Measured as	
Benzene			
All authorities	16.25 µg m^{-3}	Running annual mean	31 December 2003
Scotland and N. Ireland	3.25 µg m^{-3}	Running annual mean	31 December 2010
1,3-Butadiene	2.25 µg m^{-3}	Running annual mean	31 December 2003
Carbon Monoxide			
England, Wales and N. Ireland	10.0 mg m^{-3}	Maximum daily running 8-hour mean	31 December 2003
Lead	0.5 µg m^{-3}	Annual mean	31 December 2004
	0.25 µg m^{-3}	Annual mean	31 December 2008
Nitrogen Dioxide	200 µg m^{-3} not to be exceeded more than 18 times a year	1-hour mean	31 December 2005
	40 µg m^{-3}	Annual mean	31 December 2005
Particles (PM10) (gravimetric)			
All authorities	50 µg m^{-3}, not to be exceeded more than 35 times a year	Daily mean	31 December 2004
	40 µg m^{-3}	Annual mean	31 December 2004
Particles (PM2.5) (gravimetric) *	25 µg m^{-3} (target)	Annual mean	2020
All authorities	15% cut in urban background exposure	Annual mean	2010 - 2020
Sulphur dioxide	350 µg m^{-3}, not to be exceeded more than 24 times a year	1-hour mean	31 December 2004
	125 µg m^{-3}, not to be exceeded more than 3 times a year	24-hour mean	31 December 2004
	266 µg m^{-3}, not to be exceeded more than 35 times a year	15-minute mean	31 December 2005
PAH *	0.25 ng m^{-3}	Annual mean	31 December 2010
Ozone *	100 µg m^{-3} not to be exceeded more than 10 times a year	8 hourly running or hourly mean*	31 December 2005

* not included in regulations at present

Shaded data shows new objectives

Table 2.2: UK Air Quality Objectives for protection of vegetation and ecosystems- July 2007

Pollutant	Air Quality Objective		To be
	Concentration	Measured as	achieved by
Nitrogen dioxide (for protection of vegetation & ecosystems) *	30 µg m^{-3}	Annual mean	31 December 2000
Sulphur dioxide (for protection of vegetation & ecosystems) *	30 µg m^{-3} 30 µg m^{-3}	Annual mean Winter Average (Oct - Mar)	31 December 2000
Ozone *	18 µg m^{-3}	AOT40^{+}, calculated from 1h values May-July. Mean of 5 years, starting 2010	01 January 2010

* not included in regulations at present

$^{+}$ AOT 40 is the sum of the differences between hourly concentrations greater than 80 µg m^{-3} (=40ppb) and 80 µg m^{-3}, over a given period using only the 1-hour averages measured between 0800 and 2000.

Shaded data shows new objectives

2.2.2 The Environment (Northern Ireland) Order 2002 (Amendment) Regulations (Northern Ireland) 2010

This policy guidance is principally for district councils in Northern Ireland to have regard to in carrying out their local air quality management (often shortened to LAQM) duties under Part III of the Environment (Northern Ireland) Order 2002 (the Order). This guidance is intended to enable district councils to improve on the service they already provide in tackling poor air quality.

Part 1 of this Policy Guidance provides an overview of the local air quality management system and the various considerations that district councils should bear in mind. Part 2 points the reader towards other sources of advice, as well as Practice Guidance on some of the more effective and ambitious measures that district councils may wish to consider. This guidance complements the revised Technical Guidance, LAQM TG (09).

2.2.3 Local Air Quality Management Policy Guidance - LAQM.PGNI(09)

Where air quality objectives are likely to be exceeded then the relevant local authority must declare an Air Quality Management Area (AQMA). Under the guidance to local authorities, local authorities are required to carry out a staged assessment of local air quality. The Technical Guidance to local authorities for the review and assessment of air quality was updated in February 2009. The Technical Guidance sets out the methods to be used to determine if the air quality objectives up to 2020 are likely to be achieved. The Parliamentary Environmental Audit Committee (EAC) announced its intention to carry out an inquiry into air quality in the UK on 21 October 2009. The purpose of the enquiry was to assess whether the Government is developing an effective strategy for meeting its

obligations under the EU Air Quality Directives. The committee also examined whether the strategy is enough to ensure that air pollution is reduced to acceptable levels across all the UK.

The Parliamentary Select Committee published its EAC Report on air quality in the UK on 22 March 2010 with recommendations for government to do more to raise awareness of the health and environmental impacts of air pollution and to work with local authorities to improve air quality. Local Air Quality Management Policy Guidance - LAQM.PGNI(09) is designed to assist relevant authorities, district councils and public bodies with their local air quality management duties under Part III of the Environment (Northern Ireland) Order 2002. The guidance requires that local authorities integrate air quality considerations into the planning process at the earliest possible stage. As a result, the land use planning system is integral to improving air quality.

LAQM PGNI(09) sets out those circumstances under which air quality may be a material issue for planning applications and provides guidance to planning authorities on making these decisions. It states that air quality is likely to be particularly important:

- where the development is proposed inside, or adjacent to, an Air Quality Management Area (AQMA);
- where the development could in itself result in the designation of an AQMA;
- where the development, including associated traffic, is likely to result in the deterioration of local air quality; or
- where to grant planning permission would conflict with, or render unworkable, elements of a local authority's air quality action plan.

Updating and Screening Assessments have been carried out by Moyle District Council as part of the Review and Assessment process required by the above mentioned legislation.

3.0 METHODOLOGY

The contributions to ambient concentrations of nitrogen dioxide and carbon monoxide from the proposed flaring operations at Rathlin Energy Limited's Ballinlea well site have been modelled using the Atmospheric Dispersion Modelling System (ADMS) version 3.1.2. The use of this modelling tool is widely accepted by the Environment Agency and UK Local Authorities.

ADMS 3.2 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 flare location (303938E, 439839N) located approximately at the centre (see Appendix B for dispersion plots).

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 Receptors

Reference	Address	X Co-Ordinate	Y Co-Ordinate
1	53 Ballinlea Road (Parochial House)	303930	439743
2	41 Kilmahamogue Road	304270	439700
3	46 Straid Road	304116	440132
4	47 Straid Road	304052	440153
5	47A Straid Road	304017	440109
6	86 Straid Road	303769	440044
7	87 Straid Road	303661	440065

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.

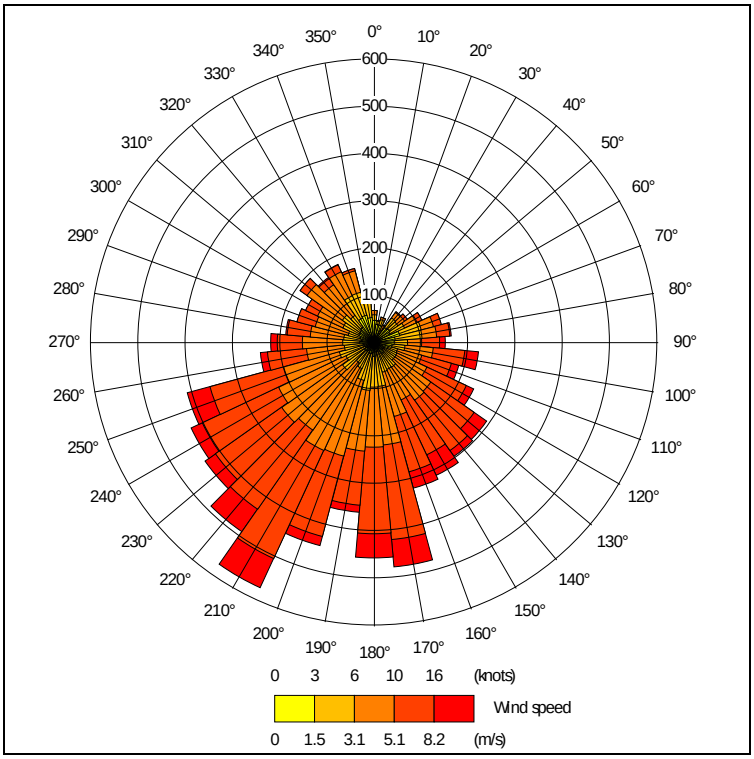
It is not considered that the temporary buildings intended for this site will have any significant impact on dispersion of flare discharges and as such the presence of buildings has not been considered in this assessment.

3.3 Meteorology

For this modelling assessment hourly sequential meteorological data from the nearest suitable meteorological station to the Ballinlea site was obtained. The data, provided by the UK Met Office, was from the Aldergrove station and covered the 5-year period 2007 to 2011.

The data included, among other parameters, hourly measurements of wind speed and direction. A typical annual windrose (2011) for the Aldergrove station is shown in Graphic 1.1

Graphic 1.1 Windrose for Aldergrove (2011)



The prevailing wind is from the south and south east.

3.4 Terrain

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 3.2, 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).

3.5 Flare Arrangement

The flaring system to be employed at the Ballinlea site is a single tip shrouded flare as shown in Graphic 1.2.

Graphic 1.2 Single Tip Shrouded Flare

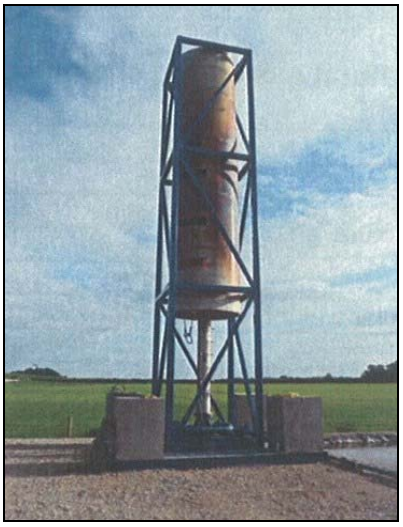


Table 3.2 Main properties of single tip flare configuration

Configuration	Single Tip Shrouded Flare
Flare tip height above ground	12.0 m
Flare tip diameter	1 off 12" (305 mm) (shroud 2.44 m diameter, 12m high)

3.6 Flare Gas Properties

Rathlin Energy Limited has provided details regarding the composition of the natural gas to be flared.

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 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	5
	Nm^3/s	1.55

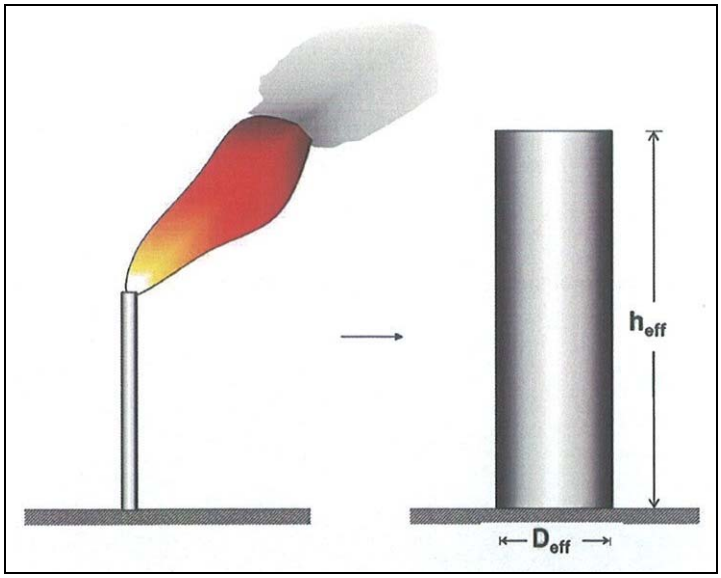
Natural gas molecular weight	g/gmol	16.02
Net heat of combustion	MJ/kmol	765
	Btu/scf	867
	kJ/kg	47767
Gross heat of combustion	MJ/mol	851
	Btu/scf	965
	kJ/kg	53158
Net heat release rate*	Btu/s	49166
	MW	51.87
Gross heat release rate*	Btu/s	54715
	MW	57.72

**heat release assumes a combustion efficiency of 98%*

3.7 Flare Discharge Conditions

United States Environmental Protection Agency (US EPA) guidelines form the basis for dispersion modelling of flare discharges. The guidelines require flares to be considered as point sources, however, it is necessary to examine the effective height and diameter of the plume, flame temperature, and the radiative heat loss.

Graphic 1.3 Plume Height and Diameter



For the purposes of this investigation; the US EPA recommended default values for stack temperature and exit velocity have been used. The release parameters used for modelling for each configuration of flare, based on the recommended methodology, are summarised within Table 3.5.

Table 3.5 Flare discharge conditions

Flare Configuration	Single Tip Shrouded Flare
Flare temperature	1000[3]
Radiation loss	10[2]
Effective release height	14.3
Effective diameter	2.25

Gas velocity	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

Table 3.6 depicts the flue gas discharge conditions which have been calculated based upon the contents on Table 3.2

Table 3.6 Estimated flue gas conditions

Parameter		Value
Flare gas disposal rate	Nm^3/s	1.55
Stoichiometric air requirement[1]	Nm^3air/Nm^3 gas	9.43
Assumed excess air	%	134
Total flue gas rate	Nm^3/s	35.6
Total flue gas rate[1]	m^3/s at 1000°C	166
Velocity at shroud tip	m/s	35.4

1. Based on an assumed gas temperature of 1000°C and an excess air level at the shroud tip of 134%.

3.8 Pollutant discharge rates

Emission factors are generally used to estimate the pollutant discharge rates from flare operations, in the absence of measurements. Table 3.7 summarises the total pollutant discharges from the flare operations.

Table 3.7 Pollutant discharge rates

Parameter		Nitrogen Oxides (as NO_2)	Carbon Monoxide	Volatile organic compounds (as carbon)
Emission factor	$lb/10^6Btu$[1]	0.068	0.37	0.11
Total discharge rate	g/s	1.69	9.18	2.60
Concentration	mg/Nm^3	47	258	98

1. Based on gross heating value.

2. Concentrations based on calculated flue gas volumes in Table 3.6 and mass discharges rates in Table 3.7.

The emission of nitrogen oxides into the atmosphere are primarily in the form of nitrogen monoxide however, reactions in the atmosphere cause a conversion to nitrogen dioxide; which is of considerable more importance to air quality than nitrogen monoxide. It is therefore essential to employ a representative measure of the conversion from NO to NO_2. Guidance highlights than an appropriate worst-case scenario is to assume:

- 35% conversion of NO to NO_2 for short term averaging
- 70% conversion of NO to NO_2 for long term averaging

This assessment has employed these conversion factors.

4.0 MOYLE DISTRICT COUNCIL REPORTS

In accordance with the requirements of the Local Air Quality Management (LAQM) process contained within the Environment (Northern Ireland) Order 2002, the Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2007 and the relevant Policy and Technical Guidance documents; Moyle District Council have carried out regular assessments of the air quality every year since 2001. Results of these investigations have been analysed in relation to the air quality objectives for Northern Ireland contained in the Air Quality Regulations (Northern Ireland) 2003.

4.1 Previous Moyle District Air Quality Reports: 2001-2010

Moyle District Council completed a "1st Stage Review and Assessment of Air Quality" in 2001, using DETR guidance documents, which highlighted a need for further examination of PM_{10} emissions from road traffic and for SO_2 emanating from one industrial combustion system.

The Second stage review and assessment concluded that the objectives for NO_2, PM_{10} and SO_2 are likely to be met and further study was not deemed necessary in relation to vehicular and industrial sources. However, a third stage investigation was determined to be required for SO_2 and PM_{10} emanating from two areas of domestic coal burning.

The two locations to be further assessed were situated in Bushmills and Ballycastle. The assessment ultimately concluded that concentrations of PM_{10} and SO_2 were unlikely to exceed their respective objectives.

A progress report prepared in 2005 identified that concentrations of NO_2 and SO_2 were within their respective objective concentration levels due to the limited amount of industrial development taking place between 2001 and 2005.

The 2006 updating and screening assessment concluded that it was unlikely that any of the national air quality objectives would be breached within the council area; detailed assessment was therefore not required at this moment for any of the seven pollutants analysed.

The progress report completed in 2007 for the 2006-2007 monitoring period concluded that air quality objectives were being met and no further analysis was required. In accordance with technical guidance, SO_2 diffusion tubes erected throughout the Moyle district were discontinued at the end of 2006.

Prior to the completion of the 2008 Progress Report; the NO_2 diffusion tube monitoring locations were moved in 2007 which resulted in incomplete data sets for all of these sites for analysis in the report. It was noted within this progress report that no significant development had taken place during this monitoring period and therefore objectives were unlikely to have been exceeded and no further assessment was required.

Moyle District Council prepared both an Updating and Screening Assessment in addition to a Progress Report in 2010. The data acquired for nitrogen dioxide confirms that the relocated sites for the diffusion tubes are more appropriate. The NO_2 concentration levels for this period were within the relevant objectives.

Although no significant development had taken place during this 2009-2010 monitoring period; the council identified two areas within the district not previously assessed in which diesel or steam trains

were regularly stationed for periods of more than 15 minutes. The council then progressed to a detailed assessment for sulphur dioxide in relation to this newly identified area.

4.2 Air Quality Progress Report for Moyle District Council: May 2011

Moyle District Council does not have any automatic monitoring sites throughout its district. At present, Moyle District Council monitors Nitrogen Dioxide concentrations at 10 locations employing passive diffusion tubes.

Table 4.1 indicates the results obtained for Nitrogen Dioxide monitoring for the period 2007-2010. No exceedences of Nitrogen dioxide objectives were detected at any of the locations.

Table 4.1 – Nitrogen Dioxide Results 2007-2010

Site ID	Location	Within AQMA?	Estimated Annual Mean concentrations (µg/m3) Adjusted for bias	Annual mean concentrations (µg/m3) Adjusted for bias	Annual mean concentrations (µg/m3) Adjusted for bias	Annual mean concentrations (µg/m3) Adjusted for bias
			2007 (Lambeth SS)	2008 (Gradko)	2009 (Gradko)	2010 (Gradko)
BC1	Quay Road, Ballycastle	No	19.63	18.00	15.89	19.38
BC2	Ann Street, Ballycastle	No	35.70	33.83	28.03	34.87
BC3	Castle Street, Ballycastle	No	23.51	27.75	31.25	26.86
BC4	Market Street/ Leyland Road junction, Ballycastle	No	20.68	17.65	16.80	19.21
CD1	Mill Street, Cushendall	No	17.00	18.75	15.02	18.34
CD2	Coast Road, Cushendall	No	18.89	10.06	9.17	11.10
BM1	The Diamond, Bushmills	No	19.26	16.39	15.67	16.48
BM2	Main Street, Bushmills	No	26.06	26.41	23.37	25.19
BM3	Priestland Road, Bushmills	No	11.05	11.82	11.45	12.68
BM4	Main Street, Armoy	No	16.71	13.67	11.99	13.32

Concerning the results from the monitoring that took place prior to the completion of this report; Moyle District Council concluded that levels were below their respective objective concentrations. Therefore, no detailed assessment was required. Furthermore, Moyle District Council has confirmed, at the time of preparing this report, there were no newly identified local developments which may impact upon local air quality.

The recorded levels of NO_2 are representative of urban/semi urban areas and would not be reflective of a rural area where the proposal is situated. Background levels at the proposed development site would be significantly lower than these recorded measurements.

It was detailed within the 2010 combined Updating and Screening Assessment and the Progress Report that the council had identified two previously unmonitored locations at which steam or diesel trains were regularly stationed for periods of 15 minutes or more. This discovery was concluded to require a detailed assessment due to its late identification in relation to publishing the 2010 assessment. In contrast to the preliminary recommendations for this identification of a new monitoring location; Moyle District Council recognised that any relevant SO_2 exposure would be identified at the picnic tables situated at the Giants Causeway station however, at this location the trains do not remain idle for more than 15 minutes in addition the picnic tables are not continuously in usage and when they are it is possible for any members of the public to maintain a distance greater than 15 metres between the train and the picnic tables; therefore exposure cannot be considered as regular. In respect of these observations Moyle District Council deemed it unnecessary to conduct a Detailed Assessment for the Giants Causeway and Bushmills Railway.

4.3 The Smoke Control Areas

'Clean Air' Legislation was introduced to help alleviate the problems with smog prevalent in the 1950s and 1960s caused by the widespread burning of coal for domestic heating and by industry. The Acts gave local authorities powers to control emissions of dark smoke, grit, dust and fumes from industrial premises and furnaces and to declare "smoke control areas" in which emissions of smoke from domestic properties are banned. Since then, smoke control areas have been introduced in many of large towns and cities.

The implementation of smoke control areas, coupled with the increased popularity of natural gas and the changes in the industrial and economic structure of the UK lead to a significant reduction in concentrations of smoke and atmospheric concentrations of sulphur dioxide (SO_2). Under the Clean Air Order local councils may declare the whole or part of the district to be a smoke control area. It is an offence to emit smoke from a chimney of a building, from a furnace or from any fixed boiler if located in a designated smoke control area. It is also an offence to acquire an "unauthorised fuel" for use within a smoke control area. The Smoke Control Areas (Authorised Fuels) Regulations (Northern Ireland) 2008, this came into effect in November 2008. For the purposes of the Clean Air (Northern Ireland) Order 1981, this policy declares authorised fuels.

Moyle District Council has not declared smoke control areas at the time of writing this report.

5.0 RELEVANT ATMOSPHERIC POLLUTANTS

5.1 Pollutant Type

The process of burning a material or fuel containing sulphur releases **Sulphur Dioxide (SO_2)** into the earth's atmosphere. A large proportion of the SO_2 content in the atmosphere is produced from natural sources however in the UK the major source is from power stations burning fossil fuels. Widespread domestic use of coal has also lead to high SO_2 levels in some parts of the world, such as China and high levels of the gas can have undesirable health effects, such as a decline in lung function in asthma sufferers, resulting in tightness of the chest and coughing. SO_2 is considered to be more harmful when other particle and pollution concentrations are high, an example of combines or synergistic effects of air pollutants.

Methane is a greenhouse gas associated with the exploration of oil and gas. Methane is a highly flammable gas and is released during oil/gas drilling operations.

Volatile Organic Compounds, more commonly known as VOCs, are chemicals used to manufacture a variety of household products and are found within fuel sources; all of these products release VOC's when used and to an extent when they are stored. During this operation; the aim is to identify these pollutants and release them in a controlled manner by incineration.

Hydrogen Sulphide Hydrogen Sulfide is a naturally occurring component of crude oil and natural gas. Hydrogen Sulfide (H_2S) is a flammable, colourless gas that is toxic at extremely low concentrations. It is heavier than air, and can therefore collect in low-lying areas. It has a pungent smell similar to "rotten eggs" at low concentrations.

Nitric oxide (NO) is associated with road transport emissions and other combustion processes such as the electricity supply industry. NO itself is not considered to be harmful to health however when released into the atmosphere NO rapidly oxidises to nitrogen dioxide (NO2). Nitrogen Dioxide is harmful to health and can irritate the lungs and is associated with lowering resistance to respiratory infections such as influenza. Prolonged and frequent exposure to concentrations higher then those found in the ambient air can result in increased incidence of acute respiratory illness in children.

Fine particles comprise a range of materials arising from both natural and man-made sources, including:

- combustion sources (mainly road traffic);
- secondary particles, mainly sulphate and nitrate formed by chemical reactions in the atmosphere, and often transported over national or continental distances;
- coarse particles and material from construction work; and,
- suspended soils and dusts (e.g. from farm fields, sea salt, volcanic emissions and biological particles (such as pollen).

These fine particles are different size fractions which relate to their mean aerodynamic diameter. Most monitoring of these particles is currently focussed on PM_{10}, but the finer fractions such as $PM_{2.5}$ and PM_1 are becoming of increasing interest in terms of health effects. With regard to health effects, fine particles can be carried deep into the lungs where they can cause inflammation and a worsening of the condition of people with heart and lung diseases. They may also carry surface-absorbed carcinogenic compounds into the lungs.

Aside from health effects, particles also have a range of important non-biological impacts including:

- soiling of man-made materials and buildings, resultant loss of amenity;
- reducing visibility (fine particles - aerosol);
- effects on heterogeneous atmospheric chemistry.

The limits presented in the EU Directives on Air Quality take into account people with respiratory illness and the limits include a margin of tolerance for such people, as well as children and the elderly. The limits are largely based on World Health Organisation (WHO) review of epidemiological studies on health impacts around the world. For example, oxides of nitrogen (NO, NO2 and NOx) are known to affect the pulmonary function of the lungs in short term doses. Of all of the medical literature reviewed by the WHO, the lowest adverse affect of exposure was recorded at about 560ug/m3 which showed a reduced lung function in asthmatics. As such, the WHO use this lowest adverse impact and apply a margin of tolerance (usually 50%) to generate a limit of 200ug/m3 for 1-hour human exposure to oxides of nitrogen. This approach is replicated for all pollutants.

5.2 Background Pollutant Levels

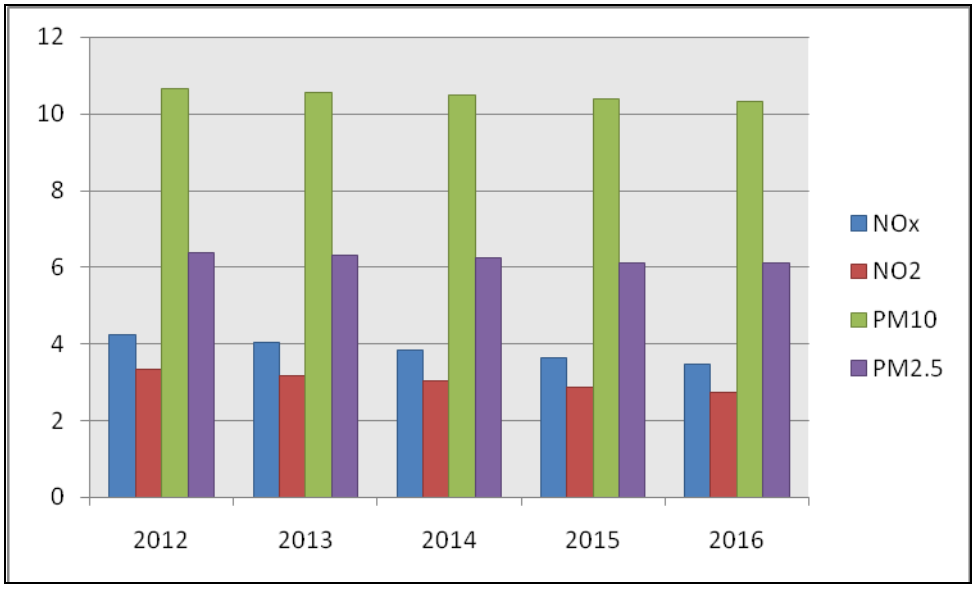
Figures from Local background pollutant concentrations data has been obtained from the website – http://laqm.defra.gov.uk/maps/maps2010.html. Estimates of ambient levels of air pollution are based on National Environmental Technology Centre (NETCEN) data. Table 5.1 below shows the background levels used in the model. The highest and closest background concentration within 2km is located off Straid Road; X304,500 Y440,500. The levels are reflective of a rural area with low input from road traffic and industrial sources.

Table 5.1: Background Pollutant Levels

Background Pollutant	**Annual mean concentrations ($\mu g/m^3$)**			
	NOx	**NO2**	**PM10**	**PM2.5**
2012	4.24	3.34	10.65	6.39
2013	4.04	3.19	10.56	6.31
2014	3.84	3.03	10.48	6.24
2015	3.64	2.88	10.39	6.12
2016	3.48	2.75	10.33	6.11
Average	*3.85*	*3.04*	*10.48*	*6.23*
UK Air Quality Objective	*NOx as NO2*	*40 Annual Mean 200 1-hour Mean*	*40 Annual Mean 50 Daily Mean*	*25 Annual Mean*

Graphic 1.4 Bar Chart of Background Pollutant Levels

Annual mean concentrations (µg/m^3) 2012 – 2016 for NOx, NO2, PM10 and PM2.5



6.0 CERC ADMS DETAILED DISPERSION MODEL

It was deemed appropriate to assess all of the aforementioned scenarios using the CERC ADMS Roads 3.1.2 detailed dispersion modelling. This is a modern dispersion model that has an extensive published track record of use in the UK, for the assessment of local air quality, including model validation and verification studies (CERC, 2009).

Model outputs are shown in Appendix B for gas flare emissions incorporating background pollution levels and emissions from traffic.

7.0 POTENTIAL IMPACTS

7.1 Emissions to the Atmosphere

A transport statement has been completed as part of this planning application; it provides full description of traffic and vehicle activity associated with the proposal. The potential exists for emissions of nitrogen oxides, fine particles and other combustion related pollutants to arise from vehicles associated with the proposed development. Full traffic details are listed in the Transport Assessment accompanying this application.

The preparation phase of the proposal will involve HGVs operating for a 12 Day (Rig Mobilisation) and the operational phase will involve a 33 day time period (Drilling).

With reference to the DMRB guidelines for air quality a road (in this case internal site roads and exterior roads used by HGVs and other vehicles) could require assessment in terms of atmospheric impact if the development. The DMRB lists the following criteria in relation to gauging whether or not an assessment is required.

Affected roads are those that meet any of the following criteria:

- road alignment will change by 5 m or more; or
- daily traffic flows will change by 1,000 AADT or more; or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or
- daily average speed will change by 10 km/hr or more; or
- peak hour speed will change by 20 km/hr or more.

Emissions of combustion related pollutants from the development are expected to be insignificant in terms of the effect on local air quality as the operation of diesel-powered plant & other vehicles will be localised, and vehicles are low in concentration. The proposal does not fall within a defined category for assessment according to the DMRB guidelines.

The traffic flow generated during the construction phase will be associated with the construction traffic, comprising contractor's vehicles and HGVs, diggers, and other diesel-powered vehicles. This traffic flow will result in emissions of nitrogen oxides, fine particles and other combustion related pollutants. The operation of these vehicles will be localised. With regard to local air quality, emissions of combustion related pollutants from the construction phase are expected to be negligible. Residual impacts as a result of the proposal are not expected. Impacts during the construction phase such as dust generation and plant vehicle emissions are predicted to be short-lived and only relevant during the construction phase.

7.2 Dust

Dust is a generic term used to describe a wide range of particulate materials that are generated from the disintegration of solids. The sizes of the particles are generally in the range 1-100 µm (1 µm = 1 micrometre = 10^{-6} metres). Particle size is important because it determines the settling velocity of the dust. In order to assess the potential for a dust nuisance problem to be caused during any potentially dust-generating activity, there is a need to consider both the likely particle size of the material and the effects of wind dispersion. Nuisance caused by the deposition of dust from excavation top soil movement and storage at preparation phase is likely to be the most significant issue in relation to air quality impacts from the proposed development.

The environmental effects of particles depend on their deposition rate and their concentration in air. Deposition rate is expressed in terms of mass per unit area per unit time, e.g. $g.m^{-2}.month^{-1}$. Concentration is expressed in terms of mass per unit volume, e.g. $\mu g.m^{-3}$. Dust nuisance is experienced usually as a result of dust deposition upon clean surfaces such as windows, cars, furniture or laundry. Guidance states that most non-toxic dusts will begin to be perceived as a nuisance when deposition reaches 200 $mg.m^{-2}.day^{-1}$. This figure is based on an annual deposition rate and represents the threshold for significant nuisance, although a range of criteria from 133 to 350 $mg.m^{-2}.day^{-1}$ is found in various examples from other countries. Examples of dust deposition standards are shown in Table 7.1.

Table 7.1: Examples of dust deposition standards

Country	Averaging period	mg m^{-2} day^{-1}
UK	Annual average	200
Germany	Annual average	200
Spain	Annual average	200
Finland	Annual average	333
Australia	Annual average – Loss of amenity first perceived	133
	– Unacceptable reduction in air quality	333
Canada	Annual average – Maximum desirable	200
	– Maximum acceptable	266
United States	Annual average	333

The level and distribution of dust emissions will vary according to factors such as type of dust, duration and location of dust-generating activity, weather conditions and the effectiveness of suppression measures. It is therefore difficult to predict emissions and conventional modelling tools are of limited use.

The assessment of dust is normally confined to an evaluation of the likelihood that emissions may give rise to some perceptible nuisance. This is defined on the basis of the distance from site works of sensitive receptors such as residential properties. It is normally possible, by proper control, to ensure that dust deposition does not give rise to nuisance effects. It is common practice to use a distance of 100m as the radius within which impacts may occur. Appendix A, Figure 1.1 shows distance bandings and proximity of sensitive receptors. Routine dust control measures would normally ensure that the risk of long-term impacts is insignificant but short-term events may occur, for example, technical failure or exceptional weather conditions.

7.3 Construction (Preparation) Phase

The potential for dust nuisance impacts from the preparation phase is difficult to quantify. A more qualitative approach is made to predict potential impacts from the anticipated construction/preparation works associated with the development. The main emphasis throughout this phase will be to minimise the potential dust impacts at source through appropriate site management and control mechanisms and practices. Premises and occupants within 100m of a construction site are generally considered to experience the most significant impacts from construction dust. Table 7.2 below lists examples of dust sensitive receptors.

Table 7.2: Dust Sensitive Receptors (Minerals Policy Statement 2)

High Sensitivity	Medium Sensitivity	Low Sensitivity
Hospitals & Clinics	Schools	Farms
Retirement Homes	Residential Areas	Light & Heavy Industry
Hi-Tech Industries	Food Retailers	Outdoor Storage
Food Processing	Offices	

Construction/preparation activities associated with the site are to be undertaken over 6 week period. The site will be considered as a minor active preparation and operational site. The following classification system was adhered to for the assessment of potential adverse air quality effects arising from dust generation by construction /preparation activities associated with the proposed development:

Major: High or Medium sensitive receptor is less than 10m from a major active construction or demolition site.
Moderate: High or medium sensitivity receptor is within 100m of a major active construction or demolition site.
Minor: Medium or low sensitivity receptor is between 100m and 200m from a major active construction or demolition site or up to 100m from a minor active construction site, demolition site or construction compound.
Negligible: Area affected is 100m from any minor construction site or 200m from any major construction area.

The major influence on air quality throughout the construction/preparation phase of a proposed development is likely to be dust-generating activities such as movement of plant vehicles both on and around the working area. Nuisance caused by the deposition of construction dust is likely to be the most significant issue in relation to local air quality impacts.

During the construction of the development, activities that may cause fugitive dust emissions are as follows:

- earthworks;
- handling and disposal of spoil;
- wind-blow from stockpiles of particulate material;
- movement of vehicles, both on and off site; and
- handling of loose construction materials.

Levels and distribution of dust created during construction/preparation phase are likely to vary according to factors such as the type of dust, duration and location of dust-generating activity, the effectiveness of suppression measures and the weather conditions. It is therefore difficult to predict emissions and conventional modelling tools are of limited use.

7.4 Drilling Phase

Due to the nature of the drilling operations it is necessary to continue 24 hours a day to maintain well bore stability and permit safe operations. During the drilling operations a dense fluid known as "mud" is pumped down inside of the drill string. The mud lubricates the drill bit and returns to the surface fragments of rock which are analysed. The likelihood from significant amounts of fugitive dust at this stage is restricted due to the nature of the operations and the amount of lubrication used, which in essence dampens down dust/particles and prevents them from becoming airborne.

7.5 Testing Flaring Stage

The flare size is dependent upon the type and amount of gas in the flare stack. There is also the potential for noise from flaring depending upon the volume and velocity of the gas going through the flare stack. It is worth nothing at this stage that the flaring and venting of gas is recognised as being a very small overall contributor to anthropogenic greenhouse gas-related emissions (International Association of Oil and Gas Producers, 2000).

Natural gas primarily comprises of methane however, the main pollutants from the flaring of natural gas are; nitrogen oxides (NOx), carbon monoxide (CO), and volatile organic compounds (VOCs). Nitrogen oxides (NOx) comprise, generally, of nitrogen monoxide (NO), and nitrogen dioxide (NO2). Nitrogen monoxide is primarily emitted following combustion however, reaction with the atmosphere converts this to nitrogen dioxide, which is the primary nitrogen oxide of interest with respect to ambient pollution. The efficiency and effectiveness of the combustion will impact upon the presence of carbon monoxide and volatile organic compounds as they are generally formed from the incomplete combustion of fuel. Appendix B shows dispersion model plots from the flaring of gas.

Sulphur dioxide (SO2) has not been examined within this assessment due to the understanding that there is negligible sulphur content in the natural gas. Poor combustion and the presence of a smoky flame during the flaring process can lead to the production of fine particulate matter. Concerning this site; its characteristics and its flaring activities, this report is of the opinion that there will be no significant discharge of fine particulate matter and as such has not been examined within this report.

7.6 Reinstatement Phase

This is essentially a repetition of construction (preparation) phase assessment and the same impacts and suggested mitigation will apply as appropriate.

8.0 IMPACT ASSESSMENT

8.1 Traffic Derived Atmospheric Pollution

Air pollution emanting from HGVs and motor cars accessing and egressing the site will be minimal. The amount of predicted traffic does not fall with the DMRB assessment requirements. Risk of significant atmospheric pollution from this source is negligible. Mitigation measures set out in section 9.0 should be adhered too.

8.2 Operational Engine Derived Atmospheric Pollution

The drilling rig will operate, 24 hours a day. This may give rise to atmospheric pollution in the form of exhaust fumes from diesel engines and other associated atmospheric releases associated with oil exploration. These include:

- Methane – A greenhouse gas prevalent with the existence of coal and gas.
- Volatile Organic Compounds – VOCs are organic compounds that can be natural and manmade.
- Hydrogen Sulphide - Hydrogen sulphide is a naturally occurring component of crude oil and natural gas.
- BTEX - BTEX is an acronym that stands for benzene, toluene, ethylbenzene, and xylenes.

Due to the nature of the operation and sensitive receptors in the region, monitoring for these atmospheric releases should be undertaken during the drilling phases. Section 9.0 discusses monitoring during the proposed drilling phases.

8.3 Dust

There are several sensitive residential receptors in close proximity to the proposed well site extent. Table 8.1 below details residential properties and the distance from the proposed well site. Appendix A, Figure 1.1 indicates the location of the sensitive receptors in relation to the proposal.

Table 8.1: Sensitive Residential Receptors

Reference	Address	Distance from well site	Potential Impact
01	53 Ballinlea Road (Parochial House)	80.3m	Moderate
02	41 Kilmahamogue Road	345m	Negligible
03	46 Straid Road	227m	Negligible
04	47 Straid Road	214m	Negligible
05	47A Straid Road	164m	Negligible
06	86 Straid Road	163m	Negligible
07	87 Straid Road	270m	Negligible

The majority of properties are over 150m away from the closest part of the proposed well extent. One property, 53 Ballinlea Road is within 100m from the southern boundary of the working area. This sensitive receptor is deemed to be moderate in terms of potential impact without any mitigation measures in place. With mitigation in place the impact would be negligible. Mitigation measures are detailed in section 9.0.

The preparation of the site will involve disturbance and transporting of topsoil in order to create a platform for the proposed well site extent. Impacts during the construction phase such as dust generation and plant vehicle emissions are predicted to be short-lived and most relevant during the construction/preparation phase. Adherence to mitigation measures and suggested best practice are set out in Section 9.0, these shall help ensure that fugitive dust from the preparation phase is negligible.

8.4 Predicted concentrations from Flaring

Table 8.2 summarises the maximum process contributions to ground level concentrations of nitrogen dioxide, carbon monoxide and volatile organic compounds for the operating arrangement considered.

Table 8.2 Predicted Maximum Process Contributions for Single Tip Shrouded Flare

Pollutant	Averaging Basis	Maximum Process Contribution to Ground Level Concentration (µg/m^3)
NO_2	Short Term	17
NO_2	Long Term	0.24
CO	8 Hours	0.06
VOC	Annual Mean	1.1

The assessment indicates that the single tip shrouded flare does not provide much process contribution to ground level concentrations as a result of its higher discharge height by virtue of the higher flare tip and reduced heat radiation.

It should be noted that the values in Table 8.2 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 Appendix B illustrate the predicted pattern of dispersion for discharges.

In table 8.3 the predicted maximum process contributions are summarised as a proportion of the applicable air quality standards.

Table 8.3 Predicted Maximum Process Contributions - Relative to Air Quality Standards

Pollutant	Averaging Basis	Maximum Process Contribution to Ground Level Concentration (%AQS)
NO_2	Short Term	2
NO_2	Long Term	2
CO	8 Hours	1

It may be seen that for the proposed single tip flare the maximum process contribution for nitrogen dioxide ranges from 1 to 3%. For carbon monoxide the value is just 1%. For both pollutants; the maximum process contributions are significantly below the applicable air quality standards. There are no current air quality standards applicable to total volatile organic compounds.

8.5 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.

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 8.2, and background concentrations for Ballinlea, the total maximum predicted environmental concentration (PEC) for each pollutant has been determined and is summarised in Table 8.4.

Table 8.4 Maximum Predicted Environmental Concentrations of Pollutants

Pollutant	Averaging Basis	Maximum Process Contribution to Ground Level Concentration (%AQS)
NO_2	Short Term	Less than 10%
NO_2	Long Term	Less then 15%
CO	8 Hours	Less than 1%

Table 8.5: Sensitive Residential Receptors and Results of Model (Appendix B)

Reference	Address	NO2	CO	VOC	Potential Impact
01	53 Ballinlea Road (Parochial House)	Within Relevant Threshold Limits			Negligible
02	41 Kilmahamogue Road	Within Relevant Threshold Limits			Negligible
03	46 Straid Road	Within Relevant Threshold Limits			Negligible
04	47 Straid Road	Within Relevant Threshold Limits			Negligible
05	47A Straid Road	Within Relevant Threshold Limits			Negligible
06	86 Straid Road	Within Relevant Threshold Limits			Negligible
07	87 Straid Road	Within Relevant Threshold Limits			Negligible

Appendix B illustrates dispersion plots from the model.

9.0 MITIGATION

The project incorporates mitigation measures based on 'good housekeeping' site practices and other measures that would greatly reduce emissions of nuisance dusts. Such measures are generally implemented on well run construction sites and would greatly reduce emissions of nuisance dusts. These are expected to be sufficient to control nuisance dust to a level where no nuisance effects would be expected.

Various mitigation measures are proposed in order to alleviate potential problems arising from dust dispersion from proposed site activity. Many of these potential impacts can be prevented or mitigated by the implementation of good practice.

Reference shall be made to best practice guidance and procedures contained with, *The control of dust and emissions from construction and demolition*, produced in partnership by London Councils and the Greater London Authority (Appendix C). This guidance document outlines good site management and practice to help reduce emissions and dust from operational sites. Reference should also be made to:

- BRE (2003a): Guidance on the Control of Dust from Construction and Demolition Activities; and,
- BRE (2003b): Controlling Particulates, Vapours and Noise Pollution from Construction Sites

Both of these documents discuss appropriate preventative measures that may be adopted in order to control fugitive emissions to the atmosphere. The following preventative measures should be adopted:

- Wet suppression methods should be used to control fugitive dust emissions from site operations;
- Wet suppression equipment must have an adequate supply of water;
- Boundary screening can be effective at reducing dust dispersion from a site;
- Use of physical barriers such as buildings, windbreaks, solid fences, vegetated embankments and trees to reduce wind speed and the potential for erosion;
- Appropriate shielding/dust suppressant guard on machinery; and,
- Periodic review of dust suppression methods for machinery & adoption into dust management plan.

A dust management plan (DMP) should be adopted during the construction/preparation phase of the proposed development in order to help alleviate potential impact on air quality in the immediate locality.

A DMP should include the following mitigation measures:

- Site roads will be regularly cleaned and maintained as appropriate. Hard surface roads will be swept to remove mud and aggregate materials from their surface while any unsurfaced roads will be restricted to essential site traffic only.
- Any site roads with the potential to give rise to dust will be regularly watered, as appropriate, during dry and/or windy conditions (if applicable also relevant to vehicles delivering material with dust potential).
- Site stockpiling of materials should be stored to minimise exposure to wind.

- Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.
- The contractor will be required to ensure that all vehicles are suitably maintained to ensure that emissions of engine generated pollutants is kept to a minimum.
- Restriction of drop heights onto HGVs and other demolition/construction equipment.
- Provision of appropriate fencing/screening to reduce dust dispersion and lengthen the distance of the public-site interface.
- A non-idling policy should be put in place when site vehicles are static and not in use.
- The transport of soils or dusty materials should be undertaken in covered vehicles.
- Prior to commencement of works on site it is recommended that site management undertake a site-specific air quality risk assessment. A methodology for this assessment is presented in Appendix C The London Councils and the Greater London Authority developed the London Best Practice Guide (used as a template document throughout the UK) as part of its Air Quality and Planning Guidance.

9.1 On-site Monitoring

During the operational phase of the proposed development on-site monitoring in the form of diffusion tubes may be conducted, if required, in order to give confidence to Moyle District Council that atmospheric pollutants associated with the drilling and flaring are within acceptable levels. Nitrogen dioxide and VOCs may be measured through the use of diffusion tubes. Methane levels may also be monitored by appropriate methods (i.e. grab samples or use of portable monitoring equipment).

10.0 CONCLUSION

This report has examined the potential impacts that may arise as a result of the proposed operations at the Ballinlea site. Taking into consideration the maximum gas disposal rate for full time flaring activities; it has been possible to predict the processes contributions to local ambient concentrations of nitrogen dioxide, carbon monoxide, and volatile organic compounds.

Whilst there is the potential for short term minor adverse impacts, for example during technical failure or exceptional weather conditions (prolonged dry period coupled with high wind speed), these can be adequately controlled with the implementation of appropriate measures in accordance with best practice, good housekeeping and adherence to mitigation described in this report.

Adherence to suggested mitigation measures and best practice detailed in section 8.0 should be implemented though continued correspondence with Moyle District Council Environmental Health representatives.

Appendix B details results of dispersion model highlighting the impact flaring activities will have upon the local area. 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 and statutory designed sites, the impact of flaring on air quality is around or below the level at which it would be considered insignificant.

11.0 REFERENCES

- *Air Quality Archive, 2010. http://www.airquality.co.uk/arcriive/inclex.php*
- *Air Quality NI, 2010. www.airqualityni.co.uk*
- *Air Quality Regulations (Northern Ireland) 2003*
- *Caliber Planning (no date) What is Flaring?*

  https://rfn.caliberplanning.com/index.php?content=faq&section=flaring
- *DEFRA Local Air Quality Management Technical Guidance LAQM.TG(09)*
- *Directive 2004/107/EC (the Fourth Daughter Directive) relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air.*
- *Directive 2008/50/EC on Ambient Air Quality and Cleaner Air For Europe (the Air Quality Directive);*
- *International Association of Oil and Gas Producers (2000) Flaring & venting in the oil & gas exploration & production industry. Report No. 2.79/288.* [Online] Available at: *http://www.ogp.org.uk/pubs/288.pdf*
- *Moyle District Council Review and Assessment of Air Quality Stage 1 Report 2001*
- *Moyle District Council Review and Assessment of Air Quality Stage 2 & 3 Report 2004*
- *Moyle District Council Progress Report 2005*
- *Moyle District Council Update and Screening Report 2006*
- *Moyle District Council Progress Report 2007*
- *Moyle District Council Progress Report 2008*
- *Moyle District Council Combined 2009 Air Quality Update and Screening Assessment and 2010 progress Report. In fulfillment of Part IV of the Environment Act 1995 - Local Air Quality Management. March 2010*
- *Moyle District Council, 2011, Air Quality Progress Report for Moyle District Council. In fulfillment of Part IV of the Environment Act 1995 - Local Air Quality Management. May 2011.*
- *The Air Quality Standard Regulations (Northern Ireland) 2010*
- *The Air Quality Strategy for England, Scotland, Wales and Northern Ireland 2000*
- *The Environment (Northern Ireland) Order 2002 (Amendment) Regulations (Northern Ireland) 2010*

Appendix A

N

BALLINLEA UPPER

STRAID ROAD

BALLINLEA LOWER

BALLINLEA ROAD

RATHLIN ATHMOGUE ROAD

St Mary's Parochial House

St Mary's RC Church

Grave Yard

Hall

Issues

01 02 03 04 05 06 07

LEGEND

- Survey Areas
- Proposed Well Site Extent
- 10m Buffer from Well Site
- 100m Buffer from Well Site
- 200m Buffer from Well Site
- 01 Sensitive Receptor (with reference number)

ISSUE DETAILS

Drawn:	SMcA	**Project No.**	RPS: NI 1444
Chkd:	-		
Appd:	DOL	**Status:**	FINAL
Date:	June 2013	**Drawing No.**	**Rev.**
Scale:	Not to Scale	1.1	0001

RPS
Elmwood House
74 Boucher Road
BELFAST
BT12 6RZ
T: 028 9066 7914
F: 028 9066 8286

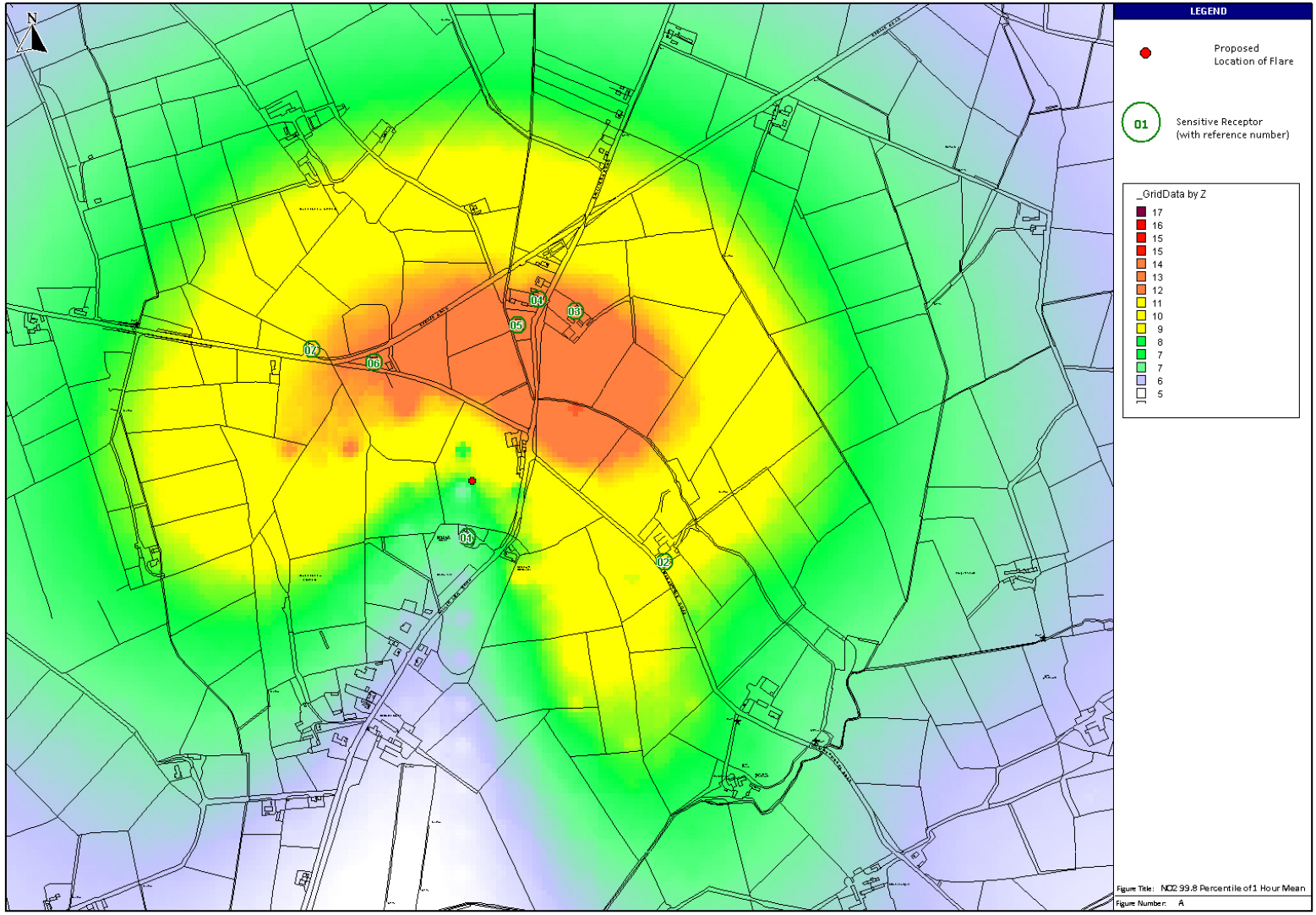
PROJECT & FIGURE DETAILS

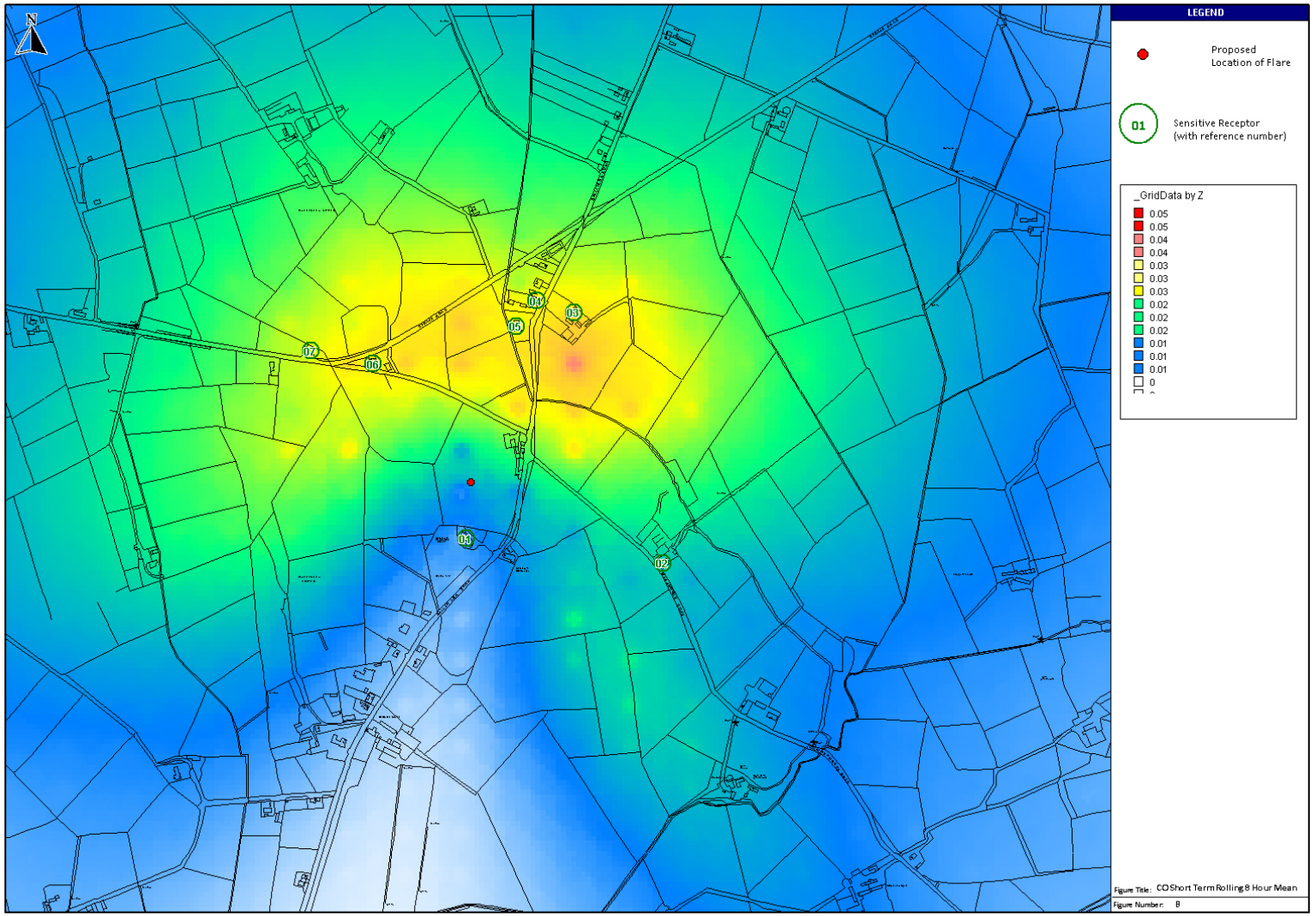
Project Title:
Rathlin Energy, Ballinlea

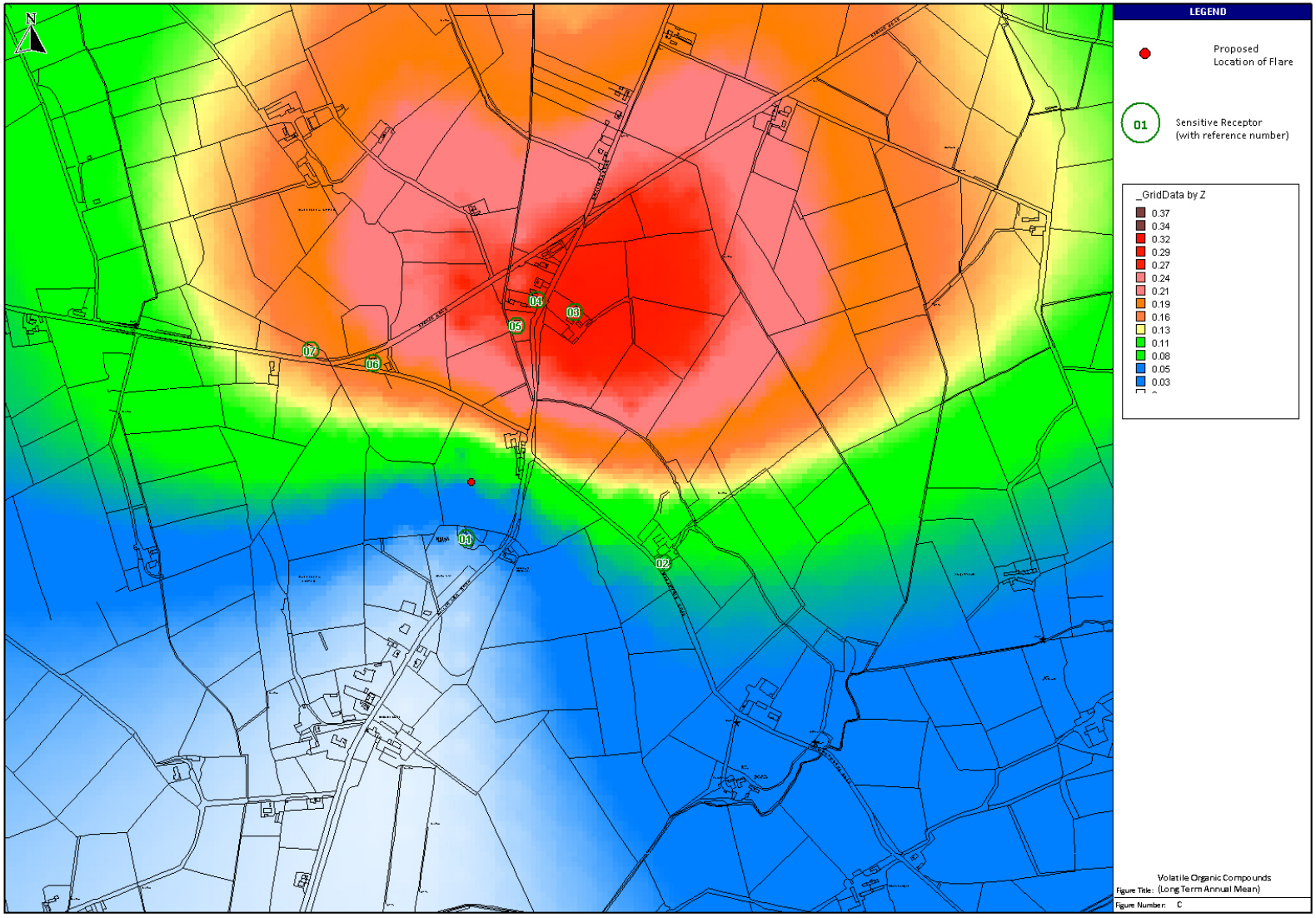
Figure Title: Air Quality

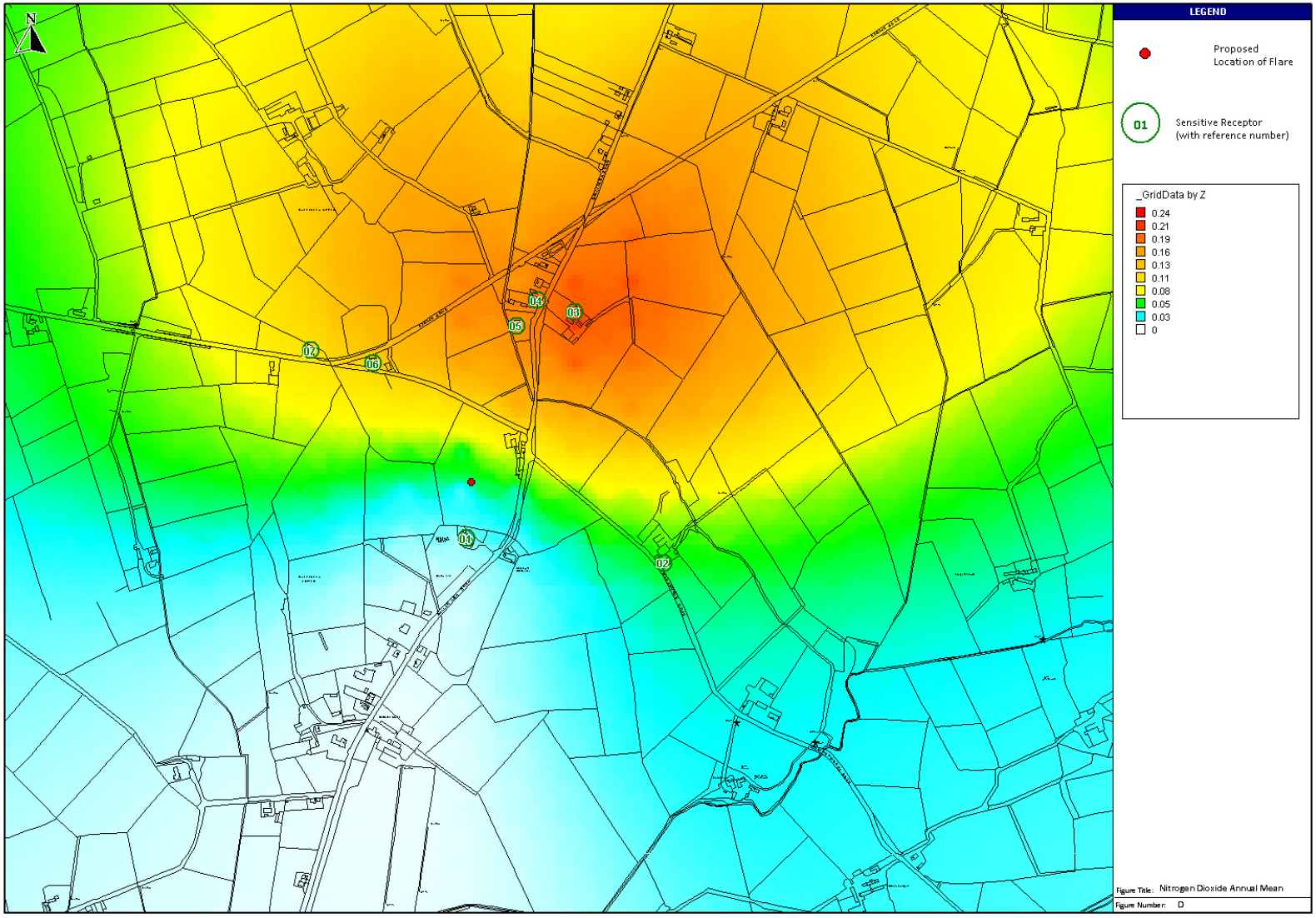
Figure Number: 1.1

Appendix B


N
LEGEND
Proposed
Location of Flare
01
Sensitive Receptor
(with reference number)
_GridData by Z
17
16
15
15
14
13
12
11
10
9
8
7
7
6
5
01
02
03
04
05
06
07
Figure Title: NO2 99.8 Percentile of 1 Hour Mean
Figure Number: A


N
LEGEND
Proposed
Location of Flare
01
Sensitive Receptor
(with reference number)
_GridData by Z
0.05
0.05
0.04
0.04
0.03
0.03
0.03
0.02
0.02
0.02
0.01
0.01
0.01
0
Figure Title: CO Short Term Rolling 8 Hour Mean
Figure Number: B


N
LEGEND
Proposed
Location of Flare
01
Sensitive Receptor
(with reference number)
_GridData by Z
0.37
0.34
0.32
0.29
0.27
0.24
0.21
0.19
0.16
0.13
0.11
0.08
0.05
0.03
01
02
03
04
05
06
07
Volatile Organic Compounds
Figure Title: (Long Term Annual Mean)
Figure Number: C


N
LEGEND
Proposed
Location of Flare
01
Sensitive Receptor
(with reference number)
_GridData by Z
0.24
0.21
0.19
0.16
0.13
0.11
0.08
0.05
0.03
0
01
02
03
04
05
06
07
Figure Title: Nitrogen Dioxide Annual Mean
Figure Number: D

All plots show maximum process contribution to ground level concentration (ug/m3)

The modelling assessment methodology and necessary assumptions provide a conservative assessment of impact on air quality. The overall results and conclusions reached therefore incorporate a reasonable margin of comfort.

Appendix C

Appendix C: Suggested Air Quality Risk Assessment Procedure for Construction Phase

Air Quality Risk Assessment

A risk assessment can be undertaken using the Air Pollution Risk Assessment (APRA) scoring system contained in the Draft London Best Practice Guide developed by the Greater London Authority, London Boroughs and the Association of London Government. The APRA focuses on the surrounding area and the proposed site activities which impact on the local air quality and management of the construction site. It identifies susceptible receptors adjacent to the site and potential air polluting activities on the site and allocates a score. The APRA has 3 sections; Surrounding Environment, Development of the Site and Construction Activities. Each section asks a series of questions and a 'score' is given according to the answer. The final scores of each section are then collated to evaluate the overall risk for the construction site (i.e. High, Medium or Low).

When the overall risk has been determined, the level of dust mitigation measures can be recommended. Providing these mitigation measures are adhered to, the affect of dust on nearby receptors will be minimal. Dust emissions from the proposed construction site will be the sum of a large number of small activities so it is therefore important that the mitigation measures are implemented across the site.

Air Pollution Risk Assessment (APRA)
Surrounding Environment.

Surrounding Environment 1:		
	Possible scores	**Score given**
*Is the site >30m from an Air Quality Management Area?	**5**	
*Is the site <30m from an AQMA?	**10**	
Is the site within an AQMA?	**15**	
***measured from site boundary to nearest AQMA.*		

Surrounding Environment 2:		
	Possible scores	**Score given**
Is the site between 20m-1km from a main road (>10,000vpd)?	**5**	
Is the site <20m from a main road (>10,000vpd)?	**10**	
Is the site within 20m of a busy road junction*?	**15**	
***busy road junction defined as a combined flow of >10,000vpd from all directions.**		

Surrounding Environment 3:		
	Possible scores	**Score given**
Are there residents >5m from the site?	**5**	
Are there residents <5m from the site?	**10**	

Surrounding Environment 4:		
	Possible scores	**Score given**
Are there any sensitive receptors within 30m of the site? (i.e. schools, hospitals, care homes etc)		
Yes	**10**	
No	**0**	

Surrounding Environment 5:		
	Possible scores	**Score given**
Is there any other construction work >20m of the site at the same time?	**5**	
Is there any other construction work <20m of the site at the same time?	**10**	

Surrounding Environment Total Score:	

Development of site.

Development of site 1:		
	Possible scores	**Score given**
Is the site to be developed for business use >1000m^2?		
Yes	**7**	
No	**0**	

Development of site 2:		
	Possible scores	**Score given**
Is the site to be developed for residential use >10 dwellings?		
Yes	**7**	
No	**0**	

Development of site 3:		
	Possible scores	**Score given**
Is the site to be developed for mixed use and is either >1000m^2 or >10 dwellings?		
Yes	**7**	
No	**0**	

Development of site 4:		
	Possible scores	**Score given**
Is the site to be developed* in autumn or spring?	**3**	
Is the site to be developed* in winter?	**5**	
Is the site to be developed* in summer?	**7**	
Autumn = Sept, Oct, Nov. Spring = Mar, Apr, May. Winter = Dec, Jan, Feb. Summer = Jun, Jul, Aug. **The term developed is taken to refer to the majority of dust producing activities e.g. demolition and remediation activities*		

Development of site 5:		
	Possible scores	**Score given**
Is the planned length of works <20 weeks?	**3**	
Is the planned length of works between 20 – 52 weeks?	**5**	
Is the planned length of works >52 weeks?	**7**	

Development of site 6:		
	Possible scores	**Score given**
Will solid barriers be erected along the site boundary?		
Yes	**0**	
No	**5**	
Do the site works involve remediation/ earth moving works?		
Yes	**5**	
No	**0**	
Do the site works involve demolition works (including digging up and removal of over site concrete)?		
Yes	**5**	
No	**0**	

Development of Site Total Score:	

Construction Activities.

Construction Activities 1:		
	Possible scores	**Score given**
Will construction traffic (lorry) movements be <5 / day?	**5**	
Will construction traffic (lorry) movements be 5–10 / day?	**10**	
Will construction traffic movements be >10 / day?	**15**	
One lorry movement is defined as entering and leaving the site.		

Construction Activities 2:		
	Possible scores	**Score given**
Will a concrete crusher be used on site?		
Yes	**5**	
No	**0**	
Is there to be cement batching on site?		
Yes	**5**	
No	**0**	
Is Non-road mobile machinery to be used on site?		
Yes	**5**	
No	**0**	
Will there be stockpiles of materials?		
Yes	**5**	
No	**2**	
Will tools such as cement mixers, brick/concrete cutters be used on site?		
Yes	**5**	
No	**0**	

Construction Activities Total Score:	**30**

Surrounding Environment + Development of Site + Construction Activities Total Score:	**Range 33 to 141**	

Risk Category: *High=score of >104,* *Medium=score of 71-103,* *Low=score of 33 – 70*	

Where no information on planned construction strategy is currently available to answer questions, the worst-case points should be assigned. For example, it is assumed that all work will take place during summer months when dust generation is greatest. This may not actually be the case.

The mitigation measures recommended for low, medium and high-risk sites is detailed below.

MITIGATION MEASURES FOR LOW RISK SITES:

- No bonfires.
- Wheel Washing.
- Solid barriers to site boundary.
- Covered lorries leaving site.
- Cleaning road and footpath/pavement directly adjacent entrance to site.
- Water to be used as a suppressant for dust generating activities.

MITIGATION MEASURES FOR MEDIUM RISK SITES:

- Site Planning
- Carry out main dust causing activity in spring /autumn.
- Plan site layout–locate dust activity away from sensitive receptors.
- Erect solid barriers to site boundary
- No bonfires.
- All site personnel to be fully trained.
- Identify responsible person in charge.
- Hard landscape site haul routes.

Construction Traffic

- All vehicles to switch off engines – no idling vehicles.
- Wheel washing on leaving site.
- All loads leaving site to be covered.
- No site runoff of water / mud.
- All off-road vehicles to use ULSD where available.
- On-road vehicles to comply with LEZ requirements as a minimum

Demolition Works

- Use water as dust suppressant.
- Use enclosed chutes and covered skips.
- Wrap building to be demolished.
- Cutting equipment to use water as suppressant or suitable LEV.

Earth Moving Works

- Minimise dust-generating activities on dry or windy days.
- Use water as dust suppressant where applicable.
- Re-vegetate or cover dusty stockpiles.

Implementation of the suggested mitigation measures above will help reduce the impact of the construction activities to low risk.

MITIGATION MEASURES FOR HIGH RISK SITES:

- Site Planning
- Carry out main dust causing activity in spring /autumn.
- Plan site layout–locate dust activity away from sensitive receptors.
- Plan site layout – minimise movement of construction traffic around site.
- Erect solid barriers to site boundary
- No bonfires
- All site personnel to be fully trained
- Trained and responsible manager on site during working times to maintain logbook and site inspections.
- Use of nearby waterways for materials to / from site.
- Put in place dust real-time monitors across site.

Construction Traffic

- All vehicles to switch off engines – no idling vehicles.
- Fixed wheel washing on leaving site and damping down of haul routes
- 5mph speed limit around site.
- Hard landscaping of haul routes.
- On-road vehicles to comply to set emission standards (see slide scale in Section 5)
- Non Road Mobile Machinery (NRMM) should be fuelled by ULSD and fitted with exhaust after-treatment on the approved list where available
- All loads leaving site to be covered.
- No site runoff of water / mud.

Demolition Works

- Use water as dust suppressant.
- Use enclosed chutes and covered skips.
- Wrap building to be demolished.
- Cutting equipment to use water as suppressant or suitable LEV.
- Ensure concrete crusher has permit to operate and that water bowsers are fully operational.
- Earth Moving Works
- Not on dry or windy days.
- Use water as dust suppressant where applicable.
- Re-vegetate earthworks and exposed areas.

Site Activities

- Minimise dust-generating activities on windy and dry days.
- Use water as dust suppressant where applicable.
- Cover seed and fence stockpiles to prevent wind whipping.

Implementation of the suggested mitigation measures above will help reduce the impact of the construction activities to medium or even low risk.

APPENDIX 7 – MANAGEMENT OF RADIOACTIVE WASTE

*** Page Left Blank Intentionally ***

The Management of Radioactive Waste Exploratory Operations Ballinlea 2

*** Page Left Blank Intentionally ***

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY

This Management of Radioactive Waste document has been prepared as part of the onshore oil and gas exploration, to be performed by Rathlin Energy Limited (Rathlin Energy), on the proposed Ballinlea 2 wellsite.

Naturally occurring radioactive material (NORM) is formed from the potential dissolution of radionuclides within the formations in aqueous waste. Elements such as uranium, radium, and radon are dissolved in very low concentrations during normal reactions between water and rock or soil. The dissolved radionuclides within the formations may be transported to the surface within "produced water" during the exploratory operations. Precipitates may be formed from chemical changes occurring within the water, however, these volumes are expected to be negligible.

There is a potential for the contamination of solid components / materials during the separation of produced water and hydrocarbons on the surface. Due to the low level of NORM concentrations anticipated, the operations are not expected to give rise to any significant contamination issues.

Waste water volumes of approximately 275 m3 have been estimated for the Ballinlea 2 exploratory operations, including a 100% contingency.

Aqueous waste will be transported off site to a licenced industrial waste water treatment facility. This is the preferred option for treatment and will ensure that the aqueous waste will be managed effectively in accordance with current regulations and should minimise any environmental impact associated with the waste. It has been demonstrated that the treatment process will not give rise to any significant radiological exposure to members of the public or the environment, and is considered to be the best practicable environmental option.

The generation of solid waste is not anticipated during the exploratory operations, however, disposal options have been considered for this unlikely waste stream.

This document details the management arrangements using the best available techniques for naturally occurring radioactive materials, which should ensure compliance with the conditions of the Radioactive Substances Act 1993, the Radioactive Substances Act 1993 (Amendment) Regulations (Northern Ireland) 2011 and the Ionising Radiations Regulations (Northern Ireland) 2000.

2. SCOPE

This Management of Radioactive Waste document is applicable to the Ballinlea 2 wellsite and all exploratory operations permitted therein. This document has been prepared in advance of planning permission being granted by the Department of the Environment (DOE) and is being used to support the Ballinlea 2 planning application.

It is applicable to Rathlin Energy, its contractors and subcontractors and can be used in support of Radioactive Substances Regulation applications to the Planning Service and Northern Ireland Environment Agency (NIEA) where there is a requirement to consider Best Practicable Means (BPM) and Best Practicable Environmental Option (BPEO).

3. DEFINITIONS

BAT	Best Available Techniques
BPEO	Best Practicable Environmental Option
BPM	Best Practicable Means
DETI	Department of Enterprise, Trade and Investment
DOENI	Department of Environment Northern Ireland
ELV	Emission Limit Values
IED	Industrial Emissions Directive 2010
IRR2000	Ionising Radiations Regulations 2000 NI
LAIP	Letter of Agreement in Principle
LLW	Low Level Waste
NIEA	Northern Ireland Environment Agency
NORM	Naturally Occurring Radioactive Material
RPA	Radiation Protection Adviser
RSA	Radioactive Substances Act 1993
RSA(A)NI	Radioactive Substances Act 1993 (Amendment) Regulations (Northern Ireland) 2011
RSCR	Radiological Site Condition Report
RWA	Radioactive Waste Adviser
SQEP	Suitably Qualified and Experienced Personnel
UKAS	United Kingdom Accreditation Service

4. INTRODUCTION

4.1 Rathlin Energy

Rathlin Energy 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 Northern Ireland operations are conducted through Rathlin Energy and are directed from the Rathlin Energy office in London.

Rathlin Energy is engaged in the exploration and production of petroleum onshore in the United Kingdom and holds 100% interest in Department of Enterprise, Trade and Investment (DETI) Petroleum Licence (PL) PL3/10, within which it proposed to drill and test one exploratory borehole at Ballinlea 2, County Antrim, Northern Ireland.

An application for planning permission for the proposed Ballinlea 2 exploration operations has been submitted to the Planning Service within the DOENI. The application is for the construction of a wellsite and the drilling and testing of a petroleum exploratory borehole.

The purpose of this document is to outline the management of radioactive waste for Naturally Occurring Radioactive Material (NORM) to be implemented at the Ballinlea 2 wellsite during exploratory operations, which for clarity includes drilling, testing and maintenance operations, and can be used to support any existing or future applications for planning and environmental permits.

4.2 Site Details

The proposed Ballinlea 2 exploratory operations are being undertaken at the following location:

Ballinlea 2 Wellsite
Rathlin Energy Limited
49 Ballinlea Road
Ballinlea Upper
Ballycastle
County Antrim
Northern Ireland
BT54 6NN

National Grid Ref: NW 22182 97672

Site Area: 1.17 hectares

Waste Registration Number: To be applied for following receipt of planning consent

5. BACKGROUND

This Management of Radioactive Waste document has been prepared as part of an application for planning permission, in accordance with the Radioactive Substances Act (RSA) 1993 and the Radioactive Substances Act 1993 (Amendment) Regulations (Northern Ireland) 2011. The practice relates to onshore oil and gas exploratory operations to be performed by Rathlin Energy at the Ballinlea 2 wellsite.

5.1 BAT Definition and Requirements

In the absence of any specific guidance relating to RSA-regulated activities and the concepts of BPM/BPEO, applicable guidance from another regulatory regime has been considered, which refers to the concept of Best Available Techniques (BAT). It is considered that BAT and BPM/BPEO are broadly similar in concept. As such the terms BPM and BPEO (applicable to the RSA regulatory regime) are (for the purpose of this document) considered equivalent to, and interchangeable with, the term BAT.

The Industrial Emissions Directive (IED), transposed within the Pollution Prevention and Control (Industrial Emissions) Regulations (Northern Ireland) 2013, requires that permit conditions should be set on the basis of best available techniques. The permit conditions including emission limit values (ELVs) must be based on the Best Available Techniques (BAT), as defined in the Industrial Emissions Directive (IED).

Within the Industrial Emissions Directive (IED) Best Available Techniques (BAT) is defined as:

The term "best available techniques" means the most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent and, where that is not practicable, to reduce emissions and the impact on the environment as a whole.

(a) "Techniques" includes both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned;

(b) "available techniques" means those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages, whether or not the techniques are used or produced inside the Member State in question, as long as they are reasonably accessible to the operator;

(c) "best" means most effective in achieving a high general level of protection of the environment as a whole.

In determining whether a set of processes, facilities and methods of operation constitute the best available techniques in general or individual cases, special consideration will be given to:

- *comparable processes, facilities or methods of operation which have recently been successfully tried out;*
- *technological advances and changes in scientific knowledge and understanding;*
- *the economic feasibility of such techniques;*

- *time limits for installation in both new and existing plants;*
- *the nature and volume of the discharges and emissions concerned.*

It therefore follows that what is "best available techniques" for a particular process will change with time in the light of technological advances, economic and social factors, as well as changes in scientific knowledge and understanding.

If the reduction of discharges and emissions resulting from the use of best available techniques does not lead to environmentally acceptable results, additional measures have to be applied.

The aim of the concept of BAT is to optimise, and thus restrict, the activity of radioactivity handled, the amount of contamination generated, and the activity of waste requiring disposal, so minimising the activity which is ultimately discharged to the environment.

Part of the concept of BAT is that users should consider the work procedures and the resulting waste generated from the operation before work commences. Consideration in the planning stage will assist in ensuring that the volume of waste generated is minimised at all stages throughout the operation. BAT is an on-going process and is to be reviewed both periodically and whenever there is a substantive change in circumstances. The Northern Ireland Environment Agency (NIEA) requires that the BAT approach is adopted in an appropriate manner at a level which is proportionate to the environmental risk. There is no de minimis level below which BAT does not apply, proportionality being a key principle.

Key elements of BAT include justifying the use of radioactive material (not applicable to the application in question, see section 6), performing tasks efficiently without creating unnecessary waste and decay-storing solid waste where practicable. During the planning stage of the Ballinlea 2 exploratory operation, the hierarchy of waste was considered to ensure that waste generated was minimised. To ensure waste generated during the operations is kept to a minimum the following factors were considered:

- practicality;
- operator safety;
- monetary cost; and
- the benefits to the environment of reduced discharges and disposals.

The RSA requires that Authorisations granted require operators to use BPM/BPEO (considered equivalent to BAT) to minimise the activity of radioactive waste produced that will require disposal under the Authorisation.

The application of BAT requires operators when designing facilities are to use the best available techniques and these are to be applied during the operational management of their facilities. The application of the best available techniques will minimise the amount of discharges and disposals of radioactive waste. The application of BAT will ensure that focus is directed on achieving a high standard of protection for the public and the environment.

BAT is applied to the following aspects of the operation:

- minimising waste creation;
- abating discharges;
- monitoring of plant;
- monitoring discharges; and
- monitoring the environment.

BAT takes into account such factors as the availability and cost of relevant measures, operator safety and the benefits of reduced discharges and disposals.

This Management of Radioactive Waste document has been drafted in support of an application for planning permission for the Ballinlea 2 petroleum exploration operations and any subsequent planning and permitting applications. It is anticipated that any Authorisations granted for the proposed operations will include the following conditions:

Operating techniques

1. The operator shall use the BPM/BAT [*i.e. BAT*]:

   (a) to minimise the period over which radioactive waste is accumulated;

   (b) to minimise the activity of radioactive waste produced on the premises that will require to be disposed of on or from the premises;

   (c) to ensure that all relevant parts of the premises are constructed, maintained and used in such a manner that:

      (i) they do not readily become contaminated; and

      (ii) any contamination which does occur can be easily removed;

   (d) to prevent:

      (i) the loss of any radioactive waste; and

      (ii) access to any radioactive waste by any person not authorised by the operator.

2. The operator shall use the BPM/BPEO [*i.e. BAT*] in respect of the disposal of radioactive waste pursuant to this Authorisation to:

   (a) minimise the activity of gaseous and aqueous radioactive waste disposed of by discharge to the environment;

   (b) minimise the volume of radioactive waste disposed of by transfer to other premises; and

   (c) dispose of radioactive waste at times, in a form, and in a manner so as to minimise the radiological effects on the environment and members of the public.

3. The operator shall use BPM/BPEO to:

   (a) exclude all entrained solids, gases and non-aqueous liquids from radioactive aqueous waste prior to discharge to the environment;

(b) ensure that any discharge of radioactive gas to the atmosphere is made in a manner which prevents its entry into any building.

The operator shall maintain in good repair the systems and equipment provided:

(b) to carry out any monitoring and measurements necessary to determine compliance with the conditions of this Authorisation.

4. The operator shall check, at an appropriate frequency, the effectiveness of systems, equipment and procedures provided to meet the requirements of conditions 1, 2 and 3.

5. Any container in which radioactive waste are stored shall be clearly and legibly marked with the word 'Radioactive', with the ionising radiation symbol conforming with BS 3510: 1968 or ISO 361 and any other information necessary for the identification of the radioactive waste present.

6. The operator shall have and comply with appropriate criteria for the acceptance into service of systems, equipment and procedures for carrying out any monitoring and measurements necessary to determine compliance with the conditions of this Authorisation.

7. The operator shall post copies of this Authorisation on the premises, in such characters and in such positions to be conveniently read by persons who have duties on the premises which are or could be affected by the matters set out in this Authorisation.

The following sections address the various requirements in considering whether BPM/BPEO are being applied to the practice and associated waste streams.

6. JUSTIFICATION OF PRACTICES

In accordance with the Justification of Practices Involving Ionising Radiation Regulations 2004, consideration whether the operations will generate radioactive waste and the potential increase of exposure to individuals is justified, however, as defined within the EC Basic Safety Standard Directive, the naturally occurring radioactive materials are not being used for their radioactive, fissile and fertile properties and further consideration of the Justification Regulations is not required.

7. DESCRIPTION OF WASTE STREAMS

The potential presence of NORM in aqueous waste from the dissolution of radionuclides within the formations is an unavoidable consequence of the petroleum exploration process. The NORM may be transported to the surface with ‘produced water’ and as a result, the potential for the contamination of solid materials (for example, phase-separator components, and/or build-up of insoluble scales within pipework/components) may arise.

Radiologically-significant concentrations of radionuclides are present in waste material alone and radionuclides are not specifically used on the site. The only methods of the petroleum exploration process which require consideration are the storage and off-site consignment of aqueous radioactive

waste to a treatment/disposal facility, and the potential generation of solid radioactive waste through contamination of equipment/PPE which will require treatment/disposal.

Given the relatively low concentrations of NORM anticipated, operations are not expected to give rise to any significant contamination issues.

7.1 Produced Water

The anticipated waste water is a mixture of produced waters which will be released from the target formations during flow testing and flow-back water associated with the Carboniferous Sands conventional hydraulic fracture stimulation.

Based on the New Location Preliminary Planned Completion Summary for Ballinlea 2 wellsite, an approximate total volume (incorporating headroom of 100 %) of 275 m3 of waste water has been estimated.

The total estimated annual volume of waste produced waters is considered to be a conservative (over-estimate) of the volume likely to be produced from the site.

Produced water accumulated on site will be stored in four 60 m3 steel cylindrical storage tanks, affording a maximum accumulating waste storage capacity of 240 m^3. In the highly unlikely event that the maximum storage capacity is approached, then the well shall be shut-in until the accumulating waste produced water can be taken off-site for disposal creating further storage capacity.

The elevated concentrations of NORM present within the produced waters relate predominantly to radioisotopes of radium (and associated progeny), which find their way into the water due to their chemical solubility. Elevated concentrations of radium-226 and radium-228 progeny may also be present due to dissolved Rn-222 (radon) and, to a lesser extent, Rn-220 (thoron) gas.

Based on the maximum reported uranium and thorium concentrations within the formation in question, and based on knowledge of radium dissolution within other formations (and assuming a similar extent of dissolution within the target formation at the well site in question), it has been estimated (worst-case) that the produced waters could contain Ra-226 at a maximum specific activity concentration of 140 Bq/l. Based on the maximum estimated volume of 275 m3, this equates to approximately 39 MBq of Ra-226. It has been estimated (worst-case) that the produced waters could contain Ra-228 at a maximum specific activity concentration of 14 Bq/l. Based on the maximum estimated volume of 275 m3, this equates to approximately 3.9 MBq of Ra-228.

Produced waters may contain significant quantities of dissolved solids and also relatively small volumes of suspended solids. The waste will be contained at all times in steel, bunded storage tanks on site, and be sent offsite for treatment at a permitted licenced waste treatment facility.

7.2 Miscellaneous Solid Waste

Given the potential for scale to accumulate in pipework (with insoluble radium carbonate and sulphate scales), and/or the contamination of phase separator equipment/material, allowance has

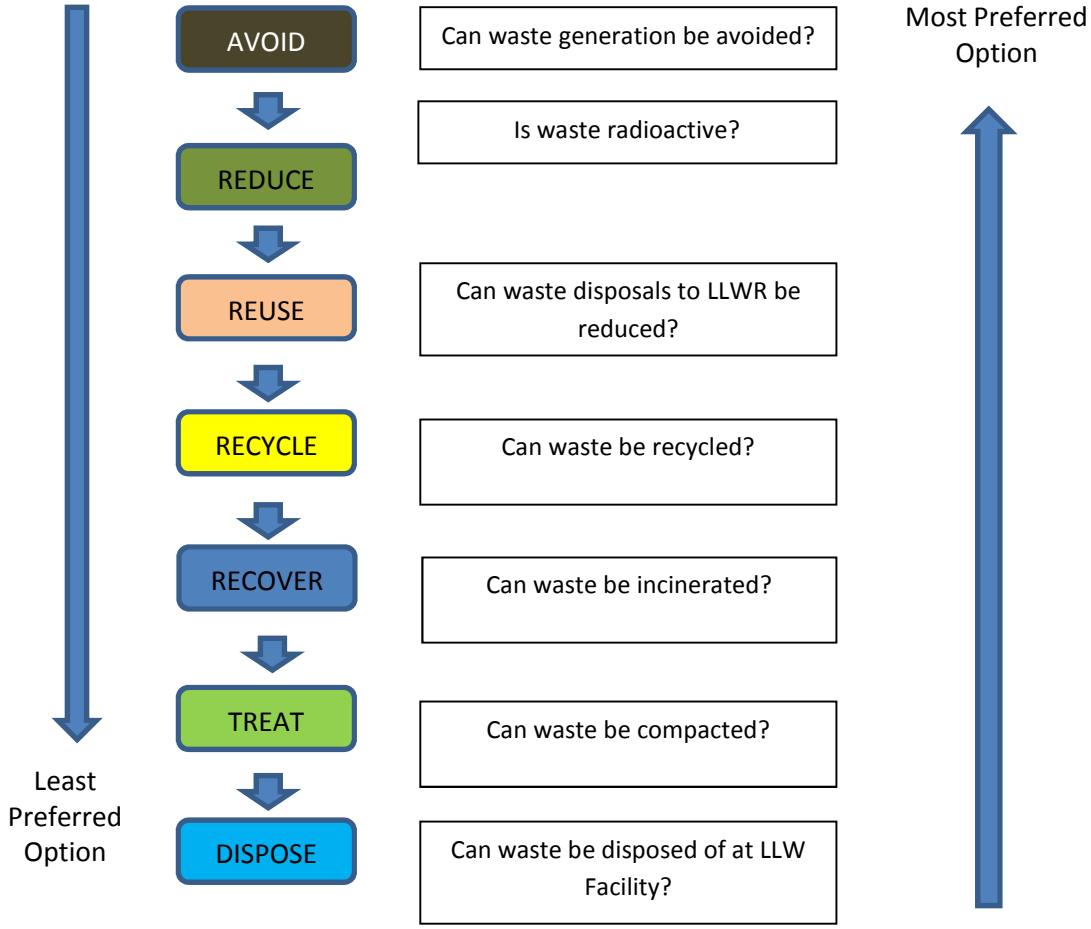
also been made for the generation of a relatively small quantity of solid radioactive waste. Accumulation and disposal of a nominal 10 MBq each of Ra-226, Pb-210, and Po-210, and 4 MBq each of Ra-228 and Th-228 has been requested within the permit application.

8. WASTE MANAGEMENT OPTIONS ASSESSMENT

The UK Low Level Waste Policy requires the application of the waste hierarchy to the management of Low Level Waste (LLW). The waste hierarchy (Figure 1) describes an ordering of preferences for the management of waste:

- Not create waste where practicable
- To reduce waste arisings
- To minimise the quantity of waste requiring final disposal; through application of the remaining options of the waste hierarchy (e.g. recycle, recover)

Figure 1 The Waste Hierarchy



Disposal of waste is always considered the least preferred option. If disposal of waste is the preferred option then it should always be justified through the application of BPM/BPEO.

Options for each waste stream have been identified and assessed, the aim being to identify a waste route that can be considered BPM/BPEO.

9. OPTIONS ASSESSMENT

Given that the potential waste arisings are simply the bi-product of a NORM industrial activity, there is no scope for the prevention of waste generation or for the reduction of waste arisings. This Management of Radioactive Waste document, therefore, simply relates to the disposal of the waste generated and the measures that are to be adopted to ensure that the environmental impact of potential contamination is minimised as low as reasonably practicable.

9.1 Waste Route Selection for Aqueous Waste

9.1.1 Direct Discharge from Site into a Watercourse

There is no plan for the direct discharge from site into a watercourse during exploratory operations. The environmental impact of discharging direct to a water course is likely (assuming a watercourse with a relatively low flow-rate) to be relatively significant and is not considered as a viable option.

At present there is no commercially available treatment technology to treat relatively low volumes of aqueous waste and any necessary on-site pre-treatment prior to discharge is not considered as being economically viable.

9.1.2 Direct Discharge from Site into the Public Sewer

The direct discharge from site to a public sewer is not considered to be a viable option. There is no sewer connection at the proposed site and the installation of such is not considered as being economically viable given the relatively low volume of waste anticipated.

9.1.3 Transfer to Waste Water Treatment Facility

Transfer of aqueous waste to a waste water treatment facility has proven difficult for the industry within the UK. If this route were made available, the associated environmental impact is not expected to be significant, being principally associated with the transfer of waste.

9.1.4 Transfer to a Bespoke Radioactive Substances Regulated Waste Treatment Facility

The offsite treatment of aqueous waste is the preferred option in the waste hierarchy and is clearly the preferred option for the Ballinlea 2 wellsite operation. Treatment of the aqueous waste at either a RSA Authorisation-holding facility in Northern Ireland, or an EPR10-permitted facility in England or Wales should minimise any environmental impact associated with the waste. If this route were made available, the associated environmental impact is not expected to be significant, being principally associated with the transfer of waste.

9.1.5 Transfer to Incinerator

The potential volume of waste generated is expected to be low and the transfer of the aqueous waste to an incinerator facility is considered a viable option. This will be dependent on the concentrations of non-radiological contaminants within the waste. If this route were made available, the associated environmental impact is not expected to be significant, being principally associated with the transfer of waste.

9.2 Waste Route Selection for Solid Waste

It is not anticipated that solid waste will be generated during the exploratory phase of operations. However, if solid waste is generated the following options would be considered dependent on the specific radioactive concentration of the waste.

9.2.1 Disposal to Landfill Disposal Facility

Type 1 NORM waste (Type 1 NORM waste is classed as a concentration of ≤5 Bq/g), has the potential to be disposed of to a licenced landfill disposal facility. This will be subject to consideration of the potential for non-radiological contaminants within the solid waste.

9.2.2 Disposal to Low Level Waste Disposal Facility

If the solid waste has a total activity concentration of ≤200 Bq/g it could be classified as 'low activity low level waste' and could be disposed of to an appropriately licenced waste disposal facility if this route were made available. This will be subject to the consideration of potential non-radiological contaminants within the solid waste.

9.2.3 Transfer to Treatment Facility

Where it is possible to separate radiological contamination from equipment (for example by high-pressure water-jetting) and the process is economically viable, consideration to transport the solid waste to a licenced waste treatment facility would be the preferred option within the waste hierarchy.

It is considered that the generation of solid waste will only likely occur after daily production for several years, and in any event, when the equipment reaches end-of-life and becomes waste.

As generation of solid waste is not anticipated at the Ballinlea 2 wellsite, the raising of a Letter of Agreement in Principle (LAIP) related to treatment of scale-contaminated equipment has not been sought. In the event that solid waste was generated, Rathlin Energy would notify the Northern Ireland Environment Agency (NIEA) and submit a suitable LAIP. This would allow for the transfer of solid waste to a licenced facility offering NORM decontamination services.

9.3 Summary & BPM/BPEO Justification

9.3.1 Aqueous Waste

Incineration is considered a BPM/BPEO, however this route is simply a disposal, and does not involve treatment of the waste. Disposal is the least preferred option within the waste hierarchy and the transfer of aqueous waste to a licenced waste treatment facility is identified as the preferred option. The transfer to a licenced waste treatment facility, involving pre-treatment prior to any disposal would immobilise the NORM in to a solid filter cake that would be suitable for disposal to a licenced landfill disposal facility. This option would ensure that any potential environmental impacts are minimised. This option therefore also aligns with the concept of the waste hierarchy.

9.3.2 Solid waste

The generation of solid waste is not anticipated during the exploratory operations at the Ballinlea 2 wellsite. If solid waste was generated, treatment and disposal options would be considered in detail (following waste characterisation) and transferred to a licenced waste disposal facility (if considered to be non-exempt Low-level Waste), or to a licenced landfill facility (if considered as being either Out-of-Scope of the requirements of the Radioactive Substances Act 1993, or as conditionally-exempt Type 1 NORM waste).

10. ENVIRONMENTAL IMPACT ASSESSMENTS

The direct discharge of aqueous waste to a watercourse or public sewer is not proposed within this statement. To demonstrate that the potential transfer of aqueous waste to a waste treatment facility is indeed a BPM/BPEO, confirmation of the potential radiological environmental impacts are presented below.

Treatment sites permitted to receive NORM potentially utilise an acid/alkali treatment process to treat the waste waters, and produce an inert, non-hazardous solid filter-cake residue. The process removes approximately 90 and 42 % of the radium and lead, respectively. The phase conversion results in the production of solid material which is estimated to contain NORM at activity concentrations which render the material Out-of-Scope of the requirements of the Radioactive Substances Act 1993. Based on the anticipated volumes and activity concentrations of the resultant aqueous waste produced by the treatment process, the radiological impact of the discharges from the treatment site are expected to be negligible.

10.1 Summary

It is therefore considered that the consignment and consequent disposal of NORM waste to a licenced waste treatment facility where the majority of the NORM is removed within a solid filter-cake residue (suitable for landfilling) is considered the best practicable environmental option.

11 GENERAL WASTE MANAGEMENT CONSIDERATIONS

11.1 Minimisation of Accumulating Waste Activities and Volumes

The volume of waste accumulated on site is dictated by the rate at which aqueous material is transported to the surface. This also identifies the rate at which items of equipment may become contaminated if at all.

The removal offsite of aqueous waste to a licenced waste treatment facility will occur as soon as is reasonably practicable. The removal of aqueous waste will be conducted by a licenced haulier in road haulage tankers.

As soon as practicable, after identification and characterisation, arrangements will be made for the transfer of low level waste to a suitable licenced waste treatment or disposal facility. Waste classified as Out-of-Scope or which is considered to be conditionally-exempt Type 1 NORM waste would be transferred to a licenced landfill facility or considered for recycling or reuse as appropriate.

11.2 Contamination Monitoring

Prior to commencement of works on the site, a number of baseline samples will be taken. The baseline samples will determine background concentrations of radionuclides in the local area.

A background contamination survey will also be performed (using a suitable alpha/beta contamination monitor) and a contamination monitoring programme will be devised, to ensure that any significant (albeit improbable) environmental contamination is promptly identified. This will include alpha/beta contamination monitoring of key areas/surfaces, including:

- Well-head (and immediately surrounding site surface)
- Separator equipment (external surfaces, and any internal surfaces opened for maintenance/access (and immediately surrounding site surface))
- Storage tanks (internal surfaces where practicable, external valves and immediately surrounding site surface)

All consignments of produced water will be screened externally for contamination prior to leaving site. At close of works, all potentially-contaminated equipment will be screened prior to leaving site.

Monitoring shall be conducted in accordance with the Rathlin Energy Radiological Management Standard and the frequency, actions and responsibilities associated with monitoring shall be documented.

The Rathlin Energy Radiological Management Standard will ensure compliance with the Authorisation conditions.

11.3 Storage Arrangements

All aqueous waste will be stored in steel tanks. The site will be constructed with an impermeable membrane underlying the site surface and containment ditches around the perimeter of the site to ensure that the probability of environmental contamination is minimised.

Solid waste would be stored within a secure container, or within a secure lay-down area, as appropriate. Pipework/components would be capped to prevent release of contamination when not in use.

The site will be secured by perimeter fencing and site security will be provided on a 24 hour basis.

11.4 Waste Characterisation

Waste characterisation will involve representative sampling of wastes generated and radiochemical analysis of the samples will be conducted by a United Kingdom Accreditation Service (UKAS) accredited laboratory.

Sampling of produced water will be conducted by a competent person at surface from a valve situated after the separator. Analysis of the sample will include the determinants listed in the OSPAR-related Revised Reporting Procedures for Discharges of Radioactive Substances from Non-nuclear Sectors Ref. 2005-7 2009 update (i.e. Ra-226, Ra-228 and Pb-210). Analysis for Po-210 will also be undertaken. Sampling procedures, equipment and competent personnel will be identified and detailed within the Rathlin Energy Radiological Management Standard Document.

An initial screening (prior to consignment) of the produced water will be unable to accurately determine the specific activities within the sample due to the relatively low-level concentrations of radionuclides within the produced water. Reliance, therefore, will be necessary on the results from the analysis of the samples undertaken at the UKAS accredited laboratory

However, a qualitative check of sampled water will be performed as aqueous waste accumulates to confirm the absence of any unexpected (albeit unlikely) gross contamination. It will be assumed, until proven otherwise by quantitative laboratory analysis, that the water contains Ra-226 and Ra-228 at approximately 140 Bq/l and 14 Bq/l respectively.

All consignments of produced water for offsite disposal will undertake a qualitative check to confirm the absence of any gross contamination prior transportation.

Sampling and analysis of solid waste will be considered further should any such material be identified during the proposed, routine contamination monitoring. Analyses will include the determinants listed above.

11.5 Suitable Qualified and Experienced Personnel (SQEP) & Training

Rathlin Energy will appoint a suitable, qualified, experienced and appropriately trained, Radiation Protection Supervisor (RPS) who will be responsible for ensuring compliance with the conditions of the site Authorisation. Support will be provided by a formally appointed Radiation Protection Adviser (RPA) and Radioactive Waste Adviser (RWA). All site operatives with direct responsibilities associated with radioactive waste will also receive training, as appropriate prior to operations commencing.

11.6 Maintenance and Audit of Facilities

A routine maintenance and audit program will be implemented prior to commencement of operations. The program will ensure quality control in the function and application of the facilities. A baseline Radiological Site Condition Report (RSCR) will be produced prior to commencement of operations, and will include details of background concentrations of NORM at the site location (involving a combination of sampling and laboratory analyses and contamination monitoring).

The RSCR can subsequently be used to confirm the absence of any radiologically-significant contamination at the time of any Authorisation revocation. During site operations, routine contamination monitoring of items/equipment will be performed wherever a possibility of contamination exists or in the unlikely event of a spill. Site-specific maintenance and audit procedures during well testing shall be available on site.

11.7 Management of Radiation Work

The management arrangements for radioactive work will be documented within the Rathlin Energy Radiological Management Standard document and support this Management of Radioactive Waste document, which incorporates a BPM/BPEO Statement.

Prior to operations commencing, Rathlin Energy will formally appoint a Radiation Protection Adviser (RPA) and Radioactive Waste Adviser (RWA).

11.8 Working Arrangements

Prior to the start of works, a radiological risk assessment and Local Rules document (as required by the Ionising Radiations Regulations 2000 (NI) (IRR2000), detailing the safe management of the material on site, including contingency plans, will be prepared by the RPA.

12. CONCLUSIONS

This Management of Radioactive Waste document details the results of a BPM/BPEO assessment for two specific waste streams. The BPEO for the aqueous waste stream has been identified and justified, being the off-site transfer of waste to a suitable waste treatment facility at which liquid waste will effectively be converted to Out-of-Scope solid material as defined within the Radioactive Substances Act 1993. The on-site generation of solid waste is considered unlikely during the proposed exploratory operations. A monitoring regime will be in place to ensure that the potential for the generation of solid waste is continually assessed.

For the levels of radioactivity to be encountered, current procedures and facilities are considered adequate.

Given the timescales associated with proposed works, a review date for this Management of Radioactive Waste document and BPM/BPEO statement is not considered necessary, however, this

will be re-assessed should there be significant delays or fundamental alterations to the scope of works.

13. REFERENCES

The Radioactive Substances Act 1993.

Justification of Practices Involving Ionising Radiation Regulations 2004 (SI: 1769).

Council Directive 96/29/Euratom, Official Journal of the European Communities L159/1 (1996).

Policy for the Long Term Management of Solid Low Level Radioactive Waste in the United Kingdom (2007).

The Ionising Radiations Regulations 2000 (Northern Ireland)

The Radioactive Substances Act 1993 (Amendment) Regulations (Northern Ireland) 2011