



Weaverthorpe Wellsite

Waste Gas Management Plan

Environmental Permitting (England and Wales) Regulations 2016

- **Application for a Bespoke Mining Waste Operation with Flare**
- **Application for a Bespoke Installation**

ISSUE No.	Description
250527	Draft for Client Review
250814	Initial issue for an application for a Mining Waste Operation with Flare >10 Tonnes per day
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1. PURPOSE AND CONTEXT

This Waste Gas Management Plan forms part of an application to the Environment Agency to authorise the undertaking of specific 'permitted activities' at the proposed Weaverthorpe Wellsite (herein referred to as the 'Wellsite'). With regards to onshore oil and gas operations, an activity that produces extractive waste is classified as a 'mining waste operation'.

A 'mining waste operation' is considered a 'regulated facility' under The Environmental Permitting (England and Wales) Regulations 2016, as amended [\[Ref.1\]](#) (EPR2016). Throughout the life of the Wellsite, this Waste Gas Management Plan shall be considered a live 'operating technique' and must be complied with as it forms part of the environmental permit.

This Waste Gas Management Plan has been produced in accordance with EPR2016, which has been transposed, in part, from the Mining Waste Directive [\[Ref.2\]](#) (MWD), the Environment Agency Report: SC170013/R [\[Ref.3\]](#) and follows the principles of the Waste Framework Directive's (WFD) [\[Ref.4\]](#) waste hierarchy.

The purpose of this Waste Gas Management Plan is to demonstrate to the Environment Agency how Egdon Resources U.K. Limited (herein referred to as the 'Operator') established Best Available Technique (BAT) for the management of waste gas associated with the short term well testing phase of operations, whilst also providing an explanation into how the BAT assessment was undertaken.

The Operator is proposing to construct a wellsite ~850m to the east of the village of Foxholes located within the administrative boundary of North Yorkshire Council and within Foxholes with Butterwick parish. The boundary with the East Riding of Yorkshire lies approximately 350m to the east.

The Wellsite is located ~2 Km to the west of Wold Newton, ~15 Km south of Scarborough and ~16 Km northwest of Bridlington.

The Wellsite will be constructed to accommodate the drilling of an exploratory borehole to evaluate the potential for natural gas accumulations within the Sherwood Sandstone target formation.

An application to the Environment Agency is being proposed under EPR2016 to apply for a 'Mining Waste Operation with Flare', as defined by reference 1.8.6 of the Environment Agency (Environmental Permitting and Abstraction Licensing) (England) Charging Scheme [\[Ref.5\]](#).

For clarity, domestic legislation derived from European Union legislation such as the MWD and the WFD continues to have an effect in domestic law following the UK's withdrawal from the European Union in accordance with the European Union (Withdrawal) Act 2018 [\[Ref.6\]](#). The MWD and WFD are therefore still applicable to this Waste Gas Management Plan and activities performed by the 'Operator'.

All figures included in this document, for example volumes, tonnages, formation depth represent best estimates at the time of document production, and may change, as operations develop.

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2. SCOPE

This Waste Gas Management Plan is applicable to the Weaverthorpe Wellsite and all operations conducted therein. It is applicable to the 'Operator', its contractors and subcontractors and may be used in support of an application to the Environment Agency for an environmental permit under EPR2016.

This Waste Gas Management Plan is applicable to the short term well testing phase of operations at the Wellsite and is specific to the potential for associated (waste) gas produced from the Weaverthorpe-1 Well.

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3. ABBREVIATIONS AND DEFINITIONS

%:	Percentage
~:	Approximately
ALARP:	As Low as Reasonably Practicable
AOD:	Above Ordnance Datum
AQIA:	Air Quality Impact Assessment
BAT:	Best Available Technique
CH₄:	Methane
CNG:	Compressed Natural Gas
CO₂:	Carbon Dioxide
CQAP:	Construction Quality Assurance Plan
EPR2016:	The Environmental Permitting (England and Wales) Regulations 2016
Extractive Waste:	Has the meaning given within Regulation 2 of EPR2016
EWC:	European Waste Catalogue
Groundwater Activity:	Has the meaning given within Regulation 2 of EPR2016
ha:	Hectare
Km:	Kilometre
kPa:	Kilopascal
m:	Metre
Mining Waste Operation:	Has the meaning given within Regulation 2 of EPR2016
MMscf:	Million Standard Cubic Feet
MMscfd:	Million Standard Cubic Feet per Day
MWD:	Mining Waste Directive
NGL:	Natural Gas Liquids
NGR:	National Grid Reference
NPPF:	National Planning Policy Framework
NSTA:	North Sea Transition Authority
NTS:	National Transmission System
Operating Technique:	Documents approved by the regulator to ensure compliance with the issued permit.
Operator:	Has the meaning given within Regulation 7 of EPR2016
Permitted Activities:	Any activity or operation defined within Schedule 1 to 29 of EPR2016

PSE:	Point Source Emission
PVT:	Pressure, Volume, Temperature
Regulated Facility:	Has the meaning given within Regulation 8 of EPR2016
UK:	United Kingdom
Water Discharge Activity:	Has the meaning given within Regulation 2 of EPR2016
WCU:	Well Clean Up
WFD:	Waste Framework Directive
WR11:	Environment Agency's form for 'Notice of the intention to drill for minerals'

Table 1: Abbreviations and Definitions

4. REGULATED FACILITY

The 'regulated facility' is located in the countryside in the county of North Yorkshire. It is centred on National Grid Reference (NGR) TA 02308 73142 and is located at the following address.

Weaverthorpe Wellsite
Land North of Butt Lane
Foxholes
North Yorkshire
YO25 3HY



Figure 1: Weaverthorpe Wellsite – Current (Source: Google Earth 17/12/2024)

4.1 Site Location Plan and Site Layout Plan

A number of site plans have been provided within the Site Plans document (04 – Site Plans) and detail the extent of the Wellsite, including its location, site layouts and point source emissions.

A copy of the following plans are provided within the Site Plans document (04 – Site Plans).

- 04A - ZG-ER-WRP1-FH-EPR-04-01 Location Plan 2500 Scale A2
- 04B - ZG-ER-WRP1-FH-EPR-04-02 Location Plan 10000 Scale A3
- 04C - ZG-ER-WRP1-FH-EPR-04-03 Indicative Site Layout Plan - Construction Phase 500 Scale A2
- 04D - ZG-ER-WRP1-FH-EPR-04-04 Indicative Site Layout Plan - Drilling Phase 500 Scale A3
- 04E - ZG-ER-WRP1-FH-EPR-04-05 Indicative Site Layout Plan - Well Testing Phase 500 Scale A3
- 04F - ZG-ER-WRP1-FH-EPR-04-06 Indicative Site Layout Plan - Retention Phase 500 Scale A2
- 04G - ZG-ER-WRP1-FH-EPR-04-07 Indicative Site Layout Plan - Well Abandonment Phase 500 Scale A3
- 04H - ZG-ER-WRP1-FH-EPR-04-08 Indicative Section Plan - Covered Ditch Construction 25 Scale A3

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5. ENVIRONMENTAL PERMITTING (ENGLAND AND WALES) REGULATIONS 2016

5.1 Permitted Activities

The Wellsite has yet to be constructed and does not currently hold an environmental permit. Current Operational Status (Pre-Application)

The Wellsite is located on agricultural land to the north of Butt Lane, near Foxholes, and is currently used for growing a potato crop.

The Wellsite is located ~850m to the east of the village of Foxholes, ~2 Km to the west of Wold Newton, ~15 Km south of Scarborough and ~16 Km northwest of Bridlington and covers an area of approximately 1.3 ha including the access track.

The Wellsite is located within the administrative boundary of North Yorkshire Council and within Foxholes with Butterwick parish.

The closest residential receptors are:

- West Field House – 570m; and
- Foxholes – 870m.

The proposal is to construct a temporary Wellsite within an enclosed and secure compound to drill an exploratory borehole. Should natural gas be encountered as predicated, the drilling rig will be demobilised from the Wellsite and the intention is then to undertake a short term well test. If natural gas is not encountered during the drilling phase, the exploratory borehole will be decommissioned (abandoned) in accordance with industry guidance, the drilling rig and associated equipment then removed and the Wellsite restored to its former condition.

5.2 Proposed Development

The Operator is proposing to undertake four (4) phases of development as illustrated within Table 2.

Phase	Description	Approximate Timescale
Phase 1	Construction of Site Access and the Wellsite - Access track civils from Butt Lane; construct access track along field boundary - Install groundwater monitoring boreholes - Earthworks on well pad; install fencing and gates - Create perimeter containment system - Install liner/tertiary containment - Construct well cellar - Install temporary matting as usable surface platform	5 weeks
Phase 2	Drilling of the Weaverthorpe-1 Well. - Set conductor - Mobilise rig and services - Drill Weaverthorpe-1 well - Log well to evaluate reservoir - Rig down equipment and release drilling rig	8 weeks

Phase	Description	Approximate Timescale
Phase 3	Testing – Dependent on the outcome of Phase 2 a) Mobilise test spread b) 5–7 days operational well test (short term well test), with shut-in periods to gather downhole data c) Gas management via approved ground flare system d) Suspend well to evaluate results e) Remove equipment and facilities	4 weeks
Phase 4a	Site Suspension a) Success case (proven gas from test evaluation): with well suspended, reduce site area size, remove temporary matting, install aggregate to create smaller working platform b) Install a surface water interceptor to manage clean surface water run-off	4 weeks
Phase 4b	Site Restoration a) Failure case (no gas encountered during drilling, or insufficient gas following test evaluation): plug wellbore with cement plugs to surface, cut conductor below ground level and remove well cellar, remove matting and liner, backfill perimeter ditches and restore site to agricultural land	6 weeks

Table 2: Phases of Development

Phase 1 – Wellsite Construction

Construction of the Wellsite will be undertaken during Phase 1 and will include the construction of an access and working site area with a well cellar, perimeter containment ditch and tertiary containment system.

The perimeter containment ditch system will be installed to facilitate easy reduction in site area in the testing success case. The design and installation of the well cellar, together with the design of the tertiary containment system will be subject to review and verification by the Environment Agency, and installed under a Construction Quality Assurance Plan (CQA).

Groundwater monitoring boreholes will be installed during the site construction phase.

The tertiary containment system and perimeter containment ditch ensures that any accidental spillages that may occur during the subsequent phases of operation are contained within the Wellsite.

Security fencing will be installed.

Phase 2 – Drilling Operation

The second phase of the development will include the drilling of an exploratory borehole (Weaverthorpe-1 Well). Following mobilisation of the drilling rig to site, the Weaverthorpe-1 Well will be drilled including a c400m deviated section in a north-westerly direction.

If drilling results are positive then the Weaverthorpe-1 Well will be cased and completed for testing as set out in Phase 4a. If not, then operations will move to abandonment and restoration as detailed in Phase 4b.

Phase 3 – Short Term Well Test

The third phase of the development will include a short term well test of the Weaverthorpe-1 Well. Following demobilisation of the drilling rig, a well test spread will be mobilised to site and will include a Shrouded Ground Flare, a 3-phase separator, waste storage tanks, a slick line unit and a coiled tubing unit.

The test will follow a standard short-term well test permitted under the well test regulations provided by the North Sea Transition Authority (NSTA). This will limit flare activity to a maximum of 96 hours over the full test period. Following the testing period, the Weaverthorpe-1 Well will be suspended to evaluate the results.

Phase 4a – Site Suspension

In a success case, the Weaverthorpe-1 Well will remain suspended and the well head and well cellar left in place, whilst regulatory approvals for production are progressed, developed and submitted.

The temporary matting will be removed, and the site working platform reduced; aggregate will be brought in to facilitate this. A surface water interceptor will be installed during this phase to manage clean surface waters.

The Wellsite will be maintained on a care and maintenance basis until such point as all regulatory approvals for production are progressed or if such approvals are not forthcoming then operations will move to abandonment and restoration as detailed in phase 4b.

Phase 4b – Site Restoration

In a failure case following testing (or failure to gain regulatory approvals as per phase 4a above) the well will be fully abandoned by setting cement plugs in the casing to surface, cutting the conductor below ground level and capping the casing with a welded plate. The well cellar will be removed, as will the perimeter/tertiary containment systems, groundwater borehole systems and the temporary matting (or aggregate). The groundwater monitoring boreholes will be decommissioned and the site will be restored to its original land condition and contours.

5.3 Non-Permitted Activities

Additional activities associated with the development, but not regulated under EPR2016 as a 'permitted activity' includes, but is not limited to:

- Car parking for staff vehicles;
- Provision of welfare facilities for site staff;
- Well and wellsite maintenance; and
- Storage and disposal of non-hazardous and hazardous wastes not directly associated with the permitted activities.

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6. ENVIRONMENTAL LEGISLATION AND APPLICABILITY

The proposed Wellsite has yet to be constructed and does not currently hold an environmental permit. No permitted activities are authorised under EPR2016.

6.1 Proposed Permitted Activities

The Wellsite will be the subject of several activities which, under current environmental legislation, requires an environmental permit. The Environment Agency regulate all permitted activities under the Environmental Permitting (England and Wales) Regulations 2016, as amended (EPR2016). Under EPR2016, Operators are required to submit environmental permit applications to the Environment Agency to seek approval to undertake such activities.

Onshore oil and gas developments are the subject of the environmental permitting regulations, and as such a number of environmental permits will be required to be obtained from the Environment Agency.

This Waste Gas Management Plan provides details on the proposed operations to be conducted at the Wellsite and provides an explanation as to which permitted activities will be required/applied for.

6.2 Environmental Permitting (England and Wales) Regulations 2016

The Environment Agency regulates all permitted activities under EPR2016 and require Operators to submit environmental permit applications to seek approval to undertake such activities. The Operator has assessed the activities associated with the proposed operations and considers certain activities to fall in scope of EPR2016 and therefore require the necessary environmental permits.

6.2.1 Industrial Emissions Activity

Schedule 1, Part 2 of EPR2016 details a number of activities that are classified as an Industrial Emissions Activity including 'Energy Activities' (Chapter 1) and 'Waste Management' (Chapter 5). Energy Activities include the storage of crude oil, whilst Waste Management includes the incineration of waste.

6.2.1.1 Incineration of Natural Gas

Schedule 1, Part 2 of EPR2016 transposes the requirements of the Industrial Emissions Directive, which requires an environmental permit to authorise an installation operation for the incineration and co-incineration of waste, as detailed within Section 5.1.

Part A(1)

- (a) The incineration of hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 10 tonnes per day.*

The proposed well testing phase of operations, which include a Well Clean Up (WCU) and Short Term Well Test, may involve the incineration of natural gas exceeding 10 tonnes per day and therefore an installation permit is being applied for.

6.2.1.2 Oil Storage

Schedule 1, Part 2, of EPR2016 transposes the requirements of the Industrial Emissions Directive, which requires an environmental permit to authorise an installation for gasification, liquefaction and refining activities, as detailed within Section 1.2, Part A(1) including the loading, unloading, handling or storage of, or the physical, chemical or thermal treatment of crude oil.

The proposed exploratory operations may involve the handling and storage and unloading of oil or condensate and therefore under EPR2016 a Standard Rules SR2015 No.2 Crude Oil Storage permit will be applied for.

6.2.2 Mining Waste Operation

Schedule 20 of EPR2016 defines a mining waste operation as being the management of extractive waste, whether or not it involves a waste facility. Under EPR2016, an environmental permit is required to authorise a mining waste operation.

In order to drill, test and undertake well treatments from the proposed Weaverthorpe-1 Well, it is necessary to apply for an environmental permit for a mining waste operation (which includes a flare).

The 'mining waste operation' will consider the extractive waste volumes and waste streams created as a result of both the drilling process and any subsequent testing and well treatment operations.

6.2.3 Groundwater Activity

Under Schedule 22 of EPR2016, an activity that could involve the discharge of pollutants into groundwater must be notified to the Environment Agency, together with the nature of these pollutants, under EPR2016. The Environment Agency will then determine whether the groundwater activity needs to be permitted.

During the life of the well, it may be necessary to undertake near wellbore treatments, including the use of liquid CO₂ which falls within the definition of a 'groundwater activity' under Schedule 22 of EPR2016.

Schedule 22 3 (3) of EPR2016 provides that *'The regulator may determine that a discharge, or an activity that might lead to a discharge, is not a groundwater activity if the input of the pollutant...*

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

To assist the regulator in determining whether the proposed activities are/are not considered groundwater activities a description of the operations, together with a technical justification as to why the Operator believes these can be excluded under Schedule 22 paragraph 3 (3) of EPR2016, is included within the Waste Management Plan (05 - Waste Management Plan) provided in support of the environmental permit application.

6.2.4 Water Discharge Activity

Schedule 21 of EPR2016 relates to water discharge activities, including the discharge or entry to inland freshwaters, coastal waters or relevant territorial waters of any trade effluent.

For clarity, the Environment Agency has provided the following response with regards to surface water discharges in their pre-application response:

'Please note that with regards to the water discharge activity, providing that the water discharged from the site is only unpolluted rainwater and you are taking necessary measures to prevent pollution we would not regulate this as a Schedule 21 water discharge activity. We may put additional restrictions on discharge to the site during well workover or testing phases.'

The Operator is proposing to discharge only 'clean' surface run-off water from the Wellsite and therefore a surface water discharge permit will not be applied for.

The discharge of 'clean' surface run-off water from the Wellsite will be the subject of a Surface Water Management Plan (13 – Surface Water Management Plan) provided in support of the environmental permit application.

For clarity, the Operator is not proposing to discharge surface run-off water during Phase 2 and Phase 3 operations. Surface run-off water collected within the perimeter ditch during Phase 2 (drilling operations) and Phase 3 (short term well test) will be transferred off site by an Environment Agency licenced waste contractor to an Environment Agency licensed waste treatment facility.

In the event that the Weaverthorpe-1 Well is a success case, 'clean' surface run-off water will be discharged to surface through a Class 1 Interceptor which will be installed following a successful short term well test phase of operations.

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

Under Section 199 of the Water Resources Act 1991 [\[Ref.7\]](#) (as amended by the Water Act 2003 [\[Ref.8\]](#)), a notice of the intention to construct or extend a boring for the purpose of searching for or extracting minerals must be submitted to the Environment Agency using form WR11.

The WR11 requires that a method statement, including drilling and casing designs, together with storage and use of chemicals and drilling muds, accompanies the WR11 application form.

The Weaverthorpe-1 Well will be the subject of an individual WR11 application.

7. ESTABLISHING BEST AVAILABLE TECHNIQUE FOR WASTE GAS MANAGEMENT

BAT is defined within the Industrial Emissions Directive [\[Ref.9\]](#) as:

‘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;*

7.1 Proposed Operations and Identification of Waste Gas Streams

Upon completion of the drilling phase, the Weaverthorpe-1 Well will be the subject of well testing phase operation. The well testing phase will include a Well Clean Up (WCU) and a short term well test.

The purpose of the WCU is to get the reservoir fluids to surface and flowing at a consistent rate for testing.

The purpose of the short term well test is to evaluate the commercial viability of the hydrocarbon reservoir, if encountered. During the short term well test, hydrocarbons will be produced.

During the WCU and the short term well test, there is the potential for natural gas and wellbore fluids to be produced. Once at surface, natural gas and any produced fluids will be diverted by temporary pipework to a three-phase separator, which will separate out condensate, formation water and natural gas.

Condensate, which for clarity is not a waste, will be diverted via temporary pipework to dedicated storage tanks onsite for subsequent offsite removal by a licenced haulier to a permitted refinery for sale.

Formation water, which is considered a waste, will be diverted via temporary pipework to dedicated storage tanks onsite for subsequent offsite removal 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 separated during the three-phase separation will be managed in accordance with BAT as identified within this Waste Gas Management Plan.

For clarity, it is anticipated that wellbore fluids from the Weaverthorpe-1 Well will be dry natural gas and therefore the potential for crude oil, condensate and formation water is limited.

Disposal of produced natural gas by incineration will employ a PW Well Services shrouded ground flare with a maximum disposal capacity of 2.5 MMscfd.

This equates to a test disposal volume of 10.0 MMscf over the 96 hour short term well test.

In order to establish BAT, it is necessary to identify every point source of natural gas as a waste stream throughout the operation phase. In addition, the quantity of natural gas from each point source also needs to be understood, as this will be a factor in selecting BAT. A review of the proposed operations has confirmed each natural gas point source and referenced them as point source emissions (PSEs) within Table 3.

A Site Plan detailing the Point Source Emissions (04E - ZG-ER-WRP1-FH-EPR-04-05 Indicative Site Layout Plan - Well Testing Phase 500 Scale A3) within the wellsite can be found within the Site Plans document (04 – Site Plans) provided in support of the environmental permit application.

Activity	Unit	PSE	EWC	Quantity	
				MMSCF	Tonnes ¹
Well Clean Up (WCU)	As Determined by BAT	PSE-01	16 05 04*	10	161
Short Term Well Test	As Determined by BAT				
Condensate Storage & Transfer	Storage Tank(s)	PSE-02	-	Residual Volumes	
Produced Water Tank	Storage Tank(s)	PSE-03	-	Residual Volumes	

Table 3: Identification of Waste Gas Streams

The Operator's Air Quality consultant has assessed the air quality impact from the proposed well testing phase of operations with the assessment based on the flare operating at its maximum disposal capacity, continuously for 96 hrs during the short term well testing phase of operations.

This clearly represents a worst case scenario in terms of natural gas disposal and pollutant release and subsequent air quality impact.

The Air Quality Impact Assessment (AQIA) concluded that:

At neighbouring locations of residential occupation, where long term human exposure might be expected, it is considered that pollutant process contributions from the proposed site operations are insignificant. In all cases the predicted environmental concentration of all pollutants is less than, and in some cases substantially less than, a third of the applicable standard. Bearing in mind the precautionary assumptions made in the assessment, it is considered unlikely that pollutant process contributions from the proposed exploratory operations at the Weaverthorpe wellsite will pose any risk to, or have any meaningful influence on, the continued attainment of air quality standards at the nearest locations of human exposure.

This Waste Gas Management Plan is concerned with establishing BAT for the management of waste gas associated with the Well Testing Phase of operations.

7.2 Initial Screening of BAT

The Environment Agency has identified a "long list of technologies" within report: SC170013/R, which has been summarised below:

- Cold venting
- Incineration (Flaring)
- Heat generation
- Power generation
- Reinjection to well
- Mini liquefied natural gas
- Vapour recovery
- Conversion to fuels
- Recycling through gas processing
- Gas processing and natural gas liquids recovery
- Compressed natural gas
- Energy storage

The long list was then screened against the definition of BAT within the report with a number of technologies not currently considered BAT at the time of writing this report.

For clarity, BAT as a concept will continue to change as technologies improve or become increasingly available for use within the onshore oil and gas industry. Full details of the "long list of technologies" from the Environment Agency Report can be found within 10A – Long List of Technologies.

Table 4 provides a list of technologies that have been identified with the potential of being considered BAT for the onshore oil and gas industry.

¹ Tonnes derived natural gas conversion conditions of 0.57 specific gravity, 273.15K & 101.325 kPa at 0°C

This Waste Gas Management Plan has been produced to assess the techniques considered 'best available' for the well testing phase of operations.

As the development progresses, the selected BAT may no longer be considered 'best available' due to either advancement in technologies or changes in the volume of waste gas produced.

To summarise, where a technology / technique has not been considered suitable for the onshore oil and gas industry this is due to one or more of the following reasons:

- The technology was not readily available for supply in England - due to economics or the lack of supplier base.
- The technology was considered unproven or novel.
- There was no widespread market for the product or resource produced.
- The working capacity or specification of the technology did not meet the onshore oil and gas sector requirements.

Techniques for BAT Assessment				
Option	Technology / Process	WCU	Short Term Well test	Reason for Considering / Not Considering
Cold Venting	Direct Release to atmosphere	×	✓	Worst environmental impact with Methane (CH ₄) being 28 times greater in global warming potential. Potential use during very short term low flow.
Incineration	Elevated Flares	✓	×	Produces a visible flame and excessive noise. May be suitable for sour gas or WCU given its ability to incinerate across a wide range of flow.
	Shrouded Flare	✓	✓	Considered to have a reduced combustion efficiency. Able to accommodate variable and unpredictable flow (associated gas).
	Enclosed Flare / Incinerator	✓	✓	Provides the best combustion efficiency and reduced noise and visible flame. Can only operate within a defined range of flow specifications.
Heat Generation (Harness Gas)	Incinerators / Boilers	×	×	No demand for heat, steam or hot water at site ordinarily, however some operators who produce oil will use bath heaters to heat wellbore fluids to ensure good separation. Natural gas may be used to fuel bath heaters but only if the gas volumes and composition allow.

Techniques for BAT Assessment				
Option	Technology / Process	WCU	Short Term Well test	Reason for Considering / Not Considering
Power Generation (Harness Gas)	Spark Engines	×	✓	Well understood technology and available to rent/buy in the UK. May need to be used in combination with a flare system. Gas may be used to fuel the generators but only after a significant understanding of gas rate and PVT has been established. Small scale spark engines are available.
	Gas Turbines	×	✓	Well understood technology and available to rent/buy in the UK. May need to be used in combination with a flare system. Gas can be used to fuel the turbine but only after a significant understanding of gas rate and PVT has been established. Gas volume may hinder their use.
	ORC (waste heat recovery)	×	✓	Not available to rent. Used in conjunction with gas turbine.
Mini Liquefied Natural Gas	Liquefaction of Natural Gas	×	×	Limited infrastructure and therefore not an economical proposal.
Conversion to Fuels	Natural Gas Liquid	×	×	Lack of equipment in the UK together with unproven technology.
	Hydrogen	×	×	Small scale hydrogen production is available but untested within the UK.
Recycling Through to Gas Processing	Recycling of Waste Gases	×	×	Subject to limitations, only after a significant understanding of gas PVT has been established.
	Pipeline Export	×	×	Only considered if pre-existing pipelines are present and available.
Compressed Natural Gas	Compression to CNG for collection or direct export.	×	×	Limited infrastructure and therefore not an economical proposal. Direct export only considered if pre-existing pipelines are present and available.
Gas Processing / Gas Liquids Recovery	Recovery of NGL from Natural Gas	×	×	Export of raw condensate to refinery considered a more practical option.

Techniques for BAT Assessment				
Option	Technology / Process	WCU	Short Term Well test	Reason for Considering / Not Considering
Vapour Recovery	Compression to CNG for collection or direct export.	×	×	Logistics and lack of equipment in the UK. So not considered available. Direct export only considered if pre-existing pipelines are present and available.
	Compression to CNG for export via a pipeline	×	×	Logistics and lack of equipment in the UK. So not considered available. Direct export only considered if pre-existing pipelines are present and available.
Energy Storage	Electricity - Battery Storage	×	×	Intermittent gas supply and supply unknown
	Thermal - Thermal Storage	×	×	Technology not yet available.

Table 4: BAT Options - Results of Initial BAT Screening

7.3 Short List of Technologies

The technologies which have been considered for a more detailed assessment to establish whether they can be considered BAT are outlined below within each subsection. For clarity, this information has been sourced from the Environment Agency Report: SC170013/R.

In short, the hierarchy for the management waste gas can be classified as follows:

- Harness natural gas for alternative use;
- Incineration of natural gas by flare; and
- Cold venting of natural gas directly to atmosphere.

For clarity, this section evaluates whether the short list of activities identified below can be considered for the management of associated (waste) gas with regards to the well testing phase of operations.

7.3.1 Harness Natural Gas for Alternative Use

The extent of the sub surface formation has not been appraised. Therefore, the assumptions on how to harness natural gas are multiple and will be refined as further appraisal data improves the understanding of natural gas production during the well testing phase of operations.

The preferred method for waste gas management is to harness the associated gas to produce energy i.e. electrical or heat potentially reducing the running cost of the site, or to pipe the gas or electricity away for consumer use. Following the initial screening process, a number of options have been assessed further for the harnessing of associated gas.

This has many benefits including reducing the running cost of the Wellsite and reduces the carbon intensity by displacing diesel powered generators.

Following the initial screening process, a number of options have been assessed further for the harnessing of associated gas.

7.3.1.1 Onsite Power Generation

It is anticipated during the well testing phase of operations that the natural gas will reach a steady state with regards to flowrates and pressures. During the initial part of the short term well test, it is unlikely that the harnessing of natural gas can be achieved. Representative samples of gas will need to be taken and analysed to determine the gas

composition. With this in mind the use of a temporary 'gas fuelled' generator could be considered part way through the short term well test, however by the time the relevant information has been obtained it is likely that the short term well test will have been completed and therefore no longer required. This would result in significant time and effort without any benefit.

It is not feasible at this stage to design or order appropriate generators due to having unknown/unreliable gas composition or PVT.

For clarity the WCU operations will not provide the necessary information to inform the selection or specification of a gas generator.

The harnessing of natural gas for the purpose of providing electricity for internal use only has not been considered further as part of the Well Testing Phase of operations.

7.3.1.2 Power Export (Gas to Wire)

For the reasons set out in Section 7.3.1.1, the harnessing of natural gas for the purpose of providing electricity for export has not been considered further as part of the Well Testing Phase of operations, not least due to the short duration of the Well Testing Phase of operations and the infrastructure required to achieve this.

7.3.1.3 Gas Export (Gas to Grid)

The volume of associated gas anticipated during the well testing phase of operations is expected to be below the volumes that would make commercial benefit for a grid entry and so unlikely to be feasible in the first instance.

A proposal to export natural gas is not considered possible as further assessment is required on the gas composition to demonstrate compliance with the Gas Safety (Management) Regulation 1996 [\[Ref. 10\]](#) and subsequent Safety Case for grid entry.

Additional plant may also be required to introduce Mercaptans to the gas so it becomes odorous and identifiable, depending on the receiving pipeline i.e. National Transmission System (NTS) or private. This would also create additional emission points.

Depending on the composition of the gas and its pressure, further treatment packages e.g., compressor, dehydration, dual monitoring skids, may also be required to ensure it meets the minimum standard of the NTS.

The harnessing of natural gas, specifically providing natural gas for export has not been considered further as part of the Well Testing Phase of operations.

7.3.1.4 Heat Generation

The wellsite may require the intermittent production of heat for very short periods for a well treatment known as hot water washing. There is no permanent requirement for a heat source and as such, heat generation is not considered feasible.

No further use for heat has been identified within the site internally or externally.

The harnessing of natural gas for the purpose of providing heat generation for either internal or export use has not been considered further as part of the Well Testing Phase of operations.

7.3.2 Incineration of Natural Gas

Hydrocarbon gases, such as Methane (CH_4) have a Global Warming Potential 28 times greater than Carbon Dioxide (CO_2), based on a 100-year time horizon, therefore, the incineration of unburnt hydrocarbons represents a decrease in the environmental impact over the venting of natural gas. In addition, the incineration of large volumes of hydrocarbons presents a decreased risk of fire and/or explosion.

7.3.2.1 Elevated Flare

Elevated pipe flares generally have a single burner flare tip, elevated some metres above ground to provide greater dispersion performance. The flare tip is not enclosed nor is it shrouded, resulting in a visible flame and no noise attenuation. Elevated flares are capable of incinerating natural gas with high methane content across a significantly variable range of flowrates and inlet pressures, such as those likely to be experienced during the initial phase of hydrocarbon exploration, such as WCU, where the gas composition, pressure and flow rates are unknown.

Whilst technically feasible, an elevated flare can be used for the short term well test, however their combustion efficiency and environmental impacts regarding noise and light have meant that their use within onshore oil and gas wells has diminished.

The Operator has identified alternative incineration units which generate a lesser environmental impact.

Although a lesser preferred option to that of harnessing waste gas, the incineration of natural gas by means of an elevated flare is not being considered further as part of the Well Testing Phase of operations due to its potential environmental impact.

7.3.2.2 Shrouded Flare

A shrouded flare, is essentially an open pipe flare, which is designed to incinerate natural gas with high Methane content across a significantly variable range of flowrates and inlet pressures, such as those likely to be experienced during the initial phase of hydrocarbon exploration such as WCU, where the gas composition, pressure and flow rates are unknown.

Whilst having a slightly lower combustion efficiency due to not having multiple burners, a shrouded flare provides confidence of natural gas combustion across the significantly variable range of flowrates and inlet pressures. Due to their simplicity of design, shrouded ground flares can be easily modified to aid combustion efficiency at low inlet pressures. This can be achieved by increasing the flow of support gas (propane). Historically, pre- August 2013, open pipe flares have been used extensively onshore UK without significant impact or concern.

As a shrouded flare can operate efficiently across a wide operating envelope it is also feasible that it can be used for a short term well test. The shroud placed around the flare tip aids in the reduction of the environmental impact, with respect to noise and visual impact. The size of the shroud is largely dictated by transportation restrictions onshore UK. As stated in National Planning Policy Framework (NPPF) [\[Ref. 11\]](#), minerals, which includes oil and gas, 'can only be worked where they are found', often resulting in wellsite's being located in areas with minimal and restrictive highway infrastructure.

Some shrouded flares have been analysed and assessed during operation to ensure that data on their efficiency is available. Should an enclosed flare be considered, the Operator will ensure that evidence of the shrouded flares efficiency (that is, above 98% combustion efficiency) is provided.

A shrouded flare unit is being considered for use as part of the Well Testing Phase of operations, largely due to its design to accommodate a wide variance of flowrates and ensure high combustion efficiency across the expected range.

7.3.2.3 Enclosed Flare

Enclosed units, such as those used in landfill, are designed with either a single or multiple burner, to incinerate natural gas with lower Methane (CH₄) contents, typically around 56% Methane (CH₄) and 31% Carbon Dioxide (CO₂). However, their environmental performance is based on consistent pressures and flow rates.

These burner tips are limited insofar as inlet pressure and flowrate capabilities and therefore can only be used for oilfield purposes when there is significant confidence that any associated natural gas pressures and/or flow rate is low.

Whichever unit is selected needs to have the capability to operate as a gas management technique and also as a safety device, where flow rates may be very high in the first instance, before being reduced and the well(s) closed in.

Although a lesser preferred option to that of harnessing waste gas, the incineration of natural gas by means of an enclosed flare is not being considered further as part of the Well Testing Phase of operations due to its limited ability to operate in a defined range of flow specification.

7.3.3 Cold Venting

Ordinarily, venting of natural gas is only considered in the event that low volumes of natural gas are anticipated and, evidence is available to support that the cost of installing a flare for this activity would be disproportionate to the environmental benefit and subject also to the health and safety risks of cold venting having been deemed as being as Low as Reasonably Practicable (ALARP).

When determining BAT for onshore oil and gas exploratory operations, the following points are considered with respect to cold venting:

- An increase in environmental impact;
- An increase of the risks associated with safety; and
- Minimal cost increase using a filtration unit, which in turn reduces both environmental impact and safety risks.

The cold venting of associated natural gas is not being considered further due to the volume of gas and the impact on both the environment and the associated safety concerns.

7.4 Initial Conclusion on Potential Techniques

Following an appraisal of each available technology, initial conclusions have been made as to the BAT for the proposed well testing phase of operations and is detailed within Table 6.

Option	Technology	Considered	Reason
Incineration	Elevated Flares	No	Whilst feasible for use during WCU and short term well test due to its ability to operate over a wide operating envelope and incinerate gas safely, the use of an open flare causes environmental impacts such as visual and noise impact.
	Shrouded Flare	Yes	A shrouded flare is suitable for use for both WCU and short term well test due to its ability to operate over a wide operating envelope and incinerate gas safely. It provides a reduced environmental impact in comparison to an elevated pipe flare. Combustion efficiency whilst expected to be above 98% can be more difficult to regulate than that of enclosed units. A shrouded flare can be considered for WCU due to its ability to incinerate gas at variable flow rates and pressures efficiently. A shrouded flare can be considered for the short term well test due to its ability to incinerate inconsistent flowrates efficiently.
	Enclosed Flare	No	Environmental performance is based on consistent pressures and flow rates. These flares are limited insofar as inlet pressure and flowrate capabilities, therefore, can only be used for oilfield purposes when there is significant confidence that any associated natural gas pressures and/or flow rate is known. Gas may result in being cold vented, if pressure and volumes are too low or too high.
Harness Gas	Heat Generation	No	There is no permanent requirement for a heat source.
	Onsite Power Generation	No	Not suitable for WCU or early stages of a short term well test due to unknown gas composition. Potential for use part way through the short term well test for gas once the gas composition and flowrate have been established. However, once the correct generator has been identified, supplied and installed the short term well test is likely to have been concluded.
	Export via Pipeline	No	The volume of associated gas anticipated during the well testing phase of operations is expected to be below the volumes that would make commercial benefit for a grid entry.

Option	Technology	Considered	Reason
Cold Venting	-	No	Potential for significant global warming emissions (Methane (CH ₄)). Environmentally beneficial to incinerate at the very least.

Table 5: BAT Options - Result of Short List

Following the initial screening process, the 'Operator' considers the disposal of natural gas via incineration (shrouded flare) to be necessary to, either in part or fully manage, the waste gas as a result of the well testing phase of operations

7.5 Quantitative BAT Assessment

7.5.1 Well Clean Up and Short Term Well Test

The Operator has considered that a shrouded flare is BAT and suitable for use for both the WCU and short term well test due to its ability to operate over a wide operating envelope and incinerate gas safely.

To this end a qualitative BAT assessment has not been undertaken, as the only safe option is to incinerate the gas whereby the fluctuation in flowrates and composition can be safely managed. It is acknowledged that this is perhaps not the most environmentally beneficial, however the safe undertaking of the well test is paramount.

7.6 BAT Conclusion

This Waste Gas Management Plan has been produced to demonstrate the process which has been undertaken to identify the Best Available Technique with regards to the management of waste gas generated during the WCU and short term well testing phase of operations.

Any subsequent production phases would be covered by a revised Waste Gas Management Plan once additional information (during the short term well test) has been obtained.

This Waste Gas Management Plan has been written in line with the Environment Agency Report: SC170013/R 'Waste gas management at onshore oil and gas sites: framework for technique selection'.

The Weaverthorpe-1 Well will be tested to ascertain whether commercial hydrocarbon rates can be achieved. The test will involve two (2) phases, a WCU and a short term well test. The quantities of associated natural gas cannot be confirmed; however, the proposal is expected not to exceed an aggregated volume of 10 MMscf.

The Environment Agency has identified a 'long list of technologies' within report: SC170013/R which provided the initial list of technologies that had the potential to be considered BAT. The long list was then screened against the definition of BAT and the proposed operation which resulted in a number of technologies being screened out and not being considered further.

For clarity, BAT as a concept will continue to change as technologies improve or become increasingly available for use within the onshore oil and gas industry.

Technologies which have passed through the initial screening process have been considered for a more detailed assessment to establish whether they can be considered BAT. The technologies which were the subject of further assessment were placed onto a short list. Each technology was then assessed for compatibility against the proposed exploration development. It was considered that the incineration of natural gas using a shrouded flare was considered BAT.

A cost benefit analysis was not undertaken as the only consideration was the incineration of natural gas using a shrouded flare.

Although the enclosed unit has a slightly greater combustion efficiency than that of the shrouded flare and neither option can generate revenue for the operator, it can therefore be considered that the environmental cost of the enclosed unit is cheaper than that of the shrouded unit on combustion efficiency alone, without considering rental cost. However, when assessing the feasibility of each option, the shrouded unit is expected to perform better than an enclosed unit due to being able to operate across a wider operating envelope.

The ability to operate across a wider operating envelope is a necessary requirement when we consider that the natural gas flowrates and volumes will vary throughout both the WCU and the short term well test.

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