IGas Energy Production Limited

Glentworth West Drilling and Testing Operation

Waste Gas Management Plan

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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 a proposed new wellsite, Glentworth West. 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 (EPR2016) [REF.1]. 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.

The objective of this Waste Gas Management Plan is to ensure that any waste gas that arises as part of the proposed operations is managed in such a way so as to reduce the quantities of gas emitted to air and minimise environmental impacts so far as available techniques allow. This document aims to demonstrate how IGas Energy Production Limited (herein referred to as the 'Operator') will apply the principles of Best Available Technique (BAT) selection with regards to waste gas management.

This Waste Gas Management Plan has been produced in accordance with the Environment Agency's BAT Report [REF.2] and other relevant statutory guidance documents. It has been produced for the purpose of informing the Environment Agency how BAT for the management of waste gas was established, whilst also providing an explanation into how the BAT assessment was undertaken.

The Waste Gas Management Plan has been produced in accordance with EPR2016 which has been transposed, in part, from the Industrial Emissions Directive (IED) [REF.3].

For clarity, domestic legislation derived from European Union legislation such as the IED 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.4].

2. SCOPE

This Waste Gas Management Plan is applicable to the Glentworth West 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 identifies the BAT for management of waste gas arising from both the initial well testing phase and the extended well testing phase.

3. ABBREVIATIONS AND DEFINITIONS

BAT:	Best Available Technique
CBA:	Cost Benefit Analysis
EPR2016:	The Environmental Permitting (England and Wales) Regulations 2016
IED:	Industrial Emissions Directive
Km:	Kilometre
Mining Waste Operation:	Has the meaning given within Regulation 2 of EPR2016
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
PVT:	Pressure Volume Temperature
Regulated Facility:	Has the meaning given within Regulation 8 of EPR2016
scfd:	Standard Cubic Feet per Day
SSSI:	Sites of Special Scientific Interest

Table 1: Abbreviations and Definitions

4. REGULATED FACILITY

The boundary of the 'regulated facility' (Glentworth West Wellsite) has been provided in Appendix 1. The Glentworth West Wellsite has an area of approximately three hectares and is centred on grid reference SK 92000 87900 and located at the following address:

Glentworth West Wellsite
Off Northlands Road
Glentworth
Gainsborough
DN21 5DN

Figure 1: Regulated Facility Boundary (Source: Google Earth 18/08/2022)

4.1 Environmental Setting

The site is visible from the Public Bridleway which runs adjacent to the site, the B1398 which is elevated above the site to the east and a cluster of dwellings on the south side of Glentworth.

The site is not within an area subject to ecological designations. There are no SSSIs within 2 km of the site or European designated habitats sites within 10 km of the site. Nor are there any heritage designations, and it is not in an area identified as being at risk of flooding.

The site is not within a groundwater source protection zone. There are no waterbodies within the site boundary. An extensive network of drains is present within the vicinity of the site which discharge into Upper Witham IDB approximately 1.5 km southeast of the site. The closest Main Rivers are the Fillingham Beck (tributary of River Till) 4 km southwest and River Till 4 km west of the site.

The site is situated in a rural area of intensively managed arable farming, where hedgerows and woodland blocks create a linear and organised pattern of large-scale fields. In visual terms the site is relatively rural and remote, however, representative viewpoints will be selected from nearby isolated properties, public highways and rights of way.

Receptors	Search Radius (km)	Name	Distance (km)	Direction from Site	Grid Reference (Edge)
RAMSAR	10	No Receptor Identified	-	-	-
Special Areas of Conservation	10	No Receptor Identified	-	-	-
Special Protection Areas	10	No Receptor Identified	-	-	-
Marine Protection Areas	10	No Receptor Identified	-	-	-
Sites of Special Scientific Interest	2	No Receptor Identified	-	-	-
Scheduled Ancient Monuments	2	Harpswell Hall	1.93	Northeast	SK 93052 89693
National Nature Reserves	2	No Receptor Identified	-	-	-
Local Nature Reserves	2	No Receptor Identified	-	-	-
Local Wildlife Sites	2	No Receptor Identified	-	-	-
Water Features (Closest in All Directions)	2	Field Drain 1	0.00	South	SK 91986 87859
		Field Drain 2	0.30	North	SK 91799 88258
		Field Drain 3	0.52	East	SK 92608 88091
		Field Drain 4	0.55	West	SK 91379 87621
		Field Drain 5	0.62	North	SK 91972 88636
Sensitive Receptors: Households / Businesses	2	Westlands Farm	0.50	Southwest	SK 91724 87361
		Low Farm	0.61	South	SK 92046 87237
		Orchard House	0.63	South	SK 92001 87162
		Grange Court	0.73	South	SK 92342 87209
		Billyards Farm	0.82	Northwest	SK 91154 88348
		Grange Cottages	0.83	Southeast	SK 92608 87225
		Hermitage Low Farm House	0.87	North	SK 92113 88900
		Northlands Cottage	1.49	East	SK 93553 88299
		Low Field Farm	1.49	West	SK 90494 87316
		Lowfield Farmhouse	1.67	Southwest	SK 90555 86936
		Manor Farm	1.81	West	SK 90133 88373
		Heapham Cliff Farm	1.92	West	SK 89967 88275
		Heapham Cliff Farmhouse	1.96	West	SK 89952 88378

Table 2: Sensitive Receptors

5. ENVIRONMENTAL PERMIT AND GENERAL DESCRIPTION

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

5.1 Development Description

The 'Operator' is proposing to construct a new site to be known as the Glentworth West Wellsite. The purpose of the new wellsite is to accommodate future drilling, testing and production operations to further develop the Glentworth oil field. In brief, the site construction will be designed to house a drilling rig, well test spread, storage tanks, production equipment and any other ancillary equipment as necessary.

The well, once drilled will be the subject of an extended period of testing comprising of two phases. In total the testing phase will take place over a period of 12 months within which time produced fluid (a mixture of oil and water) will be flowed to surface and stored in dedicated storage tanks pending collection by road tanker to the Welton Gathering Centre for processing. Small volumes of associated gas will be produced alongside the produced fluids. In the first instance the flowrate will be unstable and suitable mitigation in the form of the identified BAT will need to be deployed.

Once the production rates have settled down and the well moves into phase two of the testing regime, the second identified BAT will be installed and utilised.

Following the 12 month well test the well will be the subject of a suspension period in which the 'Operator' will make a decision over the future of the GLN12 well with one of two options being considered.

- The well shall be the subject of an abandonment and decommissioning programme and the site restored.
- The wellsite shall be developed further with the drilling of additional wells (subject to future regulatory consents).

6. WASTE GAS MANAGEMENT PLAN

6.1 Objectives of the Waste Gas Management Plan

The objective of this Waste Gas Management Plan is to ensure that any waste gas that arises as part of the proposed operations is managed in such a way so as to reduce the quantities of gas emitted to air and minimise environmental impacts so far as available techniques allow.

This objective will be achieved by:

- Identifying Waste Gas Streams;
- Undertaking an initial screening process to remove unavailable or unsuitable techniques;
- Establishing BAT to manage identified Waste Gas Streams;
- Implement a programme of Management based on BAT;
- Reviewing the Waste Gas Management Plan and revise where necessary.

6.2 Distribution of the Waste Gas Management Plan

The 'Operator' will communicate the Waste Gas Management Plan to the Wellsite Supervisor, stored within his office and be made available for review by regulatory bodies. It will be issued as an electronic version or paper copy with a copy of the receipt or transmittal recorded by the 'Operator'.

The Waste Gas Management Plan will be communicated to site personnel and a copy of the Waste Gas Management Plan will be displayed and made available on site to all personnel during operations.

6.3 Alterations to the Waste Gas Management Plan

Any required changes or deviations from this Waste Gas Management Plan are to be referred to the 'Operator' or to the Wellsite Supervisor in the first instance. No changes to, or deviations from, this Waste Gas Management Plan are to be implemented until the required changes or deviations have been reviewed and approved by the 'Operator'. Alterations to the plan will be submitted to the Environment Agency for approval; however, alterations may be implemented as an immediate control measure to resolve an identified problem prior to notification to the Environment Agency.

6.4 Changes to Operations, Processes or Equipment

In the event that there are significant or material changes to operations, processes or equipment during the exploratory operations, the 'Operator' will review the Waste Gas Management Plan and will communicate a copy of any revised Waste Gas Management Plan to the Wellsite Supervisor and forward a copy to the Environment Agency.

7. ESTABLISHING BEST AVAILABLE TECHNIQUE

BAT is defined within the IED 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 the Identification of Waste Gas Streams

Within the onshore oil and gas industry there are a number of activities that produce natural gas which require management. For the proposed testing operations the production of associated gas will be the primary source of waste gas. Other sources of waste gas include the entrained gas from oil storage tanks, however due to the separation process this is expected to minimal and not considered further within this Waste Gas Management Plan.

The predicted volume of natural gas to be flowed during the well testing phase is 35,000 scfd and will continue to operate for a period of up to 12 months. As stated previously the well testing phase will be split into two phases, the initial phase and the extended phase.

Activity	Type	EWC	Hourly		Annual Total Quantity	
			Sm^3	Tonnes[1]	Sm^3	Tonnes[1]
Well Testing	Associated Gas	16 05 04*	~41.34	~0.03	~361,748	~300.40

Table 3: Identification of Waste Gas Stream Activities

7.2 Initial Screening of BAT

The Environment Agency has identified a '*long list of technologies*' within its BAT Report which is summarised below.

- Cold Venting;
- Flaring;
- Heat Generation;
- Power Generation;
- Well Reinjection;
- Recycling Through to Gas Processing;
- Mini Liquefied Natural Gas;
- Conversion to Fuels;
- Vapour Recovery;
- Gas Processing and Natural Gas Liquids Recovery;
- Compressed Natural Gas; and
- 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.

Table 4 overleaf provides a list as to what technologies have been considered as potentially being BAT for the onshore oil and gas industry. 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 the UK - 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; and/or
- The working capacity and capabilities of the technology doesn't meet onshore oil and gas sector requirements.

[1] Tonnes derived natural gas conversion conditions of 0.83 specific gravity, 273.15K & 101.325 kPa at 15^{oC}

Techniques for BAT Assessment for Well Testing (Associated Gas)			
Option	**Technology / Process**	**Y/N**	**Reason for Considering / Not Considering**
Cold Venting	Direct Release to atmosphere	✓	Worst environmental impact with Methane being 28 times greater in global warming potential than CO_2. Potential for use in the event of very low gas volume and flowrates.
Incineration	Elevated Flares	×	Produces a visible flame and excessive noise. May be suitable for sour gas given its ability to incinerate across a wide flow range. Struggles with very small gas volumes.
	Shrouded Flare	✓	Considered to have a reduced combustion efficiency but able to accommodate variable and unpredictable flow (associated gas).
	Enclosed Flare / Incinerator	✓	Provides the best combustion efficiency and reduced noise and visible flame, but can only operate within a defined range of flow.
Heat Generation	Incinerators / Boilers	✓	No demand for heat, steam or hot water at site ordinarily, some operators who produce oil 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.
Power Generation	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 (pressure, volume, temperature) 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 (heat recovery)	×	Not available to rent. Used in conjunction with gas turbine, no use for heat onsite.
Well Reinjection	Enhanced Oil Recovery	×	Would only work for associated gas wells where conditions dictate. No permissions to re-inject in place.
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	✓	May be considered if pre-existing pipelines are present or gas volumes are of such quantities that it makes pipeline installation financially viable. and available.
Mini Liquefied Natural Gas	Liquefaction of Natural Gas	×	Lack of equipment in the UK. So not considered available.
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.
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 or gas volumes make it financially viable.
	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 or gas volumes make it financially viable.
Gas Processing / Gas Liquids Recovery	Recovery of NGL from Natural Gas	×	Lack of equipment in the UK. So not considered available.
Compressed Natural Gas	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 or gas volumes make it financially viable.
Energy Storage	Electricity - Battery Storage	×	Could be considered in circumstances where there is sufficient gas flow to harness the gas to generate electricity and then store within a battery.
	Thermal - Thermal Storage	×	Technology not yet available.

Table 4: Results of 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. This information has been sourced from the Environment Agency BAT Report.

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

- Harness natural gas for alternative use.
- Incineration of natural gas by flare.
- 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 waste gas with regards to the proposed testing operations.

7.3.1 Harness Natural Gas for Alternative Use

The preferred method for waste gas management is to harness the associated gas at the wellsite to produce energy i.e. electrical or heat, potentially reducing the running cost of the site. Technologies providing means of onsite power generation (gas harnessing) typically consist of gas-powered generators (gas engines) or micro-turbines, the latter only recently becoming more widely available.

Prior to the commissioning of either technology it is necessary to understand the composition of the fuel. On this basis alone it is not technically feasible to harness the natural gas during the initial well testing phase.

7.3.1.1 Onsite Power Generation

In the context of the extended well testing phase it is reasonable to assume (subject to sufficient gas volumes and suitable compositions) there is the potential to harness the natural gas to produce electricity for site use.

A gas-powered generator would be 'technically' feasible for the extended well test provided there is sufficient gas volumes and there is sufficient consumption for the electricity to be produced. Given that the wellsite will be performing a testing regime, the site load (demand) is likely to be low and a surplus of electricity would be generated and would subsequently need to be exported. Given the testing phase is temporary the installation of battery systems and grid connection is not feasible. Smaller gas-powered generators have not been identified.

More recently to the market is the installation of micro-turbines which are able to function with lower volumes of gas and in turn provide smaller volumes of electricity. This would likely be used in partnership with an enclosed flare system as the surplus gas would still need to be managed and disposed of safely. The harnessing of natural gas in the context of a micro gas turbine is being considered further as part of this BAT Assessment.

7.3.1.2 Power Export (Gas to Wire)

The exportation of surplus electricity is not being considered.

7.3.1.3 Gas Export (Gas to Grid)

With regards to the testing phase, gas to grid is not considered feasible. The development is only temporary and there is no guarantee of gas volumes to warrant the expenditure to facilitate export to the gas network.

7.3.1.4 Heat Generation

The requirement for heat generation at onshore oil and gas sites is limited to water/oil heater units performed at production sites to aid in the production of oil. The proposed development is for a temporary well testing facility and not production there is no requirement for heat.

7.3.2 Incineration of Natural Gas

Methane has a Global Warming Potential 28 times greater than carbon dioxide, based on a 100-year time horizon, therefore, venting of unburnt hydrocarbons represents an increased environmental impact over incineration of natural gas. In addition, the venting of large volumes of hydrocarbons presents an increased risk of fire and/or explosion.

7.3.2.1 Enclosed Flare

Enclosed flares, such as those used in landfill, are designed with either a single or a multiple burner, to incinerate natural gas with lower methane contents, typically around 56% methane and 31% carbon dioxide. 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, as would be the case with the extended well testing phase.

An enclosed flare is being considered further as part of this BAT Assessment with regards to the extended well test on the basis that the 'Operator' will have sufficient information over the PVT of the associated natural gas. For this same reason an enclosed flare cannot be considered for the initial well testing phase.

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 well clean up, where the gas composition, pressure and flow rates are unknown.

Whilst having 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. Historically, pre-August 2013, open pipe flares have been used extensively onshore UK without significant impact or concern.

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, minerals, which includes oil and gas, 'can only be worked where they are found', often resulting in wellsites being located in areas with minimal and restrictive highway infrastructure.

A shrouded flare is being considered for the initial well testing phase only on the basis it is designed to operate with uncertainty in mind i.e. gas volumes / condition albeit at a slightly lower combustion efficiency.

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. Cold venting is only applicable where volumes of gas are too small, or too intermittent, to be efficiently combusted within a flare unit.

The cold venting of natural gas is not being considered further as part of the well testing operations.

7.4 Initial Conclusion on Potential Techniques

Option	Technology	BAT Potential	Reason
Harness Gas	Onsite Power Generation	Yes	Gas from extended well testing operations is has the potential to be used in a microturbine in collaboration with a flare unit.
	Gas to Wire	No	The proposed well testing operation is temporary only. Any future production operations will be subject to a separate waste gas management plan.
	Gas to Grid	No	The proposed well testing operation is temporary only. Any future production operations will be subject to a separate waste gas management plan.
	Heat Generation	No	There is no requirement for heat at the wellsite. A bath heater may be used should the development reach the production stage.
Incineration	Enclosed Flares	Yes	An enclosed flare may be used in the extended well testing phase once the specification of the associated gas has been determined and the PVT is known.
	Shrouded Flares	Yes	A shrouded flare has been identified as the only technique available for the initial well testing phase based on its ability to efficiently incinerate gas across wide flow ranges.
Cold Venting	Vent Stack	No	Potential for significant global warming emissions (Methane), unless the gas volumes are considerably low.

Table 5: Results of Initial Conclusions for Production Testing

Section 7.4 concludes that three technologies have been identified as potential BAT for the well testing operations.

1. Shrouded Flare Unit for the Initial Well Testing Phase.
2. Small scale onsite power generation harnessing microturbines for the Extended Well Testing Phase.
3. Enclosed Flare Unit for the Extended Well Testing Phase.

As the only technically feasible option for the initial well testing phase is the use of a shrouded flare, this is considered BAT by the 'Operator'.

7.5 Quantitative BAT Assessment

A Cost Benefit Analysis (CBA) has been prepared and has been provided within Appendix 2. The CBA has considered a base case (cold venting) against that of using flare units and gas harnessing technologies i.e. engines and turbines to produce electricity for internal use. It is likely that an enclosed flare will also be required to work with the gas harnessing techniques to incinerate excess gas should it arise (as a result of the site load being to small to consume all of the gas). Whilst the obvious financial cost of hiring a turbine and an enclosed flare unit would be greater than the hiring of the enclosed flare only, the pollution damage costs (PDC) also need to be considered.

All figures presented consider CapEx, OpEx and PDC throughout a worst case 12-month testing period at the Glentworth West Wellsite.

The CBA has determined that Option 3 - Enclosed Flare as BAT for the extended well testing operations on the basis that it provides the least cost (financial expenditure and pollution damage cost) compared to the other options.

7.6 Qualitative BAT Assessment

This section details the qualitative risk assessment that has been undertaken for assessing the impact each proposed option will pose. The methodology has been utilised from the Environment Agency BAT Report.

7.6.1 Considerations of the Assessment

The proposed Glentworth West Wellsite is located within open countryside approximately 16 km north of Lincoln. The proposed wellsite falls within the district of West Lindsey in the county of Lincolnshire. A 2 km radius was established from the site boundary and a study was undertaken to identify how many sensitive receptors are present within the 2 km radius. It was identified that no less than 13 sensitive receptors were present.

7.6.2 Impact and Receptors

The following matrices and calculation of magnitude of risk have been developed with consideration of the Environment Agency BAT Report. The scale of an impact has been determined by considering the size of the relative benefit or risk against the number of people likely to be affected. This allows a scale value to be determined for each factor being considered. For the purpose of this qualitative assessment the 'Operator' has considered that cold venting should be considered as the base case.

The development is considered to fall within a general population of 11-100 based on a 2 km radius from the wellsite. However, the actual number of people affected is expected to be much lower largely due to the location of the site and the natural screening around the perimeter.

	Number of People Likely to be Affected				
	General Population				
Increase / Decrease of Risk / Benefit	1-10	11-100	101-1000	1001-10k	>10k
	Disadvantaged Groups				
	NA	NA	10-100	101-1000	>1000
No Consequence (NC)	NC	NC	NC	NC	NC
Very Small (VS)	NC	VS	S	S	M
Small (S)	VS	S	S	M	M
Modest (M)	S	M	M	M	L
Large (L)	M	M	L	L	VL
Very Large (VL)	M	L	L	VL	VL

Table 6: Scale of Impact Matrix

7.6.3 Magnitude of Impact

The scale of impact illustrated in Table 6 has shown that the general population that may be affected is between 11-100 receptors. This categorisation of 11-100 general population confirms that there will be no impact considered 'Very Large' based on population alone, by any of the proposed BAT options. The purpose of Table 7 is to determine the severity of the impact by assessing the duration and scale of an effect.

A duration of 'Up to 1 Year' is being considered as the extended well testing phase is will not exceed this duration.

Duration of Effect	Impact Based on Population					
	No Consequence	Very Small	Small	Medium	Large	Very Large
Days / One Off Event	NC	VS	VS	VS	S	M
Weeks / Months - Repeat Event	NC	VS	VS	S	M	L
Up to 1 Year	NC	VS	S	M	L	VL
1 - 3 Years	NC	VS	S	M	L	VL
4 - 6 Years	NC	VS	M	L	L	VL
Over 6 Years	NC	VS	M	L	VL	VL

Table 7: Magnitude of Risk

For simplicity, the score of each factor will be converted using a numerical score to provide easy comparison (Table 8), with the results presented in Table 9. Depending on the techniques being considered the impact may be positive (i.e. reduction in noise) or negative (i.e. increase in noise). Each option may bring with it both positive and negative impacts, when compared to that of the base case.

Magnitude Output	Ranking Score
Very Large Positive	>+10
Large Positive	+8
Medium Positive	+6
Small Positive	+4
Very Small Positive	+2
Neutral	0
Very Small Negative	-2
Small Negative	-4
Medium Negative	-6
Large Negative	-8
Very Large Negative	<-10

Table 8: Magnitude Score

7.6.4 Assessment of Short Listed Options

The short listed options for the extended well testing phase, as identified within Table 5, have been assessed using the methodology presented within Section 7.6.2 and Section 7.6.3. The results are presented within Table 9. For clarity the assessed impacts include:

- Visual;
- Noise;
- Land Take;
- Smoke (Combustion Efficiency); and
- Global Warming Potential.

Impact Factor	Table 6 Scale of Impact	Table 7 Magnitude of Impact	Table 8 Magnitude Score	Total Magnitude Score
Cold Venting (Base Case)				
Visual	NC	NC	0	
Noise	NC	NC	0	
Land Take	NC	NC	0	0
Smoke	NC	NC	0	
Global Warming Potential	NC	NC	0	
Shrouded Flare				
Visual	S-	S-	-4	
Noise	S-	S-	-4	
Land Take	NC	NC	0	-4
Smoke	S-	S-	-4	
Global Warming Potential	L+	L+	+8	
Enclosed Flare				
Visual	VS	VS	-2	
Noise	VS	VS	-2	
Land Take	NC	NC	0	+2
Smoke	VS	VS	-2	
Global Warming Potential	L+	L+	+8	
Micro Turbine (with Enclosed Flare)				
Visual	VS	VS	-2	
Noise	S-	S-	-4	
Land Take	NC	NC	0	0
Smoke	VS	VS	-2	
Global Warming Potential	L+	L+	+8	
Gas Engine (with Enclosed Flare)				
Visual	VS	VS	-2	
Noise	S-	S-	-4	
Land Take	NC	NC	0	0
Smoke	VS	VS	-2	
Global Warming Potential	L+	L+	+8	

Table 9: Impact of Proposal

7.7 Results of the Qualitative Assessment

The Qualitative Assessment has identified that the overall impact of introducing an enclosed flare will provide the least impact when assessed against all the other options.

Cold venting as the base case will inevitably result in better noise, smoke and visual impact that any other option as a result of its simplicity and lack of combustion process. Nevertheless, a very small positive impact was observed in the qualitative assessment by the enclosed flare when compared to cold venting. Due to the safe combustion of methane and large reduction in global warming potential.

8. 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. It has been written with consideration for the Environment Agency BAT Report.

The main commodity at the proposed Glentworth West Wellsite is oil with the potential for small volumes of associated natural gas also being produced. During well testing operations oil with any formation water and associated gas will be flowed to surface, with the associated gas being separated on site. The well testing operations are expected to continue for a period no longer than one year.

The Environment Agency has identified a 'long list of technologies' within its BAT report 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 that have passed through the initial screening process were then considered for a more detailed assessment to establish whether they can be considered BAT for this particular scenario. The technologies that were the subject of further assessment were placed onto a short list. Each technology was then assessed for compatibility against both the initial well test and the extended well test.

It was identified during the technical feasibility stage that the only technique suitable for the initial well testing was the use of a shrouded ground flare due to it technical capabilities and the confidence it provides when encountering unknown gas compositions and/or volumes. No further assessment was undertaken with regards to the initial well testing phase.

With regards to the extended well test a number of techniques were identified including gas harnessing technologies such as gas engines and turbines, as well as shrouded and enclosed flare units for disposal. To identify the best available technology a quantitative and qualitative assessment was undertaken.

The quantitative assessment confirmed that the quantitative assessment which was undertaken in accordance with the Environment Agency BAT report and considered the financial expenditure required for each technique together the with pollution damage costs associated with the production of carbon dioxide, methane and oxides of nitrogen. The quantitative assessment concluded that flaring the associated natural gas via an enclosed flare unit is BAT, despite gas harnessing technologies being available. No consideration for export was made as the development is only temporary and the volume of gas is uncertain.

A qualitative assessment was undertaken by to assess the impact the technologies may have on the nearby receptors. The qualitative assessment identified that an enclosed flare is considered a better option when considering potential impact (noise, visual, land take, smoke and global warming potential) on the local population. Though in practice it is likely the impact would be similar should a gas harnessing technique was adopted in isolation, however a flare unit would need to be in place to incinerate surplus gas.

Therefore, the BAT assessment concluded that incineration via an enclosed flare is BAT for the extended well testing operations on the basis that:

- it is a technology readily available within the United Kingdom; and
- the financial and pollution damage cost of an enclosed flare is less than either gas harnessing techniques or that of a shrouded flare.

The BAT assessment also concluded that the incineration via a shrouded flare is BAT for the initial well testing phase due to being the only feasible option given the unknown gas parameters when performing the initial well testing phase.

REFERENCES

1. The Environmental Permitting (England and Wales) Regulations 2016
Available at: https://www.legislation.gov.uk/uksi/2016/1154/contents/made

2. Environment Agency's BAT Report: SC170013/R 'Waste gas management at onshore oil and gas sites: framework for technique selection'

3. Council Directive 2010/75/EU on the industrial emissions (integrated pollution prevention and control)
Available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010L0075&from=EN

4. European Union (Withdrawal) Act 2018
Available at: https://www.legislation.gov.uk/ukpga/2018/16/contents/enacted

APPENDIX 1 - REGULATED FACILITY BOUNDARY PLAN

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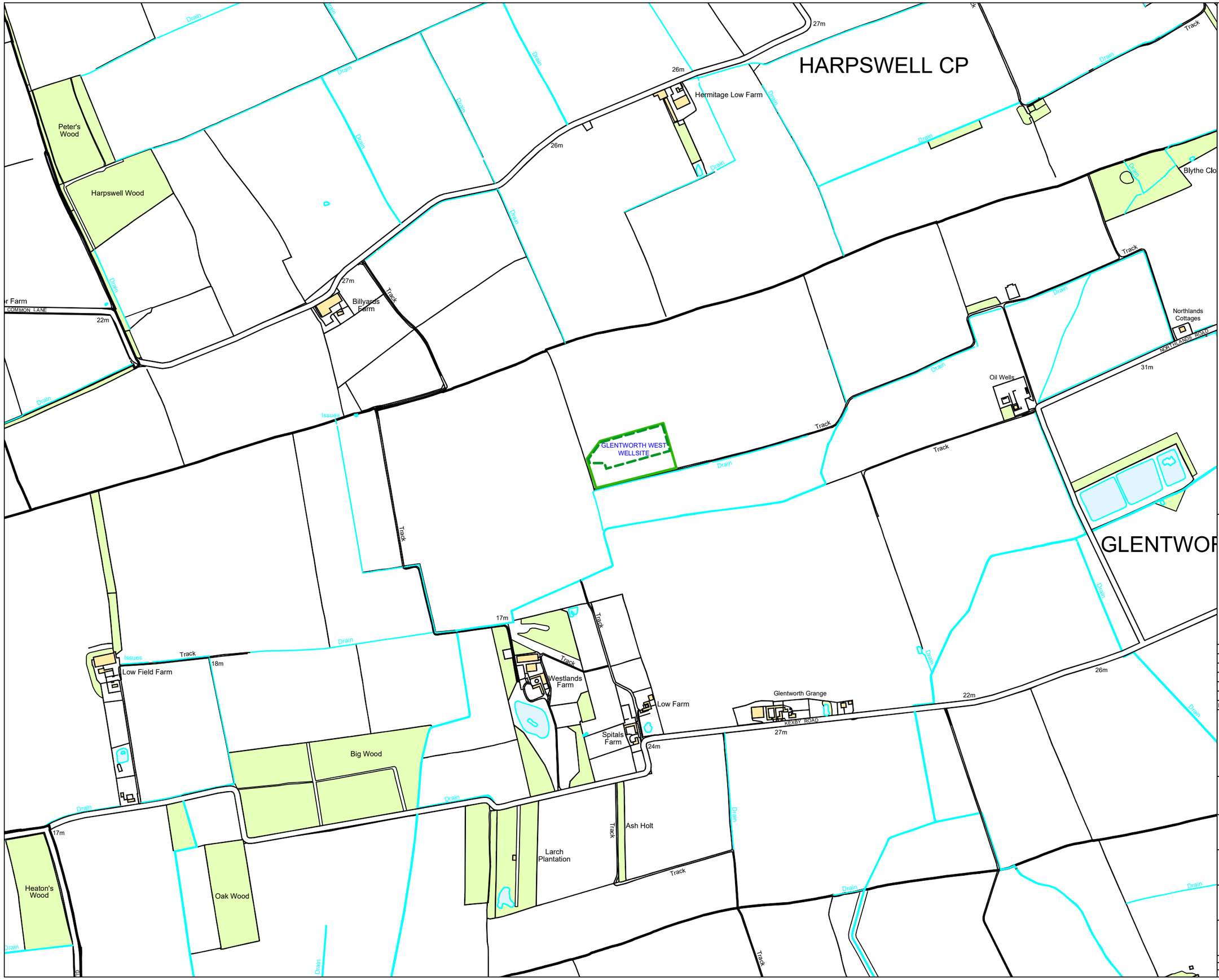

KEY:

PERMIT BOUNDARY (MINING WASTE & NORM)

PERMIT BOUNDARY (OIL STORAGE)

WATER FEATURE (PONDS, DRAINS)

NOTES:

REVISION HISTORY				
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0	OCT22	JF	FIRST ISSUE	JF
REV	DATE	BY	DETAILS	APR

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FROM CONCEPTION TO COMPLETION

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SITE: GLENTWORTH WEST WELLSITE, LINCOLNSHIRE

PROJECT: DRILLING & TESTING OPERATIONS

TITLE: LOCATION PLAN

CLIENT: IGAS ENERGY PRODUCTION LIMITED

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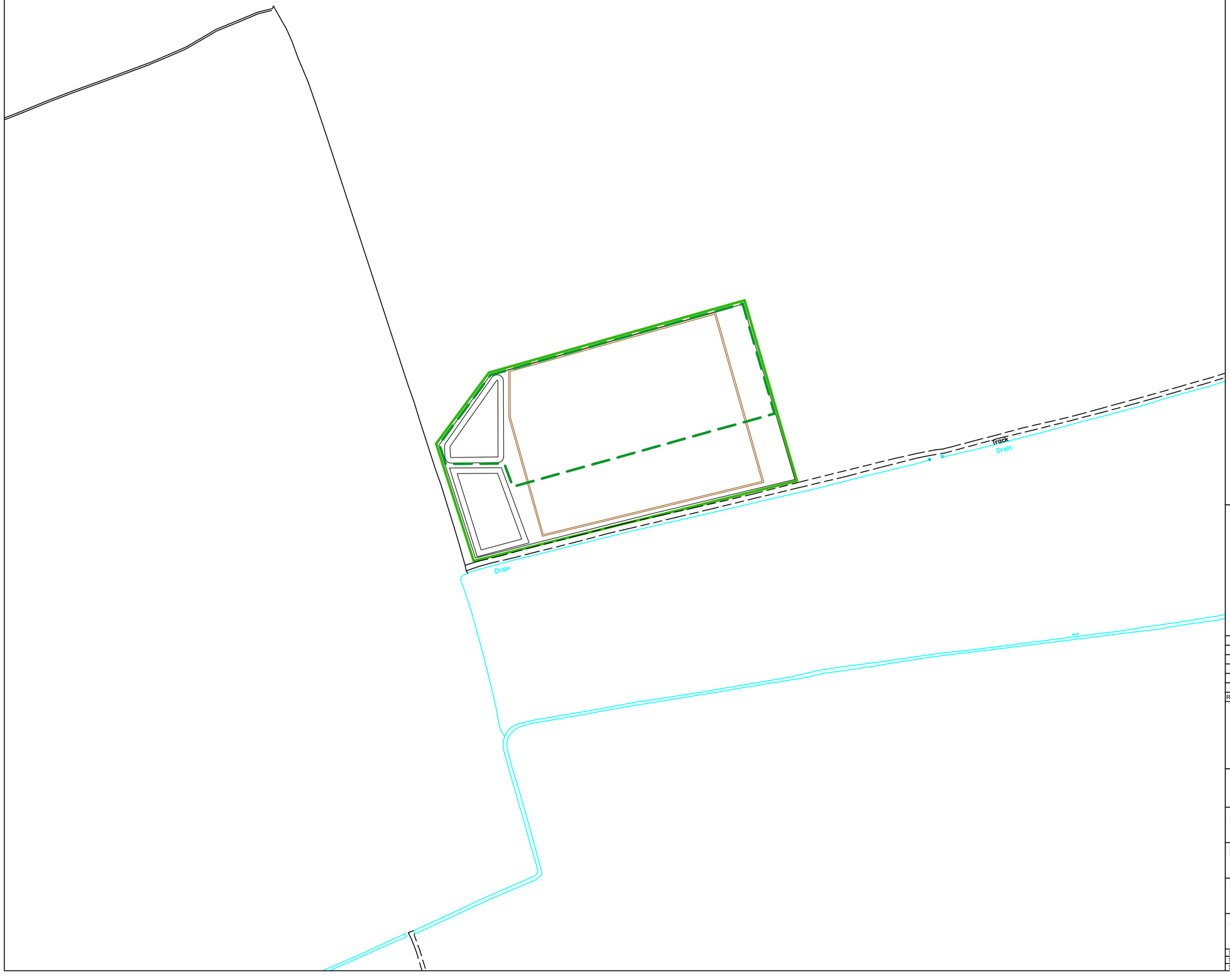
Size:	A3	ZG-IGAS-GLEN-EPR-01
Sheet:	1 of 1	



KEY:

PERMIT BOUNDARY (MINING WASTE & NORM)

PERMIT BOUNDARY (OIL STORAGE)

WATER FEATURE (PONDS, DRAINS)

NOTES:

REVISION HISTORY				
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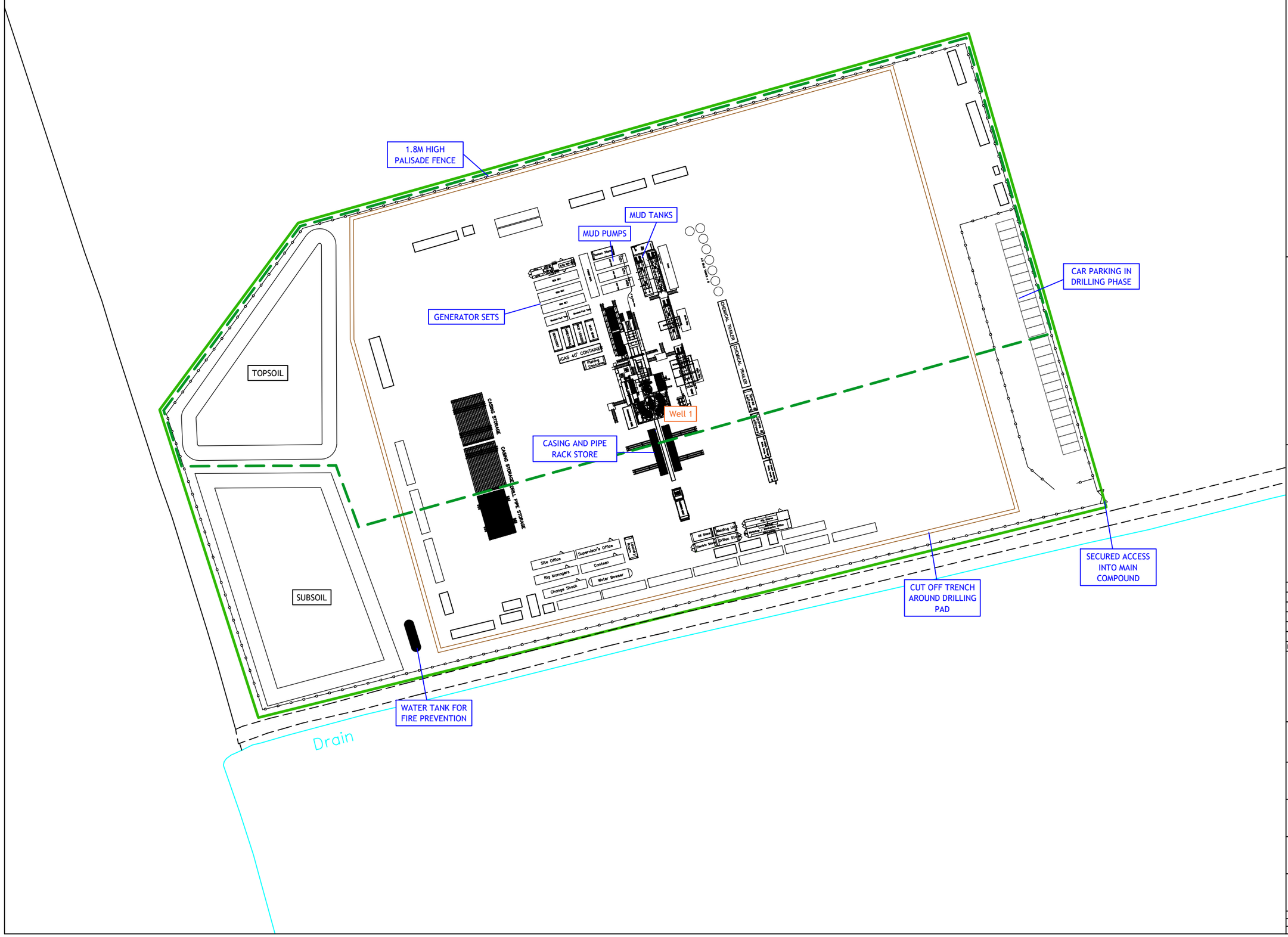
SITE: GLENTWORTH WEST WELLSITE, LINCOLNSHIRE

PROJECT: DRILLING & TESTING OPERATIONS

TITLE: LOCATION PLAN

CLIENT: IGAS ENERGY PRODUCTION LIMITED

Scale:	1:2,500	DWG. No:
Size:	A3	ZG-IGAS-GLEN-EPR-02
Sheet:	1 of 1	



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PERMIT BOUNDARY (MINING WASTE & NORM)

PERMIT BOUNDARY (OIL STORAGE)

WATER FEATURE (PONDS, DRAINS)

EMISSIONS POINT:

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REVISION HISTORY				
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REV	DATE	BY	DETAILS	APR

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SITE: GLENTWORTH WEST WELLSITE, LINCOLNSHIRE

PROJECT: DRILLING & TESTING OPERATIONS

TITLE: SITE LAYOUT PLAN - DRILLING PHASE

CLIENT: IGAS ENERGY PRODUCTION LIMITED

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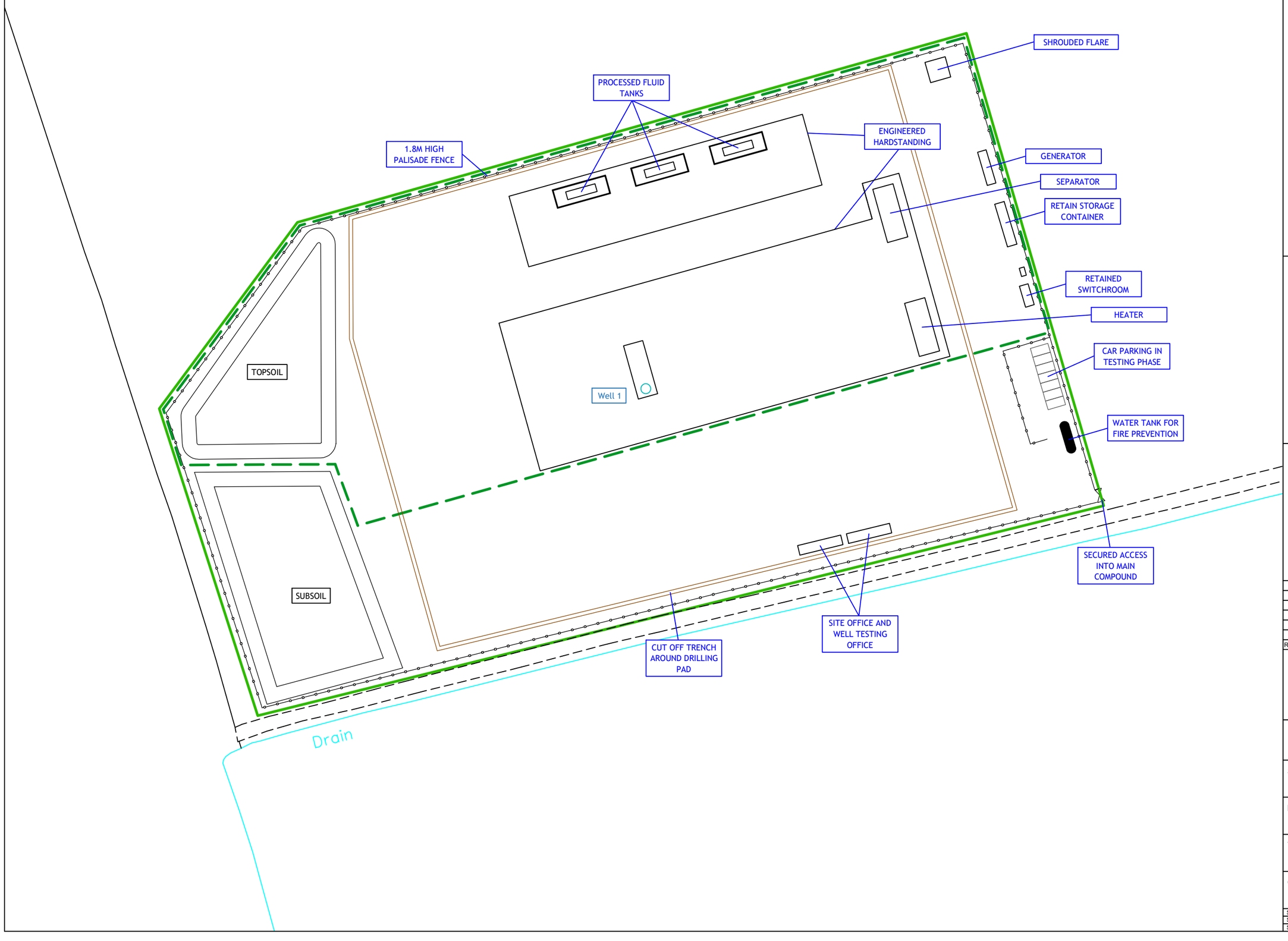

KEY:

PERMIT BOUNDARY (MINING WASTE & NORM)

PERMIT BOUNDARY (OIL STORAGE)

WATER FEATURE (PONDS, DRAINS)

EMISSIONS POINT:

NOTES:

REVISION HISTORY

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SITE: GLENTWORTH WEST WELLSITE, LINCOLNSHIRE

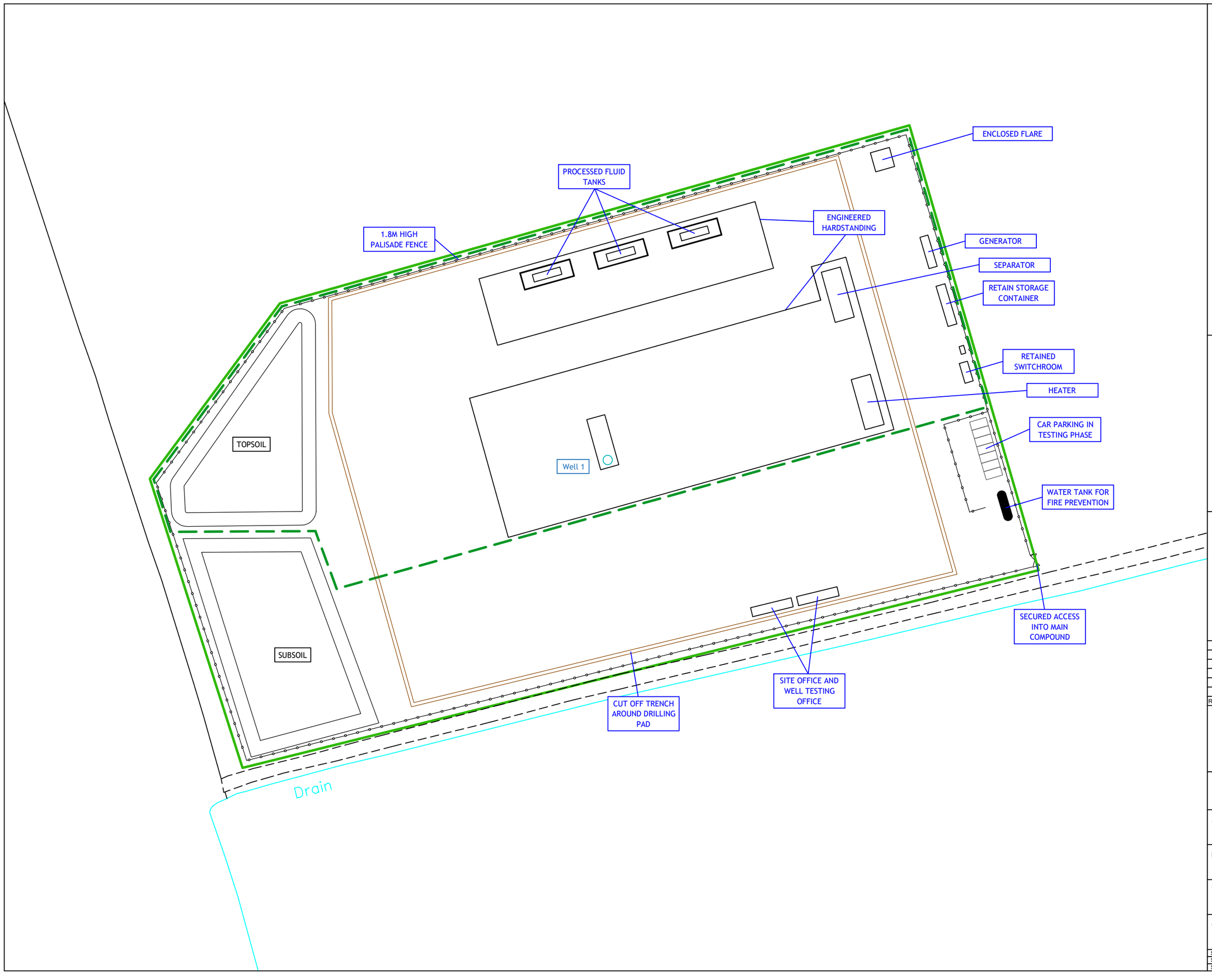
PROJECT: DRILLING & TESTING OPERATIONS

TITLE: SITE LAYOUT PLAN - INITIAL WELL TESTING PHASE

CLIENT: IGAS ENERGY PRODUCTION LIMITED

Scale:	1:1,000
Size:	A3
Sheet:	1 of 1

DWG. No: ZG-IGAS-GLEN-EPR-04



KEY:

PERMIT BOUNDARY (MINING WASTE & NORM)

PERMIT BOUNDARY (OIL STORAGE)

WATER FEATURE (PONDS, DRAINS)

EMISSIONS POINT:

NOTES:

REVISION HISTORY

REV	DATE	BY	DETAILS	APR
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SITE: GLENTWORTH WEST WELLSITE, LINCOLNSHIRE

PROJECT: DRILLING & TESTING OPERATIONS

TITLE: SITE LAYOUT PLAN - EXTENDED WELL TESTING PHASE

CLIENT: IGAS ENERGY PRODUCTION LIMITED

Scale:	1:1,000
Size:	A3
Sheet:	1 of 1

DWG. No: ZG-IGAS-GLEN-EPR-05

APPENDIX 2 - COST BENEFIT ANALYSIS

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BAT Assessment Summary - Oil Testing Facility with Associated Gas Flow

Option Number	Description	Total NPV	NPV vs Base Case
Option 1	Cold Venting	-£ 1,495,840.39	£ -
Option 2	Shrouded Flare	-£ 444,734.38	£ 1,051,106.01
Option 3	Enclosed Flare	-£ 343,006.93	£ 1,152,833.46
Option 4	Micro Turbine with Enclosed Flare	-£ 372,428.98	£ 1,123,411.41
Option 5	Gas Generator with Enclosed Flare	-£ 448,383.99	£ 1,047,456.41

Considerations

- Exportation of either gas or electricity have been ruled out due to the operation being temporary, and may not be successful in the first instance.
- Cold venting is considered the base case, unless an exisiting site already has a technique installed. i.e. enclosed flare.
- Microturbine and Gas fuel Generator considers powering the site only, with remaining gas being incinerated by flare unit.
- Gas composition was derived from sampling and analysis from sister sites in the area.
- The testing period shall not last more than 12 months.

Cold Venting

Month (2024 Prices)	1	2	3	4	5	6	7	8	9	10	11	12
Carbon Cost per Tonne	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00
Direct Cost to Operator												
Cold Vent Capital (CAP Ex)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Cold Vent Maintenance (Op Ex)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Cold Vent Consumables / Chemicals / Parts	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Site Electricity Cost Direct and / or Indirect (Generator Hire + Fuel)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Modifications to Existing Equipment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Land	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Civils	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Materials	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Project Planning (If Not Civils)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Major Refurbishment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Residual Value of Equipment - Enter in Final Month as a Negative Value	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Decommissioning - Enter in Final Month	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #1	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #2	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #3	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #4	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Financial Cost (Monthly)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Pollution Quantities												
Total Natural Gas Flow (Sm3/hr)	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
Venting: Waste Natural Gas Flow Cold Vented (Sm3/hr) (Assume 100% Uncombusted)	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
Venting: Waste Natural Gas Flow to Flare (Sm3/hr) (Assume 0% Combusted)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting: Methane Flow Cold Vented (CO2eq Tonnes/Month)	417.98	417.98	417.98	417.98	417.98	417.98	417.98	417.98	417.98	417.98	417.98	417.98
Venting: CO_2 from Methane Flare Combustion (Tonnes/Month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting: Methane Slip (CO2eq Tonnes/Month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting: C2-C5 Flow Cold Vented (CO2eq Tonnes/Month)	68.95	68.95	68.95	68.95	68.95	68.95	68.95	68.95	68.95	68.95	68.95	68.95
Venting: CO_2 from C2 - C5 Flare Combustion (Tonnes/Month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting: C2-C5 Slip (CO2eq Tonnes/Month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Venting: NOx From Flare (Tonnes/Month)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Cost												
Methane Emitted	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05	-£ 107,002.05
Methane Combusted (CO2 Emission)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
C2-C5 Emitted	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32	-£ 17,651.32
C2-C5 Combusted (CO2 Emission)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
NOx	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Capital & Operating	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Total Montly Costs Financial and Environmental	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37	-£ 124,653.37
Income & Benefit												
No Income Foreseeable	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -

Summary	
Present Value Cost	-£1,495,840.39
Present Value Benefit	£0.00
Net Present Value	-£1,495,840.39

Shrouded Flare Only

Month (2024 Prices)	1	2	3	4	5	6	7	8	9	10	11	12
Carbon Cost per Tonne	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00
Direct Cost to Operator												
Shrouded Flare Capital (CAP Ex)	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00
Shrouded Flare Maintenance (Op Ex)	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00
Shrouded Flare Consumables / Chemicals / Parts	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Site Electricity Cost Direct and / or Indirect (Generator Hire + Fuel)	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00
Modifications to Existing Equipment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Land	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Civils	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Materials	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Project Planning (If Not Civils)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Major Refurbishment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Residual Value of Equipment - Enter in Final Month as a Negative Value	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Decommissioning - Enter in Final Month	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #1	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #2	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #3	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #4	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Financial Cost (Monthly)	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00
Pollution Quantities												
Total Natural Gas Flow (Sm3/hr)	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
Flare and Vent: Waste Natural Gas Flow Cold Vented (Sm3/hr) (Assume 5% Uncombusted)	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10
Flare and Vent: Waste Natural Gas Flow to Flare (Sm3/hr) (Assume 95% Combusted)	39.90	39.90	39.90	39.90	39.90	39.90	39.90	39.90	39.90	39.90	39.90	39.90
Flare and Vent: Methane Flow Cold Vented (CO_2eq Tonnes/Month)	20.90	20.90	20.90	20.90	20.90	20.90	20.90	20.90	20.90	20.90	20.90	20.90
Flare and Vent: CO_2 from Methane Flare Combustion (Tonnes/Month)	37.05	37.05	37.05	37.05	37.05	37.05	37.05	37.05	37.05	37.05	37.05	37.05
Flare and Vent: Methane Slip (CO_2eq Tonnes/Month)	19.85	19.85	19.85	19.85	19.85	19.85	19.85	19.85	19.85	19.85	19.85	19.85
Flare and Vent: C2-C5 Flow Cold Vented (CO_2eq Tonnes/Month)	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45	3.45
Flare and Vent: CO_2 from C2 - C5 Flare Combustion (Tonnes/Month)	13.53	13.53	13.53	13.53	13.53	13.53	13.53	13.53	13.53	13.53	13.53	13.53
Flare and Vent: C2-C5 Slip (CO_2eq Tonnes/Month)	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28	3.28
Flare and Vent: NOx From Flare (Tonnes/Month)	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Total Cost												
Methane Emitted	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70	-£ 10,432.70
Methane Combusted (CO_2 Emission)	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49	-£ 9,484.49
C2-C5 Emitted	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00	-£ 1,721.00
C2-C5 Combusted (CO_2 Emission)	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11	-£ 3,463.11
NOx	-£ 959.89	-£ 959.89	-£ 959.89	-£ 959.89	-£ 959.89	-£ 959.89	-£ 959.89	-£ 959.89	-£ 959.89	-£ 959.89	-£ 959.89	-£ 959.89
Capital & Operating	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00
Total Montly Costs Financial and Environmental	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20	-£ 37,061.20
Income & Benefit												
No Income Foreseeable	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -

Summary	
Present Value Cost	-£444,734.38
Present Value Benefit	£0.00
Net Present Value	-£444,734.38

Enclosed Flare Only

Month (2024 Prices)	1	2	3	4	5	6	7	8	9	10	11	12
Carbon Cost per Tonne	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00
Direct Cost to Operator												
Enclosed Flare Capital (CAP Ex)	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00
Enclosed Flare Maintenance (Op Ex)	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00
Enclosed Flare Consumables / Chemicals / Parts	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Site Electricity Cost Direct and / or Indirect (Generator Hire + Fuel)	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00
Modifications to Existing Equipment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Land	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Civils	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Materials	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Project Planning (If Not Civils)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Major Refurbishment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Residual Value of Equipment - Enter in Final Month as a Negative Value	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Decommissioning - Enter in Final Month	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #1 - Enclosed Flare CAPEX for Remaining Gas	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #2 - Flare Monitoring	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #3	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #4	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Financial Cost (Monthly)	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00	£ 11,000.00
Pollution Quantities												
Total Natural Gas Flow (Sm3/hr)	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
Flare and Vent: Waste Natural Gas Flow Cold Vented (Sm3/hr) (Assume 1% Uncombusted)	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Flare and Vent: Waste Natural Gas Flow to Flare (Sm3/hr) (Assume 99% Combusted)	41.58	41.58	41.58	41.58	41.58	41.58	41.58	41.58	41.58	41.58	41.58	41.58
Flare and Vent: Methane Flow Cold Vented (CO2eq Tonnes/Month)	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18
Flare and Vent: CO_2 from Methane Flare Combustion (Tonnes/Month)	40.23	40.23	40.23	40.23	40.23	40.23	40.23	40.23	40.23	40.23	40.23	40.23
Flare and Vent: Methane Slip (CO2eq Tonnes/Month)	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14	4.14
Flare and Vent: C2-C5 Flow Cold Vented (CO2eq Tonnes/Month)	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
Flare and Vent: CO_2 from C2 - C5 Flare Combustion (Tonnes/Month)	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69	14.69
Flare and Vent: C2-C5 Slip (CO2eq Tonnes/Month)	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
Flare and Vent: NOx From Flare (Tonnes/Month)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Total Cost												
Methane Emitted	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34	-£ 2,129.34
Methane Combusted (CO2 Emission)	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00	-£ 10,300.00
C2-C5 Emitted	-£ 351.26	-£ 351.26	-£ 351.26	-£ 351.26	-£ 351.26	-£ 351.26	-£ 351.26	-£ 351.26	-£ 351.26	-£ 351.26	-£ 351.26	-£ 351.26
C2-C5 Combusted (CO2 Emission)	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88	-£ 3,760.88
NOx	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43	-£ 1,042.43
Capital & Operating	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00	-£ 11,000.00
Total Montly Costs Financial and Environmental	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91	-£ 28,583.91
Income & Benefit												
No Income Foreseeable	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -

Summary	
Present Value Cost	-£343,006.93
Present Value Benefit	£0.00
Net Present Value	-£343,006.93

Micro Turbine with Enclosed Flare

Month (2024 Prices)	1	2	3	4	5	6	7	8	9	10	11	12
Carbon Cost per Tonne	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00
Direct Cost to Operator												
Micro Gas Turbine Capital (CAP Ex)	£ 10,800.00	£ 10,800.00	£ 10,800.00	£ 10,800.00	£ 10,800.00	£ 10,800.00	£ 10,800.00	£ 10,800.00	£ 10,800.00	£ 10,800.00	£ 10,800.00	£ 10,800.00
Micro Gas Turbine Maintenance (Op Ex)	£ 3,400.00	£ 3,400.00	£ 3,400.00	£ 3,400.00	£ 3,400.00	£ 3,400.00	£ 3,400.00	£ 3,400.00	£ 3,400.00	£ 3,400.00	£ 3,400.00	£ 3,400.00
Micro Gas Turbine Consumables / Chemicals / Parts	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Site Electricity Cost Direct and / or Indirect (Generator Hire + Fuel)	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00
Modifications to Existing Equipment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Land	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Civils	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Materials	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Project Planning (If Not Civils)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Major Refurbishment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Residual Value of Equipment - Enter in Final Month as a Negative Value	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Decommissioning - Enter in Final Month	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #1 - Enclosed Flare CAPEX for Remaining Gas	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00
Additional Cost #2 - Flare Monitoring	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00
Additional Cost #3	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #4	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Financial Cost (Monthly)	£ 15,200.00	£ 15,200.00	£ 15,200.00	£ 15,200.00	£ 15,200.00	£ 15,200.00	£ 15,200.00	£ 15,200.00	£ 15,200.00	£ 15,200.00	£ 15,200.00	£ 15,200.00
Pollution Quantities												
Total Natural Gas Flow (Sm3/hr)	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
Gas Turbine												
Waste Natural Gas Flow to Turbine (Sm3/hr) (Increase rate to meet Site Load)	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Site Load (MW)	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
CO_2 from Methane Gas Turbine Combustion (Tonnes/Month)	29.32	29.32	29.32	29.32	29.32	29.32	29.32	29.32	29.32	29.32	29.32	29.32
CO_2 from C2 - C5 Gas Turbine Combustion (Tonnes/Month)	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71	10.71
Number of Turbines	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
NOx From Gas Turbine (Tonnes/Month)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Flare and Vent												
Waste Natural Gas Flow Cold Vented (Sm3/hr) (Assume 1% Uncombusted)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Waste Natural Gas Flow to Flare (Sm3/hr) (Assume 99% Combusted)	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88	11.88
Methane Flow Cold Vented (CO2eq Tonnes/Month)	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19
CO_2 from Methane Flare Combustion (Tonnes/Month)	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50	11.50
Methane Slip (CO2eq Tonnes/Month)	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18	1.18
C2-C5 Flow Cold Vented (CO2eq Tonnes/Month)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
CO_2 from C2 - C5 Flare Combustion (Tonnes/Month)	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20	4.20
C2-C5 Slip (CO2eq Tonnes/Month)	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
NOx From Flare (Tonnes/Month)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Total Cost												
Methane Emitted	-£ 608.38	-£ 608.38	-£ 608.38	-£ 608.38	-£ 608.38	-£ 608.38	-£ 608.38	-£ 608.38	-£ 608.38	-£ 608.38	-£ 608.38	-£ 608.38
Methane Combusted (CO2 Emission)	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38	-£ 10,449.38
C2-C5 Emitted	-£ 100.36	-£ 100.36	-£ 100.36	-£ 100.36	-£ 100.36	-£ 100.36	-£ 100.36	-£ 100.36	-£ 100.36	-£ 100.36	-£ 100.36	-£ 100.36
C2-C5 Combusted (CO2 Emission)	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43	-£ 3,815.43
NOx	-£ 862.20	-£ 862.20	-£ 862.20	-£ 862.20	-£ 862.20	-£ 862.20	-£ 862.20	-£ 862.20	-£ 862.20	-£ 862.20	-£ 862.20	-£ 862.20
Capital & Operating	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00	-£ 15,200.00
Total Montly Costs Financial and Environmental	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75	-£ 31,035.75
Income & Benefit												
No Income Foreseeable	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -

Summary	
Present Value Cost	-£372,428.98
Present Value Benefit	£0.00
Net Present Value	-£372,428.98

Gas Engine with Enclosed Flare

Month (2024 Prices)	1	2	3	4	5	6	7	8	9	10	11	12
Carbon Cost per Tonne	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00	£ 256.00

Direct Cost to Operator												
Gas Generator Capital (CAP Ex)	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00
Gas Generator Maintenance (Op Ex)	£ 1,200.00	£ 2,500.00	£ 2,500.00	£ 2,500.00	£ 2,500.00	£ 2,500.00	£ 2,500.00	£ 2,500.00	£ 2,500.00	£ 2,500.00	£ 2,500.00	£ 2,500.00
Gas Generato Consumables / Chemicals / Parts	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Site Electricity Cost Direct and / or Indirect (Generator Hire + Fuel)	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00	-£ 5,000.00
Modifications to Existing Equipment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Land	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Civils	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Materials	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Project Planning (If Not Civils)	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Major Refurbishment	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Residual Value of Equipment - Enter in Final Month as a Negative Value	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Decommissioning - Enter in Final Month	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #1	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00	£ 5,000.00
Additional Cost #2	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00	£ 1,000.00
Additional Cost #3	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Additional Cost #4	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -
Financial Cost (Monthly)	£ 7,200.00	£ 8,500.00	£ 8,500.00	£ 8,500.00	£ 8,500.00	£ 8,500.00	£ 8,500.00	£ 8,500.00	£ 8,500.00	£ 8,500.00	£ 8,500.00	£ 8,500.00

Pollution Quantities												
Total Natural Gas Flow (Sm3/hr)	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00

Gas Engine													
	Waste Natural Gas Flow to Engine (Sm3/hr) (Max Flow)	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00	20.00
	Available Power (MW)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	CO_2 from Methane Gas Engine Combustion (Tonnes/Month)	19.55	19.55	19.55	19.55	19.55	19.55	19.55	19.55	19.55	19.55	19.55	19.55
	CO_2 from C2 - C5 Gas Engine Combustion (Tonnes/Month)	7.14	7.14	7.14	7.14	7.14	7.14	7.14	7.14	7.14	7.14	7.14	7.14
	Number of Engines	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	NOx From Gas Engines (Tonnes/Month)	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93	0.93

Flare and Vent													
	Waste Natural Gas Flow Cold Vented (Sm3/hr) (Assume 1% Uncombusted)	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
	Waste Natural Gas Flow to Flare (Sm3/hr) (Assume 99% Combusted)	21.78	21.78	21.78	21.78	21.78	21.78	21.78	21.78	21.78	21.78	21.78	21.78
	Methane Flow Cold Vented (CO2eq Tonnes/Month)	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19	2.19
	CO_2 from Methane Flare Combustion (Tonnes/Month)	21.08	21.08	21.08	21.08	21.08	21.08	21.08	21.08	21.08	21.08	21.08	21.08
	Methane Slip (CO2eq Tonnes/Month)	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17	2.17
	C2-C5 Flow Cold Vented (CO2eq Tonnes/Month)	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
	CO_2 from C2 - C5 Flare Combustion (Tonnes/Month)	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
	C2-C5 Slip (CO2eq Tonnes/Month)	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
	NOx From Flare (Tonnes/Month)	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04

Total Cost												
Methane Emitted	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37	-£ 1,115.37
Methane Combusted (CO2 Emission)	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58	-£ 10,399.58
C2-C5 Emitted	-£ 183.99	-£ 183.99	-£ 183.99	-£ 183.99	-£ 183.99	-£ 183.99	-£ 183.99	-£ 183.99	-£ 183.99	-£ 183.99	-£ 183.99	-£ 183.99
C2-C5 Combusted (CO2 Emission)	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24	-£ 3,797.24
NOx	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47	-£ 13,477.47
Capital & Operating	-£ 7,200.00	-£ 8,500.00	-£ 8,500.00	-£ 8,500.00	-£ 8,500.00	-£ 8,500.00	-£ 8,500.00	-£ 8,500.00	-£ 8,500.00	-£ 8,500.00	-£ 8,500.00	-£ 8,500.00
Total Monthly Costs Financial and Environmental	-£ 36,173.67	-£ 37,473.67	-£ 37,473.67	-£ 37,473.67	-£ 37,473.67	-£ 37,473.67	-£ 37,473.67	-£ 37,473.67	-£ 37,473.67	-£ 37,473.67	-£ 37,473.67	-£ 37,473.67

Income & Benefit												
No Income Foreseeable	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -	£ -

Summary	
Present Value Cost	-£448,383.99
Present Value Benefit	£0.00
Net Present Value	-£448,383.99

Site Parameters	
Flow Rate (Sm3/hr)	413.00
Monthly Hours	730.00
Site Electrical Load (MW)	0.08
C1 - Methane Gas Density (kg/m3) (based on STP)	0.716
Methane Global Warming Potential	28
Methane to CO2 Conversion Factor	2.75
Methane Concentration	68.00%
C2 - C5 Average Gas Density (kg/m3) (based on STP)	2.280
C2 - Ethane Gas Density (kg/m3) (based on STP)	1.342
C3 - Propane Gas Density (kg/m3) (based on STP)	1.967
C4 - Butane Gas Density (kg/m3) (based on STP)	2.593
C5 - Pentane Gas Density (kg/m3) (based on STP)	3.219
C2 - C5 Global Warming Potential (EA Confirmed)	4.6
C2 - C5 to CO2 Conversion Factor	1
C2 - C5 Concentration	21.44%
C2 - Ethane Concentration	8.00%
C3 - Propane Concentration	7.00%
C4 - Butane Concentration	4.00%
C5 - Pentane Concentration (assumed)	2.44%

Conversion Factors	
Conversion of KWh to CO2 in Tonnes (kgCO2/kWh)	0.28088
Conversion of KWh to NOx in Tonnes (kgNOx/kWh)	0.00153

Flare Parameters	
Combustion Efficiency - Shrouded Flare	95.00%
Combustion Efficiency - Enclosed Unit	99.00%
CH4 to Total Flue Gas Ratio	16.71
Max Allowable Nox Emissions (mg/m3)	150.00

Gas Engine Parameters	
Energy per Unit Volume of Gas MJ/Sm3	37.60
Gas Engine Efficiency	40%
Gas Engine NOx Emission (mg/Nm3)	95.00
Engine Electrical Output (MW)	3.33
Engine Size Swept Volume / Displacement (Litres)	149.70
Engine (RPM)	1500.00

Gas Turbine Parameters	
Energy per Unit Volume of Gas MJ/Sm3	39.10
Gas Turbine Efficiency (%)	28%
Gas Turbine NOx Emission (mg/m3)	19.00
Gas Turbine Electrical Output (High) (MW)	0.07
Density of Air (kg/mg)	1.20
Gas Turbine Exhaust Flow (kg/s)	0.49

Gas Volumes (scf to m³)						
scfd	**SG**	**Sm³**	**hours**	**Sm³/hr**	**Mass (kg)**	**Mass (t)**
35,000	0.83	991.090	24.00	41.295	822.604	0.823
mmscfd		**Nm³**		**Nm³/hr**	**Mass (kg)**	**Mass (t)**
0.035000		939.497		39.146	779.783	0.780

Gas Volumes (m³ to scf)							
Sm³/hr	**hours**	**Sm³**	**scfd**	**mmscfd**	**SG**	**Mass (kg)**	**Mass (t)**
412.954	24.00	9,910.90	350,000	0.350	0.70	6,937.627	6.938
Nm³/hr		**Nm³**	**scfd**	**mmscfd**		**Mass (kg)**	**Mass (t)**
391.457		9,394.97	350,000	0.350		6,576.478	6.576

Pth = V*Hg / 3.6

Fuel Flow Rate Load	21 m3/h	V
Lower Heating Value	39.1 MJ/m3	Hg
Thermal Input Power	228.08 kWth	Pth
Efficiency	28%	
Electricity Output	63.86	

Year	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Non-Traded Carbon Prices - Central Band from BEIS (Revised October 2021)	£252.00	£256.00	£260.00	£264.00	£268.00	£272.00	£276.00	£280.00	£285.00	£289.00	£293.00	£298.00	£302.00	£307.00	£312.00	£316.00	£321.00	£326.00	£331.00	£336.00	£341.00	£346.00	£351.00	£356.00	£362.00	£367.00	£373.00	£378.00
Wholesale Electricity Prices - Central Band from BEIS	£86.01	£87.58	£94.56	£96.22	£91.79	£91.56	£91.68	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50	£91.50
Wholesale Gas Prices - Central Band from BEIS	£18.29	£19.32	£20.01	£21.04	£21.72	£22.41	£23.44	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12	£24.12
NOx Value from IED Derogation Tool (2018)	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840	£13,840
Crude Oil Prices bbls/£ - BEIS 2019 Price Forecast	£46.70	£47.79	£48.85	£49.90	£50.94	£52.66	£53.65	£54.63	£55.60	£56.56	£58.17	£59.09	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00	£60.00