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Environmental Permit Application for a Biomethane to Grid Plant

SGN Gas to Grid ProjectCo1 Ltd

April 2024

Knostrop Biomethane to Grid Plant

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Glossary of Terms

AMP	Accident Management Plan
ATEX	ATmosphere EXplosible
BAT	Best Available Techniques
BAT-AEL	Best Available Techniques Associated Emission Level
Biomethane	In the context of this document the term 'biomethane' refers to biogas that has been treated / upgraded in the BtG plant.
BREF	Best Available Techniques Reference Document
BtG	Biomethane to Grid
CHP	Combined Heat and Power
CO_2	Carbon dioxide
COMAH	Control of Major Accident Hazards
DSEAR	Dangerous Substances and Explosive Atmospheres Regulations
EA	Environment Agency
EAL	Environmental Assessment Level
EMS	Environmental Management System
EMP	Environmental Management Plan
EPR	Environmental Permitting Regulations
GEU	Grid Entry Unit
GSMR	Gas Safety (Management) (Amendment) Regulations
H_2S	Hydrogen Sulphide
LDAR	Leak Detection and Repair
LNR	Local Nature Reserve
LoD	Limit of Detection
LWS	Local Wildlife Site
NGN	Northern Gas Networks
NMVOCs	Non-Methane Volatile Organic Compounds
Ofgem	Office of Gas and Electricity Markets
OMP	Odour Management Plan
PRV	Pressure Relief Valve
ROV	Remote Operated Valve
SCR	Site Condition Report
SID	Supporting Information Document
SPZ	Site Protection Zone
SSSI	Site of Special Scientific Interest
STF	Sludge Treatment Facility
TGN	Technical Guidance Note
VOCs	Volatile Organic Compounds
YWS	Yorkshire Water Services
WFD	Waste Framework Directive
WRAP	Waste and Resources Action Programme
WwTW	Waste Water Treatment Works

Non-Technical Summary

Introduction

SGN Gas to Grid ProjectCo1 Ltd. (SGN) proposes to build and operate a new biomethane to grid (BtG) plant within Knostrop Sludge Treatment Facility (STF). The STF is in the grounds of the wider Knostrop Wastewater Treatment Works (WwTW), which is owned and operated by Yorkshire Water Services (YWS). The YWS STF is a regulated facility and the BtG plant will also be a regulated facility, requiring an environmental permit to operate. Both facilities will be regulated by the Environment Agency (EA). The area of land that the BtG plant will be built on is being leased to SGN by YWS. YWS is submitting an application for the 'partial surrender' of this area of land from the present day STF permit boundary.

Biomethane will be produced from treating / upgrading raw biogas, a waste gas generated at the YWS STF through anaerobic digestion of sewage sludge. Consequently, the BtG plant will be a Directly Associated Activity (DAA) to the YWS anaerobic digestion activity and SGN is applying for a bespoke DAA environmental permit for the BtG plant. This Section of this document is the Non-Technical Summary for the application's supporting information document, which it provides the detailed information required for the permit application.

The biogas is currently used by YWS as a fuel to help meet the heat and power demand at the WwTW. Any off-specification or excess biogas is disposed of at the YWS STF waste gas burner. Once the BtG plant is operational, the raw biogas will instead be routed to the BtG plant, cleaned (upgraded) and conditioned to produce biomethane of a quality that is suitable for injection into the local grid network operated by Northern Gas Networks (NGN).

The raw biogas contains mostly methane, some carbon dioxide and water, as well as small quantities of impurities. In order to upgrade the raw biogas to biomethane suitable for entry into the local gas grid it is necessary to increase the methane content and reduce the quantity of water, carbon dioxide and impurities.

Operation and Process Overview

Typical Operation

The BtG plant will operate 24 hours per day, 7 days per week. Plant shutdown for planned maintenance is scheduled to take place every 6 months. The plant has been designed to operate remotely for much of the time and a level of remote monitoring can be carried out through the monitoring systems for pressures / temperatures etc. The operational life expectancy of the BtG Plant is currently 15 years, with a possible 5 year extension.

The BtG plant has been sized to be capable of processing flows greater than the maximum flows historically produced by Knostrop STF. The maximum operational flow rate of biogas to the BtG plant will be 2,950 Nm^3/h with a routine flow rate of 1,675 Nm^3/h and a minimum flow rate of 740 Nm^3/h. The biogas inlet to the BtG plant will be fitted with an automated isolation valve that will close in the event of provision of off-specification biogas from YWS.

The treatment / upgrading processes include: dewatering (chilling via heat exchangers and condensing), pressure boosting (using blowers), removal of hydrogen sulphide, siloxanes and non-methane volatile organic compounds (using carbon filters), compression and removal of carbon dioxide (membrane separation).

There are three main locations within the regulated facility for monitoring the biogas specification through its transformation to biomethane: pre-treatment (de-watering), after the activated carbon filters and at the Grid Entry Unit (GEU).

Following treatment, and depending on the quality of the biomethane gas, it will either be sent for final conditioning in the GEU prior to entry to the local gas network as a renewable fuel; or, if non-compliant, routed to a new biomethane flare at the BtG plant for disposal. The biomethane flare will also be used to dispose of non-compliant biomethane that is produced during start-up, until the process stabilises (typically 20-30 minutes).

Conditioning involves the addition of propane to ensure the biogas meets NGN's daily target calorific value (CV) and odourisation. NGN require that the gas is odourised and that they have control over the odourisation process. The GEU will contain a separate, locked compartment within which the NGN odourisation system will be located. As NGN will have control over the odourisation system, this part of the GEU has been excluded from the BtG plant permit boundary.

At the outlet to the GEU underground pipework will transport the odourised biomethane to the Remote Operated Valve (ROV) kiosk, which is where the biomethane enters the gas transmission system. The ROV will be owned and operated by NGN. At the point at which the biomethane exits the GEU there is no further processing of the biomethane and the gas will be compliant with the requirements Gas Safety (Management) (Amendment) Regulations 2023 and the 'Quality Protocol Biomethane from Waste' publication (i.e. at this point it will cease to be a waste). As the biomethane exiting the GEU is no longer a waste requiring regulation via the environmental permit, the pipeline from the GEU to the ROV and the ROV will not form part of the regulated facility.

At the maximum biogas input flow rate, biomethane would be produced at a rate of 1,933 Nm^3/h (2,110 Nm^3/h following the addition of propane).

Abnormal Operation

In the event that off specification biogas is produced by YWS the BtG plant inlet valve will close. Where technically possible and safe to do so, off-specification biogas shall be used in the YWS boilers until the composition of the biogas returns to being compliant with the specification. Only if the YWS boilers are incapable of processing the biogas during this period would the YWS waste gas burner be used.

In the event that the BtG plant cannot operate, biogas would be directed to the YWS biogas using assets (the YWS boilers and CHPs). If the capacity of all these assets were exceeded, the YWS waste gas burner would be utilised.

Materials Use, Waste and Utilities

The principal materials that will be used will be biogas, activated carbon and propane. Relatively small quantities of mineral oil and glycol will also be used and stored at the facility, along with maintenance sundries such as grease and solvent (WD 40). There are no suitable alternatives for the materials used and stored on site.

Generation of waste at the BtG plant is very limited. The main waste is spent / saturated activated carbon which is removed from site by a waste contractor for regeneration / disposal. Minimal quantities of additional waste will be produced (waste glycol, waste lubrication oil and maintenance sundries). Waste recovery and disposal is not expected to be a significant issue.

The BtG plant does not require water as part of the process.

The total installed electrical power for the BtG regulated facility is estimated at 1,405 kW. The main users of energy at the BtG plant are the pre-treatment processes, the biogas compressors and the membrane separation unit. The BtG plant has been designed to incorporate an energy management system which will:

- automatically adjust the use of equipment to meet the process demands as efficiently as possible; and
- regulate energy use at the facility to ensure maximum efficiency.

Shared Services

The shared services and direct interactions between SGN and YWS will be:

- YWS to supply raw biogas to SGN, the supply point is the isolation valve on the SGN facility boundary;
- SGN drainage systems will connect to the existing YWS drainage system; condensate returns and site runoff water will be transferred from SGN control to YWS control at the SGN site boundary. Isolation valves will be installed within the SGN boundary to protect the YWS system and a non-return valve will be installed to prevent backflow of YWS drainage into the SGN drainage systems;
- YWS will supply electricity to the BtG plant; and
- YWS will supply potable water to the BtG plant.

Environmental Management

A new environmental management system (EMS) and associated Environmental Management Plan (EMP) will be developed for the BtG plant. The EMS will take account of the EA and DEFRA guidance: Develop a management system: environmental permits; and will be prepared with reference to one or more of the following certified schemes / standards: ISO 14001:2015, Green Dragon, phases 1 to 5 of British Standard (BS) 8555, BS EN ISO 14005:2019 and EMAS Global.

Interactions between SGN and YWS and their respective responsibilities are subject to a contractual agreement. This, along with any associated procedures / protocols will be addressed and fully documented in the BtG plant EMS.

Site Condition Report

A Site Condition Report (SCR) has been produced for the activities covered by this permit application. The SCR defines the existing baseline conditions at the BtG facility and thus provides the benchmark for the requirement of any remedial works that may be needed following cessation of activities.

Site Location and Environmental Setting

The BtG plant will be located within the area administered by Leeds City Council, just over 4 km to the south east of Leeds. The plant will be situated within an industrialised area with the A63 located approximately 100 m to the north of the BtG plant.

The closest residential properties are located almost 900 m to the north of the BtG plant while the nearest commercial buildings are 260 m to the north of the BtG, beyond the A63. The closest air quality management area is over 2 km away. As the BtG plant will be located in a predominantly industrial area, and close to main transport links, the existing ambient noise levels in the vicinity of the BtG plant and the nearest noise sensitive receptors are likely to be moderate to high.

There are no statutory nature conservation sites of European or international importance within 10 km of the BtG plant. The nearest statutory nature conservation site of national importance is Townclose Head Site of Special Scientific Interest (SSSI), some 6.8 km to the south east. There are four other SSSIs within 10 km of the BtG plant. Halton Moor Local Nature Reserve is the only statutory nature conservation site of local or national importance within 2 km, located approximately 850 m to the north of the BtG plant. There are two non-statutory conservation sites within 1 km: Temple Newsam Estate Wood Local Wildlife Site (LWS) 450 m east and Halton Moor LWS 850 m north.

The superficial drift aquifer beneath the site is classified as a Secondary A aquifer, the bedrock is also classified as a Secondary aquifer. The site location is not within a groundwater Source Protection Zone (SPZ). The nearest water course is Wyke Beck, which is located approximately 35 m the north east of the BtG plant location. The next nearest water course is the River Aire, approximately 900 m to the north west. The site is located within Flood Zone 1 on the EA's Flood Map for Planning,

meaning that there is a low probability of flooding. A Flood Risk Assessment was prepared and submitted in support of the planning application for the BtG plant.

Point Source Emissions

There are two point source emissions to air (A1 and A2), their locations are shown in Appendix A, Figure A.5.

- A1 - offgas from the membrane separation unit exhaust stack; primarily consisting of carbon dioxide with a small quantity of methane (<1%) and very low concentrations hydrogen sulphide, siloxanes, volatile organic compounds (VOC); and
- A2 - the biomethane flare exhaust; primarily consisting of carbon dioxide, carbon monoxide, oxides of nitrogen, sulphur dioxide, and VOC.

[Note: ammonia is not expected to be present in the incoming biogas at any appreciable level. Recent testing of the raw biogas supports this as ammonia was not present above the limit of detection. This is consistent with reported monitoring data for biogas produced at similar plant.]

There are no direct releases to sewer or surface water. Condensate and potentially contaminated site runoff water from within the regulated facility will be collected in two separate drainage systems. The effluent from the two systems will be transferred (gravity fed) into the existing YWS drainage system. From there it will be returned to the WwTW inlet. This is effectively no change to current operations at the STF, where condensate is removed from the raw biogas and returned to the WwTW inlet, along with site runoff water.

There are no emissions to land. The clean water from rainfall onto roofs, or areas that have no potential to be contaminated, will discharge to soil (and potentially groundwater) via soakaway(s). Clean rain water is not considered to be an ‘emission’.

Fugitive Emissions

Biogas treatment is not an inherently dusty process and fugitive dust emissions are not anticipated. There will be the potential for fugitive emissions to air from the BtG, as a result of abnormal / accidental releases of biogas, biomethane and propane from plant equipment and pipework.

The principal potential sources of fugitive emissions will arise from the storage and handling of materials and wastes, the drainage systems and associated accidental releases. Potential sources of fugitive emissions to land / water are propane (in its liquid form) releases and the raw materials and wastes used / generated at the site. Measures to control the storage and containment of these substances are described in the application supporting document.

Techniques for Process and Emissions Control and BAT Assessment

The main over-arching forms of process and emissions control for normal and abnormal operations at the BtG plant will be managed and controlled through a combination of measures including; design, compliance with appropriate standards / legislation and guidance, process controls, operational procedures, the EMS and EMP (including management procedures, inspection and maintenance regimes, training, AMP and emergency response plans).

A BAT assessment of the process and emissions controls to be installed and employed at the BtG plant has been undertaken. Guidance used to derive BAT includes:

- general EA guidance for permit compliance;
- Biological Waste Treatment Appropriate Measures for Permitted Facilities guidance 2022 (as amended);
- the relevant sections of the Waste Treatment BREF BAT Conclusions; and

- reference to typical / likely permit conditions.

The BAT assessment considers:

- Development and Scope of the EMS.
- Design / Operational Standards & Controls & Protection Measures.
- Process Monitoring / Controls.
- Record Keeping and Procedures.
- Contingency Plans and Procedures.
- Technology and the Use, Treatment and Disposal of Biogas.
- Control of Point Source and Fugitive Emissions (Including Noise).
- Materials Storage and Handling.
- Waste.
- Process Efficiency.
- Environmental Performance Indicators.
- Maintenance and Corrective Action.
- Commissioning.
- Site Closure and Decommissioning.

The BAT assessment concludes that the BtG plant will meet BAT requirements for all of the above aspects.

Impact Assessment

An assessment has been undertaken to determine the potential environmental impact and risks posed by the BtG plant, and to ensure that there are no significant impacts on the environment or human health. In accordance with EA guidance, and appropriate to the nature of the activities and potential impacts on site, the following assessments have been carried out:

- air quality;
- odour;
- noise;
- global warming potential (GWP);
- site waste; and
- fugitive releases and accidents.

The only channelled aqueous releases are via transfer from the BtG plant drainage systems to the YWS drainage system, which is routed to the WwTW inlet. The resultant YWS WwTW final effluent discharge is subject to regulation via a separate permit. The BtG plant drainage will comprise small quantities of condensate returns (identical to that produced presently at the YWS STF) and site runoff water; therefore, a quantitative assessment of point source emissions to water is not deemed necessary to determine that impact is insignificant.

The only discharge to ground (or groundwater) is clean water from rainfall onto roofs (or areas that do not have the potential to be contaminated). This will discharge to ground (and potentially groundwater) via soakaway(s). Clean rain water is not considered to be an ‘emission’ therefore impacts from point source emissions to land have been screened out as an insignificant risk to environmental or human health.

Air Impact

The main emissions are emissions to air from the offgas released from the membrane separation unit exhaust stack and, to a lesser extent combustion gases from the biomethane flare.

Data for the CO_2 offgas emission point was entered into the H1 risk assessment tool. The assessment of contaminant concentrations in the CO_2 offgas considered short term and long term exposure. The assessment determined that there is an insignificant impact on human health and the environment from the membrane separation unit stack emissions. No further assessment is required.

The information provided for the flare was processed using the Environment Agency's dispersion factors for landfill gas flares for a human health receptor in the range 250-300 m (commercial building). The assessment determined that the impact of the biomethane flare is considered insignificant and that no further assessment is required.

Odour

A semi-quantitative odour assessment has been undertaken for the offgas from the membrane separator unit. The offgas is not expected to contain odour concentrations at an appreciable level. The carbon filters have a very high efficiency (over 99%) and will effectively reduce emissions of odorous organic compounds. The predicted odour emission concentration demonstrates compliance with the Waste Treatment BREF (for odour from biological treatment processes). It is therefore not considered necessary to carry out detailed odour modelling, or to produce an odour management plan.

Noise

The main sources of noise are the blowers, chillers and compressors. The flare is not a significant noise source. Noise attenuation has been taken into account as part of the overall design of the BtG Plant and for specific items of equipment. The design for the BtG plant will ensure a maximum noise limit of 85 dBA at 1 m.

A screening assessment of potential noise impacts from the BtG plant on noise sensitive receptors has been conducted. The assessment considers the requirements of the EA's guidance for 'Step 1: desktop risk assessment' as well as applicable noise guidance. Predicted external noise levels were found to be below the lowest observed adverse effect level, and below the existing ambient noise levels, at all receptors considered, during both daytime and night-time periods. Therefore, no adverse impact from the BtG plant is expected and the risk from noise from the BtG plant at the closest noise sensitive receptor is considered to be low. It is therefore not considered necessary to carry out detailed noise modelling, or to produce a noise management plan.

Global Warming Potential

The GWP at the maximum design biogas inlet flow rate is estimated at approximately 18,500 t/yr CO_2 equivalent; at the average biogas inlet flow rate this drops to approximately 10,500 t/yr CO_2 equivalent. Energy use, which leads indirectly to the generation of greenhouse gases, will be minimised though an energy management system which will automatically adjust the use of equipment to meet the process demands as efficiently as possible; and regulate energy use at the facility to ensure maximum efficiency.

Waste

There will be minimal waste arising from activities associated with the BtG plant. The main waste stream is spent activated carbon which will be removed from site by a waste contractor for regeneration / disposal. For any wastes generated, the Waste Framework Directive (WFD) hierarchy will be applied, with the option of disposal only considered once all other options have been considered.

Minimisation of air emissions and emissions to land, groundwater or surface water from waste will be achieved through design, via effective waste storage, inspection, maintenance and management / control and handling procedures. It is considered that the potential for environmental impacts arising from the generation, handling and transport of wastes at the BtG plant is insignificant.

Fugitive Emissions and Accidents

There will be no fugitive emissions as a result of normal operation of the BtG plant. Fugitive emissions would only arise as a result of abnormal operation or an accident scenario. A qualitative risk assessment has been undertaken for potential impacts of fugitive / accidental releases to air; land groundwater and surface water. The outcome of the assessment concludes that the risk is low.

Monitoring

The membrane separation unit exhaust stack will be monitored during performance testing, following hot commissioning works. Thereafter it is proposed that six-monthly hydrogen sulphide (or odour) monitoring be undertaken on the stack from the membrane separation unit. The exhaust stack will be fitted with a suitable port to enable access and monitoring.

As the biomethane flare will operate for notably less than 10% of the year, emissions testing is not proposed on a regular basis. However, the biomethane flare will be monitored during performance testing (following hot commissioning) and these results can be made available to the EA if required.

No routine monitoring of the effluent transferred from the BtG facility to YWS is proposed. However, condensate returns will be sampled during performance testing (following hot commissioning) and these results can be made available to the EA if required.

There are no emissions to land and no monitoring is proposed.

1. The Regulated Facility & Operator

1.1 General Information

1.1.1 Introduction

SGN Gas to Grid ProjectCo1 Ltd. (SGN) proposes to build and operate a new biomethane to grid (BtG) plant within Knostrop Sludge Treatment Facility STF). The STF is in the grounds of the wider Knostrop Wastewater Treatment Works (WwTW), which is owned and operated by Yorkshire Water Services (YWS) (see Appendix A for location and layout drawings / plans). The YWS STF is a regulated facility (Permit number EPR/FB3809MM) and the BtG plant will also be a regulated facility, requiring an environmental permit to operate. The area of land that the BtG plant will be built on is being leased to SGN by YWS. YWS is submitting an application for the 'partial surrender' of this area of land from the STF permit boundary.

The raw biogas is produced at the YWS STF by anaerobic digestion and is currently used by YWS as a fuel in combined heat and power (CHP) engines and boilers to help meet the heat and power demand at the WwTW. Any off-specification biogas, or excess biogas, is disposed of by YWS at the STF waste gas burner. Once the BtG plant is operational, the raw biogas will instead be routed to the BtG plant and cleaned (upgraded) to produce biomethane of a quality that is suitable for injection into the local gas grid network.

Depending on the quality of the biomethane gas, it will either be sent for final conditioning prior to entry to the local gas network (operated by Northern Gas Networks (NGN)) as a renewable fuel; or, if non-compliant, routed to a new biomethane flare at the BtG plant for disposal. The biomethane product will comply with:

- the Gas Safety (Management) (Amendment) Regulations 2023[1] (GSMR); and
- the Quality Protocol Biomethane from Waste (hereafter referred to as 'Biomethane Protocol)[2].

The BtG plant will have a higher tolerance to the variations in the raw biogas specification and consequently a higher 'asset availability'. This will help to reduce net carbon emissions from the YWS STF as the overall requirement to flare off-specification / excess biogas will reduce.

The BtG plant will be a Directly Associated Activity (DAA) to the YWS anaerobic digestion activity. Consequently, SGN is applying for a bespoke DAA environmental permit for the new BtG plant. This document is the supporting information document (SID); it provides the detailed information required for the application.

1.1.2 Guidance Documents

General EA guidance for the preparation of Environmental Permitting Regulations (EPR) application documentation is referenced as applicable throughout this document. In addition, reference to typical / likely permit conditions has been made where this is considered to be useful.

1 The Gas Safety (Management) (Amendment) Regulations 2023, available at: https://www.legislation.gov.uk/uksi/2023/284/contents/made.

2 Quality Protocol Biomethane from Waste, WRAP and Environment Agency, December 2013.

Activity specific guidance is provided in the following EA documents:

- Biological Waste Treatment Appropriate Measures for Permitted Facilities guidance[3] 2022 (as amended) (herein referred to as 'BWT AppM'); and
- relevant sections of the Waste Treatment BREF / BAT Conclusions (2018).

These documents make up the technical guidance referred to in the Best Available Techniques (BAT) assessments in the main sections of this application, detailing the measures expected of operators to control the risk of pollution. It is noted that the more recent BWT AppM guidance is informed by the Waste Treatment BREF. Consequently, only any additional requirements of the Waste Treatment BREF itself have been specifically addressed.

1.1.3 Programme

Construction works are due to commence in June 2024 (subject to planning approval). Cold commissioning is due to start in February 2025 with completion of hot commissioning works by September 2025. At this point the plant will be capable of providing biomethane to the local gas network. Performance testing is scheduled from September to October with handover to the SGN operations team thereafter. SGN politely requests determination of this permit application on an appropriate timescale to dovetail with the proposed programme.

1.2 Application Information

1.2.1 Type of Application

This application is for a new bespoke DAA environmental permit, as agreed in pre-application discussions.

1.2.2 Regulated Facility Name

The name of the regulated facility is Knostrop BtG Plant.

1.2.3 Regulated Facility Address

Knostrop BtG Plant
Knostrop Sludge Treatment and Tankered Waste Facility
Knowsthorpe Lane
Leeds
LS9 0PJ

1.2.4 Regulated Facility Grid Reference

The site is centred at National Grid Reference SE 33852 31762.

1.2.5 Pre-application Discussions

Basic pre-application advice from the EA in relation to this permit application has been sought. An initial meeting was held on 13th July 2022. Due to the passage of time and additional queries, further

3 Biological waste treatment: appropriate measures for permitted facilities - Guidance - GOV.UK (www.gov.uk).

discussion commenced in September 2023 and a series of email pre-application related communications were exchanged between then and April 2024.

1.3 Legal Status of Operator

SGN will be the operator of the plant for the purposes of the Environmental Permitting Regulations.

The registered company address is SGN Gas to Grid ProjectCo1, St Lawrence House, Station Approach, Horley, Surrey, RH6 9HJ. The company registration number is 14833622 and a copy of the company's information from Company's House is located in Appendix B.

1.4 Site Location

The BtG plant will be located within the area administered by Leeds City Council (LCC), just over 4 km to the south east of Leeds, within the YWS WwTW and within the boundary of the STF.

The site location is described further in Section 1 of the Site Condition Report (SCR), which is provided in Appendix C of this document. The proposed BtG plant facility boundary is in provided in Figure A.1 in Appendix A. The location of the BtG plant facility boundary within the STF permit boundary is in Figure A.2 (Appendix A) and Figure A.3 provides the location of the STF within the local area.

1.5 Environmental Context / Setting

The plant is to be situated within an industrial area (YWS WwTW) with the A63 located approximately 100 m to the north of the BtG plant.

The closest air quality management area (AQMA) is over 2 km away. The closest residential properties are located almost 900 m to the north of the BtG plant while the nearest commercial buildings are 260 m to the north of the BtG plant, beyond the A63.

As the BtG plant will be located in a predominantly industrialised area, within a working WwTW and close to main transport links, the existing ambient noise levels in the vicinity of the BtG plant and at the nearest noise sensitive receptors are likely to be moderate to high.

There are no statutory nature conservation sites of European or international importance within 10 km of the BtG plant. The nearest statutory nature conservation site of national importance is Townclose Head Site of Special Scientific Interest (SSSI), some 6.8 km to the south east. There are four other SSSIs within 10 km of the BtG facility (Leeds - Liverpool Canal (6.9 km to the north west), Mickletown Ings (7.2 km to the south east) Roach Lime Hills (7.8 km to the east) and Eccup Reservoir (9.9 km to the north, north west)).

Halton Moor Local Nature Reserve (LNR) is the only statutory nature conservation site of local or national importance within 2 km, located approximately 850 m to the north of the BtG plant. There are two non-statutory conservation sites within 1 km: Temple Newsam Estate Wood Local Wildlife Site (LWS) 450 m east and Halton Moor LWS 850 m north. There is no Ancient Woodland within 1 km.

The nearest water course is Wyke Beck, which is located approximately 35 m the north east of the BtG plant location. The Wyke Beck is classified as a Water Framework Directive watercourse. The next nearest water course is the River Aire, approximately 900 m to the north west. The superficial drift aquifer beneath the site is classified as a Secondary A aquifer, the bedrock is also classified as a

Secondary aquifer. The site location is not within a groundwater Source Protection Zone (SPZ), the nearest SPZ (Zone 3) is nearly 10 km to the north east.

The site is located within Flood Zone 1 on the EA's Flood Map for Planning, meaning that there is a low probability of flooding. A Flood Risk Assessment (FRA) was prepared and submitted in support of the planning application for the BtG plant.

The environmental context of the facility is described further in Section 2 of the Site Condition Report (SCR) (which is Appendix C to this SID).

1.6 Overview of the BtG Plant

1.6.1 Operational Hours and Control

The BtG plant will operate 24 hours per day, 7 days per week. Plant shutdown for planned maintenance is scheduled to take place every 6 months for 6 monthly and annual servicing. This will equate to a total of 384 hours per year (equivalent to 16 days)[4]. The operational life expectancy is currently 15 years, with a possible 5 year extension.

The plant will be automated for much of the time. SGN will provide a 24/7 out of hours standby system to support the facility. See also Section 2.4.6 in relation to site inspection.

1.6.2 Security

Security measures that will apply to the BtG plant are provided in Section 5.6 of the BWT AppM guidance.

The BtG plant will be built within the existing YWS WwTW which has CCTV monitoring and 24-hour security presence. The YWS site is surrounded in security and perimeter fencing and the SGN area will also be fenced with padlocked access / egress gates. Regular security inspections will be carried out as part of site inspections.

1.6.3 Supply of Biogas

YWS will install a short section of new above ground biogas pipework to transfer raw biogas from the existing YWS biogas network to the BtG plant. The biogas inlet will be fitted with an automated isolation valve that will close in the event of provision of off-specification biogas from YWS. The location of the biogas inlet valve is shown in Appendix A, Figure A.4.

1.6.4 Equipment and Facilities

The main equipment / modules will be located on impermeable surfacing / equipment bases with sealed drainage that meets the requirements of CIRIA 736 (or equivalent approved standard) with sealed construction joints.

4 Where, relevant (e.g. for the calculation of annual emissions) the period of planned maintenance has not been taken into account and it has been assumed that the BtG plant will operate for the entire year (8760 h/yr).

The following main items of plant / equipment will be located within the BtG plant permit boundary:

- 1 No. biogas inlet isolation valve;
- 2 No. heat exchanger / blower packages;
- 2 No. chiller units;
- 6 No. activated carbon filters (ACFs) (arranged in 3 pairs, each in lead / lag configuration), 2 pairs for siloxane removal and 1 pair for removal of hydrogen sulphide (H_2S);
- 2 No. biogas compressors;
- 1 No. three stage membrane separation unit (including air compressor) and control room (this is a single modular unit);
- 1 No. Grid Entry Unit (GEU) kiosk (excluding the compartment with odorant injection system[5]);
- 1 No. underground propane storage tank with a 16 tonne capacity; and
- biomethane flare.

In addition the regulated facility will include:

- 1 x COSHH stores container (for storage of oils and chemicals);
- 1 x stores container (for critical spares - electrical and mechanical parts only);
- 1 x gas bottle stores (nitrogen, hydrogen / helium and calibration gases);
- low voltage (LV) switchroom (for housing electrical distribution equipment and switchgear for powering site wide plant and equipment);
- all ancillary piping, instrumentation, power and control cabling; and
- separate drainage systems for condensate returns and site runoff water, with tie-ins to the existing YWS drainage system.

With the exception of burning non-compliant biomethane in the biomethane flare, there will be no combustion activities at the regulated facility.

Outside of the regulated facility SGN will have a site welfare / office, a parking area and there will be underground pipework to take the biomethane from the GEU to the Remote Operated Valve (ROV) kiosk, which is where the biomethane enters the gas transmission system. The ROV will be owned and operated by NGN.

1.6.5 Process Overview

The maximum operational flow rate of biogas to the BtG plant will be 2,950 Nm^3/h[6] with a routine flow rate of 1,675 Nm^3/h. At the maximum biogas input flow rate, biomethane would be produced at a rate of 1,933 Nm^3/h (2,110 Nm^3/h following the addition of propane).

The raw biogas contains mostly methane, some carbon dioxide (CO_2) and water / water vapour, as well as small quantities of impurities such as H_2S and siloxanes. In order to upgrade the raw biogas to biomethane suitable for entry into the local gas grid it is necessary to increase the methane content and reduce the quantity of water, CO_2 and impurities. The biomethane product will contain >95 vol% methane. Gas cleaning / upgrading will be undertaken through a number of stages and these are described in detail in Section 2.

5 As described in Section 2.4.2.6, the odorisation system will be adopted and operated by NGN, the local gas network operator and is excluded from the SGN permit boundary.

6 The use of 'Nm^3/h' (normal cubic metres per hour) throughout this document is for 'normal' conditions being at 0°C and at atmospheric pressure.

1.7 Application for EPR Permit

This application is for a new bespoke DAA Environmental Permit.

The YWS anaerobic digestion activity is regulated under the Environmental Permitting (England and Wales) Regulations 2016 (as amended) (EPR16) under s5.4A(1)(b)(i) - recovery or a mix of recovery and disposal of non-hazardous waste with a capacity exceeding 75 tonnes per day (or 100 tonnes per day if the only waste treatment activity is anaerobic digestion) involving biological treatment.

The BtG plant will accept biogas from YWS anaerobic digestion plant and will therefore be a Directly Associated Activity (DAA) to the listed activity undertaken by YWS. This approach has been agreed during pre-application discussions with the Environment Agency (EA). The site will operate as a multi operator site with the YWS and SGN facilities each having their own distinct site boundary.

A figure showing the SGN BtG plant permit boundary within the YWS STF permit boundary is provided in Appendix A, Figure A.1. A figure showing the interactions between the YWS site and SGN's site is provided in Appendix A, Figure A.4. This interactions and responsibilities between the two operators are discussed further in Section 3.2.

The limit of the activities at the regulated facility is:

- from receipt of biogas, gas cleaning and upgrading to biomethane to a specification that is suitable for injection into the local gas transmission network, including:
  - operation of the biomethane flare, from the receipt of the biomethane rejected by the BtG plant to the release of combustion products from the flare stack, with sufficient flaring capacity to fully combust the maximum rate of biomethane production under emergency circumstances,
  - collection of process water (condensate) and potentially contaminated surface water and transfer to the YWS drainage system (for treatment in the YWS WwTW).

Due to the nature and quantities of materials used and stored the BtG plant in isolation does not fall under the remit of the Control of Major Accident Hazard (COMAH) Regulations. YWS STF does not currently fall under the remit of the COMAH Regulations. However, as a result of the BtG Plant and other planned YWS schemes, the increase in the total aggregated volume of hazardous substances will mean that Knostrop STF will be classified as a lower tier COMAH site. YWS is actively progressing the preparation of the COMAH submission, which will include the BtG plant hazardous substances inventory.

1.8 Regulated Facility Boundary

As described above, the BtG plant will be located within the existing YWS STF facility. YWS is applying for a partial surrender for the area of land that the BtG Plant will occupy. Appendix A of this document provides:

- the BtG plant permit boundary and site layout (Figure A.1);
- the location of the BtG regulated facility relative to the present day YWS permit boundary (Figure A.2); and
- a site location plan showing the YWS STF boundary in the context of the wider area (Figure A.3).

1.9 Remaining Sections of Document

The remaining sections of this document provide supporting information to the application for a new bespoke permit application for the proposed BtG plant and the management of the associated potential impacts. The remaining sections of the document are as follows:

- Section 2: Process Description & Design;
- Section 3: Management, Closure and Multi-Operator Interactions;
- Section 4: Emissions Inventory;
- Section 5: Techniques for Process and Emissions Control and BAT Assessment;
- Section 6: Environmental Impact; and
- Section 7: Monitoring and Reporting.

Appendices in support of this document are as follows:

- Appendix A: Plans and Drawings;
- Appendix B: Company Information;
- Appendix C: Site Condition Report;
- Appendix D: Air Quality Screening Assessment;
- Appendix E: Noise Screening Assessment; and
- Appendix F: Accident Scenarios and Mitigation Measures

2. Process Description & Design

2.1 Introduction

Anaerobic digestion of sewage sludge leads to the production of biogas, a potentially substantial source of renewable energy. The optimum recovery and management of this energy is a primary operational objective for YWS, in order to maximise the overall energy efficiency of its WwTW activities at Knostrop STF. This primary objective exists in conjunction with the operational imperative that the digester heat load must always be achieved. Recovery of renewable energy can lead to significant reductions in the use of primary non-renewable sources of energy, such as direct combustion of fossil fuels or the import of electricity generated elsewhere by the combustion of fossil fuels and delivered via the electricity grid.

The SGN BtG plant will enable YWS to maximise the use of the biogas produced by the anaerobic digestion facilities on the YWS site through upgrading the biogas to biomethane and for entry into the local gas network. In addition, as the BtG plant will have a higher tolerance to the variations in the raw biogas specification it will have a higher 'asset availability'. This will help to reduce net carbon emissions from the YWS STF as the overall requirement to flare off-specification / excess biogas will reduce.

2.2 Process Overview

The main processing / activities at the BtG plant will involve:

- receipt of raw biogas;
- pre treatment of the raw biogas, involving:
  - chilling (via heat exchangers) to remove water (condensate),
  - gas boosting (via blowers) to 200 mbar,
  - removal of H_2S and siloxanes (in the activated carbon filters);
- compression of the biogas to approximately 16.5 to 17 bar(a);
- chilling to facilitate further removal of any residual condensate;
- removal of CO_2 (in the membrane separation unit); and
- checking compliance of the biomethane against the GSMR (in the GEU):
  - non-compliant biomethane is routed to the biomethane flare for disposal,
  - compliant biomethane is conditioned in the GEU, ready for injection into the local gas network via the ROV.

The ROV will control the feed of the biomethane to the existing NGN 17 Bar Central and West Pipeline, approximately 1.5 km to the west of the BtG facility. The ROV will be owned and operated by NGN, the company that operates the local gas distribution network.

At the point at which the biomethane exits the GEU:

- there is no further processing of the biomethane; and
- the gas will be compliant with the requirements GSMR and the Biomethane Protocol[2,7].

[7] Owing to the inherent uncertainty over the point at which waste has been fully recovered and therefore ceases to be waste within the meaning of Article 3(1) of the European Union (EU) Waste Framework Directive [2008/98/EC], the EA (in conjunction with WRAP) developed the Quality Protocol Biomethane from Waste. The protocol sets out end of waste criteria for the production and use of biomethane arising from the degradation of organic wastes in a landfill site or

As the biomethane exiting the GEU is no longer a waste requiring regulation via the environmental permit, the pipeline from the GEU to the ROV and the ROV will not form part of the regulated facility. This approach has precedence, having been applied at other BtG plant. Consequently, the GEU to ROV pipeline and the ROV are not considered, or discussed, further in this document.

2.3 Biogas Specification

Raw biogas is a waste; the relevant code for the European Waste Catalogue (EWC) is considered to be 19 06 99 - wastes from anaerobic treatment of waste – wastes not otherwise specified[8]. Further details are provided below.

SGN and YWS have agreed a biogas specification which sets upper and lower limits on biogas volume and quality. This specification is based on the operational capability of the BtG plant, which is greater than the capacity of YWS existing CHPs. In addition, the BtG plant will be able to process biogas with higher pollutant loads and operate across a wider range of flow than the existing YWS CHPs.

The biogas will be transferred to the BtG plant at a routine operational flow rate of 1,675 Nm^3/h, with the minimum and maximum flow rates being 740 Nm^3/h and 2,950 Nm^3/h respectively. It is a contractual requirement between SGN and YWS that the BtG plant will be capable of processing the maximum biogas flow rate of 2,950 Nm^3/h; however, it is worth noting that this flow rate is only expected to occur on around 10-12 days per year. This 'oversizing' does not affect the efficiency of the plant as the BtG plant has been designed with a built-in energy efficiency management system which will automatically adjust the use of equipment to meet the process demands as efficiently as possible.

The capacity and criteria for the design of the BtG has been based on the raw biogas specification in Figure 2-1.

anaerobic digestion plant, for injection into the gas grid (or for use in an appliance suitably designed and operated for natural gas). If these criteria are met, the biomethane will normally be regarded as having been fully recovered and to have ceased to be waste.

8 Guidance on the classification and assessment of waste (1st Edition v1.2.GB) Technical Guidance WM3

Figure 2-1 - Plant Design Criteria

	Range		
	Minimum	Typical Average	Maximum
Raw Biogas Flowrate (Nm^3/hr)	740	1,675	2,950
Methane Concentration (%)	51.5%	62.6%	N/A

Parameter	Range			
	Minimum	Average	Normal Limit	Maximum
Hydrogen Sulphide (ppm)	5	26	45	250
Siloxanes (mg/m^3)	0	112	150	200

Parameter	Range	
	Minimum	Maximum
Nitrogen	0	2
Oxygen	0	1
Pressure (mbar)	To be confirmed +15mBar @ interface	To be confirmed +35mBar @ interface
Water vapour (condensate)	0 mg/m^3	*Wet Saturated at 50°C*
Temp (°C)	5°C	50°C

Note: the 'normal limit' and maximum values given above for H_2S and siloxanes relate to the contractual agreement between YWS and SGN for raw biogas supply. YWS monitoring data for H_2S (based on 4 years of in-line monitoring of the biogas in the gas holder (1,419 samples)) shows that the 45 ppm 'normal limit' value was exceeded less than 1 % of the time, with the maximum recorded H_2S concentration being 64 ppm. Monitoring data has indicated that the 'normal limit' for siloxanes (150 mg/m^3) is not exceeded; the range of reported siloxane concentrations being approximately 80-130 mg/m^3 (though it is noted that YWS does not yet have in-line siloxane monitoring at Knostrop so the results are from manual sampling and as such the dataset is small).

Concentrations non-methane volatile organic compounds (NMVOC) in the raw biogas are very low, <1 mg/Nm^3. Ammonia is not expected to be present in the incoming biogas at any appreciable level. Ammonia in AD process largely exists in the liquid phase as it is extremely soluble in water. Ammonia drops out in either the sludge or the return liquors from the AD process. Recent testing[9] of the raw biogas supports this as ammonia was not present above the limit of detection (LoD) of 0.05 mg/m^3. This is consistent with reported monitoring data for biogas produced at similar AD plant.

2.4 BtG Plant Process Description

2.4.1 Biogas Supply and Pipework

Biogas is produced at the YWS STF anaerobic digestion activities and transported across the site at 15-35 mbar pressure. A new section of above ground biogas pipework will be installed by YWS to

9 Scienco Ltd Analytical Certificate, sample date 14/02/24, Report No. 20240110, reported on 23/02/24.

transfer the raw biogas from the existing YWS biogas system to the BtG plant. The connection to the BtG plant is planned to be taken from a 500 mm connection off the inlet pipework to the YWS biogas waste gas burner.

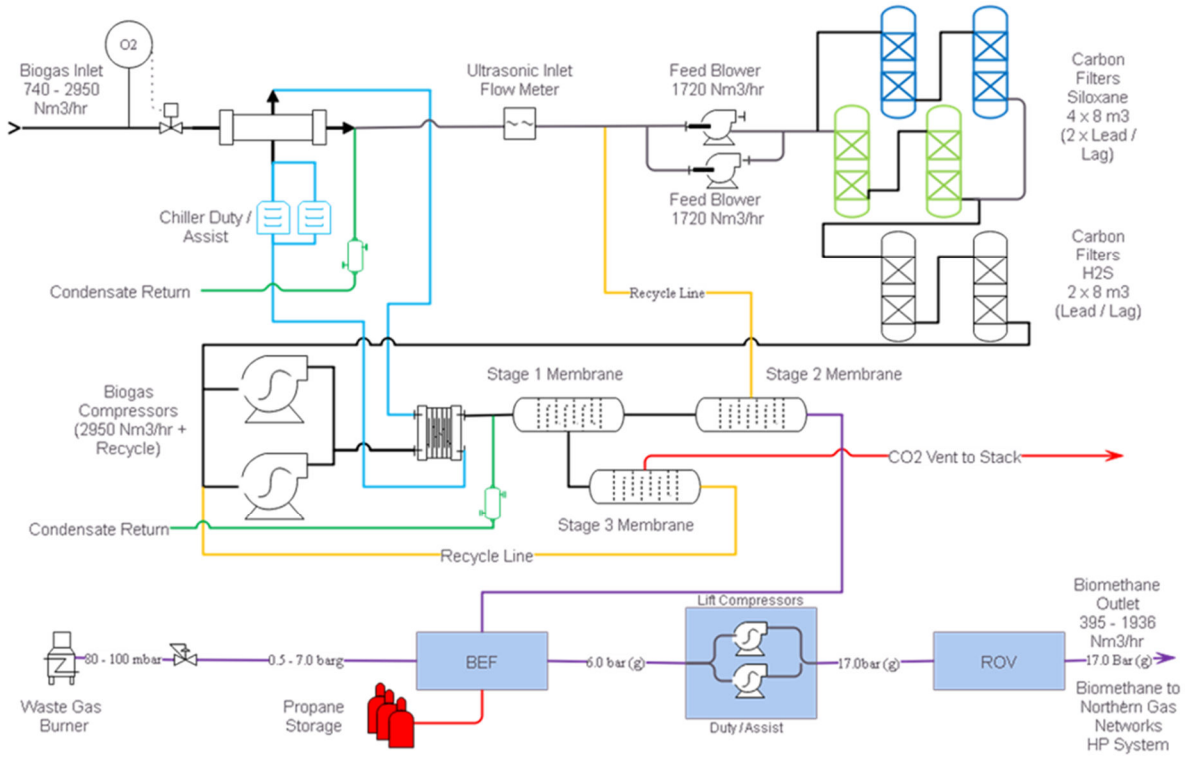
The biogas inlet will be fitted with an automated isolation valve that will close in the event of provision of off-specification biogas from YWS. The location of the biogas inlet valve is shown in Appendix A, on Figure 4. See Section 2.4.4.2 for a description of what happens in the event of the supply of off-specification inlet biogas and its fate.

Incoming gas pipework will be designed to YWS and Water Industry Mechanical and Electrical Standards (WIMES) and other gas pipework will be designed to Gas Institute Standards (GIS). Above ground pipework will be inspected as part of the routine inspection programme (see Section 2.4.6). Periodic CCTV inspection[10] of below ground drainage pipework will be undertaken. A comprehensive preventative maintenance programme will be in place.

2.4.2 Biogas Upgrading - Typical Operation

To upgrade the raw biogas to the standard required for biomethane injection into the local gas grid, the gas will be continuously processed through the various stages of the BtG plant. These stages are described below. Figure 2-2 provides a schematic process flow diagram for the BtG plant.

Figure 2-2 - Schematic Process Flow Diagram



Note (1) 'BEF' (biomethane entry facility) in the above schematic is the same as the GEU (grid entry unit) referred to elsewhere in this document. The terms can be used inter-changeably; however for clarity the remainder of this document only uses the term 'GEU'.

Note (2) The 'Waste Gas Burner' is the same as the biomethane flare, the remainder of this document only uses the term 'biomethane flare' for the BtG plant.

10 The frequency of inspection is yet to be specified but is expected to be at least every 10 years.

Note (3) The limit of permitted activities is up to the point that compliant biomethane exits the BEF (GEU), i.e. excluding the lift compressors and the ROV.

2.4.2.1 Pre-Treatment Water / Condensate Removal

The first stage of the process is to remove water and water vapour from the raw biogas. De-watering is achieved by chilling the biogas in an inline heat exchanger and condensing the water droplets / vapour in a condensate separator. The condensate, which will contain extracted contaminants will be collected in sub-surface catch pots which will drain by gravity to the condensate returns drainage system (see Section 2.5). Trace heating will be installed to reduce the risk of freezing in catch pot and drain line.

The coolant for the heat exchangers will be a glycol / water mixture which will be provided by a non-ATEX rated chiller (and standby unit). The coolant will be circulated through the closed loop heat exchanger circuit. The chiller system comes complete with a circulating pump, expansion vessel and monitoring for temperature and pressure.

The chilled water circuit is also used for chilling the gas after it's been compressed in the biogas compressors (see Section 2.4.2.4).

2.4.2.2 Pre-treatment - Boosting

The de-watered biogas will be routed to the blower (and standby unit) where it will be increased in pressure, typically to approx. 200 mbar and routed to the activated carbon filters.

The blower will be controlled by a variable speed drive with feedback provided by downstream pressure monitoring. The blower will be provided with upstream / downstream isolation valves, non-return valve and a direct connected low inlet pressure protection switch. A secondary function achieved by this stage in the process is the increase in biogas temperature which reduces the risk of condensate drop out in the downstream activated carbon filters.

2.4.2.3 Pre-treatment - Activated Carbon Filters

The activated carbon filters will be used to remove contaminants such as H_2S, and siloxanes (along with any NMVOC) from the biogas. The filter units are totally enclosed. There will be three pairs of activated carbon filters and each pair will be arranged in a lead / lag configuration to allow continuous operation. There will be two pairs for siloxane removal (4 x 8 m^3 tonne vessels, each containing 8,200 kg of activated carbon) and one pair for removal of H_2S (2 x 8 m^3 vessels, each containing 8,200 kg of activated carbon).

The filter units are sized to cater for the full range of the anticipated H_2S and siloxane content of the biogas, with an estimated typical lifetime of 230 days per filter. The higher the content of impurities in the gas, the short the lifetime of the activated carbon. The manufacturer states that the efficiency of the activated carbon filters will be >99%.

H_2S will be continually monitored online between lead / lag filters which will provide a measure of the performance / efficiency of the activated carbon filter units and provide pre-warning of when a filter will require changing. Breakthrough of the lead filter (i.e. when the lead filter is saturated) will drive carbon replacement operations. The lead / lag configuration will be interchanged and the carbon in the original lead unit will be replaced with fresh carbon and will become the new lag unit. Regeneration / disposal of the saturated activated carbon filter will be carried out offsite. The valve arrangement around the carbon filter vessels will permit double block and bleed isolation, to facilitate changes to lead / lag configuration, maintenance, and filter isolation for carbon exchange.

2.4.2.4 High Pressure Biogas Compression and Chilling

The biogas will pass through the high pressure air cooled compressors (two 1,700 Nm^3/h screw compressors capable of 58% turndown ratio) to increase the pressure to the optimum level for the separation of methane and CO_2. This pressure will be in the range 16.5 bar(a) to 17 bar(a), depending on process requirements. Heat is recovered from the oil circuit of the high pressure compressors and used to enhance the CO_2 separation process in the membrane separation unit. The compressors will be housed within their own container.

After compression the biogas is chilled using the chiller circuit (see Section 2.4.2.1) through a 17.3 kW thermal heat exchanger, at approximately 9.6 l/h (at maximum flow). The biogas will pass through coalescer filters, which will remove any residual water droplets (condensate). To protect the operation and performance of the downstream membrane separation unit, any remaining dust / small particle contaminants from the upstream processes will be filtered out and any trace oil carry-over from the biogas compressor will also be removed. The gas then passes to the membrane separation unit.

As for the pre-treatment chilling stage, the condensate, which will contain extracted contaminants will be collected in sub-surface catch pots. The pots will drain to the condensate returns drainage system (see Section 2.5) from which condensate will be transferred to the YWS drainage system for treatment in the WwTW. Trace heating will be installed to reduce the risk of freezing in catch pot and drain line.

2.4.2.5 Membrane Separation Unit and Stack

The membrane separation unit will use highly selective polymer membranes in a 3-stage configuration to separate CO_2 from methane. The polymer membranes have a higher selectivity for CO_2 than for methane and the separation of the former from the latter occurs inside the polymer fibre by a solution and diffusion mechanism. The polymer from which the membrane is formed allows the methane molecule to be retained within the gas stream while allowing the CO_2 molecule to pass through its structure and separate from the methane. CO_2 removal can be adjusted, as required, by changing the pressure across the membranes. The partially processed biogas will be fed to one side of the membrane.

Two streams are produced by the membrane:

- a retentate, which is enriched in methane; and
- a permeate, which is enriched in CO_2.

Stages 2 and 3 of the membrane separation process are designed with recycle lines so that partially processed biogas can be recirculated back to either the blowers (via stage 2) or the biogas compressors (via stage 3) - see Figure 2-2. The methane rich stream from stage 2 passes to the GEU, the CO_2 offgas from the upgrading process is emitted through a stack, approximately 6 m high. The offgas will contain CO_2 in excess of 98.3 vol%. See Appendix A, Figure A.5 for the location of the stack. See Appendix D for further details of stack parameters and the associated emissions.

2.4.2.6 Grid Entry Unit

The GEU will be housed in a separate kiosk on concrete hardstanding. It will provide an automated decision on the suitability of biomethane for grid entry. As biomethane enters the GEU it will be monitored for its quality and suitability for injection into the local gas grid. The biomethane will need to comply with the requirements GSMR and the Biomethane Protocol for acceptance into the local gas grid. Non-compliant gas will be routed to the biomethane flare. If biomethane is ‘rejected’ for prolonged periods (over 20-30 mins) the BtG plant will shut down until the issue can be resolved (see Section 2.4.4).

The ‘official’ calorific value determination device (CVDD) will be Office of Gas and Electricity Markets (Ofgem) approved and will be maintained to a strict schedule. Other monitors / analysers will be used to determine the other monitored parameters (e.g. H_2S content, O_2 content and the Wobbe index (a measure of the burnability of the gas)).

The GEU will ensure that each output stream (whether to grid or to biomethane flare) will be fully compliant with pressure systems regulations and will be fitted with the appropriate active / monitor / slam shut pressure regulators. The regulators will ensure that the pressure of the gas streams is appropriate. The actual pressure levels will be determined in detailed design but are expected to be between 4.5 and 6.9 barg for gas to the grid and between 0.5 and 6.9 barg for reject gas to the biomethane flare.

NGN will require the site to produce biomethane to meet a target calorific value (CV). This target CV will be conveyed to the GEU over a NGN telemetry link, which will be monitored continually. If the CV of the biomethane is too low a small amount of propane (typically 3 - 4%,) will be added to increase the level of the calorific value.

Liquid propane will be stored below ground in a vessel with a 16 tonne capacity. The propane vessel and pipework will not generate any emissions to air. Propane is vaporised prior to addition to the biomethane. The pressure of propane in the propane pipework will be controlled by a pressure regulator and a slam shut valve will also be installed. Propane pressure is monitored remotely (via a human interface panel and remote connection devices) in the liquid and vapour phase. The propane storage vessel will have a visual sight glass or gauge and will be fitted with low and high level alarms and there is a safety cut out at 80% fill capacity to prevent overfilling.

Propane use will vary subject to the raw biogas composition and flow rates and the target CV set by NGN on a daily basis. However, based on an average target calorific value of 39.6 MJ/m^3 and average biogas production rate (1,675 Nm^3/hr), annual propane use has been estimated at approximately 600 tonnes. The calorific value of the biomethane will be checked (re-measured) after the addition of propane. Once the compliant biomethane has the correct CV it will be odourised.

NGN requires that the gas is odourised and that they have control over the odourisation process. The GEU will contain a separate, locked compartment within which the NGN odourisation system will be located. The odourisation system has been designed to automatically deliver the precise amount of odorant required into the gas stream to give it its characteristic smell. The odorant will be a blend of tertiary-butylmercaptan and. Odorant will be stored in a 70 l Schmidt keg double bunded container which will have a visual sight glass or gauge and will be fitted with low and high level trips and alarms. It is estimated that approximately 140 kg/yr of odorant will be used. As NGN will have control over the odourisation system, this part of the GEU has been excluded from the permit boundary (as illustrated (bounded in green) in Figure A.1 in Appendix A).

At the typical average biogas inlet flow rate of 1,675 Nm^3/h, the biomethane production rate will be approximately 1,050 Nm^3/h. The minimum and maximum biogas inlet flow rates are 740 Nm^3/h and 2,950 Nm^3/h; these flow rates will result in biomethane production rates of 395 Nm^3/h to 1,933 Nm^3/h (approximately 2,110 Nm^3/h following the addition of propane). NGN has confirmed that the local gas grid has sufficient capacity to accept this flow rate. Biomethane exported for injection to the local gas grid will be metered to required standards and flow and energy data will be provided for billing purposes.

2.4.2.7 Biomethane Flare

A new biomethane flare will be installed at the BtG plant to enable the safe disposal of non-compliant biomethane. The biomethane flare will operate on start up of BtG plant or in the event of the

production of non-compliant biomethane gas. The biomethane flare is not anticipated to operate for more than a 30 minute period under normal circumstances.

The new biomethane flare will be a shrouded ground flare with a maximum flow capacity of 2,110 Nm^3/h. This is consistent with the maximum biomethane production capacity of the BtG plant. The biomethane flare is designed for fully automatic, unattended operation. In-built process controls automatically initiate the operation of the biomethane flare in response to operating system triggers and then control combustion conditions for optimum performance. The biomethane flare will be subject to regular performance monitoring and planned maintenance to ensure minimum emissions, maximum combustion efficiency and maximum operational availability. The biomethane flare will comply with the operating conditions of 0.3 seconds' residence time at 1,000°C as listed in Environment Agency guidance document: Guidance for Monitoring Enclosed Landfill Gas Flares (LFTGN05 v2 2010)[11], will be fitted with a monitoring port, and is designed to meet the emission limits set in LFTGN05 v2 2010.

See Appendix A, Figure A.1 for the location of the biomethane flare and Figure A.5 for the discharge point location. See Section 4.1.3 and Appendix D for further details on the biomethane flare and the associated emissions.

2.4.2.8 Biogas Measurement and Monitoring

Operation of the BtG plant will be monitored by means of flow, temperature and pressure instrumentation, which will provide process control and ensure safe operation. The management system for the BtG plant will control the process parameters to achieve compliant biomethane output proportional to the biogas input.

There are three main locations within the regulated facility for monitoring the biogas specification through its transformation to biomethane:

- pre-treatment;
- after the activated carbon filters; and
- at the GEU.

During pretreatment the biogas will be monitored to ensure that it meets the contractual (and design) specification for the BtG plant. After the removal of water vapour the biogas will be monitored using an ultrasonic flow meter, with pressure and temperature correction. The location of the meter is yet to be confirmed but is likely to be between the blower and the activated carbon filters. If any measured parameters (e.g. H_2S, methane, oxygen, nitrogen and CO_2) are deemed to be out of specification the automated isolation valve at the biogas inlet to the BtG plant will close and the BtG plant will shut down.

Monitors will be installed on the three pairs of activated carbon filters, after the lead filter for measuring concentrations of H_2S and siloxanes (as relevant). The monitors will be fitted with high (warning) level and shut down level alarms. The alarm levels will be set depending on the finalisation of detailed design and the Gas Quality Risk Assessment (GQ8 process). As an example, on previous installations 1.5 ppm and 2.7 ppm have been used for the warning and shutdown levels respectively for H_2S.

As described previously, at the GEU the biomethane is monitored to ensure compliance with the requirements of the GSMR and Biomethane Protocol. Biomethane that fails this check is routed to

11 Guidance for Monitoring Enclosed Landfill Gas Flares (LFTGN05 v2 2010).

SGN's biomethane flare. Compliant gas is conditioned (the calorific value is then re-measured), odourised (by NGN) and sent for injection into the local gas grid.

2.4.2.9 Safety Valves

Safety valves such as pressure relief valves (PRVs) and slam shuts will be implemented across the BtG plant which will operate only under fault conditions to depressurise the system. This is likely to include pressure relief valves on the outgoing side of the activated carbon filter units and pressure relief valves on the compressors. PRVs will only be used if they are designed, tested and manufactured in line with recognised standards such as BS EN ISO 28300:2008 or API2000. All pressure safety equipment will be covered by a 'Written Scheme of Examination' and will be tested at the required frequencies, as set out by the Competent Person. The installation, maintenance and testing of PRVs will be undertaken by an approved qualified engineer. The selection, design and setting of PRVs will ensure that fugitive emissions are minimised. The relevant requirements of BWT AppM Section 8.11 (Pressure and vacuum relief control - AD and TAD plants) will be taken into account. SGN's final detailed design solution will provide further details and information on the location of the valves.

2.4.3 Biomethane Specification

As discussed previously, biomethane that is injected into the local gas grid will meet the requirements and specified criteria in the GSMR[1] and the Biomethane Protocol[2]. SGN will incorporate suitable procedures into the facility's EMS, including operating procedures for the BtG plant, which will assure compliance with the criteria set out in the GSMR and the Biomethane Protocol.

The BtG plant has been designed to deliver biomethane within the following typical specification:

- methane content: ≥ 95.0 vol%;
- CO_2 ≤ 1.6 vol%;
- nitrogen ≤ 3.1 vol%;
- oxygen ≤ 0.4 vol%;
- H_2S ≤ 3 ppmv;
- ammonia ≤ 1 ppmv;
- VOCs ≤ 1 vol%;
- Siloxanes ≤ 1 vol%;
- temperature ≤ 15°C;
- dewpoint ≤ -50°C; and
- pressure ≤ 10.5 barg.

2.4.4 Start Up and Abnormal Operation

If there is a period where no biogas is available from YWS, the BtG plant will idle in standby mode awaiting run command from YWS. When biogas is available once more, the BtG plant will receive a signal which will automatically initiate the start- up sequence.

Other than when biogas is not available, there are four main modes of atypical / abnormal operation:

- start up of the BtG plant;
- receipt of off-specification biogas from YWS;
- production of non-compliant biomethane; and
- closure of the ROV.

Use of the biomethane flare for all modes of atypical operation will be less than 10% of the year; however, a more realistic expectation is estimated at less than 200 hours per year.

2.4.4.1 Start Up

The BtG plant will be required to start up periodically, after maintenance and / or after unplanned shutdown or process upset conditions such as:

- an electricity supply failure;
- equipment failure; or
- insufficient biogas to maintain the operation of the BtG plant.

When the BtG plant first starts up biogas will be processed at low flow conditions. The initial output gas will not be suitable for injection to the grid, as it will not meet the grid entry requirements. The output gas product will therefore be directed to the biomethane flare whilst the process stabilises and the requirements for grid injection can be demonstrated as met. Once the biomethane requirements are met, grid injection can commence and flaring will cease. Rejection of biomethane during start up is expected to occur for less than 30 minutes, typically 20 minutes.

2.4.4.2 Off-Specification Biogas

SGN shall install monitors to measure the flow rate and the component gases within the raw biogas supplied by YWS to ensure that it is within the agreed volume and quality specifications.

Off-specification Biogas Volumes

As noted previously, the BtG plant has been sized to be capable of processing flows greater than the maximum flows historically produced by Knostrop STF. If biogas production were to exceed the capacity of the BtG plant, for example during planned BtG plant maintenance, excess biogas would be directed to the YWS biogas using assets (the YWS boilers and CHPs). If the capacity of all these assets were exceeded, the YWS waste gas burner would be utilised.

The BtG plant will be capable of operating at approximately 25% of maximum flow. When the biogas supply is less than the minimum flow, the BtG plant will shut down until a sufficient flow rate can be resumed. During that period, biogas would be directed to the YWS boilers and CHPs.

Off-specification Biogas Quality

The biogas specification contains quality parameters for methane, nitrogen, oxygen, hydrogen sulphide and siloxanes. Biogas that is outside of the specification will not be accepted by SGN on the basis it cannot be processed by the BtG and / or it poses an unacceptable health and safety risk.

The specification for biogas supply is based on YWS historical biogas data and the ability of the BtG assets to safely process biogas. Of particular concern for asset health and availability are hydrogen sulphide and siloxanes due to their respective corrosive and abrasive nature. Upper limits for both substances have been set at a level much higher than has been recorded on site. YWS estimates that production of off-specification biogas would occur less than once per year.

If the quality of the raw biogas is out of specification, the biogas inlet valve to the BtG plant would be closed automatically and the BtG plant will start to shut down (see Section 3.2.3 in relation to communications between the BtG plant and YWS). Where technically possible and safe to do so, off-specification biogas shall be used the YWS boilers until the composition of the biogas returns to being compliant with the specification. Only if the YWS boilers are incapable of processing the biogas during this period would the YWS waste gas burner be used.

2.4.4.3 Non-Compliant Biomethane

If the grid entry requirements for biomethane cease to be met at any point during grid injection, the non-compliant biomethane will be routed to the biomethane flare. The BtG plant control and monitoring systems will automatically attempt to correct the deviation(s) in biomethane quality. If

biomethane is ‘rejected’ for prolonged periods (over 20-30 mins) the BtG plant will shut down until the issue can be resolved.

YWS will then be responsible for the use / fate of the raw biogas. As described in Section 2.4.4.2, in the first instance the preferred option would be to use the biogas as a fuel. Only biogas that cannot be used as a fuel would be routed to YWS waste gas burner.

2.4.4.4 Closure of the ROV

Although it is acknowledged that there will be periods in the summer etc. where demand on a gas network is low; a detailed gas analysis study has been carried out with NGN. The study concluded that even in the event of low demand, the network the Knostrop BtG plant will be connected to will always be able to accept the maximum biomethane production rate from the BtG plant. Consequently, the only times that NGN will close the ROV are expected to be for periods of maintenance to the ROV and associated equipment; or in the event of an emergency where the downstream gas network may need to be isolated.

If the ROV closes the BtG plant will stop taking biogas from YWS and the BtG plant will close down (see Section 3.2.3 in relation to how this will be communicated to YWS). YWS will then be responsible for the use / fate of the raw biogas - as described above, the biogas will preferentially be used as a fuel and only routed to the YWS waste gas burner as a last resort.

2.4.5 Maintenance and Corrective Action

2.4.5.1 Planned Maintenance

A preventative maintenance programme and maintenance plan will be implemented, the plan will take account of the measures listed in Section 5.2 of the BWT AppM.

A high level of planned preventative maintenance is designed to avoid unscheduled down time, maximising plant availability and its ability to control emissions and maintain an efficient level of operation between overhauls. Record sheets will be complete and will highlight any issues that may require operator intervention outside the routine maintenance programme.

Plant shutdown for planned maintenance is scheduled to take place every 6 months for 6 monthly and annual servicing. This will equate to a total of 384 hours per year (equivalent to 16 days). Three monthly services will not require a shutdown. Occasionally change out of the carbon in the carbon filters may need to take place outside of the 6 monthly / annual servicing, this will require a shutdown.

SGN will have service level agreements with all of the key equipment manufacturers for undertaking the six monthly and annual servicing. Consequently, the BtG plant will be maintained in accordance with manufacturer recommendations and guidelines.

The BtG plant will be turned off for planned maintenance, with no biogas supply. In the event of a shutdown the raw biogas would become the responsibility of YWS, and would be preferentially used as a fuel, or routed to the YWS waste gas burner. However, during a planned BtG plant shutdown, YWS has the opportunity to reduce the digester feed to try to ensure that excess biogas would not be generated. Consequently, there wouldn’t necessarily be flaring during a planned shutdown.

Maintenance records will be retained and made available for inspection, as required.

2.4.5.2 Unplanned Maintenance

All reactive (unplanned) maintenance will be carried out by the SGN operations team in the first instance, with adhoc support drafted in from the supply chain when required. Maintenance records will be retained and made available for inspection, as required.

The BtG plant may be required to shut down in the event of a single source failure, with no built in redundancy. However, such events will be limited by holding sufficient levels of critical spares and through provision of quick response times to get qualified personnel to site to resolve issues. In addition, the plant has been designed to enable mobilisation and quick connection of hire equipment to help ensure high levels of uptime and plant availability.

In the event of a shutdown, the raw biogas would become the responsibility of YWS, and would be preferentially used as a fuel, or routed to the YWS waste gas.

2.4.6 Site Inspection

An inspection programme will be developed, the programme will take account of the applicable measures in Section 5.2 of the BWT AppM.

Although the BtG plant will be automated for much of the time, it will be attended daily throughout the working week for frequent operational checks by SGN technicians. Operational checks will consist of visual inspection of plant and equipment, security fencing as well as any sampling or analysis required as part of the day to day operation of the site.

Monthly visits will also be carried out to undertake more detailed checks (visual detailed inspection of plant and equipment (including impermeable surfacing and drainage systems), sampling, changing gas bottles when required etc.). A level of remote monitoring of the BtG plant can be carried out through the monitoring systems for pressures / temperatures etc.

Inspection records will be maintained and made available for inspection, as required.

SGN will provide a 24/7 out of hours standby system to support the facility.

2.4.7 Commissioning

Cold commissioning is due to start in February 2025 with completion of hot commissioning works by September 2025. At this point the plant will be capable of providing biomethane to the local gas network. Performance testing is scheduled from September to October with handover to the SGN operations team thereafter. The detail of the commissioning programme is yet to be developed, however, initial indications are that some flaring from the biomethane flare will be required. It is estimated that the biomethane flare may be used for up to 4 hours per day for 2-3 weeks of BtG plant hot commissioning period. Emissions from commissioning activities are likely to be largely the same as those from operation of the BtG plant.

A commissioning plan will be developed, the plan will take account of the relevant measures in BWT AppM, Section 5.11.

2.4.8 Decommissioning

When designing new plant, SGN takes into consideration the environmental impacts from both the plant's operating life and eventual decommissioning. When planning a new project, SGN liaises with manufacturers / suppliers / designers and collate relevant information on the potential environmental impacts resulting from installation and operation of new plant. This includes consideration of the future decommissioning of the plant and any necessary procedures that need to be included in order to safely decommission the plant. For example:

- design will consider opportunities for modular plant and sub-assemblies to enable efficient removal at decommissioning; and
- written procedures will be in place to address DSEAR and ATEX requirements for safe removal or closure of plant with potentially explosive atmospheres.

The operational life expectancy of the BtG Plant is currently 15 years, with a possible 5 year extension. Upon cessation of activities and site closure, SGN will submit a permit surrender application.

All decommissioning works will be carried out under what SGN terms a 'Non-Routine Operation' (NRO). As part of the EMS for the facility, a Site Closure Plan will be developed within 12 months of issue of the Permit. The plan will include consideration of the future decommissioning of the BtG plant (and individual modules / equipment) and any necessary procedures that need to be included in order to safely decommission the plant. The site closure plan will take account of the relevant measures in BWT AppM, Section 5.11 in relation to decommissioning.

2.5 Site Drainage

The main equipment / modules will be located on impermeable surfacing / equipment bases with sealed drainage that meets the requirements of CIRIA 736 (or equivalent approved standard) with sealed construction joints. The delivery area will be fully surrounded by kerbing and road ramps.

Condensate and potentially contaminated site runoff water (e.g. from areas of hardstanding, car park etc.) from within the regulated facility will be collected in two separate drainage systems. The effluent from the two systems will be transferred (gravity fed) into the existing YWS drainage system. From there it will be returned to the YWS WwTW inlet. This is effectively no change to current operations at the STF, where condensate is removed from the raw biogas and returned to the works inlet, along with site runoff water. This approach has precedence, having been applied at other BtG plant.

The drainage systems will be designed and installed using approved materials and in locations that are suitable for the lifecycle of the BtG plant. The design will take account of firefighting water flows. An oil interceptor will be installed in the drainage system for site runoff from roadways etc. The interceptor will feed to an attenuation tank and an isolation valve prior to the transfer point. If an accidental spill were to enter the site runoff drainage system (including firewater), the system would be isolated and the contents pumped into waste IBCs / tankers for disposal via a waste management contractor. The condensate returns system will be a sealed system with an isolation valve at the transfer point. A non-return valve will be installed after the transfer points to prevent back feeding from the YWS drainage system to the BtG plant drainage systems.

SGN will operate a robust inspection and preventative maintenance programme. Condensate pots will be checked during routine inspection for damage and there will be periodic CCTV inspection[12] of below ground drainage pipework.

It is recognised that for new facilities segregated drainage systems for process water (condensate) and surface water runoff are considered to be good practice. The BtG plant drainage system has been designed with this in mind. However, the existing YWS drainage system is a combined system for condensate return and site runoff water and BtG plant is constrained by this. It is considered that the design of the BtG plant drainage system provides future proofing in relation to it being designed in such a way that will enable it to dovetail into any future upgrade to the existing YWS drainage system.

The location of the transfer points (TP1 for condensate return and TP2 for site runoff water) from SGN drainage systems to the YWS drainage system is shown in Appendix A, Figure A.5 and an indicative drainage plan has been produced and provided in Appendix A, Figure A.6. Any changes to the drainage system design for the BtG plant that occur as a result of finalising design will be provided to the EA. In the event of an emergency the drainage plan will be available to the emergency services.

Clean runoff water (rain) from the roofs of buildings and areas that have no potential to be contaminated, will be collected in a sealed system and discharged to soakaway(s) within areas of soft landscaping in the SGN compound. The locations of pipework and the soakaway(s) will be confirmed during detailed drainage design.

2.6 Raw Material Use and Storage

The main raw material is biogas. A summary of raw materials use, storage and fate is provided in Table 2-1. There are no viable alternatives for the material used at the BtG plant. A substances location plan is provided in Appendix A, Figure A.7.

Table 2-1 - Raw Material Use, Storage and Fate

Material	Storage and Location [1]	Fate	Estimated Quantity
Biogas	Not stored but present in equipment and pipework throughout the BtG plant	upgraded to biomethane for injection into local gas grid	Max: 2,950 Nm^3/h Min: 740 Nm^3/h Average: 1,675 Nm^3/h (approx. 14,673,000 Nm^3/yr)
Activated carbon	In H_2S and siloxane activated carbon filters. Each filter contains 8,200 kg of activated carbon.	waste – recycled / disposed of offsite	49,200 kg on site at any one time.
Propane	Stored below ground in a vessel with a 16 tonne capacity.	added to biomethane and injected into the local gas grid	600 t/yr (based on average biogas flow rate)

12 The frequency of inspection is yet to be specified but is expected to be at least every 10 years.

Material	Storage and Location [1]	Fate	Estimated Quantity
Glycol	Stored in the COSHH stores in a 200 l bunded container. Used in the cooling water in the chillers and circulated to the heat exchangers and biogas compressors. Also used in the membrane separation unit and during maintenance.	waste – expected to be disposed of offsite as soon as reasonably practical following maintenance	<500 litres per year
Mineral / Lubrication Oil	Stored in the COSHH stores in a 400 l bunded container. Used in the biogas compressors and during maintenance.	waste - disposed of offsite	<1,000 litres per year

Table Notes:

[1] Bunds will be designed to hold at least 110% of the volume of an individual container or, when a common bund is used for more than 1 container, the bund will be capable of holding 25% of the volume of the largest container.

In addition to the main raw materials there will be small quantities of calibration gases (nitrogen, hydrogen / helium, other inert gas mixtures) used for the calibration of sample instrumentation on the BtG plant. These will be stored in the Gas Bottles Stores and used in the membrane separation unit and the GEU. Solvent for cleaning (WD 40) will also be stored in the COSHH stores.

Minimisation of air emissions, emissions to land, groundwater or surface water are achieved through design and via effective materials delivery, storage and handling procedures, controls and management.

2.7 Waste

The BtG plant is itself, by nature, a waste recovery activity. The raw biogas is classified as a waste (EWC 19 06 99) until it meets the requirements of the Biomethane Protocol[2]. Minimal quantities of waste will be produced and it is expected that waste storage, recovery and disposal will not be a significant issue. A summary of waste generation, storage and disposal is given in Table 2-2. A substances location plan, including waste, is provided in Appendix A, Figure A.7.

Table 2-2 - Waste Generation, Storage and Disposal

Waste Arising	Location of Storage on Site	Storage / Fate	Predicted Estimated Annual Quantity
Condensate	Not stored on the site. Collected from the heat exchangers and biogas compressors in catch pots that drain to the condensate returns drainage system.	Transferred to the existing YWS drainage system for treatment in the WwTW.	1,680 m^3 (based on the maximum production rate of 192 l/h, 24 hours/day, 365 days/year)

Waste Arising	Location of Storage on Site	Storage / Fate	Predicted Estimated Annual Quantity
Spent activated carbon	In H_2S and siloxane activated carbon filters.	Not stored on site. Spent carbon will be removed by a waste contractor by vacuum tanker for regeneration / disposal offsite during maintenance / as required.	49,200 kg (per 230 days)
Waste membranes	In membrane separation unit.	Not stored on site. Membranes will be removed from site for disposal during maintenance / as required.	An indicative estimate is membrane replacement every 5 - 10 years
Waste lubrication oil [1]	Mostly from compressors.	Stored in a 1,000 container, on a bund, in the COSHH stores. Removed from site for disposal during maintenance, or as required.	800 litres
Waste glycol [2]	From chillers, heat exchanger / blower packages, compressors (cooling) and membrane separation unit.	Not intended to be stored on site. Expected to be removed from site for disposal as soon as reasonably practical following maintenance activities.	400 litres

Table Notes:

[1] Waste oil is the only waste stored on site. It is only transferred from equipment to the waste oil container during maintenance with appropriate use of bunding / drip trays. The volume of oil transferred is limited by the small quantities of oil used in the equipment.

[2] Waste glycol is transferred from equipment to an IBC during maintenance only, with appropriate use of bunding / drip trays. The volume of waste glycol is limited by the quantities of used in the equipment. It is not intended to store waste glycol on site; it will be removed following maintenance.

In addition, minor quantities of general maintenance waste (e.g. rags, filters, grease, solvent (WD 40), small mechanical / electrical parts) will be generated. Wastes that cannot be regenerated / re-used will be disposed of by a waste management contractor under a waste carriers licence.

Minimisation of air emissions and emissions to land, groundwater or surface water from waste will be achieved through design, via effective waste storage, maintenance, management / control and handling procedures. In line with typical environmental permit requirements, a residues management plan will be developed by SGN which will take appropriate measures to ensure that:

- the waste hierarchy referred to in Article 4 of the Waste Framework Directive (WFD) is applied to the generation of waste by the activities;
- any waste generated by the activities is treated in accordance with the waste hierarchy referred to in Article 4 of the WFD; and
- where disposal is necessary, this is undertaken in a manner which minimises its impact on the environment.

SGN will undertake a regular review, and record, whether changes to these measures should be made and take any further appropriate measures identified by a review. All waste documentation for the facility will be maintained centrally on site, including records of waste carrier licences, waste transfer notes and waste consignment notes.

2.8 Utilities: Water and Energy

The BtG plant does not require water as part of the process.

The main users of energy at the BtG plant are the pre-treatment processes, the biogas compressors and the membrane separation unit. The BtG plant has been designed to incorporate an energy management system which will:

- automatically adjust the use of equipment to meet the process demands as efficiently as possible; and
- regulate energy use at the facility to ensure maximum efficiency.

The total installed electrical power for the BtG regulated facility is estimated at 1,405 kW.

3. Management, Closure and Multi-Operator Interactions

3.1 Environmental Management System

A new environmental management system (EMS) and associated Environmental Management Plan (EMP) will be developed for the BtG plant. The EMS will:

- be an adaption of SGN's existing safety, health and environment (SHE) management system and made specific to the Knostrop BtG plant;
- draw on SGN's experience at other BtG plant;
- be designed to dovetail with the existing EMS for the neighbouring YWS STF facility (as relevant);
- describe and define the roles and responsibilities of (and the interactions between) SGN and YWS, along with any associated procedures / protocols;
- meet the relevant requirements in Section 5 of the BWT AppM guidance[3];
- take account of the EA and DEFRA guidance: Develop a management system: environmental permits[13]; and
- be prepared with reference to one or more of the following certified schemes / standards: ISO 14001:2015, Green Dragon, phases 1 to 5 of British Standard (BS) 8555, BS EN ISO 14005:2019 and EMAS Global.

In accordance with BAT1 of the Waste Treatment BREF BAT Conclusions, the content of the EMS will also be cross-checked against the following requirements (as relevant):

1. commitment of the management, including senior management;
2. definition, by the management, of an environmental policy that includes the continuous improvement of the environmental performance of the installation;
3. planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment;
4. implementation of procedures paying particular attention to:
   (a) structure and responsibility,
   (b) recruitment, training, awareness and competence (see also Section 5.3 of BWT AppM),
   (c) communication,
   (d) employee involvement,
   (e) documentation,
   (f) effective process control,
   (g) maintenance programmes,
   (h) emergency preparedness and response,
   (i) safeguarding compliance with environmental legislation;
5. checking performance and taking corrective action, paying particular attention to:
   (a) monitoring and measurement,
   (b) corrective and preventive action,
   (c) maintenance of records,
   (d) independent (where practicable) internal or external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;

13 Develop a management system: environmental permits, EA and DEFRA, updated April 2023: Develop a management system: environmental permits - GOV.UK (www.gov.uk).

6. review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;
7. following the development of cleaner technologies;
8. consideration for the environmental impacts from the eventual decommissioning of the plant at the stage of designing a new plant, and throughout its operating life;
9. application of sectoral benchmarking on a regular basis;
10. waste stream management;
11. an inventory of waste water and waste gas streams;
12. residues management plan;
13. accident management plan (AMP);
14. odour management plan;
15. noise and vibration management plan.

The scope (e.g. level of detail) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have (determined also by the type and amount of wastes processed).

Further information is provided below in relation to the residues management plant and the AMP. The requirement for odour and noise management plans is discussed in Sections 6.4.1 and 6.5.1 respectively.

3.1.1 Residues Management Plan

A residues management plan will be developed and implemented as part of the EMS to ensure:

- minimisation of the generation of residues arising from the treatment of waste;
- optimisation of the reuse, regeneration, recycling or energy recovery of residues (including packaging); and
- the proper disposal of residues where recovery is technically or economically impractical.

3.1.2 Accident Management Plan

The AMP is a fundamental component of the EMS and resultant EMP. The EMS for the BtG plant has not yet been developed; however a preliminary AMP has been prepared in relation to the identification and assessment of potential accident scenarios for the operation of the BtG plant (see Appendix F) based on general good practice, information from SGN and experience from other BtG plant. The AMP will be revisited and revised as / if necessary as part of the development of the EMS, and as the specifics of the design are developed further and finalised. YWS will be consulted on the development of the AMP. The AMP will be cross-checked against the requirements of Section 5.4 and Section 5.5 of the BWT AppM guidance. In addition, the development of the AMP will ensure that measures and actions relating to fire-fighting are clearly addressed, as per the requirements of Section 5.8 of the BWT AppM guidance.

The accident scenarios considered are:

- loss of containment / spills;
- plant / equipment failure;
- provision of incorrect or out of specification materials;
- fire and explosion;
- vehicle collisions;
- adverse weather; and
- security breach.

A summary table is presented in Appendix F which describes the potential accident scenarios relating to the BtG plant, their impact and likelihood and the severity of each scenario occurring.

3.1.3 Site Condition Report and Site Closure

The operational life expectancy of the BtG plant is currently 15 years, with a possible 5 year extension. On cessation of activities and site closure, Technical Guidance states that the operator should be able to show that it has "taken the necessary measures to avoid any pollution risk resulting from your activities and that the site has been returned to a satisfactory state".

All appropriate pollution prevention measures have been considered during the design and specification of the BtG plant and associated pipework. The installation of the BtG plant will be undertaken ensuring that all appropriate pollution prevention measures have been put in place.

The area of operations is predominantly situated on hard standing. Any activities occurring in areas not on hardstanding are carefully controlled both by local containment and operational techniques. Substances used and stored on-site are recorded in Table 2-1 and wastes are recorded in Table 2-2. All potentially polluting substances are provided with adequate primary and secondary containment, which meets EA guidelines.

3.1.3.1 Site Condition Report (SCR)

A SCR (see Appendix C) has been produced for the activities covered by this permit application. The SCR defines the existing baseline conditions at the BtG facility and thus provides the benchmark for the requirement of any remedial works that may be needed following cessation of activities.

The SCR includes information relating to:

- the environmental setting (location and current land use, surrounding land use, geology of the site, hydrogeology, hydrology and details of nearby discharges and abstraction licences
- pollution history (site history, pollution incidents, nearby licensed facilities; historical contamination; baseline soil and groundwater reference data);
- permitted activities (identification of substances used / generate; identification of hazardous substances; storage transport and handling of hazardous substances, environmental management and control); and
- a pollution risk evaluation.

Based on the relatively small quantities of liquids to be used / stored / generated and the proposed pollution prevention measures, the SCR concludes that, 'there will be limited potential for leaks / spills to impact underlying ground / groundwater. Therefore, none of the substances to be used or handled at the site as part of the permitted activities are considered to represent a significant site specific potential pollution risk.' i.e, the measures that will be in place should ensure that operations during the life of the Permit will not lead to deterioration of the state of the land or groundwater.

The SCR is a live, standalone document which will be updated (as / if required) throughout the lifetime of the BtG plant. Any incidents that arise, which could impact on the site condition will be documented by SGN in line with the regulator's 'lifetime approach[14]', along with the measures taken to mitigate their impact on the site condition.

3.1.3.2 Site Closure Plan

As part of the EMS for the facility, a Site Closure Plan will be developed within 12 months of issue of the Permit. The plan will include consideration of the future decommissioning of the BtG plant (and

14 Regulatory Guidance Note, RGN 9: Surrender, 2013 (EPR RGS9 (publishing.service.gov.uk))

individual modules / equipment) and any necessary procedures that need to be included in order to safely decommission the plant. The plan will be reviewed following any decision to close / decommission all (or part) of the facility and updated as necessary. Upon cessation of activities and site closure, SGN will submit a permit surrender application.

3.2 Interactions between SGN and YWS

Interactions between SGN and YWS and their respective responsibilities are subject to a contractual agreement. This, along with any associated procedures / protocols will be addressed and fully documented in the BtG plant EMS.

The location of the BtG plant permit boundary within the YWS permit boundary for the STF is provided in Appendix A, Figure A.2. The locations of the interaction points for shared services are illustrated in Appendix A, Figure A.4.

3.2.1 Obligations and Responsibilities

3.2.1.1 SGN Obligations

As per the 'Technical Solution' agreed by SGN / YWS; SGN will be responsible for the:

- design of the BtG plant;
- build of the BtG plant;
- financing of the BtG plant; and
- operation and maintenance of the BtG plant; and
- decommissioning of the BtG plant.

During the operation of the BtG facility, SGN will be responsible for:

- day to day control of the activity and facility;
- ensuring permit conditions are complied with;
- deciding who holds staff positions;
- making investment and financial decisions; and
- making sure activities are controlled in an emergency and cooperating with YWS in the event of any joint emergency.

The design shall comply with any contractual agreements between YWS and SGN, including the high-level obligations set out in the schematic below.

Figure 3-1 - High-level Obligations Schematic

Design

SGN Commercial Services

- SGN CS shall produce the design within the timescales set out in Project Timetable

- **Preliminary Design**

- **Detailed Design**

- The Design shall conform with all respects with the Bid Design (SGN CS' obligations under Schedule 2) and be made available to YW in accordance with Review Procedure and Programme

- Works are split into two categories: Category 1 (Service Connection works) and Category 2 (Upgrading Facility/Export Facilities) and must comply with YW's Design Technical Standards.

- YW shall provide all information reasonably requested by SGN CS to facilitate the provision of SGN CS' design as soon as possible and within 5 business days

Design Technical Standards

- Category 1: SGN is to adhere to YW/WIMES standards
- Category 2: SGN is to adhere to Industry Standards

Green Gas Solutions

3.2.1.2 YWS Obligations

YWS Construction and Operational Obligations

Construction and operational obligations include the following:

1. YWS shall (and shall procure that its subcontractors shall) co-operate during the construction and operation of the BtG facility as may reasonably be required by SGN and its subcontractor(s).
2. During the Construction Period and the Operational Period, YWS shall:
    a. Use reasonable endeavours to provide all necessary information for the site of the BtG plant; including but not limited to provision of details of existing services and utilities, boreholes and reports of existing ground conditions, site rules and any access / egress restrictions statutory and / or regulatory information that may be required by the SGN's Design.
    b. Maintain all temporary and permanent accesses in a fit state for SGN and any sub-contractors, provided that SGN shall be responsible for adhering to any Applicable Law or requirements of the Planning Permission with regards to working hours and YWS Management Procedures.
    c. Participate in gas quality risk assessments on the site, such as GQ8.
    d. Use reasonable endeavours to provide all relevant and available layout plans of the site containing the YWS plants, temporary and permanent structures, utility plans including electric, gas, water, propane storage facility, cabling, and drainage ducts, access roads and service connection points required for the purposes of the BtG project.
    e. Provide information to SGN as reasonably requested prior to commissioning to support development of site emergency plans covering the BtG site.
    f. Provide a suitable and sufficient hard-wired control and monitoring signals from the YWS facility as reasonably required by SGN’s design.
    g. Fulfil their obligations as a user and owner of the Pressure Regulation Equipment ensuring that a compliant “Written Scheme of Examination” (WSE) is in place prior to operation of the system in accordance with Pressure Systems Safety Regulations 2000.
    h. Provide details of any material changes to existing layout plans (which SGN acknowledges have already been provided) showing existing and new plant locations, main service connections and access roads.
    i. Maintain the provision input and output signals from the YWS facility as reasonably required by SGN.
    j. Subject to criteria to be agreed between both parties, receive condensate and potentially polluted surface water for treatment in the YWS WwTW.

Commissioning Obligations

Without prejudice to SGN’s obligations under the contractual agreement with YWS, YWS will provide reasonable assistance to SGN necessary to ensure commissioning is undertaken, including:

- provision of the minimum volume of biogas; and
- provision of hard-wired control and monitoring signals as reasonably required pursuant to SGN’s design.

Gas Input

YWS shall:

- be fully and solely responsible for and shall procure the delivery of biogas in accordance with the contractually agreed specification;
- ensure that no material or substance other than biogas is delivered from the YWS facility to the BtG plant entry point; and

- use reasonable endeavours to comply with any reasonable request by SGN to provide biogas when required in connection with any maintenance, repair or testing of the facility.

3.2.2 Shared Services

The shared services and direct interactions between SGN and YWS will be:

- YWS to supply raw biogas to SGN, the supply point is the isolation valve on the SGN facility boundary;
- SGN drainage systems will connect to the existing YWS drainage system; condensate returns and site runoff water will be transferred from SGN control to YWS control at the SGN site boundary (see Section 2.5). Isolation valves will be installed within the SGN boundary to protect the YWS system and a non-return valve will be installed to prevent backflow of YWS drainage into the SGN drainage systems;
- YWS will supply electricity to the BtG plant; and
- YWS will supply potable water to the BtG plant.

The locations of the points at which YWS supplies biogas, water and electricity, and the transfer points between the SGN and YWS drainage systems are illustrated in Appendix A, Figure A.6.

3.2.3 Communications Between SGN and YWS

3.2.3.1 Remote Communication

An instrumentation, control and automation (ICA) panel will be installed to manage the remote communications interface between SGN and YW. The communications interface will enable two-way communication between YWS and the BtG plant. The system will, as a minimum, include specific commands and alarms such that:

- SGN can inform YWS when the BtG plant is shutting down;
- YWS can inform SGN when there is no (or very low levels of) biogas; and
- YWS can inform SGN when the biogas supply is available.

If there is a period where no biogas is available, the BtG plant will idle in standby mode awaiting run command from YWS. When the signal is received that biogas is available the BtG plant will automatically initiate start up sequence. In addition, SGN will have online monitoring of the pressure in the YWS biogas holder so that the BtG plant biogas compressors can automatically ramp up (or down) as required to ensure optimum operation.

3.2.3.2 Non-Remote / General Communications

SGN will work with YWS to develop a communications strategy and a communications plan for the potential interactions and interfaces between the BtG plant and the WwTW. The plan will define agreed roles, responsibilities and procedures for day to day and emergency communications.

3.2.3.3 Third Party Complaints

Typically SGN facilities are built within existing developments, so in normal circumstances a complaint would go to SGN's client and then is passed to SGN. However, SGN does have its own customer services department and there is an official SGN complaints line (https://www.sgn.co.uk/help-and-advice/customer-service/complaints). A complaints procedure will be developed and implemented as part of the facility's EMS.

As discussed above, SGN will work with YWS to develop a communications strategy and a communications plan; the plan will address liaison and responsibility in relation to third party complaints that may involve the BtG plant.

4. Emissions Inventory

4.1 Point Source Emissions to Air

4.1.1 Overview

There are two point source emissions to air (A1 and A2), their locations are shown in Appendix A, Figure A.5.

- A1 - CO_2 offgas from the membrane separation unit exhaust stack; containing a small quantity of methane (< 1%) and very low concentrations H_2S, siloxanes, NMVOC; and
- A2 - the biomethane flare exhaust; primarily consisting of CO_2, NOx, CO, SO_2, and VOC.

4.1.2 Membrane Separation Unit Exhaust (A1)

The membrane separation unit will operate 24 hours per day, 7 days a week. Design and process measures to control emissions are identified in Sections 5.7 and 5.8. Stack and stack gas parameters and emission rates are provided in Appendix D. Emission benchmarks are provided (where available) in Section 4.4. An impact assessment summary is provided in Section 6.3 and the results of an H1 risk assessment[15] are provided in Appendix D.

4.1.2.1 Carbon Dioxide

At the design flow rate of 2,950 Nm^3/h of biogas, the flow rate of the CO_2 offgas has been calculated to be 1,017 Nm^3/h (assuming 35% CO_2 and 62.6% methane in the raw biogas). The minimum CO_2 content of the offgas is 98.3% which equates to a minimum CO_2 content in the offgas of 1,000 Nm^3/h. At the routine operational flow rate of 1,675 Nm^3/h of biogas the CO_2 content of the offgas would be up to 568 Nm^3/h.

The density of CO_2 is 1.977 kg/m^3 (at 0°C and 1 atmosphere pressure)[16]. Therefore, at the design flow rate of 2,950 Nm^3/h of biogas, the emission of CO_2 in the offgas will be 1.98 te/h (1,000 Nm^3/h x 1.977 kg/m^3), which equates to an emission of up to 17,314 t/yr. At the routine operational flow rate of 1,675 Nm^3/h of biogas, the emission of CO_2 will be up to 9,831 t/yr.

4.1.2.2 Methane

At the design flow rate of 2,950 Nm^3/h of biogas, the flow rate of the CO_2 offgas has been calculated to be 1,017 Nm^3/h (assuming 35% CO_2 and 62.6% methane in the raw biogas). The maximum methane content of the offgas is 0.9% which equates to a maximum methane content of the offgas of 9.2 Nm^3/h. At the routine operational flow rate of 1,675 Nm^3/h of biogas the methane content of the offgas would be up to 5.2 Nm^3/h.

The density of methane is 0.717 kg/m^3 (at 0°C and 1 atmosphere pressure)[16]. Therefore, at the design flow rate of 2,950 Nm^3/h of biogas, the emission of methane in the offgas will be 0.007 t/h (9.2 Nm^3/h x 0.717 kg/m^3), which equates to an emission of up to 57 t/yr. At the routine operational flow rate of 1,675 Nm^3/h of biogas, the emission of methane will be up to 33 t/yr.

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15 H1 Risk Assessment Tool (v8) H1 Tool | ADMLC.

16 Densities and molecular weights of some common gases like acetylene, air, methane, nitrogen, oxygen and others https://www.engineeringtoolbox.com/gas-density-d_158.html

4.1.2.3 Trace Contaminants

The annual emissions of H_2S, siloxanes and NMVOC will be very low as the efficiency of the carbon filters efficiency will be greater than 99% and so will reduce these to trace levels. Stack monitoring will be undertaken post-commissioning to confirm the very low concentrations of trace contaminants in the off gas exhausted to atmosphere.

Hydrogen Sulphide

The plant has been designed so that it can process / upgrade biogas containing up to 250 ppm of H_2S. As noted previously, 45 ppm (63 mg/m^3) has only been exceeded for less than 1% of the time (over a 4 year monitoring period). The average H_2S content in the incoming biogas is 26 ppm (36 mg/m^3), recent testing[9] reported an H_2S content of 12 ppm (17 mg/m^3).

A maximum value of 3 ppm (approximately 4.2 mg/m^3) H_2S is allowed in the biomethane entering the grid; however the actual value is likely to be much lower following the carbon filtration stage of the process and given the typically low concentrations in the raw biogas. Manufacturers specify that the efficiency of the BtG plant carbon filters will be greater than 99% which will give an emission of substantially less than 1 mg/m^3 total sulphur in the offgas (less than 0.63 mg/m^3 using the 'normal limit' concentration of H_2S in the raw biogas, or less than 0.36 mg/m^3 based on the average H_2S content of the biogas). These are conservative figures as they only account for 99% removal of impurities in the carbon filters, whereas in reality the lead filter bed will remove 99% and the lag filter bed will act as a polishing unit.

NMVOCs

Concentrations non-methane volatile organic compounds (NMVOC) in the raw biogas are very low, <1 mg/Nm^3. With the BtG plant carbon filters having an efficiency of greater than 99%, this would give an emission of <0.01 mg/Nm^3, which is typically below the limit of detection. It can therefore be deduced that NMVOCs (other than siloxanes) are not expected to be present in the incoming biogas at any appreciable level.

Siloxanes

The plant has been designed so that it can process / upgrade biogas containing up to 200 mg/Nm^3, of siloxanes with a 'normal limit' of 150 mg/Nm^3. As noted previously, monitoring has indicated that the 'normal limit' for siloxanes (150 mg/m^3) is not exceeded; the range of reported siloxane concentrations being approximately 80-130 mg/m^3 (though it is noted that the dataset was small). The plant has been designed to result in a siloxanes concentration of <1.0 mg/m^3 in the offgas, and in the biomethane.

4.1.2.3.1 Ammonia

Ammonia is not expected to be present in the incoming biogas at any appreciable level. Ammonia in AD process largely exists in the liquid phase as it is extremely soluble in water. Ammonia drops out in either the sludge or the return liquors from the AD process. Recent testing[9] of the raw biogas supports this as ammonia was not detected above the limit of detection (LoD) of 0.05 mg/m^3. This is consistent with reported monitoring data for biogas produced at similar AD plant.

4.1.2.3.2 Odour

The odour detection threshold for H_2S[17] is 0.0005 ppm or 0.00076 mg/m^3. An emission concentration of 1 mg/m^3 equates to approximately 1,315 ou_E /m^3.

17 M. Woodfield and D. and Hall, "Odour Measurement and Control - An Update," AEA Technology for Department of the Environment, 1994.

The offgas is not expected to contain odour concentrations at an appreciable level as the carbon filter has a very high efficiency (over 99%) and will retain over 99% of contaminants. As noted above, the concentration of H_2S in the offgas is expected to be less than 1 mg/m^3. At the 'normal limit' the concentration of H_2S in the raw biogas would be <0.63 mg/m^3; and <0.36 mg/m^3 [18] based on the average H_2S content of the biogas. This would equate to 828 ou_E/m^3 using the 'normal limit' concentration of H_2S in the biogas, or 473 ou_E/m^3 based on the average H_2S content of the biogas.

4.1.3 Biomethane Flare (A2)

The biomethane flare is designed to burn biomethane gas that will be close to grid specification; it will not burn raw biogas. The biomethane flare will operate infrequently (notably less than 10% of the year) during start up and when non-compliant biomethane is detected. The biomethane flare will not normally operate for periods of more than 20-30 minutes. Design and process measures to control emissions are identified in Sections 5.7 and 5.8. Stack and stack gas parameters and emission rates are provided in Appendix D. Emission benchmarks are provided in Section 4.4. An impact assessment summary is provided in Section 6.3 and a screening assessment is provided in Appendix D.

The biomethane flare will be a fully automatic, shrouded ground flare with a maximum flow capacity of approximately 2,110 Nm^3/h. The biomethane flare will comply with the operating conditions of 0.3 seconds' residence time at 1,000°C as listed in Environment Agency guidance document Guidance for Monitoring Enclosed Landfill Gas Flares (LFTGN05 v2 2010), will be fitted with a monitoring port, and is designed to meet the emission limits set in LFTGN05 v2 2010:

- NOx 150 mg/Nm^3
- CO 50 mg/Nm^3
- VOC 10 mg/Nm^3

The specification data for the biomethane flare assumes a maximum H_2S content of 5 ppm in non-compliant biomethane.

4.1.4 Pressure / Safety Relief Valves

Traces of biogas / biomethane, H_2S, NMVOCs, siloxanes, CO_2 and methane from the pressure relief valves will be released (during emergency scenario only) at their individual locations (to be confirmed in detailed design). These emissions will be extremely limited in quantity and duration and therefore do not warrant further consideration or inclusion in the emissions inventory.

4.2 Effluent Transfer to YWS Drainage System

Condensate and potentially contaminated site runoff water (e.g. from areas of hardstanding, car park etc.) from within the regulated facility will be collected in two separate drainage systems. The effluent from the two systems will be transferred (gravity fed) into the existing YWS drainage system. From there it will be returned to the WwTW inlet. This is effectively no change to current operations at the STF, where condensate is removed from the raw biogas and returned to WwTW inlet, along with site runoff water. As noted previously, the BtG plant is a DAA to the YWS biological waste treatment activity and the BtG plant is entirely within YWS STF boundary.

[18] Note , this concentration is below the limit of detection for monitoring for stack gas measurement (<0.5 mg/m^3).

The quantity of biogas condensate is estimated at 192 l/h / 1,680 m^3/yr for the design flow rate of 2,950 Nm^3/h of biogas; on a pro-rata basis this equates to approximately 109 l/h / 955 m^3/yr at the average biogas inlet flow rate of 1,675 Nm^3/h.

The location of the transfer points (TP1 - condensate returns and TP2 - site runoff water) from SGN drainage systems to the YWS drainage system is shown in Appendix A, Figure A.4 and an indicative drainage plan has been produced and provided in Appendix A, Figure A.6.

4.3 Emissions to Land

There are no emissions to land. The clean water from rainfall onto roofs, or areas that have no potential to be contaminated, will discharge to soil (and potentially groundwater) via soakaway(s). Clean rain water is not considered to be an 'emission'.

4.4 Emissions Benchmarks

4.4.1 Air Emissions Benchmarks

4.4.1.1 Membrane Separation Unit

There are no benchmarks for H_2S, siloxanes, NMVOC and ammonia (or odour) in the BWT AppM guidance however the Waste Treatment BREF provides some BAT-AELs, albeit for biological treatment processes. The BtG plant will not itself be a biological treatment process however, it will be a DAA to the YWS anaerobic digestion (biological treatment) process. BAT34 of the Waste Treatment BREF BAT Conclusions provides the following AELs specifically for biological treatment of waste.

- VOCs BAT-AEL 5 - 20 mg/Nm^3;
- ammonia BAT-AEL 0.3 - 20 mg/Nm^3; and
- odour BAT-AELs 200 - 1,000 ou_E/Nm^3.

As described in Section 4.1.2, the expected emission concentrations in the offgas exhaust stack from the membrane separation unit are.

- VOCs <1 mg/Nm^3;
- ammonia <0.05 mg/Nm^3 (below the limit of detection); and
- odour approximately 470-800 ou_E/Nm^3.

[Note, the odour concentration range is based on average and 'normal limit' H_2S concentrations in the inlet biogas and no more than 99% efficiency of the carbon filters.]

Thus the estimated concentrations for emissions from are within the ranges for BAT-AELs for biological treatment processes specified in the Waste Treatment BREF BAT Conclusions.

4.4.1.2 Biomethane Flare

The most relevant benchmarks for emission of combustion products from the biomethane flare are from the EA guidance document: Guidance for Monitoring Enclosed Landfill Gas Flares (LFTGN05 v2 2010). The emission standards are as follows (specified at reference conditions 273K, 101.3 kPa, 3% O_2, dry gas):

- nitrogen oxides (as NO_2) 150 mg/Nm^3;
- carbon monoxide 50 mg/Nm^3; and
- VOCs (as carbon) 10 mg/Nm^3.

4.4.2 Water / Sewer Emissions Benchmarks

Condensate and site runoff water will be transferred to the YWS drainage system for treatment in the YWS WwTW (as is currently the case for the condensate produced at the STF from the raw biogas). The final effluent discharge from the WwTW has been assessed by the EA previously and is subject to separate permit controls. Application of benchmarks to the releases from BtG plant is therefore not considered appropriate or proportionate.

There will be no discharges to surface water as a result of the changes to the facility.

4.4.2.1 Land Emissions Benchmarks

There will be no landfilling of waste, or emissions to land at the facility. No land emission benchmarks are therefore applicable.

4.4.3 EA Guidance on Benchmarks

BAT requirements for emission benchmarks based on typical permit requirements include:

- compare specified emissions with relevant benchmark values; and
- where benchmarks are not met appropriate improvements should be proposed, or justifications given for not making the required improvements.

No appropriate emission benchmarks have been identified from activity specific guidance for CO_2, siloxanes or H_2S.

The Waste Treatment BREF BAT Conclusions BAT-AELs for channelled emissions to air from biological treatment of wastes are considered relevant to the emissions from the membrane separation unit (see Sections 4.1.2 and 4.4.1.1), as the BtG plant will be a DAA to YWS anaerobic digestion activities.

Benchmark values for flare emissions have been identified in the Environment Agency guidance document “Guidance for Monitoring Enclosed Landfill Gas Flares” (LFTGN05 v2 2010 (see Section 4.4.1.2)).

The benchmarks identified will be met by the BtG plant. Consequently it is considered that the BtG complies with BAT / guidance relating to emission benchmarks.

5. Techniques for Process and Emissions Control and BAT Assessment

5.1 Overview

This section considers the measures in place for the prevention, minimisation and control of emissions to air, water and land and aims to demonstrate that appropriate BAT measures are in place to control emissions from the BtG plant. This includes consideration of start up, shutdown and abnormal operations.

The main over-arching forms of process and emissions control will be achieved through appropriate design the development and implementation of the EMS / EMP (including the associated procedures and the AMP).

Guidance used to derive BAT is as noted in Section 1.1.2:

- general EA guidance for permit compliance;
- the BWT AppM guidance;
- the relevant sections of the Waste Treatment BREF BAT Conclusions; and
- reference to typical / likely permit conditions.

It is noted that the more recent BWT AppM guidance is informed by the Waste Treatment BREF. Consequently, there is significant overlap between the two documents. Where this is the case It is also noted that Waste Treatment BREF applies to a number of waste treatment options (not just biological treatment) and the BWT AppM guidance applies to the entire biological treatment process, not just the 'finishing stage' which included biogas treatment. BtG plant is not an actual biological treatment process, it is a DAA to the YWS anaerobic digestion process; therefore there are a number of BAT requirements in these two documents that are not relevant or applicable to the BtG plant.

Where BAT comparison tables have been provided in this document they include a compliance status rating. The key for this rating is as follows:

- 1 = BAT requirement met;
- 2 = BAT requirement partially met;
- 3 = BAT requirement not met; and
- N/A = not applicable.

Where detailed information is provided in other Sections of this document, a summary is provided in the BAT assessment, with cross reference to that Section. This chapter has been organised to describe and assess BAT for general features of the design, management and operation of the BtG plant prior to the more detailed specifics of emissions control. The remainder of this Section is structured as follows:

5.2 Development and Scope of the EMS

EMS BAT requirements are addressed in BAT1 of the Waste Treatment BREF BAT Conclusions and in Section 5.1 (Nos. 1-14) of the BWT AppM guidance.

A new, site specific EMS and associated EMP will be developed and implemented for the BtG plant. The EMS will:

- be an adaption of SGN's existing SHE management system;
- draw on SGN's experience at other BtG plant;
- be designed to dovetail with the existing EMS for the neighbouring YWS STF facility (as relevant);
- meet the relevant requirements in Section 5 of the BWT AppM guidance[3] (see Section 5.2);
- take account of the EA and DEFRA guidance: Develop a management system: environmental permits[19]; and
- be prepared with reference to one or more of the following certified schemes / standards: ISO 14001:2015, Green Dragon, phases 1 to 5 of British Standard (BS) 8555, BS EN ISO 14005:2019 and EMAS Global.

The content of the EMS will also be cross-checked against the relevant requirements of BAT1 of the Waste Treatment BREF BAT Conclusions - further detail is provided in Section 3.1. On this basis it is concluded that BAT will be met through the development and implementation of the new EMS.

19 Develop a management system: environmental permits, EA and DEFRA, updated April 2023: Develop a management system: environmental permits - GOV.UK (www.gov.uk).

5.3 Design / Operational Standards & Controls & Protection Measures

The design, control, protection and management of the plant will conform with a range of standards and legislative requirements and general management procedures. These are noted throughout this document and include, for example:

- a DSEAR assessment will be undertake as part of detailed design and used to inform ATEX zoning and equipment requirements and an explosion prevention document will be produced;
- incoming gas pipework will be designed to YWS and WIMES and other gas pipework will be designed to GIS;
- design and installation of PRVs will be in accordance with recognised standards where possible, for example BS EN ISO 28300:2008;
- the CVDD will be Ofgem approved;
- the biomethane product will comply with the requirements of GSMR[1] and the Biomethane Protocol[2];
- drainage system design will meet the requirements of CIRIA 736 (or equivalent approved standard);
- operation of the biomethane flare will comply with the operating conditions and emission limit values in LFTGN05 v2 2010[11];
- installation of suitable heat and gas detection systems at appropriate locations
- development of an EMS in accordance with BAT guidance (see Section 3.1), including the production of:
  - an AMP (see Section 3.1.2),
  - an residues management plan (see Section 3.1.1), and
  - a Site Closure Report (including a decommissioning plan) (see Section 3.1.3);
- preparation of a Site Condition report (see Appendix C) and return of the site to a satisfactory state upon closure (as per RGN9 requirements;
- preparation of emergency response plans;
- installation of spill kits at appropriate locations and the production of the spill kit location plan;
- development and implementation of planned inspection procedures (see Section 2.4.6), including:
  - implementation of a leak detection and repair (LDAR) programme to reduce fugitive emissions,
  - CCTV inspection of below ground drainage pipework / storage vessel; and
- development and implementation of preventative maintenance programme and maintenance plan (see Section 2.4.5).

5.4 Process Monitoring / Controls

The BtG plant is designed to operate unattended with process parameters being monitored continuously by the plant process management system. SGN will have remote visibility and control. Safety features will be fully automatic and of the required integrity. Operating logs will be stored electronically. All records relating to the equipment will be available in electronic format or can be supplied as paper copies. These logs will be kept for a minimum period of four years.

The BtG plant has been designed to be equipped with comprehensive monitoring facilities for the process to ensure optimum efficiency and minimum environmental impacts. There will be monitoring of critical process parameters and injection of biomethane to the grid; including monitoring of the inlet biogas, monitoring after the carbon filters, monitoring of the biomethane prior to injection into grid and of biomethane production flow rates (see Section 2.4.2.8). The flow rate of the CO_2 offgas is also monitored. The key parameters for the BtG plant will be automatically recorded for the purposes of process control.

The process management system will use these measurements to adjust the operation of the biogas upgrader, including the loading / aging of the activated carbon units and the performance of the membranes in the membrane separation unit. The GEU will monitor biomethane quality and calorific value and will control biomethane pressure. The calorific value of the gas will be re-measured after the addition of propane. The process operating system for each stage of the process is designed to automatically shut down the BtG plant in the event that any trip level value or action level be reached; or as a result of a serious fault condition which is outside the parameters for which the process can compensate.

In the event of a shutdown of the BtG plant, the isolation valve at the biogas inlet will close and prevent further biogas from entering the BtG Plant. The raw biogas will then become the responsibility of YWS and will be preferentially used as a fuel; or if necessary routed to the YWS waste gas burner. After a shutdown the start up procedure will be initiated. The start up procedure will be carried out at low flow with return of the biomethane to the biomethane flare until the process has stabilised and is producing compliant biomethane.

To a large extent, it is anticipated that compliance with permit conditions will be demonstrated by the retention of records of the monitoring of key operating parameters and planned preventative maintenance activities (see Section 2.4.5) in order to show that the BtG plant is operating in an optimum manner and are performing in accordance with the design specification.

5.5 Record Keeping and Procedures

In line with the anticipated permit requirements for the BtG plant, SGN will provide the EA with:

- information relating to regular reporting; and
- notification in the event of emissions that are outside those allowed by the permit.

This information will be supplied using the forms that will be provided in the BtG Plant permit, or as otherwise agreed (in advance) with the EA.

As per the requirements of Section 5.9 of the BWT AppM guidance, SGN will:

- keep an up to date record of all accidents, incidents, near misses, changes to procedures, abnormal events, and the findings of maintenance inspections;
- carry out investigations into accidents, incidents, near misses and abnormal events and record the steps taken to prevent their reoccurrence;
- maintain an inventory of substances, which are present (or likely to be) and which could have environmental consequences if they escape; and
- record and hold a critical plant and equipment asset register, including a register of equipment installed in explosive atmospheres (ATEX-rated equipment).

The EA will be notified without delay (and within 24 hours) if any of the following events are detected and are causing significant pollution:

- a malfunction;
- a breakdown or failure;
- an accident;
- an emission of a substance not controlled by an emissions limit; and
- a breach of an emissions limit.

5.6 Contingency Plans and Procedures

Contingency plans and procedures will be developed and implemented in line with the relevant measures listed in Section 5.10 of the BWT AppM guidance.

5.7 Technology and the Use, Treatment and Disposal of Biogas

5.7.1 Biogas Upgrading Technology

The following technologies are typically considered as viable candidates for the BtG plant:

- chemical scrubbing;
- membrane separation; and
- water scrubbing.

For each technique the following criteria have been considered:

- methane recovery efficiency;
- resource use;
- waste production;
- emissions arising (including odour and noise);
- integration with existing site;
- maintainability; and
- complexity.

Taking the above into account, 3-stage membrane separation technology is considered to be BAT for the BtG plant. The main considerations supporting this conclusion are its potentially higher methane recovery efficiency, its lower energy requirement, the absence of need for a potable water supply (water conservation) and water discharge (other than condensate return).

Other advantages include: suitably noise attenuated compressor housings, working at height risk for maintenance greatly reduced in comparison to other technologies, potential expansion into CO_2 recovery in future (CO_2 more easily recovered from membrane technology in comparison with other systems), the modular design is less intrusive than other technologies (i.e. no large scrubbing / stripping vessels); and the double compressor (duty / standby) allows higher plant availability, as one compressor can be shutdown at a time for overhaul / maintenance.

5.7.2 Use Treatment and Disposal of Biogas

The following tables consider BAT requirements for use of biogas (Table 5-1), biogas treatment (Table 5-2) and disposal (Table 5-3). There will be no storage of biogas or biomethane at the BtG plant.

Section 8.10 of the BWT AppM guidance addresses biogas production and management for AD plant, much of the focus is on gas storage and combustion plant using biogas; as such it is only partially relevant to the BtG plant - see Table 5-1. Section 8.11 of the BWT AppM guidance addresses pressure and vacuum relief valves - this is discussed in Section 2.4.2.9 and not repeated herein.

5.7.2.1 Use of Biogas

Table 5-1 - BAT Requirements for Use of Biogas

BAT No	BAT Justification	BAT Status			
		1	2	3	n/a
Appropriate Measures for the Biological Treatment of Waste Section S8.10					
S8.10 (1)	You must manage gas production volumes within the processing constraints of the facility.				
Compliance measures YWS supplies the biogas; SGN has no control over biogas production rates; however, the BtG plant has been sized to take the maximum biogas production flow rates and this is formalised in the contractual agreement between YWS and SGN.					√
S8.10 (2)	You must have contingency measures in place and appropriately manage any excess gas produced, including when there is limited gas to grid availability during low demand periods.				
Compliance measures A gas network study has been undertaken which concluded that even during periods of low demand the maximum biomethane output of the BtG plant can always be accepted by NGN at the proposed connection location. If the ROV closes (e.g. for repair) the BtG plant will stop taking biogas from YWS and the BtG plant will close down (see Section 3.2.3 in relation to how this will be communicated to YWS). YWS will then be responsible for the use / fate of the raw biogas, which will preferentially be used as a fuel in the YWS CHPs / boilers and only routed to the YWS waste gas burner as a last resort.		√			
S8.10 (3)	You must make sure there is adequate gas storage capacity and combustion contingency available at all times. You must implement measures such as decreasing loading rate and diverting feedstocks if these are compromised.				
Compliance measures YWS supplies the biogas; SGN has no control over biogas production rates and storage capacities. SGN will keep YWS informed of periods of planned maintenance so that YWS can reduce the feed to the digesters during this time as / if required.					√
S8.10 (4)	When determining gas storage capacity, you must consider how changes in climatic conditions, such as high temperatures in the summer, affect the volume of gas to be stored.				
Compliance measures YWS supplies the biogas; SGN has no control over biogas production and storage.					√
S8.10 (5)	You must protect your biogas upgrading and energy recovery plant with flame arrestors and slam shut valves.				
Compliance measures Flame arrestors and slam shut valves will be installed.		√			
S8.10 (6)	You must install a permanent back-up generator to power critical plant and equipment in the event of power failure. Critical plant and equipment would				

	include for example, lighting, maintaining the integrity of gas storage systems and flares for preventing plant failure and to manage health and safety risks.				
Compliance measures YWS supplies the biogas; SGN has no control over biogas production and storage. In the event of a power failure the BtG plant will shutdown, no gas will be received from YWS and so there will be no requirement to use the biomethane flare.					√
S8.10 (7)	You must implement a leak detection programme that identifies and controls methane slippage from all processes and storage on site.				
Compliance measures There will be no onsite storage. SGN will implement an LDAR programme thereby providing a structured approach to reduce fugitive emissions or organic compounds by detection and subsequent repair or replacement of leaking components. The LDAR plan that will be developed will consider leakage from the BtG plant (and associated plant e.g. compressors). The LDAR plan will be produced as part of compliance with the Waste Treatment BREF BAT Conclusions.		√			
S8.10 (8)	You must implement procedures for the safe handling of propane and odorants, for example mercaptans.				
Compliance measures All handing of the propane will be subject to stringent procedures and this will be incorporated in the EMS. Operatives are trained in the necessary measures to ensure safe handling and prevent fugitive releases. A DSEAR Assessment, ATEX zoning and use of ATEX rated plant and equipment in ATEX zones, operating and maintenance procedures and emergency plans will be used to minimise risk of fire and explosion. See also Sections 2.6 and 5.9.		√			
S8.10 (9 -15)	Measures 9 to 15 relate to combustion plant.				
Compliance measures There will be no combustion plant at the BtG plant.					√
S8.11	Measures relating to pressure relief valves				
Compliance measures See Section 2.4.2.9		√			

On the basis of the information provided in the above BAT table it is concluded that BAT is met for biogas use.

Section 8.12 of the BWT AppM guidance relates to biogas treatment and storage for AD plant. Consequently, only some of the measures are applicable to the BtG plant - see Table 5-2.

5.7.2.2 Biogas Treatment and Storage

Table 5-2 - BAT Requirements for Biogas Treatment and Storage

BAT No	BAT Justification	BAT Status			
		1	2	3	n/a
Appropriate Measures for the Biological Treatment of Waste					
S8.12 (1)	You must prevent the emission of uncontrolled release of biogas and biomethane.				
Compliance measures All gas piping will be design approved and appraised to appropriate standards, using approved materials, with suitable protection installed as part of the design. All gas treatment plant, pipework and equipment will be routinely inspected, maintained and tested in accordance with manufacturers' recommendations. Isolation valves will be in place at appropriate locations. The management system for the BtG plant will control the process parameters to achieve compliant biomethane output proportional to the biogas input. Leaks will be detected though mass balance by monitoring gas flow into the BtG plant, output offgas and biomethane to grid gas flows. The plant will be designed and operated and designed to minimise leaks / fugitive emissions (also see Section 5.8.4).		√			
S8.12 (2)	You must inspect, maintain and routinely test all gas storage and treatment plant and equipment in accordance with manufacturers' recommendations.				
Compliance measures All gas treatment plant and equipment will be routinely inspected, maintained and tested in accordance with manufacturers' recommendations.		√			
S8.12 (3)	You must identify the intended end use of the biogas in order to determine the appropriate treatment method. You must consider the following factors: ▪ dewatering; ▪ removing H_2S due to corrosive nature which may corrode gas engines; ▪ removing oxygen and nitrogen (where present); ▪ removing ammonia; ▪ removing siloxanes particularly from digesting sewage sludge; ▪ removing particulates; ▪ removing CO_2 (for upgrading to biomethane); and ▪ adding propane to improve calorific value for biomethane grid injection.				
Compliance measures The only intended use of the biomethane is for injection into the local gas grid. The gas will be treated (which will include dewatering, removal of H_2S, siloxanes, NMVOC, dust and particles, removal of CO_2, adding propane (as required) and odourisation (by NGN). The gas will be tested to check compliance with the requirements of the GSMR and Biomethane Protocol prior to injection into the local gas network. Ammonia treatment is not required ammonia is not expected to be present in the raw biogas above the limit of detection (0.05 mg/m^3).		√			

S 8.12 (4)	You must assess hydrogen sulphide levels in the biogas to determine the efficiency of the removal methods applied. This can be done by monitoring both before and after gas cleaning equipment.				
Compliance measures H_2S in the raw biogas will be routinely monitored before and after carbon filtration and in the GEU.		√			
S 8.12 (5)	You must continuously monitor biogas flow, quality and composition. Monitoring systems must be interlocked where possible and provided with remote alarm capability.				
Compliance measures Operation of the BtG plant will be monitored by means of flow, temperature and pressure instrumentation, which will provide process control and ensure safe operation. Monitoring the biogas specification through its transformation to biomethane will be undertaken at pre-treatment; after the activated carbon filters; and at the GEU. If off-specification biogas is detected in the pre-treatment area the automated inlet isolation valve will close and the BtG plant will shut down. If non-compliant biomethane is detected at the GEU the gas will be routed to the biomethane flare. If the process can't be stabilised within 30 minutes the automated inlet isolation valve will close and BtG plant will shutdown		√			
S 8.12 (6)	You must remove water (condensate) from the biogas to protect the collection system, energy recovery plant and auxiliary flare. Condensate must be discharged into a contained drainage system or recirculated back into a digester. Condensate storage must not produce odourous emissions.				
Compliance measures Condensate will be collected in a segregated (contained) drainage system and transferred to YWS existing drainage system for return to the WwTW inlet for treatment. See Section 2.5. Condensate is not stored at the BtG plant.		√			
S 8.12 (7)	You must collect biogas from all digesters and all other treatment and storage vessels where methane is actively generated at your facility.				
Compliance measures Not applicable to the BtG plant.					√
S 8.12 (8)	Your biogas storage facilities must be gas tight, pressure-resistant and resistant to ultraviolet (UV) light, fluctuations in temperature and must be weather-proof.				
Compliance measures Not applicable to the BtG plant.					√
S 8.12 (9)	You must not allow biogas and air to mix unless it is used for desulphurisation. If you used oxygen to desulphurise biogas you must automatically monitor oxygen levels. You must also use high level alarms which are set to automatically stop adding air before the LEL is reached.				
Compliance measures					√

Not applicable to the BtG plant.					
S 8.12 (10)	If you use carbon filters, for example for gas cleaning prior to combustion, you must implement procedures to minimise the risk of exothermic reactions occurring during their maintenance, for example, by purging with nitrogen, you must contain and treat purged gases.				
Compliance measures Carbon filters are not used prior to combustion, there are no combustion units at the BtG facility. Minimisation of the risk of exothermic reactions occurring to as low as possible will be achieved through selection of the activated carbon. Maintenance related to regeneration of spent carbon is undertaken offsite.		√			

On the basis of the information provided in the above BAT table it is concluded that BAT is met for gas treatment. BAT requirements for flaring are included in the Waste Treatment BREF BAT Conclusions (BAT16) and the BWT AppM guidance (Section 8.12, No. 11 to 26).

5.7.2.3 Flaring

Emissions from the biomethane flare will comprise oxides of nitrogen, carbon monoxide, CO_2 as well as traces of NMVOCs. The biomethane sent to biomethane flare will have been processed in the biogas upgrader (and will therefore have gone through the filtration stages) and will have a composition close to the biogas grid acceptance specification. The flared biomethane will therefore have a lower contaminant load than the biogas flared directly from the biogas holders in the existing YWS flare. Measures incorporated in the design of the biomethane flare and operational emissions controls are identified in Table 5-3.

Table 5-3 - BAT Requirements for Flaring

BAT No	BAT Justification	BAT Status			
		1	2	3	n/a
Waste Treatment BREF					
BAT16	In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use both of the techniques given below: a) Correct design of flaring devices. Optimisation of height and pressure, assistance by steam, air or gas, type of flare tips, etc., to enable smokeless and reliable operation and to ensure the efficient combustion of excess gases. b) Monitoring and recording as part of flare management. This includes continuous monitoring of the quantity of gas sent to flaring. It may include estimations of other parameters (e.g. composition of gas flow, heat content, ratio of assistance, velocity, purge gas flow rate, pollutant emissions (e.g. NOx, CO, hydrocarbons), noise). The recording of flaring events usually includes the duration and number of events and allows for the quantification of emissions and the potential prevention of future flaring events.				
Compliance measures The biomethane ground flare is an enclosed design, with flare tip and height designed to optimise emissions and accord with residence times and emissions levels specified in the BWT AppM guidance and in the EA Guidance for Monitoring Enclosed Landfill Gas Flares (LFTGN05 v2 2010). No steam or gas assistance is required to achieve combustion efficiency and stability in the ground flare design.		√			

The quantity of gas sent to the biomethane flare will be monitored and recorded, as will the time and date and the number and duration of flaring events.					
Appropriate Measures for the Biological Treatment of Waste S8.12					
S8.12 (11)	You must install a gas flare available for use at all times. You must not routinely use flares or vent directly to atmosphere.				
Compliance measures A biomethane flare will be available for use at all times. The biomethane flare will only be used during start up and if non-compliant biomethane is detected and for no more than 30 minutes at any one time. There will be no routine venting of biogas / biomethane.		√			
S8.12 (12)	You should use enclosed (ground) design on all new plant. They should be capable of achieving a minimum of 1,000°C with 0.3 seconds retention time at this temperature.				
Compliance measures The biomethane flare is an enclosed design it will comply with the residence time and temperature requirements (minimum of 1,000°C with at least 0.3 seconds retention time).		√			
S8.12 (13)	Only applies to existing sites.				
Compliance measures Not appliable					√
S8.12 (14) and (15)	You must make sure that the finish on the exterior of the flare is weatherproof as well as heat-resistant. The structure of the flare must be designed to withstand wind stresses. You must protect ancillary items such as control and instrumentation equipment, including cabling. Providing housing makes maintenance tasks easier, but you must consider any explosion hazards.				
Compliance measures The biomethane flare will have a weatherproof finish and is designed to withstand local weather conditions. Ancillary equipment will be protected and not housed.		√			
S8.12 (16)	You must minimise the operation of the flare and use it only for emergencies and during maintenance to protect the integrity of the plant (for example, start ups or shutdowns). You must not use flares routinely.				
Compliance measures Use of the biomethane flare will be minimised, being used only in emergencies to dispose of non-compliant biomethane and on start up, until the process stabilises.		√			
S8.12 (17)	You must specify measures in your procedures to minimise flare use during routine maintenance. This includes, for example: ▪ reducing feeding rates to reduce gas production; ▪ increasing the safe storage of gas where capacity is available; and ▪ installing stand-by gas utilisation plant.				
Compliance measures Biogas will not be supplied to the BtG plant when it is in maintenance - therefore there will not be any flaring in maintenance periods.		√			

S8.12 (18)	You must monitor and record the use of your flare. Your records must include the date, duration and number of flaring events.				
Compliance measures The use of the biomethane flare will be monitored and the date, duration and number of flaring events will be recorded.		√			
S8.12 (19)	Your SCADA systems must be able to continuously monitor gas flow when the flare is activated.				
Compliance measures SCADA systems will be able to continuously monitor gas flow when the biomethane flare is activated.		√			
S8.12 (20)	You must be able to quantify emissions if required and identify the potential prevention of future flaring events.				
Compliance measures Emission will be quantifiable, for example on the basis of manufacturer's data / run time / bas throughput etc. Continual improvement will be addressed in the development for the EMS and this will include flaring events.		√			
S8.12 (21)	You must routinely measure other parameters, for example: ▪ composition of gas flow; ▪ gas temperature; ▪ heat content; ▪ ratio of assistance; ▪ velocity; and ▪ purge gas flow rate.				
Compliance measures The composition of non-compliant biomethane will be monitored at the GEU. The biomethane flare will be provided with monitoring access and shall be monitored for gas flow, temperature and any other parameters as specified in the issued permit.		√			
S8.12 (22) and (23)	You must routinely measure pollutant emissions, for example: ▪ oxides of nitrogen (NOx); ▪ carbon monoxide (CO); and ▪ VOCs. Monitoring and interlocking must be linked to your SCADA system.				
Compliance measures See Section 7.2.2. The biomethane flare will be fitted with a monitoring port; and is designed to meet the emission limits set in LFTGN05 v2 2010. As the biomethane flare will operate for notably less than 10% of the year, emissions testing is not proposed on a regular basis. However, the biomethane flare will be monitored during performance testing (following hot commissioning) and these results can be made available to the EA if required.		√			
S8.12 (25)	Flares must be automatically activated when the quantity of biogas exceeds a set maximum limit and before venting of biogas occurs.				
Compliance measures		√			

The biomethane flare will be automatically activated; no venting is proposed.					
S8.12 (26)	Flares can be a source of noise from vents, the combustion process and smoke suppressant injection. You must design new flares to minimise noise emissions. Noise avoidance may for example include the following measures: ▪ reducing or attenuating the high-frequency steam jet noise by using multi-port steam injectors. (Designing the orifice to cope with potential coke formation is essential); ▪ installing the injectors in a way that allows the jet stream to interact and reduce the mixing noise; ▪ increasing the efficiency of the suppressant with better and more responsive forms of control; ▪ restricting the steam pressure to <0.7MPa gauge; ▪ using a silencer around the steam injector as an acoustic shield for the injectors; and ▪ using enclosed ground flares.				
Compliance measures The biomethane flare design is an enclosed ground flare without steam or air injection support. Noise levels are specified as 65dBA at 1 m.		√			

On the basis of the information provided in the above BAT table it is concluded that BAT is met for gas disposal / flaring.

5.8 Control of Point Source and Fugitive Emissions

Operation under the EPR regime prioritises prevention of emissions to the environment by primary techniques above their abatement by secondary techniques. Based on this philosophy and the overall purpose of the BtG plant, the objective of the primary in-process controls will be to maintain the BtG plant in peak operating condition in order to deliver the maximum conversion of biogas to biomethane, whilst controlling emissions and managing energy efficiency.

Such controls will include plant design, process monitoring will be implemented through a number of methods, including:

- design of the plant;
- removal and treatment of contaminants from biogas;
- monitoring and corrective action; and
- and maintenance and corrective action.

There will be other controls in place which specifically cover start up, shutdown and emergencies, and materials storage and handling. The nature of the upgrading process dictates that secondary controls will be necessary in order to minimise emissions from the BtG plant.

5.8.1 Point Source Emissions to Air

There are two point source emissions to air (A1 and A2), their locations are shown in Appendix A, Figure A.5.

- A1 - CO_2 offgas from the membrane separation unit exhaust stack; containing a small quantity of methane (< 1%) and very low concentrations H_2S, siloxanes, NMVOC; and
- A2 - the biomethane flare exhaust; primarily consisting of CO_2, NOx, CO, SO_2, and VOC.

Information relating to the composition of raw biogas and biomethane product are provided in Sections 2.3 and 2.4.3 respectively. The treatment processes including removal of contaminants is provided in 2.4.2. Information relating to emissions, emission concentrations and annual emissions from A1 and A2 is provided in Section 4.1. Emission benchmarks are provided (where available) in Section 4.4. An assessment of point source emissions is provided in Section 6.3.

Stack and stack gas parameters and g/s emission rates for A1 and A2 are provided in Appendix D (the Air Quality Screening Assessment).

BAT for the biomethane flare is considered in Table 5-3.

A summary is provided below in relation to the key treatment measures and BAT for the membrane separation unit.

5.8.1.1 Hydrogen Sulphide, Siloxane and NMCOC Control

The control technique for the minimisation of H_2S and siloxanes (including NMVOC) emissions in the exhaust for the biogas upgrader is pre-treatment through adsorption on activated carbon filters. Manufacturers specify the efficiency of the carbon filters to be >99%. This is substantiated by experience at other, similar, BtG plant. As a result, the emissions will contain only traces of H_2S, siloxanes and NMVOC which are unlikely to lead to significant impact either in health or odour terms. The secondary control technique is considered to represent BAT for the biogas upgrader. The routine maintenance regime that will be in place for the carbon filters, which will include operating in lead / lag formation, periodic replacement of the carbon medium and checking that the carbon filters are gas tight, will ensure that the system operates correctly.

5.8.1.2 Ammonia Control

Ammonia is not expected to be present in the incoming biogas at any appreciable level. The recent testing of the raw biogas[9] supports this as ammonia was not detected above the LoD of 0.05 mg/m^3. No further control of ammonia emissions is therefore required.

5.8.1.3 Methane and Carbon Dioxide Control

CO_2 and methane do not present a direct environmental risk to health.

Methane slip in the CO_2 offgas will be minimised through the selection of the 3-stage membrane process, which selectively separates CO_2 from the methane in the biogas. It is in everyone's interests to maximise the biomethane produced and reduce the amount of methane emitted to atmosphere and the design of BtG and the process and management controls reflect this.

Innovations for the reuse of the CO_2 offgas have been considered however there is very limited market for non-food grade CO_2. As noted in Section 5.7.1 one of the advantages of membrane separation technology for CO_2 removal is the potential expansion into CO_2 recovery in the future (CO_2 is more easily recovered from membrane technology in comparison with other systems).

Therefore, no techniques for control of methane or CO_2 are proposed at the present time. SGN will review options for the use or storage / disposal of CO_2 on a regular basis.

Table 5-4 considers BAT requirements for point source emissions to air as per Section 11.5 in the BWT AppM guidance.

Table 5-4 - BAT Requirements for Point Source Emissions to Air

Appropriate Measures for the Biological Treatment of Waste S11.6					
S11.6 (1)	To reduce point source emissions to air (for example ammonia, dust, organic compounds and odorous compounds) from your biological treatment process, you must use one or more of the relevant abatement techniques, such as: ▪ biofiltration, biotrickling or bioscrubbing; ▪ scrubbing (for example wet or chemical); ▪ adsorption, for example activated carbon; ▪ thermal oxidation; and ▪ fabric filter - in the case of mechanical biological treatment to remove dust.				
Compliance measures Activated carbon filters are used at the pre-treatment stage to adsorb H_2S, siloxanes, and NMVOCs. Analysis of the incoming biogas indicates ammonia is not present in the incoming biogas above the LoD (0.05 mg/m^3) and therefore does not require abatement in the biogas upgrading plant. Dust is not present in the raw biogas at any notable level. To protect the operation and performance of the downstream membrane separation unit, any dust / small particle contaminants from the upstream processes will be filtered out.		√			
S11.6 (2)	You must assess the fate and impact of the substances emitted to air, following the Environment Agency's air emissions risk assessment methodology.				
Compliance measures An H1 risk assessment has been undertaken to assess the impact of the substances emitted from the biogas upgrading plant stack. Stack monitoring will be undertaken post-commissioning to corroborate the conclusions. An assessment of the biomethane flare emissions has also been undertaken. See Section 6.3 and Appendix D.		√			
S11.6 (3) and (4)	In order to make sure the abatement system is effective in treating odorous and chemical emissions you must monitor and maintain your abatement to achieve continual optimum conditions. To demonstrate effective control, monitoring and assessment may include the following parameters: ▪ gas flow or loading rate; ▪ bacterial viability (applicable to bio-oxidisation treatment systems); ▪ pH; ▪ acid growth (indicated by pH); ▪ gas temperature; ▪ pollutant removal efficiency rate; ▪ chemical injection (redox potential - applicable for chemical scrubbing and bio-oxidisation systems); ▪ spent solutions (for waste recovery or disposal); ▪ humidity or moisture content; ▪ back-pressure; ▪ thatching and compaction of media (thatching is the formation of a natural barrier to the ingress of additional water to the surface layer); ▪ channelling (preferential pathways for gas flow) and vegetation growth; ▪ ammonia, H_2S and odour concentrations (in both input and exhaust gas streams); and ▪ energy requirements for providing adequate and continuous airflow.				

	You must observe trends and changes over time, which could indicate that additional maintenance is required.				
Compliance measures The biogas upgrading plant is not itself a biological treatment process but it is a directly associated activity treating biogas from the YWS AD plant. The abatement equipment used, activated carbon filters, will be monitored for efficiency in line with permit and National Transmission System / Network Entry Agreement (NEA) requirements. The filters will be maintained as part of a programme of planned and preventative maintenance. The carbon filters will be operated in a lead / lag arrangement ensuring there will always be abatement equipment 'online'. Monitoring will be recorded and trended to allow observation of changes over time.		√			
S11.6 (5) and (6)	You must have: ▪ procedures in place to deals with a loss in abatement efficiency due to toxic compounds; ▪ a program of filter media replacement which is informed by performance and condition; ▪ a program to replenish chemical reagents in abatement scrubbers); and ▪ procedures for commissioning new filter media or abatement. At least once a year you must carry out an efficiency assessment of your abatement system.				
Compliance measures Procedures will be developed and included in the site EMS to ensure the correct operation, monitoring and maintenance of abatement equipment. At least once a year an efficiency assessment of abatement system will be undertaken.		√			
S11.6 (7) to (21)	S11.6 (7) to (21) related to biofilters and pre-abatement scrubbers.				
Compliance measures Not applicable to the BtG.					√
S11.6 (22) (for activated carbon)	You must monitor your activated carbon filter for the following parameters: ▪ inlet and outlet gas temperature and flow rate by continuous monitoring; ▪ inlet moisture content or humidity; ▪ back-pressure; ▪ carbon bed temperature; ▪ ammonia ▪ H_2S and ▪ odour.				
Compliance measures Pressure, flow and temperature of the biogas in the upgrading system / biomethane in the GEU will be monitored by the control system. H_2S and humidity will be monitored online throughout the system which will provide a measure of the performance of the activated carbon filters and indicate when a filter requires changing. H_2S will be used as an indicator for odour.		√			

Analysis of the incoming biogas indicates ammonia is not present in the incoming biogas above the LoD (0.05 mg/m^3) and therefore does not require monitoring.					
S11.6 (22) (for activated carbon)	You must make sure that carbon is either replaced or regenerated prior to saturation to prevent reduced performance.				
Compliance measures Carbon condition will be monitored. Carbon filters will be arranged in a lead / lag formation.		√			
S11.6 (24) (for activated carbon)	You must make sure the concentrations of volatile organic compounds within the gas stream are below their lower explosive limit (LEL).				
Compliance measures NMVOCs in the incoming biogas are present at very low (<1 mg/Nm^3) concentrations. NMVOCs will be monitored by the use of regular sampling dictated by NGN GQ8 (gas quality) process. SGN will refer to NGN NEA requirements for controlling levels of acceptable NMVOC's. If these levels are exceeded and levels are different to that recorded within the GQ8 the GEU will close the process down.		√			
S11.6 (25), (26) and (28) (for activated carbon)	You must make sure you follow the manufacturers' recommended maximum operating temperature. You must use a cooling system if you exceed the upper temperature limit. You must not allow exothermic reactions when maintaining activated carbon units.				
Compliance measures Temperature of the incoming gas will be continuously monitored which will ensure the manufacturers recommended maximum operating temperature is not exceeded. Activated carbon unit will be maintained by the manufacturer, exothermic reactions are not anticipated.		√			
S11.6 (27) (for activated carbon)	You must make sure impurities such as particulates are removed before gases pass through the carbon filter.				
Compliance measures Dust is not present in the raw biogas at any notable level. Partial removal of water and contaminants from the raw biogas is achieved by chilling and condensing water vapour within the saturated incoming biogas (prior to the carbon filters).		√			
S11.6 (29) (for activated carbon)	You must store activated carbon safely to prevent spontaneous combustion. You must store it following supplier or manufacturers' recommendations.				

Compliance measures Activated carbon is not stored on site.					√
S11.6 (30)	Stack or stack and vents must release at an appropriate height, temperature and velocity to make sure the emissions disperse well. You must use dispersion modelling to demonstrate the emissions do not impact on sensitive receptors.				
Compliance measures The air screening assessment concluded that there would be an insignificant impact on human health and the environment from both the membrane separation unit stack and biomethane flare emissions and that no further assessment is required. (See Section 6.3 and Appendix D)		√			
S11.6 (31) and (32)	You must install a suitable monitoring point on stacks and vents with appropriate safe access. You must monitor emissions following the Environment Agency guidance on monitoring stack emissions: (https://www.gov.uk/government/collections/monitoringstack-emissions-environmental-permits).				
Compliance measures See Section 7.2. The membrane separation unit exhaust stack will be monitored during performance testing, following hot commissioning works. It is proposed that six-monthly H_2S (or odour) monitoring be undertaken on the stack from the membrane separation unit. The exhaust stack will be fitted with a suitable port to enable access and monitoring. Monitoring will be undertaken following the Environment Agency guidance on monitoring stack emissions.		√			

On the basis of the information provided herein and in the above BAT table it is concluded that BAT requirements will be met.

5.8.2 Point Source Emissions Surface Water or Sewer

There are no direct point source releases to sewer or surface water. The only channelled ‘aqueous releases’ are via transfer from the BtG plant drainage systems (see Section 2.5) to the YWS drainage system. The BtG plant drainage will comprise small quantities of condensate returns (identical to that produced presently at the YWS STF) and site runoff water (e.g. from areas of hardstanding, car park etc.) from within the regulated facility.

The BtG drainage system includes separate systems for the collection of condensate returns and site run off water. Both systems have an isolation valve at the transfer point to the YWS system. There is also a non-return valve to prevent back flow from the YWS system to the BtG plant drainage. An oil interceptor will be installed in the site runoff drainage system. An indicative drainage plan (see Appendix A, Figure A.6) has been produced at this stage for inclusion with this permit application and will be finalised through detailed design. The final plan can be provided to the EA once completed.

The drainage transferred to the YWS drainage system will be routed to the WwTW inlet for treatment. This is effectively no change to current operations at the STF, where condensate is removed from the raw biogas and returned to the WwTW inlet, along with site runoff water. The resultant YWS WwTW final effluent discharge is subject to regulation via a separate permit.

On the basis of the above and given the BtG facility will be a DAA to the YWS AD activity, that there is no change to present day return of condensate to the YWS WwTW and the YWS drainage system and the final effluent discharge from the WwTW are already regulated under a separated permit, no further consideration of BAT is considered necessary and it is concluded that BAT is met.

5.8.3 Point Source Emissions to Land or Groundwater

There are no process emissions to land. The clean water from rainfall onto roofs, or areas that have no potential to be contaminated, will discharge to soil (and potentially groundwater) via soakaway(s). Clean rain water is not considered to be an ‘emission’.

5.8.4 Fugitive Emissions to Air

Biogas treatment is not an inherently dusty process and fugitive dust emissions are not anticipated. There will be the potential for fugitive emissions to air from the BtG, as a result of abnormal / accidental releases of biogas, biomethane and propane from plant equipment and pipework. The inherent design of the BtG plant (and associated pipework) and the measures that will be in place (see Section 6.11.1 for examples) are such that the opportunity for fugitive emissions will be virtually eliminated.

Risks to the environment from abnormal operation and from accident scenarios, along with the measures that will be in place to mitigate such risks, have been summarised in Table 6-3 (for air emissions). BAT for emissions associated with biogas use and handling has been addressed in Section 5.7.2. BAT associated with material storage, use and handling has been addressed in Section 5.9. See Section 5.8.6 in relation to odour. The outcome of these sections concludes that BAT is met. This is substantiated by the risk assessment for potential releases to atmosphere, including fugitive emissions (see 6.11 and Table 6-3) which concludes that the risk level is low, indicating that BAT is met.

5.8.5 Fugitive Emissions to Water and Land

The principal potential sources of fugitive emissions will arise from the storage and handling of materials and wastes, the drainage systems and associated accidental releases. Potential sources of fugitive emissions to land / water are propane (in its liquid form) releases and the raw materials and wastes used / generated at the site (see Table 2-1 - Raw Material Use, Storage and Fate and Table 2-2 - Waste Generation, Storage and Disposal). Liquid propane would rapidly vaporise to the gaseous form - gaseous fugitive releases are described above.

Risks to the environment from abnormal operation and from accident scenarios, along with the measures that will be in place to mitigate such risks, have been summarised in Table 6-5 (for land and water). BAT for emissions associated with biogas use and handling has been addressed in Section 5.7.2. BAT associated with material storage, use and handling and waste has been addressed in Sections 5.9 and 5.10. The outcome of these sections concludes that BAT is met. General measures for preventing fugitive emissions are listed in Section 6.11.

This is substantiated by the risk assessment for potential releases to land / water, including fugitive emissions (see 6.11 and Table 6-5) which concludes that the risk level is low, indicating that BAT is met.

5.8.6 Odour

Odour in the membrane separation unit exhaust could arise from the presence of H_2S and VOC. The offgas is not expected to contain odour concentrations at an appreciable level as the carbon filter has a very high efficiency (over 99%) and will retain over 99% of these contaminants. A conservative estimate of odour emissions gives an odour emission concentration of approximately 470-800 ou_E/Nm^3; which is within the range of the BAT-AELs for odour (200 - 1,000 ou_E/Nm^3).

The inherent design of the new biogas and biomethane pipework will be such that the opportunity for fugitive emissions will be virtually eliminated. Further to this, the inspection and maintenance regime that will be in place for the new pipework will ensure that the potential for such fugitive emissions will be kept low. See Section 5.9 for additional measures that will be in place to prevent fugitive / accidental emissions of odour as a result of materials transfer.

Based on the information available and the controls that will be in place; odour is considered unlikely to result in significant effects as a result of typical operation of the BtG plant. The potential for offsite odour from H_2S, NMVOCs, H_2S and siloxanes in the membrane separation unit exhaust stack and from fugitive emissions of biogas or biomethane is therefore low. Potential releases to atmosphere due to an incident or abnormal operation are presented in Table 6-3 which concludes that the risk level is low. No further control of odour emissions is therefore required proposed and it is not considered necessary or proportionate to produce an Odour Management Plan for the BtG plant.

Section 11.5 of the BWT AppM guidance relates to emission of odour; however the measures relate to odour management plans and monitoring of odour. Neither of these are relevant to the BtG plant. A complaints procedure will be developed and implemented as part of the EMS for the facility. Any complaints that are received relating to odour will be investigated, and should it be required, following a number of substantiated complaints, production of an odour management plan will be considered.

On the basis of the information provided herein it is concluded that BAT is met.

5.8.7 Noise and Vibration

The main sources of noise and the noise impact assessment are provided in Section 6.5, a noise screening assessment is provided in Appendix E. There will be no notable sources of vibration.

Existing ambient noise levels in the vicinity of the proposed BtG plant and nearest noise-sensitive receptors are likely to be moderate to high as the proposed site is located in a predominantly industrial urban area, within Knostrop WwTW and close to main transport links. The nearest noise sensitive receptor is 770 m to the south east.

Noise attenuation has been taken into account as part of the overall design of the BtG Plant and for specific items of equipment. For example, each of the biogas compressors will be in individual acoustic enclosures. The biomethane flare design is an enclosed ground flare without steam or air injection support. Noise from the biomethane flare will be below 65dBA at 1 m and is not anticipated to give rise to any noise impacts. The design for the BtG plant will ensure a maximum noise limit of 85 dBA at 1 m.

A screening assessment of potential noise impacts from the BtG plant concluded that no adverse impact from the BtG plant is expected and the risk from noise from the BtG plant at the closest noise sensitive receptor is considered to be low. It is therefore not considered necessary to carry out detailed noise modelling, or to produce a noise management plan. However, due to the potential for noise releases as a result of an incident or abnormal operation, a qualitative assessment has been carried out and is presented in Table 6-4, this also concludes that the risk level for noise is low.

BAT requirements for control of noise are addressed in BAT17 and BAT18 of the Waste Treatment BREF BAT Conclusions and in Section 11.11 of the BWT AppM guidance.

Table 5-5 - BAT Requirements for Noise and Vibration

BAT No	BAT Justification	BAT Status			
		1	2	3	n/a
Waste Treatment BREF BAT Conclusions, S6.1.4: Noise and Vibration					
BAT17	In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to set up, implement and regularly review a noise and vibration management plan, as part of the environmental management system.				
Compliance measures The applicability of BAT17 is restricted to cases where noise nuisance at sensitive receptor is expected or has been substantiated. As noted above, noise screening assessment concluded that no adverse impact from the BtG plant is expected BtG and the risk from noise from the BtG plant at the closest noise sensitive receptor is considered to be low. Therefore BAT 17 does not apply and a noise management plan is not required. A complaints procedure will be developed and implemented as part of the EMS for the facility. Any complaints that are received relating to noise will be investigated, and should it be required, following a number of substantiated complaints, production of an noise management plan will be considered.					√
18	In order to prevent or, where that is not practicable, to reduce noise and vibration emissions, BAT is to use one or a combination of the techniques given below.' [The techniques listed for new plant include appropriate location of equipment, operational measures, use of low noise equipment, noise and vibration control equipment (e.g. acoustic insulation, enclosures) and noise attenuation.]				
Compliance measures The location of the BtG plant is limited by the constraints of the existing WwTW and the supply of the biogas; however the nearest residential area is approximately 900 m to the north and there are large industrial buildings and warehouses between the housing and the BtG plant that would act as screening and reduce noise levels. Operational measures to reduce noise that will be implemented at the BtG plant include: inspection and maintenance of equipment, closing of doors and windows of enclosed areas where possible and using experienced staff. Noise specifications have been taken into account in the design and selection of equipment. The compressors will be located in acoustic housing.		√			
Appropriate Measures for the Biological Treatment of Waste S11.11					
S11.11 (1)	You should locate potential sources of noise (including building exits and entrances) away from sensitive receptors and boundaries. You must locate buildings, walls, and embankments so they act as noise screens.				
Compliance measures The location of the biogas upgrading plant will be within the existing waste operation facility and wider WwTW which is set predominantly within an industrial setting. The location of the BtG plant is limited by the		√			

constraints of the existing WwTW and the supply of the biogas; however the nearest residential area is approximately 900 m to the north and there are large industrial buildings and warehouses between the housing and the BtG plant that would act as screening and reduce noise levels.					
S11.11 (2)	You must use measures to control noise including: ▪ maintaining plant or equipment parts which may become more noisy as they wear out (for example, bearings, air handling plant, the building fabric, and specific noise attenuation kit associated with plant or machinery); ▪ closing doors and windows to prevent noise break through; ▪ avoiding noisy activities at night or early in the morning; ▪ minimising drop heights and the movement of waste and containers; ▪ using white noise reversing alarms and enforcing the on-site speed limit; ▪ using low-noise equipment (for example, drive motors, fans, compressors, pumps); ▪ adequately training and supervising staff; and ▪ where possible, providing additional noise and vibration control equipment for specific noise sources (for example, noise reducers or attenuators, insulation, or sound-proof enclosures).				
Compliance measures A robust inspection and preventative maintenance programme noise will be implemented (see Sections 2.4.5 and 2.4.6). Closing of doors and windows of enclosed areas will be undertaken where possible. Staff will be trained and deliveries supervised. Materials and waste storage is at ground level as far as possible. Noise specifications have been taken into account in the design and selection of equipment. Compressors will be housed in acoustic enclosures/kiosk.		√			
S11.11 (3)	You should have a noise and vibration management plan. This must be part of the environmental management system, and must include: ▪ actions and timelines to address any issues identified; ▪ a procedure for conducting noise and vibration monitoring; and ▪ a procedure for responding to identified noise and vibration events, for example, complaints.				
Compliance measures As noted above, sources of vibration are minimal and a noise management plan will not be required. A complaints procedure will be developed and implemented as part of the EMS for the facility. Any complaints that are received relating to noise will be investigated, and should it be required, following a number of substantiated complaints, production of an noise management plan will be considered.					√

On the basis of the information provided in the above BAT table it is concluded that BAT for noise and vibration is met.

5.9 Materials Storage and Handling

The principal materials that will be used will be biogas, activated carbon and propane. Relatively small quantities of mineral oil and glycol will also be used and stored at the facility, along with maintenance sundries such as grease and solvent (WD 40). There are no suitable alternatives for the materials used and stored on site.

Biogas use and handling is discussed in Section 5.7. There will be no storage of biogas (or biomethane) at the BtG plant.

Activated carbon will be located in six carbon filters. When the medium is saturated, the spent carbon will be replaced with fresh carbon, the spent carbon will be removed by vacuum extraction and regenerated / disposed of offsite. The filters are completely enclosed.

Propane will be stored below ground in a gas tight storage vessel. Compliance with Dangerous Substances and Explosive Atmospheres Regulations[20] (DSEAR) is required for the storage and handling of propane. Propane will be managed under a 'tank, equipment and commodity supply' agreement with a specialist leading propane supplier. All bulk deliveries of propane will be arranged with the prior agreement and will be carried out under supervision. Propane is an extremely flammable gas at ambient temperatures and containment systems for liquid spillages are not appropriate because any losses during offloading will lead to immediate generation of a propane gas cloud. Control measures are therefore tailored to address the key risk which is explosion and / or fire.

Information relating to storage arrangements, volumes and use of materials is provided in Section 2.6 and Table 2-1. A risk assessment for the handling and use of raw materials is provided in Section 6.12. The following general measures will limit the potential for impacts associated with materials handling and storage:

- staff / maintenance contractors and waste contractors will be fully trained in handling of materials;
- deliveries and filling of vessels / tanks / containers will be conducted by a trained contractor, who will be accompanied by trained site staff at all times;
- staff will be trained to detect leaks and spills as part of day to day site inspections;
- appropriate bunding and drip trays will be used during materials delivery and handling;
- a programme of regular inspections and a preventative maintenance will be in place;
- propane storage container levels will be monitored; the container will have a visual sight glass or gauge and high and low level trips and alarms;
- spillages in enclosures / the COSHH store will be contained;
- spill procedure will be in place and all staff will be trained in how to deal with spills;
- spill kits will be located at appropriate locations and a Spill Locations Plan will be produced;
- there will be concrete hardstanding beneath plant items;
- delivery area will be surrounded by kerbing and road ramps;
- spillages outside of enclosures / the COSHH store may enter the site runoff water drainage system;
- the drainage system is fitted with an oil interceptor and there is an isolation valve which would be used to prevent transfer of accidental spills to the YWS drainage systems;
- site runoff drainage discharged to YWS drainage is routed on to the WwTW where it is treated then released surface water under a separate permit;
- records will be available and kept up to date for all drainage structures including the routing of all drains; and
- materials use, handling and storage will be included in the EMS and an AMP will be developed and implemented.

On the basis of the information provide above and in Section 2.6 it is concluded that BAT is met for waste storage and handling.

20 Dangerous Substances and Explosive Atmospheres Regulations 2002 SI 2002 No 2776.

5.10 Waste

Information on the generation, storage, handling and fate of wastes is provided in Section 2.7 and Table 2-2.

5.10.1 Waste Storage and Handling

Waste lubrication oil is the only waste stored on site. It is stored in the COSHH stores in a 1,000 litre container on a bund (capable of holding at least 110% of the capacity of the container). It is only transferred from equipment to the waste oil container during maintenance with appropriate use of bunding / drip trays. The volume of oil transferred is limited by the small quantities of oil used in the equipment. Staff / maintenance contractors and waste contractors will be fully trained in handling of materials (including waste lubrication oil). Lubrication oil is used primarily in the compressors which are located in enclosures which would contain spills. Spill kits will be located at appropriate locations and a Spill Locations Plan will be produced. Waste oil spilled outside the compressor area / COSHH store may enter the site runoff water drainage system. The drainage system is fitted with an oil interceptor and there is an isolation valve which would be used to prevent transfer to the YWS drainage systems. A programme of regular inspections and a preventative maintenance will be in place. Waste management will be included in the EMS and an AMP will be developed and implemented.

There are also a number of measures listed in the Appropriate Measures for Biological Treatment of Waste, July 2020. These provide further detail on the above and are not considered relevant or proportionate to the BtG activity which itself, is not a biological treatment and which does not accept waste other than raw biogas from YWS.

On the basis of the information provide above it is concluded that BAT is met for waste storage and handling.

5.10.2 Waste Recovery and Disposal

The BtG plant is a waste recovery activity, transforming raw biogas into biomethane, that meets GSMR and the Biomethane Protocol, for injection into the local gas grid.

Information relating to waste recovery and disposal has been considered in Section 2.7 and Table 2-2. As note above the generation of waste at the BtG plant is very limited. The main waste is spent / saturated activated carbon which is removed from site by a waste contractor for regeneration / disposal. Minimal quantities of additional waste will be produced, and waste recovery and disposal is not expected to be a significant issue.

For all waste generated, the WFD hierarchy will be applied, with the option of disposal only considered once all other options have been considered. Wastes that cannot be regenerated / re-used will be disposed of by a waste management contractor under a waste transfer licence. Waste disposal / recovery routes will be regularly audited to ensure that waste is being properly handled and dealt with. All waste documentation for the facility will be maintained centrally on site, including records of waste carrier licences, waste transfer notes and waste consignment notes. Waste management (and disposal) procedures and auditing will be incorporated into the EMS and a residues plan will be produced (see Section 3.1.1).

Minimisation of air emissions and emissions to land, groundwater or surface water from waste will be achieved through design, via effective waste storage, inspection, maintenance and management / control and handling procedures for more details.

There are also a number of measures listed in the Appropriate Measures for Biological Treatment of Waste, July 2020. These provide further detail on the above and are not considered relevant or proportionate to the BtG activity which itself, is not a biological treatment process.

On the basis of the information provide above it is concluded that BAT is met for waste recovery and disposal.

5.11 Process Efficiency

SGN will have an Energy Management System in place for the BtG upgrading plant (see Section 2.8). The BWT AppM indicates energy efficiency does not need to be considered further for biological treatment operations, other than to review process efficiency on an annual basis. SGN will monitor and review annual consumption of energy and raw materials as well as the annual generation of residues and waste water at least once a year. This information will be reported to the EA as required by permit conditions.

5.12 Environmental Performance Indicators

The key environmental performance indicators for the BtG plant will be biomethane quality for injection to the grid, the control of odour and minimisation of trace emissions to air (through removal of NMVOCs, H_2S and siloxanes by the activated carbon filters).

5.13 Maintenance and Corrective Action

Maintenance will be a key component of operational control at the BtG plant; in particular, to ensure emissions to air and energy efficiency are maintained at the required level. A robust programme of inspection and preventative maintenance, along with procedures for corrective action will be developed for the BtG plant as part of the facilities EMS. See Sections 2.4.5 and 2.4.6 for further details.

5.14 Commissioning and Validation

Table 5-6 considers BAT requirements for commissioning and validation. See also Section 2.4.7.

Table 5-6 - BAT Requirements for Plant commissioning and validation

BAT No	BAT Justification	BAT Status			
		1	2	3	n/a
Appropriate Measures for the Biological Treatment of Waste Section 5.11					
5.11 (1)	The term commissioning means to bring an item of plant or equipment into working condition. You must notify the Environment Agency before you start commissioning. You must consider communicating with local communities during the commissioning phase, to comply with your management system and odour management plan.				

Compliance measures The EA will be informed prior to commissioning. Consideration will be given to communicating with local communities during commissioning, though it is noted that the nearest residents are some 900 m away.		√			
5.11 (2), (3) and (4)	You must consider arrangements for commissioning your plant at the design stage. You must have a commissioning plan in place before commissioning to minimise the risks of pollution and harm to human health and the environment. The level of detail can be based on the complexity of and risks associated with the process. You must define the suite of indices you will use to determine and monitor process performance and efficiency. You must review and refine the relevant monitoring parameters during the facility's operation as part of an on-going process of system optimisation.				
Compliance measures A commissioning plan will be produced by SGN to minimise the risk of pollution and harm to human health and the environment. The level of detail will be proportionate to the complexity and risks associated with the process. Key performance indicators will be defined for monitoring performance and efficiency and these will be revised as part of process optimisation and on-going operations.		√			
S5.11 (5) and (6)	You must test and validate all systems and components of your plant and building(s) against operational requirements identified at the design stage. This must include, for example, the air extraction and abatement system and containment structures. You must have completion certificates (for each commissioning phase) in place, signed by an appropriately qualified person.				
Compliance measures SGN will test and validate all systems and components of the BtG plant using competently qualified engineers and in conjunction with NGN requirements (SGN will provide the results of on-site testing to demonstrate it has been installed correctly and is fit for purpose). NGN will approve the on-site test results and once completed will undertake joint testing to check that the signals from site to their Distribution Network Control Centre are fully operational. Gas sampling on the raw biogas and biomethane will be carried out in line with the sampling protocol and output of the Gas Quality Risk Assessment (GQ8 process) and will be provided for approval to NGN. Completion certificates will be obtained for each phase of commissioning.		√			
S5.11 (7) and (8)	Commissioning biological treatment plants must be carried out to relevant industry standards where they are available and in accordance with manufacturers' guidelines. As a minimum, the commissioning plan must include summaries of: ▪ commissioning phases (and sequences) including milestones and timeframes (for example pre, cold, hot commissioning); and ▪ procedures and mechanical tests at each phase including relevant industry test standard (or otherwise), for example manufacturers' guidelines. Mechanical tests could include, for example: ▪ tests for leaks; ▪ pressure tests of piping and equipment; ▪ purging or inerting requirements; ▪ pressure and vacuum safety relief; ▪ temperature; ▪ flow and pressure control; ▪ mixing;				

	▪ air-flow ventilation; and ▪ extraction. Your commissioning plan must also include the: ▪ scope of performance tests, for example, acceptance criteria, measurement requirements, sampling requirements, reference to analytical procedures, chemical and biological analysis; ▪ identification of potential releases to the environment of displaced and generated emissions and measures to mitigate these, for example lean burn flares; ▪ scope of responsibilities of the person(s) related to the test procedures, including the sign-off process; ▪ qualifications of the responsible person(s) involved; ▪ process for dealing with failed tests and problems that you may encounter; and ▪ health and safety precautions and protective measures employed.				
Compliance measures The BtG plant is not in itself a biological treatment plant, however it does treat biogas from the YWS biological treatment process. Commissioning of the BtG plant will be carried out to relevant industry standards and in accordance with NGN requirements and manufacturers guidelines. A proportionate commissioning plan will be developed, taking into account the relevant features described in S5.11 of the BWT AppM guidance.		√			

On the basis of the information provided in the above BAT table it is concluded that BAT is met for commissioning and validation.

5.15 Site Closure and Decommissioning

Table 5-7 considers BAT requirements for closure and decommissioning. See also Sections 2.4.8 and 3.1.3.

Table 5-7 - BAT Requirements for Closure and Decommissioning

BAT No	BAT Justification	BAT Status			
		1	2	3	n/a
Typical Permit Requirements					
1	To surrender the permit, you will need to be able to show that the site has been returned to a satisfactory state. In order to do this you will produce a Site Condition Report which describes the condition of the site. (Application Form B2 guidance, p.4)				
Compliance measures Appropriate measures to protect the site are referenced in the Site Condition Report. A Site Closure Plan will be produced within 12 months of permit issue (See Section 3.1.3).		√			
2	The management system should record details of how the land under the site was thoroughly protected at all times. This can be recorded by recording the use and maintenance of impermeable surfacing and leak tight drains. You should also record how you have cleaned any incidents and spillages.				
Compliance measures Records will be maintained as part of the EMS and noted in the Site Condition Report.		√			

Appropriate Measures for the Biological Treatment of Waste - Section 5.12					
S5.12 (1) and (2)	You must consider the decommissioning of your plant or ceasing activities (moth-balling) at the design stage. You must have plans that minimise risks during later decommissioning or if moth-balling takes place. This includes removing or replacing individual items of plant throughout the life of the facility.				
Compliance measures Decommissioning of the plant will be considered during the design stage and plant and sub-assemblies are modular enabling efficient removal at decommissioning. Items of plant will be removed and replaced throughout the life of the facility as indicated by inspections and maintenance.		√			
S5.12 (3)	Before you decommission plant you must notify the Environment Agency and provide a copy of your decommissioning plan.				
Compliance measures Prior to decommissioning, the EA will be notified and provided with a copy of the decommissioning plan		√			
S5.12 (4)	Once decommissioning is complete you must provide a written report to the Environment Agency verifying that you have carried out activities in line with your plan.				
Compliance measures On completion of decommissioning the EA will be provided with a report to confirm that decommissioning activities were carried out activities in line with the plan.		√			
S5.12 (5)	If you bring plant back into service after a period of dormancy you must follow the commissioning requirements set out in this document or be directed by a suitably qualified person.				
Compliance measures It is not anticipated that the plant would be mothballed for re-commissioning at a later date. However, should this occur, commissioning will be undertaken in line with the commissioning required in the BWT AppM guidance and any YWS / NGN requirements.		√			
6	You must have a decommissioning plan to demonstrate: ▪ plant can be decommissioned without causing pollution; and ▪ the site will be returned to a satisfactory condition, for example in accordance with your site condition report.				
Compliance measures The BtG plant will treat biogas from the YWS AD process. Should the BtG plant be decommissioned, a suitable alternative use for the biogas would be found ahead of decommissioning. A site condition report has been prepared (see Appendix C) and site will be returned to a satisfactory state upon closure as per RGN9 requirements.		√			
5.12 (7)	The decommissioning plan must include details on (not limited to): ▪ removing or flushing out of pipelines and vessels where appropriate and completely emptying of any potentially harmful contents; ▪ drawings showing all the underground pipes and vessels; ▪ the method and resources needed for clearing lagoons; ▪ how you will dismantle buildings and other structures in a way that				

	protects surface water and groundwater at construction and demolition site; ▪ the soil testing needed to understand the degree of any pollution caused by the site activities, and information on what remediation is needed to return the site to a satisfactory state as defined by the initial site report; ▪ the measures proposed, once activities have ceased, to avoid any pollution risk and to return the site to a satisfactory state (including, where appropriate, those covering the design and construction of the plant); and ▪ how you will clear any residues, waste and any contamination resulting from the waste treatment activities.				
Compliance measures A decommissioning plan will be prepared proportionate to the risk posed as part of the Site Closure Plan.		√			

On the basis of the information provided in the above BAT table it is concluded that BAT is met for decommissioning.

6. Environmental Impact

6.1 Scope of Assessment

An assessment has been undertaken to determine the potential environmental impact and risks posed by the BtG plant, and to ensure that there are no significant impacts on the environment or human health. In accordance with EA guidance, and appropriate to the nature of the activities and potential impacts on site, the following assessments have been carried out:

- air quality;
- odour;
- noise;
- global warming potential (GWP);
- site waste; and
- fugitive releases and accidents.

The main emissions are emissions to air from the offgas released from the membrane separation unit exhaust stack and, to a lesser extent combustion gases from the biomethane flare.

The only channelled aqueous releases are via transfer from the BtG plant drainage systems to the YWS drainage system, which is routed to the WwTW inlet. The resultant YWS WwTW final effluent discharge is subject to regulation via a separate permit. The BtG plant drainage will comprise small quantities of condensate returns (identical to that produced presently at the YWS STF) and site runoff water; therefore, a quantitative assessment of point source emissions to water is not deemed necessary to determine that impact is insignificant.

The only discharge to ground (or groundwater) is clean water from rainfall onto roofs (or areas that do not have the potential to be contaminated). This will discharge to ground (and potentially groundwater) via soakaway(s). Clean rain water is not considered to be an ‘emission’ therefore impacts from point source emissions to land have been screened out as an insignificant risk to environmental or human health.

Due to the potential for accidental releases, a qualitative assessment on the impact to receiving ground, groundwater and surface water has been carried out for fugitive / accidental releases.

Techniques to minimise the environmental impacts associated with the BtG plant are described in Section 5. Screening assessments for air quality and noise are provided in Appendix D and E respectively and summarised below in sections 6.3 and 6.4. Qualitative risk assessments are presented in Table 6-3 - Emissions to Air, Table 6-4 - Noise Emissions and Table 6 5 - Emissions to Land and Water; a risk assessment summary is provided in Section 6.12.

6.2 Receptors and Environmental Setting

The BtG plant is located just over 4 km to the south east of Leeds on an area within YWS STF. The A63 is located approximately 100 m to the north of the BtG plant. There are no AQMAs within 2 km. Existing ambient noise levels in the vicinity of the BtG plant and nearest noise sensitive receptors are likely to be moderate to high as the BtG plant is located in a predominantly industrial urban area, within a working WwTW, and close to main transport links. The facility is within Flood Zone 1 (low risk of flooding). The activities carried out at the BtG plant have a low inventory of potentially polluting substances and therefore significant environmental impacts are considered unlikely.

The closest residential properties are located almost 900 m to the north of the BtG plant while the nearest commercial buildings are 260 m to the north of the BtG, beyond the A63.

There are no statutory nature conservation sites of European or international importance within 10 km of the BtG plant. The nearest statutory nature conservation site of national importance is Townclose Head SSSI, some 6.8 km to the south east. There are 4 other SSSIs within 10 km of the BtG facility (Leeds - Liverpool Canal (6.9 km to the north west), Mickletown Ings (7.2 km to the south east) Roach Lime Hills (7.8 km to the east) and Eccup Reservoir (9.9 km to the north, north west)).

Halton Moor LNR is the only statutory nature conservation site of local or national importance within 2 km, located approximately 850 m to the north of the BtG plant. There are two non-statutory conservation sites within 1 km: Temple Newsam Estate Wood LWSs 450 m east, and Halton Moor LWS 850 m north. There is no Ancient Woodland within 1 km.

There is made ground underlying the site. The superficial geology underlying the site comprises River Terrace Deposits (alluvium) of clay, silt, sand and gravel. The bedrock geology underlying the site comprises mudstone, siltstone and sandstone of the Pennine Lower Coal Measures Formation. The superficial drift aquifer beneath the site is classified as a Secondary A aquifer, the bedrock is also classified as a Secondary aquifer. The site location is not within a groundwater SPZ, the nearest SPZ (Zone 3) is nearly 10 km to the north east. The main equipment / modules will be located on sealed hard standing, and materials will be stored in a dedicated COSHH store. On this basis of this, and given the low inventory of potentially polluting materials, impact on the underlying soil and groundwater is unlikely.

The nearest water course is Wyke Beck, which is located approximately 35 m the north east of the BtG plant. The Wyke Beck is classified as a Water Framework Directive watercourse. The next nearest water course is the River Aire, approximately 900 m to the north west. Impact on watercourses or to ground is likely to be minimal, given the low inventory of potentially polluting materials and as site runoff water drainage within operational areas will be routed to the existing WwTW inlet.

6.3 Impact of Emissions to Air

6.3.1 Emissions and Screening Assessment

The point source emissions to air are from:

- A1 - CO_2 offgas from the membrane separation unit exhaust stack; containing CO_2, a small quantity of methane (< 1%) and very low concentrations[21] of H_2S, siloxanes and NMVOC; and
- A2 - the biomethane flare exhaust; primarily consisting of CO_2, NOx, CO, SO_2, and VOC.

CO_2 and methane do not pose direct impact to human health or ecological receptors; however they are greenhouse gases. GWP is considered in Section 6.9.

21 As noted previously, activated carbon filters in the pre-treatment stage of the BtG plant will remove H_2S, siloxanes and NMVOCs from the incoming biogas (with an efficiency of greater than 99%) prior to the membrane separation process. The CO_2 offgas will therefore contain extremely low concentrations of these substances.

The Environment Agency's air emissions risk assessment guidance[22] recommends using a risk assessment tool[23] (H1) to determine whether there is an insignificant environmental impact or if further work is required using a detailed air dispersion model. Appendix D provides an H1 risk assessment of the membrane separation unit and a screening assessment of the flare.

Conservative H1 emission dispersion factors have been combined with robust estimates of emission rates to provide ground level concentrations for screening against relevant air quality criteria, or environmental assessment levels (EALs), to determine whether further assessment is required. The screening assessment of the atmospheric emissions from A1 (H_2S, siloxanes, NMVOC) and A2 (NOx, CO, SO_2, and VOC) was undertaken for both human health and ecological receptors.

The screening assessment concluded that there would be an insignificant impact on human health and the environment from both the membrane separation unit stack and biomethane flare emissions and that no further assessment is required.

Stack monitoring will be undertaken post-commissioning to confirm the very low concentrations of trace contaminants in the off gas emitted to atmosphere.

Semi-qualitative assessment of the odour resulting from H_2S in the CO_2 offgas is provided in Section 6.4. Design and process measures to control emissions are identified in Sections 5.7 and 5.8. Stack and stack gas parameters and emission rates for A1 and A2 are provided in Appendix D. Emission benchmarks are provided (where available) in Section 4.4.

6.3.2 Screening for Protected Conservation Areas

In accordance with the EA guidance[24], an assessment of the effects of certain substances on protected conservation areas is required for internationally designated sites within 10 km as well as SSSIs and local nature sites (ancient woods, local wildlife sites and national and local nature reserves) within 2 km. There are no internationally designated sites within 10 km and there are no SSSIs within 2 km. There are a number of local sites within 2 km, the nearest being 450 m away, to the east, the next nearest being 850 m to the north.

The screening process for protected conservation areas is limited to the emissions of substances listed in the guidance. CO_2, methane, H_2S and NMVOCs (including siloxanes) are not amongst the substances listed in the guidance. Ammonia is listed but as it is not expected to be present in the offgas, a specific assessment of potential effects for the local nature sites is not considered necessary or proportionate.

6.3.3 Air Impacts Conclusions

Overall, it can be concluded that the emissions to air arising from the BtG plant will not have any adverse impact on human health or ecological receptors because:

- CO_2 and methane do not present a direct environmental risk to health;
- the carbon filters have a high efficiency rating of >99% which will effectively remove H_2S (and odour) and NMVOCs including siloxanes. The estimated PCs using the H1 risk assessment tool are very low and below EA assessment thresholds;

22 Environment Agency (2016, updated March 2023) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

23 H1 Risk Assessment Tool (v8) H1 Tool | ADMLC.

24 Air emissions risk assessment for your environmental permit, DEFRA and EA, 2016, https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit.

- CO_2, methane, H_2S and NMVOCs (including siloxanes) are not amongst the substances for which an assessment of potential effects on designated ecological site receptors is required. Ammonia is listed as a substance requiring assessment; however ammonia concentrations are only present below the limit of detection in the raw biogas, as such they do not warrant further assessment.
- The biomethane flare will be operated for limited occasions and for short durations; its design and process controls are regarded as BAT and sufficient to ensure the impact of emissions is not significant.

It is therefore not necessary to carry out detailed dispersion modelling. Potential releases to atmosphere due to an incident or abnormal operation are presented in Table 6-3 which concludes that the risk level is low.

As noted above, stack emissions testing will be undertaken post-commissioning to confirm the very low concentrations of trace contaminants in the offgas exhaust stack.

6.4 Impact of Odour

6.4.1 Membrane Separation Unit Exhaust

The odour detection threshold for H_2S[17] is 0.0005 ppm or 0.00076 mg/m^3. An emission concentration of 1 mg/m^3 equates to around 1,315 ou/m^3.

The offgas is not expected to contain odour concentrations at an appreciable level. The carbon filters have a very high efficiency (over 99%) and will effectively reduce emissions of odorous organic compounds, including H_2S.

As described in Section 4.1.2.3.2, the concentration of H_2S in the offgas is expected to be less than 0.63 mg/m^3 (based on the 'normal limit'[25] concentration of H_2S in the biogas), or less than 0.36 mg/m^3 (based on the average H_2S content of the biogas). This would equate to 828 ou_E/m^3 using the 'normal limit' concentration of H_2S in the biogas, or 473 ou_E /m^3 based on the average H_2S content of the biogas. The BAT-AEL for odour from biological waste treatment (see Section 4.4.1) is 200 - 1,000 ou_E/Nm^3.

It can therefore be concluded that the routine operation of the plant is unlikely to give rise to any significant odour. A release of odour in the offgas would only occur in abnormal circumstances that would cause the carbon filters to become overloaded. There will be monitors and controls in place to ensure this does not happen. Stack monitoring will be undertaken post-commissioning to confirm the very low concentrations of trace contaminants, including H_2S, in the off gas emitted to atmosphere. Consequently, it is not considered necessary or proportionate to produce an Odour Management Plan for the BtG plant.

6.5 Impact of Noise

The main sources of noise are:

- blowers;
- biogas compressors;
- chiller units;
- air compressor (in membrane separation unit building).

[25] Note: H_2S emissions at these concentrations will be around or below the limit of detection for monitoring (<0.5 mg/m^3).

Noise from the biomethane flare will be below 65dBA at 1 m and is not anticipated to give rise to any noise impacts.

Existing ambient noise levels in the vicinity of the proposed BtG plant and nearest noise sensitive receptors are likely to be moderate to high as the proposed site is located in a predominantly industrial urban area, within YWS WwTW and close to main transport links. The nearest noise sensitive receptor is an environment centre 770 m to the south east, the nearest residential area is approximately 900 m to the north (there are large industrial buildings and warehouses between the housing and the BtG plant that would act as screening and reduce noise levels).

Noise attenuation has been taken into account as part of the overall design of the BtG Plant and for specific items of equipment. For example, each of the biogas compressors will be in an acoustic enclosure and the air compressor will be inside the membrane separation unit building. The design for the BtG plant will ensure a maximum noise limit of 85 dBA at 1 m. Further details on design and process measures to control noise emissions are identified in Section 5.8.7.

A screening assessment of potential noise impacts from the BtG plant on noise sensitive receptors has been conducted. The assessment considers the requirements of the EA's guidance for 'Step 1: desktop risk assessment'[26] as well as applicable noise guidance and is presented in Appendix E As part of the assessment, a three-dimensional computer noise model was set up to predict the external noise levels at the nearest noise sensitive receptors. Predicted external noise levels were found to be below the lowest observed adverse effect level, and below the existing ambient noise levels, at all receptors considered, during both daytime and night-time periods. Therefore, no adverse impact from the BtG plant is expected and the risk from noise from the BtG plant at the closest noise sensitive receptor is considered to be low.

6.5.1 Noise Impacts Conclusions

Based on the information available, no adverse impact from the BtG plant is expected and the risk from noise from the BtG plant at the closest noise sensitive receptor is considered to be low. It is therefore not considered necessary to carry out detailed noise modelling, or to produce a noise management plan. However, due to the potential for noise releases as a result of an incident or abnormal operation, a qualitative assessment has been carried out and is presented in Table 6-4 which concludes that the risk level is low.

6.6 Impact of Aqueous Emissions to YWS Drainage System

The only channelled aqueous releases are via transfer from the BtG plant drainage systems to the YWS drainage system, which is routed to the WwTW inlet. The resultant YWS WwTW final effluent discharge is subject to regulation via a separate permit. The BtG plant drainage will comprise small quantities of condensate returns (identical to that produced presently at the YWS STF) via TP1 and site runoff water via TP2; therefore, a quantitative assessment of point source emissions to water is not deemed necessary to determine that impact is insignificant.

[26] Noise and vibration management: environmental permits - GOV.UK (www.gov.uk)

6.7 Impact of Aqueous Emissions to Surface Water

There will be no emissions directly to surface water from the BtG plant.

6.8 The Habitats Regulations

An assessment of the impact of the facility on relevant European sites in the UK has been carried out as part of this application. On the basis of the information and assessments provided above it can be concluded that the impact of the BtG plant on relevant European sites in the UK (and the overall environmental impact of the facility) will not be significant.

6.9 Global Warming Potential

The GWP of the BtG plant has been calculated in accordance with the EA's 'Assess the Impact of Air Emissions on Global Warming' guidance[27] and using a global warming factor of 1 for CO_2 and 21 for methane - see Table 6-1.

Table 6-1 - Global Warming Potential

Emission	Flow Rate of inlet biogas (Nm^3/h)	t/yr [1]	CO_2 equivalent (t/yr)
CO_2	2,950 (max)	17,314	17,314
Methane	2,950 (max)	57	1,207
Total GWP at Design Biogas Flow Rate			**18,521**
CO_2	1,675 (average	9,831	9,831
Methane	1,675 (average)	33	685
Total GWP at Average Biogas Flow Rate			**10,516**

Table Notes [1] See Section 4.1.2 for the source of these data.

The GWP at the maximum design biogas inlet flow rate is estimated at 18,521 t/yr CO_2 equivalent; at the average biogas inlet flow rate this drops to 10,516 t/yr CO_2 equivalent. The biomethane flare emissions have not been addressed as part of the GWP estimation as use of the flare will be infrequent and for a very limited number hours per year.

Energy use, which leads indirectly to the generation of greenhouse gases, will be minimised though an energy management system which will automatically adjust the use of equipment to meet the process demands as efficiently as possible; and regulate energy use at the facility to ensure maximum efficiency.

6.10 Site Waste

There will be minimal waste arising from activities associated with the BtG plant. The main waste stream is spent activated carbon. The carbon will remain within the activated carbon filters until it is

27 Assess the impact of air emissions on global warming, DEFRA & EA, 2016 https://www.gov.uk/guidance/assess-the-impact-of-air-emissions-on-global-warming

saturated, at which point the carbon is replaced and the saturated carbon is removed from site by a waste contractor for regeneration / disposal. There will be small amounts of maintenance wastes, including oil and waste glycol. In addition, minor quantities of general maintenance waste (e.g. rags, filters, grease, solvent (WD 40), small mechanical / electrical parts) will be generated.

As noted above, for any wastes generated, the WFD hierarchy will be applied, with the option of disposal only considered once all other options have been considered. Wastes that cannot be regenerated / re-used will be disposed of by a waste management contractor under a waste transfer licence. All waste documentation for the facility will be maintained centrally on site, including records of waste carrier licences, waste transfer notes and waste consignment notes.

Minimisation of air emissions and emissions to land, groundwater or surface water from waste will be achieved through design, via effective waste storage, inspection, maintenance and management / control and handling procedures - see Section 5.10 for more details.

It is considered that the potential for environmental impacts arising from the generation, handling and transport of wastes at the BtG plant is insignificant.

6.11 Fugitive Emissions

6.11.1 Overview

There will be no fugitive emissions as a result of normal operation of the BtG plant. Fugitive emissions would only arise as a result of abnormal operation or an accident scenario, for example resulting from:

- failure, or damage to pipework and equipment;
- failure, or damage to storage vessels (propane only); and
- spills during handling, use and storage of materials (propane only).

Damage and / or spills could occur as a result of:

- poor maintenance and inspection regimes;
- inadequate training;
- fires / explosions;
- vehicle collision;
- security breaches, including damage, theft and arson; and
- extreme weather, including flooding.

The BtG plant activities will be managed and operated in accordance with the AMP. The AMP is a fundamental component of the EMS and resultant EMP. The EMS for the BtG plant has not yet been developed; however a preliminary AMP has been prepared (see Appendix F). The AMP will be revisited and revised as / if necessary as part of the development of the EMS, and as the specifics of the design are developed further and finalised.

In addition to (or through) the EMS and AMP, general measures that will be in place to prevent fugitive emissions include:

- design in accordance with appropriate standards and legislative requirements;
- selection of appropriate equipment and materials;
- operation in accordance with legislative requirements;
- implementation of robust operating systems and procedures;
- appropriate monitoring of process variables and emissions;
- regular inspection regime;

- preventative maintenance programme and maintenance plan;
- appropriate staff training;
- safe systems of work, including associated permit systems;
- induction and safety briefing for contractors and visitors;
- appropriate use and locations of spill kits;
- potential to isolate the site runoff water drainage system; and
- development and implementation of an emergency response plan and associated procedures.

Control measures to prevent fugitive releases are described in more detail in Sections 5.9 and 5.10. Risks to the environment from normal operation, abnormal operation and from accident scenarios, along with the measures that will be in place to mitigate such risks, have been summarised in Table 6-3 (for air emissions), Table 6-4 (for noise) and Table 6 5 (for emissions to land / water).

6.11.2 Fugitive Emissions to Air

Potential sources of fugitive emissions to air are biogas, biomethane and propane releases.

The potential fugitive releases of biogas, biomethane and propane will not result in direct effects / harm to human health or the environment. They are flammable gas and any impacts are more likely to be associated with safety issues.

The inherent design of the BtG plant (and associated pipework) and the measures that will be in place (as described above in Section 6.11.1) are such that the opportunity for fugitive emissions will be virtually eliminated. Thus, the risk associated with fugitive releases to air is considered to be low. Preventive measures are summarised in Table 6-3 and the AMP (Appendix F).

6.11.3 Fugitive Releases to Land and Water

Potential sources of fugitive emissions to land / water are propane (in its liquid form) and the raw materials and wastes used / generated at the site (see Table 2-1 - Raw Material Use, Storage and Fate and Table 2-2 - Waste Generation, Storage and Disposal).

Liquid propane would rapidly vaporise to the gaseous form - gaseous fugitive releases are described above.

Releases of solid materials / waste can be readily cleaned up and removed from site. Depending on the location of the release and the cause of the release, liquids would either be retained in bunds and / or buildings or spilled to ground. Spills to ground would be either captured in the site's drainage system or encounter unmade ground. There is an interceptor in the site runoff drainage system and the onsite isolation control valve would be closed in the event of a spill. Spills on, or near to, soft landscaping areas (unmade ground) could potentially percolate through the ground and into groundwater.

The inherent design of the BtG plant (and associated pipework) are such that the opportunity for fugitive emissions will be virtually eliminated. Any remaining risk will be minimised through the measures that will be in place (as described above in Section 6.11.1). Thus, the risk associated with fugitive releases to land and water is considered to be low. Preventive measures are summarised in Table 6-5 and the AMP (Appendix F).

6.12 Risk Assessment

Table 6-3, Table 6-4 and in Table 6-5 describe and assess the main risks to the environment from the addition of the BtG plant. Potential hazards have been assessed and evaluated in relation to the level of environmental risk they pose to receptors. For each hazard, the probability of exposure and

consequence level have been categorised, and these used to establish an overall risk level using the following matrix:

Table 6-2 - Risk Rating Matrix

Risk Matrix		**Consequence**		
		High	Medium	Low
Probability of exposure	High	High	High	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Low

The principles of applying a certain probability and consequence rating are described below:

Probability of exposure:

- Low - an incident that is highly unlikely to occur without mitigation.
- Medium - a reasonably likely incident without mitigation.
- High - an incident that is highly likely to occur without mitigation.

Consequence:

- Low - an incident that would cause a negligible impact on receptors.
- Medium - an incident that would cause a slight impact on receptors.
- High - an incident that would cause a serious threat to human health or the environment.

Finally, a residual risk level is established after consideration of the control measures that will be in place to mitigate that risk.

Table 6-3 - Emissions to Air Risk Assessment

Hazard	Normal or Accidental	Source	Pathway	Receptors	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Emission from membrane separator unit exhaust	N	Membrane separator unit exhaust stack	Release to air via stack	Local atmosphere Global atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	High	Low	Medium	Activated carbon filters will be used to remove contaminants from the incoming biogas. The BtG plant will be inspected regularly and is designed to operate within permitted limits (where required). SGN will operate a preventative maintenance programme which includes the BtG plant. Critical spare parts are maintained on-site. Emissions monitoring will be carried out (as required) to check compliance with any permitted limits. [For further details of routine monitoring see Section 6.13.]	Low
Release of odour from membrane separator unit exhaust	N	Membrane separator unit exhaust stack	Release to air	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	High	Low	Medium	Correct selection of activated carbon filters. All plant and equipment will be maintained in good working condition and subject to routine inspection and maintenance. Emissions monitoring will be carried out (as required) to check compliance with any permitted limits. [For further details of routine monitoring see Section 6.13.]	Low

Hazard	Normal or Accidental	Source	Pathway	Receptors	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Release of emissions from biomethane flare	N	Biomethane flare	Release to air of combustion gases	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	High	Low	Medium	On detection of off-specification biogas the biogas inlet to the BtG plant will close automatically and the BtG plant will shut down. Biomethane flare designed in accordance with appropriate requirements / guidance. The biomethane flare is a modern design, it does not require a pilot flame, it will comply with the relevant emission limits, burner temperature and residence time. The BtG plant will be inspected and maintained regularly and is designed to operate within permitted limits (where required). SGN will operate a preventative maintenance programme which includes the BtG plant. Critical spare parts will be maintained on-site. Operation of BtG plant will be monitored via SCADA system.	Low
Release of fugitive emissions of biogas, biomethane or propane from BtG plant	A	BtG plant equipment, biogas and biomethane pipework; propane vessel and pipework	Release to air	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites	Medium	Low	Low	Plant designed in accordance with appropriate requirements and legislative standards. All gas pipework will be design approved and appraised to appropriate standards, using approved materials with suitable protection installed as part of the design. Pumps and valves will be sealed.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptors	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
				Local ecological sites				Storage of propane will be in an underground gas tight vessel. The propane system will be monitored remotely via the GEU. The system has alarm setpoints for vapour and liquid pressure. The propane storage vessel will have a visual sight glass or gauge and is fitted with high and low level trips and alarms. There will be a safety cut out at 80% capacity to prevent overfilling. Gas detection installed in appropriate areas. All plant and equipment will be maintained in good working condition and subject to routine inspection and maintenance. SGN will implement an LDAR programme to reduce fugitive emissions and CCTV inspection of below ground storage vessel. Operation of BtG plant will be monitored via SCADA system. An AMP will be in place.	
Failure of PRVs (release of fugitive emissions of biogas, biomethane)	A	PRVs	Release to air and potential to create fire and explosion	Local atmosphere Global atmosphere Site personnel Local residents	Low	High	Medium	SGN will operate a robust inspection and preventative maintenance programme which will include checking pressure settings for pressure relief valves. Gas detection installed.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptors	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
				Workforce at local businesses and amenity sites Local ecological sites				Operation of BtG plant will be monitored via SCADA system. An AMP will be in place.	
Failure of biomethane flare resulting in release of un-combusted biomethane	A	Biomethane flare	Release to air and potential to create fire and explosion		Low			SGN will operate a robust inspection and preventative maintenance programme. Gas detection installed. Operation of biomethane flare will be monitored via SCADA system. An AMP will be in place.	
Failure of other equipment	A	Blowers, heat exchangers, chiller, activated carbon filters, compressors, membrane separation unit	Release to air	Local atmosphere Global atmosphere Site personnel Local residents Workforce at local businesses / amenity sites Local ecological sites	Low	Low	Low	Plant designed in accordance with appropriate requirements and legislative standards. SGN will operate an inspection and preventative maintenance programme. Gas detection installed. Operation of BtG plant will be monitored via SCADA system. An AMP will be in place.	Low
Smoke from accidental fire at site	A	BtG plant - due to maintenance activities / hot works, external	Air transport of smoke then deposition / inhalation	Local atmosphere Site personnel	Low	Medium	Low	Use of ATEX rated equipment in designated areas on DSEAR zoning plan.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptors	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
		fires, igniting fuels, or electrical failure.		Local residents Workforce at local businesses and amenity sites Local ecological sites				Gas detection and heat detectors will be in place. Activities will be managed and operated in accordance with a EMS and AMP, which will include procedures and actions required in the event of a fire. All plant and equipment and electrical installations will be maintained in good working condition and subject to routine inspection and maintenance. Good housekeeping measures are in place. The site will enforce a 'No Smoking' policy. Control or elimination of potential sources of ignition and combustible materials (e.g. immediate cleaning of small leaks of oils or other flammable liquids). Good access for emergency vehicles. Training and simulation / testing of emergency systems. Plant designed in accordance with appropriate requirements and legislative standards. SGN will operate an inspection and preventative maintenance programme. Gas detection installed.	

Hazard	Normal or Accidental	Source	Pathway	Receptors	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
								Operation of BtG plant will be monitored via SCADA system.	
Smoke from fire at site caused by vandalism or unauthorised access	A	BtG plant May be caused by vandalism, arson, or other unauthorised activity.	Air transport of smoke then deposition / inhalation	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	Medium	Low	As per the relevant measures above, plus: The BtG plant will be built within the existing YWS WwTW which has CCTV monitoring and 24-hr security presence. The YWS site is surrounded in security and perimeter fencing. The SGN area will also be fenced with padlocked access/egress gates. Regular security inspections will be carried out as part of site inspections.	Low
Catastrophic loss of containment of biomethane, biogas or propane	A	Loss of containment on site from BtG plant or pipework	Release to air and potential to create fire and explosion	Local atmosphere Global atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	High	Medium	All gas pipework will be design approved and appraised to appropriate standards, using approved materials with suitable protection installed as part of the design. The propane system is monitored remotely via the GEU human interface panel via remote connection devices. Pressure and vacuum relief systems will be in place. Welded pipework used where possible. Gas tight seals utilised. ATEX Zoning and rated plant / equipment used with gas detection installed. Heat detectors in place.	Low

Hazard	Normal or Accidental	Source	Pathway	Receptors	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
								All plant and equipment and electrical installations are maintained in good working condition and subject to routine inspection and maintenance. EMS and AMP will be in place. Operation of BtG plant will be monitored via SCADA system.	
Overfilling of propane storage vessel	A	Loss of containment on site in vicinity of propane vessel	Release to air and potential for fire and explosion	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	High	Medium	Vessel will be remotely monitored. Propane system will be monitored remotely. The storage vessel will have a visual sight glass or gauge and high and low level trips and alarms. The system will be fitted with a safety cut out (mechanical slam shut valve) at 80% fill capacity to prevent overfilling. The valve will be tested on delivery and in accordance with supplier procedures. Filling of vessel will be conducted by a trained contractor, who will be accompanied by trained SGN site staff at all times. Spill procedure will be in place and all staff trained. EMS and AMP will be in place.	Low
Spill of liquified propane during delivery,	A	Loss of containment on site in vicinity of propane vessel	Release to air	Local atmosphere Site personnel	Low	Medium	Low	Filling of vessel will be conducted by a trained contractor, who is	Low

Hazard	Normal or Accidental	Source	Pathway	Receptors	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
handling and transfer				Local residents Workforce at local businesses and amenity sites Local ecological sites				accompanied by trained site staff at all times. Propane system will be monitored remotely. The vessel will have a visual sight glass or gauge and high and low level trips and alarms. Propane will rapidly vaporise. An AMP will be in place.	
Vehicle collision with plant / pipework leading to loss of containment	A	All on-site machinery and vehicles	Release to air and potential to create fire and explosion	Drivers, on-site staff Local atmosphere Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	High	Medium	Equipment and pipework will be located away from site traffic / protected by crash barriers (where required) and appropriate signage will be in place. Delivery area will be surrounded by kerbing and road ramps. Propane storage vessel will be below ground. Staff will be trained to direct and guide delivery vehicles and visitors to appropriate areas away from hazards. EMS and AMP will be in place.	Low
Flooding involving BtG plant	A	Rainfall, nearby surface watercourses, YWS drainage system.	Release to air and potential to create fire and explosion	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites	Low	High	Medium	Facility is located in flood zone 1. Use of ATEX rated equipment in designated areas on DSEAR zoning plan, with gas detection installed. Gas and heat detectors in place. A non-return valve will be in place to prevent back flow from the YWS drainage	Low

Hazard	Normal or Accidental	Source	Pathway	Receptors	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
				Local ecological sites				system to the BtG plant drainage systems. EMS and AMP will be in place.	
High winds causing damage to BtG plant	A	Loss of containment	Release to air and potential to create fire and explosion	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	High	Medium	Use of ATEX rated equipment in designated areas on DSEAR zoning plan, with gas detection installed. Gas and heat detectors in place. All infrastructure will be secured and is unlikely to be affected by high wind speeds. Propane storage vessel will be below ground. EMS and AMP will be in place.	Low

Table 6-4 - Noise Emissions Risk Assessment

Hazard	Normal or Accidental	Source	Pathway	Receptor	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Loss of noise containment	A	BtG plant compressors	Noise propagation through the air	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	Low	Low	Compressors will be located in acoustic enclosures, limited risk of breach of containment. SGN will operate a robust inspection and preventative maintenance programme which will include measures to prevent / minimise noise generation. Critical spare parts will be maintained on-site. External complaints will be immediately notified to SGN's Customer Centre for action who will then co-ordinate appropriate actions according to the nature of the communication. BtG plant will be located in an industrialised area within the wider WwTW and is not located close to receptors which are sensitive to noise. An EMS and AMP will be in place.	Low
Noise from BtG plant compressors	N	BtG plant compressors	Noise propagation through the air	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	High	Low	Medium	Compressors will be located in acoustic enclosures, limited risk of breach of containment. SGN will operate a robust inspection and preventative maintenance programme which will include measures to prevent / minimise noise generation. Critical spare parts will be maintained on-site. External complaints will be immediately notified to SGN's Customer Centre for action who will then co-ordinate appropriate actions according to the nature of the communication. BtG plant will be located in an industrialised area within the wider	Low

								WwTW and is not located close to receptors which are sensitive to noise.	
Noise from delivery vehicles	N	Delivery vehicles	Noise propagation through the air	Local atmosphere Site personnel Local residents Workforce at local businesses and amenity sites Local ecological sites	Low	Low	Low	Very limited number of deliveries. Speed rustication will be in place. Receptors are not located close to delivery areas. External complaints will be immediately notified to SGN's Customer Centre for action who will then co-ordinate appropriate actions according to the nature of the communication. BtG plant will be located in an industrialised area within the wider WwTW and is not located close to receptors which are sensitive to noise.	Low

Table 6-5 - Emissions to Land and Water Risk Assessment

Hazard [1]	Normal or Accidental	Source	Pathway	Receptor	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Loss of containment glycol or lubrication oil from BtG plant	A	On site release of glycol / lubrication oil in vicinity of BtG plant (e.g. chillers, heat exchangers, and compressors)	Percolation through and into soils Direct run-off from site across the ground and entering site drainage	Workforce Areas of unmade ground Groundwater Surface water Nearby natural habitats	Medium	Low	Low	Compressors will be located within compressor housing. Glycol and lubrication / waste lubrication oil are stored on a bund in the COSHH stores. Concrete hardstanding beneath plant items. Volume of releases will be limited by the small quantities that will be stored and used. Delivery area will be surrounded by kerbing and road ramps. Site runoff drainage system will be fitted with interceptor and isolation valve. Retained contaminants would be pumped into IBCs for disposal offsite. Site runoff drainage discharged to YWS drainage is routed on to the WwTW where it is treated then released to surface water under a separate permit. Records will be available and kept up to date for all drainage structures including the routing of all drains. Spill procedure will be in place and all staff will be trained in how to deal with spills. A spills location plan will be produced. Rigorous inspection and preventative maintenance programme will be in place. Staff will be trained to detect leaks and spills as part of day to day site inspections.	Low

Hazard [1]	Normal or Accidental	Source	Pathway	Receptor	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
								An AMP will be in place.	
Overfilling of glycol, lubrication oil, waste lubrication oil containers, or spillage resulting from delivery / collection, handling and transfer	A	On site release of glycol / lubrication oil / waste lubrication oil in vicinity of COSHH stores	Percolation through and into soils Direct run-off from site across the ground and entering site drainage	Workforce Areas of unmade ground Groundwater Surface water Nearby natural habitats	Medium	Low	Low	Glycol and lubrication / waste lubrication oil are stored on a bund in the COSHH stores. Delivery of containers will be conducted by a trained contractor, who will be accompanied by trained site staff at all times. Delivery area will be surrounded by kerbing and road ramps. Use of materials (e.g. during maintenance) will be conducted by a trained personnel. Drip trays will be used. Volume of release will be limited by the small quantities that will be stored and used. Site runoff drainage system will be fitted with interceptor and isolation valve. Retained contaminants would be pumped into IBCs for disposal offsite. Site runoff drainage discharged to YWS drainage will be routed on to the WwTW where it is treated then released surface water under a separate permit. Records will be available and kept up to date for all drainage structures including the routing of all drains. Materials handling procedures will ensure the appropriate use of bunds and drip trays. Spill procedure will be in place and all staff will be trained in how to deal with spills.	Low

Hazard [1]	Normal or Accidental	Source	Pathway	Receptor	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
								Spill kits will be distributed at key locations across the facility. An AMP will be in place.	
Release of condensate from the condensate pots and drainage system		Condensate drainage system	Percolation through soils	Workforce Areas of unmade ground Groundwater Surface water Nearby natural habitats	Low	Medium	Low	Design of condensate pots and drainage system will be to appropriate standards using appropriate materials. The condensate drainage system is a below ground system. Condensate pots will be monitored / checked for damage through regular inspection. Underground drainage pipework will be checked by CCTV[12]. Preventative maintenance programme will be in place. Staff will be trained to detect leaks and spills as part of day to day site inspections. An AMP will be in place.	Low
Release of potentially contaminated fire water in BtG plant area of site	A	Fire-fighting water	Percolation through and into soils Direct run-off from site across the ground and entering site drainage	Workforce Areas of unmade ground Groundwater Surface water Nearby natural habitats	Low	High	Medium	Fire prevention measures will be in place (see the fire scenarios in Table 6-3). Firewater will be collected in the site runoff drainage system. The drainage system will be isolated from the YWS drainage system. Depending on the make-up of the firewater it could be collected and disposed of offsite, or, if suitable discharged to the YWS drainage for treatment in the WwTW. Activities will be managed and operated in accordance with a EMS and AMP, which will include procedures and actions required in the event of a fire. Training and simulation / testing of emergency systems.	Low

Hazard [1]	Normal or Accidental	Source	Pathway	Receptor	Exposure Probability	Consequence	Magnitude of Risk	Risk Management	Residual Risk
Loss of containment / of activated carbon / spent activated carbon	A	Carbon filters	Potential leaching into soils Transportation as airborne dust.	Workforce and local human receptors Areas of unmade ground Groundwater Surface water Nearby natural habitats	Low	Low	Low	Carbon is contained within the activated carbon filters. Spent carbon is removed by vacuum extraction and fresh carbon is decanted into the top of the filter units. The spent carbon is not regenerated on the site. Concrete hardstanding beneath plant items. Delivery area will be surrounded by kerbing and road ramps. Delivery of carbon and change out will be conducted by a trained contractor, who will be accompanied by trained site staff at all times. Rigorous inspection and preventative maintenance programme will be in place. Carbon filters will be located away from site traffic / protected by crash barriers (where required) and appropriate signage. Spill kits will be distributed at key locations across the facility. A spill procedure will be in place and all staff trained. An AMP will be in place.	Low

Table Notes:

[1] Liquid propane is not considered as a source due it the very high rate of evaporation to its gaseous form.

6.13 Emissions Assessment Summary

The BtG plant is located just over 4 km to the south east of Leeds on an area of land within YWS WwTW. The area is characterised predominantly as industrial urban area and is close to main transport links. The closest residential properties are located almost 900 m to the north of the BtG plant while the nearest commercial buildings are 260 m to the north of the BtG plant, beyond the A63. There are no AQMAs within 2 km. Existing ambient noise levels in the vicinity of the BtG plant and at the nearest noise sensitive receptors are likely to be moderate to high.

There are no statutory nature conservation sites of European or international importance within 10 km of the BtG plant. There are no SSSIs within 2 km. The nearest local nature conservation sites are Temple Newsam Estate Wood LWS 450 m east, and Halton Moor LWS and LNR 850 m north. The site location is not in a SPZ, the nearest SPZ is nearly 10 km away. The nearest water course is Wyke Beck, which is located approximately 35 m to the north east of the BtG plant location. The facility is within Flood Zone 1 (low risk of flooding).

Impacts from normal and abnormal operations at the BtG plant will be managed and controlled through a combination of measures including; design, compliance with appropriate standards / legislation and guidance, process controls, operational procedures, the EMS and EMP (including management procedures, inspection and maintenance regimes, training, AMP and emergency response plans).

Other than the raw biogas and activated carbon, materials usage will be limited to relatively small quantities of propane, glycol, mineral / lubrication oil, and maintenance sundries. The BtG plant does not require water as part of the biogas treatment process. With the exception of the spent carbon from the carbon filters (which will be take offsite for regeneration / disposal by a waste contractor), waste generation will be minimal. Energy use will be minimised though an automated energy management system which will automatically adjust the use of equipment to meet the process demands as efficiently as possible and regulate energy use at the facility to ensure maximum efficiency.

The main emissions with the potential to cause impact on the environment are point source emissions to air, where the emissions of interest comprise CO_2 and traces of methane, H_2S (and odour arising from this), siloxanes and NMVOCs, as well as minor emissions of combustion products from the biomethane flare. The CO_2 and methane emissions have been assessed for global warming potential, which is the relevant potential impact as CO_2 does not present an environmental risk to human health. The activated carbon filters provide control of H_2S (and odour), siloxanes and NMVOCs. The predicted concentrations in the offgas from the membrane separator unit do not indicate that there will be any significant impact on local air quality, human health or the ecological receptors.

A qualitative risk assessment has been undertaken for potential for fugitive / accidental releases to air (see Table 6-3); the outcome of the assessment concludes that the risk is low.

A semi-quantitative odour assessment has been undertaken for the offgas from the membrane separator unit. The predicted odour emission concentration of less than 1,000 OU_E/m^3 demonstrates compliance with the Waste Treatment BREF BAT-AEL for odour from biological treatment processes. It is therefore not considered necessary to carry out detailed odour modelling, or to produce an odour management plan. A qualitative risk assessment has been undertaken for potential for fugitive / accidental releases (see Table 6-3); the outcome of the assessment concludes that the risk is low.

No adverse impact from the BtG plant is expected and the risk from noise from the BtG plant at the closest noise sensitive receptor is considered to be low. It is therefore not considered necessary to carry out detailed noise modelling, or to produce a noise management plan. A qualitative risk

assessment has been undertaken for potential for fugitive / accidental releases (see Table 6-4); the outcome of the assessment concludes that the risk is low.

There are no direct point source releases to sewer or surface water. The only channelled aqueous releases are via transfer from the BtG plant drainage systems to the YWS drainage system, which in turn is routed to the WwTW inlet. The BtG plant drainage will comprise small quantities of condensate returns (identical to that produced presently at the YWS STF) and site runoff water. The resultant YWS WwTW final effluent discharge is subject to regulation via a separate permit. On the basis of these factors, it is considered that the impact is insignificant and a quantitative assessment of point source emissions to water is not deemed necessary.

The only point source discharge to ground (or groundwater) is clean water from rainfall onto roofs (or areas that do not have the potential to be contaminated). This has been screened out as an insignificant risk to environmental or human health.

A qualitative risk assessment on the impact from potential fugitive and accidental releases to land and water has been undertaken (Table 6-5); the outcome of the assessment concludes that the risk is low.

7. Monitoring and Reporting

7.1 Guidance

The BWT AppM guidance does not contain any information on monitoring specific parameters for emissions to air. However, Section 11.2 (Emissions monitoring and limits) provides some general information and states that:

> *Where you are required to monitor emissions to comply with the requirements of your environmental permit you must follow our monitoring guidance (https://www.gov.uk/guidance/control-and-monitoremissions-for-your-environmental-permit#monitoringyour-emissions).*

Any monitoring undertaken to comply with the conditions of the permit will be undertaken in line with the requirements of the above EA monitoring guidance.

Section 6.1.2 of the Waste Treatment BREF BAT Conclusions relates to monitoring and is referred to below, as relevant.

7.2 Emissions to Air

7.2.1 Membrane Separation Unit

BAT8 of the Waste Treatment BREF BAT Conclusions contains the following monitoring requirements for the biological treatment of waste. It is noted that the BtG plant is not an actual biological treatment process, it is a DAA to the YWS anaerobic digestion process.

BAT8 notes that monitoring should be undertaken in line with EN standards; where these are not available BAT is to use ISO, national or other international standards the ensure the provision of data is of an equivalent scientific quality. The BAT8 monitoring requirements are associated with the BAT-AELs in BAT34 (see Section 4.4.1).

Table 7-1 - Monitoring Requirements for the Biological Treatment of Waste (BAT8)

Substance / Parameter	Standard(s)	Minimum Frequency [1]
Hydrogen sulphide [2]	No EN Standard available	Once every 6 months
Ammonia [2]	No EN Standard available	Once every 6 months
Odour [3]	EN 13725	Once every 6 months

Table Notes:

[1] Monitoring frequencies may be reduced if the emission levels are proven to be sufficiently stable.

[2] The odour concentration may be monitored instead.

[3] The monitoring of H_2S or NH_3 concentration can be used as an alternative to the monitoring of the odour concentration.

The membrane separation unit exhaust stack will be monitored during performance testing, following hot commissioning works. The ammonia concentration in the inlet biogas is below the limit of detection, consequently any ammonia in the CO_2 offgas will also be below the limit of detection. This can be verified during performance testing. Therefore it is not proposed to monitor ammonia. In accordance with the requirements of BAT8, it is proposed that six-monthly H_2S (or odour) monitoring

be undertaken on the stack from the membrane separation unit. The exhaust stack will be fitted with a suitable port to enable access and monitoring.

7.2.2 Biomethane Flare

The biomethane flare will be subject to regular performance monitoring and planned maintenance to ensure minimum emissions, maximum combustion efficiency and maximum operational availability and shall be monitored for:

- biomethane flare operation (number of instances, date, time and duration); and
- gas flow rate to the biomethane flare.

The biomethane flare will:

- comply with the operating conditions of 0.3 seconds' residence time at 1,000°C as listed in Environment Agency guidance document Guidance for Monitoring Enclosed Landfill Gas Flares (LFTGN05 v2 2010),
- be fitted with a monitoring port; and
- is designed to meet the emission limits set in LFTGN05 v2 2010.

As the biomethane flare will operate for notably less than 10% of the year, emissions testing is not proposed on a regular basis. However, the biomethane flare will be monitored during performance testing (following hot commissioning) and these results can be made available to the EA if required.

7.2.3 Pressure Relief Valves

Pressure relief valves will be regularly inspected and the duration and frequency of any biogas / biomethane releases will be recorded.

7.3 Emissions to Water / Sewer

There are no point source emissions to water.

There are no direct emissions to sewer. Surface water and condensate returns are transferred (via TP1 - condensate returns and TP2 - site runoff water) to the YWS drainage system which feeds back to the WwTW inlet for treatment (see Appendix A, Figure A.4 for the location of TP1 and TP2). The ultimate discharge from the YWS WwTW has been previously assessed by the EA and is subject to separate final effluent discharge permit controls. No routine monitoring of the effluent transferred from the BtG facility to YWS is therefore proposed. However, condensate returns will be sampled during performance testing (following hot commissioning) and these results can be made available to the EA if required.

7.4 Emissions to Land

There are no emissions to land and no monitoring is proposed.

7.5 Monitoring (Beyond Facility)

Emissions monitoring beyond the facility is not deemed necessary or proportionate, as demonstrated by the results of the assessment of the emissions for the BtG plant (Section 6).

7.6 Other Monitoring / Reporting

A number of checks (and associated reporting) will be undertaken during site inspections (See Section 2.4.6) such as checking equipment, for odour at the site boundary, and for evidence of leaks. Process monitoring and controls are discussed in Section 5.4. Record keeping and procedures are discussed in Section 5.5.

APPENDICES

Appendix A. Plans and Drawings

The following Figures are provided in Appendix A:

Figure A-1: Biomethane to Grid Plant Site Layout and Boundary Plan.
Figure A-2: Location of the Biomethane to Grid Plant Boundary Relative to the YWS STF Boundary.
Figure A-3: Indicative Location Plan
Figure A-4: Location of Shared Services.
Figure A-5: Location of Emission and Transfer Points.
Figure A-6: Indicative Drainage Plan.
Figure A-7: Substances Location Plan.

Figure A-1: Biomethane to Grid Plant Site Layout and Boundary Plan

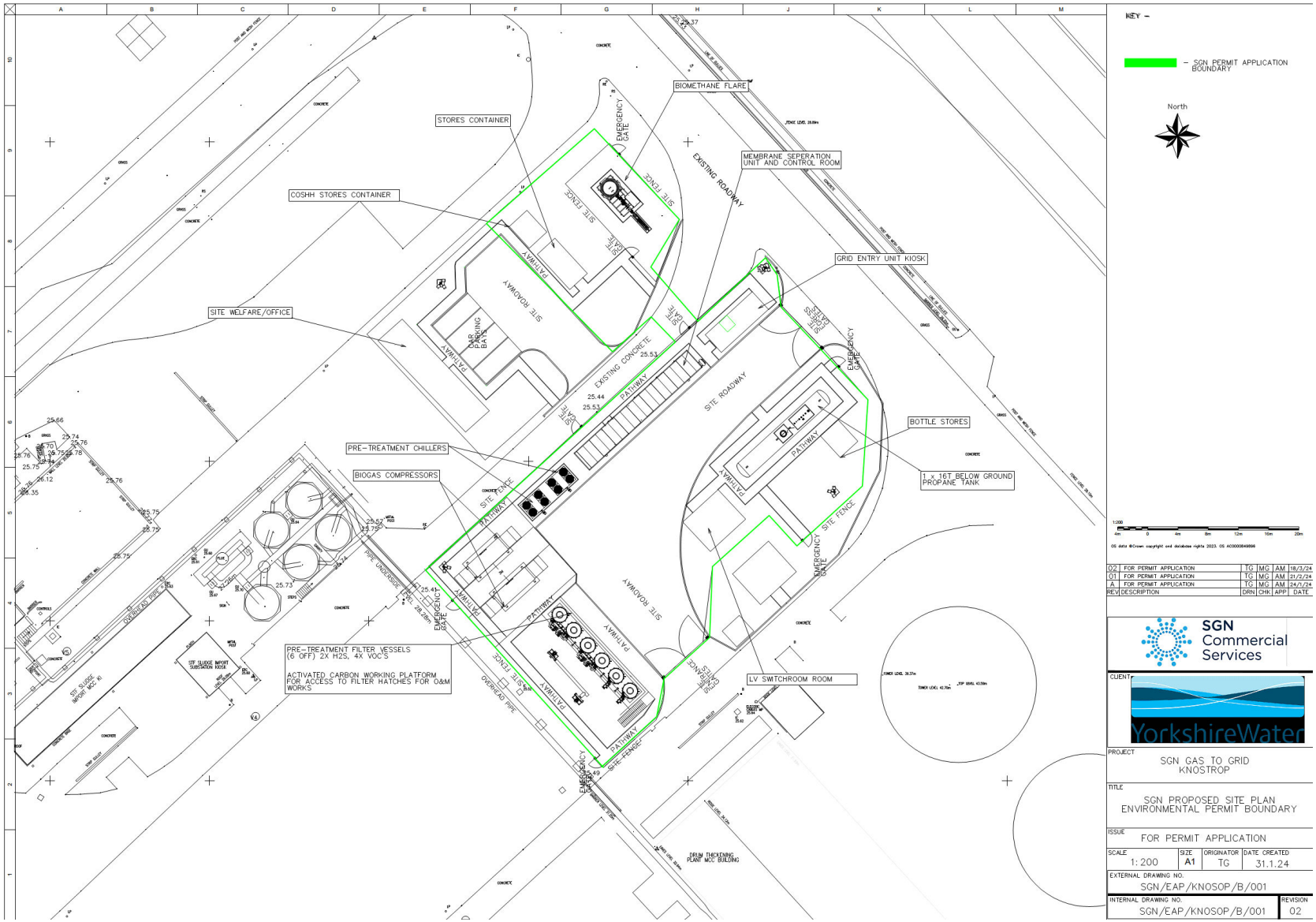


Figure A-2: Location of the BtG Plant Boundary Relative to the YWS STF Boundary

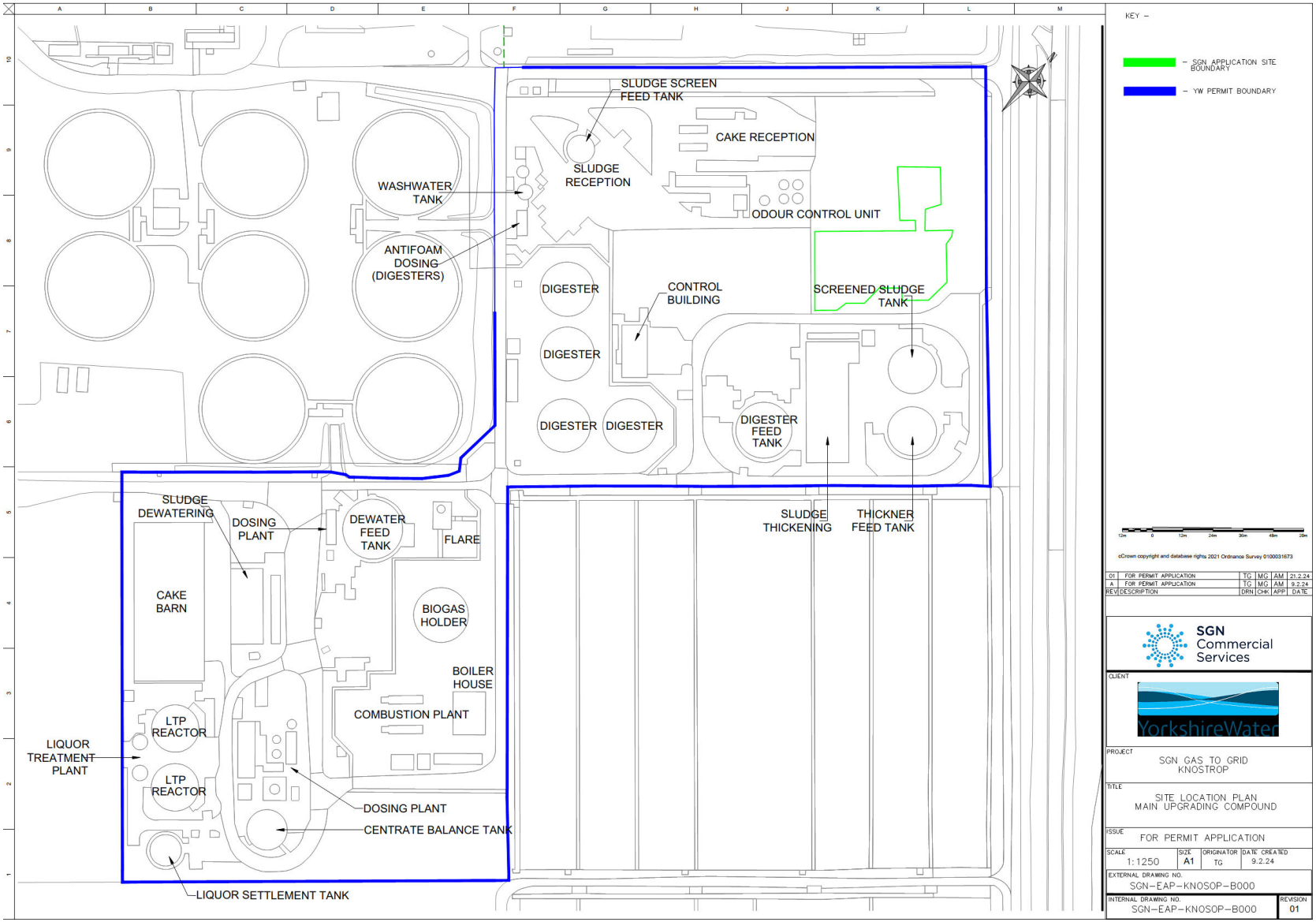


Figure A-3: Indicative Location Plan (Reproduced Courtesy of Yorkshire Water Services)

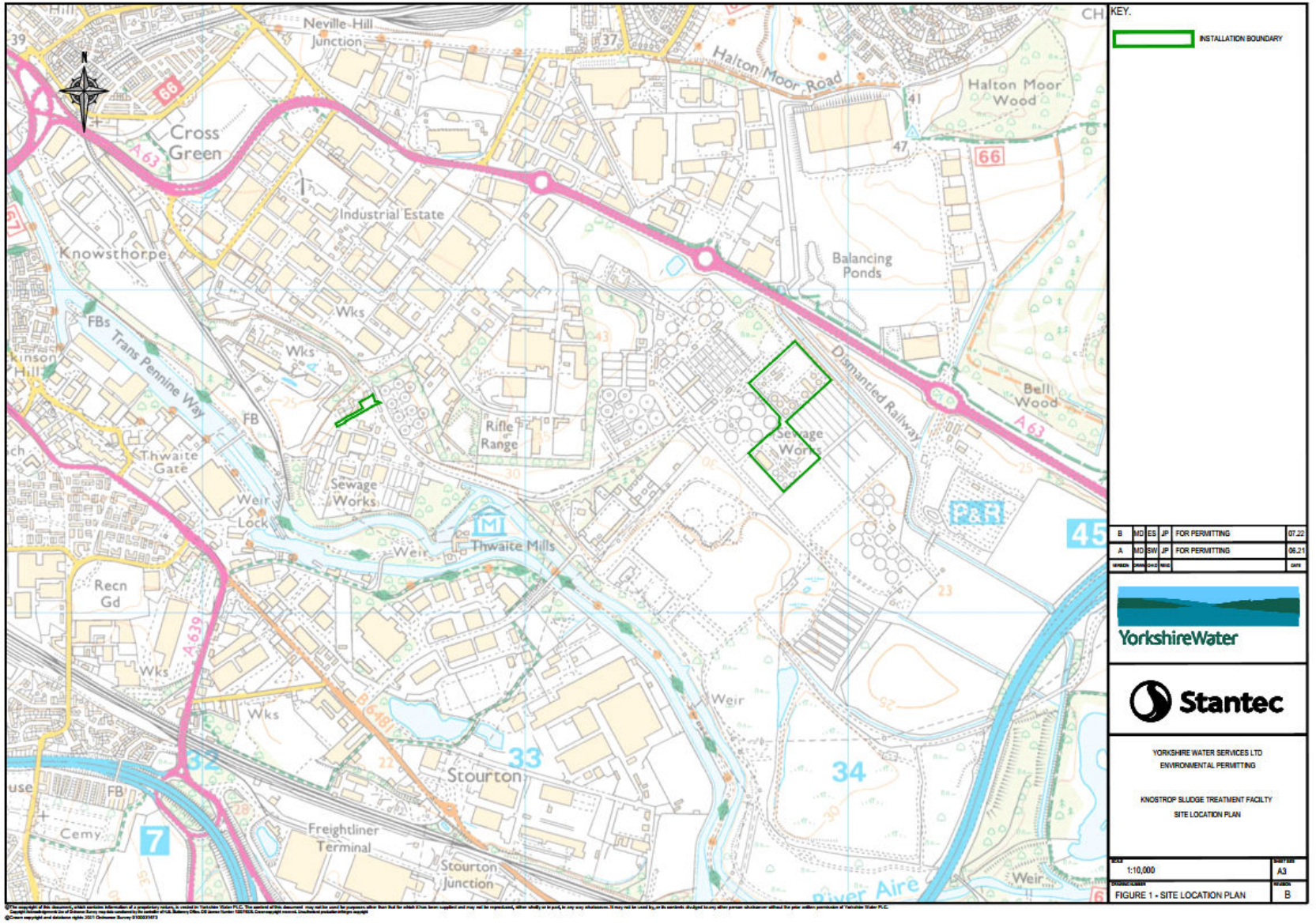


Figure A-4: Location of Shared Services

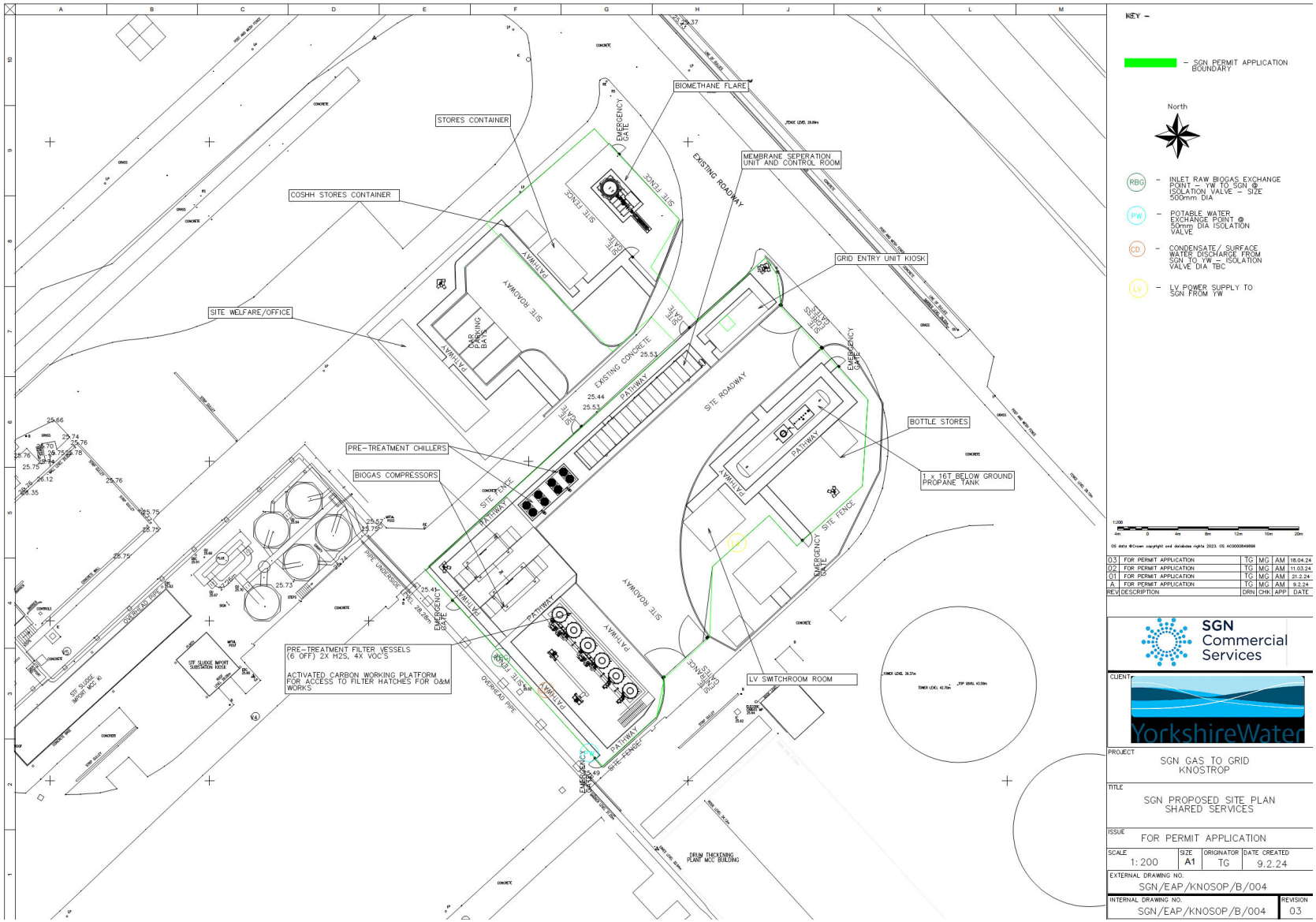


Figure A-5: Location of Emission and Transfer Points

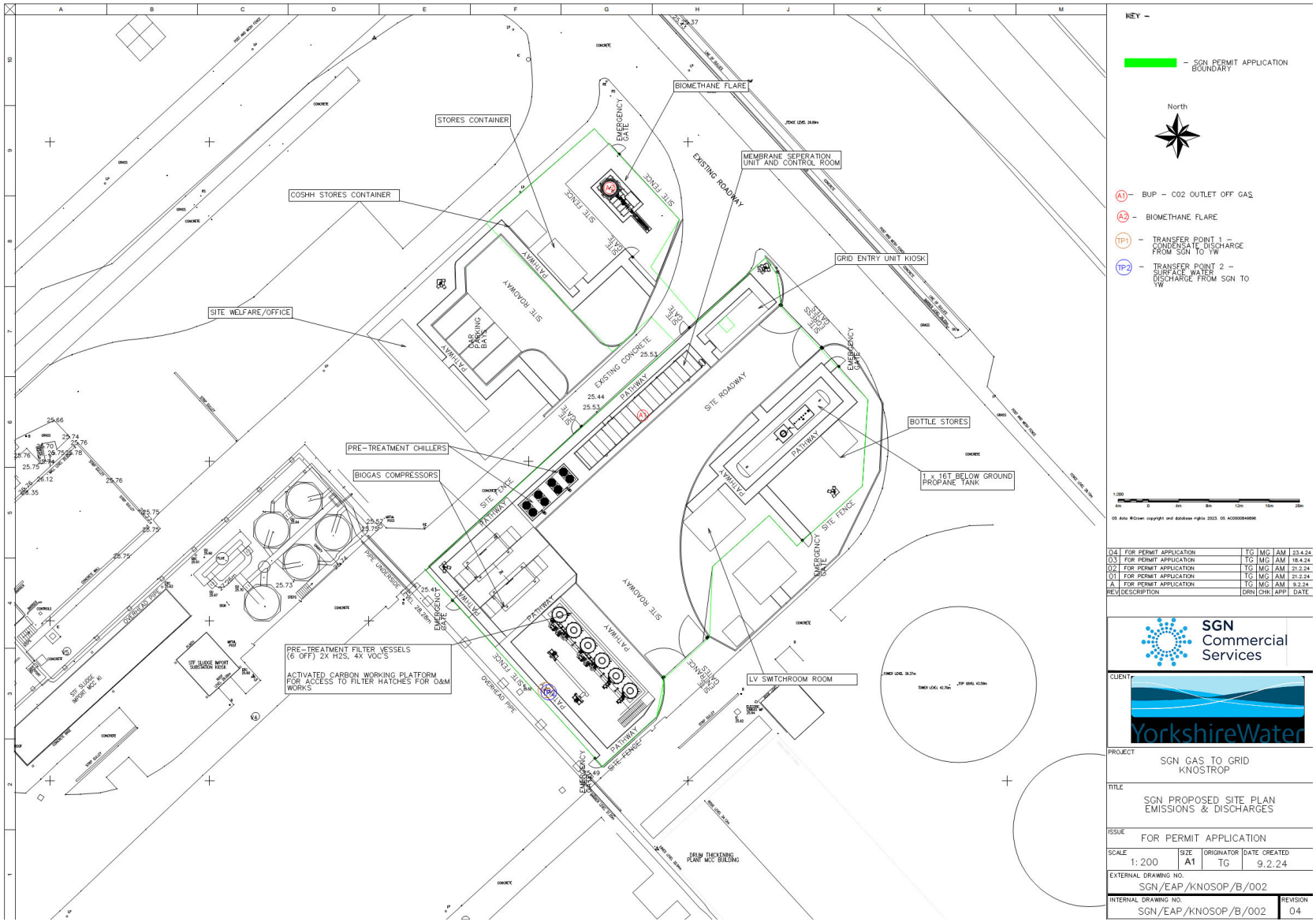


Figure A-6: Indicative Site Drainage Plan

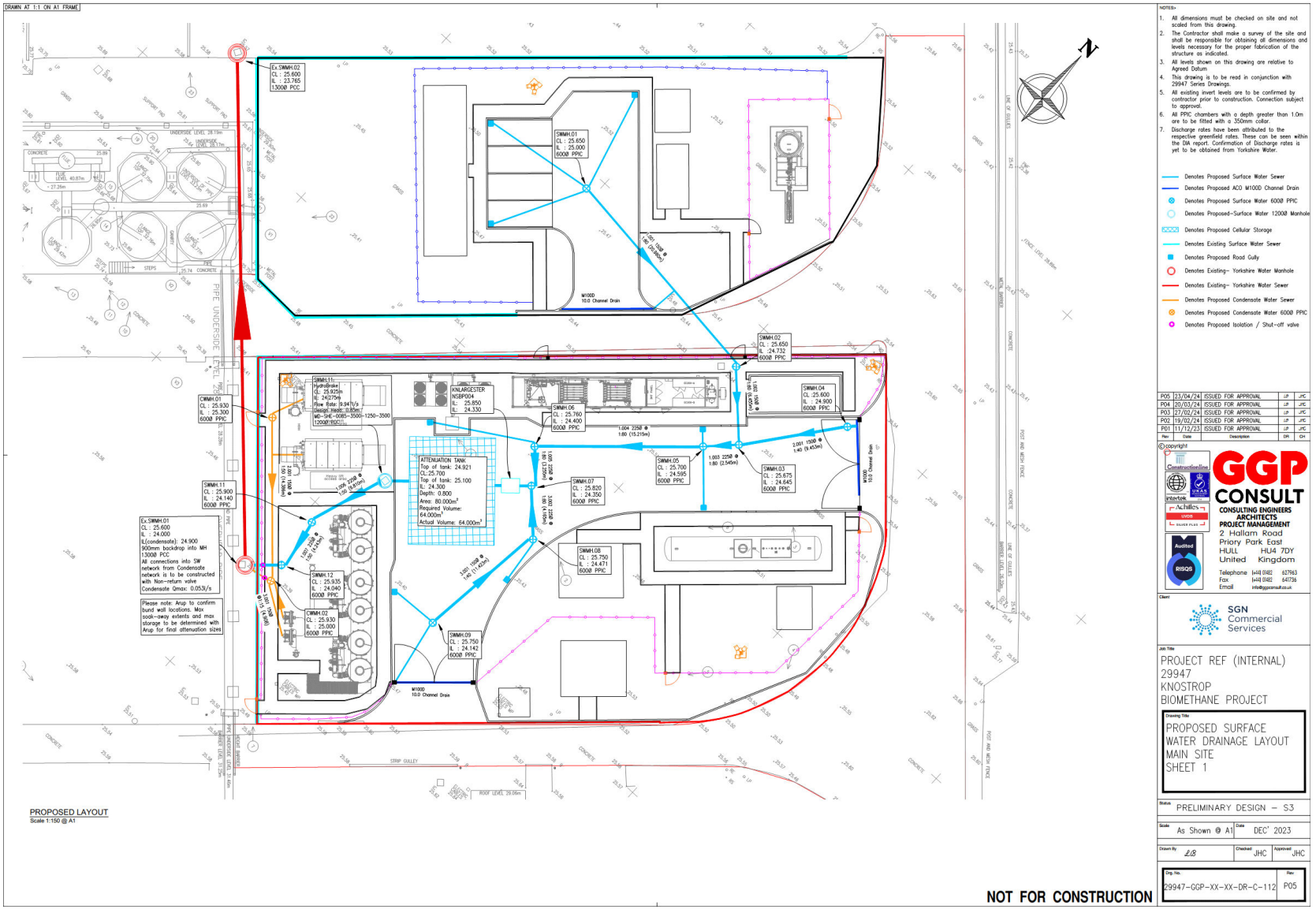
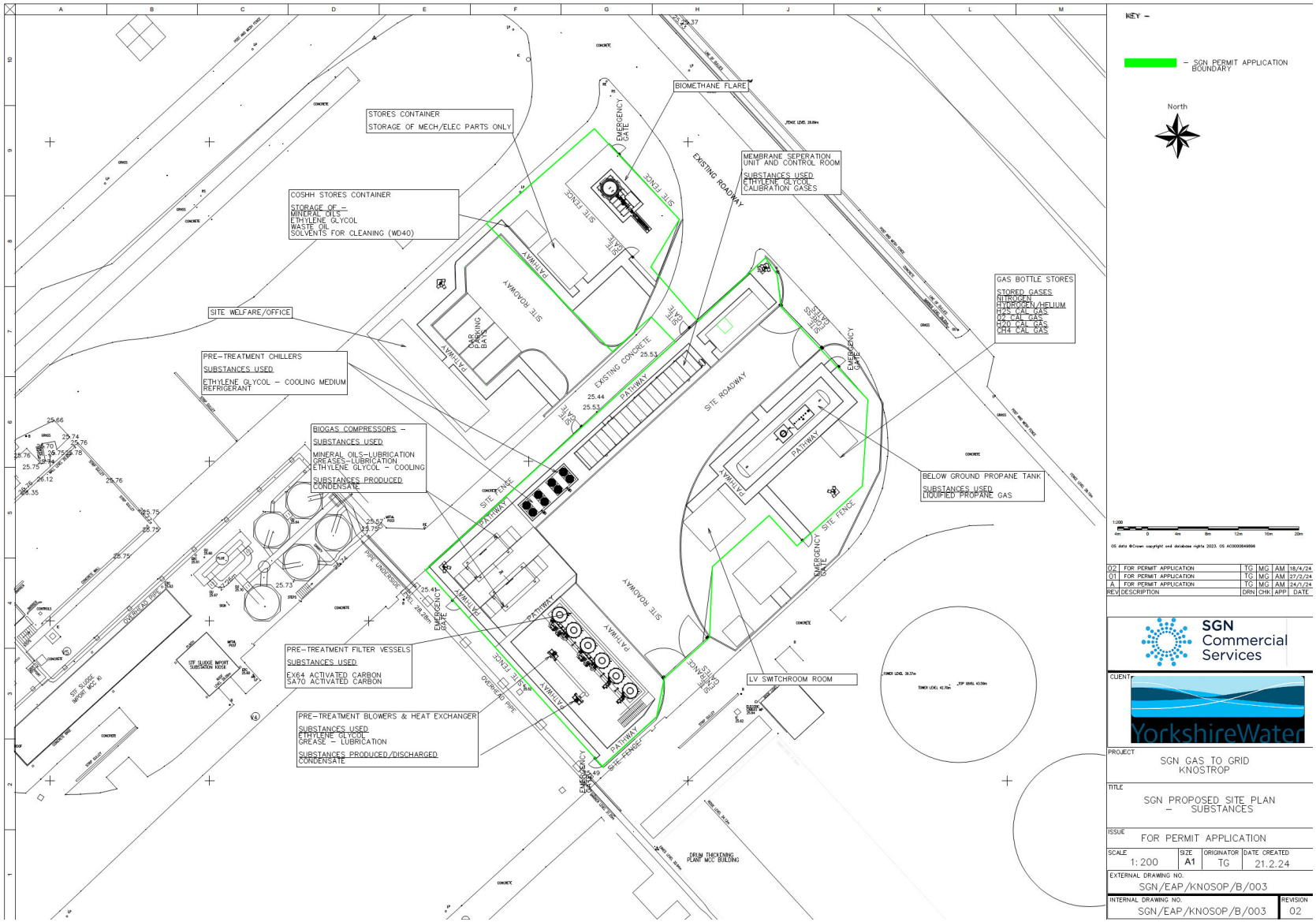


Figure A-7: Substances Location Plan



Appendix B. Company Information

Company Information

SGN GAS TO GRID PROJECTCO1 LIMITED

Company number **14833622**

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Overview | Filing history | People | More

Registered office address
St Lawrence House, Station Approach, Horley, United Kingdom, RH6 9HJ

Company status
Active

Company type
Private limited Company

Incorporated on
28 April 2023

Accounts

First accounts made up to **31 March 2024**
due by **31 December 2024**

Confirmation statement

First statement date **27 April 2024**
due by **11 May 2024**

Nature of business (SIC)

35210 - Manufacture of gas

List of Relevant Offences

None.

Details of SGN Directors

People

Officers:
5 officers / 0 resignations

- Secretary MACKAY, Steven Stuart **ACTIVE**
- Appointed: 28 April 2023
- Correspondence address: St Lawrence House, Station Approach, Horley, United Kingdom, RH6 9HJ

- Director CASTELL, Paul Andrew **ACTIVE**
- Nationality: British
- Appointed: 28 April 2023
- Date of birth: November 1981
- Correspondence address: St Lawrence House, Station Approach, Horley, United Kingdom, RH6 9HJ
- Country/State of Residence: United Kingdom
- Occupation: Solicitor

- Director HUNT, Marcus Keith **ACTIVE**
- Nationality: British
- Appointed: 28 April 2023
- Date of birth: August 1976
- Correspondence address: St Lawrence House, Station Approach, Horley, United Kingdom, RH6 9HJ
- Country/State of Residence: United Kingdom
- Occupation: Business Development Director

- Director MACARTHUR, Fraser Henry **ACTIVE**
- Nationality: British
- Appointed: 7 September 2023
- Date of birth: January 1987
- Correspondence address: St Lawrence House, Station Approach, Horley, United Kingdom, RH6 9HJ
- Country/State of Residence: Scotland
- Occupation: Chartered Accountant

- Director WEST, Annabel **ACTIVE**
- Nationality: British
- Appointed: 28 April 2023
- Date of birth: June 1979
- Correspondence address: St Lawrence House, Station Approach, Horley, United Kingdom, RH6 9HJ
- Country/State of Residence: United Kingdom
- Occupation: Chartered Mechanical Engineer

Appendix C. Site Condition Report

See standalone file, sent under separate cover:

Appendix C Site Condition Report

Appendix D. Air Quality Screening Report

TECHNICAL NOTE

Knostrop Biomethane to Grid Plant (SGN Gas to Grid ProjectCo1 Ltd.)

SUBJECT	PROJECT NO.	DATE
Air Quality Assessment for an Environmental Permit Application for Knostrop BtG Plant	5223650	23 April 2024

AUTHOR	DISTRIBUTION	REPRESENTING
Sarah Horrocks	All	All

Document history

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Permitting	SH	FL	MDL	ES	19/02/24
1.1	Permitting (minor updates)	SH	-	-	ES	20/02/24
1.2	Permitting (minor updates)	SH	-	-	ES	23/04/24

1. Introduction

SGN Gas to Grid ProjectCo1 Ltd. (SGN) proposes to build and operate a new biomethane to grid (BtG) plant at Knostrop Sludge Treatment Facility (STF). The STF is in the grounds of the wider Knostrop Wastewater Treatment Works (WwTW), which is owned and operated by Yorkshire Water Services (YWS).

Biogas is produced at the STF by anaerobic digestion and is currently used as a fuel by YWS. Once the BtG plant is operational, the raw biogas will instead be routed to the BtG plant and cleaned (upgraded) to produce biomethane. The biomethane will be monitored to ensure compliance with the Gas Safety (Management) (Amendment) Regulations 2023[1] (GSMR). Compliant gas will be sent for final conditioning prior to entry to the local gas network. Any non-compliant biomethane will be routed to the new biomethane flare for disposal.

A screening assessment has been undertaken of the gaseous emissions to atmosphere from the two emission points associated with the new BtG plant:

- the carbon dioxide (CO_2) exhaust from the membrane separation unit (A1); and
- the biomethane flare (A2).

The BtG plant is located within the area administered by Leeds City Council (LCC), just over 4 km to the south east of Leeds. The closest air quality management area (AQMA) is over 2 km away. The closest residential properties are located almost 900 m to the north of the BtG permit boundary while the nearest commercial buildings are 260 m to the north of the BtG, beyond the A63.

There are no statutory nature conservation sites of European and international importance within 10 km of the BtG permit boundary. Halton Moor Local Nature Reserve (LNR) is the only statutory nature conservation site of local or national importance within 2 km, approximately 850 m to the north of the BtG permit boundary. There are two non-statutory conservation sites within 1 km: Temple Newsam Estate Wood Local Wildlife Site (LWS) 450 m east, and Halton Moor LWS 850 m north. There is no Ancient Woodland within 1 km.

The Environment Agency's air emissions risk assessment guidance[2] recommends using a screening tool[3] (H1) to determine whether there is an insignificant environmental impact or if further work is required using a detailed air dispersion model. Conservative H1 emission dispersion factors were combined with robust estimates of emission rates to provide ground level concentrations for screening against relevant air quality criteria, or environmental assessment levels (EALs), to determine whether further assessment is required.

1 The Gas Safety (Management) (Amendment) Regulations 2023, available at: https://www.legislation.gov.uk/uksi/2023/284/contents/made

[2] Environment Agency (2016, updated March 2023) https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit

[3] H1 Risk Assessment Tool (v8) H1 Tool | ADMLC

2. Data inputs

2.1 Membrane separation unit CO_2 offgas exhaust

The proposed BtG plant will include a membrane separation unit with associated emissions to atmosphere. The carbon dioxide (CO_2) extracted via the process from the biogas and associated offgas will be vented to atmosphere via a new stack. This air release point is emission point A1 in the permit application.

2.1.1 Effective stack height

The stack is located at grid reference 433848, 431789, as indicated in the Emissions and Discharges Figure in Appendix A of the 'Supporting Information Document' for the environmental permit application.

The emission point will discharge at a height of approximately 2.5 metres above roof level, giving a release height of approximately 6 metres above ground level. Given the potential for taller structures in the vicinity of the discharge, and for the purposes of a conservative assessment, the effective stack height is assumed to be zero.

2.1.2 Source characteristics

As part of the pre-treatment processing, activated carbon filters will remove trace contaminants such as H_2S, VOCs (including siloxanes) from the incoming biogas prior to the removal of CO_2 in the membrane separation unit. Consequently, the emissions to air from the separation process (CO_2 offgas) will contain extremely low concentrations of these substances.

The design maximum raw biogas flow rate that may be treated by the unit is 2,950 Nm^3/h, with a minimum biogas flow rate of 740 Nm^3/h and an average of 1,695 Nm^3/h. The internal stack diameter is 0.150 metres giving an efflux velocity of 16.7 m/s for the design flow rate provided of 1063 Am^3/h (0.30 Am^3/s). The exit gas temperature is estimated to be approximately 15 to 30°C. It is assumed that operation will be continuous, 24 hours a day throughout the year.

There will be no emissions from the regeneration of the activated carbon filters themselves.

2.1.3 Air emissions inventory

Raw Biogas Data

The upper operational limits (called 'normal limits') of the BtG plant are 45 ppm H_2S, and up to 150 mg/m^3 siloxanes in the inlet biogas; the maximum limits are 250 ppm H_2S, and up to 200 mg/m^3 siloxanes. The 'normal limit' and maximum values for H_2S and siloxanes relate to the contractual agreement between YWS and SGN for raw biogas supply. YWS monitoring data for H_2S (based on 4 years of in-line monitoring of the biogas in the gas holder (1,419 samples)) shows that the 45 ppm 'normal limit' value was exceeded less than 1% of the time, with the maximum recorded H_2S concentration being 64 ppm. Monitoring data has also indicated that the 'normal limit' for siloxanes (150 mg/m^3) is not exceeded; the range of reported siloxane concentrations in the biogas being approximately 80-130 mg/m^3 (though it is noted that YWS does not yet have in-line siloxane monitoring at Knostrop so the results are from manual sampling and as such the dataset is small).

Concentrations non-methane volatile organic compounds (NMVOC) in the raw biogas are very low, <1 mg/Nm^3. Ammonia is not expected to be present in the incoming biogas at any appreciable level. Ammonia in AD process largely exists in the liquid phase as it is extremely soluble in water. Ammonia drops out in either the sludge or the return liquors from the AD process. Recent testing[4] of the raw biogas supports this as ammonia was not detected above the limit of detection of 0.05 mg/m^3. This is consistent with reported monitoring data for biogas produced at similar AD plant.

Offgas

The activated carbon filters will remove H_2S, siloxanes and NMVOC, thus reduce the sulphur content of the biogas prior to the membrane separation unit. To protect the operation and performance of the downstream membrane separation unit, any remaining dust / small particle contaminants from the upstream processes will be filtered out and any trace oil carry-over from the biogas compressor will also be removed.

While a maximum value of 3 ppm (approximately 4.2 mg/m^3) H_2S has been specified for the CO_2 offgas from the membrane separation unit (and for the biomethane entering the grid), the actual value is likely to be lower as a result of the carbon filtration stage of the process. The efficiency of the carbon filters is expected to be greater than 99%, which, even at the 'normal limit' would give an emission of less than 1 mg/m^3 total sulphur in the CO_2 offgas. This is in line with data from emissions monitoring from other biogas upgrading units at similar sites. The maximum value of 3 ppm H_2S (approximately 4.2 mg/m^3) has been used in the screening assessment.

An offgas NMVOC concentration of 1 mg/m^3 has been assumed as a basis for the H1 assessment, and the same value is applied for individual components including siloxanes (this is based on the offgas specifications). However, as there are no EALs in H1 for siloxane, or other published air quality guidelines, a hypothetical screening approach using benzene as a surrogate has been applied.

The maximum offgas specification value of 1 ppm for ammonia has been converted to a concentration of 0.7 mg/m^3. This is a highly conservative approach; as noted previously ammonia is not expected to be present in the raw biogas (or the offgas) above the limit of detection (0.05 mg/m^3).

Information used in the assessment of the BtG plant for the vent from the membrane separation unit is provided in Table 1.

Table 1 - Input data for BtG membrane separation unit CO_2 vent

Parameter	Value
Location of stack, OS coordinates	433848, 431789
Height of stack, m	6
Biogas input design flow rate, Nm^3/hr	2,950
Design exhaust flow rate, Am^3/h	1,063
Design exhaust flow rate, Am^3/s	0.30
Internal diameter, m	0.150

[4] Scienco Ltd Analytical Certificate, sample date 14/02/24, Report No. 20240110, reported on 23/02/24.

Parameter		Value
Exit velocity, m/s		16.7
Emissions concentration, mg/Nm^3	H_2S	4.2 [see note 1]
	NMVOC	1
	Siloxane	1
	NH_3	0.7 [see note 2]
Emission rate, g/s	H_2S	0.0012
	NMVOC	0.0003
	Siloxane	0.0003
	NH_3	0.0002
Dispersion factor for Heff = 0	Hourly	3,900
	Annual	148

Table Notes:

[1] This concentration is conservative; it is the from the maximum offgas specification value for H_2S; however, H_2S is only expected to be present in the offgas at concentrations of <1 mg/m^3.

[2] This concentration is highly conservative; it is the from the maximum offgas specification value for ammonia; however, ammonia is not expected to be present in the raw biogas (or offgas) at concentrations above 0.05 mg/m^3.

2.2 Biomethane flare

Information regarding proposed biomethane flare at the BtG plant is provided in Table 2. The air release point is emission point A2 in the permit application.

Table 2 - Input data for BtG plant biomethane flare

Parameter	Value
Location of stack, OS coordinates	433850, 431794
Height of stack, m	8.85
Internal diameter, m	2.531
Combustion heat release, MW	20.6
Biomethane design flow rate, Nm^3/hr	2,110
Exhaust gas flow rate, Am^3/h	208,223
Exhaust gas flow rate, Am^3/s	58
Exhaust gas flow rate, Nm^3/s	5.7

Parameter		Value
Exit velocity, m/s		11.5
Flue gas temperature, °C		1000
Emissions concentration, mg/Nm^3 (based on ELVs at other permitted sites)	NOx	150
	CO	50
	VOC	10
Maximum H_2S content of the fuel, ppm	H_2S	5
Emission rate, g/s	NOx	0.86
	CO	0.29
	VOC	0.06
	SO_2	0.004*
Distance to closest human receptor^, m (approx.)		250-300
Dispersion factor	Hourly	30
	Annual	2.5

* estimated from fuel consumption rate, fuel density and H2S content of fuel

^ nearest commercial buildings to north of BtG immediately beyond A63

The approach assumes:

- Maximum design flow rate of biogas.
- Maximum CO_2 content of biogas.
- Maximum H_2S content of biogas (5 ppm, based design specification data for the flare).
- Shortest distance to human receptor beyond the BtG permit boundary (commercial/industrial unit).

3. Results

3.1 Membrane separation plant CO_2 vent

3.1.1 Air impacts and screening

The above information for the emission point was entered into the Environment Agency's H1 spreadsheet and the findings are reported in Table 3 for short term (S/T) and long term (L/T) exposure. Dispersion factors were applied for an effective release height of 0 m.

Table 3 - Results for BtG membrane separation plant CO_2 vent

	S/T PC,	S/T EAL,	S/T PC/EAL,	L/T PC, µg/m^3	L/T EAL,	L/T PC/EAL,
H_2S	2.85 (daily)	150	1.90	0.18	140	0.13
Benzene	0.68 (daily)	30	2.26	0.044	5.0	0.87
Toluene	1.15	8,000	0.01	0.044 (annual) 0.026 (daily)	1,910 260	<0.01 0.01
Xylene	1.15	66,200	<0.01	0.044	4,410	<0.01
Ammonia – human	0.80	2,500	0.03	0.030	180	0.02
Ammonia – ecology	0.80	-	-	0.030	1.0	**3.04**

The results assume:

- Effective stack height of zero.
- 24 / 7 operation.
- 100% of the NMVOC emission is benzene / toluene / xylene.

As would be expected (given the use of the pre-treatment / filtration stages), the PCs for the substances of interest from the membrane separator unit are extremely low. In no case does the PC exceed the Environment Agency's threshold of 1% of the long term EAL or 10% of the short term EAL for human health. The ecological impact of ammonia is not screened out by the H1 tool; however, the assessment was conservative as it was undertaken on the basis of a 'less than' value from the offgas composition (i.e. < 1 ppm / < 0.7 mg/Nm^3), which is over ten times higher than the monitored concentration in the raw biogas, which is below the limit of detection (<0.05 mg/Nm^3). Using the more realistic value of 0.05 mg/Nm^3, the ecological impact of ammonia would be screened out by the H1 tool. Irrespective of this, the nearest ecological receptor is a local nature site (450 m to the east at its closest point). The Environment Agency's risk assessment guidance states that, for local nature sites, if the PC is less than 100% of the EAL it can be considered insignificant without the need to calculate PEC.

On basis of the above screening assessment of contaminant concentrations in the CO_2 offgas, there is an insignificant impact on human health and the environment from the membrane separation unit stack emissions. No further assessment is required.

3.2 Biomethane flare

3.2.1 Air impacts and screening

The information provided for the flare was processed using the Environment Agency's dispersion factors for landfill gas flares for a human health receptor in the range 250-300 m (commercial building). The findings for short term (S/T) and long term (L/T) exposure are reported in Table 4. Dispersion factors were applied for a release height of 8 m.

Table 4 - Results for biomethane flare

	S/T PC, µg/m^3	S/T EAL, µg/m^3	S/T PC/EAL, %	L/T PC, µg/m^3	L/T PC factored, µg/m^3	Annual L/T EAL, µg/m^3	L/T PC factored/ EAL, %
NO_2	9.0	200	4.5	1.51	0.15	40	0.4
CO[§]	8.6 (hourly) 6.0(8 hourly)	30,000 10,000	0.03 0.06	-	-	-	-
Benzene[*^]	1.0	30	3.4	0.14	0.014	5	0.29
SO_2[^]	0.08	125	0.06	0.01	0.001	20	0.01

* 100% of NMVOC;

^ hourly PC has been factored by 0.59 for comparison to daily EAL (for SO_2 this gives a marginally higher % of EAL than hourly or 15 mins);

§ hourly PC has been factored by 0.7 for comparison to 8 hourly EAL (result for hourly PC also <0.1% of EAL)

The results assume:

- the flare would operate 10% of the year.
- 100% of the VOC emission is benzene.
- Conversion of NOx to NO_2 35% for short term and 70% for long term.

There are no pollutants with PCs above the relevant screening thresholds of 10% for short term and 1% for long term for human health.

The nearest boundary of an ecological site is further away (~450 metres to north east) than the human health receptor (~250 metres). By factoring the results in Table 4 for NO_2, it has been determined[5] that the short-term impact on the nearest designated ecological receptor will be insignificant; the criterion for both short term EALs and local nature sites is for the PC to be less than 100% of the EAL.

On this basis, the impact of the biomethane flare is considered insignificant. No further assessment is required.

[5] An annual PC of 0.15 µg/m^3 as NO_2 using a dispersion factor of 2.5 (receptor at 250m) is equal to 0.13 µg/m^3 as NOx using a dispersion factor of 1.5 (receptor at 450m), which is less than 1% of the critical level of 30 µg/m^3. An hourly PC of 9 µg/m^3 as NO_2 using a dispersion factor of 30 is equal to 17 µg/m^3 as daily NOx using a dispersion factor of 20, which is 10% of the non-statutory daily target of 75 µg/m^3 assuming 24h of flaring.

Appendix E. Noise Screening Assessment

AtkinsRéalis

Environmental Permit Application for a Biomethane to Grid (BtG) Plant: Step 1 Noise Risk Assessment

SGN Gas to Grid ProjectCo1 Ltd

23 April 2024

5223650_NRA

Knostrop Biomethane to Grid Plant

Notice

This document and its contents have been prepared and are intended solely as information for SGN Gas to Grid ProjectCo1 Ltd and use in relation to supporting the permit application for the Knostrop Biomethane to Grid Plant.

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Document history

Document title: Environmental Permit Application for a Biomethane to Grid (BtG) Plant: Step 1 Noise Risk Assessment

Document reference: 5223650_NRA

Revision	Purpose description	Originated	Checked	Reviewed	Authorised	Date
1.0	Initial Version	DG	JM	PH	PH	02/02/2024
2.a	Revised following internal comments	DG	JM	PH	PH	13/02/2024
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3.0	Final draft for client comment	DG	JM	PH	PH	28/02/2024
4.0	Final	DG	JM	PH	PH	23/04/2024

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Executive Summary

SGN Gas to Grid ProjectCo1 Ltd. (SGN) proposes to build and operate a new biomethane to grid (BtG) plant at Knostrop Sludge Treatment Facility (STF). The STF is in the grounds of the wider Knostrop Waste water Treatment Works (WwTW), which is owned and operated by Yorkshire Water Services (YWS).

AtkinsRéalis has been instructed to prepare an initial desktop risk assessment of potential noise impact from the BtG plant on nearby noise sensitive receptors (NSRs). The assessment considers the requirements of the Environment Agency's guidance for "Step 1: desktop risk assessment"[1] and also considers applicable noise guidance.

The BtG plant is located within the area administered by Leeds City Council (LCC), just over 4km to the south east of Leeds. There are no residential areas in the immediate vicinity of the Proposed Scheme, with the nearest residential area being located approximately 880m away to the north. There is also the Skelton Grange Environment Centre located approximately 770m to the southeast.

Existing ambient noise levels in the vicinity of the proposed BtG plant and nearest NSRs are likely to be moderate to high as the proposed site is located in a predominantly industrial urban area, within Knostrop Wastewater Treatment Works (WwTW) and close to main transport links.

A three-dimensional computer noise model was set up to predict the external noise levels at the nearest NSRs. Predicted external noise levels were found to be below the lowest observed adverse effect level (LOAEL), and below the existing ambient noise levels, at all NSRs considered, during both daytime and night-time periods. Therefore, no adverse impact from the BtG plant is expected and the risk from noise from the BtG plant at the closest NSRs is considered to be low.

[1] Noise and vibration management: environmental permits - GOV.UK (www.gov.uk)

1. Introduction

1.1 Project Description

SGN Gas to Grid ProjectCo1 Ltd. (SGN) proposes to build and operate a new biomethane to grid (BtG) plant at Knostrop Sludge Treatment Facility (STF). The STF is in the grounds of the wider Knostrop Wastewater Treatment Works (WwTW), which is owned and operated by Yorkshire Water Services (YWS).

Biogas is produced at the STF by anaerobic digestion and is currently used as a fuel by YWS. Once the BtG plant is operational, the raw biogas will instead be routed to the BtG plant and cleaned (upgraded) to produce biomethane. The biomethane will be monitored to ensure compliance with the Gas Safety (Management) (Amendment) Regulations 2023[2] (GSMR). Any non-compliant biomethane will be routed to the new biomethane flare for disposal.

The BtG plant will operate 24 hours a day and requires a permit to operate from the Environment Agency (EA).

1.2 Purpose and Scope

AtkinsRéalis has been instructed to prepare an initial desktop noise risk assessment of potential noise impact from the BtG plant on the nearest noise sensitive receptors (NSRs). The assessment considers the requirements of the EA's guidance for "Step 1: desktop risk assessment"[3] and also considers applicable noise guidance.

This report is structured as per EA guidance on reporting and is therefore more detailed than the requirements for the "Step 1: desktop risk assessment". However, the specific information required for the Step 1 assessment is located in the following Sections:

Step 1: Desktop Risk Assessment Requirement:	Located in this Report:
Identify plant or operations that could be audible at any known (or proposed) NSR – include noise sources that are not routine, for example, emergency pressure relief or venting systems	Section 4.1, Table 4-1.
Describe and rank the noise sources in terms of their potential off-site impact – note what they sound like and when they operate.	Section 4.1, Table 4-1.
Identify current and proposed NSR by name, type, location and distance from source	Section 2.2
Describe the land between your site and the NSR and whether any natural or man-made features could increase or decrease the audibility of the sound at the NSR	Section 2.2

This indicative noise impact assessment, taking account of noise guidance, is provided based on available data.

A glossary of technical terms used in the following report is shown in Appendix A.

2 The Gas Safety (Management) (Amendment) Regulations 2023, available at: https://www.legislation.gov.uk/uksi/2023/284/contents/made

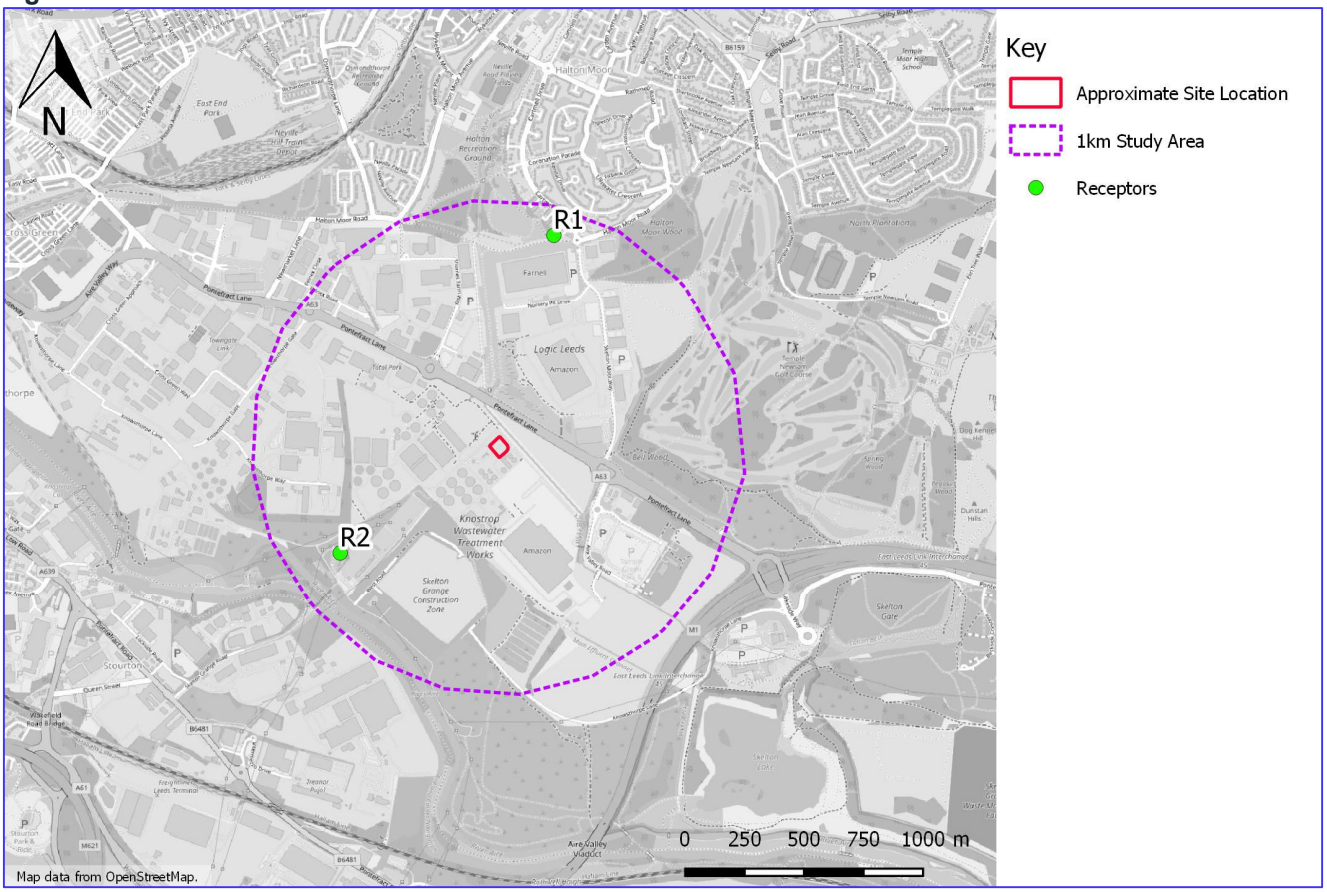
3 Noise and vibration management: environmental permits - GOV.UK (www.gov.uk)

2. Site Context

2.1 Site Location

The BtG plant will be located approximately 4km to the southeast of Leeds City Centre. The proposed permit boundary and site layout are provided in Appendix A of the 'Supporting Information Document' for the environmental permit application. Figure 2-1 shows the locations of the NSRs within 1 km relative to an approximation of the BtG site location.

Figure 2-1 Location of NSRs



The BtG plant is located within a predominantly industrial area, which incorporates the existing facilities associated with the Knostrop WwTW, as well as industrial manufacturing facilities and warehousing.

The BtG site is located approximately 100m south of the A63 Pontefract Lane; a main arterial road providing access between Junction 45 of the M1 motorway (approximately 1km to the east) and Leeds to the west. Beyond the A63 Pontefract Lane lies further industrial areas.

To the east of the site is a car garage (approximately 400m distant) and the Temple Green Park and Ride carpark (approximately 600m distant), beyond which lies the M1 at a distance of approximately 1km. A golf course is located to the north of M1 Junction 45.

There are no residential areas in the immediately vicinity of the BtG plant, with the nearest residential area being located approximately 880m to the north (R1). There is also an Environment Centre (R2) located approximately 770m southwest. Further detail of NSRs is provided in Section 2.2.

2.2 Noise Sensitive Receptors

The study area for the assessment of operational noise is 1km from the BtG plant, based on guidance from ISO 9613-2:1996[4] (ISO 9613) which limits the estimate of calculation accuracy to within this range. The study area and the locations of NSR are shown in Figure 2-1. Within the study area the nearest residential NSRs are:

- R1 – Levens Garth, Halton, Leeds, LS15 0AR (Grid Ref: 434077/321660) located approximately 880m north of the site. There are large industrial buildings and warehouses between R1 and the BtG plant that would act as screening to reduce noise levels.

There is also the following non-residential NSR:

- R2 – Skelton Grange Environment Centre (Educational), Skelton Grange Road, Leeds, LS10 1RS (Grid Ref: 433180/431323) located approximately 770m southeast of the site. There is a relative line-of-sight between R2 and the BtG plant, with the WwTW and an electrical substation located between, but there are no substantive structures which may provide screening.

2.3 Noise Climate

2.3.1 General Noise Climate

Noise monitoring has not been conducted as part of this desktop assessment. However, the noise climate around the location of the BtG plant and at the nearest NSRs can be described with reference to Defra strategic noise mapping data[5]. The data includes road and rail sources from main transport routes. Noise Important Areas[6] (NIA) are also shown for information. Defra noise data does not include contributions from industrial sources or minor local roads.

Defra noise data for daytime periods are shown in Figure 2-2, and during night-time periods are shown in Figure 2-3.

The Defra noise map data indicates that the noise levels around the BtG plant are moderate, in the order of 60 to 65 dBA during the day and 55 to 60 dBA during the night, with relatively high levels (greater than 65 dBA) close to main transport routes; This is typical of an urban area close to a major city.

The main sources of noise in the area are the M1 to the west, the A63 to the north and the A639 to the south. Although not indicated in the Defra noise mapping, there is also likely to be a contribution to the noise climate from industrial and commercial premises, and road traffic on local roads. There is also the Hallam/Pontefract railway line located approximately 1.7km to the south.

[4] ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation

[5] Strategic noise mapping (2017) - GOV.UK (www.gov.uk)

[6] Noise Important Areas (NIA) for roads and railways are based upon the strategic noise maps results. The NIA highlight “hotspot” locations where the highest 1% of noise levels at residential. locations can be found.

Figure 2-2 Defra Noise Map Data - Daytime

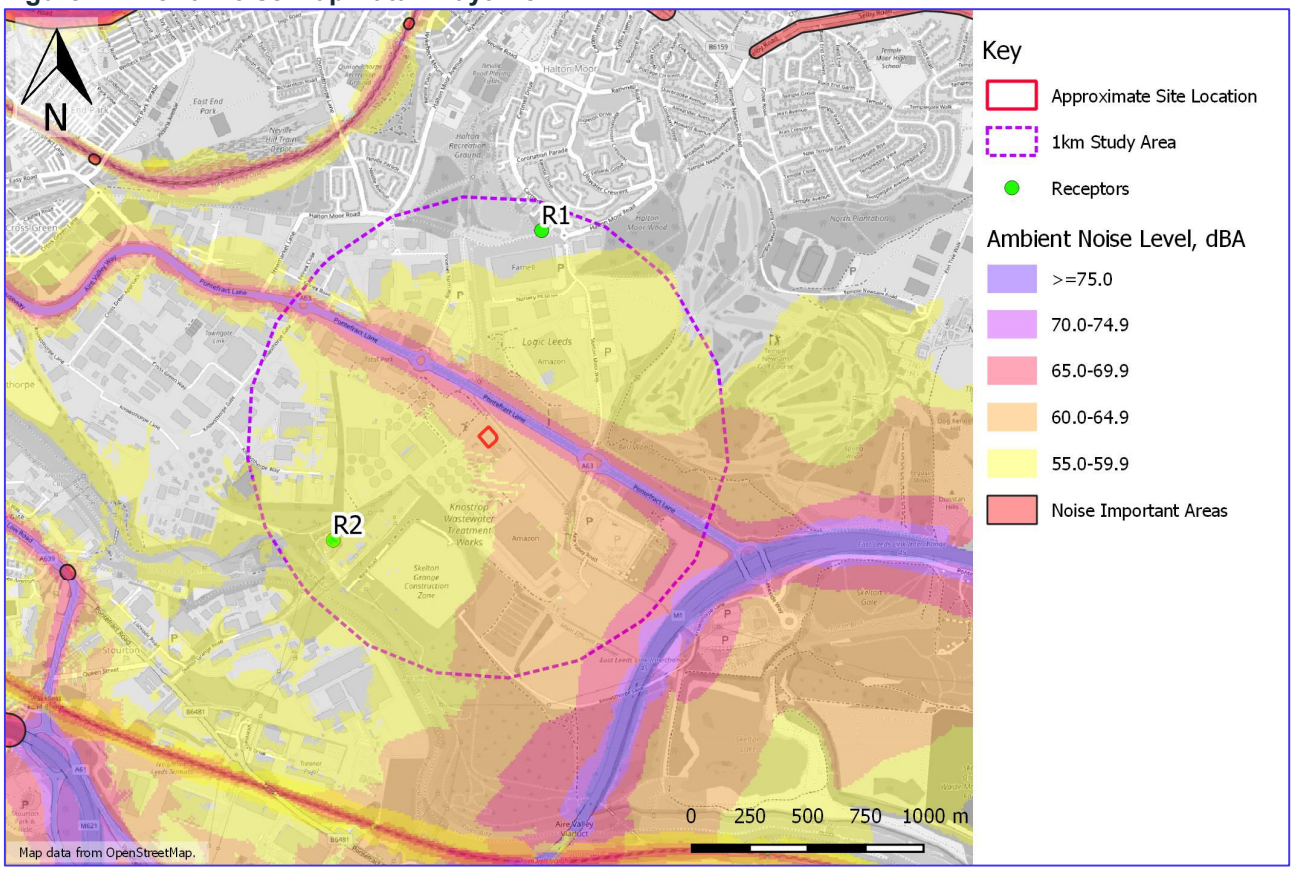
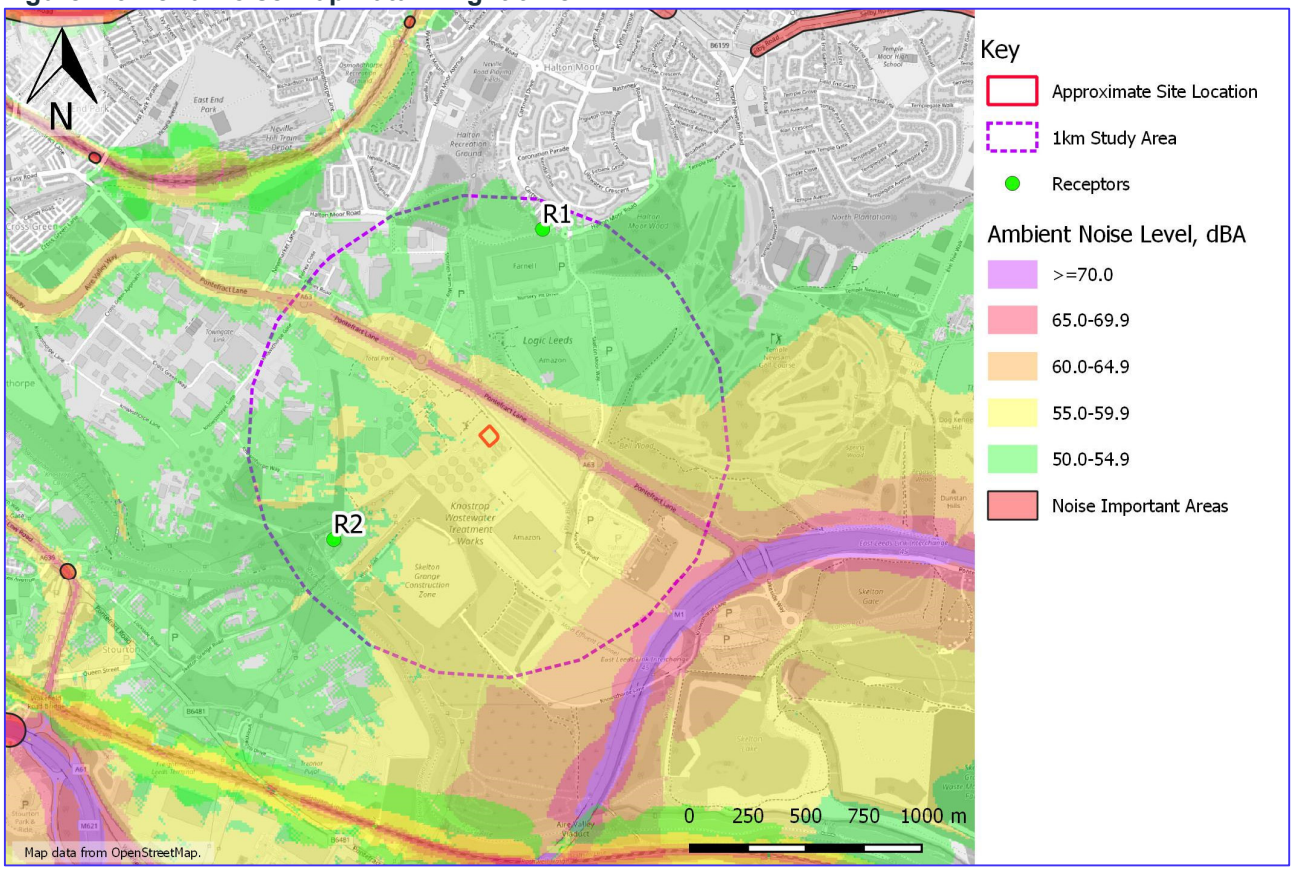


Figure 2-3 Defra Noise Map Data – Night-time



2.3.2 Noise Climate at NSR

2.3.2.1 R1 – Levens Garth

Levens Garth (and surrounding NSRs) is located at the southern extent of the residential area of Halton, bordering an industrial area to the south, with grass park land to the west and woodland to the east. There are no major transport routes in the immediate vicinity, with the A63 located approximately 700m to the south and the M1 located approximately 1.7km to the southeast. Based on Defra noise data the ambient noise level in the area is expected to be between 50 and 55 dBA during daytime periods (being just outside the lowest 55 dBA contour), and approximately 50 dBA during night-time periods. The is also likely to be contributions to the noise climate from industrial sources to the south and road traffic on local roads.

2.3.2.2 R2 – Skelton Grange Environment Centre

The Skelton Grange Environment Centre is located to the north of the River Aire and the Aire & Calder Navigation Main Line canal. The immediate vicinity of the centre is a wooded area, with industrial areas being located approximately 30m to the east (electrical substation), 170m to the north, 500m to the south, and 400m to the south. There are no major transport routes in the immediate vicinity, with the A63 located approximately 840m to the north, the M1 located approximately 1.4km to the east, and the A639 located approximately 1km to the south. Based on Defra noise data the ambient noise level in the area is expected to be between 55 and 60 dBA during daytime periods, and between approximately 50 and 55 dBA during night-time periods. There are also likely to be contributions to the noise climate from industrial sources in the area.

3. Assessment Methodology

3.1 Guidance

3.1.1 Overview

The potential effects of noise have been assessed with reference to the following guidance:

- Environment Agency Guidance – Noise and vibration management: environmental permits, 2022;
- British Standard 4142:2014+A1:2019, 'Methods for rating and assessing industrial and commercial sound' (BS 4142);
- World Health Organization Night Noise Guidelines for Europe (NNG), 2009;
- British Standard BS 8233:2014, 'Guidance on sound insulation and noise reduction for buildings' (BS 8233);
- Building Bulletin 93, Acoustic design of schools: performance standards (BB93), 2015;
- The Chartered Institution of Building Services Engineers (CIBSE) Environmental Design Guidance – Guide A; and
- Leeds City Council Planning Consultation Guidance. Noise & Vibration, December 2019 (LPCG).

The assessment makes reference to lowest observed adverse effect level (LOAEL), which is defined by the Noise Policy Statement for England[7] (NPSE), the National Planning Policy Framework[8] (NPPF), and Planning Practice Guidance for Noise[9] (PPGN), with reference to the above guidance documents.

[7] Noise Policy Statement for England (publishing.service.gov.uk)
[8] National Planning Policy Framework (publishing.service.gov.uk)
[9] Noise - GOV.UK (www.gov.uk)

3.1.2 Guidance

3.1.2.1 Environment Agency

EA's guidance for "Step 1: desktop risk assessment" states that the desktop risk assessment requires the assessor to:

- Identify plant or operations that could be audible at any known (or proposed) NSR – include noise sources that are not routine, for example, emergency pressure relief or venting systems.
- Describe and rank the noise sources in terms of their potential off-site impact – note what they sound like and when they operate.
- Identify current and proposed NSR by name, type, location and distance from source.
- Describe the land between your site and the NSR and whether any natural or man-made features could increase or decrease the audibility of the sound at the NSR.

If noise emissions could cause pollution at a NSR then a noise impact assessment would be required.

3.1.2.2 BS 4142:2014+A1:2019 (BS 4142)

BS 4142:2014+A1:2019 (BS4142) provides guidance on noise assessments for commercial and industrial sites. According to this standard, the rating level of the noise from the item of plant is determined and compared to the existing measured L_{A90} background sound level for that period. It states:

"The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact."

Background noise level data at the nearest NSRs is not available, although background noise levels are expected to be moderate to high based on urban nature of the area (as described in Section 2.3).

A full BS 4142 assessment is outside of the scope of this initial noise risk assessment. The assessment will therefore consider absolute plant noise levels, with a low risk being expected if the noise rating level (taking account of any likely acoustic character) is low (i.e. below the LOAEL).

3.1.2.3 World Health Organization Night Noise Guidelines (NNG)

The external sleep disturbance criteria in accordance with the NNG is 40 dB $L_{Aeq,8hr}$ at the most exposed façade.

3.1.2.4 British Standard BS 8233:2014 (BS 8233)

BS 4142 references BS 8233 as providing context where background and rating noise levels are low. BS 8233 recommends internal sound levels in bedroom spaces of ≤30 dB $L_{Aeq,8h}$ during night-time periods and states that the attenuation of sound through a particularly open window for ventilation is 15 dB. As such, suitable internal sound levels in bedroom spaces (≤30 dB $L_{Aeq,8h}$) would be expected to be achieved where the sound rating level is below 45 dB $L_{Aeq,8h}$ externally. With closed windows, internal sound levels would be significantly lower.

3.1.2.5 The Chartered Institution of Building Services Engineers (CIBSE)

CIBSE guidance provides recommended noise criteria for various internal spaces, including bedrooms. The recommended internal noise level is NR25 or 30 dBA. BS 8233 indicates that the NR value is approximately 6 dB lower than the corresponding dBA level (i.e. NR25 ≈ 31 dBA (30 dBA assumed for simplicity)). As above, BS 8233 states that the attenuation of sound through a particularly open window for ventilation is 15 dB. As such, suitable internal sound levels in bedroom spaces (≤30 dB $L_{Aeq,8h}$) would be expected to be achieved where the sound rating level is below 45 dB $L_{Aeq,8h}$ externally. With closed windows, internal sound levels would be significantly lower.

3.1.2.6 Building Bulletin 93, Acoustic design of schools: performance standards (BB93)

BB93 provides guidance noise levels for education facilities, which may be applicable to the Skelton Grange Environment Centre, which has educational type facilities. For general classroom areas BB93 recommends internal sound levels of ≤35 dB $L_{Aeq,30min}$. As above, BS 8233 states that the attenuation of sound through a particularly open window for ventilation is 15 dB. As such, suitable internal sound levels in classroom spaces (≤35 dB $L_{Aeq,30min}$) would be expected to be achieved where the sound rating level is below 50 dB $L_{Aeq,30min}$ externally.

3.1.2.7 Leeds City Council Planning Consultation Guidance – Noise & Vibration (LPCG)

The LPCG provides guidance to relevant environmental/acoustic professionals and planning officers within Leeds City Council (LCC) when deciding upon the applicable criteria to avoid a significant loss of amenity due to planning developments. The document provides general guidelines, drawing on information that can be found in a number of local, national and international documents. For those occasions where issues are not fully addressed by this guidance, other guidance or criteria may be applicable, subject to an equivalent level of protection from loss of amenity being provided. The document may be used by developers to clarify the criteria expected to be achieved for developments and assist with the submission of supporting information that would be considered as acceptable in terms of noise and vibration.

With regards to noise of an industrial nature, the LPCG indicates that, if assessed in accordance with BS 4142, the rating level should be no higher than the existing background noise level at nearby NSRs. Alternatively, the use of Noise Rating (NR) curves is acceptable in establishing suitable noise levels which will be achieved in noise sensitive premises. Where noise would be identifiable as emanating from commercial or industrial premises the following criteria should be demonstrated.

- NR 20 in bedrooms (23:00 to 07:00 hours).
- NR 25 in all habitable rooms (07:00 to 23:00 hours).

As above, BS 8233 indicates that the NR value is approximately 6 dB lower than the corresponding dBA level (i.e. NR20 ≈ 26 dBA (25 dBA assumed for simplicity)). BS 8233 states that the attenuation of sound through a particularly open window for ventilation is 15 dB. As such, suitable internal sound levels in bedroom spaces would be expected to be achieved where the sound rating level is below 40 dB $L_{Aeq,8h}$ externally. With closed windows, internal sound levels would be significantly lower.

3.2 Noise Modelling Methodology

An indicative noise propagation model has been created to provide an indicative assessment of likely noise impacts. The noise model has been created using SoundPLAN software version 8.2. The model predicts the propagation of sound based on the methodology described in ISO 9613.

The model takes account of predicted source sound power levels, source and receiver locations (and their respective distances from each other), topography, meteorological effects, screening from intervening structures, reflections, and ground conditions.

The following assumptions were used in the modelling:

- 1m ground contours based on Ordinance Survey (OS) topography data;
- Existing buildings outlines based on OS and Google mapping;
- Building heights predicted based on desktop review of OS and Google mapping/streetview data (precautionary principle applied);
- Calculation based on spectrum of a compressor taken from BS 5228-1, ref: C.3.19, corrected to calculated sound power level;

- Receiver height of 1.5m, and additional 2.5m for each floor;
- Reflection order of 3;
- 70% humidity;
- 10°C temperature; and
- Ground factor of 0.3 (relatively hard ground).

Further details of the modelling are provided in Section 4.2.

3.3 Assessment Criteria

The BtG plant will operate 24 hours per day and therefore the assessment considers the worst-case night-time periods for residential receptors, and daytime periods for the Skelton Grange Environment Centre.

Based on the policy and guidance described above, the LOAEL is considered to be an external noise rating level of 40 dBA at residential receptors, and 50 dB at the Skelton Grange Environment Centre. Where applicable, the level will take account of any likely penalties, as described by BS 4142 for acoustic character (i.e. tonality, impulsivity, and intermittency).

If predicted external noise plant levels are below the LOAEL values stated above at nearby NSRs, then there would be no observed adverse effect, as defined by the PPGN, and the noise risk would be considered to be low.

Where predicted external noise levels are predicated to exceed the LOAEL at a receptor, this may require additional mitigation to mitigate and reduce the impact. A full detailed assessment in accordance with BS 4142, taking account of background sound levels would be recommended, where the predicted external noise levels are predicated to exceed LOAEL at a NSR.

4. Noise Impact Assessment

4.1 Source Data

The BtG plant has been designed to ensure that the sound level for the plant will be below 85 dBA at 1m. The main sources with the potential to generate noise are detailed in Table 4-1. At the time of the Step 1 noise assessment, the design of the BtG had not been finalised; consequently the table provides an indication of the likely noise levels and dimensions of the associated equipment / enclosures, based on the information available to date. Where data have not been finalised, or available, conservative assumptions have been made.

Table 4-1 BtG Plant Noise Sources and Likely Noise Levels

BtG Plant Element	Number of Units	Assumed Sound Power Level per Item, dB $L_{W,A}$	Comment
Blowers	2	99	Maximum 84 dBA at 1m: Assume 84 dBA sound pressure level at 1m and approximately 1m x 1m x 1m unit dimensions. Located externally with no noise attenuation.
Biogas Compressors	2	106	80 ± 3 dBA at 1m. Assume 83 dBA sound pressure level at 1m and

				approximately 9.7m x 3.0m x 3.1m (unit dimensions, L x W x H). Each unit is in an acoustic (noise attenuated) enclosure.
Chiller Units	2		94	Maximum 75 dBA at 1m: Assume 75 dBA sound pressure level at 1m and approximately 3m x 2.25m x 2.4m (unit dimensions, L x W x H). Located externally with no noise attenuation.
Air Compressor (in building)	2		85	Housed in a purpose built noise attenuated building (19.2 x 3 x 2.85, L x W x H). Based on BS 5228 data assumed sound power of 105 dBA per unit as worst case and assumed 20 dB reduction from building.
		Total:	110.0	Sum of sound power of all plant items.
Note: For large plant items, the conversion between sound pressure level is based on the calculation of the measurement surface, 'S' (i.e. if the measurement distance is 1m, the measurement surface is equal to the area 1m from the plant item. The correction is $10*\log_{10}(S)$.				

Based on the in data shown Table 4-1 the likely sound power from the BtG plant is assumed to be 110.0 dB $L_{W,A}$.

4.2 Noise Modelling

4.2.1 Noise Model Setup

Based on the likely noise output from the BtG, a noise propagation model has been created to predict the propagation of noise to the nearest NSRs. For the purposes of this initial assessment the source has been modelled as an area source with the total sound power across the BtG plant equalling 110 dB $L_{W,A}$. The source height was set at 4m as a relative worst-case.

The model is shown in 2D and 3D in Figure 4-1 and Figure 4-2, respectively.

Figure 4-1 Noise Model – 2D View

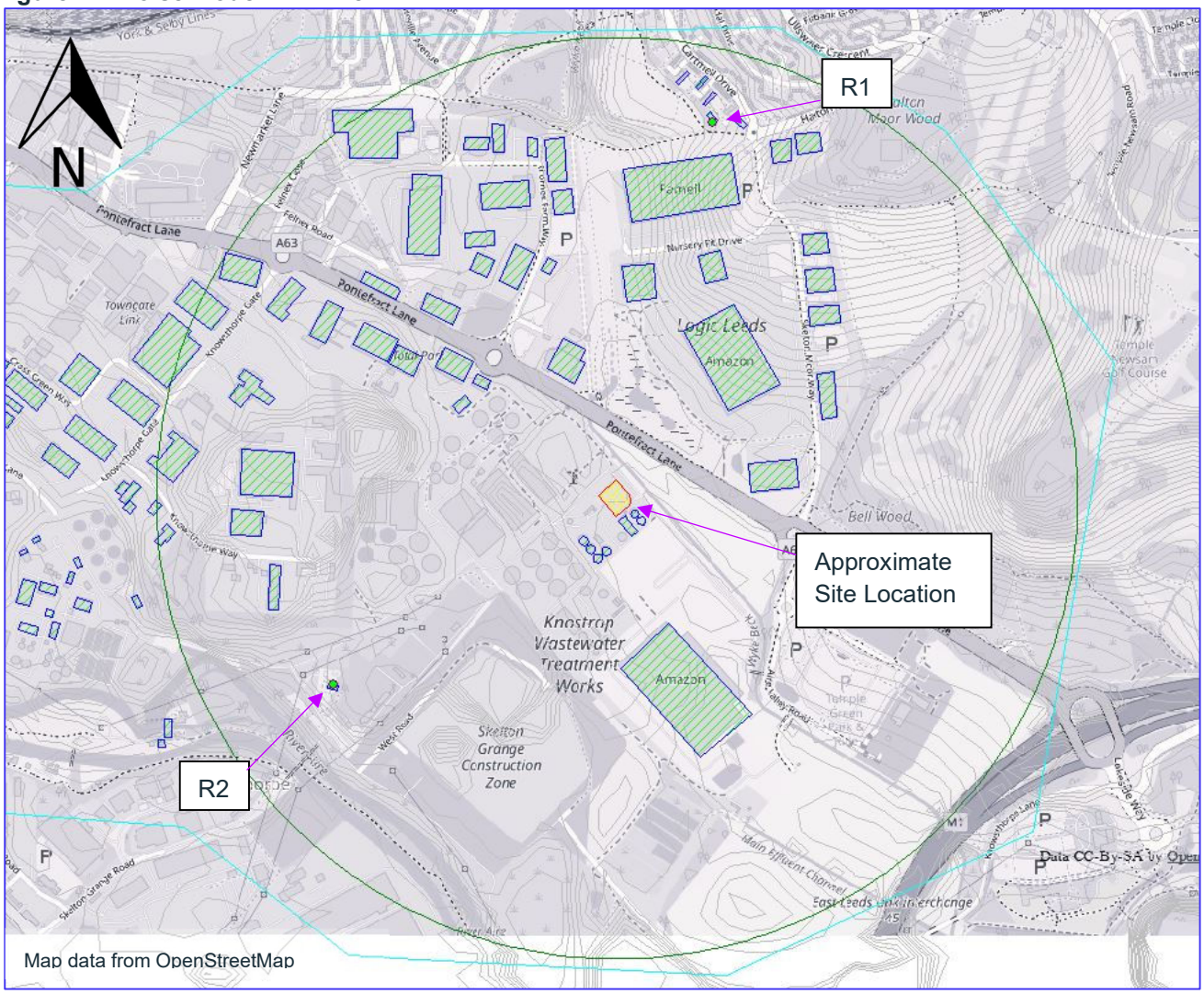
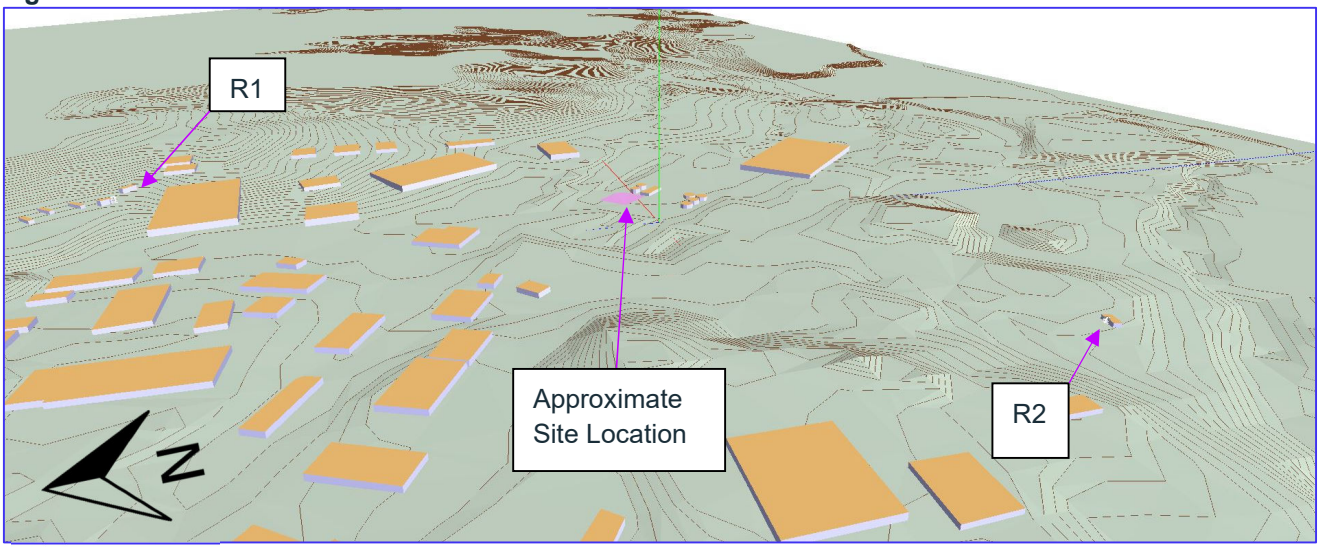


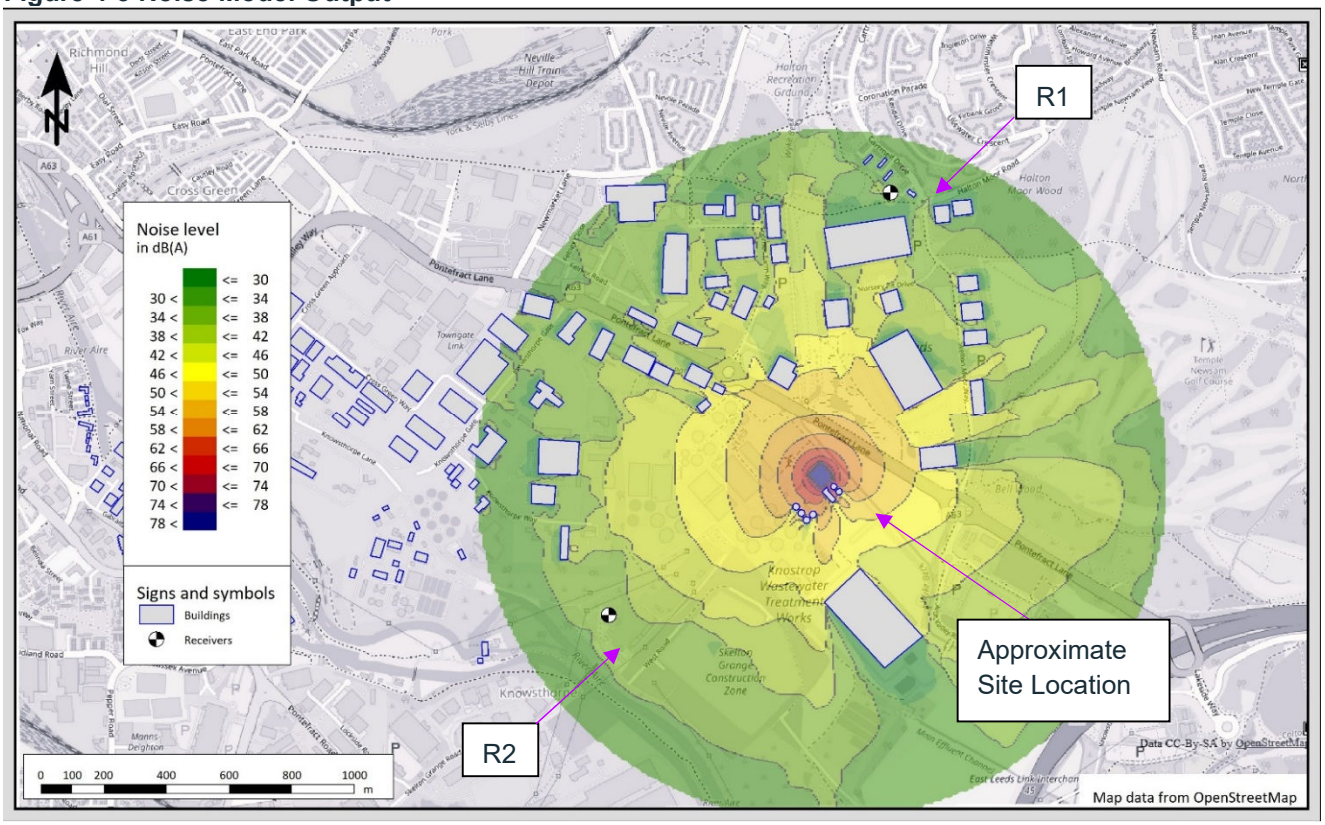
Figure 4-2 Noise Model – 3D View



4.2.2 Modelling Results and Assessment

A graphical view of the noise propagation from the BtG plant is presented in Figure 4-3.

Figure 4-3 Noise Model Output



The results of the modelling are summarised in Table 4-2, including a comparison with the LOAEL. For each NSR, the highest noise level from the various receiver heights is presented. It is assumed that the plant contains no particular acoustic character and therefore the noise rating level equals the specific sound level.

Table 4-2 Noise Modelling Results and comparison with LOAEL Value

NSR	Predicted Noise Level, dBA	LOAEL Value, dBA	Below LOAEL?
R1 – Levens Garth Halton	34	40 (Night-time)	Yes
R2 – Skelton Grange Environment Centre	36	50 (Daytime)	Yes

The results of the assessment indicate that the noise rating levels would be below the LOAEL at all NSRs. Table 4-3 presents a comparison of the noise modelling results with ambient noise levels in the area of each NSR.

Table 4-3 Noise Modelling Results and Comparison with Ambient Noise Levels

NSR	Predicted Noise Level, dBA	Ambient Noise Level, dBA		Below Ambient Level?	
		Daytime	Night-time	Daytime	Night-time
R1 – Levens Garth Halton	34	50 - 55	50	Yes (>10dB below ambient)	Yes (>10dB below ambient)
R2 – Skelton Grange Environment Centre	36	55 - 60	N/A	Yes (>10dB below ambient)	N/A

The results of the assessment indicate that noise rating levels are expected to be significantly below ambient noise levels at nearby NSR during both daytime and night-time periods.

Based on the results presented in Table 4-2 and Table 4-3, the assessment indicates that the BtG plant presents a low noise risk at the NSRs.

5. Conclusion

AtkinsRéalis has prepared an initial Step 1 desktop risk assessment of potential noise impacts from the BtG plant on noise sensitive receptors. The assessment has been conducted based on applicable noise guidance.

Existing ambient noise levels in the vicinity of the BtG plant and the nearest NSRs are likely to be moderate to high as the BtG site is located in predominantly industrial urban area, within Knostrop WwTW and close to main transport links.

A three-dimensional computer noise model was set up to predict the external noise levels at the nearest NSRs. Predicted external noise levels were found to be below the LOAEL at all nearby NSRs indicating that no adverse impact from BtG plant is expected.

Additionally, noise levels are expected to be significantly below ambient noise levels at nearby NSRs during both daytime and night-time periods.

The noisiest items of equipment (compressors) will be housed in noise attenuated enclosures. The assessment indicates that the BtG plant presents a low noise risk at the nearest NSRs. Assuming plant noise levels are similar to those assumed, further noise attenuation measures are likely not necessary.

Information required for the EA's Step 1: desktop risk assessment is provided within this report.

APPENDICES

Appendix A. Glossary of Acoustic Terms

Acoustic Environment

Sound from all sound sources as modified by the environment.

Ambient Sound Level, $L_{Aeq,T}$

Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval**, *T***

A-weighting, dB(A)

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq}, L_{A90} etc., according to the parameter being measured.

Background Sound Level, $L_{A90.T}$

A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting, F, and quoted to the nearest whole number of decibels.

Decibel (dB)

A logarithmic scale for comparing the ratios of two quantities, including sound pressure and sound power. The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.

Equivalent Continuous A-Weighted Sound Pressure Level, $L_{Aeq,T}$

A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.

Measurement Time Interval, T_m

Total time over which measurements are taken.

Rating Level, $L_{Ar,Tr}$

Specific sound level plus any adjustment for the characteristic features of the sound.

Reference Time Interval, T_r

Specified interval over which the specific sound level is determined.

This is 1 h during the day from 07:00 h to 23:00 h and a shorter period of 15 min at night from 23:00 h to 07:00 h.

Residual Sound Level, $L_r = L_{Aeq,T}$

Equivalent continuous A-weighted sound pressure level of the ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound over a given time interval, T.

R_w

The weighted sound reduction index of a material. A number, measured in decibels (dB), used to rate the effectiveness of a material to insulate sound.

Sound Pressure Level (L_p)

A value equal to 20 times the logarithm to the base 10 of the ratio of the root-mean-square pressure of a sound to a reference pressure, which is normally taken to be 20μPa. Its unit of measurement is the decibel (dB).

Specific Sound Level, $L_s = L_{Aeq,Tr}$

Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, Tr.

Time Weightings, Fast (F), Slow (S) and Impulse (I)

Time weighting is used in sound level meters to stabilize the reading. This is achieved by standardizing the speed with which the metering circuit and meter respond. Two different averaging's are used (1) 'FAST', 'F', which has a time constant of 125ms, and (2) 'SLOW', 'S', which has a time constant of 1000ms. The impulse (I) characteristic is sometimes used to measure gunshots, punch presses, etc. It has a rise time constant of 35ms and a decay time constant of 1500ms.

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Appendix F. Accident Scenarios and Mitigation Measures

An Accident Management Plan is required to ensure that there is a plan in place to deal with any incidents, or events, that could result in:

- pollution; or
- not being able to comply with the environmental permit.

An AMP will be developed as part of the EMS for the BtG facility. The AMP will address the requirements of Develop a management system: environmental permits - GOV.UK (www.gov.uk). It is expected that the AMP will contain information such as:

- Site location.
- Emergency contact details.
- Chemical (including waste storage), fire hydrant and spill kit locations plans.
- DSEAR zoning plan.
- Materials inventory.
- A copy of the EA's notification form (for completion following an incident with potentially significant environmental consequences.
- Relevant guidance and documentation.
- Overview of regulated activities and an equipment list.
- Summary of receptors.
- Description of the categories of potential incidents considered.
- Incident control matrix.

As an interim measure, a preliminary AMP has been prepared in relation to the identification and assessment of potential accident scenarios for the operation of the BtG plant (see Table F-2) based on general good practice, information from SGN and experience from other BtG plant. The AMP will be revisited and revised as / if necessary as part of the development of the EMS, and as the specifics of the design are developed further and finalised. YWS will be consulted on the development of the AMP. The AMP will be cross-checked against the requirements of S5.4 and S5.5 of the Biological Waste Treatment Appropriate Measures for Permitted Facilities guidance[1] 2022 (as amended) (herein referred to as 'BWT AppM'). In addition, the development of the AMP will ensure that measures and actions relating to fire-fighting are clearly addressed, as per the requirements of S5.8 of the BWT AppM guidance.

Potential accident scenarios for the operation of the BtG plant have been identified and assessed. The likelihood and severity of an accident occurring has been assessed using the risk matrix in Table F-1 to produce the overall level of risk for each accident scenario identified. The effect of mitigative measures has been incorporated into the assessment and a residual risk assigned to each accident scenario. Actions to be taken in the event of a failure have also been identified.

1 Biological waste treatment: appropriate measures for permitted facilities - Guidance - GOV.UK (www.gov.uk).

Table F-1 - Risk Rating Matrix

Risk Matrix		Severity		
		High	Medium	Low
Likelihood	High	High	High	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Low

The principles of applying a certain likelihood or severity rating to an incident / accident are described below:

Likelihood

- Low - An incident that is highly unlikely to occur.
- Medium - A reasonably likely incident.
- High - An incident that is highly likely to occur.

Severity

- Low - An incident that would cause a negligible impact on receptors.
- Medium - An incident that would cause a slight impact on receptors.
- High - An incident that would cause a serious threat to human health or the environment.

Table F-2 – Preliminary Incident Control Matrix

Incident	Likelihood	Consequence of Occurrence[2]	Actions Taken or Proposed to Minimise Chances of Incident Occurring	Residual Risk
Loss of containment of solids or liquids[3]				
Loss of activated carbon from carbon filters	Low – at least monthly check of filters	Low - contamination of land with solids and dusts released to air, solids and dusts could be washed into or deposited onto surface water bodies	At least monthly external visual check of filter units. Filters are enclosed, carbon is replaced when saturated. Staff are tasked with monitoring for evidence of leaks and spillages during their day to day routine.	Low
Loss of containment of liquified propane	Low - propane vessel will be remotely monitored	Medium - potentially significant uncontrolled release of propane to atmosphere with significantly increased risk of fire and explosion	Propane vessel will be remotely monitored. Preventative maintenance programme and maintenance plan are in place. CCTV inspection of below ground storage vessel.	Low
Loss of containment of lubrication oil / waste lubrication oil / glycol containers, or equipment containing lubrication oil /	Low - weekly external visual check of containers	Low - contamination of drainage system and potential adverse effect on performance of WwTW, with adverse effect on quality of final effluent and receiving watercourse and consequent harm to human and ecological receptors	At least weekly external visual check of containers and equipment. Containers are bunded and located in the COSHH stores. Preventative maintenance programme and maintenance plan are in place. Staff are tasked with monitoring for evidence of leaks and spillages during their day to day routine. Volume of release is limited by small volumes stored and used. BtG plant drainage system has an oil interceptor and an isolation valve to prevent spills entering the YWS drainage system. If not isolated, lubrication oil / glycol could drain to WwTW via site drainage systems.	Low

2 Where the consequence of occurrence is contamination of land and (potential) pollution of local groundwater and surface watercourses, it is assumed that contamination of the drainage system and potential adverse effect on the performance of WwTW could also occur. The latter is not specifically addressed in the table because the former is considered to represent a worse case.

3 Where secondary containment (or tertiary containment) would be expected to retain the liquid it is assumed, as a worst case, that the containment fails to do this.

Incident	Likelihood	Consequence of Occurrence[2]	Actions Taken or Proposed to Minimise Chances of Incident Occurring	Residual Risk
waste lubrication oil / glycol				
Loss of containment of condensate from condensate system	Low - regular external visual check of biogas condensate pots	Low - contamination of land and potential pollution of local groundwater and surface watercourses, potential harm to local human and ecological receptors	External visual check of biogas condensate pots during site inspections. Preventative maintenance programme and maintenance plan are in place. Staff are tasked with monitoring for evidence of leaks and spillages during their day to day routine. Condensate drains from pots into drainage systems. CCTV inspection of below ground drainage pipework. Condensate could run to land or seep from condensate drainage system to land.	Low
Loss of containment of gases				
Catastrophic loss of containment of biogas / biomethane from BtG plant or pipework	Low - at least monthly external visual check of biomethane to grid plant	High - potentially significant uncontrolled release of biogas / biomethane to atmosphere with significantly increased risk of fire and explosion and potential harm to human and ecological receptors	At least monthly external visual check of BtG plant. Pressure relief systems in place. Welded pipework used where possible. Gas tight seals utilised. ATEX Zoning and rated plant / equipment used. Gas and heat detectors in place.	Medium
Loss of containment of noise				
Loss of containment of noise for biomethane to grid plant compressors	Low - compressors are in acoustic enclosures	Low - potential harm to nearest human receptors and nearest ecological receptors	Compressors are in acoustic enclosures. Doors to enclosures are kept closed at all times while compressors are in operation. Preventative maintenance programme and maintenance plan are in place which minimise noise generation. Any damage to containment would be repaired as soon as reasonably possible. Signage and hearing protection are provided.	Low

Incident	Likelihood	Consequence of Occurrence[2]	Actions Taken or Proposed to Minimise Chances of Incident Occurring	Residual Risk
Overfilling[3]				
Overfilling of propane storage vessel	Low - tank is remotely monitored	Medium - potentially significant uncontrolled release of propane to atmosphere with increased risk of fire and explosion and potential harm to human and ecological receptors	Vessel is remotely monitored. The system is fitted with a safety cut out at 80% volume. The cut out valve is tested on delivery and in accordance with supplier procedures. Deliveries are carried out by qualified personnel (agreement with specialist propane supplier for tank, equipment and commodity supply) and supervised by a SGN site representative. Preventative maintenance programme and maintenance plan are in place. Chemical Delivery and Controlling Spillage procedure will be developed as part of the EMS.	Low
Overfilling of clean / waste lubrication oil and glycol containers	Low - staff are trained in safe material handling	Low - contamination of drainage system and potential adverse effect on performance of WwTW, with adverse effect on quality of final effluent and receiving watercourse and consequent harm to human and ecological receptors	Staff are trained in safe material handling. Drip trays and bunds are used. Preventative maintenance programme and maintenance plan are in place. Staff are tasked with monitoring for evidence of leaks and spillages during their day to day routine. Chemical Delivery and Controlling Spillage procedure will be available. Bunding should contain lubrication oil / glycol. Volume of release is limited by small volumes stored and used. BtG plant drainage system has an oil interceptor and an isolation valve to prevent spills entering the YWS drainage system. If not isolated, lubrication oil could drain to WwTW via BtG site drainage system.	Low
Spillages				
Spillage of liquified propane during delivery, handling and transfer	Low - deliveries are carried out by qualified personnel and supervised by a SGN site representative	Low - uncontrolled release to atmosphere with increased risk of fire and explosion and potential harm to human and ecological receptors	Deliveries are carried out by qualified personnel (agreement with specialist propane supplier for vessel, equipment and commodity supply) and supervised by a SGN site representative. Chemical Delivery and Controlling Spillage procedure will be available. Staff are trained in safe material handling.	Low

Incident	Likelihood	Consequence of Occurrence[2]	Actions Taken or Proposed to Minimise Chances of Incident Occurring	Residual Risk
Spillage of glycol, waste / clean lubrication oil during delivery, handling and transfer	Low - deliveries are carried out by qualified personnel and supervised by a SGN site representative	Low - contamination of drainage system and potential adverse effect on performance of WwTW, with adverse effect on quality of final effluent and receiving watercourse and consequent harm to human and ecological receptors	Deliveries are carried out by qualified personnel and supervised by a SGN site representative. Chemical Delivery and Controlling Spillage procedure will be available. Staff are trained in safe material handling. BtG plant drainage system has an oil interceptor and an isolation valve to prevent spills entering the YWS drainage system. If not isolated, glycol / lubrication oil could drain to WwTW via BtG site drainage system.	Low
Provision of incorrect or out of specification materials				
Off-specification biogas	Low – biogas monitored at pre-treatment area	Medium - failure to meet NGN requirements and contamination of Grid Natural Gas / safety risks	Biogas composition is monitored and BtG plant will automatically shut down if off-specification biogas is detected.	Low
Non-compliant biomethane	Low – biomethane monitored at GEU and ROV	Medium - failure to meet NGN requirements and contamination of Grid Natural Gas / safety risks	Biomethane composition is monitored and plant will automatically prevent discharge of out of specification biomethane to the biomethane flare. Where necessary, Biomethane to grid plant will shut down.	Low
Failure of equipment				
Failure of pressure relief valve	Low - preventative maintenance programme and maintenance plan are in place for pressure relief valves	Medium - uncontrolled release of biogas / biomethane to atmosphere with significantly increased risk of fire and explosion and potential harm to human and ecological receptors	Preventative maintenance programme and maintenance plan are in place for pressure relief valves. Maintenance includes checking pressure settings for pressure relief valves. Pressure is monitored online, so if an incident of this nature occurs it can be identified, reported and solved as quickly as possible. Gas detectors are in place which will raise the alarm should a leak of biogas be detected.	Low
Failure of activated carbon filters	Low - activated carbon filter does	Low - additional quantities of H_2S, siloxanes and NMVOCs released to atmosphere, potential effects on	Activated carbon filters do not have moving parts. Carbon beds are monitored for deterioration / efficiency. Operation of BtG plant and biogas composition are monitored, so if an incident of	Low

Incident	Likelihood	Consequence of Occurrence[2]	Actions Taken or Proposed to Minimise Chances of Incident Occurring	Residual Risk
	not have moving parts	local human and ecological receptors	this nature occurs it can be identified, reported and solved as quickly as possible.	
Failure of BtG plant with diversion of biogas to flare	Low - preventative maintenance programme and maintenance plan are in place	Low - additional quantities of combustion products released from flare to atmosphere, potential harm to human and ecological receptors	Preventative maintenance programme and maintenance plan are in place for the BtG plant. Operation of BtG plant is monitored (via SCADA system or equivalent), so if an incident of this nature occurs it can be identified, reported and solved as quickly as possible.	Low
Vehicle impact[4]				
Vehicle impact involving BtG plant	Low - vehicle movements on site are limited to minimum necessary	High - potentially significant uncontrolled release of biogas, biomethane or propane atmosphere with increased risk of fire and explosion and potential harm to human and ecological receptors	Vehicle movements on site are limited to minimum necessary. All deliveries and collections are scheduled and are supervised by site staff. Equipment located outside is remote from vehicle routes wherever practicable or protected by crash barriers and carries appropriate signage. Preventative maintenance programme and maintenance plan are in place.	Medium
Fire and explosion				
Fire involving BtG plant	Low - smoking is restricted to a specified area of site and use of non ATEX (explosive atmospheres) rated equipment	Medium - heat, smoke and combustion products released to atmosphere, firewater released to drainage system, potential harm to human and ecological receptors and increased risk of explosion	In the event of an emergency the plant will auto isolate. Smoking is restricted to a specified area of site and use of non ATEX rated equipment not permitted in designated areas. Heat detectors in place. A fire risk assessment will be undertaken at all relevant stages of change. Preventative maintenance programme and maintenance plan are in place. Equipment is routinely checked. Drainage system will contain firewater. BtG plant drainage system has an oil interceptor and an isolation valve to prevent firewater entering the YWS drainage system. If	Low

4 Lubrication oil, waste lubrication oil and glycol have not been considered in this preliminary incident control matrix due to the low volumes used and stored and as the storage containers are located within a building (COSHH store). Propane tank is underground and so accidental propane releases have only been considered where relevant.

Incident	Likelihood	Consequence of Occurrence[2]	Actions Taken or Proposed to Minimise Chances of Incident Occurring	Residual Risk
	not permitted in designated areas		not isolated firewater could drain to WwTW via BtG site drainage system.	
Failure of auto isolation	Low - preventative maintenance programme and maintenance plan in place	Medium - heat, smoke and combustion products released to atmosphere, potential harm to human and ecological receptors and increased risk of explosion	Preventative maintenance programme and maintenance plan in place for slam shut valves. Heat detectors in place. A fire risk assessment is undertaken at all relevant stages of change.	Low
Explosion due to ignition of biogas / biomethane / propane leak from BtG plant orpropane storage vessel with catastrophic failure of containment systems and fire	Low - smoking is restricted to a specified area of site and use of non ATEX rated equipment not permitted in designated areas	High - blast impacts, and heat, smoke and combustion products released to atmosphere, and contamination of land and pollution of local groundwater and surface watercourses, with potential harm to human and ecological receptors.	Smoking is restricted to a specified area of site and use of non ATEX rated equipment not permitted in designated areas, which include biogas storage areas. Heat detectors in place. Any fire-fighting water could run to land / water.	Medium
Flooding[4]				
Flooding on site involving BtG plant	Low - facility is located in flood zone 1	High - potentially significant uncontrolled release of biogas, biomethane or propane to atmosphere with potential harm to human and ecological receptors and increased risk of fire and explosion	Facility is located in flood zone 1. In the event of flooding the plant would be safely shut down and isolated remotely. Gas detectors are in place which will raise the alarm should a leak of biogas be detected as a result of flooding. ATEX Zoning and rated plant / equipment used with gas detection installed in all equipment. Heat detectors in place.	Medium
Extreme weather conditions[4]				

Incident	Likelihood	Consequence of Occurrence[2]	Actions Taken or Proposed to Minimise Chances of Incident Occurring	Residual Risk
High winds on site causing damage to BtG plant	Low - facility is located inland	High - potentially significant uncontrolled release of biogas or biomethane to atmosphere with potential harm to human and ecological receptors and increased risk of fire and explosion	Facility is located inland. ATEX Zoning and rated plant / equipment used with gas detection installed in all equipment. Heat detectors in place.	Medium
Breach of security involving arson, vandalism or theft[4]				
Arson involving BtG plant	Low - security measures are in place	High - potentially significant uncontrolled release of biogas, biomethane or propane to atmosphere with increased risk of fire and explosion and potential harm to human and ecological receptors	Medium Security measures are in place. WwTW is surrounded by palisade fencing and CCTV is in place on YWS site. Entrance / exit to BtG plant is secured by locked gate. Packaged plant such as the GEU and membrane separation unit will be locked. Security risk appraisal will be in place. Preventative maintenance programme and maintenance plan are in place for fencing. ATEX Zoning and rated plant / equipment used with gas detection installed in all equipment. Heat detectors in place.	Low
Vandalism and / or theft involving BtG plant	Low - security measures are in place	High - potentially significant uncontrolled release of biogas or biomethane to atmosphere with potential harm to human and ecological receptors and increased risk of fire and explosion	Medium Security measures are in place. WwTW is surrounded by palisade fencing and CCTV is in place on YWS site. Entrance / exit to BtG plant is secured by locked gate. Packaged plant such as the GEU and membrane separation unit will be locked Security risk appraisal will be in place. Preventative maintenance programme and maintenance plan are in place for fencing. ATEX Zoning and rated plant / equipment used with gas detection installed in all equipment. Heat detectors in place.	Low

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