

REPORT

Specified Engineering Works (SEW) Proposal for Knockharley Gas Cleaning System (Biogas Desulphurisation)

Knockharley Landfill Ltd.

Submitted to:

Environmental Protection Agency

on behalf of
Knockharley Residual Landfill
Knockharley
Kentstown
Navan
Co. Meath
Ireland

Submitted by:

Golder Associates Ireland Limited

Town Centre House Dublin Road Naas
Co. Kildare Ireland

+353 45 81 0200

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1.0 SCOPE OF REPORT

This document presents the Specified Engineering Works (SEW) Proposal for the installation of a gas cleaning system (biogas desulphurization) for its power generation compound at the Knockharley Landfill Site as required by Conditions of Waste Licence Register Number W0146-02 (Reference 1).

This Licence was amended to an Industrial Emissions Licence (IEL) on 20 December 2013 (Reference 2).

The proposal presented in this document has been prepared by Golder Associates Ireland Ltd (Golder) on behalf of the licensee, Knockharley Landfill Limited, in accordance with Part 1 Activities Licensed: Class 9 and to fulfil the requirements of Conditions 3.2.1, 3.2.2, 3.11.2, 3.11.3, 3.11.4, 3.11.5, 3.11.6, 3.15.1, 3.15.4, 3.16.4, 3.20.1, 6.1, 6.3.2, 6.9 and 6.10 and Schedule B: Specified Engineering Works, Schedule C: Emission Limits and Schedule D: Monitoring of the Waste Licence W-0146-02.

2.0 SITE LOCATION AND LAYOUT

Knockharley Landfill Limited (KLL) operates a Waste Management Facility, known as Knockharley Landfill, at Knockharley, Kentstown, Navan, in Co. Meath (includes townlands of Tuiterrath and Flemingstown).

The facility was developed in 2004 and opened in late 2004 accepting residual, non-hazardous, household, commercial and industrial waste. The site encompasses approximately 135 hectares, of which the landfill will cover approximately 25 hectares, comprise of 28 Cells and is located adjacent to the N2 National Primary Route approximately 7 km south of Slane, Co. Meath. To date, 19 of the 28 proposed landfill cells have been constructed.

The Landfill Gas Compound is located to the south east of the Knockharley Facility, which is the focus of this SEW Proposal.

The Development Works for the Gas Cleaning System is located within the red line boundary indicated in Figure 1 and Drawing 1 of Appendix A.



Figure 1: Landfill, Restoration and Gas Compound Works

3.0 BACKGROUND

The facility was developed in 2003 and opened in late 2004 accepting residual waste. The landfill accepts residual non – hazardous household, commercial and industrial waste. The combined tonnage of these wastes accepted must not exceed 200,000 tonnes per annum as specified in Schedule A of the licence.

This facility was granted a Waste Licence (W0146-01) by the Environmental Protection Agency (EPA or the Agency) on 19th March 2003 which was amended (W0146-02) on 15 January 2013 (Amendment A), 01 October 2013 (Amendment B). It was amended to an Industrial Emissions Licence on 20 December 2013 (IED Amendment) and further amended on 15 November 2016 (Amendment C) and 28 March 2017 (Amendment D). The Licence was initially granted to Greenstar Holdings Limited and was subsequently transferred to KLL on 4 March 2014.

Starrus LFG Limited (Starrus) operate and maintain the Gas Compound at Knockharley and currently have four gas utilisation engines and three enclosed flares present at the compound.

Recently, Starrus have been researching methods to improve gas production, improve energy efficiency, reduce emissions and reduce maintenance for the gas compounds that they manage and operate. Consequently, Starrus propose to install a gas cleaning system (biogas desulphurization) for its power generation site at Knockharley Landfill to be sourced from Ecotec, an original equipment manufacturer (OEM) who specialises in providing equipment for the cleaning of biogas.

Starrus has retained Golder to provide engineering consultancy services, prepare this Specified Engineering Works Proposal and in due course provide supervision for the construction works. Further, Golder has been retained to provide Project Supervisor Design Process (PSDP) role for the project.

The Landfill is designed and managed to operate under the conditions of the Waste Licence Register No. W0146-02, including all amendments.

Licence Conditions of particular relevance to this report are reproduced below:

Condition 3.2.1 which states:

'The licensee shall submit proposals for all Specified Engineering Works, as defined in Schedule B: Specified Engineering Works, of this licence to the Agency for its agreement at least two months prior to the intended date of commencement of any such works. No such works shall be carried out without the prior agreement of the Agency.'

Condition 3.11.3 which states:

'All tank and drum storage areas shall, as a minimum, be bunded, either locally or remotely, to a volume not less than the greater of the following:

- a) 110% of the capacity of the largest tank or drum within the bunded area; or*
- b) 25% of the total volume of substance which could be stored within the bunded area.*

and **Schedule B** which lists the following items as Specified Engineering Works that are relevant to these proposed Works:

- *Installation of Landfill Gas Management Infrastructure.*
- *Installation of Surface Water Management Infrastructure.*

4.0 GAS CLEANING SYSTEM

4.1 Process

Biogas cleaning is a two-stage process which uses biological micro-organisms to convert the H_2S from a gaseous form present in the landfill gas into a liquid phase. The “scrubbed” landfill gas contains CH_4 , following passage through the **Scrubber**, is delivered to the engines where it is used for the generation of electricity. The liquid containing the H_2S is pumped into the **Biological Reactor (Bioreactor)** where the H_2S is oxidised into elemental sulphur, through the addition of air, and the regenerated biological liquid is recycled to the **Scrubber** to continue to remove H_2S .

The elemental sulphur is pumped in sludge form into a **Settler Tank** where it is stored prior to being transferred to a **Sludge Tank**. The sludge is then pumped through a dewatering process. The filtrate is sent to the landfill site leachate treatment system and the dry solids, which are primarily elemental sulphur, will be removed off site for use as a soil enhancement product site by a licensed contractor.

The proposed layout and sections for the Gas Cleaning System are shown on the Drawings provided in Appendix A.

Figure 1 below shows a schematic of the process and the Specification is provided in Appendix B;

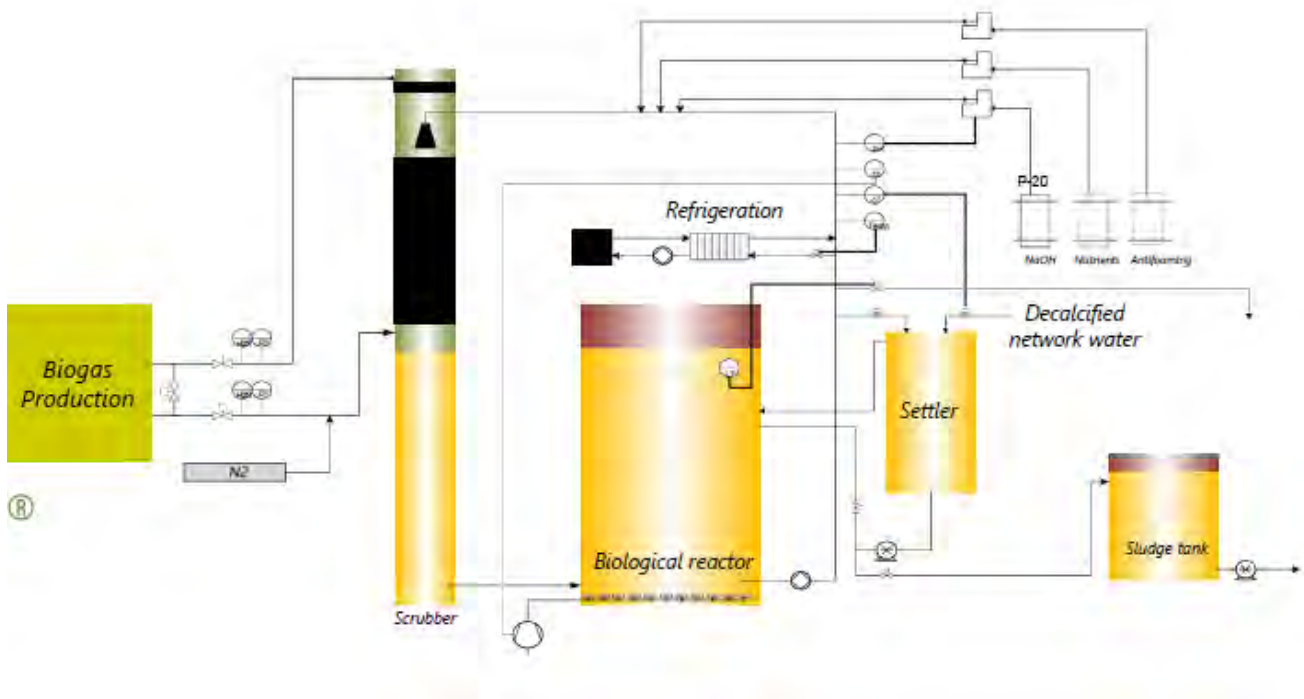


Figure 2: Gas Cleaning Process

4.2 Emissions

4.2.1 Noise

In accordance with the landfill license, noise emissions shall not reach 55 dB(A) L_{Aeq} (30 minutes) daytime and 45 dB(A) L_{Aeq} (30 minutes) night-time when recorded at monitoring points located around the landfill facility.

The proposed Gas Cleaning System is expected to emit a 69 dB(A) L_{Aeq} (30 minutes) at a 1-meter distance.

Currently, the highest noise emissions at the gas compound is emitted from the four combustion engines. An 80 dB(A) L_{Aeq} (30 minutes) at 1 meter is the regular recorded reading for the combustion engines. These

readings recorded to date have yet to trigger above the landfill license requirements at the monitoring points, hence it is not expected that the proposed new Gas Cleaning System will lead to a noise emission exceedance.

Existing monitoring requirements will confirm during operation and emissions will be recorded in accordance with the Landfill License W145-02, Schedule C and Schedule D.

4.2.2 Sludge Dewatering

The sludge generated by the process is pumped from the **Settler Tank** to the holding **Sludge Tank**. The sludge is then pumped from the holding tank and is passed through a dewatering system. In the dewatering system the sludge is separated into liquid and dry solids. The dry solids will consist of 80% to 85% elemental sulphur, 10 to 15% biomass and 5% to 10% inorganic salts. The dry solids will be deposited into a skip for removal off site for use as a soil enhancement product by a licensed contractor.

The liquid shall be returned to the landfill leachate system through an existing connection located at the Gas Compound. This will generate a volume of approximately 9 m³ per day of leachate during peak operation resulting in an increase of circa. 10% in the volume of leachate removed from site.

4.2.3 Surface Water

It is expected that during rain periods an accumulation of water will occur in the containment bunds. Level sensors within the bunds will alarm and trigger the following protocol:

- Site technicians will visually inspect bunds; and
- Bund water will be tested for contaminants. These samples will be tested at source by means of a calibrated handheld meter which will measure pH, temperature and electrical conductivity.

The subsequent actions are dependent on the results from the bund water tests:

- Clean water will be pumped into the surface water collection system to be passed through the Petrol Interceptor and discharged through existing Surface Water Lagoon, where further analyses is undertaken for the Surface Water Lagoon in accordance with the landfill license; and
- Contaminated water will be pumped into the leachate collection system to be tankered off site to an agreed Sanitary Authority Wastewater Treatment Plant in accordance with the landfill license.

In accordance with Condition 3.16.4 and 6.4 of IEL Licence, Starrus shall coordinate visual inspection of the rainwater collecting in the sump prior to discharge.

Records of inspection, sampling, testing and pumping shall be maintained on site.

5.0 CONTAINMENT BUNDS

The Gas Cleaning System will require a secondary containment system, in accordance with the License.

A local containment system is the preferred option for this facility. These secondary containment facilities provide retention in the event of a loss of containment in the primary system.

5.1 IEL Guidance

In accordance with the direction given in the above Conditions (Section 3.0), the secondary containment bunds are also designed with regard to:

- IPC Guidance Note, '**Guidance Note on Storage and Transfer of Materials for Scheduled Activities**', EPA 2004 (Reference 3).

This document is a general guidance document and sets out the minimum requirements for industry to comply with Industrial Emissions Licence (IEL) licence conditions in relation to storage and movement of potentially polluting substances. The technologies identified in the Guidance Note for the new activities, unless otherwise specifically stated, are regarded as representing Best Available Techniques (BAT) in accordance with BAT Reference Document (BREF) 07.2006, Emissions from Storage (Reference 4); and

- The Integrated Pollution Prevention and Control (IPPC) BREF on '**Emission from Storage**', July 2006, (Reference 4) addresses storage, transfer / handling of liquids, liquefied gases and solids, regardless of the sector or industry and provides a summary of principal BAT conclusions.

5.2 Recognised Engineering Standard

The IEL Guidance Note lists the following recognised engineering standards to be regarded for the proposed bund design:

- **BS EN 1992-1: 2004 + A1: 2014:** Eurocode 2: Design of concrete structures. General rules and rules for buildings. (Reference 5); and
- **CIRIA C736 (2014):** Containment systems for the prevention of pollution. Secondary, tertiary and other measures for industrial and commercial premises. (Reference 7)

CIRIA C736 recommends the following code of practice for concrete structures:

- **BS EN 1992-3: 2006:** (Eurocode 2) Design of concrete structures. Liquid retaining and containment structures. (Reference 6).

5.3 Classification

Sodium Hydroxide Solution at 25%, is the main ingredient for the gas cleaning process and is not classified as a priority substance which presents a significant risk to or via the aquatic environment.

The **German WGK (Water Hazard Classification) System** (Reference 8) rates Sodium Hydroxide (Natriumhydroxid, Index Number 142) as **WGK 1 – Low Hazard to Waters**.

The Table below summarises the chemicals proposed to be used in the gas cleaning process and their assigned WGK rating.

Table 1: WGK Chemical Classification

Chemical Product	Cas Number	EC Number	Index Number	WGK Rating
Sodium Hydroxide Solution	1310-73-2	215-185-5	142	1
dBiox Nutrients				
Phosphoric Acid	7664-38-2	231-633-2	392	1
Potassium Nitrate	7757-79-1	231-818-8	346	1
dBiox Defoamer	Not Applicable	Not Applicable	Not Applicable	Not Applicable

All of the chemicals proposed to be used in the gas cleaning process have a rating of **WGK 1 – Low Hazard to Waters** or are listed as not applicable to a rating. Safety Data Sheets for the chemicals proposed to be used in the gas cleaning process are attached in Appendix C.

The **CIRIA C736 Guidance** (Reference 7) sets out a framework and a 3-step approach for the classification system of secondary containment systems based on three categories (Class 1, 2 or 3) each representing a different level of integrity to match the requirements of the overall Site Risk Rating (High, Moderate and Low).

This Guidance has been followed to assign a **Class 1 - Low Overall Site Risk Containment Type** for the secondary containment systems.

5.4 Design of Containment Bunds

The proposed installation of the Gas Cleaning System will incorporate the use of three local secondary containment bunds. The in-situ reinforced concrete bunds will be designed and built to comply with the requirements of BS EN 1992-3:2006 and BS EN 1992-1-1:2004 + A1: 2014.

The drawings provided in Appendix A illustrate the layout and the details described below.

5.4.1 Gas Cleaning System Bund

The main operations of the Gas Cleaning System, located in the south-west sector of the Gas Compound, will be surrounded with an in-situ reinforced concrete retaining bund. The concrete bund will have a concrete reinforced base and concrete reinforced walls.

The base of the bund will have a fall, minimum 1:60, to an open grid sump located in the south west corner of bund, where a pump will be located to manage surface water accumulations. Automated level alarm sensors along with daily inspections will monitor containment levels.

The concrete reinforced bund design retention period for the secondary containment bund shall be categorised as **Medium: Limited retention time of between 8 hours and 72 hours** for a catastrophic failure of the primary containment tank. This retention time is selected based on the presence of electrical components, classification testing times for surface water sampling and the penetration period (15 mm after 72 hrs) of the sodium hydroxide solution, should a failure occur.

The bund will be structurally independent from the primary containment tank and shall have a durability design life of a minimum of 50 years, which is required to be capable of withstanding the effects of weather, aggressive ground conditions, abrasion, fire and mechanical impact.

5.4.1.1 Gas Cleaning System Bund Retention Volume

In accordance with the IEL Guidance Note and Condition 3.11.3 of W0146-02, the retention volume of the secondary containment bund will be the minimum of 110% of the capacity of the largest tank or drum within the banded area.

There are 4 large tanks in the main gas cleaning system bund. These are:

- 1 x **Scrubber / Washing Column Tank**; 12 m height x 2 m diameter, Volume = 40 m³;
- 1 x **Bioreactor Tank**; 8.5 m height x 4 m diameter, Volume = 75 m³;
- 1 x **Settler Tank**; 6 m height x 1 m diameter, Volume = 5 m³;
- 1 x **Nutrients Tank**, 200 litre, Volume = 2 m³; and
- 1 x **Water Tank**, Volume = 10 m³.

The capacity of the **Bioreactor Tank** is approximately 75 m³, which is the largest tank involved in the process. The minimum retention capacity of the secondary containment bund shall be **82.5 m³**.

5.4.2 Sodium Hydroxide Solution Tank Bund

The onsite storage of Sodium Hydroxide Solution will consist of 2 No. x 10 m³ Tanks. The two Tanks will be surrounded with an in-situ reinforced concrete retaining bund. The concrete bund will have a concrete reinforced base and concrete reinforced walls.

The Sodium Hydroxide Solution Tanks are located in the north-west sector of the Gas Compound, so as to allow for ease of access and egress for unloading of deliveries. All connections to the tanks for unloading will occur within the banded tanks.

The base of the bund will have a fall, minimum 1:60, to an open grid sump located in the north east corner of bund, where a pump will be located to manage surface water accumulations. Automated level alarm sensors along with daily inspections will monitor containment levels.

The concrete reinforced bund design retention period for the secondary containment bund shall be categorised as **Medium: Limited retention time of between 8 hours and 72 hours** for a catastrophic failure of the primary containment tank. This retention time is selected based on the classification testing times for surface water sampling and the penetration period (15 mm after 72 hrs) of the sodium hydroxide solution, should a failure occur.

The bund will be structurally independent from the primary containment tank and have a durability design life of a minimum of 50 years, which is required to be capable of withstanding the effects of weather, aggressive ground conditions, abrasion, fire, and mechanical impact.

5.4.2.1 Sodium Hydroxide Solution Tank Bund Retention Volume

In accordance with the IEL Guidance Note and Condition 3.11.3 of W0146-02, the retention volume of a secondary containment bund shall be the minimum of 110% of the capacity of the largest tank or drum within the banded area.

The capacity of the **Sodium Hydroxide Solution Tank** is approximately 10 m³, which is the largest tank involved in the process. The minimum retention capacity of the secondary containment bund shall be **11 m³**.

5.4.3 Sludge Dewatering Tank Bund

The Sludge Dewatering process will require a holding tank volume of 10 m³. The tank will be surrounded with an in-situ reinforced concrete retaining bund. The concrete bund will have a concrete reinforced base and concrete reinforced walls.

The **Sludge Tank** is located in the north-west sector of the Gas Compound so as to allow for ease of access and egress for loading / unloading of skips. All connections to the tank and skip for unloading, will occur within the banded tanks.

The base of the bund will have a fall, minimum 1:60, to an open grid sump located in the north east corner of bund, where a pump will be located to manage surface water accumulations. Automated level alarm sensors along with daily inspections will monitor containment levels.

The concrete reinforced bund design retention period for the secondary containment bund shall be categorised as **Medium: Limited retention time of between 8 hours and 72 hours** for a catastrophic failure of the primary containment tank. This retention time is selected based on the classification testing times for surface water sampling and the penetration period (15 mm after 72 hrs) of the sodium hydroxide solution, should a failure occur.

The bund will be structurally independent from the primary containment tank and have a durability design life of a minimum of 50 years, which is required to be capable of withstanding the effects of weather, aggressive ground conditions, abrasion, fire, and mechanical impact

5.4.3.1 Sludge Dewatering Tank Bund Retention Volume

In accordance with the IEL Guidance Note and Condition 3.11.3 of W0146-02, the retention volume of a secondary containment bund shall be the minimum of 110% of the capacity of the largest tank or drum within the bunded area.

The capacity of the holding tank is approximately 10 m³, which is the largest tank involved in the process. The minimum retention capacity of the holding tank secondary containment bund shall be **11 m³**.

6.0 PREPARATORY WORKS

The installation of the Gas Cleaning System will require the preparatory works as described below. The requirements of Condition 3.2.2 will be fulfilled during these works, namely that:

'All specified engineering works shall be supervised by a competent person(s) and that person, or persons, shall be present at all times during which relevant works are being undertaken'.

6.1.1 Relocation of Monitoring Well LG05

Gas Monitoring Well LG05, is located within the footprint of the proposed extension to the Gas Compound. KLL propose to relocate this well to accommodate the new gas cleaning system. The gas monitoring well, will be relocated approximately 2 m to the west of its current position and closer to the landfill. The new location of well LG05 as shown in Drawing 03.

KLL will endeavour to comply with Condition 3.20.1 (i) (a) of the licence, where installed perimeter monitoring boreholes will be set at 50 m intervals around the periphery of the landfill footprint.

6.1.2 Gas Compound Fence

The existing Gas Compound fence will be removed at the north entrance to the Gas Compound and the sections of fence at the west and south of the Gas Compound will be removed for installation of the Gas Cleaning System. Upon completion of the works the Gas Compound fence will be reinstated as shown in Drawing 03.

6.1.3 Relocation of Screening Bund

An existing small screening bund located along the southern and eastern extents of the Gas Compound and shall be removed and relocated to accommodate the proposed works. The new screening bund will be relocated further south and the east bund shall be extended to meet it as shown on Drawing 03.

6.1.4 Site Clearance

Removal of topsoil from the footprint of the Gas Cleaning System, for the proper execution of the works and effective operation of construction plant on-site is required. Excavated topsoil will be deposited into the screening berm located adjacent to the Gas Compound as highlighted in Drawing 03.

6.1.5 Drainage

Interceptor toe drains / swales and sump holes shall be excavated at suitable locations outside the footprint of the Gas Cleaning System development to allow for pumping away of accumulated surface water. Surface water from the works will be directed to the Surface Water Lagoon via the Petrol Interceptor located to the south west of the Gas Compound.

6.1.6 Services

There are several existing services within the footprint of the works:

- Water supply and electrical supply, which transverses to the north of the existing Gas Compound site, are located in the proximity of the Sodium Hydroxide Solution Bund and will be required to be diverted away from of the bund. The existing CCTV Pole will also be required to be relocated to accommodate the new installation;
- Electrical ducting which crosses the proposed Gas Cleaning System will also be relocated and diverted around the bund; and
- Existing storm water drains and gullies will not be affected by the Gas cleaning installation system.

The layout of the services to the Gas Cleaning System are shown in Drawing 02 of Appendix A.

7.0 GAS CLEANING SYSTEM INSTALLATION

Ecotec, who are the Original Equipment Manufacturers for the GAS Cleaning System, shall supply and install the facility.

Suitably experienced civil engineering and earthworks personnel shall be employed to construct the civil aspects to the Gas Cleaning Facility. The Works shall be overseen by a suitably experienced civil engineering consultant.

7.1.1 Formation

The installation works for the proposed Gas Cleaning System is located in several sectors of the existing Gas Compound. The **Sodium Hydroxide Solution Storage Bund** and **Sludge Dewatering Bund** are located in the north-west sector of the Gas Compound and will be installed on existing hard standing areas.

The bulk of the proposed Gas Cleaning System will be located in the south-west sector of the Gas Compound. The Formation Level for the base of the Gas Cleaning System will be installed on existing hard standing areas of the Gas Compound and some newly constructed fill areas.

Following excavation to the Formation Level, the footprint will require trimming, grading and compaction prior to the placement of the compacted fill. The fill used to construct the base of Gas Cleaning System will be sourced from existing stockpiles on site and/or suitable excavated material. The final excavated surfaces shall be trimmed and rolled to provide a clean, even and firm foundation to permit the movement of construction vehicles without causing rutting or other deleterious effects.

Compaction of the underlying soil materials shall be in accordance with Table 6/4 Methods 2 and 3, as appropriate, in accordance with Clause 612 of the NRA Manual of Contract Documents for Road Works, Series 600 - Earthworks, March 2013, (Reference 9).

A minimum of 4 passes of a minimum 10 tonne vibratory roller is required for the underlying soils.

Soft spots and areas of unsuitable materials identified shall be excavated and replaced with suitable material placed and compacted and / or shall be improved in-situ via compaction or the installation of appropriate geosynthetics.

7.1.2 Concrete and Reinforcement

7.1.2.1 Structural Concrete

Concrete supplied for the bunds shall conform to the requirements of I.S. EN 206-1 (Reference 10) and shall comply with the specification and design drawings:

- Exposure Classes – XC4, XF1 and XF3 and XA2;
- Aggregates to I.S. EN 12620 with sufficient freeze-thaw resistance (20 mm);
- Cement Types: One of the following (No GGBS) – CEM I, CEM II / A-L, CEM II / LL, CEM II / A-V, CEM II / A-S or SRPC;
- Minimum Cement Content: 340 kg/m³;
- Max Water Content Ratio: 0.5;
- Minimum Strength Class: C32 / 45;
- 40 mm cover to all reinforcements; and
- Plain Finish to I.S. EN 13670:2009.

7.1.2.2 Grade Concrete

Concrete supplied for the grading of the exposed surface beneath the concrete bunds (if required) shall conform to the requirements of I.S. EN 206-1 and shall comply with the specification and design drawings:

Lean Mix, Minimum Strength Class: C12 / 15.

7.1.2.3 Reinforcement

Steel reinforcement supplied shall comply with BS EN 4449, shall be cut and bent in compliance with BS 8666:2005 and shall be obtained from a firm holding a valid CARES (or fully equivalent scheme) certificate of approval for the production and supply of steel reinforcement.

7.1.3 Mechanical, Electrical and Water Services

The Gas Cleaning System requires the following services:

- **Electricity:** This requires 60 kW, 3 phase 400 v power supply which will be supplied through existing site electrical distribution system;
- **Compressed Air:** This requires compressed air for the operation of the valves. This will be supplied through the existing site compressed air system;
- **Water:** Water will be supplied through on site and delivered through a softener system supplied as part of the OEM installation;
- **Sodium Hydroxide Solution:** is required to maintain a pH level in the bioreactor. This will be supplied by a licensed chemical contractor and delivered to the Sodium hydroxide storage tanks in the bunded area; and
- **Emergency Showers (2 No.)** shall located in the vicinity of the Gas Cleaning System Bund and the Sodium Hydroxide Solution Bund and will also require water and electrical supply.

8.0 OPERATION OF THE GAS CLEANING SYSTEM

The system is a continuous automated process which will be expected to operate 24 hours per day and 7 days per week. Operations will be controlled by a SCADA system. Alarms will be monitored remotely by both Starrus and the OEM. In the event of a fault, the system can be quickly bypassed by means of an automatic bypass valve on the gas inlet. This automatic bypass will allow for the landfill gas to be diverted directly to the gas flare, as per current operations at the compound.

The proposed new Gas Cleaning system is positioned to operate between the gas booster and the gas engines. This will not impact the existing operation of the gas flare.

The OEM will provide relevant training to staff involved in the daily running of the Gas Compound.

9.0 MAINTENANCE

The OEM during the initial maintenance period will continuously monitor the performance of the system.

Real-time analysis, alarm monitoring and performance reporting will be delivered consistently through to site staff. OEM staff will inspect the proposed system bi-monthly for the proposed initial maintenance programme.

Daily, weekly and annual maintenance checks are required to ensure continued successful operation of the gas cleaning system. These procedures will be provided as part of the OEM maintenance documentation and will be integrated into the existing Starrus preventative maintenance system. Training will be provided for the site technicians during the commissioning and handover phases. After the handover phase continuous remote support will be provided by the OEM for the initial period of operation. Maintenance check sheets will be retained for inspection as required similar to the maintenance management of the gas engines.

10.0 TELEMETRY SYSTEM

One room within the administration building is dedicated to a supervisory control and data acquisition (SCADA) system. The SCADA system manages all electronic data arising on site. The system also exercises control over certain elements of the site such as:

- Leachate pumps;
- Storm water pumps;
- Storm water control valves;
- Traffic management barriers etc.;
- CCTV; and
- Internal and external alarms.

Data logged includes information from:

- The weather station;
- Level sensors in all tanks and lagoons;
- Continuous monitors (both environmental and safety);
- The weighbridge computer;
- Electrical power usage;

- Active landfill gas management system (flare); and
- Run/overload status on all motors.

The SCADA system is equipped with an internal backup system that transmits all data off site on a daily basis.

The SCADA system will be updated where applicable to consider new elements added to support the monitoring of the Gas Cleaning System.

11.0 WORKS PROGRAM

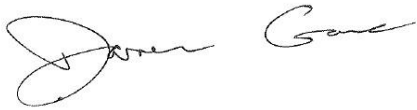
The Works program for the installation and testing of the GAS Cleaning System is scheduled to commence in November 2019 and is due for completion by end of March 2020.

12.0 REFERENCES

- 1) Waste Licence Register Number W0146-02 (as amended November 2016).
- 2) Section 76A (11) Amendment to Industrial Emissions Licence, December 2013.
- 3) IPC Guidance Note, Guidance Note on Storage and Transfer of Materials for Scheduled Activities, EPA 2004.
- 4) BREF (07.2006) Emissions from Storage, EC, July 2006.
- 5) BS EN 1992-1: 2004 + A1: 2014: Eurocode 2: Design of concrete structures. General rules and rules for buildings.
- 6) BS EN 1992-3: 2006: (Eurocode 2) Design of concrete structures. Liquid retaining and containment structures.
- 7) CIRIA C736 (2014): Containment systems for the prevention of pollution. Secondary, tertiary and other measures for industrial and commercial premises.
- 8) German WGK, Classification of Substances Hazardous to Waters in Water Hazard Classes, 1999.
- 9) Transport Infrastructure Ireland: Specification for Road Works Series 600 – Earthworks.
- 10) National Standards Authority of Ireland: IS EN 206:2013 Concrete - specification, performance, production and conformity (+A1:2016).
- 11) BS 4449: 2005 + A3: 2016: Steel for the reinforcement of concrete.

Signature Page

Golder Associates Ireland Limited



Darren Crowe
Engineer



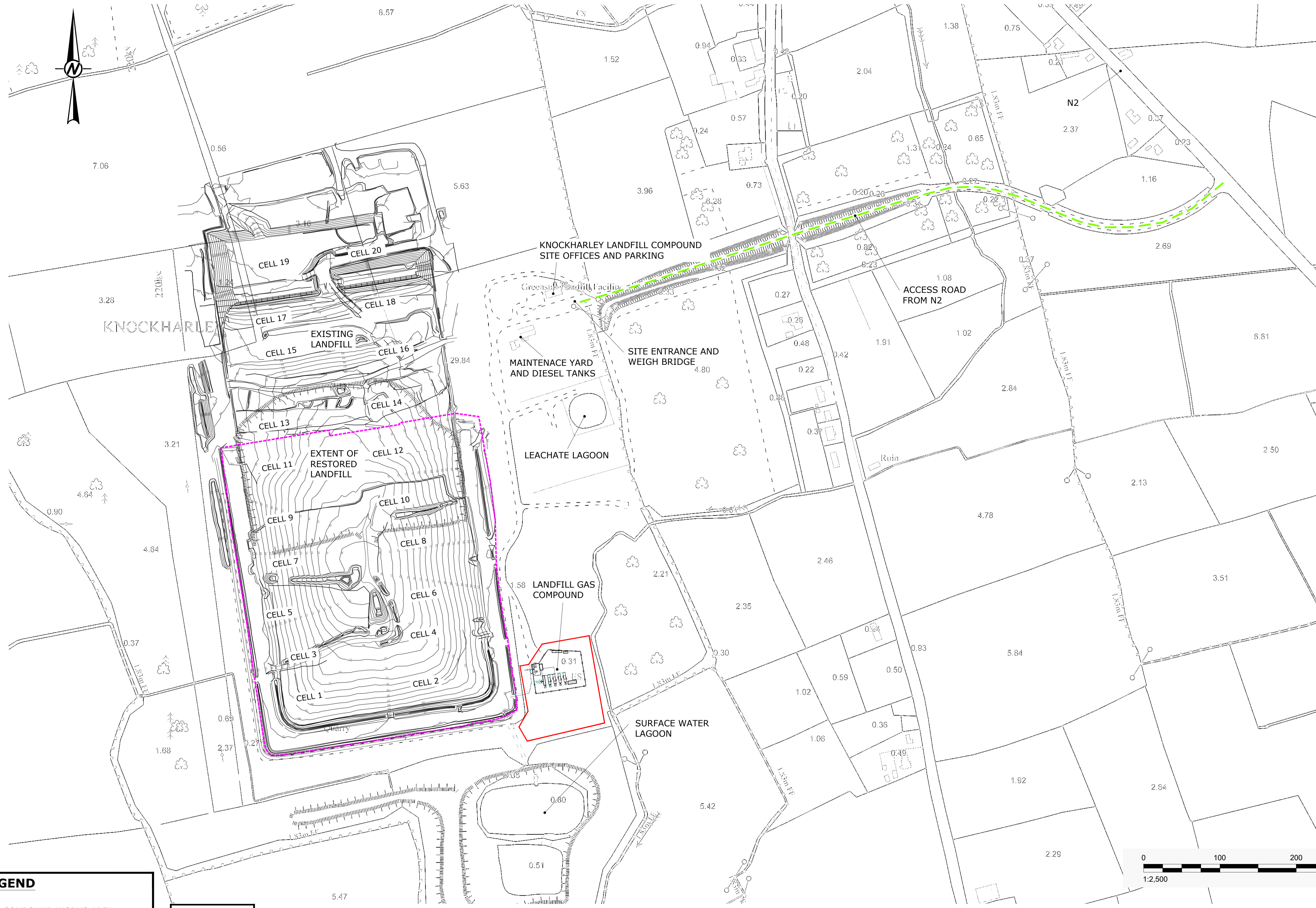
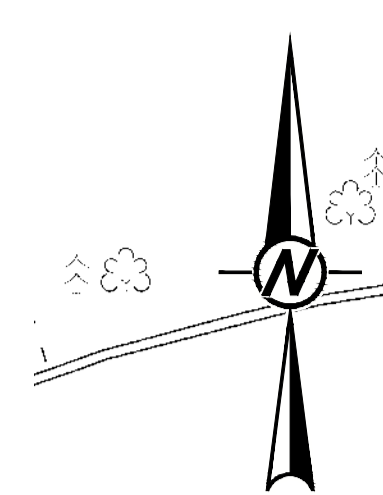
Brian Keenan
Associate

DC/BK/es

Date: 8 October 2019

VAT No.: 8297875W

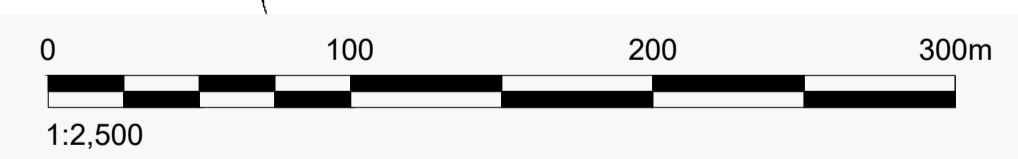
APPENDIX A
Drawings



LEGEND

- GAS COMPOUND WORKS AREA
- RESTORED LANDFILL
- ACCESS ROAD FROM N2
- EXISTING GROUND CONTOUR (MOD)
- FENCING
- GAS LEACHATE LINES

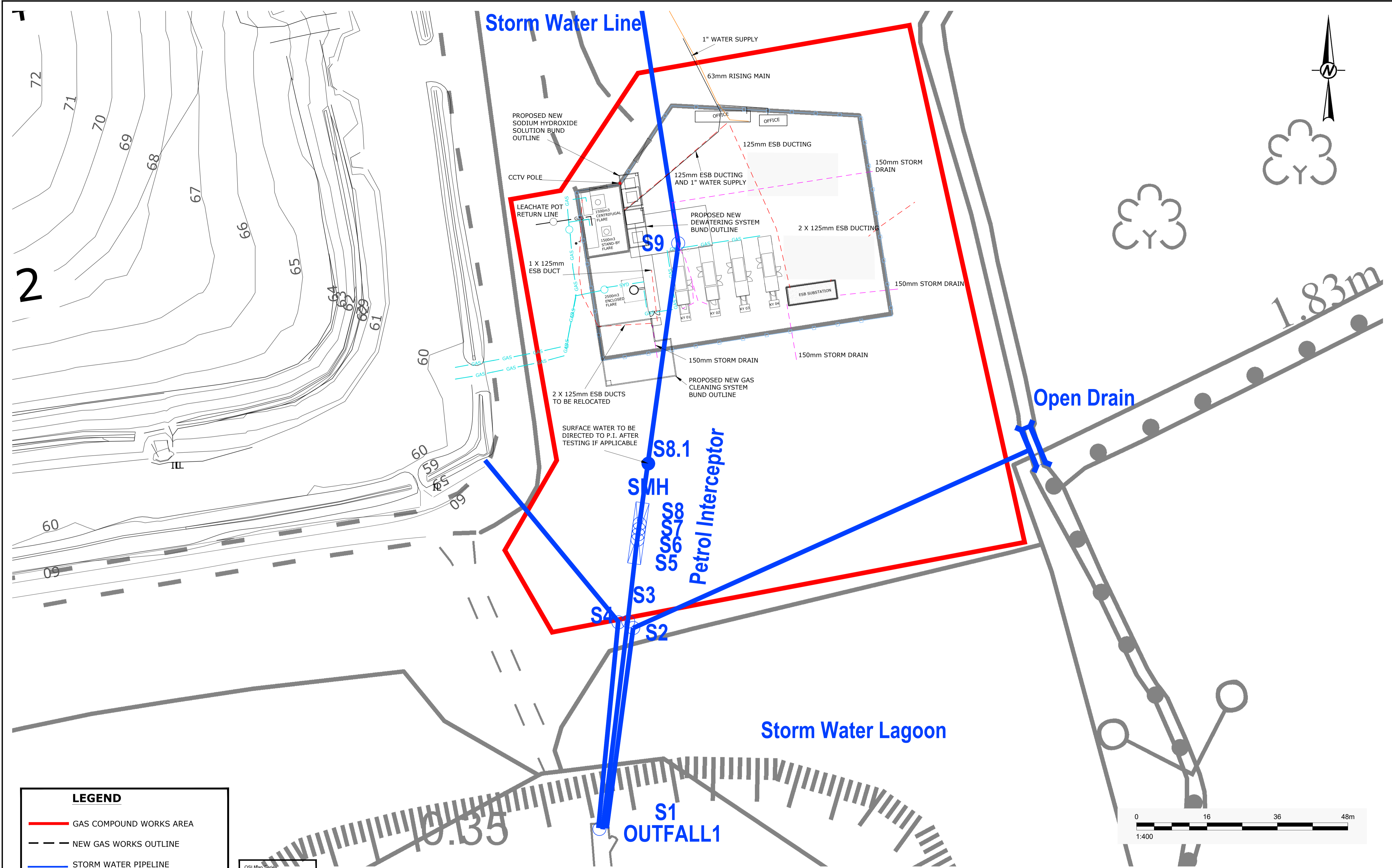
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 2509
 REVISION DATE = 14-Nov-2011
 SURVEY DATE = 31-Jul-2000
 ITM Centre Point Co-ordinate:
 X,Y = 697672,767184



CLIENT			PROJECT		
KNOCKHARLEY LANDFILL LTD.			SEW - KNOCKHARLEY LANDFILL GAS CLEANING PROJECT		
CONSULTANT			TITLE		
GOLDER			SITE LOCATION PLAN & EXISTING CONDITIONS		
YYYY-MM-DD	2019-Sep-27	PROJECT No.	19129656	DRAWING No.	01
PREPARED	DC	Rev.	A	SCALE	1:2500 A1
DESIGN	DC				
REVIEW	BK				
APPROVED	PC				

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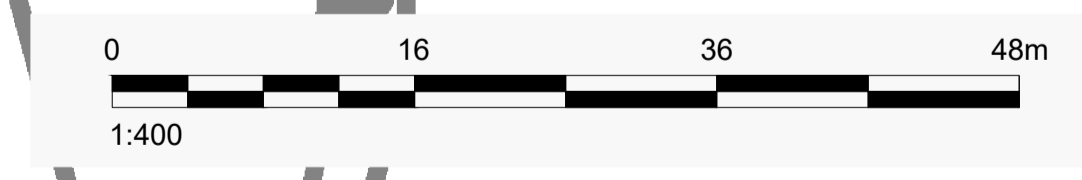
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A1



LEGEND

- GAS COMPOUND WORKS AREA
- - - NEW GAS WORKS OUTLINE
- STORM WATER PIPELINE
- - - STORM DRAINS
- - - ESB DUCTING
- WATER SUPPLY
- FENCING
- - - GAS LEACHATE LINES

OSI Map Series:
 1:5000
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 REVISION DATE = 14-Nov-2011
 SURVEY DATE = 31-Jul-2000
 ITM Centre Point Co-ordinate:
 X,Y = 697672,767184

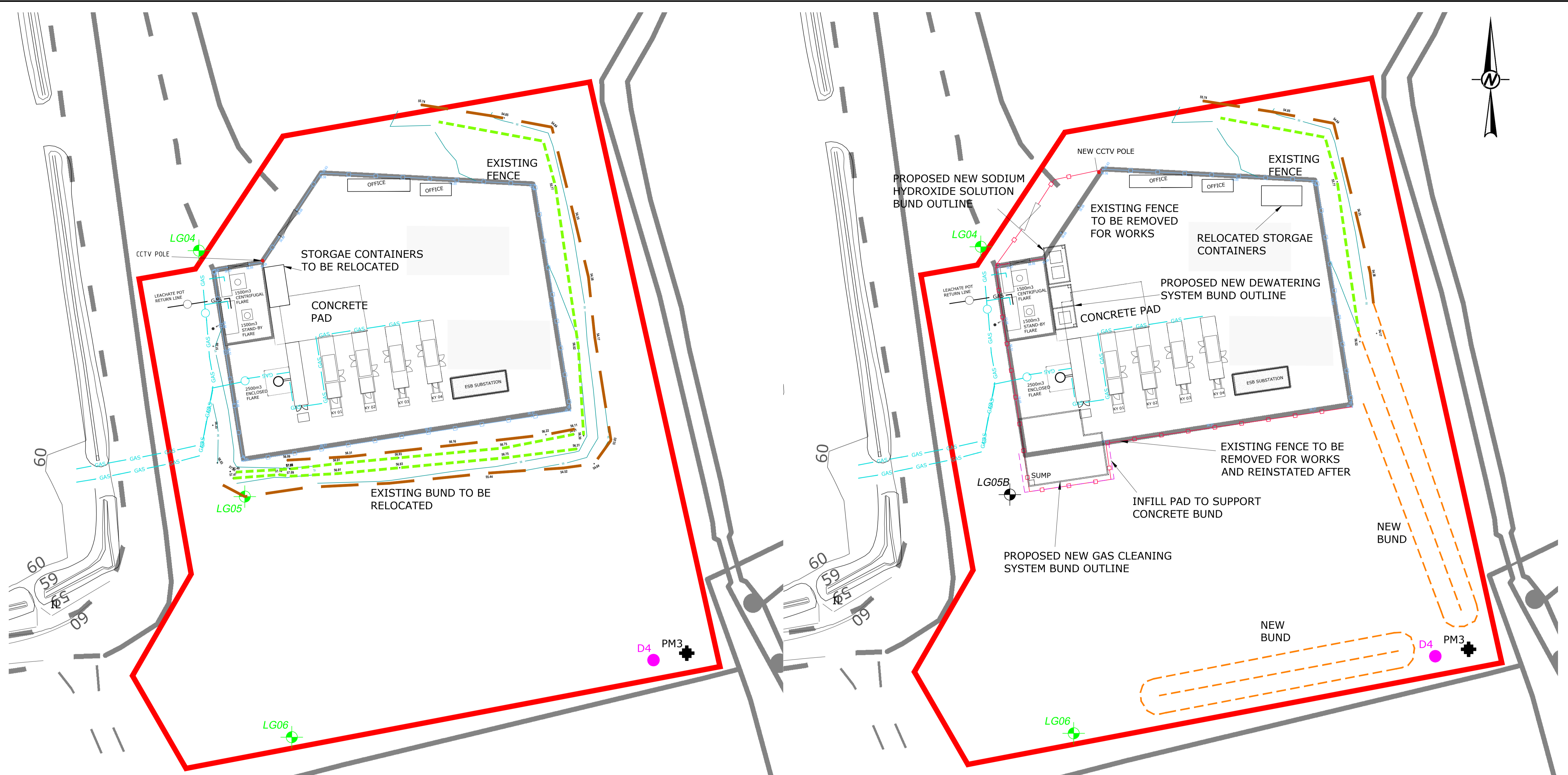
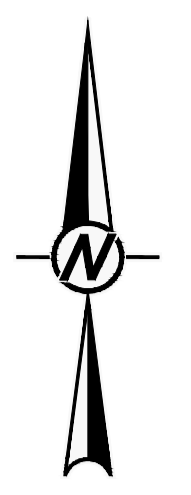


CLIENT	KNOCKHARLEY LANDFILL LTD.		PROJECT	SEW - KNOCKHARLEY LANDFILL GAS CLEANING PROJECT	
CONSULTANT	YYYY-MM-DD	2019-Sep-27	TITLE	GAS COMPOUND - SERVICES LAYOUT	
	PREPARED	DC	PROJECT No.	DRAWING No.	Rev.
	DESIGN	DC	19129656	02	A
	REVIEW	BK			SCALE
	APPROVED	PC			1:400 A1



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IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ISO A1



LEGEND	
[Red solid line]	GAS COMPOUND WORKS AREA
[Black dashed line]	NEW GAS WORKS OUTLINE
[Green dashed line]	TOP OF BUND
[Brown dashed line]	BOTTOM OF BUND
[Orange dashed line]	NEW BUND
[Blue line with circles]	FENCING
[Red dashed line with circles]	FENCING TO BE REMOVED FOR WORKS
[Blue line with circles]	GAS LEACHATE LINES
[Green circle with cross]	EXISTING GAS WELLS
[Black circle with cross]	RELOCATED GAS WELL
[Pink circle]	DUST JAR
[Black square with cross]	AIR MONIOTRING
[Blue line]	CONTOUR

GAS COMPOUND EXISTING CONDITIONS

GAS COMPOUND WHEN PROPOSED WORKS COMPLETE

OSI Map Series:
1:5000
2509
REVISION DATE = 14-Nov-2011
SURVEY DATE = 31-Jul-2000
ITM Centre Point Co-ordinate:
X,Y = 697672,767184

- NOTES: CIVIL CHANGES**
- 1)RELOCATED CCTV POLE.
 - 2)RELOCATED STORAGE CONTAINERS.
 - 3)REMOVE AND REINSTATE SECURITY FENCE.
 - 4)RELOCATE GAS MONITORING WELL.
 - 5)RELOCATE SCREENING BUND.
 - 6)CONSTRUCTE INFILL PAD TO SUPPORT CONCRETE BUND.

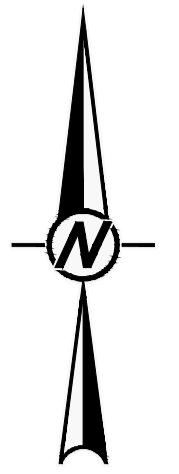
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CONSULTANT	YYYY-MM-DD	2019-Sep-27
	PREPARED	DC
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	REVIEW	BK
	APPROVED	PC



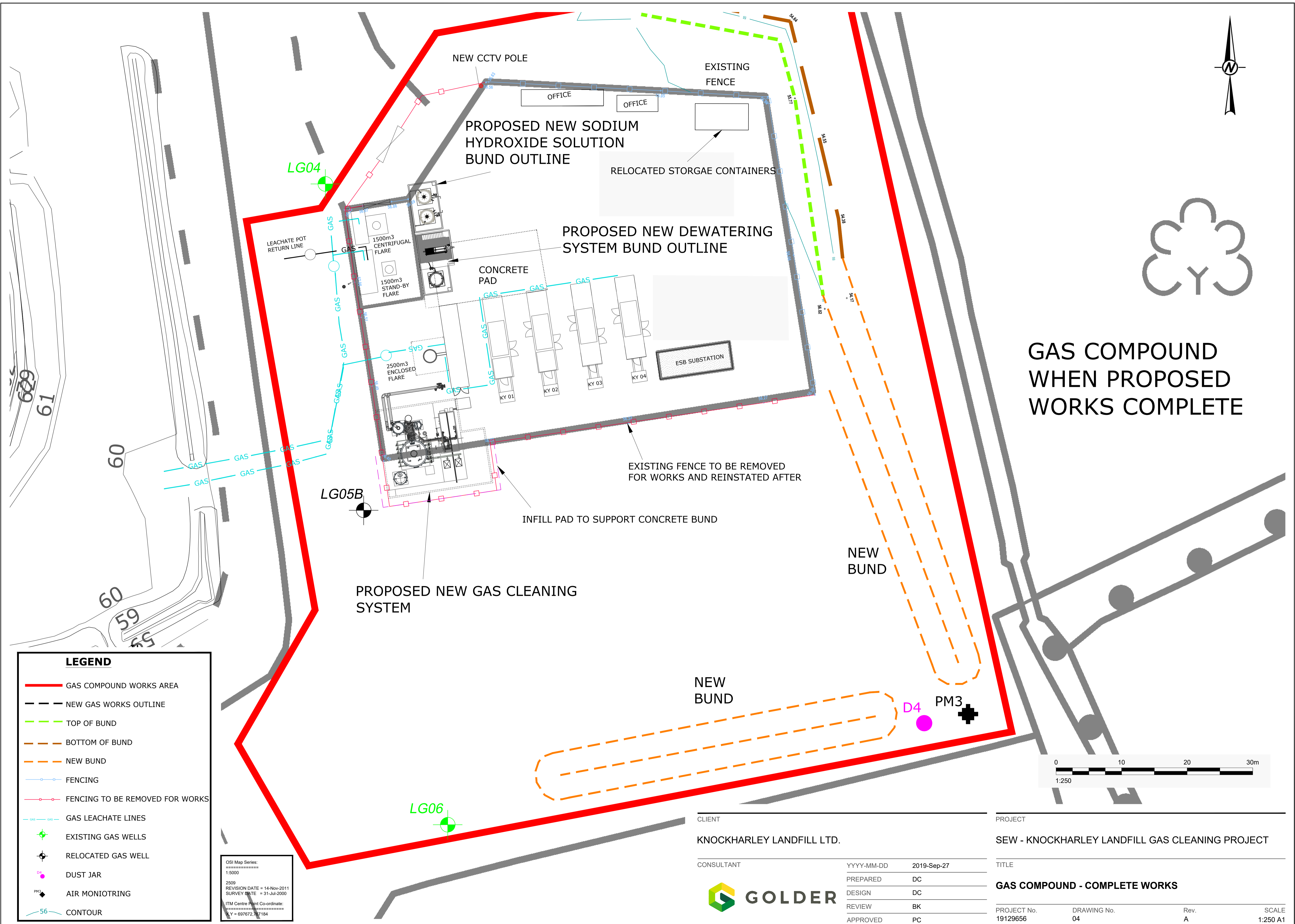
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TITLE	GAS COMPOUND - CIVIL WORKS		
PROJECT No.	DRAWING No.	Rev.	SCALE
19129656	03	A	1:400 A1

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GAS COMPOUND WHEN PROPOSED WORKS COMPLETE

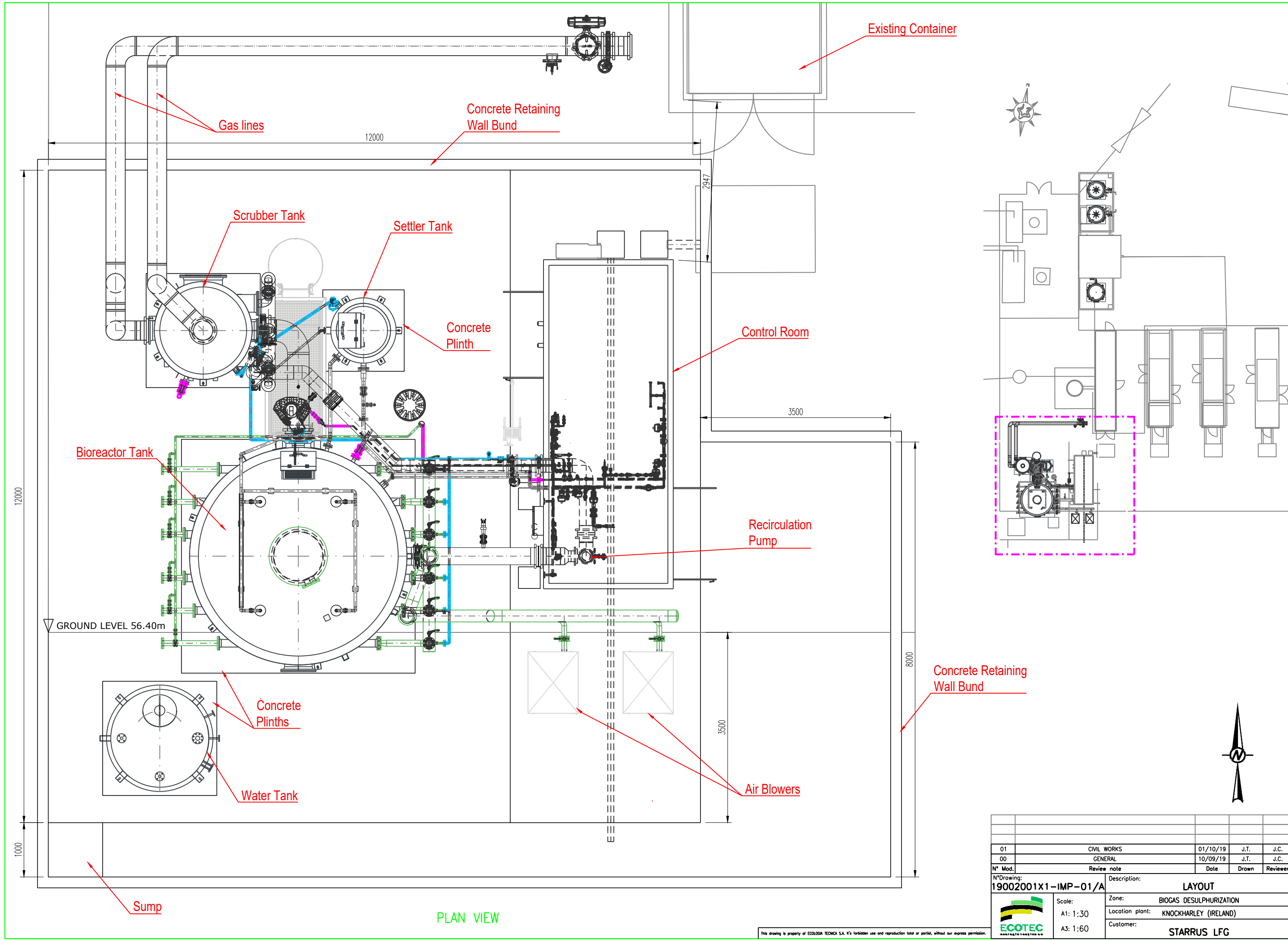


LEGEND

- GAS COMPOUND WORKS AREA
- NEW GAS WORKS OUTLINE
- TOP OF BUND
- BOTTOM OF BUND
- NEW BUND
- FENCING
- FENCING TO BE REMOVED FOR WORKS
- GAS LEACHATE LINES
- EXISTING GAS WELLS
- + RELOCATED GAS WELL
- DUST JAR
- + AIR MONIOTRING
- 56 CONTOUR

OSI Map Series:
 1:5000
 2509
 REVISION DATE = 14-Nov-2011
 SURVEY DATE = 31-Jul-2000
 ITM Centre Point Co-ordinate:
 X Y = 697672, 787184

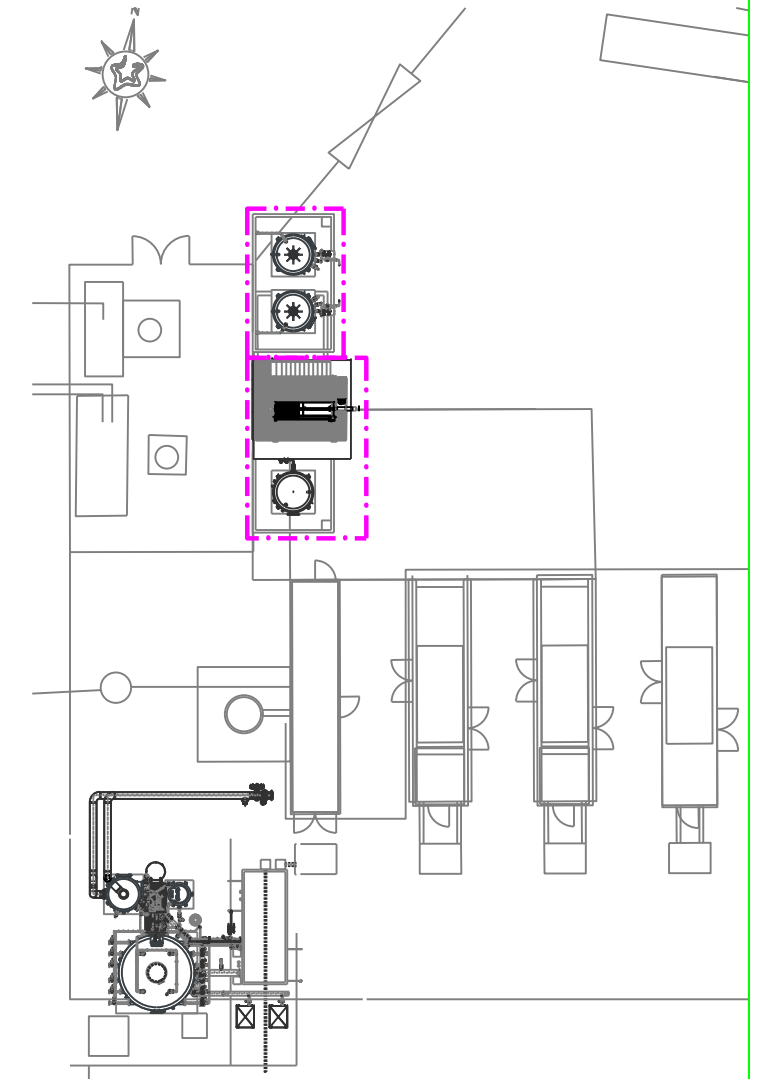
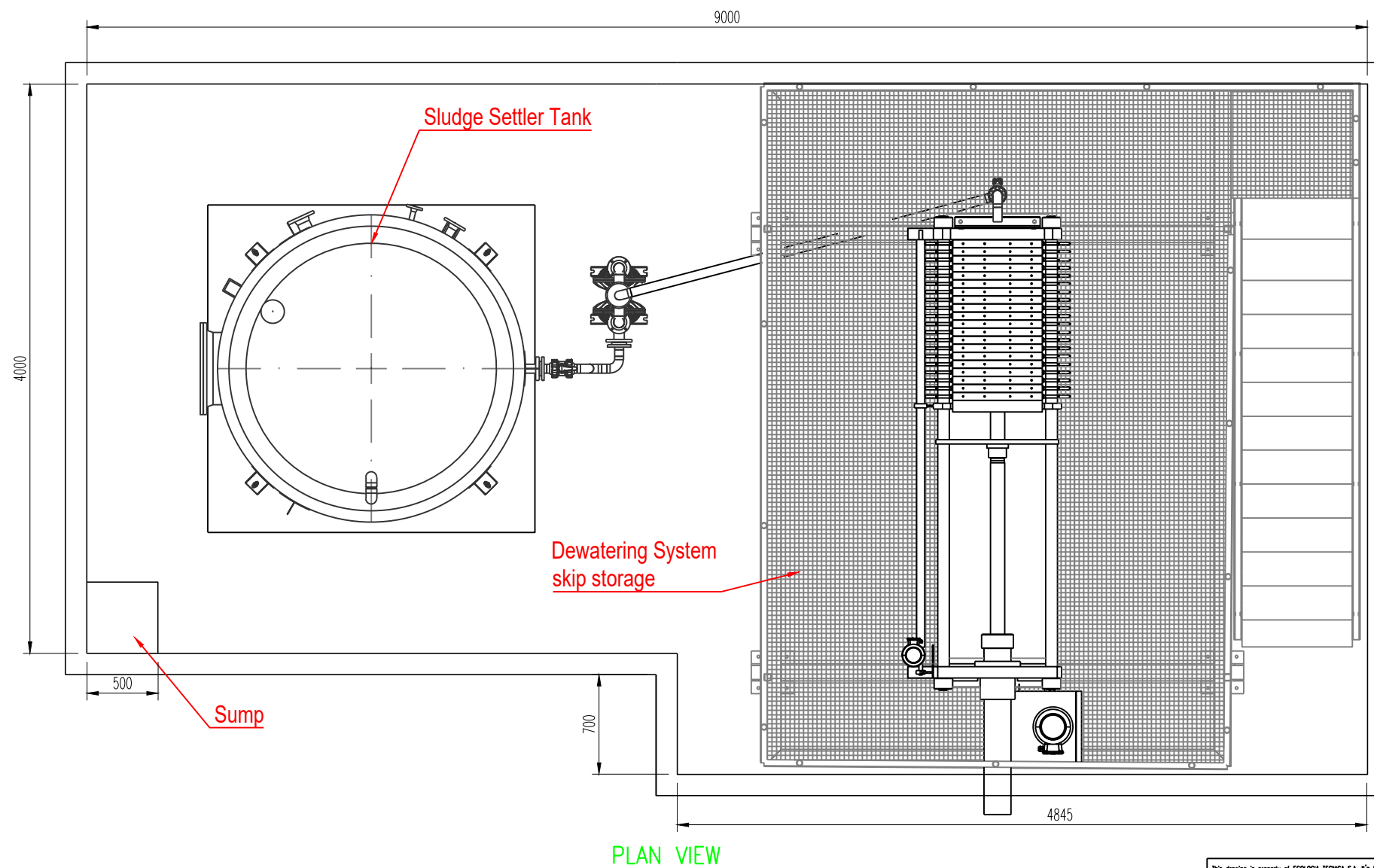
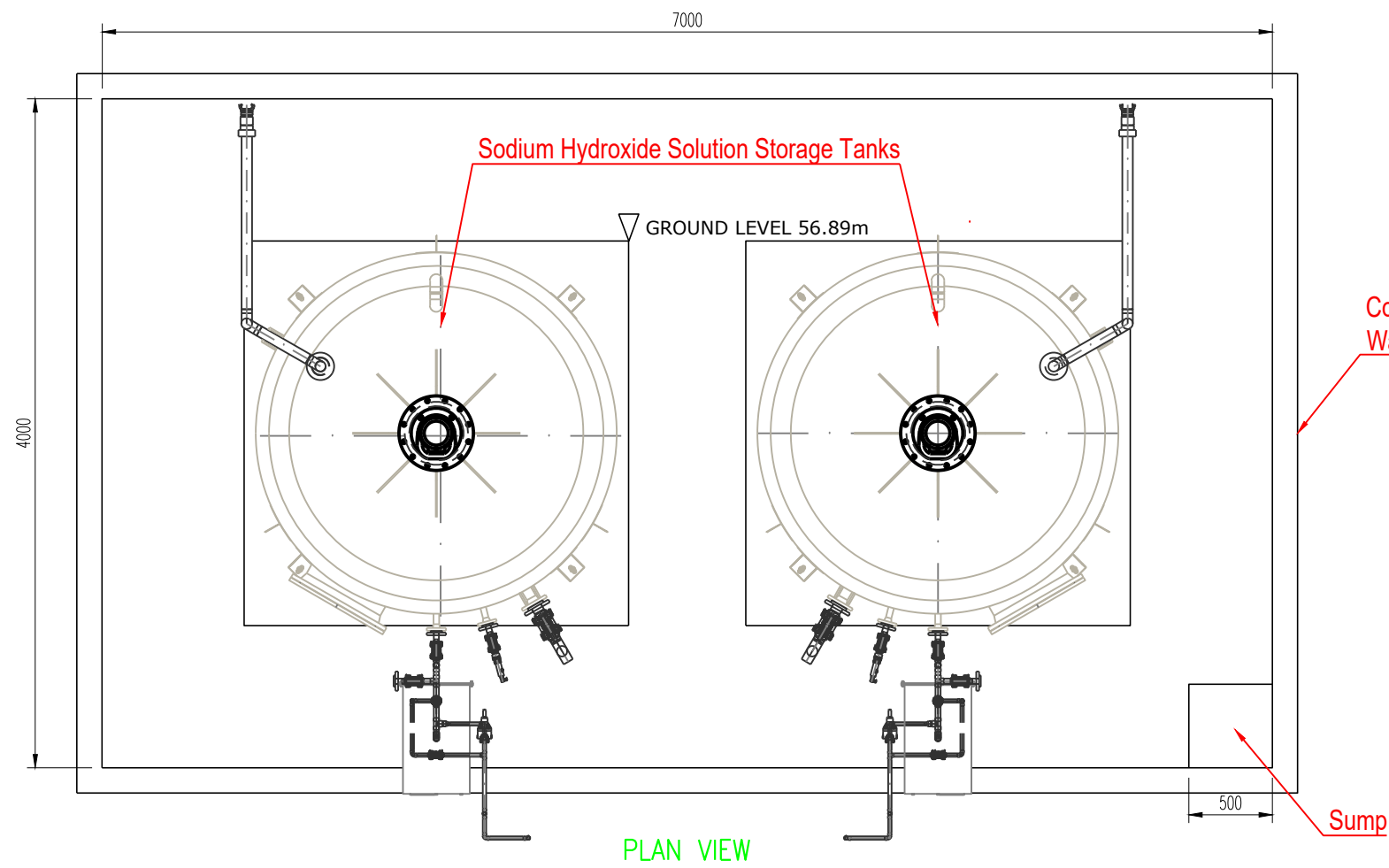
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CONSULTANT	GOLDER		TITLE	GAS COMPOUND - COMPLETE WORKS	
	YYYY-MM-DD	2019-Sep-27	PROJECT No.	19129656	DRAWING No.
	PREPARED	DC	04	Rev.	A
	DESIGN	DC	SCALE	1:250 A1	
	REVIEW	BK			
	APPROVED	PC			



PLAN VIEW

01	CIVIL WORKS	01/10/19	J.T.	J.C.
00	GENERAL	10/09/19	J.T.	J.C.
N° Mod.	Review note	Date	Drawn	Reviewer
N°Drawing: 19002001X1-IMP-01/A		Description: LAYOUT		
Scale: A1: 1:30 A3: 1:60		Zone: BIOGAS DESULPHURIZATION		
ECOTEC		Location plant: KNOCKHARLEY (IRELAND)		
		Customer: STARRUS LFG		

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N° Mod.	Review note	Date	Drawn	Reviewer
01	GENERAL	01/10/19	J.T.	J.C.
00	GENERAL	10/09/19	J.T.	J.C.

N° Drawing: 19002001X1-IMP-01/B

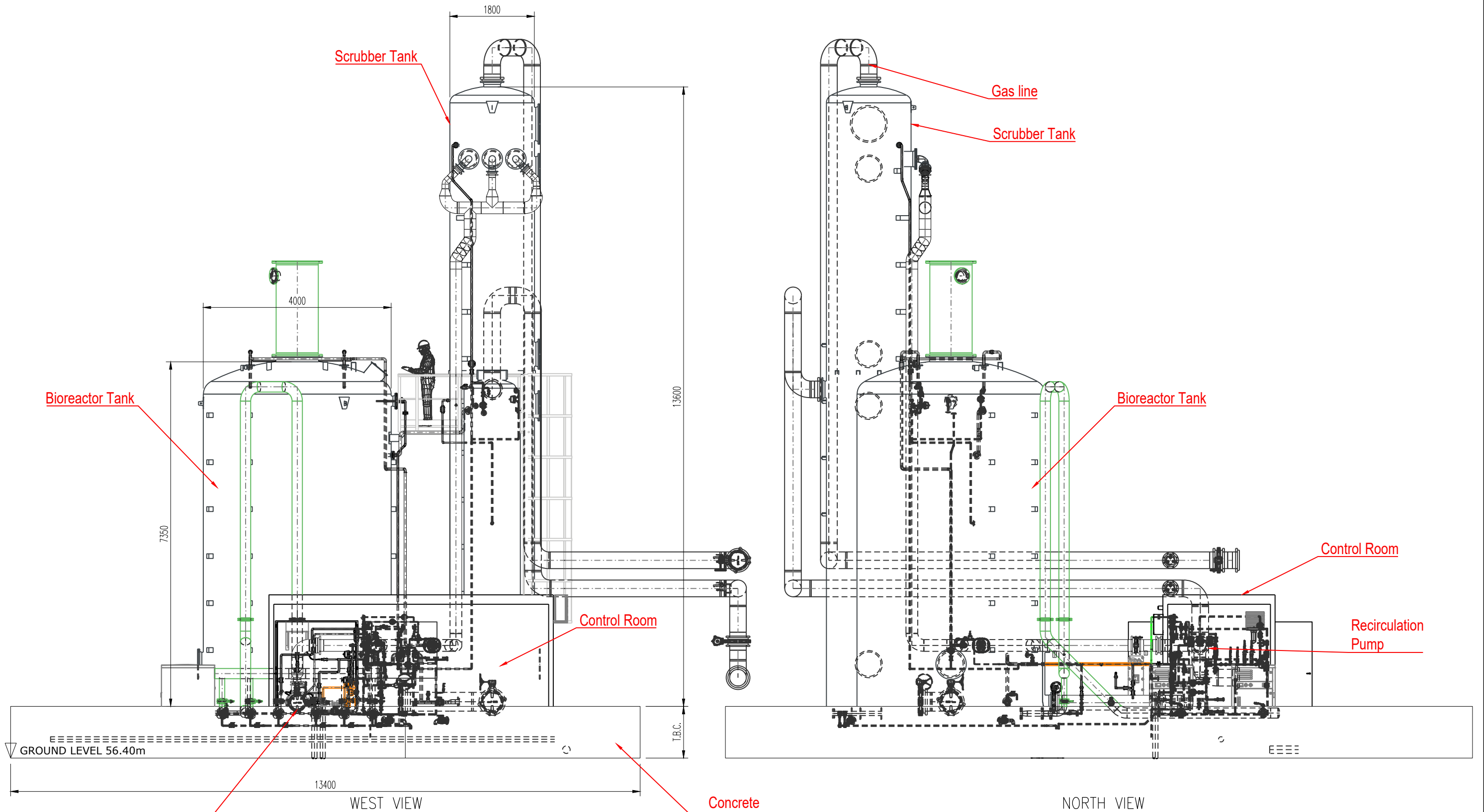
Description: LAYOUT

Scale: A1: 1:20, A3: 1:40

Zone: BIOGAS DESULPHURIZATION

Location plant: KNOCKHARLEY (IRELAND)

Customer: STARRUS LFG



01	CIVIL WORKS	01/10/19	J.T.	J.C.
00	GENERAL	10/09/19	J.T.	J.C.
N° Mod.	Review note	Date	Drawn	Reviewer
N°Drawing: 19002001X1-IMP-02/A		Description: VIEWS		
Zone: BIOGAS DESULPHURIZATION		Location plant: KNOCKHARLEY (IRELAND)		
Customer: STARRUS LFG		Scale: A1: 1:40 A3: 1:80		

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Sludge Settler Tank

Dewatering System

Skip Storage

Sodium Hydroxide Solution Storage Tanks

Concrete Retaining Wall Bund

400

2900

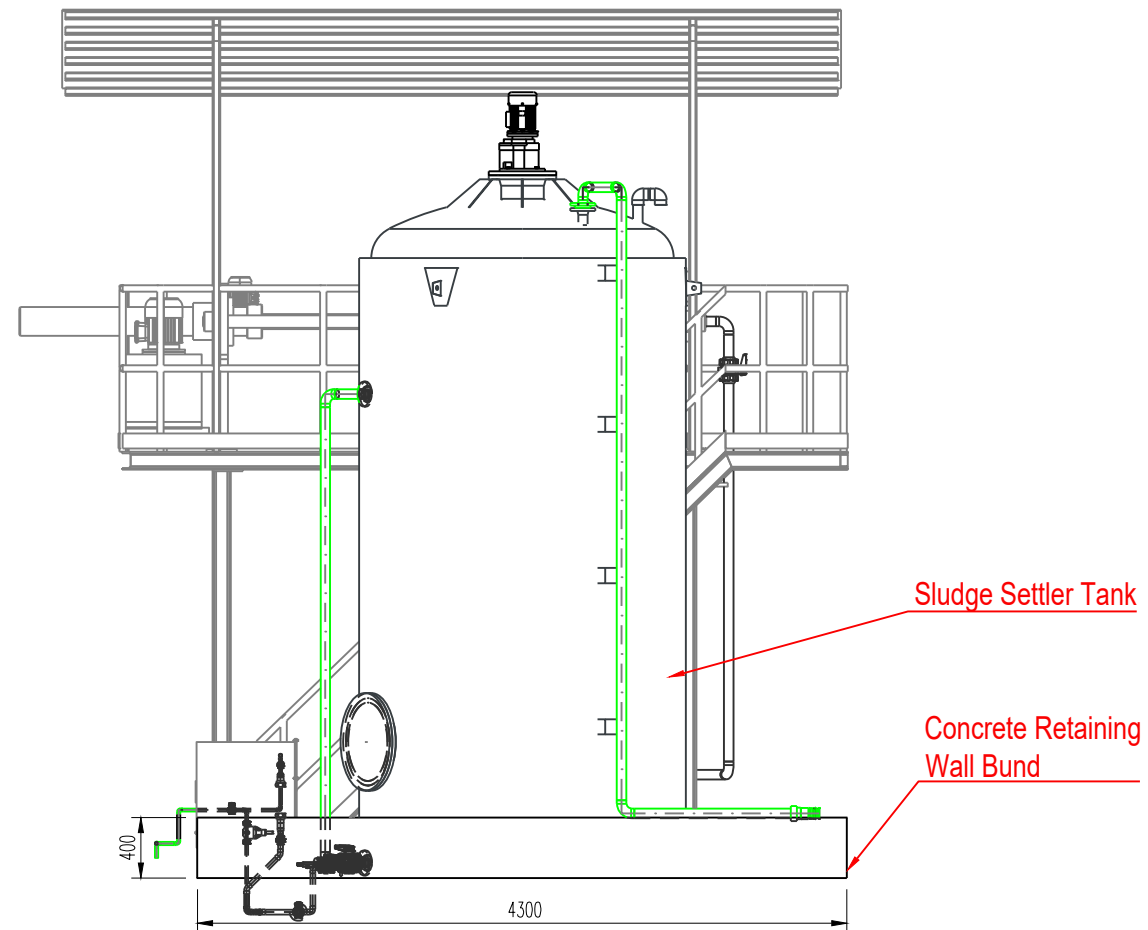
9000

GROUND LEVEL 56.89m

7300

4200

WEST VIEW



SOUTH VIEW

N° Mod.	Review note	Date	Drawn	Reviewer
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00	GENERAL	10/09/19	J.T.	J.C.

N° Drawing: 19002001X1-IMP-02/C

Description: VIEWS

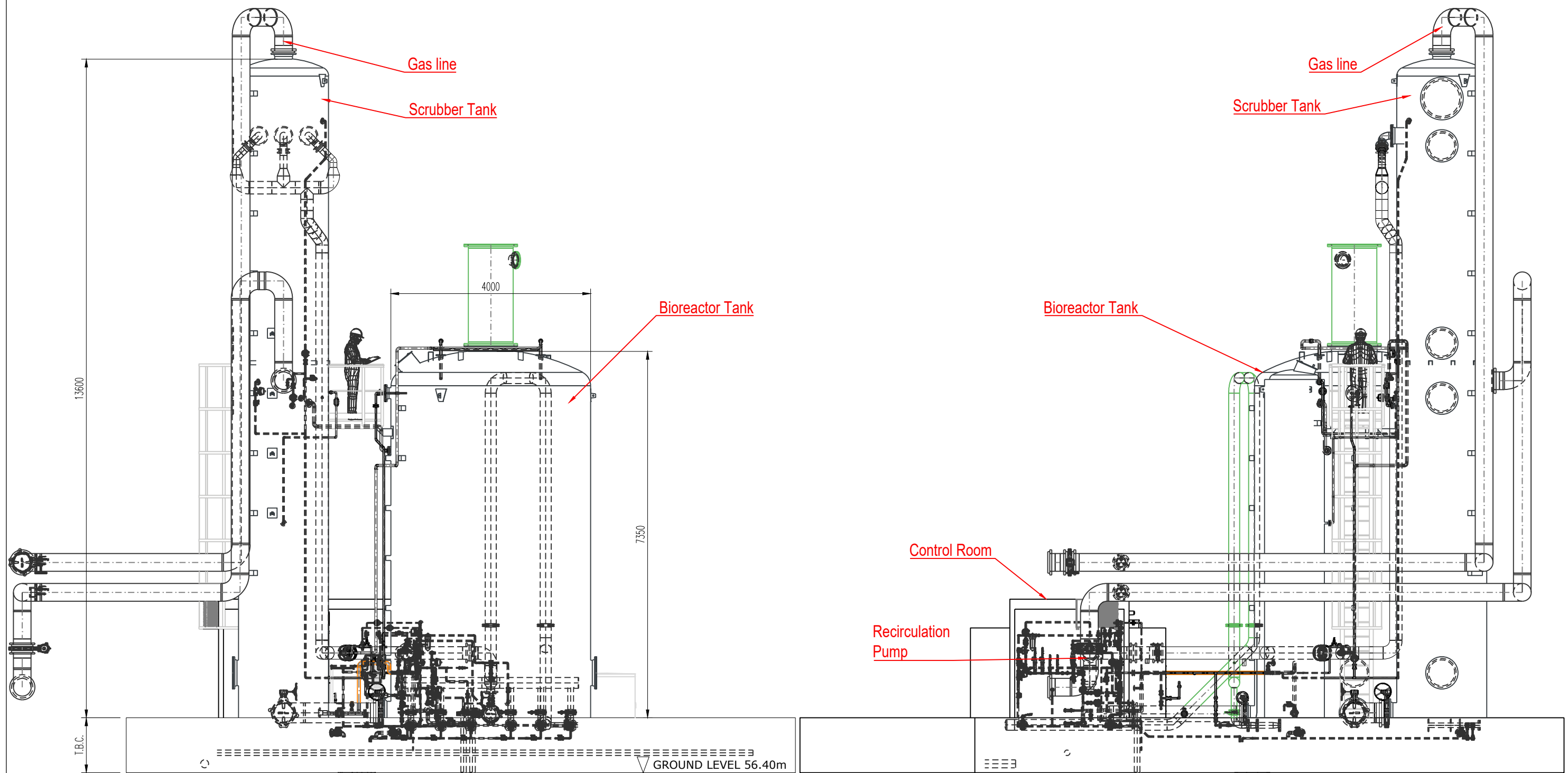
Zone: BIOGAS DESULPHURIZATION

Location plant: KNOCKHARLEY (IRELAND)

Customer: STARRUS LFG


Scale: A1: 1:25
A3: 1:50



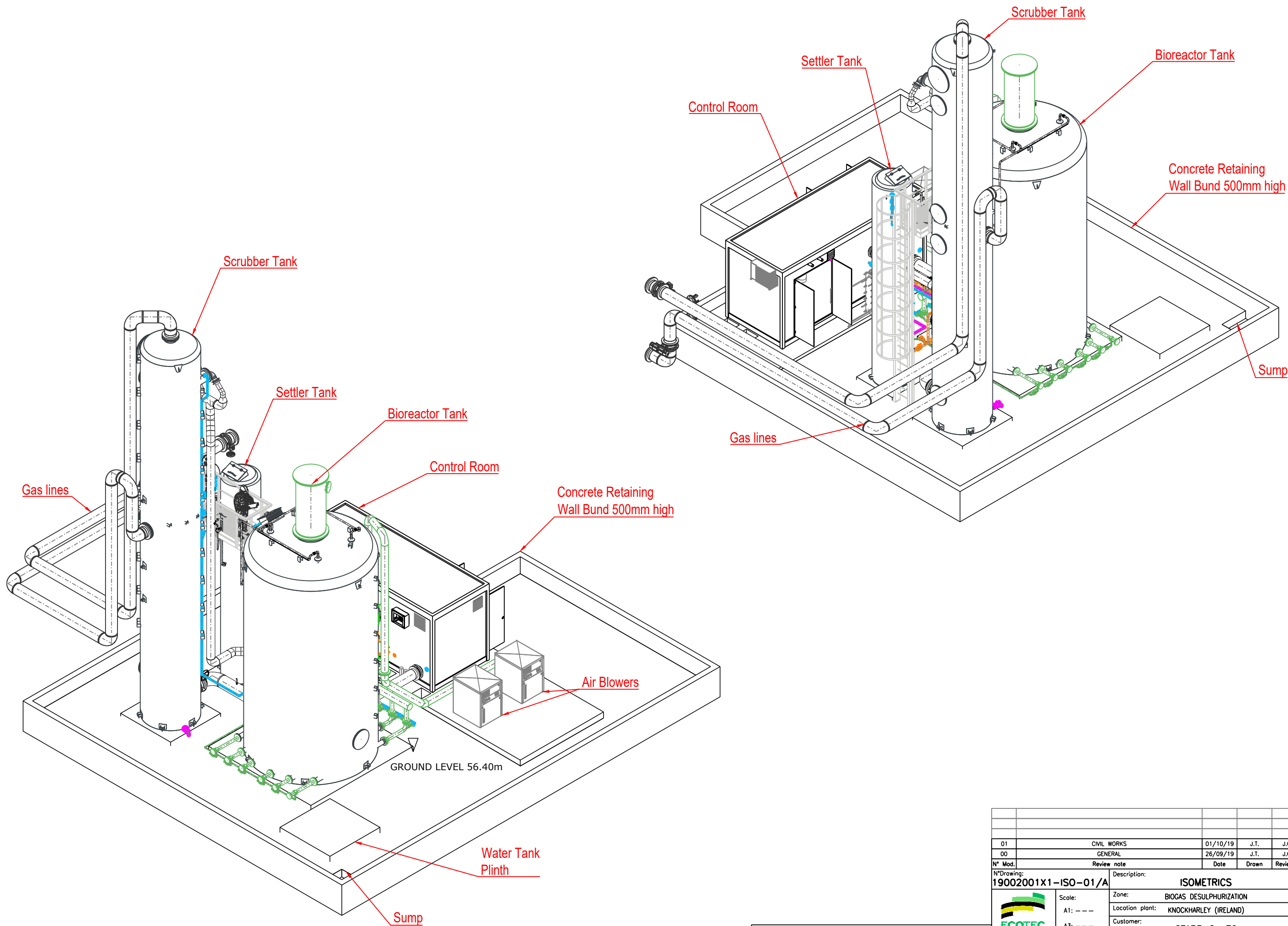


EAST VIEW

SOUTH VIEW

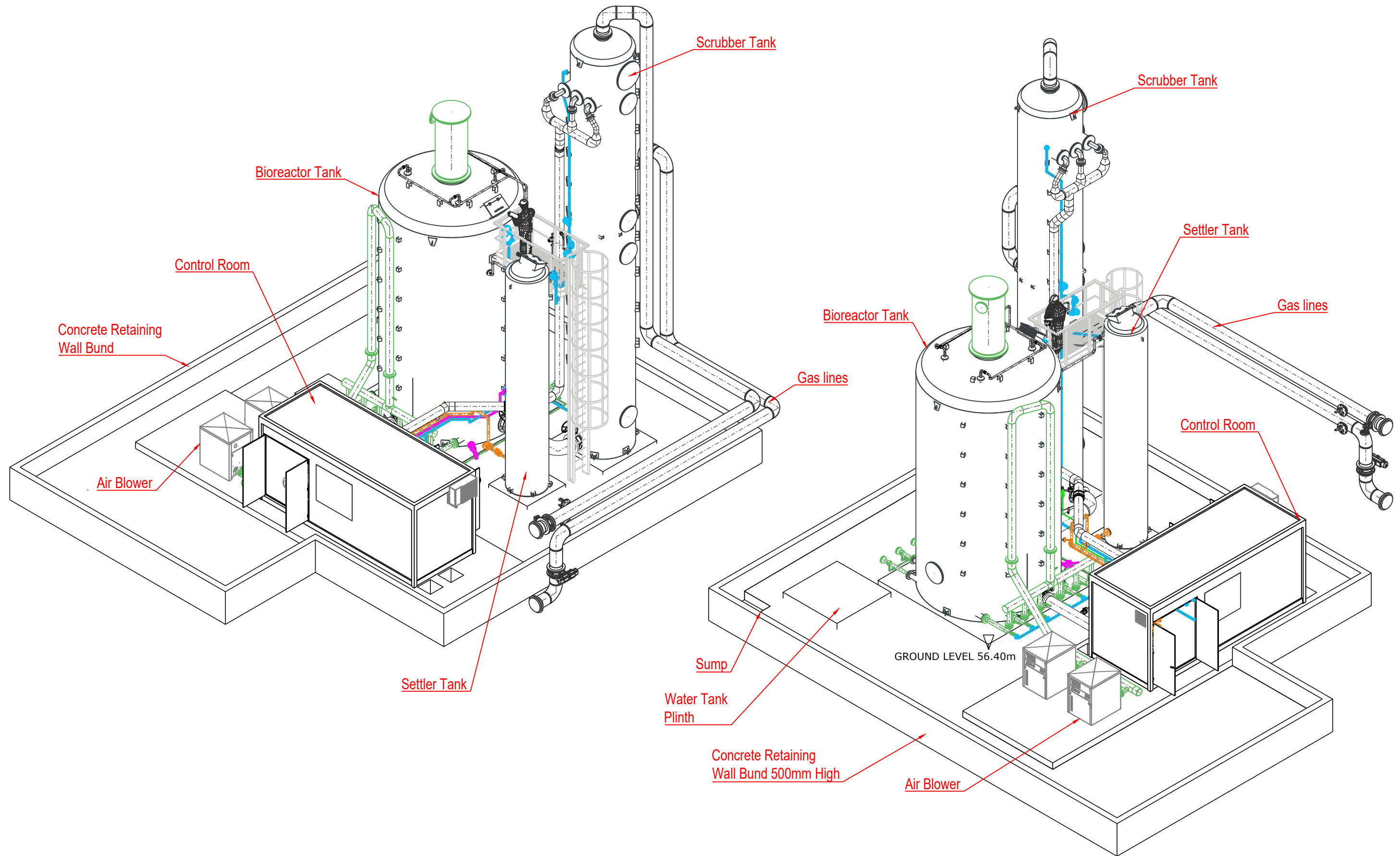
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00	GENERAL	10/09/19	J.T.	J.C.
N° Mod.	Review note	Date	Drawn	Reviewer
N° Drawing: 19002001X1-IMP-02/B		Description: VIEWS		
		Scale:	Zone: BIOGAS DESULPHURIZATION	
		A1: 1:40	Location plant: KNOCKHARLEY (IRELAND)	
		A3: 1:80	Customer: STARRUS LFG	

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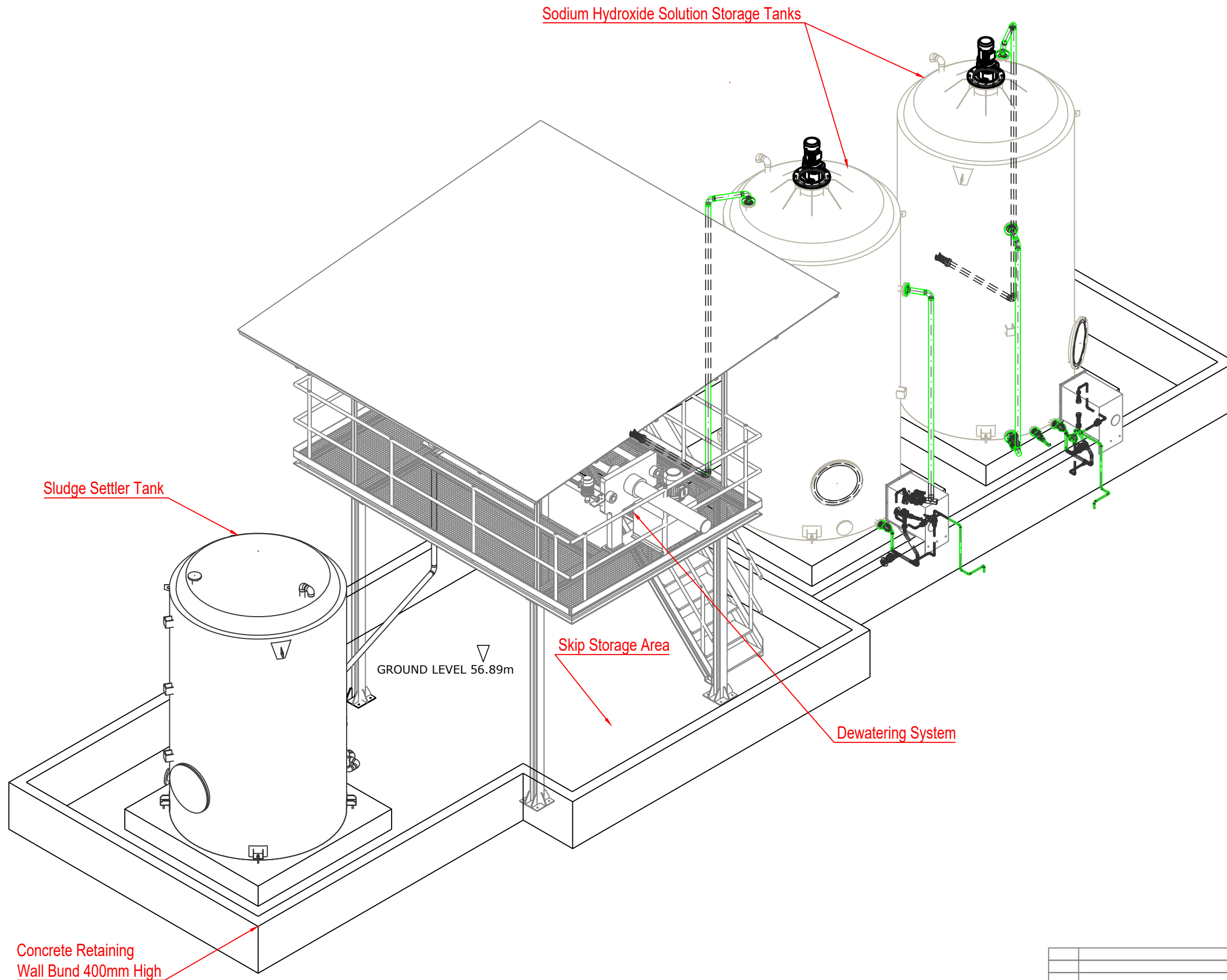
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00	GENERAL	26/09/19	J.T.	J.C.
N° Mod.	Review note	Date	Drawn	Reviewer
N° Drawing: 19002001X1-ISO-01/A		Description: ISOMETRICS		
Scale: A1: --- A3: ---		Zone: BIOGAS DESULPHURIZATION		
ECOTEC		Location plant: KNOCKHARLEY (IRELAND)		
		Customer: STARRUS LFG		

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01	CIVIL WORKS	01/10/19	J.T.	J.C.
00	GENERAL	26/09/19	J.T.	J.C.
N° Mod.	Review note	Date	Drawn	Reviewer
N° Drawing: 19002001X1-ISO-01/B		Description: ISOMETRICS		
Scale: A1: --- A3: ---		Zone: BIOGAS DESULPHURIZATION		
ECOTEC		Location plant: KNOCKHARLEY (IRELAND)		
		Customer: STARRUS LFG		

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N° Mod.	Review note	Date	Drawn	Reviewer
01	GENERAL	01/10/19	J.T.	J.C.
00	GENERAL	26/09/19	J.T.	J.C.
N° Drawing: 19002001X1-ISO-01/C		Description: ISOMETRICS		
Scale: A1: --- A3: ---		Zone: BIOGAS DESULPHURIZATION		
ECOTEC		Location plant: KNOCKHARLEY (IRELAND)		
This drawing is property of ECOLOGIA TECNICA S.A. It's forbidden use and reproduction total or partial, without our express permission.		Customer: STARRUS LFG		

APPENDIX B

**Gas Cleaning System
Specification**



BIOGAS DESULFURIZATION INSTALLATION BY MEANS OF A BIOSCRUBBER SYSTEM DBIOX-H2S-18



AGB LANDFILLS

Att. Mr Damien Holmes

S/Ref.: Ireland

N/Ref.: 19002001X rev3 (Knockharley)

August 2, 2019

Design specifications

Gases coming from	Biogas
Design flow, Nm ³ /h	2.100
Minimum Flow ,Nm ³ /h	1.000
Maximum Flow , Nm ³ /h	2.100
Outside Temperature, °C	0 < Tº < 30
Gas temperature, °C	15 < Tº < 20
Gas characteristics	H ₂ S
Guaranteed availability of the Desulfurization (%)	98
H ₂ S outlet concentration, ppm	< 100
Concentration of O ₂ that is added in the biogas (ppm)	< 500
Dust concentration, ppm	----
Pressure drop (mbar)	< 30
Design pressure (mbar)	< + 495
NaOH (25 %) consumption (l/h) at maximum flow and maximum H ₂ S concentration	< 55,6
Water consumption (m ³ /d) at maximum flow and maximum H ₂ S concentration	10,1
Sludge purge (m ³ /d) at maximum flow and maximum H ₂ S concentration	9,5
Nutrients consumption (l/d) at maximum flow and maximum H ₂ S concentration	< 14,5
Limit of toxic substances:	<ul style="list-style-type: none"> . Terpenes < 1.000 mg/m³ . Aromatic Hydrocarbons < 500 mg/m³ . Mercaptans < 500 mg/m³ . Ammonia < 200 mg/m³ . 2-butanona < 200 mg/m³ . Phenol < 100 mg/m³

Desulphurization system DBIOX

Hydrogen sulphur removal in energetically usable gases has been traditionally carried out by means of physical-chemical technologies such as adsorption or reactive absorption. Even these technologies provide high efficiencies, the requirements for media replacement (for adsorption) and the

Página 2 de 16

ECOLOGÍA TÉCNICA S.A.

Pol. Ind. Bufalvent C/Estevé Terradas 37ª 08243 MANRESA (Barcelona)

Tel. 93 877 31 33 Fax 93 877 05 58

Web: www.ecotec.es E-mail: ecotec@ecotec.es

consumption of chemical reactives (for absorption systems) increase in most cases the operation costs significantly.

Biological systems, or bioreactors, are one of the new gas treatment technologies supplied by ECOTEC-AERIS. These systems reach equivalent or higher H₂S removal efficiencies than conventional systems by means of microorganisms, at much lower operation costs, since reactive dosing and media replacement requirements are reduced down to almost zero. This fact provides a much faster investment return than in conventional systems.

The working principle of these technologies is based on the metabolism of certain microorganisms, which are capable of using pollutants such as hydrogen sulphur (H₂S) for their growth, removing them from the environment with high efficiency. In biogas desulphurization applications, the desulphurization unit is placed after the digester and the gas blower, and before the energetic use, working at positive and constant pressure.

The system proposed for this specific application is part of the new product range of ECOTEC-AERIS, suitable for the desulphurization of usable gases with H₂S concentrations up to 20.000 ppmv. These systems allow H₂S removal from the stream with efficiencies over 99%, also providing cost reductions down to minimal values (for both reactive and power consumption).

As opposed to traditional biotrickling filters (which are suitable to remove H₂S concentrations in biogas up to 6000-8000 ppmv), bioscrubber has 2 stages. In the first one, a washing column, H₂S content in the biogas is transferred to a watery fase. In the second stage, a bioreactor in liquid phase, H₂S is oxidized to elemental sulphur and a small amount of sulphate and other more oxidized forms of sulphur. So, a small amount of a liquid effluent containing elemental sulphur is generated, which can be applied in other industrial activities.

The washing tower is filled with plastic random material specifically chosen for the application, which provides optimal transference of H₂S to watery phase with virtually no sulphur accumulation, which eliminates the need of routine maintenance of the media and reduces the pressure drop of the material. The liquid medium is feeded counter currently from the bioreactor, and distributed over the media surface by means of one or several non-clogging, wide-irrigation diffusers. At this stage, biogas pressure is carefully controlled, in order to ensure that the pressure drop is kept within correct values. There is no oxygen feeding in the chemical washer, so biogas treated is not diluted and it does not lose any calorific value. The liquid with H₂S is pumped to the reactor afterwards.

In the bioreactor, the mixed culture of microorganisms carries out the partial oxidation of S-2 to SO. At this stage, a small flow of liquid effluent is generated, which enables to keep a constant concentration of dissolved solids inside the bioreactor. The feeding of external air is carefully controlled through different measuring of various analytic sensors in the H₂S-rich feeding water line, which do actuate over a frequency inverter that controls the operation of the air feeding blower. In

order to optimize this feeding, the system has a number of internal diffusers that deliver a very small bubble size at the air inlet, which enables oxygen transference to the liquid phase. This way, in addition to oxygenating the liquid of the bioreactor, water feeding works as an homogenizer thus avoiding existence of anaerobic zones. The fact that there is no contact between biogas and O₂ in none of the two stages eliminates the risk of explosive conditions in the system. The air at bioreactor outlet which does not contain neither H₂S nor other potentially damaging or smelly compounds is vented to the atmosphere through its upper part.

The bioreactor also has control systems for redox potential and pH (pH control is carried out by means of NaOH addition).

On the other hand, biological activity tends to increase temperature inside the bioreactor. That's why the equipment has a cooling system placed in the liquid return pumping line (now H₂S poor and SO₂-rich) to the washing column. This return line also enables liquid excess pouring outwards (process enabled by a level sensor installed in the bioreactor) and control of scum formation in the upper part of the washing column.

Finally, the system incorporates an automated system for nutritive solution dosing. This solution provides all nutrients required for the proper operation of microorganisms. The dosing rate is set up for each case, according to specific operation conditions of the system and the total amount of sulphur supplemented.

Basic equipment

1 **ECOLAV washing columns**, made in Glass reinforced plastics (GRP) , with the following general characteristics:

Model	CRV-18
Diameter, mm	1.800
Total height, mm	14.000

Including the following elements and accessories:

- ECOPALL 1 1/2" media rings in PP.
- Vertical flow drop separator, mesh type, in PP.
- Air inlet nozzle.
- Air outlet nozzle.
- 2 Nozzles for load/unload of the media rings, DN-500.
- 1 Nozzle DN-500 as access to bottom.
- 1 Inlet nozzle for the liquid feeding ramp.
- Ramps with sprayers for liquid distribution in PP.
- "Pigtail" sprayers in PP, with 90º dispersion angle.
- Media support grid, with over 75% of open surface, rectangular framework type.

Including the following nozzles and accessories:

- Access and cleaning nozzle
- Pump aspiration nozzle.
- Reactive feeding nozzle.
- Emptying nozzle.

1 BIOREACTOR , made in Glass reinforced plastics (GRP) with the following general characteristics:

Model	BIO-75
Diameter, mm	4.000
Total height, mm	8.500
Volume, m ³	75
Cover	Conic

Including the following nozzles and accessories:

- Access and cleaning nozzle
- Pump aspiration nozzle, DN-65
- Reactive feeding nozzle, DN-25
- Emptying nozzle, DN-50
- Siphon overflow nozzle
- 2 water inlet nozzles, DN-25

1 Settler, made in Glass reinforced plastics (GRP) , with the following general characteristics:

Model	DEC-10
Diameter, mm	1.000
Total height, mm	6.000

NOTE: Settler will be thermally insulated by polyurethane foam, covered by an external GRP sheet envelope.

1 Recirculation centrifugal pump, horizontal assembly, with the following characteristics:

Model	ETB-200-150-315
Flow, m ³ /h	274
Total head (m.l.c.)	28
Power (Kw)	45
Voltage, V	400/690
Motor protection	IP-55
Motor speed, rpm	1.450
Operation	Continuous
Casing material	Carbon steel
Impeller material	SS316

Including:

- Static and dynamic balancing of the impeller
- Functional tests

1 Tank for NaOH at 25 % with the following characteristics:

Model	EPD-150
Material	GRP
Volume (l)	10.000
Diameter (mm)	2.000
Total height (mm)	3.500
Bottom	Plane
Cover	Klopper
Thickness (mm)	6/8

Including:

- Cleaning nozzle, DN-500
- Dosing pump aspiration nozzle, DN-25
- Emptying nozzle, DN-50
- Loading nozzle, DN-50
- Aeration nozzle, DN-50
- Level indicator, visual type, with transparent pipe
- Level switch with 2 magneto inductive contacts, 10-30V, CC according to sheet attached

- 3 Anchorages in SS304
- 3 Anti-vortex blades, at 120°
- Agitator in SS304
- Electrical resistor.
- Thermal insulation by means polyurethane.

1 Tank for nutrients with the following characteristics:

Model	EPD-2
Material	GRP
Volume (l)	200
Diameter (mm)	800
Total height (mm)	1.100
Bottom	Plane
Cover	Plane
Thickness (mm)	5/6

Including:

- Cleaning nozzle, DN-500
- Dosing pump aspiration nozzle, DN-25
- Emptying nozzle, DN-50
- Loading nozzle, DN-50
- Aeration nozzle, DN-50
- Level indicator, visual type, with transparent pipe
- Level switch with 2 magneto inductive contacts, 10-30V, CC according to sheet attached
- 3 Anchorages in SS304
- 3 Anti-vortex blades, at 120°
- Agitator in SS304

Dosing pumps

1 Dosing pump for reactive feeding, with the following characteristics:

Fluid	NaOH	Nutrients	Antifoam
Flow	17-170 l/h	2-20 l/h	2-20 l/h
Material	PP	PP	PP
Motor	120 W	120 W	120 W
Units	1	1	1

Auxiliary supplies:

- Pipes and valves in PP, for conduction from the tanks to scrubber.
- Bolts and nuts in SS304
- EPDM joints

Auxiliary equipment

- 2 Roots Blowers .
- 1 fine bubble diffuser grid.
- 1 peristaltic pump.
- Water softener
- Control booth.
- Anti-foam tank (50 l)

Instrumentation and control

- 2 pH and redox potential measurer with electrode holder and Ingold electrode. Scale 0-14
- 1 Heat exchanger.
- 1 Conductivity measurer.
- 1 Manometer for pressure control of the recirculation pumps
- 1 Temperature probe Pt100
- Sensors and sample conditioning system of O₂ and H₂S measuring at the outlet and inlet (inlet measurements at demand).
- Control and operation panel with PLC, graphic on-screen tactile display visualization, data register and remote access for distance control and operation.

Only the instrumentation that is in contact with biogas will be ATEX certified (ATEX Zone 1).

Pipes, gas ducts, valves and accessories

Pump aspiration circuits

Pipes, elbows, flanges and accessories in PP/PEHD, including:

- Valves in PP
- EPDM joints
- Bolts and nuts in SS304

Pump impulsion circuits

Pipes, elbows, flanges and accessories as shown in the drawing, made in PP/PEHD:

- Valves in PP
- Retention valves in PP
- EPDM joints
- Bolts and nuts in SS304

Emptying – overflow

Pipes, elbows, flanges, accessories and hydraulic sealing DN-50 in PP/PEHD.

Reactive pipe

Flexible PP 6x12

NOTE: Pipes will be thermally insulated and electric tracing, covered by an external aluminum envelope.

Biogas ducts

It's not included in our scope of supply.



Start up

Biological inoculation and control and operation parameter adjustment during start-up.

Start-up include:

- 1- 2 weeks at site of a start-up technician.
- 3 months of remote control of the installation including 2 visits at site.

Maintenance service

ECOTEC and **AERIS** offer a basic maintenance service of the installation during a minimum period of 2 years from the start up. This service is usually carried out electronically by means of continuous data register and remote control of the installation through AERIS server and, punctually, by means of visits on site by our staff which will complete the routine follow-up with portable sensor measuring, and a maximum number of 12 visits to the plant included.

After the visits to the plant and once the data are analyzed, the corresponding operational reports are sent to the customer. They include a description of the sampling, the method used, the results obtained and their analysis and, whenever necessary, the proposal of changes in the operational protocol of the installation of which the desulphurization installation depends, in order to correct possible operation variations.

During the start up and the visits on site, a basic education of the staff in charge of the routine maintenance will be carried out, so that at the end of the maintenance year, customer can keep the biological equipment in correct shape along the possible changes that may take place due to the variation of temperature, flow, pollutant concentration, maintenance stops.



Calculation and fabrication standards

For the fabrication of the equipment proposed, the following standards will be applied:

Mechanical and fabrication calculations

- GRP : UNE – EN13121
- Thermoplastics: DVS 2205

Tests and fabrication controls

During equipment production, and once they are finished, the following tests and controls will be carried out:

- Visual aspect
- Dimensional control of the equipment
- Welding control for thermoplastic constructions
- Operational pump test (according to the manufacturer)
- Instruction manual according CE standard in English language.

Supply exclusions

Included and excluded items from the offer	
Supply of detailed equipment	Included
Documentation and implementation drawings	Included
Civil works and masonry	Excluded
Structures and gangways	Included
Transport	Included
Connections to biogas	Excluded
Connections of industrial water, electricity and other services	Excluded
Cooling system	Excluded
Electrical installation	Included
Cranes for unloading and installation of equipment	Excluded
Thermal insulation of equipment	Included
Lifting elements for people and objects	Excluded
Changing rooms and personal hygiene areas	Excluded
Mounting waste disposal	Excluded
Reagents and consumables for commissioning	Excluded
Testing and analysis	Excluded
All that is not explicitly specified	Excluded

Guarantees

Chemical and mechanical

ECOTEC guarantees for a 24 months period from the supply the chemical and mechanical resistance of the equipment delivered, if service and operation conditions are in accordance to the ones described in this offer.

For electromechanical equipment, the guarantees cover the equipment placed in our workshop.

All pieces and components subject to wear due to equipment operation are excluded from our guarantees, specially mechanical seals, belts and bearings.

Functional

ECOTEC and **AERIS** guarantees the efficiencies indicated in chapter 1, related to design specifications.

Prices

- Detail engineering
- 1 Scrubber CRV-18 + 1 Bioreactors BIO-75.
- 1 Pump ETB-200-150-315.
- 1 Tank for NaOH EPD-100 + 1 Tank for nutrients EPD-2 + dosing pumps.
- Pump recirculation pipes + reactive dosing pipe
- Instrumentation
- Protection and operation control panel (PLC).
- Equipment assembling
- Start-up.
- Transport.
- Thermal insulation of equipment and pipes.
- Consumables for commissioning
 - The microbial inoculum (10 m3)
 - Nutrient mixt (440 kg)
 - Sodium bicarbonate (10 Tm)
 - Defoamer (200 kg)
 - Transport

Optional

- Dehydration system : Including press filter, Feeding pump
- Sludge storage tank EPD-100
- Activated carbon filter + fan + pipes

Critical spare parts

1 Pump ETB-200-150-315

1 blower

1 Peristaltic pump

1 pH sensor

1 Rx sensor

1 Conductivity sensor

10 diffusers in EPDM + PTFE

1 drop separator

1 Dosing pump

1 temperature probe



Sales terms

Delivery time for drawings: To confirm

Delivery time of equipment and assembling: 8 Months.

Payment terms: To confirm

Òscar Carretero
ECOTEC SA

APPENDIX C

Chemical Safety Data Sheet

SECTION 1: MATERIAL AND SUPPLIER IDENTIFICATIONS.

1.1 Product identification.

Product name: dBiOX® Nutrients

1.2 Relevant identified uses of the substance and uses not advised.

dBiOX biogas desulfurization process.

Uses not advised:

Uses different to the advised ones.

1.3 Safety data sheet provider data.

Company: **Ecología Técnica, S.A.**
Address: C/ Esteve Terradas, 37^a P.I. Bufalvent
City: 08243 MANRESA
Province: Barcelona
Phone: (+34)938 773 133
E-mail: ecotec@ecotec.es
Web: www.ecotec.es

1.4 Emergency phone: 704100087 (Available 24h)

SECTION 2: RISKS IDENTIFICATON.

2.1 Substance classification.

According to EU regulation 1272/2008:

Eye Irrit. 2: Leads to serious eye injury.
Contact with the skin can cause severe irritation and burns.
Harmful if swallowed.

2.2 Badge elements.

Labeled according to EU regulation 1272/2008:

Pictograms:



Warning texts:

Atención / Warning

H Phrases:

H302 Harmful if swallowed.
H314 It causes burns to the skin and serious eye injuries.

P Phrases:

P260 Do not breathe dust / smoke / gas / mist / vapors / spray.
P280 Always wear gloves/protective clothes/goggles/mask.
P301+P330+P331 IN CASE OF SWALLOWED: Rinse mouth. Does not cause vomiting.
P303+P361+P353 IN CASE OF CONTACT WITH SKIN (or hair): Remove all contaminated clothing immediately. Rinse the skin with water/shower.
P304+P340 IN CASE OF INHALATION: Transport the person outdoors and keep them in a position that facilitates breathing.
P305+P351+P338 IN CASE OF CONTACT WITH EYES: Rinse cautiously with water for several minutes.
Remove contact lenses, if present and easy to do. Keep rinsing.
P310 Call immediately a toxicology center / doctor/ ...
P337+P313 If eye irritation persists: Consult a physician.
P405 Keep locked.

2.3 Other hazards.

Under normal conditions of use and in its original form the product has no other negative effects on health and on the environment.

SECTION 3: MATERIALS COMPOSITION/INFORMATION.

3.1 Substance.

Does not apply.

3.2 Composition.

Components	CAS N.	CE N.	% w	Classification
Non-hazardous components (mixture of N and P compounds)	Mixture		78,8	Substances classified as non-hazardous in this concentration
[1] Phosphoric acid (H ₃ PO ₄) 85%	7664-38-2	231-633-2	10,6	Skin corr. 1B: Causes severe burns to the skin and serious eye damage
[1] Potassium nitrate (KNO ₃)	7757-79-1	231-818-8	10,6	

[1] Substance to which it a communitary exposure level in work spaces is applied (see section 8.1).

SECTION 4: FIRST AID.

4.1 First aid measures.

In cases of doubt, or when symptoms persist, seek medical attention. Do not supply anything orally to unconscious people.

Inhalation.

Place the affected person in the open air. Keep the person warm and at rest. In case of irregular breathing or non breathing at all, practice artificial respiration. Do not supply anything orally. If unconscious, place in proper position and seek medical advice.

Eye contact.

In case of wearing contact lenses, remove them. Wash the eyes thoroughly with clean, cool water for at least 10 minutes, pulling up on the eyelids. Seek medical attention.

Skin contact.

Remove contaminated clothing. Wash skin thoroughly with soap and water or a suitable skin cleanser. NEVER use solvents or thinners.

Ingestion.

If accidentally swallowed, seek immediate medical attention. Keep affected person at rest. NEVER induce vomiting.

4.2 Main symptoms and effects, both acute and delayed.

Corrosive product contact with eyes or skin may cause burns, ingestion or inhalation may cause internal damage, in case of occurrence, immediate medical assistance is required.

4.3 Indication of any medical attention and special treatment to be provided immediately.

In cases of doubt, or when symptoms persist, seek medical attention. Do not supply anything orally to unconscious people.

SECTION 5: FIRE FIGHTING MEASURES.

5.1 Extinguishing equipment.

Recommended extinguishing equipment.

Extinguishing powder or CO₂. In case of more severe fires also alcohol-resistant foam and water spray. Do not directly apply water.

5.2 Substance specific hazards.

Specific hazards.

Fire can produce a thick black smoke. As a consequence of the thermal decomposition, dangerous products may be formed: carbon monoxide, carbon dioxide. Exposure to combustion products or decomposition products may be harmful.

5.3 Recommendations for firefighters.

Refrigerate tanks, cisterns or containers close to the source of heat or fire with water. Take into account the direction of the wind. Prevent products used in fire fighting from entering drains, sewers or waterways.

Fire protection equipment.

Depending on the magnitude of the fire, it may be necessary to wear protective clothing, self-contained breathing apparatus, gloves, goggles or face masks and boots.

SECTION 6: MEASURES IN CASE OF SPILLAGE.

6.1 Personal precautions, protective equipment and emergency procedures.

For exposure controls and individual protection measures, see section 8.

6.2 Environmental precautions.

Avoid contamination of drains, surface or ground water and soil.

6.3 Methods and material for containment and cleaning.

The contaminated area must be cleaned immediately with a suitable decontaminant. Supply the decontaminant and leave it for several days until no reaction occurs, in an unopened container.

6.4 Reference to other sections.

For exposure controls and individual protection measures, see section 8. For waste disposal, follow the recommendations in section 13.

SECTION 7: HANDLING AND STORAGE.

7.1 Precautions for safe handling.

For personal protection, see section 8. Never use pressure to empty containers, as they are not pressure-resistant.

Smoking, eating and drinking must be prohibited in the area of application. Comply with legislation on occupational safety and health.

Keep the product in containers of the same material as the original.

7.2 Conditions for safe storage, including any incompatibilities.

Store according to local legislation. Observe the indications of the tag. Store containers between 5 and 35 °C in a dry and well-ventilated place, away from sources of heat and direct sunlight. Keep away from sources of ignition. Keep away from oxidizing agents and strongly acid or alkaline materials. No smoking. Prevent access to unauthorized people. Once opened, containers should be closed again and placed vertically to prevent spillage. The product is not affected by Directive 2012/18 / EU (SEVESO III).

7.3 Specific end uses.

Information not yet available.

SECTION 8: EXPOSURE CONTROLS AND INDIVIDUAL PROTECTION.

8.1 Control Parameters.

Exposure limit values for:

Name	CAS N.	Country	Threshold	ppm	mg/m ³
Potassium nitrate	7631-99-4	Spain [1]	8 h	Not established	
			Short term		
Phosphoric acid	7664-38-2	Spain [1]	8 h		1
			Short term		2
		European Union [2]	8 h		1
			Short term		2

[1] According to the list of Environmental Limits of Occupational Exposure adopted by the National Institute of Safety and Hygiene at Work (INSHT) in 2015.

[2] According both Binding Occupational Exposure Limits (BOELVs) and Indicative Occupational Exposure Limits (IOELVs) adopted by Scientific Committee for Occupational Exposure Limits to Chemical Agents (SCOEL).

The product does NOT contain substances with Biological Limit Values.

DNEL/DMEL concentration levels:


Name	DNEL/DMEL	Type	Value
Phosphoric acid N. CAS: 7664-38-2 N. CE: 231-633-2	DNEL (workers)	Inhalation, Chronic, Local effects	1 (mg/m ³)
	DNEL (Consumers)	Inhalation, Chronic, Local effects	0,73 (mg/m ³)
	DNEL (workers)	Inhalation, Short term, Local effects	2 (mg/m ³)
Zinc chloride N. CAS: 7646-85-7 N. CE: 231-592-0	DNEL (workers)	Inhalation, Chronic, Systematic effects	1 (mg/m ³)

8.2 Exposure controls.


Technical measures:

Provide adequate ventilation. This can be achieved by means of good local exhaust ventilation and a good general extraction system.


Respiratory protection:

- 
- Measure: Filter mask for protection against gases and particles.
 Characteristics: CE marking Category III. The mask should have wide field of view and anatomical shape to provide tightness and tightness.
 CEN Norms: EN 136, EN 140, EN 405
 Maintenance: Do not store in areas subject to high temperatures and humid environments prior to use. The condition of the inhalation and exhalation valves of the face adapter must be specially monitored.
 Observations: The manufacturer's instructions regarding the use and maintenance of the equipment should be carefully read. The necessary filters will be coupled to the equipment according to the specific characteristics of the risk.
 Type of filter: A2


Hands protection:

- 
- Measure: Protective gloves against chemical products.
 Characteristics: CE marking Category III.
 CEN Norms: EN 374-1, En 374-2, EN 374-3, EN 420
 Maintenance: Gloves should be stored in a dry place away from potential sources of heat, and exposure to the sun's rays should be avoided as far as possible. Modifications that may alter its strength or paint, solvents or adhesives shall not be applied to the gloves.
 Observations: The gloves should be of the correct size, and fit the hand without being too loose or too tight. They should always be used with clean and dry hands.
 Material: PVC (Polyvinyl chloride) Penetration time > 480 (min): Thickness (mm): 0,35

Eyes protection:

- 
- Measure: Goggles with integral frame.
 Characteristics: CE marking Category III. Full-frame eye protection for protection against dust, fumes, mists and vapors.
 CEN Norms: EN 165, EN 166, EN 167, EN 168
 Maintenance: Visibility through the eyepieces should be optimal. These elements should be cleaned daily. Protectors should be disinfected periodically according to the manufacturer's instructions.
 Observations: Indicators of deterioration can be: yellow color of the eyepieces, superficial scratches in the eyepieces, rips, etc.

Skin protection:

- 
- Measure: Protective clothing with anti-static properties.
 Characteristics: CE marking Category II. Protective clothing should not be cramped or loose so it will not interfere with the wearer's movements.
 CEN Norms: EN 464, EN 340, EN 943-1, EN 943-2, EN ISO 6529, EN ISO 6530, EN 13034, EN 1149-1, EN 1149-2, EN 1149-3, EN 1149-5
 Maintenance: The washing and maintenance instructions provided by the manufacturer must be followed to ensure unchanged protection.
 Observations: Protective clothing should provide a level of comfort consistent with the level of protection it must provide against the risk it protects against, the environmental conditions, the level of activity of the user and the intended use time.



Measure:	Protective footwear with antistatic properties.
Characteristics:	CE marking Category II. The list of chemical products against which the footwear is resistant should be reviewed
CEN Norms:	EN ISO 13287, EN13832-1, EN 13832-2, EN 13832-3, EN ISO 20344, EN ISO 20345, EN ISO 20346
Maintenance:	The footwear must be regularly checked, if its condition is deficient it should be discontinued and replaced.
Observations:	Comfort in use and acceptability are factors that are assessed very differently by individuals. It is therefore appropriate to test different models of footwear and, if possible, different widths.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES.

9.1 Information on basic physical and chemical properties.

Appearance: colourless liquid
Colour: N.D./N.A.
Odor: ammoniacal (very weak)
Olfactory Threshold: N.D./N.A.
PH: 1
Melting Point: N.D./N.A.
Boiling point / range: N.D./N.A.
Flash point: N.D./N.A.
Evaporation rate: N.D./N.A.
Flammability (solid, gas): No
Lower explosion limit: N.D./N.A.
Upper explosion limit: N.D./N.A.
Vapor pressure: N.D./N.A.
Vapor density: N.D./N.A.
Relative Density: 1,215 (20 ° C) g / cm³
Solubility: N.D./N.A.
Liposolubility: N.D./N.A.
Water solubility: N.D./N.A.
Partition coefficient (n-octanol / water): N.D./N.A.
Autoignition temperature: N.D./N.A.
Decomposition temperature: > 150 ° C
Viscosity: N.D./N.A.
Explosive properties: No
Oxidizing properties: N.D./N.A.

N.D./N.A.= Not Available / Not Applicable due to the nature of the product.

9.2. Other data.

VOC content (p/p): N.D.

SECTION 10: STABILITY AND REACTIVITY.

10.1 Reactivity.

The product is not dangerous due to its reactivity.

10.2 Chemical stability.

Unstable in contact with:

- Acids
- Bases
- Oxidizing agents

10.3 Possibility of hazardous reactions.

The product does not present any hazardous reaction.

10.4 Conditions to avoid.

Avoid the following conditions:

- Heating
- High temperature
- Contact with incompatible materials

10.5 Incompatible materials.

Keep away from oxidizing agents and strongly alkaline or acidic materials in order to avoid exothermic reactions.

10.6 Hazardous decomposition products.

Not decomposed if it is destined to the intended uses.

SECTION 11: TOXICOLOGY.
11.1 Information on toxicological effects.

Repeated or prolonged contact with the product may cause the removal of fat from the skin, resulting in a non-allergic contact dermatitis and the product being absorbed through the skin.

Splashes in the eyes may cause irritation and reversible damage.

Toxicological information.

Name	Acute toxicity			
	Tipo	Assay	Species	Value
Phosphoric acid 85% N.CAS: 7664-38-2 N.CE: 231-633-2	Oral	DL50	Rat	1530 mg/kg
	Skin	DL50	Rabbit	2740 mg/kg
Potassium nitrate N. CAS: 7757-79-1 N. CE: 231-818-8	Oral	CL50	Rat	3750 mg/kg

A) acute toxicity;

Acute oral toxicity, Category 4: Harmful if swallowed.

B) skin corrosion or irritation;

Rated product:

Corrosive skin, Category 1B: Causes skin burns and serious eye damage.

C) serious eye injury or irritation;

Rated Product:

Eye irritation, Category 2: Causes serious eye irritation.

D) respiratory or skin sensitization;

Non-conclusive data for classification.

E) germ cell mutagenicity;

Non-conclusive data for classification.

F) carcinogenicity;

Non-conclusive data for classification.

G) reproductive toxicity;

Non-conclusive data for classification.

(H) specific organ toxicity (STOT) - single exposure;

Non-conclusive data for classification.

(I) specific organ toxicity (STOT) - repeated exposure;

Non-conclusive data for classification.

J) danger of aspiration;

Non-conclusive data for classification.



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SECTION 12: ENVIRONMENTAL INFORMATION.

12.1 Toxicity.

Name	Ecotoxicity			
	Type	Assay	Species	Value
Phosphoric acid 85% N. CAS: 7664-38-2 N. CE: 231-633-2	Fish	Median Lethal pH	Fresh water species	3,25 pH (96 h)
	Aquatic invertebrates	EC50	<i>Daphnia magna</i>	>100 mg/L (48h)
	Aquatic plants	EC50	<i>Desmodium subspicatus</i>	>100 mg/L (72h)

12.2 Persistence and degradability.

No information available on the persistence and degradability of the product.

12.3 Bioaccumulation Potential.

No information on bioaccumulation is available.

12.4 Mobility in the ground.

There is no information available on ground mobility.

The product should not be allowed to enter drains or watercourses.

Avoid penetration into the ground.

12.5 Results of PBT and vPvB assessment.

No information available on the product PBT and vPvB assessment.

12.6 Other adverse effects.

No information available on other adverse effects on the environment.

SECTION 13: DISPOSAL.

13.1 Methods for waste treatment.

Do not discharge into sewers or watercourses. Waste and empty containers must be handled and disposed of in accordance with local / national legislation in force.

Follow the provisions of Directive 2008/98 / EC regarding waste management.

SECTION 14: TRANSPORTATION.

With respect to ADR transport, the product may be transported as non-hazardous on the basis of the test result O.1 Of the Manual of Tests and Criteria of the United Nations according to section 2.2.51.1.5.

Transport in accordance with ADR / TPC standards for road transport, RID by rail, IMDG by sea and ICAO / IATA for air transport.

Land: Road transport: ADR, Rail transport: RID. Transport Documentation: Bill of Lading and Written Instructions.

Sea: Transport by ship: IMDG.

Transport documentation: Bill of lading.

Air: Air transport: IATA / ICAO. Transport document: Air knowledge.

14.1 UN number.

UN number Phosphoric acid: UN1805

UN number Potassium nitrate: UN1486

14.2 Proper shipping name of the United Nations.

Description: UN 1805, PHOSPHORIC ACID IN SOLUTION, 8, GE III

14.3 Hazard class(es) for transport.

Class (s): 8

14.4 Packing group.

Packing group: III

14.5 Danger to the environment.

Marine pollutant: No

14.6 Special precautions for user.

Maximum quantity per transport unit NO ADR: 1,000 kg

Provisions relating to bulk transport in ADR:

VC1 Carriage in bulk in trolleys, in tandem containers or in bulk containers is permitted.

VC2 Carriage in bulk is permitted in covered vehicles, in closed containers or in closed bulk containers.

AP6 When the vehicle or container is made of wood or is constructed of other combustible material, they must comprise a waterproof and non-combustible coating or a silicate plaster of soda or other similar product. The awning must be equally impermeable and non-combustible.

AP7 Bulk transport should only be carried out in full loading. Transport by ship, FE - Emergency data sheets (F - Fire, S - Spills): F-A, S-Q Act according to item 6.

14.7 Transport in bulk according to Annex II of the MARPOL Convention and the IBC Code.

The product is not affected by bulk transport on ships.

SECTION 15: REGULATORY INFORMATION.

15.1 Safety, health and environmental regulations and legislation specific to the substance.

The product is not affected by Regulation (EC) No 1005/2009 of the European Parliament and of the Council of 16 September 2009, on substances that deplete the ozone layer.

See Annex I to Council Directive 96/82 / EC on the control of major-accident hazards involving dangerous substances and Regulation (EC) No 689/2008 of the European Parliament and of the Council of 17 June 2008 on the export and import of dangerous chemical products.

The product is not affected by Directive 2012/18 / EU (SEVESO III).

The product is not affected by Regulation (EU) No 528/2012 concerning the placing on the market and use of biocidal products.

The product is not affected by the procedure laid down in Regulation (EU) No 649/2012 concerning the export and import of dangerous chemicals.

15.2 Chemical Safety Assessment.

A chemical safety assessment of the product has not been carried out.

SECTION 16: ADDITIONAL INFORMATION.

Classification codes:

Skin Corr. 1B: Corrosive skin, Category 1B

Eye Irrit. 2: Eye irritation, Category 2

It is advisable to carry out basic training regarding safety and occupational hygiene to perform a correct handling of the product.

Labelling according to Directive 67/548 / EEC:

Symbols:



Corrosive

R Phrases:

R22 Harmful if swallowed

R34 Causes burns

S Phrases:

S26 In case of contact with eyes, rinse immediately and abundantly with water and seek medical advice.

S41 In case of fire and / or explosion do not breathe fumes.

S45 in case of accident or discomfort, seek medical advice immediately (if possible, show the label).

Abbreviations and acronyms used:

ADR: European Agreement on the International Carriage of Dangerous Goods by Road.

CEN: European Committee for Standardization.

DMEL: Derived Minimal Effect Level, level of exposure corresponding to a low risk.

DNEL: Derived No Effect Level, level of exposure below which no adverse effects are anticipated.



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EC50: Mean effective concentration. PPE: Personal protective equipment.
EPI: Personal protection equipment.
IATA: International Air Transport Association.
IMDG: International Maritime Dangerous Goods Code. LC50: Lethal Concentration, 50%.
LC50: Lethal concentration 50%.
LD50: Lethal dose, 50%.
RID: Regulation Concerning the International Transport of Dangerous Goods by Rail.

Main Bibliographical References and Data Sources:

[Http://eur-lex.europa.eu/homepage.html](http://eur-lex.europa.eu/homepage.html)

[Http://echa.europa.eu/](http://echa.europa.eu/)

Regulation (EU) 2015/830.

Regulation (EC) No 1907/2006.

Regulation (EU) No 1272/2008.

The information provided in this Safety Data Sheet has been written in accordance with REGULATION (EU) 2015/830 DECISION of 28 May 2015 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council, concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45 / EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 and Council Directive 76/769 / EEC and Directives 91/155 / EEC, 93/67 / EEC, 93/105 / EC and 2000/21 / EC of the Commission.

The information in this Material Safety Data Sheet is based on current knowledge and current EC and national laws, insofar as the working conditions of users are beyond our knowledge and control. The product should not be used for purposes other than those specified, without first having a written instruction, of its handling. It is always the responsibility of the user to take the appropriate measures in order to comply with the requirements established in the legislations.



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SECTION 1: MATERIAL AND SUPPLIER IDENTIFICATIONS.

1.1 Product identification.

Product name: dBiOX® Defoamer

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses: Defoamer

1.3 Details of the supplier of the safety data sheet

Company: **Ecología Técnica, S.A.**
Address: C/ Esteve Terradas, 37ª P.I. Bufalvent
City: 08243 MANRESA
Province: Barcelona
Phone: (+34)938 773 133
E-mail: ecotec@ecotec.es
Web: www.ecotec.es

1.4 Emergency phone: 704100087 (Available 24h)

SECTION 2: HAZARDS IDENTIFICATION.

2.1 Substance or mixture classification.

According to Regulation (EC) No 1272/2008 [CLP]:

No need for classification according to GHS classification

2.2 Label elements.

Globally Harmonized System, EU (GHS):

The product does not require a hazard warning label in accordance with GHS criteria.

Labeling of special preparations (GHS):

EUH208: May produce an allergic reaction. Contains: 1,2-BENZISOTHIAZOL-3(2H)-ONE, 2-METHYL-2H-ISOTHIAZOL-3-ONE

2.3 Other hazards.

According to Regulation (EC) No 1272/2008 [CLP]

If applicable information is provided in this section on other hazards which do not result in classification, but which may contribute to the overall hazards of the substance or mixture.

SECTION 3: MATERIALS COMPOSITION/INFORMATION.

3.1 Substance.

Not applicable

3.2 Mixtures.

Chemical nature

hydroxy compounds, aliphatic emulsion, in water



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SECTION 4: FIRST AID MEASURES.

4.1 Description of first aid measures.

Remove contaminated clothing

Inhalation.

Keep patient calm, remove to fresh air.

Eye contact.

Wash affected eyes for at least 15 minutes under running water with eyelids held open.

Skin contact.

Wash thoroughly with soap and water.

Ingestion.

Rinse mouth and then drink plenty of water.

4.2 Main symptoms and effects, both acute and delayed.

Symptoms: No significant reaction of the human body to the product known

4.3 Indication of any medical attention and special treatment to be provided immediately.

Treatment: Symptomatic treatment (decontamination, vital functions).

SECTION 5: FIRE FIGHTING MEASURES.

5.1 Extinguishing equipment.

Suitable extinguishing equipment:

Water spray, dry powder, carbon dioxide, foam

5.2 Special hazards from the substance/mixture.

No particular hazards known

5.3 Advice for firefighters.

Special protective equipment:

Wear a self-contained breathing apparatus.

Further information.

Dispose of fire debris and contaminated extinguishing water in accordance with official regulations.

SECTION 6: MEASURES IN CASE OF SPILLAGE.

6.1 Personal precautions, protective equipment and emergency procedures.

Use personal protective clothing.

6.2 Environmental precautions.

Do not discharge into the subsoil/soil. Do not discharge into drains/surface waters/groundwater.



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6.3 Methods and material for containment and cleaning up.

For small amounts: Pick up with suitable absorbent material (e.g. sand, sawdust, general-purpose binder, kieselguhr). Dispose of absorbed material in accordance with regulations.

For large amounts: Dike spillage. Pick up with suitable appliance and dispose of.

6.4 Reference to other sections.

Information regarding exposure controls/personal protection and disposal considerations can be found in section 8 and 13.

SECTION 7: HANDLING AND STORAGE.

7.1 Precautions for safe handling.

Ensure thorough ventilation of stores and work areas.

Protection against fire and explosion:

No special precautions necessary. The product is neither self-ignitable, nor an explosion hazard, nor does it promote fires.

7.2 Conditions for safe storage, including any incompatibilities.

Further information on storage conditions: Keep container tightly closed and dry; store in a cool place. Avoid direct sunlight. Store protected against freezing.

7.3 Specific end uses.

For the relevant identified use(s) listed in Section 1 the advice mentioned in this section 7 is to be observed.

SECTION 8: EXPOSURE CONTROLS AND INDIVIDUAL PROTECTION.

8.1 Control Parameters.

Components with occupational exposure limits:

8042-47-5: white mineral oil (petroleum)

8.2 Exposure controls.

Personal protective equipment:

Respiratory protection:

Wear respiratory protection if ventilation is inadequate.

Hands protection:

Suitable chemical resistant safety gloves (EN 374) also with prolonged, direct contact (Recommended: Protective index 6, corresponding > 480 minutes of permeation time according to EN 374): E.g. nitrile rubber (0.4 mm), chloroprene rubber (0.5 mm), butyl rubber (0.7 mm) etc. Supplementary note: The specifications are based on tests, literature data and information of glove manufacturers or are derived from similar substances by analogy. Due to many conditions (e.g. temperature) it must be considered, that the practical usage of a chemical-protective glove in practice may be much shorter than the permeation time determined through testing.

Eyes protection:

Safety glasses with side-shields (frame goggles) (e.g. EN 166)



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Skin protection:

Body protection must be chosen depending on activity and possible exposure, e.g. apron, protecting boots, chemical-protection suit (according to EN 14605 in case of splashes or EN ISO 13982 in case of dust).

General safety and hygiene measures

Handle in accordance with good industrial hygiene and safety practice. When using, do not eat, drink or smoke.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES.

9.1 Information on basic physical and chemical properties.

Appearance: liquid, emulsion

Colour: pale beige

Odour: product specific

Odour threshold: no applicable information available

PH: 6.5-9.5 (DIN ISO 976)

Solidification temperature: approx. 0 ° C

Boiling point / range: approx. 100 ° C

Flash point: > 100 ° C (DIN 51758)

Evaporation rate: not determined

Flammability: No highly flammable

Lower explosion limit: For liquids not relevant for classification and labelling. The lower explosion point may be 5 - 15 °C below the flash point.

Upper explosion limit: For liquids not relevant for classification and labelling.

Ignition temperature: not applicable

Vapor pressure: not data available

Density: approx. 0.96 g/cm³ (20 ° C)

Relative density: no data available

Relative vapour density (air): no data available

Solubility in water: miscible, emulsifiable

Partition coefficient n-octanol / water (log Kow): not applicable for mixtures

Self-ignition temperature: not self-igniting

Decomposition temperature: no decomposition if correctly stored and handled

Viscosity dynamic: 150 – 1,500 mPa.s (23 ° C) (DIN EN ISO 2555 (RV))

Explosive properties: not explosive

Fire promoting properties: not fire propagating

N.D./N.A.= Not Available / Not Applicable due to the nature of the product.



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9.2. Other data.

Miscibility in water: miscible in all proportions

Other information: if necessary, information on other physical and chemical parameters is indicated in this section.

SECTION 10: STABILITY AND REACTIVITY.

10.1 Reactivity.

No hazardous reactions if stored and handled as prescribed/indicated

Corrosion to metals: corrosive effects to metal are not anticipated.

10.2 Chemical stability.

The product is stable if stored and handled as prescribed/indicated

10.3 Possibility of hazardous reactions.

No hazardous reactions if stored and handled as prescribed/indicated

10.4 Conditions to avoid.

Avoid extreme heat. Avoid freezing

10.5 Incompatible materials.

No substances known that should be avoided

10.6 Hazardous decomposition products.

No hazardous decomposition products if stored and handled as prescribed/indicated

SECTION 11: TOXICOLOGY.

11.1 Information on toxicological effects.

A) acute toxicity:

Experimental/calculated data:

LD50 rat (oral): >2,000 mg/kg (OECD Guideline 423)

B) skin corrosion or irritation:

Assessment of irritating effects: Not irritating to skin. Not irritating to the eyes

Experimental/calculated data:

Skin corrosion/irritation: non-irritant (OECD Guideline 404)

C) serious eye injury or irritation:

Non-irritant (OECD Guideline 405)

D) respiratory or skin sensitization:

Assessment of sensitization: A sensitizing effect on particularly sensitive individuals cannot be excluded

E) germ cell mutagenicity:

Assessment of mutagenicity: The substance was not mutagenic in bacteria

F) carcinogenicity:

Assessment of carcinogenicity: No data available

G) reproductive toxicity:

Assessment of reproduction toxicity: No data available

(H) specific organ toxicity (STOT) - repeated exposure:

Assessment of repeated dose toxicity: Repeated oral uptake of the substance did not cause substance-related effects.

I) danger of aspiration:

No aspiration hazard expected

J) other relevant toxicity information:

The product has not been tested. The statement has been derived from substances/products of a similar structure or composition



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SECTION 12: ENVIRONMENTAL INFORMATION.

12.1 Toxicity.

Assessment of aquatic toxicity:

There is a high probability that the product is not acutely harmful to aquatic organisms. Inhibition of degradation activity in activated sludge is not to be anticipated during correct introduction of low concentrations.

Toxicity to fish:

LC50 (96 h) > 120 mg/l, *Brachydanio rerio* (OECD Guideline 203)

Nominal concentration.

Aquatic invertebrates:

EC50 (48 h) > 120 mg/l, *Daphnia magna* (OECD Guideline 202, part 1, static)

Nominal concentration.

Aquatic plants:

EC50 (72 h) > 120 mg/l (growth rate), *Desmodium subspicatus* (OECD Guideline 201, static)

Nominal concentration.

Microorganisms/Effect on activated sludge:

EC10 (3 h) > 1,000 mg/l, activated sludge (DIN EN ISO 8192, aerobic)

The product has not been tested. The statement has been derived from substances/products of a similar structure or composition.

12.2 Persistence and degradability.

Assessment biodegradation and elimination (H₂O): Readily biodegradable (according to OECD criteria).

Elimination information: 90 - 100 % BOD of COD (28 d) (OECD Guideline 301 F) (aerobic, activated sludge, domestic)

Readily biodegradable (according to OECD criteria).

12.3 Bioaccumulation Potential.

Bioaccumulation potential: No data available

12.4 Mobility in Soil.

Assessment transport between environmental compartments:

Adsorption in soil: No data available.

12.5 Results of PBT and vPvB assessment.

According to Regulation (EC) No.453/2010: The product does not fulfill the criteria for PBT (Persistent/bioaccumulative/toxic) and vPvB (very persistent/very bioaccumulative).

12.6 Other adverse effects.

The product does not contain substances that are listed in Annex I of Regulation (EC) 2037/2000 on substances that deplete the ozone layer.

12.7 Additional information

Adsorbable organically-bound halogen (AOX): This product contains no organically-bound halogen.

Other ecotoxicological advice: The product has not been tested. The statement has been derived from substances/products of a similar structure or composition.

SECTION 13: DISPOSAL CONSIDERATIONS.

13.1 Waste treatment methods.

Must be disposed of or incinerated in accordance with local regulations.

Contaminated packaging: Uncontaminated packaging can be re-used.

Packs that cannot be cleaned should be disposed of in the same manner as the contents.



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SECTION 14: TRANSPORT INFORMATION.

Land transport

ADR

UN number:	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user:	None known

RID

UN number:	Not applicable
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user:	None known

Inland waterway transport

AND

UN number:	Not classified as a dangerous good under transport regulations
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user:	None known
Transport in inland waterway vessel:	Not evaluated

Sea transport

IMDG

UN number:	Not classified as a dangerous good under transport regulations
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user:	None known

Air transport

IATA/ICAO

UN number:	Not classified as a dangerous good under transport regulations
UN proper shipping name:	Not applicable
Transport hazard class(es):	Not applicable
Packing group:	Not applicable
Environmental hazards:	Not applicable
Special precautions for user:	None known

14.1 UN number.

See corresponding entries for "UN number" for the respective regulations in the tables above

14.2 UN proper shipping name.

See corresponding entries for "UN proper shipping name" for the respective regulations in the tables above

14.3 Hazard class(es) for transport.

See corresponding entries for "Transport hazard class(es)" for the respective regulations in the tables above

14.4 Packing group.

See corresponding entries for "Packing group" for the respective regulations in the tables above



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14.5 Environmental hazards.

See corresponding entries for "Environmental hazards" for the respective regulations in the tables above

14.6 Special precautions for user.

See corresponding entries for "Special precautions for user" for the respective regulations in the tables above

14.7 Transport in bulk according to Annex II of the MARPOL 73/78 and the IBC Code.

Regulation:	Not evaluated
Shipment approved:	Not evaluated
Pollution name:	Not evaluated
Pollution category:	Not evaluated
Ship Type:	Not evaluated

SECTION 15: REGULATORY INFORMATION.

15.1 Safety, health and environmental regulations and legislation specific to the substance or mixture.

If other regulatory information applies that is not already provided elsewhere in this safety data sheet, then is described in this subsection.

15.2 Chemical Safety Assessment.

Chemical Safety Assessment not required

SECTION 16: ADDITIONAL INFORMATION.

Assessment of the hazard classes according to UN GHS criteria (most recent version)

Acute Tox. 5 (oral)

Any other intended applications should be discussed with the manufacturer.

The data contained in this Safety Data Sheet are based on our current knowledge and experience and describe the product only regarding to safety requirements. The data do not describe the product's properties (product specification). Neither should any agreed property nor the suitability of the product for any specific purpose be deduced from the data contained in the safety data sheet. It is the responsibility of the recipient of the product to ensure any proprietary rights and existing laws and legislation are observed.



SAFETY DATA SHEET

According to Regulation (EC) No. 1907/2006 (REACH).

Reference Number :SDS3; Revision Date: 01/08/2019; Rev No: 07



CAUSTIC SODA 5% =< CONC. <51%

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

1.1. Product Identifiers

-Product Name : CAUSTIC SODA 5% =< CONC. <51%
-Chemical Name : Sodium hydroxide solution
-Synonyms : Lye soda, Sodium hydrate, Caustic lye
-Type of Product : Mixture

1.2. Relevant identified uses of the substance or mixture and uses advised against

-Identified uses :
- Reagent
- pH-regulating agent
- Ion exchange resins regenerating agent
- Catalyst
- Etching agent
- Cleaning agent
-Uses advised against :
- None

1.3. Details of the supplier of the safety data sheet

-Company : MICRO-BIO (IRELAND) LTD.
-Address : Industrial Estate, Fermoy, Co Cork, Ireland
-Telephone : +3532531388
-Fax : +3532532458
-E-mail address : dobrien@micro-bio.ie

1.4. Emergency telephone number

-Emergency telephone number : +3532531388 (Available 24/7)

SECTION 2: HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture

2.1.1. European regulation (EC) 1272/2008, as amended

Classified as hazardous according to the European regulation (EC) 1272/2008, as amended

Hazard class	Hazard category	Route of exposure	H Phrases
Skin Corrosion	Category 1A		H314
Corrosive to metals	Category 1		H290

2.2. Label elements

2.2.1. Name(s) on label

Hazardous components : Sodium hydroxide (>=5-<51%)

2.2.2. Signal word

Danger

SAFETY DATA SHEET

According to Regulation (EC) No. 1907/2006 (REACH).

2.2.3. Hazard symbols



2.2.4. Hazard statements

- H314 - Causes severe skin burns and eye damage.
- H290 - May be corrosive to metals.

2.2.5. Precautionary statements

- | | | | |
|-------------------|----------------------------|---|--|
| Prevention | P260 | - | Do not breathe dust/fume/gas/mist/vapours/spray. |
| | P280 | - | Wear protective gloves/protective clothing/eye protection/face protection. |
| Response | P303 + P361 + P353 | - | IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower. |
| | P305 + P351 + P338 | - | IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. |
| | P301 + P330 + P331
P310 | - | IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
Immediately call a POISON CENTRE or doctor/physician. |

2.3. Other Hazards

Does not meet the criteria for persistent, bioaccumulative and toxic (PBT) or very persistent, very bioaccumulative (vPvB) substances.

SECTION 3: COMPOSITION / INFORMATION ON INGREDIENTS

3.1. Substances

Not applicable.

3.2. Mixtures

Description: Aqueous solution.

Dangerous components

Hazardous ingredient(s)	CAS No.	EC No.	REACH Registration No.	EC Classification and Hazard statement(s)	%W/W
Sodium hydroxide	1310-73-2	215-185-5	01-2119457892-27-0086	Skin Corr. 1A; H314 Met. Corr. 1; H290	≥ 5 - < 51%

3.3. Additional Information

For full text of R phrases see section 16.
 NaOH Specific Concentration Limits (SCLs)
 Skin Corr. 1A; H314: C ≥ 5 %
 Skin Corr. 1B; H314: 2 % ≤ C < 5 %
 Skin Irrit. 2; H315: 0,5 % ≤ C < 2 %
 Eye Irrit. 2; H319: 0,5 % ≤ C < 2 %

SAFETY DATA SHEET

According to Regulation (EC) No. 1907/2006 (REACH).

SECTION 4: FIRST AID MEASURES

SPEED IS ESSENTIAL

4.1. Description of first aid measures

4.1.1. If inhaled

- Move to fresh air.
- Oxygen or artificial respiration if needed.
- Victim to lie down in the recovery position, cover and keep him warm.
- Call a physician immediately.

4.1.2. In case of eye contact

- Rinse immediately with plenty of water, also under the eyelids, for at least 15 minutes.
- In the case of difficulty of opening the lids, administer an analgesic eye wash (oxybuprocaine).
- Call a physician or poison control centre immediately.
- Take victim immediately to hospital.

4.1.3. In case of skin contact

- Take off contaminated clothing and shoes immediately.
- Wash off immediately with plenty of water.
- Keep warm and in a quiet place.
- Call a physician or poison control centre immediately.
- Wash contaminated clothing before re-use.

4.1.4. If swallowed

- Call a physician or poison control centre immediately.
- Take victim immediately to hospital.
- If swallowed, rinse mouth with water (only if the person is conscious).
- Do NOT induce vomiting.
- Artificial respiration and/or oxygen may be necessary.

4.2. Most important symptoms and effects, both acute and delayed

4.2.1. Inhalation

- Corrosive to respiratory system
- Symptoms: Breathing difficulties, cough, chemical pneumonitis, pulmonary oedema
- Repeated or prolonged exposure: Risk of sore throat, nose bleeds, chronic bronchitis.

4.2.2. Skin contact

- Causes severe burns.
- Symptoms: Redness, Swelling of tissue, Burn

4.2.3. Eye contact

- Causes severe burns.
- Small amounts splashed into eyes can cause irreversible tissue damage and blindness.
- Symptoms: Redness, Lachrymation, Swelling of tissue, Burns.

4.2.4. Ingestion

- If ingested, severe burns of the mouth and throat, as well as a danger of perforation of the oesophagus and the stomach.
- Symptoms: Nausea, Abdominal pain, Bloody vomiting, Diarrhoea, Suffocation, Cough, Severe shortness of breath.

4.3. Indication of any immediate medical attention and special treatment needed

Symptomatic treatment and supportive therapy as indicated.



SAFETY DATA SHEET

According to Regulation (EC) No. 1907/2006 (REACH).

SECTION 5: FIREFIGHTING MEASURES

5.1. Extinguishing media

5.1.1. Suitable extinguishing media

- Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.

5.1.2. Unsuitable extinguishing media

- None.

5.2. Special hazards arising from the substance or mixture

- The product is not flammable.
- Not combustible.
- Hazardous decomposition products formed under fire conditions.
- Gives off hydrogen by reaction with metals.

5.3. Advice for firefighters

- In the event of fire, wear self-contained breathing apparatus.
- Use personal protective equipment.
- Wear chemical resistant oversuit.
- Cool containers / tanks with water spray.

SECTION 6: ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures

6.1.1. Advice for non-emergency personnel

- Prevent further leakage or spillage if safe to do so.
- Keep away from Incompatible products.

6.1.2. Advice for emergency responders

- Evacuate personnel to safe areas.
- Keep people away from and upwind of spill/leak.
- Ventilate the area.
- Wear suitable protective clothing.

6.2. Environmental precautions

- Should not be released into the environment.
- Do not flush into surface water or sanitary sewer system.
- If the product contaminates rivers and lakes or drains, inform respective authorities.

6.3. Methods and material for containment and cleaning up

- Dam up.
- Soak up with inert absorbent material.
- Prevent product from entering drains.
- Keep in properly labelled containers.
- Keep in suitable, closed containers for disposal.

6.4. Reference to other sections

- Refer to protective measures listed in sections 7 and 8



SAFETY DATA SHEET

According to Regulation (EC) No. 1907/2006 (REACH).

SECTION 7: HANDLING AND STORAGE

7.1. Precautions for safe handling

- Used in closed system
- Use only in well-ventilated areas.
- Keep away from incompatible products.

7.2. Conditions for safe storage, including any incompatibilities

7.2.1. Storage

- Store in original container.
- Keep in a well-ventilated place.
- Keep in properly labelled containers.
- Keep container closed.
- Keep in a bunded area.
- Keep away from incompatible products.
- Regularly check the condition and temperature of the containers.
- Minimum storage temperature: 25°C for 50% solution; 50°C for 30% Solution

The material can be stored at ambient or slightly elevated temperatures (these are needed in the case of concentrated solutions) in mild steel tanks of welded construction. Where the liquor temperature is above 40°C for concentrations of 30 % or more or above 60°C for lower concentrations, tanks must be stress relieved.

7.2.2. Packaging material

7.2.2.1. Suitable material

- Stainless steel

7.2.2.2. Unsuitable material

- No data available

7.3. Specific end use(s)

- For further information, please contact: Supplier

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters

8.1.1. Exposure Limit Values

Sodium hydroxide

- Ireland: Code of Practice for the Safety Health & Welfare at Work (Chemical Agents) Regulations 2018 (SI No. 623 of 2015) Occupational Exposure Limit Value(15 minute reference period) = 2 mg/m³
- US. ACGIH Threshold Limit Values 2009
Ceiling Limit Value = 2 mg/m³

8.2. Exposure controls

8.2.1. Appropriate engineering controls

- Ensure adequate ventilation.
- Apply technical measures to comply with the occupational exposure limits.

8.2.2. Individual protection measures

8.2.2.1. Respiratory protection

- In the case of dust or aerosol formation, use respirator with an approved filter.
- Recommended Filter type: P2

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According to Regulation (EC) No. 1907/2006 (REACH).

8.2.2.2. Hand protection

- Impervious gloves in compliance with EN374:2003.
- Take note of the information given by the producer concerning permeability and break through times, and of special workplace conditions (mechanical strain, duration of contact). The following list may be used for guidance but is not exhaustive:
- Nitrile rubber- NBR: thickness \geq 0,35mm; breakthrough time \geq 480min.
- Polyvinyl chloride- PVC: thickness \geq 0,5mm; breakthrough time \geq 480min.
- Butyl rubber: thickness \geq 0,5mm; breakthrough time \geq 480min.
- Dispose of contaminated gloves appropriately.
- Unsuitable material: Leather

8.2.2.3. Eye protection

- Chemical resistant goggles or full-face shield must be worn.
- If splashes are likely to occur, wear: Tightly fitting safety goggles and Full-Face shield

8.2.2.4. Skin and body protection

- Wear suitable protective clothing.
- If splashes are likely to occur, wear:
 - Rubber or plastic boots
 - Rubber apron.

8.2.2.5. Hygiene measures

- Ensure that eyewash stations and safety showers are close to the workstation location.
- Take off contaminated clothing and shoes immediately.
- Handle in accordance with good industrial hygiene and safety practice.

8.2.3. Environmental Exposure controls

- Dispose of rinse water in accordance with local and national regulations.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

9.1.1. General Information

- | | |
|-------------------------------------|----------------|
| <input type="checkbox"/> Appearance | Viscous liquid |
| <input type="checkbox"/> Colour | Colourless |
| <input type="checkbox"/> Odour | Odourless |

9.1.2. Important health safety and environmental information

- | | |
|---|---|
| <input type="checkbox"/> pH | > 13 |
| <input type="checkbox"/> pKa | No data |
| <input type="checkbox"/> Melting point/freezing point | 0°C (30%); +12°C (50%) |
| <input type="checkbox"/> Boiling point/boiling range | from 118 – 145°C |
| <input type="checkbox"/> Flash point | The product is not flammable. |
| <input type="checkbox"/> Evaporation rate | No data |
| <input type="checkbox"/> Flammability (solid, gas) | not applicable |
| <input type="checkbox"/> Flammability | The product is not flammable |
| <input type="checkbox"/> Explosive properties | Not explosive, See section 10. |
| <input type="checkbox"/> Vapour pressure | < 13.3 hPa, at 20°C |
| <input type="checkbox"/> Vapour density | No data |
| <input type="checkbox"/> Relative density | 1.33 (30%); 1.53 (50%) |
| <input type="checkbox"/> Bulk density | No data |
| <input type="checkbox"/> Solubility(ies) | Completely soluble in water |
| <input type="checkbox"/> Solubility/qualitative | Completely miscible, Alcohol (Glycerol) |
| <input type="checkbox"/> Partition coefficient: n-octanol/water | No data |
| <input type="checkbox"/> Autoignition temperature | No data |



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- | | |
|---|-------------------------|
| <input type="checkbox"/> Decomposition temperature | No data |
| <input type="checkbox"/> Viscosity | 12 – 120 mPa.s, at 20°C |
| <input type="checkbox"/> Oxidizing properties | Non oxidizer |

9.2. Other information

Not available.

SECTION 10: STABILITY AND REACTIVITY

10.1. Reactivity

- Potential for exothermic hazard
- May be corrosive to metals.

10.2. Chemical stability

- Stable under recommended storage conditions.

10.3. Possibility of hazardous reactions

- Exothermic reaction with water (slight for dilutions from 40% down)
- Gives off hydrogen by reaction with metals.
- Exothermic reaction with strong acids.

10.4. Conditions to avoid

- Keep away from direct sunlight
- To avoid thermal decomposition, do not overheat.
- Exposure to moisture
- Freezing
- If electric arc welding or cutting, particular attention must be paid to the way the electrical circuit is completed to eliminate the possibility of producing Hydrogen through electrolysis of the liquor.
- A potential exists for the formation of carbon monoxide gas in closed equipment during cleaning with caustic soda solutions by reaction with certain sugars including fructose, galactose, arabinose, lavalose, lactose, maltose and dry whey powder.

10.5. Incompatible materials

- Metals, Oxidizing agents, Acids, Aluminium, other light metals and their alloys

10.6. Hazardous decomposition products

- Hydrogen

SECTION 11: TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects

11.1. Acute toxicity

11.1.1. Acute oral toxicity

- no data available. Will immediately cause corrosion of and damage to gastrointestinal tract.

11.1.2. Acute inhalation toxicity

- no data available. Mist is severe irritant to the respiratory tract.

11.1.3. Acute dermal toxicity

- no data available. Corrosive.



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According to Regulation (EC) No. 1907/2006 (REACH).

11.2. Skin corrosion/irritation

- Corrosive

11.3. Serious eye damage/eye irritation

- Corrosive

11.4. Respiratory or skin sensitization

- no observed effect

11.5. Mutagenicity

- Animal testing did not show any mutagenic effects. In vitro tests did not show mutagenic effects.

11.6. Carcinogenicity

- no data available

11.7. Toxicity for reproduction

- Effect on fertility, foetotoxic effect, no observed effect

11.8. Repeated dose toxicity

- not applicable

SECTION 12: ECOLOGICAL INFORMATION

12.1. Toxicity

Large discharges may contribute to the alkalisation of water and may be fatal to fish and other aquatic life. Can cause severe damage to aquatic plants.

- Fishes, various species, LC50, 96 h, 35 – 189 mg/l (Sodium hydroxide)
- Crustaceans, Ceriodaphnia sp., EC50, 48 h, 40.4 mg/l (Sodium hydroxide)

12.2. Persistence and degradability

12.2.1. Abiotic degradation

- Air Result: neutralization by natural alkalinity
- Water Result: ionization/neutralization
Conditions: pH
- Soil Result: ionization/neutralization

12.3. Bioaccumulative potential

- Not relevant

12.4. Mobility

- Water, Soil/sediments: Considerable solubility and mobility
- Soil/sediments: Mobile, soluble, ionization/neutralization
- Air: Chemical degradation

12.5. Results of PBT and vPvB assessment

Not classified as PBT or vPvB

12.6. Other adverse effects

- No data available



SAFETY DATA SHEET

According to Regulation (EC) No. 1907/2006 (REACH).

SECTION 13: DISPOSAL CONSIDERATIONS

13.1. Waste treatment methods

Product

- Dilute with plenty of water.
- Solutions with high pH-value must be neutralized before discharge.
- Neutralise with acid.
- In accordance with local and national regulations.

Contaminated packaging

- Where possible recycling is preferred to disposal or incineration.
- Clean container with water.
- Dispose of as unused product.
- In accordance with local and national regulations.

SECTION 14: TRANSPORT INFORMATION

	ADR / RID / ADN / IMDG / IATA-DGR
14.1. UN number	UN 1824
14.2. UN proper shipping name	SODIUM HYDROXIDE SOLUTION
14.3. Transport hazard class(es)	8
14.4. Packing group	II
14.5. Environmental hazards	No
14.6. Special precautions for user	Not applicable
14.7. Transport in bulk according to Annex II of Marpol and the IBC Code-	Not applicable
14.8. Additional information	
ADR/RID HIN/UN No.	80 / 1824
IMDG EmS	F-A S-B

SECTION 15: REGULATORY INFORMATION

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

- Regulation (EC) No 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), as amended.
- Regulation (EC) No 1272/2008 of the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, as amended.
- Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work, as amended.
- Commission Directive 2000/39/EC of 8 June 2000 establishing a first list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC on the protection of the health and safety of workers from the risks related to chemical agents at work, as amended.
- Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste.
- 2018 Code of Practice for the Safety Health & Welfare at Work (Chemical Agents) Regulations (SI No. 619 of 2001)

Notification status

Inventory Information	Status
Toxic Substance Control Act list (TSCA)	- In compliance with inventory
Australian Inventory of Chemical Substances (AICS)	- In compliance with inventory
Canadian Domestic Substances List (DSL)	- In compliance with inventory



SAFETY DATA SHEET

According to Regulation (EC) No. 1907/2006 (REACH).

Korean Existing Chemicals List (ECL)	- In compliance with inventory
EU list of existing chemical substances (EINECS)	- In compliance with inventory
Japanese Existing and New Chemical Substances (MITI List)	- In compliance with inventory
Inventory of Existing Chemical Substances (China) (IECS)	- In compliance with inventory
Philippine Inventory of Chemicals and Chemical Substances	- In compliance with inventory
New Zealand Inventory of Chemicals (NZIOC)	- In compliance with inventory

SECTION 16: OTHER INFORMATION

16.1. Full text of H-Statements referred to under section 3

- H290 - May be corrosive to metals.
- H314 - Causes severe skin burns and eye damage.

16.2. Other information

Section	Revisions to Previous issue
All	General reformatting and update.

- Distribute new edition to clients

This SDS is only intended for the indicated country to which it is applicable. The European SDS format compliant with the applicable European legislation is not intended for use nor distribution in countries outside the European Union with the exception of Norway and Switzerland. Safety datasheets applicable in other countries/regions are available upon request. The information given corresponds to the current state of our knowledge and experience of the product, and is not exhaustive. This applies to product which conforms to the specification, unless otherwise stated. In this case of combinations and mixtures one must make sure that no new dangers can arise. In any case, the user is not exempt from observing all legal, administrative and regulatory procedures relating to the product, personal hygiene, and protection of human welfare and the environment.



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