# Aldbrough Hydrogen Pathfinder - Permit Application

## H5 Site Condition Report

PREPARED FOR

SSE Hornsea Limited

DATE
4th November 2025

REFERENCE
0653313

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SIGNATURE PAGE

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## H5 Site Condition Report

0653313

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## ACRONYMS AND ABBREVIATIONS

| Acronym | Description |
|---|---|
| ALD1 | Aldbrough 1 cavern |
| AGS | Aldbrough Gas Storage |
| AHP | Aldbrough Hydrogen Pathfinder |
| ALC | Agricultural Land Classification |
| aOD | Above Ordinance Datum |
| bgl | Below Ground Level |
| BGS | British Geological Survey |
| CSM | Conceptual Site Model |
| CWG | Criteria Working Group |
| C&L | Classification & Labelling |
| DAA | Directly Associated Activity |
| EA | Environment Agency |
| EMS | Environmental Management System |
| ERM | Environmental Resources Management Limited |
| ERYC | East Riding of Yorkshire Council |
| FOAK | First Of A Kind |
| HE | High Explosive |
| kg | Kilograms |
| km | Kilometres |
| kN | Kilonewton |
| m | Metres |
| $m^2$ | Square Metres |
| $m^3$ | Cubic Metres |
| OCGT | Open Cycle Gas Turbine |
| PAHs | Polyaromatic Hydrocarbons |
| PCBs | Polychlorinated Biphenyls |
| RHS | Relevant Hazardous Substance |
| SCR | Site Condition Report |
| SPT | Standard Penetration Tests |
| SPZ | Source Protection Zone |
| SSE | SSE Hornsea Limited |
| SVOC | Semi Volatile Organic Compounds |

| Acronym | Description |
|---|---|
| TPH | Total Petroleum Hydrocarbons |
| UKSO | UK Soil Observatory |
| UXO | Unexploded Ordnance |
| VOCs | Volatile Organic Compounds |
| WFD | Water Framework Directive |

# 1. SITE DETAILS

## 1.0 INTRODUCTION

SSE Hornsea Ltd (SSE) is proposing to develop the Aldbrough Hydrogen Pathfinder (AHP) project on land at SSE's Albrough Gas Storage (AGS) site, located on Garton Road in the East Riding of Yorkshire. In the context of this report 'the Site' is the AHP installation boundary. The AHP project is an important building block in the development of a thriving Humber hydrogen economy, underpinning the region's decarbonisation and supporting economic growth locally and nationally.

The AHP Project is an innovative power-to-power project, integrating electrolytic hydrogen production, salt cavern hydrogen storage and use of the hydrogen for the generation of low carbon power by way of an Open Cycle Gas Turbine (OCGT). All three components of the AHP project will be located on the same site, making it a First of a Kind (FOAK) development.

The main commercial activity at the Site will be the burning of natural gas and hydrogen to produce electricity. This activity is listed as a Part A activity in Schedule 1, Part 2 of the Environmental Permitting Regulations (England and Wales) 2016 (as amended) (EP Regulations). A new hydrogen production plant is also being developed at the Site. Up to 666 kg/h (up to 5,834,160 kg/year) of hydrogen will be produced using electrolysis for use in the OCGT. As such, SSE are also seeking to include hydrogen production as an additional listed activity on the permit under Schedule 1, Part 2 of the EP Regulations. This Site Condition Report (SCR) accompanies the permit application for the Site.

The SCR has been prepared by Environmental Resources Managed Limited (ERM) using data on current and expected future site operations provided by SSE with reference to the guidance provided by the Environment Agency (EA) in the May 2013 document Site Condition Report – Guidance and Templates Version 3[1]. The layout of this report is consistent with that suggested in the SCR template of the guidance document[2] as follows:

- Section 1 – Site details
- Section 2 – Condition of the land at permit issue
- Section 3 - Permitted Activities

## 1.1 SITE CONDITION REPORT AT PERMIT APPLICATION

This document acts as the Application SCR which has been prepared at the time of permit application. This Application SCR will be submitted to the EA with the environmental permit application.

When the time of permit surrender arises, a follow-up SCR will be produced and submitted to the EA for review.

[1] Microsoft Word - H5 SCR guide for applicants v2 0 4 August 2008.doc
[2] H5 Site Condition Report word template

| **1.0 SITE DETAILS** | |
|---|---|
| Name of the applicant | SSE Hornsea Limited |
| Activity address | Aldbrough Hydrogen Pathfinder, Garton Road, East Riding of Yorkshire |
| National grid reference | Grid Reference (6 figure)<br>TA 26099 36898<br><br>X (Easting), Y (Northing)<br>526099 , 436898<br><br>Latitude, Longitude (decimal)<br>53.813085 , -0.086284876 |
| Document reference and dates for Site Condition Report at permit application and surrender | • Mott MacDonald, Aldbrough Gas Storage Facility Ground Investigation Interpretative Report, dated November 2003<br>• Norwest Holst Soil Engineering Limited, Report on a Ground Investigation at Aldbrough Gas Storage Facility, dated September 2003<br>• Jacobs, SSE Hornsea Aldbrough Gas Storage, Application Site Report for PPC Permit Application, dated April 2006<br>• Atkins, Aldbrough 4z Borehole Support – Hydrogeological Impact Assessment, dated October 2019<br>• Atkins, Aldbrough Hydrogen Pathfinder – Feasibility Study Report, dated October 2022<br>• Socotec, Aldbrough Hydrogen Pathfinder Project Phase 2 FEED Project – Ground Investigation Report (Factual Account of Fieldwork and Laboratory Testing), Report No. A3039-23, dated June 2024<br>• ERM, AHP Phase 1 Environmental Site Assessment, dated June 2024 |
| Document references for site plans (including location and boundaries) | • ERM, Aldbrough Hydrogen Pathfinder, Permit Application: Supporting Information Document, 2025 |

## 1.2 SITE LAYOUT

The Site will comprise a series of buildings where production and processing activities will take place, with several external areas that bridge the gaps between the buildings and provide access and egress routes. The Site will comprise of the following main operational areas:

- Facility for the production, storage (Aldbrough 1 (ALD1) underground salt cavern) and retrieval of electrolytic hydrogen and its conversion into low carbon electricity by an OCGT;
- Reinstatement of an existing brine discharge pipe and associated infrastructure up to the mean low water mark; and
- Ancillary and utility equipment to support operations (including a ground flare, water treatment plant, bulk storage, nitrogen and compressed air).

Figure 1.1 in Appendix A shows the location and extent of the Site boundary. The Site surfacing comprises a mixture of hardstanding and soft landscaping.

The Site will include bulk storage facilities, and loading/unloading facilities for:

- Import of natural gas by pipeline to the Site;
- Storage and transfer of hydrogen to the OCGT; and
- Storage tanks for feedstock and intermediate products and utilities of the Site processes.

Further details on bulk storage are provided in the Environmental Permit Application Supporting Information Document (referenced in Section 1.1).

## 1.3 SITE DRAINAGE

The AHP facility drainage system is a common system which will be tied into the existing system at the AGS facility.

All chemical drains and drains from the Clean-In-Place (CIP) activities collected in the equipment areas will drain to a corner sump and will be disposed of via a third-party truck. The chemical injection packages are located indoors and therefore segregated from clean uncontaminated surface water.

Uncontaminated surface water run-off (from the roof and external areas) will be drained using new and existing surface water network at the AGS facility. Runoff is attenuated within an existing balancing lagoon to the south of the Site before discharge to the Cess Dale Drain/East Newton Drain. A separate surface water system exists to take runoff from the Aldbrough 1 (ALD1) wellhead and cellar area direct to the Cess Dale Drain. The runoff from these areas will include existing and new oil interceptors to capture any potential escape of oil i.e. during material delivery and/or loss of storage.

Process effluent from the demineralisation plant and cavern discharge (following rewatering and backflushing) will discharge via a refurbished pipe to the North Sea.

Separated water from hydrogen compression and all other separated water from gas streams will be recirculated back to the demineralisation plant for reuse.

Foul drainage from welfare facilities and offices will discharge to the existing AGS sewage treatment package plant.

Further details are provided in the Environmental Permit Application Supporting Information Document (referenced in Section 1.1).

## 1.4 SURROUNDING LAND USE

The Site is located in the East Riding of Yorkshire administrative boundary within a rural-urban fringe area with occasional manmade industrial features. The following identifies receptors surrounding the Site.

- *To the North*: Arable farmland, as well as the hamlet of East Newton (1 km northeast of the Site).
- *To the East:* Arable land and The North Sea.

- *To the South:* Arable farmland, as well as a second previously engineered vacant area. East Newton Drain (stream) is located immediately adjacent to the south-eastern boundary of the Site.
- *To the West:* Arable farmland, with Garton Road c. 650 m west of the ALD1 salt cavern wellhead area. Isolated farm buildings and dwellings are present along Garton Road. The Cess Dale Drain flows in a generally southern direction to the west of the Site.

Further details of surrounding environmental receptors and sensitive built receptors are provided in the Environmental Permit Application Supporting Information Document (referenced in Section 1.1).

# 2. CONDITION OF THE LAND AT PERMIT ISSUE

| **2.0 Condition of the land at permit issue** | |
|---|---|
| Environmental setting including:<br>• geology<br>• hydrogeology<br>• surface waters | Details are provided in **Section 2.1**. |
| Pollution history including:<br>• pollution incidents that may have affected land<br>• historical land-uses and associated contaminants<br>• any visual/olfactory evidence of existing contamination<br>• evidence of damage to pollution prevention measures | Details are provided in **Section 2.2** and **Section 2.3**. |
| Evidence of historic contamination, for example, historical site investigation, assessment, remediation and verification reports (where available) | Details are provided in **Section 2.3** |
| Baseline soil and groundwater reference data | Details are provided in **Section 2.3** |

## 2.1 ENVIRONMENTAL SETTING

### 2.1.1 REGIONAL GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

#### 2.1.1.1 SOILS

According to UK Soil Observatory (UKSO) 'Soilscapes' data[3], the majority of the Site is described as having 'slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils (Soilscape 18)', with 'slightly acid, loamy and clayey soils with impeded drainage (Soilscape 8)' at the far east of the Site.

[3] UK Soil Observatory, Soilscapes. Available online at: https://mapapps2.bgs.ac.uk/ukso/home.html

Natural England's Agricultural Land Classification (ALC) map for Yorkshire and the Humber[4] indicates that the soils underlying the Site are classified as Grade 3 ('Good to Moderate').

#### 2.1.1.2 GEOLOGY

According to British Geological Survey (BGS) online mapping[5], as well as geological maps provided in the Envirocheck® Report (see Appendix D), the Site is underlain by superficial deposits of Glacial Till, with localised alluvium (variable clay, silt, sand and gravel) associated with Cess Dale and East Newton Drains. Marine beach deposits (sand and gravel) are present at the coastline in the far east.

Bedrock underlying the Site is reported to comprise Rowe Chalk Formation. Some Made Ground may be present overlying the Glacial Till in parts of the Site which have previously been developed. The nature of the Made Ground, if present, is unknown. Elsewhere, topsoil is anticipated to be present. A stratigraphic cross section presented on the BGS 1:50,000 scale map (Sheet 73) and four available-to-view BGS borehole records within the Site boundary (TA23NE4 TA23NE6, TA23NE7 and TA23NE13) indicate the following geological sequence underlying the Site (see Table 2.1).

TABLE 2.1 SUMMARY OF GEOLOGICAL SEQUENCE UNDERLYING THE SITE

| Stratum | Depth to Top (m bgl) | Depth to Base (m bgl) | Thickness (m) | General Description |
|---|---|---|---|---|
| Glacial Till | 0.3 | 41.0 – 48.8 | 40.7-48.5 | Generally clayey glacial deposits with some sand and gravel layers. Overlain by ~0.3 m of topsoil. |
| Chalk Group (including Rowe, Flamborough, Burnham, Weldon and Ferriby Chalks) | 40.7 – 48.8 | c.600 | >550 | White Chalk with occasional chert bands, highly weathered towards the top |
| Lias Group | c.600 | c.720 | c.120 | Dark grey Mudstone and Siltstone |
| Penarth Group | c.720 | c.740 | c.20 | Red-brown Mudstone |
| Mercia Mudstone | c.740 | c.920 | c.180 | Red-brown Mudstone and Siltstone |
| Sherwood Sandstone | c.920 | c.1,600 | c.680 | Red Sandstone with Siltstone and Mudstone towards the base |
| Permian (Zechstein) Evaporites | c.1,600 | >1,940 | >340 | Evaporite sequence comprising mudstone, halite, |

[4] Natural England (2010), Agricultural Land Classification Yorkshire and The Humber (ALC003), 1:250,000 scale
[5] British Geological Survey, 1998, Map Sheet 73: Hornsea, Solid & Drift, 1:50,000 scale (https://webapps.bgs.ac.uk/data/maps) and British Geological Survey, GeoIndex Onshore (https://mapapps2.bgs.ac.uk/geoindex/home).

| Stratum | Depth to Top (m bgl) | Depth to Base (m bgl) | Thickness (m) | General Description |
|---|---|---|---|---|
| | | | | polyhalite, anhydrite (gypsum) and dolomite. 'Main salt' (halite) logged from c.1,770m – c.1,920m bgl is inferred to correspond to the depth of the cavern. |

m bgl – metres below ground level

BGS online resources[6] indicate that the coastal cliffs in the Aldbrough area are formed of Skipsea and Withernsea Glacial Tills and are actively receding. An erosion rate of approximately 2 m per annum was recorded in the last 50 years. Discussions between the SSE and ERYC in May 2024 indicated that along the coastline adjacent to the Site, this rate of erosion is predicted to increase from 2 m to up to 6 m per annum, the rate of which will be linked to the number of storm events in a particular year. The ERYC has advised SSE that a NCERM2 coastal change (with climate change) study has been commissioned at the time of writing. For this assessment, the middle value of 4 m of coastal erosion per year has been considered.

Landslides, primarily by rotational slumping, are common due to the difference in erosion profiles of the different till materials. Numerous buildings located on the cliff edge have been lost to coastal erosion over the centuries.

According to the Coal Authority's online mapping[7], the Site is not located within a Coal Mining Reporting Area.

The ALD1 storage cavern exists beneath the Site at a depth of 1,782 m bgl to 1,860 m bgl. However, given the significant depth of the cavern, and the presence of competent overlying strata, subsidence is not anticipated to materialise at the ground surface. No subsidence, or other effects at ground surface, have been observed associated with the existing AGS facility, which has nine related underground caverns at similar depths.

According to UK Radon mapping, the Site is in a low potential radon area, where less than 1% of homes are at or above the action level.

#### 2.1.1.3 HYDROGEOLOGY

EA aquifer classifications for strata underlying the Site are as follows:

- Glacial Till – Secondary Undifferentiated Aquifer, defined as 'an aquifer where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value';
- Alluvium – Secondary A Aquifer, defined as 'permeable layers that can support local water supplies, and may form an important source of base flow to rivers'; and

[6] BGS (no date), Landslides and coastal erosion at Aldbrough, East Riding of Yorkshire. Available online at: https://www.bgs.ac.uk/case-studies/landslides-and-coastal-erosion-at-aldbrough-east-riding-of-yorkshire-landslide-case-study/
[7] The Coal Authority, Interactive Map Viewer. Available online at: https://mapapps2.bgs.ac.uk/coalauthority/home.html

- Rowe Chalk Formation – Principal Aquifer, defined as 'highly permeable aquifers with significant water storage and are able to support large abstractions'. The Chalk is however likely to be brackish in nature given the close proximity to the North Sea.

According to BGS borehole log TA23NE13, drilled at the Site in 2019 as a groundwater abstraction well, resting groundwater level beneath the Site was recorded at a depth of 13.5 m bgl. The well was installed from 46 m – 100 m bgl. According to a Hydrogeological Impact Assessment report prepared by Atkins in 2019 (see Appendix C, groundwater within the Chalk aquifer beneath the Site flows in an easterly direction towards the North Sea.

According to the Envirocheck® Report (see 0), there is one licensed groundwater abstraction within the Site boundary:

- SSE's groundwater abstraction at the AGS facility, abstraction licence ref. NE/026/033/011, issued March 2020 for 'Petrochemicals: general use' (inferred to correspond to BGS borehole ref. TA23NE13, see above); and

The Atkins 2019 Hydrogeological Impact Assessment report identified two current unlicensed, private groundwater abstractions, both used for agricultural purposes (pig farms), in the vicinity of the Site which were considered to have the potential to be affected by the AGS facility groundwater abstraction, as follows:

- Springfield Farm, c. 210 m west of the Site, abstraction rate <20 $m^3$ per day, total well depth c. 65 m bgl, pump depth c. 40 m bgl; and
- Hilltop Farm, c. 1.3 km north of the Site, abstraction rate < 20 $m^3$ per day, total well depth c. 65 m bgl, pump depth unknown.

Information received from the EA on 30th June 2023 in response to a request for information on other (private) groundwater abstractions in the vicinity of the Site indicated that the AGS borehole is the only recorded abstraction within 1 km of the Site. ERM notes that this is contrary to the information obtained from the Envirocheck® Report and the 2019 Atkins Hydrogeological Impact Assessment (see above). East Riding of Yorkshire Council (ERYC) indicated via email on 30 June 2023 that they do not hold any information on private water supplies within 1 km of the Site.

The Site is not located within a groundwater Source Protection Zone (SPZ) nor a Drinking Water Safeguard Zone with respect to groundwater, and none are located within 1 km of the Site. Combined groundwater vulnerability is classified as 'medium' across the majority of the Site, with a small area classified as 'high' vulnerability at the far eastern side.

The regional Water Framework Directive (WFD) groundwater unit in the vicinity of the Site (Hull and East Riding Chalk operational catchment) is classified by the EA as having an overall 'poor' quality (2019 classifications), reportedly related to poor nutrient / agriculture / rural land management in the area. Given the proximity to the North Sea, saline intrusion is also possible.

#### 2.1.1.4 HYDROLOGY

A series of surface water drains, part of the Cess Dale and East Newton Drain networks, cross the Site and surrounding fields. Cess Dale and East Newton Drains meet adjacent to the south-eastern corner of the salt cavern part of the Site. From this point, the watercourse is known as Bail Drain and flows in a generally south-westerly direction towards Humbleton Beck. The Site is not located within a Drinking Water Safeguard Zone with respect to surface water.

According to the Envirocheck® Report (see 0), there are two licensed surface water abstractions on site (both with licence reference 2/26/33/031), registered to Jacobs Engineering UK Limited for abstraction of water from Cess Dale Drain for 'dust suppression' and 'conveying materials'. The permits were issued in 2004 and related to earthworks during construction of the AGS facility, which was complete in 2012.

The Site is located within the WFD Humbleton Beck Water Body, which is classified by the EA as having 'moderate' ecological quality (2019 classifications). According to the EA's flood maps for planning, the Site is located with a Flood Zone 1, which is defined as having a low (<0.1%) probability of flooding from rivers or sea in any given year. The Envirocheck® Report indicates that the majority of the Site is located in an area at 'low' risk of surface water flooding (i.e. flash flooding from extreme rainfall events), with localised areas close to the surface watercourses and on roadways classified as 'high' risk (flooding possible in a 30-year rainfall event). The Envirocheck® Report indicates that the Site has limited potential for groundwater flooding (i.e. emergence of groundwater at the surface).

## 2.2 HISTORICAL LAND-USES

### 2.2.1 ON-SITE AND OFF-SITE HISTORY

Historical Ordnance Survey (OS) maps obtained as part of the Envirocheck® Report (1855 – 2023), as well as publicly available aerial imagery (Google Earth, 2003 – 2022) indicate the following on-site (Table 2.2 and offsite history (Table 2.3), pertinent features within approximately 500 m of the Site only):

TABLE 2.2 SUMMARY OF ON-SITE HISTORY

| Map / Image Date | Description |
|---|---|
| 1855 - 1978 | The Site is undeveloped, agricultural land.<br>Ringbrough Farm is present at the far east of the Site, including three circular structures of unknown use, and a 'pump' labelled from 1975 (inferred to relate to the licensed groundwater abstraction. |
| 1995 - 2003 | Evidence of development of the salt cavern area of the Site, including earthworks, is visible on the 1995 map, although no buildings are present.<br>The remainder of the Site remains essentially unchanged. |
| 2007 - 2023 | The AGS facility has been constructed on the Site, generally consistent with its current layout. An above-ground pipeline is visible connecting the salt cavern area with the gas storage area.<br>The proposed laydown area appears to be bare soil, with evidence of a pond (inferred to be an attenuation pond) present in the north of the area.<br>Many of the Ringbrough Farm buildings have been lost to coastal erosion during this period (mostly between 2007 and 2012).<br>A concrete structure at the location of the water discharge pipe outfall is visible on the beach in aerial photographs from 2007 onwards. |

TABLE 2.3 SUMMARY OF OFF-SITE HISTORY

| Map / Image Date | Description |
|---|---|
| 1857 – 1999 | The wider area also comprises undeveloped, agricultural land.<br>A spring is shown to the north of Ringbrough Farm, close to the north-eastern corner of the Site.<br>The mapped location of the coastline recedes westwards by nearly 200 m during this period. |
| 2003 - 2023 | Ringbrough West (farm) has been constructed within the eastern (discharge pipeline area) part of the Site by 2003.<br>The coastline recedes to its current position during this period.<br>The remainder of the surrounding area remains essentially unchanged. |

### 2.2.2 OTHER HISTORICAL INFORMATION

The existing salt cavern, known as Aldbrough 1, was created by solution mining in 2005 and is currently used for storage of natural gas. SSE's AGS facility commenced operation in 2011. A further eight similar caverns are understood to be present beneath the wider site and surrounding area (which are not proposed to be altered as part of the proposed redevelopment). The cavern is reported to extend from a depth of 1,782 m bgl to 1,860 m bgl (based on 2018 sonar surveys by DEEP.KBB). No integrity issues were identified by Atkins in the Feasibility Study.

According to Historic England research records[8], Ringbrough Farm was reportedly used as an WWII artillery battery from 1941 to 1943, including barracks, pill boxes, observation posts, a guard room, three engine houses, a workshop and ammunition stores, as well as the original farm buildings. The majority of the buildings/structures associated with the battery have since been lost to coastal erosion.

#### 2.2.2.1 UNEXPLODED ORDNANCE (UXO)

Online unexploded ordnance (UXO) risk mapping by Zetica[9] classifies the risk of UXO at the Site as 'low'. However, a decoy site[10] is identified approximately 220 m to the north of the Site.

A Detailed UXO Risk Assessment was undertaken, which covers the current study site as well as areas to the north, south and east (offshore). It records the following:

- according to Home Office statistics, the Rural District of Holderness sustained an 'overall low density of bombing with an average of 15.2 items of ordnance dropped per 1,000 acres';
- the nearest significant bombing target in the area was Hull docks, approximately 11 km south of the Site, but a bombing decoy just north of the Site was also present;

[8]Heritage Gateway (2012), *Historic England Research Records – Ringbrough Battery*. Available online at: https://www.heritagegateway.org.uk/Gateway/Results_Single.aspx?uid=915262&resourceID=19191
[9]Zetica (2024), *Risk maps*. Available online at: https://zeticauxo.com/downloads-and-resources/risk-maps/
[10] Decoy sites were developed during WWII to create false bombing targets that were realistic enough to divert enemy aircraft away from the authentic ones.

- a written bomb census report from January 1942 indicated that the decoy site close to the northern Site boundary was responsible for the fall of several cluster bombs and high explosive (HE) bombs, some of which may have fallen within the current site boundary;
- written historical records identified at least two air raids in 1943 which may have impacted the Site, including an incendiary cluster bomb and a 500 kg HE bomb landing on or close to the north-western corner of the Site;
- As described in the aforementioned section, an allied heavy anti-aircraft battery defence station was located at Ringbrough Farm (on site) and an Auxiliary Unit operated from Bail Wood, approximately 130 m west of the Site;
- based on the local geology, potential bomb penetration depth is anticipated to be up to 12 m bgl; and
- an overall 'medium' risk from UXO was assigned to the Site and it was recommended that all ground disturbance works should be subject to mitigation measures such as a UXO Risk Management Plan, awareness briefings, magnetometer surveys and UXO specialist on-Site support.

### 2.2.3 POTENTIAL SOURCES OF CONTAMINATION

The following provides a summary of the identified potential sources of contamination from existing AGS site use within the proposed installation boundary, as provided by SSE:

- Methanol – a cylindrical, carbon steel, fixed roof, flat bottom methanol tank (35 $m^3$) provided with secondary containment is located in the northern portion of the Site this is used in the natural gas well to prevent hydrate formation during the early stages of a gas export. This is supplied to the wells by above ground or within submerged channel pipelines. Whilst no notable spill incidents are known, there exists the potential for minor unidentified leaks from tanks and associated pipelines into drainage channels.
- Methanol recovery plant – a recovery plant was installed and commissioned at the AGS facility, however this has not been operated to any significant degree. Due to the limited quantities of methanol used. The plant is provided with secondary containment for any equipment processing / storing methanol.
- Diesel – a Fuel Proof 'Fuelstore' tank double skinned diesel tank designed to be mobile and moved by fork lift truck (although which typically remains in situ) is utilised for refueling of equipment across the Site (1,000 litres). The diesel tank is stored in the stores compound to the northwest of the Site. There is potential for small spillages within the areas of filling and dispensing, along with leaks from the diesel tank where it is stored. At time of writing there have been no notable spillages or leaks associated with the mobile diesel tank.
- Waste oil – a double skinned Fuel Proof Waste Oil tank (circa 1400 litres) is used for collection of waste oil across the Site. While designed to be mobile and moved by fork lift truck, it remains in-situ located at the Central Processing Area adjacent to the east side of the control building.
- Drums and IBC storage (oils and glycols) – there are several drum and IBC storage containers located in the yard at the stores to the northwest of the AGS site. These are covered / enclosed and provided with secondary containment.

- Lease Area (southeastern portion of the Site) raised concrete bund – this is used for temporary storage of lubricant oils and glycols during well maintenance activities.
- A total volume of 91,880 litres of lubricating oil is used on Site within the three compressors for the natural gas caverns. Smaller volumes of lubricating oils are used for motor bearings and fans. There is a potential for leaks and spillages from storage containers to ground entering the drainage and groundwater system. There are also transformers, containing oil for cooling and insulation, located in the southwest area of the AGS site.
- Glycol is used as coolant in the hot water system (approximately 26,000 litres) and for the compressor (2,400 litres) systems. At time of writing there was no information on any known spillages or incidents at the Site.

A map illustrating the locations of these previous sources is provided in Appendix B.

A Phase 1 environmental risk assessment has been completed for the site and provided in Appendix C. The Phase 1 environmental risk assessment identifies potential risk to receptors from this sources.

## 2.3 BASELINE SOIL AND GROUNDWATER DATA

Available previous desk studies and site investigation reports are presented in Appendix C and are summarised below.

### 2.3.1 SUMMARY OF PREVIOUS SITE INFORMATION

**Socotec, Aldbrough Hydrogen Pathfinder Project Phase 2 FEED Project – Ground Investigation Report (Factual Account of Fieldwork and Laboratory Testing), Report No. A3039-23, dated June 2024**

In December 2023, Socotec were commissioned by SSE Hornsea Ltd to obtain geotechnical information to aid the design of the proposed electrolyser and open cycle gas turbine at the Aldbrough Gas Storage Facility, East Riding of Yorkshire.

The scope of works included the drilling of 11 cable percussion boreholes to a maximum recorded depth of 15 m below ground level (bgl) and 4 dynamic windowless sample locations to a maximum depth of 2.45 m bgl. To obtain in-situ geotechnical information standard penetration tests were undertaken, pocket penetrometer and hand vane tests were undertaken on recovered material and soil samples were collected for laboratory analysis.

A total of ninety-nine moisture content and twenty-three particle size distribution tests were completed at the Socotec Doncaster Laboratory.

Made Ground comprising brown, slightly sandy, silty, gravelly sand was encountered within each location to a maximum recorded depth of 1.2 m bgl. Gravel was of brick, limestone, chalk, coal and chert. The Made Ground was underlain by glacial till comprising firm to very stiff brown becoming dark grey slightly sandy, slightly gravelly, slightly silty clay to a maximum recorded depth of 15 m bgl. In one location (BCV-103) the Made Ground was directly underlain by alluvium, comprising soft to firm orange and brown slightly sandy, gravelly silty clay to a maximum recorded depth of 3 m bgl. The alluvium was underlain by glacial till.

A total of twenty-one Made Ground soil samples were analysed for water content, with the results ranging from 6.1 to 23.%. Two soil samples were analysed for water content within the alluvium samples with results of 15.6 and 18.4%. A total of seventy-six soil samples from the glacial till were analysed for water content, with the results ranging from 8.9 to 30.3%.

**Atkins, Aldbrough Hydrogen Pathfinder – Feasibility Study Report, dated October 2022**

A feasibility study undertaken by Atkins in 2022 noted the following in relation to ground conditions at the site.

The report noted that the potential alluvium at the site may present a geotechnical risk in relation to compressibility, as well as having the potential to generate ground gas. To be able to determine the geotechnical parameters for foundation design a site-specific ground investigation was recommended. A groundwater monitoring regime was also recommended to understand the seasonal fluctuations and help to inform foundation design.

In addition, the report noted the former presence of three 'unspecified tanks' adjacent to Ringbrough Farm. No tanks were labelled on historical maps obtained by ERM as part of the current assessment. Three circular structures were identified in this location but their depiction on historical mapping is not considered consistent with storage tanks. Various structures and buildings were reportedly present at Ringbrough Farm related to its use as an artillery battery during WWII. It is possible that fuel storage tanks were present (e.g. related to the engine houses) but the actual use of the circular structures is unknown. Furthermore, based on historical mapping, the circular structures were lost to coastal erosion sometime between 1976 and 1995.

**Atkins, Aldbrough 4z Borehole Support – Hydrogeological Impact Assessment, dated October 2019**

Atkins undertook a hydrogeological risk assessment in 2019 to support the abstraction licence application for the on-site groundwater abstraction, known as 'ALD1'.

The scope of works included the drilling of a borehole to a depth of 100 m bgl in July/August 2019. Glacial Till was encountered to a depth of 41 m bgl underlain by Chalk bedrock. The Chalk was reported to be highly fractured to approximately 65 m bgl, below which it was described as 'competent'.

Test pumping (a step test and a constant rate test) was carried out on the newly-drilled borehole. Groundwater level monitoring was carried out at two observation wells, located at Springfield Farm (actively used, c. 210 m west of the current study site and 855 m west of ALD1) and Ringbrough Farm (reported to be disused, located on the far eastern part of the current study site and 1,070 m east of ALD1). Samples were also collected from the observation wells before and after the test pumping for water quality monitoring purposes.

Resting groundwater level in the abstraction borehole (prior to test pumping) was recorded at an elevation of 0.85 – 1.05 m above Ordnance Datum (aOD). A tidal oscillation of approximately 0.1 m was identified. In the observation borehole at Ringbrough Farm, located immediately adjacent to the North Sea coastline, significant tidal oscillation was recorded (approximately 1.2 m).

The effects of the constant rate test were recorded in both observations wells, up to 1.5 m at Springfield Farm and up to 2.1 m at Ringbrough farm (when corrected for tidal effects). Atkins

reported that this indicated that transmissivity was greater inland from the ALD1 borehole than towards the coast.

Electrical conductivity monitoring reportedly showed no significant change in ALD1 or the observation wells during the pump tests, suggesting that saline water was not drawn into the wells as a result of the pumping. Nevertheless, the report identifies the potential upwelling of saline water into the Chalk aquifer as a potential long-term impact of the proposed abstraction and operational monitoring of electrical conductivity was proposed to mitigate this risk. Elevated concentrations of iron and manganese were measured in the groundwater, reportedly consistent with the Chalk aquifer in the wider area. No adverse impacts on water quality were reported in the observation wells (or ALD1) as a result of the test pumping.

A conceptual site model (CSM) was presented in the report and indicated that there is no hydraulic connectivity between surface water features and groundwater in the vicinity of the site. ERM notes that this is assumed to mean groundwater within the Chalk bedrock aquifer; shallow groundwater may also be present in Made Ground and / or superficial deposits (Alluvium).

**Jacobs, SSE Hornsea Aldbrough Gas Storage, Application Site Report for PPC Permit Application, dated April 2006**

This report was submitted for the application of a permit to operate an installation under Regulation 10 of the Pollution Prevention and Control (England and Wales) Regulations 2000 at the SSE Hornsea Natural Gas Storage Facility, Aldbrough.

Records had been reviewed of the site and surrounding areas, along with proposed operational records for the site, in order to describe site conditions, identify any potential contaminants of concern which may cause pollution risk to the site. The report also looked at pollution prevention measures and a completed assessment of pollution potential to land has been undertaken.

Details from the findings of the desk study and site reconnaissance were used in the development of a CSM. The CSM looked at potential sources, pathways and receptors.

Limited fuel and chemical storage is anticipated at the facility, therefore there is no potential contaminants of concern at the facility.

The potential pathways identified were shallow groundwater in the alluvium and surface water drains which are located on the east, south and west of the facility.

The potential receptors identified were the underlying geology, perched groundwater, groundwater in the chalk aquifer and surface waters.

Based on the low volumes of fuel/chemicals, control measures in place and good management practices, it was concluded that there is minimal risk of pollutant spillages and as such, risk to underlying ground and groundwater from future operations is minimal.

The assessment concluded that there is little likelihood that land pollution or leaks to the land will occur during the future life if the installation due to the stringent engineering standards in the design of the facility and control measures in place.

**Norwest Holst Soil Engineering Limited, Report on a Ground Investigation at Aldbrough Gas Storage Facility, dated September 2003**

Norwest Holst undertook a ground investigation at the site in July 2003 to assess ground conditions in the location of the (at the time) proposed AGS facility. The investigation comprised:

The scope of work included 16 cable percussive boreholes to depths of between 5.0 m and 10.5 m bgl, including three installed as groundwater monitoring wells; twenty-nine excavated trial pits to depths between 2.3 m and 4.0 m bgl and three trial trenches to depths between 3.1 m and 4.0m bgl approximately 12 m to 17 m in length.

Soil samples were collected for geotechnical testing, including moisture content, particle size distribution, dry density, California Bearing Ratio, consolidation, triaxial compression and BRE sulphate testing.

All investigation locations were within, or on the boundary of, the footprint of the AGS facility area subject to the current study.

The site investigation did not identify any Made Ground to be present within any of the investigation locations. Geology encountered comprised slightly sandy, slightly gravelly clay, sand and gravel and clayey gravelly sand (alluvium and glacial till).

No bedrock was encountered.

Groundwater was in encountered in nine boreholes and ten trial pit locations, at depths between 2.0 m and 8.6 m bgl.

**Mott MacDonald, Aldbrough Gas Storage Facility Ground Investigation Interpretative Report, dated November 2003**

Mott MacDonald prepared an interpretative report based on the Norwest Holst investigation (above) in November 2003. The report contained the following additional information:

The ground investigation was undertaken by Northwest Holst between the 16$^{th}$ and 29$^{th}$ July 2003 and included the drilling of sixteen cable percussive boreholes to depths ranging between 5.0 m and 10.5 m bgl, twenty-nine trial pits to a maximum depth of 4.0 m bgl and three trial trenches to depths between 3.1 m and 4.0 m bgl.

Encountered ground conditions comprised glacial till described as firm to stiff, occasionally soft, brown and orange slightly sandy, gravelly clay. The gravel comprised chalk, mudstone, sandstone, quartz and limestone.

A number of in-situ tests were conducted with Standard Penetration Tests (SPT) values ranging from 9 to 35. A total of fifty-nine hand vane tests were completed within material covered from trial pits with results ranging from 45 kN/m$^2$ to 130 kN/m$^2$.

Geotechnical laboratory analysis was undertaken on a number of soil samples recovered. Twenty-three particle size distribution tests were undertaken and the material was classified as gravelly, sandy clay. Atterberg limit tests classified the material to be intermediate plasticity clays and low to high plasticity. A total of thirty-six soil samples were analysed for moisture content returning results from 4.6 to 13.8%.

Alluvium was encountered in a total of eleven locations in the western and southern portion of the site to a maximum depth of 2.1m bgl. The alluvium comprised slightly clayey sand with gravel and occasional cobbles of chalk, sandstone, limestone, mudstone, slate and dolerite.

SPT results within the alluvium ranged between 9 and 22. A total of twenty-three hand vane tests with results ranging from 32 kN/m$^2$ to 130 kN/m$^2$. Thirteen particle size distribution tests were undertaken and the material was classed as gravelly sandy clay, clayey sand, sandy clay and sandy gravel. Five Atterberg limit test were undertaken with the material being classified as

intermediate to high plasticity clays. Moisture content analysis was undertaken on six soil samples and returned results between 14 and 34%.

Bedrock geology was not encountered during the investigation.

Groundwater was encountered in nineteen locations at depths between 2.0 m (TP202, TP220) and 8.6 m bgl (BH106). Three groundwater monitoring wells were installed as part of the investigation with resting groundwater levels measured between 0.83 m (BH117) and 3.2 m bgl (BH103). Resting groundwater levels were generally consisted with the water level in Cess Dale and East Newton Drains. It was concluded that the shallowest groundwater was likely to be perched, as a result of local variations in permeability. No groundwater analysis was undertaken during this investigation.

Two samples were analysed for pH and water soluble sulphate. pH levels results of 7.1 and 8.4 with associated water soluble sulphate as SO4 concentrations of 0.021 g/l and 0.292 g/l were reported. These results were assessed against the BRE Special Digest 1 for concrete design and classified the site as Design Sulphate class DS-1 and the ACEC classification as AC-1.

The report recommended that pad or strip foundations would likely be suitable for lightly loaded structures. However, for heavier structures, and in areas where less competent Alluvium is present, it is recommended that shallow foundations were not used.

**Foundation Exploration Services Ltd, Ground Investigation, dated 1992 (information provided within Mott MacDonald, 2003 report)**

An investigation was undertaken to determine ground conditions to aid in foundation and earthwork design at the site.

The scope of works included ten trial pits (five of which were within the site boundary) to depths ranging between 1.0 m and 2.5 m bgl. The geology comprised glacial till described as stiff to very stiff sandy, gravelly clay.

Moisture content results ranged from 13 to 45%. A total of two plasticity index tests were undertaken and indicated the material comprised intermediate to high plasticity clays (liquid limit 42 and 68%; plastic limits of 23 and 28%; plasticity index of 19 and 40%).

### 2.3.2 PROPOSED FUTURE SITE INVESTIGATION

Based on the information provided by SSE and publicly available data, the risk of existing contamination is considered to be low for the Site for the following reasons:

- Prior to the construction of the AGS site, the Site was previously an undeveloped parcel of land/greenfield, therefore contamination risk pre-construction was low and overall risk to identified receptors had been assessed as not significant.
- There are no records of pollution incidents onsite or within the immediate surrounding, as provided in the Envirocheck report.
- On review of previous site investigations (see Section 2.3.1), no visual/olfactory evidence of existing contamination was noted.
- Information provided by SSE shows a geomembrane liner is located on the eastern portion of the Site covering an area of approximately 2.3 hectares in the vicinity of the wellheads. Details of the construction and condition of the liner are not known. This liner would reduce the likelihood of contaminants reaching the subsurface material and groundwater.

Of the previous investigations undertaken, no environmental samples have been taken to assess the baseline or current conditions of the site. A further assessment in relation to the potential ground contamination in the form of an intrusive investigation will be completed by SSE ahead of the Site operational start date. The investigation should focus on areas where there is a potential source of contamination (such as the chemical storage areas, location of tanks and any known spillage locations). Additional boreholes along the Site boundary will be installed to allow for long-term monitoring of the groundwater. Monitoring locations would be proposed by SSE and confirmed with the EA prior to the construction of the new facility. The data collected will then be reviewed prior to construction to enable the risks to be adequately assessed and design to be refined, where practicable. The following analysis of soil and groundwater is recommended, but not limited to:

- Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG);
- Semi-Volatile Organic Compounds (SVOCs incl. Polyaromatic Hydrocarbons (PAHs);
- Volatile Organic Compounds (VOCs); and
- Metals.

However, mitigation measures will be implemented to reduce the potential magnitude and/or likelihood of potential impacts by compliance with the requirements of the Environmental Permit and associated implementation of an Environmental Management System (EMS) during the operation phase. Taking all of the above into account, the implementation mitigation measures, the significance of residual effects with respect to geology and ground conditions during both construction and operational phases of the Site has been assessed as 'not significant'.

# 3. PERMITTED ACTIVITIES

| **3.0 Permitted activities** | |
|---|---|
| **Permitted activities** | The permitted activity will be:<br>• the combustion of natural gas and hydrogen in appliances with an aggregated thermal input of more than 50 MWth (total thermal input of 125.8 MWth); and<br>• The production of inorganic chemicals (up to 666 kg/h of hydrogen)<br><br>A full list of directly associated activities to be undertaken at the site are provided in the Environmental Permit Application Supporting Information Document (referenced in Section 1.1). |
| **Non-permitted activities undertaken** | Not applicable at time of application. |
| **Document references for:**<br>**1. plan showing activity layout; and**<br>**2. Environmental risk assessment.** | Further details of proposed activities at the Site are provided in the Environmental Permit Application Supporting Information Document (referenced in Section 1.1). This includes a plan showing activity layout and an environmental risk assessment. |

## 3.1 SITE ACTIVITIES TO BE PERMITED

The primary activities at the Site will be the burning of natural gas and hydrogen to produce electricity and production of hydrogen gas. These activities are listed as a Part A activity in Schedule 1, Part 2 of the EP regulations and is presented in Table 3.1.

The Site permitted activities are referenced in the Environmental Permit Application Supporting Information Document (Sections 1.3 and 1.4).

TABLE 3.1 LISTED ACTIVITIES

| Listed Activity | Description | Limits |
|---|---|---|
| Section 1.1 Part A (1) (a) "Burning any fuel in an appliance with a rated thermal input of 50 or more megawatts | 1 x 125.8 MWth Open Cycle Gas Turbine fired on natural gas and hydrogen. For the production of electricity (up to 50 MWe output capacity) | From receipt of fuel (natural gas and hydrogen) to emission of combustion products and the generation of electricity for export. Includes the operation of Selective Catalytic Reduction NOx abatement plant. |
| Section 4.2 Part A (1) (a) "Producing inorganic chemicals such as (i) gases (hydrogen)" | Up to 666 kg/h production of hydrogen gas using electrolysis | From receipt of abstracted groundwater for use in electrolysis, to input into adjoining OCGT plant. |

### 3.1.1 DIRECTLY ASSOCIATED ACTIVITIES (DAA)

The EP Regulations, Schedule 1, Part 1 defines a DAA as an operation which:

- has a technical connection with the activity;
- is carried out on the same site as the activity; and
- could have an effect on pollution.

Table 3.2 sets out the activities that are directly associated with the activities listed in Table 3.1.

TABLE 3.2 DIRECTLY ASSOCIATED ACTIVITIES

| Directly associated activity | Description of Specified Activity | Limits of Specified Activity |
|---|---|---|
| Hydrogen Storage | Storage of hydrogen in Aldbrough 1 (ALD1) underground cavern. | From point of receipt to point of use. |
| Temporary flaring of $H_2S$ | Operation of temporary $H_2S$ flare from degassing of cavern discharge. | From combustion of $H_2S$ gas to venting to the atmosphere. |
| Hydrogen purification | Hydrogen purification system upstream and downstream of the ALD1 cavern via a fixed bed catalyst. For the removal of oxygen and gas drying prior to storage, and removal of impurities carried over from cavern storage prior to combustion in the OCGT. | From produced and stored hydrogen by the electrolyser package to combustion in the gas turbine. |
| Hydrogen compression, deoxygenation and drying | Compression, deoxygenation and drying of hydrogen following purification through cooling and removal of oxygen and water content. | From produced hydrogen to removal of water and impurities. |
| Flaring of Hydrogen | Operation of the hydrogen flare. | From combustion of hydrogen gas to venting to the atmosphere. |
| Water treatment | Raw water treatment in demineralisation (demin) plant. | From receipt of abstracted groundwater to the production of treated water for point of use. |
| Process effluent discharge | Wastewater discharge consisting of process effluent (RO reject) from demin plant. | From demin plant to the North Sea at emission point W5. |
| Cavern water discharge | Water discharge from ALD1 cavern dewatering. | From receipt of abstracted groundwater and collection of cavern discharge to the North Sea at emission point W5. |
| Surface water discharge | Discharge of uncontaminated surface water runoff (from the roof and external areas). | From handling and storage of uncontaminated runoff to discharge to the Site surface water system via interceptors to the Cess Dale Drain and balancing lagoon (to the Cess |

| Directly associated activity | Description of Specified Activity | Limits of Specified Activity |
|---|---|---|
| | | Dale Drain and East Newton Drain). |
| Water abstraction | Abstracted borehole water for use in rewatering ALD1 cavern, backflushing and dilution of cavern dewatering and process water. | From intake of borehole water to use in plant and final discharge to the North Sea. |
| Cooling water system | Fin-fan cooling system for process cooling, mechanical, electrical and utility spaces. | From point of receipt to point of use. |
| Nitrogen | Inert gas for use in the electrolysis system to ensure continuous operation of the electrolyser plant by providing a safe inert atmosphere prior to commencing hydrogen production. | From point of receipt to point of use. |
| Compressed Air | Use in various components of the overall system including electrolyser units, the water treatment system, Deoxo-dryer, compressors, SCR unit, control valves and instruments which require dry and oil-free instrument air. | From point of receipt to point of use. |
| Storage and handling of chemicals, raw materials and product | Storage, handling and distribution of raw materials and final product. | From point of receipt of raw materials and final product to point use. |
| Firewater management | Storage of firewater in a bulk storage tank for use in the firewater system. | From point of receipt of mains water to point of use and subsequent discharge to disposal offsite. |
| Diesel firewater pump | Combustion of diesel in 1 x emergency back-up diesel firewater pump engine with a thermal rated input <1MWth | From receipt of fuel to emission of combustion products. |

## 3.2 BASIS OF BASELINE REPORT

In order to determine whether a baseline report is required, a three-stage approach is followed[11]:

- *Stage 1 – Identify which hazardous substances are used, produced or released at the installation and produce a list of these hazardous substances;*
- *Stage 2 – Identify which of the hazardous substances from Stage 1 are 'relevant hazardous substances'. Discard those hazardous substances that are incapable of contaminating soil or groundwater. Justify and record the decisions taken to exclude certain hazardous substances;*
- *Stage 3 – For each relevant hazardous substance brought forward from Stage 2, identify the actual possibility for soil or groundwater contamination at the site of the installation, including the probability of releases and their consequences, and taking particular account of:*
  - *the quantities of each hazardous substance or groups of similar hazardous substances concerned;*
  - *how and where hazardous substances are stored, used and to be transported around the installation;*
  - *where they pose a risk to be released;*
  - *In case of existing installations also the measures that have been adopted to ensure that it is impossible in practice that contamination of soil or groundwater takes place.*

Where a potential risk to soil and groundwater is identified, then site baseline condition data must be collated and submitted as part of the Permit application and a plan established for monitoring of soil and groundwater monitoring throughout the lifetime of the permit.

### 3.2.1 STAGE 1 - SITE INVENTORY OF HAZARDOUS SUBSTANCES

The Site will store and use hazardous substances, for example:

- Import of natural gas by pipeline to the Site;
- Storage and transfer of hydrogen to the OCGT; and
- Storage tanks for raw materials used in site processes and maintenance activities.

Some hazardous waste materials are also expected to be produced onsite as a result of process activities.

The types of hazardous substances that may be stored on site, quantity and storage arrangements are provided in Table 3.3. Further details of raw materials and waste streams that may be present at the site are presented in Table 7.1 and Table 8.1 of the permit application supporting information document.

[11] Communication from the Commission — European Commission Guidance concerning baseline reports under Article 22(2) of Directive 2010/75/EU on industrial emissions

## TABLE 3.3 SUBSTANCE INVENTORY

| Material | State | Maximum amount stored at any one time | Storage Location and use |
|---|---|---|---|
| Lubricant Oil | Liquid | 14 $m^3$ | Lubrication and cooling in Gas Turbine System and Electrolysers, located adjacent to OCGT. |
| Mineral Oil | Liquid | 35 $m^3$ | Cooling in transformer across site. |
| Glycol solution (60:40 water:glycol) | Liquid | 2 $m^3$ | Used in cooling water system, located Northeast of the site. |
| Sodium Hypochlorite | Liquid | 1 $m^3$ | Used in Demin Plant and located next to Demin Plant north of the site.<br><br>Segregated from acid storage. |
| Sodium bisulphate | Liquid | 1 $m^3$ | Used in Demin Plant and located next to Demin Plant north of the site.<br><br>Segregated from acid storage. |
| Sodium hydroxide | Liquid | 5 $m^3$ | Used in Demin Plant and located next to Demin Plant north of the site.<br><br>Segregated from acid storage. |
| Citric Acid | Liquid | 5 $m^3$ | Used in Demin Plant and located next to Demin Plant north of the site.<br><br>Segregated from caustic storage. |
| Carbohydrazine | Liquid | 1.04 $m^3$ | Used in Demin Plant and located next to Demin Plant north of the site. |
| Ammonia solution (19%) | Liquid | 20 $m^3$ | Used in SCR system and located adjacent to OCGT.<br><br>Segregated from acid storage. |

| Material | State | Maximum amount stored at any one time | Storage Location and use |
|---|---|---|---|
| Biocide | Liquid | 1.04 $m^3$ | Additive in well anulus fluid. When in use, anulus fluid is contained internally between the outer casing of the well and internal casings.<br><br>IBC located in chemical storage area within building or in chemical container cabin.<br><br>Segregated from acid storage. |
| Phosphorylated oxyalkylated polyol (KD40) | Liquid | 1 $m^3$ | Additive in well anulus fluid. When in use, anulus fluid is contained internally between the outer casing of the well and internal casings.<br><br>IBC located in chemical storage area within building or in chemical container cabin. |
| Oils, greases and chemical cleaning fluids | Liquid | <0.2 $m^3$ per substance | Used in maintenance activities and located in designated storage containers/cupboards within buildings. |
| Diesel | Liquid | <0.5 $m^3$ | Used in diesel firewater pump.<br>Stored in firewater diesel pump tank northwest of the site. |
| Nitrogen | Gas | 84 $m^3$ | Used for purging/blanketing and located north of the site. |
| Sodium aluminium silicate | Solid | TBC | Used in hydrogen production drying process.<br><br>Stored within Molecular Sieve column carbon steel vessels within a dedicated skid situated on hardstanding. |
| Oxygon (Oxygen scavenger) | Liquid | 1 $m^3$ | Additive in well anulus fluid. When in use, anulus fluid is contained internally between the outer casing of the well and internal casings.<br><br>IBC located in chemical storage area within building or in chemical container cabin. |
| Hydrogen | Gas | 311,400 $m^3$ | Stored in ALD1 cavern. |

| Material | State | Maximum amount stored at any one time | Storage Location and use |
|---|---|---|---|
| | | | Used in OCGT. |
| Hazardous waste from plant maintenance – liquids such as degreaser wash fluid, waste oils and oily rags. | Liquid | <12 tonnes | Hazardous Waste storage area. |
| Brackish Water (temporary during dewatering phase) | Liquid | 2 x 150 $m^3$ | Wellhead area to the west to the site |

### 3.2.2 STAGE 2 - IDENTIFICATION OF RELEVANT HAZARDOUS SUBSTANCES

A review has been undertaken to assess whether they are considered to be Relevant Hazardous Substances[12] (RHS), i.e. having the potential to lead to pollution of soil or groundwater. The assessment has been made using the Classification and Labelling (C&L) Inventory Database. Safety Data Sheets for all raw materials are provided in Appendix E.

The initial review has not taken into account mitigation measures which could prevent or minimise loss, which are considered in Section 3.2.3. However, the maximum anticipated loss due to failure of containment has been provided to give an indication of the likely scale of loss under a loss of containment incident.

[12] Relevant Hazardous Substances (Article 3(18) and Article 22(2), first subparagraph) are those substances or mixtures defined within Article 3 of Regulation (EC) No 1272/2008 on the classification, labelling and pack aging of substances and mixtures (CLP Regulation) which, as a result of their hazardousness, mobility, persistence and biodegradability (as well as other characteristics), are capable of contaminating soil or groundwater and are used, produced and/or released by the installation.

## TABLE 3.4 IDENTIFICATION OF RELEVANT HAZARDOUS SUBSTANCES

| Hazardous Substance | Product Name | EC: European Community number/ List no.: List number assigned by ECHA. | Chemical Abstract Registry Number | Classification | Relevant Hazardous Substance? | Maximum Potential Loss from a Single Container | Pre-mitigated risk to receptors |
|---|---|---|---|---|---|---|---|
| **Raw Materials** | | | | | | | |
| Lubricant Oil | Perfecto XEP 46 | Not applicable | Not applicable | Not classified | Yes | 14 $m^3$ | Moderate risk given the volume stored onsite |
| Mineral Oil | Transformer Oil X | 265-156-6 | 64742-53-6 | H304 Aspiration Hazard Category 1 | Yes | 35 $m^3$ | Moderate risk given the volumes stored onsite |
| Glycol Solution (60:40 water:glycol) | Triethylene Glycol HP | 203-953-2 | 112-27-6 | Not classified | No - not classified as hazardous. | 2 $m^3$ | Low risk – with appropriate control measures in place |
| Sodium Hypochlorite | Sodium hypochlorite, 12% active chlorine | 231-668-3 | 7681-52-9 | H290 Substance or mixture corrosive to metals – Category 1<br>H314 Skin corrosion/irritation Category 1 B<br>H314 Serious eye damage/eye irritation Category 1<br>H400 Hazardous to the aquatic environment - acute hazards Category 1 | Yes | 1.04 $m^3$ | Low risk – with appropriate control measures in place |

| Hazardous Substance | Product Name | EC: European Community number/ List no.: List number assigned by ECHA. | Chemical Abstract Registry Number | Classification | Relevant Hazardous Substance? | Maximum Potential Loss from a Single Container | Pre-mitigated risk to receptors |
|---|---|---|---|---|---|---|---|
| | | | | H410 Hazardous to the aquatic environment – chronic hazard Category 1 | | | |
| Sodium Bisulphate | Sodium Bisulfite 38-42% | 231-548-0 | 7631-90-5 | H302 Harmful if swallowed Category 4 | Yes | 1.04 $m^3$ | Low risk - due to very small volumes and with appropriate controls in place |
| Sodium Hydroxide | Caustic Soda 50% | 215-185-5 | 1310-73-2 | H290 May corrosive to metals Category 1<br>H314 Causes severe skin burns and eye damage Category 1 and 1A | Yes | 5 $m^3$ | Moderate risk - given volumes stored onsite and assuming regular use in the demin plant |
| Citric Acid | Citric Acid 50% | 680-681-4 | 77-92-9 | H290 May be corrosive to metals Category 1<br>H315 Causes skin or irritation Category 2<br>H319 Causes serious eye irritation Category 2A | Yes | 5 $m^3$ | Moderate risk - given volumes stored onsite and assuming regular use in the demin plant |
| Carbohydrazine | Carbohydrazide | 207-837-2 | 497-18-7 | H302 Acute toxicity, Oral Category 4<br>H315 Skin irritation Category 2 | Yes | 1.04 $m^3$ | Low risk - due to very small volumes and with appropriate controls in place |

| Hazardous Substance | Product Name | EC: European Community number/ List no.: List number assigned by ECHA. | Chemical Abstract Registry Number | Classification | Relevant Hazardous Substance? | Maximum Potential Loss from a Single Container | Pre-mitigated risk to receptors |
|---|---|---|---|---|---|---|---|
| | | | | H317 Skin sensitization Category 1<br>H411 Long-term (chronic) aquatic hazard Category 2 | | | |
| Ammonia solution (19%) | Aqua Ammonia 19% | 215-647-6 | 1336-21-6 | H302 Acute Toxicity, Oral Category 4<br>H332 Acute Toxicity, Inhalation, Category 4<br>H314 Skin Corrosion Category 1A<br>H318 Eye Damage Category 1<br>H335 STOT SE 3<br>H400 Aquatic Acute Category 1<br>H412 Aquatic Category Chronic 3 | Yes | 20 $m^3$ | Moderate risk - given the volume stored onsite |
| Biocide | NUOSEPT 78 | 225-208-0 | 4719-04-4 | H330 Fatal if inhaled<br>H372 Causes damage to organs through prolonged or repeated exposure<br>H302 Harmful if swallowed<br>H319 Causes serious eye irritation | Yes | 1.04 $m^3$ | Low risk - due to very small volumes and with appropriate controls in place |

| Hazardous Substance | Product Name | EC: European Community number/ List no.: List number assigned by ECHA. | Chemical Abstract Registry Number | Classification | Relevant Hazardous Substance? | Maximum Potential Loss from a Single Container | Pre-mitigated risk to receptors |
|---|---|---|---|---|---|---|---|
| | | | | H317 May cause an allergic skin reaction | | | |
| Phosphorylated oxyalkylated polyol (KD40) | KD-40™ | Not applicable | Not applicable | Not classified | No - not classified as hazardous. | 1 $m^3$ | Low risk - due to very small volumes and with appropriate controls in place |
| Cleaning fluid | ZOK 27 READY-TO-USE | 500-241-6 | 69011-36-5 | H318 Serious Eye Damage/Eye Irritation Category 1 | Yes | <0.2 $m^3$ | Low risk - due to very small volumes and with appropriate controls in place |
| Hydraulic cleaning fluid | MOBIL HYDRAULIC OIL M 46 | Not applicable | Not applicable | Not classified | No - not classified as hazardous. | <0.2 $m^3$ | Low risk - due to very small volumes and with appropriate controls in place |
| Diesel | Auto Diesel / DERV | 269-822-7 | 68334-30-5 | H226 Flammable liquids Category 3<br>H304 Aspiration Hazard Category 1<br>H315 Skin corrosion/irritation Category 2<br>H332 Acute toxicity, Inhalation Category 4<br>H351 Carcinogenicity Category 2 | Yes | <0.5 $m^3$ | Low risk - due to very small volumes and with appropriate controls in place |

| Hazardous Substance | Product Name | EC: European Community number/ List no.: List number assigned by ECHA. | Chemical Abstract Registry Number | Classification | Relevant Hazardous Substance? | Maximum Potential Loss from a Single Container | Pre-mitigated risk to receptors |
|---|---|---|---|---|---|---|---|
| | | | | H373 Specific target organ toxicity (repeated exposure) Category 2<br>H411 Hazardous to the aquatic environment, chronic toxicity Category 2 | | | |
| Nitrogen | Nitrogen | 231-783-9 | 7727-37-9 | H280 – Gases under pressure (Compressed gas) | No - not capable of contaminating soil or groundwater as this is a gas. | 84 $m^3$ | No risk – not capable of contaminating soil or groundwater as this is a gas. |
| Sodium aluminium silicate | Molecular Sieve 4A | 215-684-8 | 1333-00-9 | Not classified | No - not classified as hazardous and in solid form. | TBC | No risk – not capable of contaminating soil or groundwater as this is a solid |
| Oxygon (Oxygen scavenger) | OXYGON | Not applicable | 7757-83-7 | Not classified | No - not classified as hazardous. | 1 $m^3$ | Low risk - due to very small volumes and with appropriate controls in place |
| **Product** | | | | | | | |
| Hydrogen | Hydrogen | 215-605-7 | 1333-74-0 | H220 – Gases under pressure | No – not capable of contaminating | N/A | No risk – not capable of contaminating |

| Hazardous Substance | Product Name | EC: European Community number/ List no.: List number assigned by ECHA. | Chemical Abstract Registry Number | Classification | Relevant Hazardous Substance? | Maximum Potential Loss from a Single Container | Pre-mitigated risk to receptors |
|---|---|---|---|---|---|---|---|
| | | | | H220 – Flammable gases under pressure | soil or groundwater as this is a gas. | | soil or groundwater as this is a gas |
| **Wastes** | | | | | | | |
| Hazardous waste from plant maintenance – liquids | Various | Various | Various | Various | Yes – assumed to incorporate some RHS. | <12 tonnes | Low risk - with appropriate controls in place |
| Brackish Water (temporary during dewatering phase) | N/A | Not applicable | Not applicable | Not classified | Yes - due to volume and potential impact of salinity to soil and groundwater. | 150 $m^3$ | Low risk – with appropriate controls in place |

## 3.2.3 STAGE 3 - POLLUTION RISK ASSESSMENT

The following section assesses the possibility of actual soil or groundwater contamination at the site. for the RHS's identified in Section 3.2.2. This includes the probability of releases and their consequences and mitigation measures. The risk assessment uses the risk matrix provided below.

| Severity | Consequences | | | Increasing Likelihood | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Impact | People | Environment | Almost Never (A) | Hardly Ever (B) | Unlikely (C) | Possible (D) | Likely (E) | Almost Certain (F) |
| | | | | Never heard of in the industry / work type | Heard of in the industry / work type | Occurred within SSE | Occurs several times within SSE | Occurs on site | Occurs several times on site |
| 1 | Incidental | • Slight Injury<br>• Slight Heath Effect | • Incidental Environmental Impact | 1 - Low Risk | 1 - Low Risk | 1 - Low Risk | 1 - Low Risk | 2 - Medium Risk | 2 - Medium Risk |
| 2 | Minor | • Minor Injury (medical treatment < 3 days lost time)<br>• Reversible Health Effect<br>• Restriction to work activity | • Minor Environmental Impact<br>• Minor Permit breach | 1 - Low Risk | 1 - Low Risk | 1 - Low Risk | 2 - Medium Risk | 2 - Medium Risk | 3 - High Risk |
| 3 | Serious | • Serious Injury (reportable)<br>• Lost time injury (>3 days)<br>• Irreversible Health Effect | • Serious Environmental Impact<br>• Serious Permit breach<br>• Prohibited activity | 1 - Low Risk | 1 - Low Risk | 2 - Medium Risk | 2 - Medium Risk | 3 - High Risk | 3 - High Risk |
| 4 | Major | • 1 – 3 fatalities<br>• Serious disability<br>• Life Threatening Health effects | • Major Environmental Breach<br>• Major Permit breach | 1 - Low Risk | 2 - Medium Risk | 2 - Medium Risk | 3 - High Risk | 3 - High Risk | 4 – Very High Risk |
| 5 | Severe | • 4 – 9 fatalities<br>• Serious disability<br>• Life Threatening Health effects | • Impact of national environmental significance | 2 - Medium Risk | 2 - Medium Risk | 3 - High Risk | 3 - High Risk | 4 – Very High Risk | 4 – Very High Risk |
| 6 | Catastrophic | • > 10 fatalities<br>• Serious disability<br>• Life Threatening Health effects | • Impact of international environmental significance | 2 - Medium Risk | 3 - High Risk | 3 - High Risk | 4 – Very High Risk | 4 – Very High Risk | 4 – Very High Risk |

| Source | | Pathway | Receptor | Likelihood of exposure | Consequence of exposure | Risk Magnitude (see Section 3.2.3.1 for details on receptor vulnerability) | Risk Management | | | | | Residual Risk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hazardous Substance** | **Maximum Potential Loss from a Single Container** | | | | | | **Primary Containment** | **Secondary Containment** | **Tertiary containment** | **Summary of containment measures** | **Management Controls** | |
| Lubricant Oil | 14 $m^3$ | The only pathway for any of the materials stored and used at site to impact on potential soil and groundwater would be the direct loss of materials to unsurfaced ground or permeable site surfacing or via drainage network | The defined receptors for this assessment will be the soil and groundwater underlying the site (as described in section 2.1.1.3):<br>• Glacial Till – Secondary Undifferentiated Aquifer, defined as 'an aquifer where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value';<br>• Alluvium – Secondary A Aquifer, defined as 'permeable layers that can support local water supplies, and may form an important source of base flow to rivers'; and<br>• Rowe Chalk Formation – Principal Aquifer, defined as 'highly permeable aquifers with significant water storage and are able to support large abstractions'. The Chalk is however likely to be brackish in nature given the close proximity to the North Sea. | Unlikely | Serious | Moderate risk - given volumes stored onsite | Steel tank | Located within bunding which is capable of holding at least 110% of the capacity of the largest vessel or 25% of the aggregated volume, whichever is greater. | Located on concrete hard standing | • Suitable primary containment within sealed containers (e.g. tanks/drums/IBCs) to prevent loss to ground.<br>• Use of impermeable surfaces and site drainage which feeds into a class 1 oil interceptor.<br>• For the retention of fire suppression water, secondary containment is provided around all chemical/oil storage. Site surface water drainage with the penstock valve closed provides a tertiary containment system capable of holding the 2-hour fire-fighting water response.<br>• For the Demin Plant, under normal operation the emissions to water will be monitored regularly in accordance with the EP requirements and standards. In the event of accidental release or failure the plant will be shut down to prevent further discharges.<br>• The plant area will be concreted and kerbed throughout the process area. Bulk storage volumes, even if spilled outside the bunded areas, are unlikely to reach non-hardstanding areas of the Site.<br>• All tanker deliveries will be unloaded within designated bays with drainage to containment sumps. All bulk storage vessels will have high level indicators within the sight-line of the delivery driver along with high alarms in the control room.<br>• Outside of the secondary containment, there will be a final balancing lagoon as part of the surface water drainage system which has a valve that can be closed to prevent discharge in the event of large-scale spillage to surface.<br>• Hazardous waste will be removed by specialist contractors.<br>• Information provided by SSE shows a 1 mm thick HDPE geomembrane liner draining to the surface water system is located on the eastern portion of the Site covering an area of approximately 2.3 hectares in the non-hardstanding areas of the Central Processing Area. Details of the construction and condition of the liner are not known. This liner should reduce the likelihood of contaminants reaching the subsurface material and groundwater. | • An Environment Management Systems (EMS) (certified to ISO14001) and procedures will be in place to ensure risks to the environment are minimised and appropriately controlled. To supplement this, site-specific management system documents will be developed to cover the processes and location-specific risks.<br>• The Site will also undergo regular maintenance of equipment and drainage systems throughout the lifetime of the Site operations. The surface water drainage system has been designed to provide a suitable allowance for climate change and therefore the impact of surface water run-off will be appropriately managed. Measures include Sustainable Drainage Systems (balancing lagoon) to attenuate runoff and provide water quality treatment by intercepting sediment and providing temporary storage prior to runoff entering the watercourse.<br>• A training schedule will be in place to ensure staff understand the procedures to handle hazardous substances and what to do in case of a spill.<br>• During the commissioning process the management procedures will be tested to ensure that any aspects that require supplementary focus will be addressed following commissioning. The EMS will detail systems and procedures that Site operations are required to follow, with the objective of effective management and mitigation of the actual and potential environmental impacts of the Site's activities. A review of the overall EMS will be undertaken on an annual basis. | Low |
| Mineral Oil | 35 $m^3$ | | | Unlikely | Serious | Moderate risk - given volumes stored onsite | Within transformer | Integral secondary containment within transformer which is capable of holding 110% of the capacity of the transformer.<br><br>Concrete secondary containment. | | | | Low |
| Sodium Hypochlorite | 1.04 $m^3$ | | | Unlikely | Minor | Low risk - due to very small volumes | Intermediate Bulk Container (IBC) | Housed on a drip tray which is capable of holding 110% of the capacity of the container. | IBC will be located within a coated concrete area with kerbs or draining to a blind sump. | | | Low |
| Sodium Bisulphate | 1.04 $m^3$ | | | Unlikely | Minor | Low risk - due to very small volumes | IBC | Housed on a drip tray which is capable of holding 110% of the capacity of the container. | IBC will be located within a coated concrete area with kerbs or draining to a blind sump. | | | Low |
| Sodium Hydroxide | 5 $m^3$ | | | Unlikely | Serious | Moderate risk - given volumes stored onsite and assuming regular use in the demin plant | IBC | Housed on a drip tray which is capable of holding 110% of the capacity of the container. | IBC will be located within a coated concrete area with kerbs or draining to a blind sump. | | | Low |
| Citric Acid | 5 $m^3$ | | | Unlikely | Serious | Moderate risk - given volumes stored onsite and assuming regular use in the demin plant | IBC | Housed on a drip tray which is capable of holding 110% of the capacity of the container. | IBC will be located within a coated concrete area with kerbs or draining to a blind sump. | | | Low |
| Carbohydrazine | 1.04 $m^3$ | | | Unlikely | Minor | Low risk - due to very small volumes | IBC | Housed on a drip tray which is capable of holding 110% of the capacity of the container. | IBC will be located within a coated concrete area with kerbs or draining to a blind sump. | | | Low |
| Ammonia solution (19%) | 20 $m^3$ | | | Unlikely | Serious | Moderate risk - given the volume stored onsite | Carbon Steel tank | Tank located within concrete bund capable of holding at least 110% of the capacity of the largest vessel or 25% of the aggregated volume, whichever is greater. | | | | Low |
| Biocide | 1.04 $m^3$ | | | Unlikely | Minor | Low risk - due to very small volumes | IBC and well anulus contained by outer well casing (diluted in water) | IBC housed on a drip tray which is capable of holding 110% of the capacity of the container. | IBC will be located in chemical storage area (within building or in chemical container cabin) | | | Low |
| Cleaning fluid | <0.2 $m^3$ | | | Unlikely | Minor | Low risk - due to very small volumes | Drums or containers with drip trays | Pallet bund capable of holding at least 110% of the capacity of the largest vessel or 25% of the aggregated volume, whichever is greater. | In designated storage containers/cupboards within buildings. | | | Low |
| Diesel | <0.5 $m^3$ | | | Unlikely | Minor | Low risk - due to very small volumes | Integrated diesel firewater pump diesel tank | Tank located within drip tray or concrete bund capable of holding 110% of the capacity of the tank. | | | | Low |

| Source | | Pathway | Receptor | Likelihood of exposure | Consequence of exposure | Risk Magnitude (see Section 3.2.3.1 for details on receptor vulnerability) | Risk Management | | | | | Residual Risk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Hazardous Substance** | **Maximum Potential Loss from a Single Container** | | | | | | **Primary Containment** | **Secondary Containment** | **Tertiary containment** | **Summary of containment measures** | **Management Controls** | |
| Hazardous waste from plant maintenance – liquids | <12 tonnes | | | Unlikely | Minor | Low risk - due to very small volumes | Appropriate waste safe type containers. | Liquid wastes will be stored in containers within bunding which is capable of holding at least 110% of the capacity of the largest vessel and 25% of the aggregated volume, whichever is greater. | | | | Low |
| Brackish Water (temporary during dewatering phase) | 150 $m^3$ | | | Unlikely | Serious | Moderate - given the volume stored onsite | Concrete Degassing tank | Temporary tanks will either be double skinned (with detection for releases from primary containment) or located within bund capable of holding at least 110% of the capacity of the largest vessel or 25% of the aggregated volume, whichever is greater. | Located on concrete hardstand and/or impermeable membranes. | | | Low |

#### 3.2.3.1 RECEPTORS SENSITIVITY AND VULNERABILITY

The defined receptors for this assessment will be the soil and groundwater underlying the site (as described in section 2.1.1.3):

- Glacial Till – Secondary Undifferentiated Aquifer, defined as 'an aquifer where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the rock type. These have only a minor value';
- Alluvium – Secondary A Aquifer, defined as 'permeable layers that can support local water supplies, and may form an important source of base flow to rivers'; and
- Rowe Chalk Formation – Principal Aquifer, defined as 'highly permeable aquifers with significant water storage and are able to support large abstractions'. The Chalk is however likely to be brackish in nature given the close proximity to the North Sea.

TABLE 3.5 RECEPTOR SENSITIVITY AND VULNERABILITY

| Potentially Impacted Receptor | Sensitivity | Vulnerability | Explanation |
|---|---|---|---|
| Groundwater | High | Low | Available borehole log (TA23NE6) indicates groundwater was struck at 39 m bgl. |
| | | | Bedrock is a Principal Aquifer. |
| Surface Water | Moderate-High | High | Drain networks on Site and within adjacent fields. |
| | | | Surface water quality of the Humbleton Beck has been classified by the EA as having moderate ecological and good chemical quality. |
| Sensitive Areas (including humans and property and environmental designations) | Low | | There are no sensitive receptors within 250 m of the Site boundary. |

The impact from the proposed site activities pre-mitigation on the surrounding sensitive receptors is considered to be **Moderate** given the hydrogeological situation and distance to surface waters and sensitive areas.

#### 3.2.3.2 PRE-MITIGATED RISK TO SENSITIVE RECEPTORS

The pre-mitigated risk of impact to individual receptors based on the proposed activities performed on the Site is summarised in Table 3.6.

TABLE 3.6 POTENTIAL RISK TO SENSITIVE RECEPTORS

| Receptor | Potential Risk | Explanation |
|---|---|---|
| Groundwater | Moderate | Given the presence of the underlying bedrock as a Principal Aquifer and the overlying relatively impermeable Glacial Till comprising very stiff clay with an approximate thickness of 40 m above. |

| Receptor | Potential Risk | Explanation |
|---|---|---|
| Surface Water | Moderate-High | Given the distance to the moderate ecological and good quality of the Humbleton Beck. |

Based on the information regarding environmental site setting and taking into account the proposed activities on site, the overall pre-mitigated risk from these activities onto the sensitive receptors is considered to be **Moderate** to **High**.

### 3.2.4 FINDINGS OF THE SOIL AND GROUNDWATER POLLUTION RISK ASSESSMENT

The assessment for the site-specific pollution potential concludes that the hazardous substances to be used at the Site represents a **low** risk to soil and groundwater receptors on/near the Site for the following reasons:

- Relatively low quantities of the hazardous substances used and produced at the installation
- Robust site engineering and drainage has been built into the design following best practice and guidance; and
- Management system control measures will be adopted once operational.

As detailed in section 2.3.2, SSE is intending to carry out a baseline survey to understand the current condition of the soil and groundwater. To monitor the management of the hazardous materials at the Site, an monitoring programme will be implemented to track the groundwater quality during the lifetime of the Site as detailed in the following Sections.

## 3.3 PROPOSED MONITORING DURING LIFETIME OF THE SITE

As part of the Environmental Management System (EMS), SSE will maintain a log to record any spill incidents and provide details of the material lost, volume, location and how the loss was contained and cleaned up as well as any corrective / preventative measures from incident investigations. These records will be retained throughout the lifetime of the Site.

**Infrastructure Monitoring**

Sitewide inspections and maintenance will be undertaken as part of the EMS under an infrastructure monitoring programme. This will be implemented to ensure all environmentally critical infrastructure used to prevent or control losses to soil and/or groundwater are maintained in good working order and fit for purpose. This will likely include:

- Site housekeeping and regular operational site walkovers to check for potential spillages/leaks;
- Integrity inspections of all primary containment measures e.g. IBCs, drums and steel tanks;
- Integrity inspections all secondary containment measures e.g. drip trays and bunded areas.

The infrastructure monitoring programme will commence prior to the operation of the Site with the records retained throughout the lifetime of the operations.

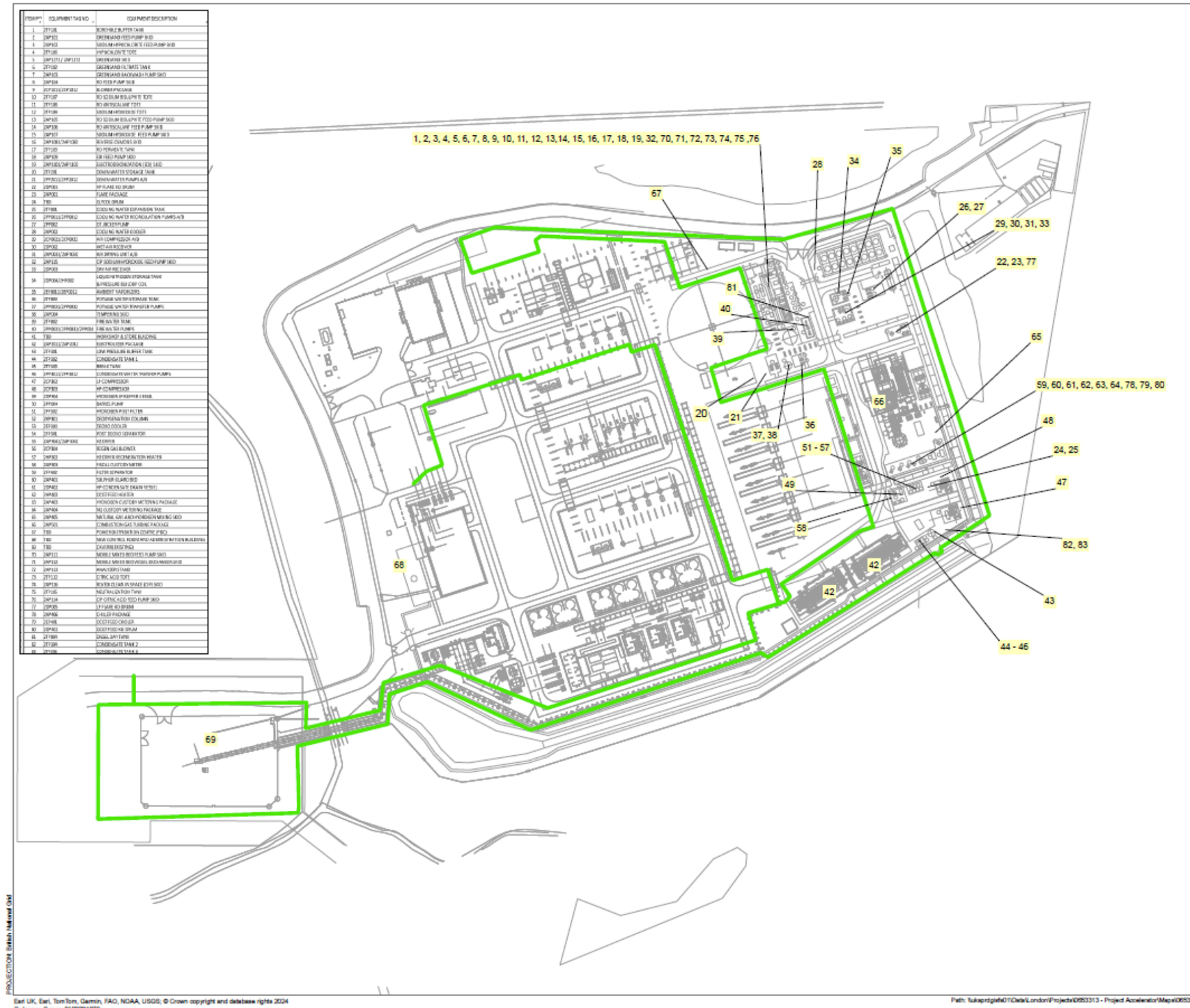
**Soil and Groundwater Monitoring**

It is likely that the Environmental Permit will require periodic soil and groundwater monitoring to be undertaken where a credible pollution risk has been identified. A monitoring plan is proposed to be submitted to the EA prior to commissioning of the site and is likely to entail 5

yearly groundwater monitoring of select boundary monitoring wells and a potential repeat soil sampling exercise every 10 years, as required based on the results of groundwater data and site material handling and spill records.

# APPENDIX A PROPOSED SITE LAYOUT

| ITEM | EQUIPMENT TAG NO. | EQUIPMENT DESCRIPTION |
|---|---|---|
| 1 | 2TT08 | BOREHOLE BUFFER TANK |
| 2 | 2MP101 | BOREHOLE FEED PUMP 1A/B |
| 3 | 2MP103 | SODIUM HYPOCHLORITE FEED PUMP 3A/B |
| 4 | 2TT105 | HYPOCHLORITE TOTE |
| 5 | 2MP117 / 2MP118 | BOREHOLE 1A/ B |
| 6 | 2TT102 | BOREHOLE FILTRATE TANK |
| 7 | 2MP103 | BOREHOLE BACKWASH PUMP 3A/B |
| 8 | 2MP104 | RO FEED PUMP 3A/B |
| 9 | 2CP201/2TP201 | BLOWER PACKAGE |
| 10 | 2TT107 | RO SODIUM BISULPHITE TOTE |
| 11 | 2TT106 | RO ANTISCALANT TOTE |
| 12 | 2TT109 | SODIUM HYDROXIDE TOTE |
| 13 | 2MP105 | RO SODIUM BISULPHITE FEED PUMP 5A/B |
| 14 | 2MP106 | RO ANTISCALANT FEED PUMP 3A/B |
| 15 | 2MP107 | SODIUM HYDROXIDE FEED PUMP 3A/B |
| 16 | 2MP108/2MP109 | REVERSE OSMOSIS SKID |
| 17 | 2TT105 | RO PERMEATE TANK |
| 18 | 2MP109 | KB HIGH PUMP 1A/B |
| 19 | 2MP110/2MP111 | ELECTRODEIONISATION (EDI) SKID |
| 20 | 2TT108 | DEMINERALISED WATER STORAGE TANK |
| 21 | 2TP201/2TP202 | DEMINERALISED WATER PUMPS A/B |
| 22 | 2SP001 | HP FLARE KO DRUM |
| 23 | 2MP001 | FLARE PACKAGE |
| 24 | TBD | FLARE STACK |
| 25 | 2TT008 | COOLING WATER EXPANSION TANK |
| 26 | 2TP001/2TP002 | COOLING WATER RECIRCULATION PUMPS A/B |
| 27 | 2TP002 | ST JET EDUCTOR |
| 28 | 2MP002 | COOLING WATER COOLER |
| 29 | 2CP002/2CP003 | AIR COMPRESSOR A/B |
| 30 | 2SP003 | INSTRUMENT AIR RECEIVER |
| 31 | 2MP003/2MP004 | INSTRUMENT AIR DRYING UNIT A/B |
| 32 | 2MP105 | CP GOOSENECK PACKAGE - SEED PUMP SKID |
| 33 | 2SP005 | DRY AIR RECEIVER |
| 34 | 2SP004/2HP002 | LIQUID HYDROGEN STORAGE TANK & PRESSURE BUILDUP COIL |
| 35 | 2TT008/2TP012 | AMBIENT VAPORIZERS |
| 36 | 2TT009 | POTABLE WATER STORAGE TANK |
| 37 | 2TP009/2TP008 | POTABLE WATER TRANSFER PUMPS |
| 38 | 2MP004 | TEMPERING SKID |
| 39 | 2TT002 | FIRE WATER TANK |
| 40 | 2TP002/2TP003/2TP004 | FIRE WATER PUMPS |
| 41 | TBD | WORKSHOP & STORE BUILDING |
| 42 | 2MP011/2MP012 | ELECTROLYSER PACKAGE |
| 43 | 2TT005 | LOW PRESSURE BUFFER TANK |
| 44 | 2TT002 | CONDENSATE TANK 1 |
| 45 | 2TT105 | BRINE TANK |
| 46 | 2TP011/2TP012 | CONDENSATE WATER TRANSFER PUMPS |
| 47 | 2CP002 | LP COMPRESSOR |
| 48 | 2CP001 | HP COMPRESSOR |
| 49 | 2SP004 | MEDIUMPRESSURE STORAGE |
| 50 | 2TP004 | BARGE PUMP |
| 51 | 2TT002 | HYDROGEN POST FILTER |
| 52 | 2MP001 | DEOXO/DRYER COLUMN |
| 53 | 2TT001 | DEOXO COOLER |
| 54 | 2TT005 | POST DEOXO SEPARATOR |
| 55 | 2MP004/2MP005 | N2 DRYER |
| 56 | 2CP004 | BOOSTER BLOWER |
| 57 | 2MP003 | N2 DRYER REGENERATION HEATER |
| 58 | 2MP005 | PRODUCT CUSTODY METER |
| 59 | 2TT002 | FILTER SEPARATOR |
| 60 | 2MP001 | SILPHER GUARD BED |
| 61 | 2TP001 | HP CENTRIFUGAL TRAIN 1(PS01) |
| 62 | 2MP003 | DEOXO FEED HEATER |
| 63 | 2MP005 | HYDROGEN CUSTODY METERING PACKAGE |
| 64 | 2MP004 | N2 CUSTODY METERING PACKAGE |
| 65 | 2MP005 | NATURAL GAS AND HYDROGEN MIXING SKID |
| 66 | 2MP001 | COMBUSTION GAS TURBINE PACKAGE |
| 67 | TBD | POWER DISTRIBUTION CENTRE (PDC) |
| 68 | TBD | MAIN CONTROL ROOM AND ADMINISTRATION BUILDING |
| 69 | TBD | CAVERN 1 (EXISTING) |
| 70 | 2TT106 | CITRIC ACID TOTE |
| 71 | 2MP102 | MOBILE MIXED BED VESSEL EXCHANGER SKID |
| 72 | 2MP103 | RINSE STAND |
| 73 | 2MP111 | MOBILE MIXED BED (MBD) PUMP SKID |
| 74 | 2TT110 | CITRIC ACID TOTE |
| 75 | 2MP106 | BOOSTER (TRAIN SPARE EDI) SKID |
| 76 | 2TT105 | NEUTRALISATION TANK |
| 77 | 2MP104 | DP CITRIC ACID TOTE PUMP SKID |
| 78 | 2SP005 | LP FLARE KO DRUM |
| 79 | 2MP006 | CHILLER PACKAGE |
| 80 | 2TT008 | DEOXO FEED KO DRUM |
| 81 | 2MP001 | DIESEL DAY TANK |
| 82 | 2TT009 | CONDENSATE TANK 2 |
| 83 | 2TT008 | CONDENSATE PUMP 2 |




Proposed Installation Boundary


0 20 40 60 80 100 Metres

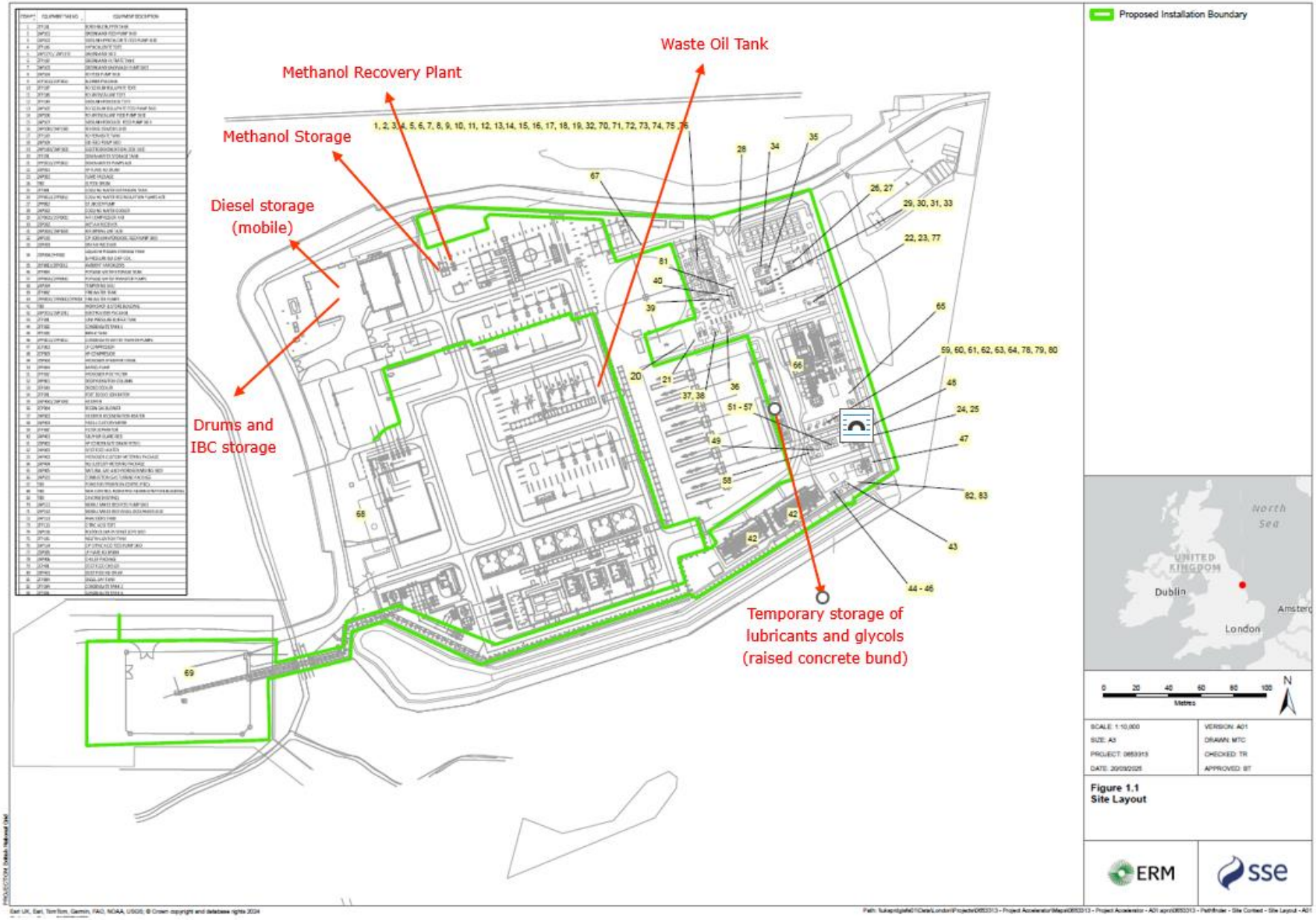
N

| | |
|---|---|
| SCALE: 1:10,000 | VERSION: A01 |
| SIZE: A3 | DRAWN: MTC |
| PROJECT: 0653313 | CHECKED: TR |
| DATE: 20/03/2025 | APPROVED: BT |

**Figure 1.1**
**Site Layout**

Path: \\uksprdgisfs01\Data\London\Projects\0653313 - Project Accelerator\Maps\0653313 - Project Accelerator - A01.aprx\0653313 - Pathfinder - Site Context - Site Layout - A01

# APPENDIX B HISTORIC SITE USES


Proposed Installation Boundary
Waste Oil Tank
Methanol Recovery Plant
Methanol Storage
Diesel storage (mobile)
Drums and IBC storage
Temporary storage of lubricants and glycols (raised concrete bund)
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13,14, 15, 16, 17, 18, 19, 32, 70, 71, 72, 73, 74, 75, 76
28
34
35
67
26, 27
29, 30, 31, 33
22, 23, 77
61
40
39
65
59, 60, 61, 62, 63, 64, 78, 79, 80
20
21
37, 38
36
66
45
51 - 57
24, 25
49
47
58
82, 83
68
42
42
43
44 - 46
69
North Sea
UNITED KINGDOM
Dublin
London
Amsterd
0 20 40 60 80 100
Metres
N
SCALE: 1:10,000
VERSION: A01
SIZE: A3
DRAWN: MTC
PROJECT: 0653313
CHECKED: TR
DATE: 20/03/2025
APPROVED: BT
Figure 1.1
Site Layout
ERM
sse

# APPENDIX C AVAILABLE PREVIOUS DESK STUDIES AND SITE INVESTIGATION REPORTS

1. Mott MacDonald, Aldbrough Gas Storage Facility Ground Investigation Interpretative Report, dated November 2003
2. Norwest Holst Soil Engineering Limited, Report on a Ground Investigation at Aldbrough Gas Storage Facility, dated September 2003
3. Jacobs, SSE Hornsea Aldbrough Gas Storage, Application Site Report for PPC Permit Application, dated April 2006
4. Atkins, Aldbrough 4z Borehole Support – Hydrogeological Impact Assessment, dated October 2019
5. Atkins, Aldbrough Hydrogen Pathfinder – Feasibility Study Report, dated October 2022
6. Socotec, Aldbrough Hydrogen Pathfinder Project Phase 2 FEED Project – Ground Investigation Report (Factual Account of Fieldwork and Laboratory Testing), Report No. A3039-23, dated June 2024
7. Environmental Resources Management Limited, AHP Phase 1 Environmental Site Assessment, dated June 2024

# APPENDIX D ENVIROCHECK REPORTS

# APPENDIX E SAFETY DATA SHEETS

ERM HAS OVER 140 OFFICES ACROSS THE FOLLOWING COUNTRIES AND TERRITORIES WORLDWIDE

Argentina
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India
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Ireland
Italy
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Kenya
Malaysia
Mexico
Mozambique
Netherlands
New Zealand
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