

# PEMBROKE GREEN HYDROGEN PROJECT: A PEMBROKE NET ZERO PROJECT: PERMIT VARIATION

Addendum to Site Condition and Baseline Report

Pembroke Power Station (EPR/DP3333TA)

JFR2794

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- Drawing 3** GHPF Layout Plan
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## Appendices

- Appendix A Groundsure Report
- Appendix B Ground Investigation Report
- Appendix C Preliminary Risk Assessment

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# 1 INTRODUCTION

## 1.1 Background

- 1.1.1 RWE Generation UK plc is currently permitted (EPR/DP3333TA) for the operation of a 4.2 GW thermal input combined-cycle gas fired power station at Pembroke Power Station, West Pennar, Pembroke, SA71 5SS.
- 1.1.2 This Site Condition Report (SCR) document supports the application to include the operation of a green hydrogen production facility (GHPF) within the permit. The green hydrogen facility will be located on land to the west of the existing power station and will therefore extend the existing permit boundary.
- 1.1.3 A SCR for Pembroke Power Station was prepared by Npower Plc in 2010. This SCR will form an addendum to the current report and provide updates on any changes as a result of the development of the Green Hydrogen Facility.
- 1.1.4 To support the application for the permit variation, there is a requirement to provide an Industrial Emissions Directive (IED) Baseline Report as well as a SCR. This report has been prepared in accordance with the European Commission Guidance<sup>1</sup> concerning baseline reports required under the IED and also Natural Resources Wales H5 Guidance<sup>2</sup>.
- 1.1.5 The Industrial Emissions Directive (IED), Article 22, paragraphs 2 to 4, contains provisions for the definitive cessation of activities involving the use, production or release of Relevant Hazardous Substances (RHS) in order to prevent and tackle potential soil and groundwater contamination from such substances. A key tool in this respect is the establishment of a 'baseline report' where an activity involves the use, production or release of RHS and having regard to the possibility of soil and groundwater contamination. The report will form the basis for a comparison with the state of contamination upon definitive cessation of activities. Where information produced pursuant to other national or union law reflects the state at the time the report is drawn up, that information may be included in, or attached to, the baseline report.
- 1.1.6 RPS has prepared this report based on information and data available at the time of preparation.

## 1.2 Key Objectives

- 1.2.1 This report serves as an update to the current permitted area at Pembroke Power Station. The objectives of this addendum to the existing SCR is to:
- Establish any updates to the environmental setting as a result of the operation of the green hydrogen facility and determine its environmental sensitivity;
  - Identify activities that will take place at the green hydrogen facility, including the identification of Relevant Hazardous Substances and preventative measures implemented to protect land and groundwater;
  - Establish the extent of historical contamination in the soil and groundwater in areas where future processes may include similar potentially contaminating substances;

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<sup>1</sup> [Communication from the Commission — European Commission Guidance concerning baseline reports under Article 22\(2\) of Directive 2010/75/EU on industrial emissions \(europa.eu\)](https://ec.europa.eu/eia/infocentre/questionnaire.cfm?id=201075)

<sup>2</sup> [Environmental Permitting Regulations , Guidance for applicants H5, Site Condition Report, Guidance and Template \(naturalresources.wales\)](https://naturalresources.wales/)

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- To identify the Site Conditions at the site at the point of varying the permit for the facility (Baseline Condition) such that they may be used as a point of reference to determine whether the site has been contaminated during the site's permitted operation in line with Environmental Permitting Regulations requirements; and
  - To provide conclusions on whether land quality has been impacted from historical activities.
- 1.2.2 With respect to the IED eight stage process outlined in Section 1.2, a summary of each stage is outlined below along with where it is addressed within this report:
- 1.2.3 Stage 1 - Identify hazardous substances used, produced or released at the installation. This is addressed within Section 5 of this report;
- 1.2.4 Stage 2 - Identify relevant hazardous substances used, produced or released at the installation from the list of hazardous substances identified in Stage 1. This is addressed within Section 6 of this report;
- Stage 3 – Undertake an assessment of site-specific pollution possibility for relevant hazardous substances. This is addressed within Section 7 of this report;
  - Stage 4 – Evaluation of Site History and potential for relevant hazardous substances to be present in soils and groundwater. This is addressed within Section 8 of this report;
  - Stage 5 – Evaluation of Environmental Setting to determine the fate of potential emissions of relevant hazardous substances This is addressed within Section 9 of this report;
  - Stage 6 – Site Characterisation that synthesises findings of Stage 5 and 6 on the basis of a Conceptual Site Model. This is addressed within Section 10 of this report;
  - Stage 7 – Site Investigation (including sampling strategy). This is addressed within Section 11 of this report; and
  - Stage 8 – Production of Baseline Report. This is addressed within Section 12 of this report.

## 2 APPLICATION SITE CONDITION REPORT

### 2.1 Application Phase

- 2.1.1 This section sets out the application stage information required by Natural Resources Wales Guidance Note H5. Where relevant it provides references to the various chapters of this report, where available information on the known current condition of the operational area is provided.

### 2.2 Site Condition Report Summary

1.0 Site Details	
Name of the applicant	RWE Generation UK Plc.
Activity address	Pembroke Power Station, West Pennar, Pembroke, SA71 5SS.
National grid reference	SM 9270 0260
Site area (ha)	At permit issue Pembroke Power Station covered an area of 10 ha.
Document reference and dates for Site Condition Report at permit application and surrender	Pembroke Environmental Permit Application, Site Condition Report (JP3638LK) Part II, Chapter 3 – Site Conditions and Contamination Hazards (2010)
Document references for site plans (including location and boundaries):	Pembroke Environmental Permit Application, Site Condition Report (JP3638LK)

2.0 Condition of the land at permit issue	
Environmental setting including: <ul style="list-style-type: none"><li>• Topography</li><li>• Geology</li><li>• Hydrogeology</li><li>• Hydrology</li><li>• Environmental Consents, Licences, Authorisations, Permits and Designations</li></ul>	Please refer to the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK)
Pollution history including: <ul style="list-style-type: none"><li>• Location, nature of incidents or direct discharges that may have affected soil or groundwater</li><li>• Historical land uses and associated contaminants</li></ul>	Please refer to the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK)
Evidence of historic contamination, for example, historical site investigation, assessment, remediation and verification reports (where available)	Please refer to the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK)

Baseline soil and groundwater reference data	Please refer to the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK)
Supporting information	<ul style="list-style-type: none"> <li>• Pembroke Environmental Permit Application, Site Condition Report (JP3638LK)</li> <li>• Part II, Chapter 3 – Site Conditions and Contamination Hazards (2010)</li> </ul>

### 3.0 Permitted activities

Permitted activities	<p>The current permitted activity is under Section 1.1 A(1)(a) Activity – Burning any fuel in an appliance with a rated thermal input of</p> <p>The activity being added is under Section 4.2 A(1)(a) Producing inorganic chemicals.</p> <p>See Section 4.1 of this report for details on the new permitted activity.</p>
Non-permitted activities undertaken	N/A
Document references for: <ul style="list-style-type: none"> <li>• plan showing activity layout; and</li> <li>• environmental risk assessment.</li> </ul>	<ul style="list-style-type: none"> <li>• Pembroke Environmental Permit Application, Site Condition Report (JP3638LK)</li> </ul>

## 3 OPERATION SITE CONDITION REPORT

### 3.1 Operational Phase

- 3.1.1 This report provides an addendum to the existing Pembroke Power Station Site condition report and addresses operational changes associated with the variation to include the GHPF. There will be no change to the materials used, produced or released from the existing power station itself, all new materials are associated with the new GHPF.

### 3.2 Site Condition Report Summary

4.0 Changes to the activity	
Have there been any changes to the activity boundary? If yes, provide a plan showing the changes to the activity boundary.	Yes, under this permit variation an additional 4.0 ha is to be added to the permitted area of Pembroke Power Station to include the electrolyser area, see Drawing 2.
Have there been any changes to the permitted activities? If yes, provide a description of the changes to the permitted activities	Yes, see section 4.A layout plan of the GHPF is provided in Drawing 3. Details of drainage associated with the new GHPF are shown in Drawing 4. drainage plan associated
Have any 'dangerous substances' not identified in the Application Site Condition Report been used or produced as a result of the permitted activities? If yes, list them	Yes, see sections 5, 6 & 7.
<b>Checklist of supporting information</b>	<ol style="list-style-type: none"> <li>1. Plan showing any changes to the boundary (where relevant) - See Drawing 2</li> <li>2. Description of the changes to the permitted activities (where relevant) - See section 4 and Drawing 3 &amp; 4.</li> <li>3. List of 'dangerous substances' used/produced by the permitted activities that were not identified in the Application Site Condition Report (where relevant) - See sections 5, 6 &amp; 7</li> </ol>
5.0 Measures taken to protect land	
Under the existing Power Station pollution prevention measures are in place and are monitored and maintained in accordance with routines specified within the site management systems. These measures will not change as a result of this variation. Proposed measures relating to the GHPF are outlined within sections 4, 5, 6 & 7 of this document.	
<b>Checklist of supporting information</b>	4. N/A
6.0 Pollution incidents that may have had an impact on land, and their remediation	
None to date	
<b>Checklist of supporting information</b>	<ol style="list-style-type: none"> <li>5. Records of pollution incidents that may have impacted on land - None</li> <li>6. Records of their investigation and remediation - None</li> </ol>

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## 7.0 Soil gas and water quality monitoring (where undertaken)

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Records of all monitoring undertaken during the permitted life of the Pembroke Power Station will be kept. These records will include the monitoring undertaken to inform the baseline condition of the additional land to be occupied by the GHPF and included within the Pembroke Power Station installation boundary.

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<b>Checklist of supporting information</b>	7. N/A
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## 4 PROPOSED VARIATION

### 4.1 Description of Proposed Activities

- 4.1.1 The existing operational power station will continue to operate as permitted following the variation. The 100-120 MWe Green Hydrogen Production Facility (GHPF) will be operated on additional land west of Pembroke Power Station, West Pennar, Pembroke, SA71 5SS.
- 4.1.2 The production of hydrogen is a Schedule 1 activity under Section 4.2 Inorganic Chemicals Part A(1) (a) Producing inorganic chemicals.
- 4.1.3 Green hydrogen will be produced using electrolysis of water with electricity supplied from renewable power from the grid. Key elements of the GHPF include the electrolyser, water pipeline route linking the electrolyser to the existing power station demineralised water treatment plant and the cable route to the 132 kV substation. The GHPF will occupy an area of approximately 4.0 hectares.
- 4.1.4 A decision on which technology will be used at Pembroke has not yet been made. The two proposed technologies are:
- Alkaline Electrolysis (AEL) - AEL operates via two electrodes, that are separated by a thin diaphragm which separates the product gases and leads to the transport of hydrogen ions from one electrode to the other.
  - Proton Exchange Membrane (PEM) - PEM technology is a process where water is split using an ionically conductive solid plastic polymer.
- 4.1.5 The primary raw material used at the facility is water. Should the AEL system be selected the electrolyte will be potassium hydroxide and associated storage will be required.
- 4.1.6 There will be no new continuous aqueous waste produced on site by the GHPF; aqueous waste water associated with the demineralised water supply to the GHPF will be produced in the existing Power Station demineralised water plant and will be discharged within the parameters included within the current Power Station permit.
- 4.1.7 For PEM and AEL technology the ion exchange resins will be replaced and removed off site for regeneration to avoid generating wastewaters.
- 4.1.8 The GHPF will require cooling, and this will be facilitated using a closed circuit cooling water (CCCW) system with a water glycol mixture. The CCCW will itself be cooled using either air cooled condensers or a hybrid cooling system. Should a hybrid system be used dosing of the cooling water with sodium hypochlorite will be required for legionella control.
- 4.1.9 Most of the hydrogen produced by the electrolysis plant will be transported to the Valero Pembroke Refinery via a 1.5 km pipeline which will run parallel to an existing natural gas pipeline, at a rate of approximately 2,000kg/hr.
- 4.1.10 Note this pipeline is not included within the installation boundary and this SCR only considers the area covering the electrolyser.
- 4.1.11 Hydrogen buffer storage will be provided in one storage tank, with a total of 1.5 m<sup>3</sup> for hydrogen from the electrolyser and a second buffer tank for storage of product hydrogen with a capacity to hold 6 m<sup>3</sup> of hydrogen.
- 4.1.12 During start-up and shutdown, and during abnormal/emergency conditions flaring is required. The three pilot lights for the flare will be fuelled either with hydrogen or propane. On occasion hydrogen venting will be required.
- 4.1.13 Oxygen produced from the electrolysis of water will be vented to air.

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- 4.1.14 The GHPF will be situated on concrete hardstanding and will be designed and constructed for operational needs with all liquid storage containment and bunding/secondary containment designed according to CIRIA C736F<sup>3</sup> guidance.
  - 4.1.15 An emergency back-up diesel generator will be included within the GHPF with associated diesel fuel storage.

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<sup>3</sup> [CIRIA C736F](#) Containment systems for the prevention of pollution

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## 5 STAGE 1 – IDENTIFY WHICH HAZARDOUS SUBSTANCES ARE USED, PRODUCED OR RELEASED AT THE INSTALLATION AND PRODUCE A LIST OF THESE SUBSTANCES

- 5.1.1 The IED relates to contamination risk associated with “hazardous substances” used, produced and/or released by the proposed facility. Hazardous substances are defined as substances or mixtures defined in Article 3 of 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 (the “CLP Regulations”). The determination of whether a substance is a hazardous substance is largely determined using the substance CAS Number and European Chemicals Agency (ECHA) database.

### Raw Materials

- 5.1.2 Table 5-1 and Table 5-2 below summarises the raw materials, expected consumption and storage arrangement for the two potential hydrogen production techniques and considers which of the listed substances are hazardous.

**Table 5-1: Proposed Raw Materials for AEL Technology**

Raw material	Concentration / Purity	Usage	Net Storage capacity	Storage Facility	Hazardous
Potassium hydroxide (KOH)	25–30%w/w solution	Replaced every 5 years equates to an average of 97 m <sup>3</sup> per annum.	483 m <sup>3</sup>	Stored within a tank designed to industry standard and present within the electrolyser.	Yes
Nitrogen	> 99,8% purity	3,100 Nm <sup>3</sup> /h (intermittent use for purging and emergency only)	30,000 l	Storage tank designed to industry standard.	No
Instrument and plant air	Compressed air	140 Nm <sup>3</sup> /h	20 Nm <sup>3</sup> (10 m <sup>3</sup> instrument air, 10 m <sup>3</sup> plant air).	15 minutes storage tank for safe shut down	No
Demineralised water (from Power Station to supply)	Demineralised water from Power Station demineralised water supply post treatment in polishing plant	22m <sup>3</sup> /hour	Additional storage tank on site 7,000 m <sup>3</sup>	Storage tank designed to industry standard.	No
Cooling water	Towns water supply (raw industrial water)	100 m <sup>3</sup> /h fed into the tank.  70 m <sup>3</sup> /h fed directly to Pembroke Power Station water treatment plant.  30 m <sup>3</sup> stored and used to supply the main cooling circuit at higher outside temperatures, when pure air cooling is no longer sufficient.	3,200 m <sup>3</sup>	No storage. Storage tank designed to industry standard.	No

Raw material	Concentration / Purity	Usage	Net Storage capacity	Storage Facility	Hazardous
Hydrogen (for pilot light system for flare <sup>4</sup> )	Standard commercial quality	6.35 Nm <sup>3</sup> /hour per Pilot 19.05 Nm <sup>3</sup> / hour	0.42 tonnes	Buffer storage tank designed to industry standard.	Yes
Propane (for pilot light system for flare <sup>4</sup> )	Standard commercial quality	0.47 Nm <sup>3</sup> /h per Pilot 1.40 Nm <sup>3</sup> /h for 3 pilot	200 m <sup>3</sup> of gas form 0.74 m <sup>3</sup> of liquid form equal to 392 kg (0.392 tonnes)	Storage tank designed to industry standard	Yes
Sodium hydroxide	50% NaOH solution	Intermittent flow during regeneration	240 l	Storage tank designed to industry standard or IBC with 110% containment and bunding. Separate secondary containment to HCl solution.	Yes
Hydrochloric acid	≥ 30% < 50% HCl solution	Intermittent flow during regeneration	600 l	Storage tank designed to industry standard or IBC with 110% containment and bunding. Separate secondary containment to HCl solution.	Yes
Compressor oil	Standard market quality	Internal compressor cycle	300 l	Up to 1 x 205 l drum.	Yes
Sodium hypochlorite (Biocide)	≥ 10% < 15% sodium hypochlorite (NaOCl) solution	Variable, as required.	2 m <sup>3</sup>	2 x IBC with 110% containment. Limited to the inventory of a closed loop cooling system.	Yes

<sup>4</sup> Note that a decision has not yet been made on the fuel used in the pilot flare but the two fuels under consideration are hydrogen and propane.

Raw material	Concentration / Purity	Usage	Net Storage capacity	Storage Facility	Hazardous
Corrosion inhibitor	Standard market quality	Intermittent quality control flow	1 m <sup>3</sup>	IBC container with 110% containment.	Yes
Hardness stabiliser	Standard market quality	Intermittent quality control flow	1 m <sup>3</sup>	IBC container with 110% containment.	Yes
Glycol	Standard market quality	Used in CCCW system	No storage	No storage, present only within the CCCW system	Yes
Diesel	Standard market quality	500 kW 24/7 (emergency back-up use)	1.3 tonnes	Diesel will be stored in compliance with Control of Pollution (Oil Storage) (Wales) regulations <sup>5</sup>	Yes
Deoxo catalyst	Standard market quality	Replaced once per year - < 1 tonne	One refill (<1 tonne)	One refill stored in warehouse for exchange	Yes <sup>1</sup>
Adsorbent	Standard market quality	Replaced once per year - < 1 tonne	One refill (<1 tonne)	One refill stored in warehouse for exchange	Yes <sup>1</sup>
Transformer Oil	Standard market quality	Topped up as and when required	No storage – limited to the inventory of the system	No storage – limited to the inventory of the system	
Ferric Chloride	Standard market quality	To be confirmed following further plant design.	2 tonnes	IBC container with 110% containment.	
Sodium Bisulphate	Standard market quality	To be confirmed following further plant design.	2 tonnes	IBC container with 110% containment.	
Acrylate Polymer	Standard market quality	To be confirmed following further plant design.	1 tonne	IBC container with 110% containment.	

<sup>5</sup> [The Water Resources \(Control of Pollution\) \(Oil Storage\) \(Wales\) Regulations 2016 \(legislation.gov.uk\)](https://www.legislation.gov.uk)

Raw material	Concentration / Purity	Usage	Net Storage capacity	Storage Facility	Hazardous
Nitric Acid	Standard market quality	To be confirmed following further plant design.	0.5 tonnes	IBC container with 110% containment.	

<sup>1</sup> As the nature of the adsorbent and deoxo catalyst are currently unknown from the information available then on this precautionary assumption we deem these substances as hazardous.

<sup>2</sup> Either propane or hydrogen could be used within the flare pilot. Pilot fuel will be confirmed following further plant design.

**Table 5-2: Proposed Raw Materials for PEM Technology**

Raw material	Concentration / Purity	Usage	Net Storage capacity	Storage Facility	Hazardous
Nitrogen	> 99,8% purity	8,400 Nm <sup>3</sup> /h (intermittent use for purging and emergency only)	30,000 l	Storage tank designed to industry standard	No
Instrument and Plant Air	Compressed air	140 Nm <sup>3</sup> /hour	20 Nm <sup>3</sup> (10 m <sup>3</sup> instrument air, 10 m <sup>3</sup> plant air).	15 minutes storage tank for safe shut down	No
Demineralised water (from Power Station to supply post treatment in polishing plant)	Demineralised water from Power Station demineralised supply post treatment in polishing plant	21 m <sup>3</sup> /hour	Additional storage tank on Site 7,000 m <sup>3</sup>	Storage tank	No
Cooling water	Towns water supply (raw industrial water)	100 m <sup>3</sup> /h fed into the tank.  70 m <sup>3</sup> /h fed directly to Pembroke Power Station water treatment plant.  30 m <sup>3</sup> stored and used to supply the main cooling circuit at higher outside temperatures, when pure air cooling is no longer sufficient.	3,200 m <sup>3</sup>	No storage. Storage tank designed to industry standard.	No
Resin filters	Mixed bed filter bottles /cartridges	36 mixed bed filter bottles /cartridges each containing 100 litre, Total 3,600 litres	42 mixed bed filter bottles /cartridges each containing 100 litre, Total 4,200 litre	Fixed installed 6 cartridges per module, one set of 6 cartridges stored in warehouse for exchange	No

Raw material	Concentration / Purity	Usage	Net Storage capacity	Storage Facility	Hazardous
Hydrogen (for pilot light system for flare <sup>6</sup> )	Standard commercial quality	6.35 Nm <sup>3</sup> /hour per Pilot 19.05 Nm <sup>3</sup> / hour	0.42 tonnes	Storage from buffer tank	Yes
Propane (for pilot light system for flare <sup>7</sup> )	Standard commercial quality	2 m <sup>3</sup> /hour Pilot, 6m <sup>3</sup> hour Total 0.47 Nm <sup>3</sup> /h per Pilot 1.40 Nm <sup>3</sup> /h for 3 pilots	200 m <sup>3</sup> of gas form 0.74 m <sup>3</sup> of liquid form equal to 392 kg (0.392 tonnes)	Storage tank designed to industry standard	Yes
Compressor oil	Standard market quality	Internal compressor cycle	300 l	Up to 1 x 205 l drum	Yes
Sodium hypochlorite (Biocide)	≥ 10% < 15% sodium hypochlorite (NaOCl) solution	Variable, as required	2 m <sup>3</sup>	2 x IBC with 110% containment. Limited to the inventory of a closed loop cooling system.	Yes
Corrosion inhibitor	Standard market quality	Intermittent quality control flow	1 m <sup>3</sup>	IBC Container with 110% containment	Yes
Hardness stabiliser	Standard market quality	Intermittent quality control flow	1 m <sup>3</sup>	IBC Container with 110% containment	Yes
Glycol	Standard market quality	Used in water cooling system (closed circuit loop)	No storage	No storage present only within the CCCW system	Yes
Diesel	Standard market quality	500 kW 24/7 (emergency back-up use)	1.3 tonnes	Diesel will be stored in compliance with Control of Pollution (Oil Storage) (Wales) regulations <sup>7</sup>	Yes
Deoxo catalyst	Standard market quality	Replaced once per year - < 1 tonne	One refill (<1 tonne)	One refill stored in warehouse for exchange	Yes <sup>1</sup>

<sup>6</sup> Note that a decision has not yet been made on the fuel used in the pilot flare but the two fuels under consideration are hydrogen and propane.

<sup>7</sup> [The Water Resources \(Control of Pollution\) \(Oil Storage\) \(Wales\) Regulations 2016 \(legislation.gov.uk\)](https://www.legislation.gov.uk)

Raw material	Concentration / Purity	Usage	Net Storage capacity	Storage Facility	Hazardous
Adsorbent	Standard market quality	Replaced once per year < 1 tonne	One refill (<1 tonne)	One refill stored in warehouse for exchange	Yes <sup>1</sup>
Transformer Oil	Standard market quality	Topped up as and when required	No storage – limited to the inventory of the system	No storage – limited to the inventory of the system	Yes
Ferric Chloride	Standard market quality	To be confirmed following further plant design.	2 tonnes	IBC container with 110% containment.	Yes
Sodium Bisulphate	Standard market quality	To be confirmed following further plant design.	2 tonnes	IBC container with 110% containment.	Yes
Acrylate Polymer	Standard market quality	To be confirmed following further plant design.	1 tonne	IBC container with 110% containment.	Yes
Nitric Acid	Standard market quality	To be confirmed following further plant design.	0.5 tonnes	IBC container with 110% containment.	Yes

<sup>1</sup> As the nature of the adsorbent and Deoxo Catalyst are currently unknown from the information available then on this precautionary assumption we deem these substances as hazardous.

<sup>2</sup> Either propane or hydrogen could be used within the flare pilot. Pilot fuel will be confirmed following further plant design.

- 5.1.3 Of the materials above, water used within the electrolyzers to generate hydrogen is the primary raw material. The raw material usage will be controlled to avoid overuse/wastage.
- 5.1.4 An emergency back-up diesel generator will also be included on the development site. The generator will only run in the event of loss of power. It will require 1,500 litres of diesel to provide a continuous 500 kW output 24/7, based on worst-case assumptions.

## Residues

- 5.1.5 Waste generation from maintenance is infrequent.
- 5.1.6 Table 4-3 and Table 4-4 below summarises the annual residues generated from the two potential hydrogen production techniques and considers which of the listed residues are hazardous.

**Table 4-3 Proposed Residues for AEL Technology**

Residue	Storage Capacity (m <sup>3</sup> )	Storage Facility	Annual Generation	Hazardous
Spent potassium hydroxide (KOH)	N/A	Not stored. Will remove directly off site once emptied from the electrolyser unit and prior to being replaced.	97m <sup>3</sup> (exchanged every 5 years)	Yes
Waste compressor oil	N/A	Up to 1 x 205 l drum. Will remove directly off site prior to being replaced.	300 l	No
Used electrolyser stacks	N/A	Not stored. Every 8 to 10 years they will be removed and taken off site. Stacks will be refurbished rather than directly replaced to reduce waste production.	N/A	No
Oxygen by product	N/A	Not stored, it will be released to atmosphere as produced at a rate of 13,600 - 15,200 kg/hour.	Up to 128,045 tonnes per annum	No
Wastewater / condensate alkaline	N/A	Wastewater from the process e.g. condensate is rerouted to a storage tank and reused in demineralised supply.	< 5000 kg/h	No
Wastewater (discontinuously) from polishing unit / cooling tower purge	N/A	Not stored. Only during regeneration every 5-6 years. Tankered offsite for treatment and disposal. Cooling tower purge is to be recycled to inlet of water treatment plant.	3,840 l	No
Spent deoxo Catalyst	N/A	One refill stored in warehouse for exchange. Will be removed directly off site prior to being replaced. Replacement approximately once per year.	< 1 tonne	Yes <sup>1</sup>
Spent adsorbent	N/A	One refill stored in warehouse for exchange. Will be removed directly off site prior to being replaced. Replacement approximately once per year.	< 1 tonne	Yes <sup>1</sup>

<sup>1</sup> As the nature of the spent adsorbent and spent Deoxo Catalyst are currently unknown from the information available then on this precautionary assumption we deem these substances as hazardous.

**Table 4-4 Proposed Residues for PEM Technology**

Residue	Storage Capacity (m <sup>3</sup> )	Storage Facility	Annual Generation	Hazardous
Spent resin filters	N/A	Replaced every 9 months. Will be removed off site prior to being replaced.	N/A	No
Waste compressor oil	N/A	Up to 1 x 205 l drum. Will remove directly off site prior to being replaced.	300 l	Yes
Used electrolyser stacks	N/A	Every 8 to 10 years they will be removed and taken off site. Stacks will be refurbished rather than directly replaced to reduce waste production.	N/A	No
Oxygen by product	N/A	Not stored, it will be released to atmosphere as produced at a rate of 13,600 - 15,200 kg/hour.	Up to 128,045 tonnes per annum	No
Wastewater / condensate alkaline	N/A	Wastewater from the process e.g. condensate is rerouted to a storage tank and reused in demineralised supply.	< 5000 kg/hour	No
Wastewater (discontinuously) cooling tower purge	N/A	Cooling tower purge is to be recycled to inlet of water treatment plant. Tankered offsite for treatment and disposal.	3,840 l	No
Spent deoxo catalyst	N/A	One refill stored in warehouse for exchange. Will be removed directly off site prior to being replaced. Replacement approximately once per year.	< 1 tonne	Yes <sup>1</sup>
Spent adsorbent	N/A	One refill stored in warehouse for exchange. Will be removed directly off site prior to being replaced. Replacement approximately once per year.	< 1 tonne	Yes <sup>1</sup>

<sup>1</sup> As the nature of the spent adsorbent and spent Deoxo Catalyst are currently unknown from the information available then on this precautionary assumption we deem these substances as hazardous.

## Site Drainage

- 5.1.7 A new drainage system will be installed to separately handle process wastewater and surface waters from the new GHPF. The new drainage system will connect into the existing power station drainage.
- 5.1.8 Surface water will be discharged to site via an existing headwall into a swale drainage system with check dams at 10 m intervals that will direct surface water to an attenuation basin and ultimately discharging into the existing surface water network via an existing manhole connection.
- 5.1.9 In an emergency event the penstock valve can be shut to stop the discharge of any contamination to surface water.
- 5.1.10 All surface water features will be managed by an appointed management company in line with SuDS Manual Guidance for regular maintenance.
- 5.1.11 There are site maintenance and inspection procedures in place for the oil interceptor to prevent the discharge from causing pollution. Therefore, the surface water discharge has been discounted as a RHS for the purpose of this baseline of soil and groundwater.
- 5.1.12 See Drawing 4 for Site Drainage Layout.

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## Summary of Hazardous Substances

5.1.13 From the raw materials and residues to be used and created at the site the following are considered hazardous and will be carried forward to stage 2:

- Potassium hydroxide (KOH)
- Propane
- Hydrogen
- Sodium hydroxide
- Hydrochloric acid
- Compressor oil
- Sodium hypochlorite (biocide)
- Corrosion inhibitor
- Hardness stabiliser
- Glycol
- Diesel
- Deoxo catalyst
- Adsorbent
- Transformer Oil
- Ferric Chloride
- Sodium Bisulphate
- Acrylate Polymer
- Nitric Acid.

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## 6 STAGE 2 – IDENTIFYING THE RELEVANT HAZARDOUS SUBSTANCES

- 6.1.1 Stage 1 identified a number of hazardous substances that will be stored and used within or produced by the GHPF. Stage 2 requires a review of the listed substances to determine which are relevant hazardous substances (RHS). Each of the substances identified within Stage 1 are reviewed below, considering their chemical and physical properties and how they are stored and used on site, to determine the potential pollution risk of each hazardous substance.
- 6.1.2 RHS in relation to IED are defined as:  
*those substances or mixtures defined within Article 3 of Regulations (EC) No1272/2008, 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.*
- 6.1.3 The following table provides a summary of the chemical and physical properties of the hazardous substances carried forward from the previous sub-section to inform the pollution risks. Those identified as a RHS are considered further in Stage 3.

**Table 6-1 Summary of Potential Pollution Risks of Hazardous Substances**

Substance	Chemical Characteristics /Risks	Physical State	Solubility	Toxicity	Mobility	Persistence	Soil and Groundwater Pollution Potential	RHS
Potassium hydroxide (KOH)	25–30%w/w solution. H290 - May be corrosive to metals H302 - Harmful if swallowed H314 - Causes severe skin burns and eye damage	Liquid	High – water soluble	High – Harmful to aquatic organisms	High – Highly Mobile in soils	Persistence is unlikely	Low - May affect pH in receiving groundwaters.	Yes
Propane	H220 – Flammable gas H280 – Gases under pressure: Compressed gas	Gas	Low	No known effects from this product.	No information available	The substance is readily biodegradable. Unlikely to persist.	Low - Because of its high volatility, the product is unlikely to cause ground or water pollution.	No
Hydrogen	H220 – Flammable gas H280 – Gases under pressure: Compressed gas	Gas	Low	No ecological damage caused by this product	No ecological damage caused by this product	No ecological damage caused by this product	Low – unlikely to cause soil and groundwater pollution as substance will mobilise upwards.	No
Sodium hydroxide <sup>8</sup>	50% NaOH solution H290 – May be corrosive to metals. H314 – causes severe skin burns and eye damage. H401 – Harmful to aquatic life.	Liquid	High	High – Harmful to aquatic organisms, may cause long term effects in the aquatic environment	Unknown	High – soluble in water, readily degradable in the environment	Low - May affect pH in receiving groundwater.	Yes

<sup>8</sup> Note this will only be required for AEL technology.

Substance	Chemical Characteristics /Risks	Physical State	Solubility	Toxicity	Mobility	Persistence	Soil and Groundwater Pollution Potential	RHS
Hydrochloric acid <sup>8</sup>	<p>≥ 30% &lt; 50% HCl solution.</p> <p>H290 – May be corrosive to metals.</p> <p>H314 - causes severe skin burns and eye damage.</p> <p>H335 May cause respiratory irritation.</p>	Liquid	High	High – Toxic to fish and aquatic organisms	High - The product is water-soluble and may spread in water systems. Volatile liquid	Product contains inorganic substances which are not biodegradable	Low - May affect pH in receiving groundwater..	Yes
Compressor oil	<p>Inhalation - If inhalation of mists, fumes or vapour causes irritation to the nose or throat, or coughing, remove to fresh air.</p> <p>Eyes – Wash eye thoroughly with copious quantities of water, ensuring eyelids are held open.</p> <p>Skin – Wash skin thoroughly with soap and water as soon as reasonably practicable.</p> <p>Ingestion - If contamination of the mouth occurs, wash out</p>	Liquid	Low - Insoluble in water	Medium - No toxic components present at levels to cause classification.	High – readily absorbed into soil.	Low – not expected to be readily biodegradable	Medium - Has potential to penetrate soil causing soil and ground water contamination.	Yes

Substance	Chemical Characteristics /Risks	Physical State	Solubility	Toxicity	Mobility	Persistence	Soil and Groundwater Pollution Potential	RHS
	thoroughly with water.							
Sodium hypochlorite (Biocide)	<p>≥ 10% &lt; 15% solution</p> <p>H290 – May be corrosive to metals</p> <p>H314 – causes severe skin burns and eye damage</p> <p>H410 – very toxic to aquatic life.</p>	Liquid	High	High – very toxic to aquatic life	High – The product is mobile in water environment and in soils.	Low - The product will quickly degrade in the environment	Medium - The product may affect the acidity (pH) of groundwater. Reacts with organic substances in soil and sediments and degrades rapidly to chloride salts.	Yes
Corrosion inhibitor	<p>H319 – causes serious eye irritation</p> <p>H411 – Toxic to aquatic life with long lasting effects.</p>	Liquid	Insoluble in water	High – harmful to aquatic life	High	Low – will not bioaccumulate	Medium - Has potential to penetrate soil causing soil and ground water contamination.	Yes
Hardness stabiliser	<p>H302, H311, H332 – Acute Toxic</p> <p>H315 – Skin irritation</p> <p>H319 – Eye irritation</p>	Liquid	High – Completely miscible in water	High – Harmful to aquatic organisms, may cause long term effects in the aquatic environment	Unknown	Unknown	Medium - Likely to be mobile as completely soluble in water.	Yes
Glycol	<p>H302 – Harmful if swallowed</p> <p>H373 – May cause damage to organs through prolonged or repeated exposure.</p>	Liquid	High	High - harmful to aquatic organisms	High – likely to be mobile due to its water solubility	Low – Substance is not considered persistence	High - soil and groundwater pollution potential due to high mobility.	Yes

Substance	Chemical Characteristics /Risks	Physical State	Solubility	Toxicity	Mobility	Persistence	Soil and Groundwater Pollution Potential	RHS
Diesel	H226 Flammable liquid and vapour. H227 Combustible liquid. H304 May be fatal if swallowed and enters airways. H315 Causes skin irritation. H332 Harmful if inhaled. H351 Suspected of causing cancer. H373 May cause damage to organs or organ systems through prolonged or repeated exposure. H401 Toxic to aquatic life. H411 Toxic to aquatic life with long lasting effects.	Liquid	Not miscible	High – toxic to aquatic life with long lasting effects	Mobility: Slightly soluble. Large volumes could penetrate soil and contaminate groundwater	N/A	Medium - Releases to groundwater will result in a hydrocarbon film floating and spreading on the surface.	Yes
Deoxo catalyst	Unknown	Solid			Unknown			Y
Adsorbent	Unknown	Solid			Unknown			Y
Transformer Oil	H304 - May be fatal if swallowed and enters airways.	Liquid	Insoluble	Low toxicity. Only large quantities are likely to have adverse	Low - will spread on the water surface	Unlikely to bioaccumulate and not considered readily	Medium - releases to water will result in a hydrocarbon film floating and spreading on the surface.	Y

Substance	Chemical Characteristics /Risks	Physical State	Solubility	Toxicity	Mobility	Persistence	Soil and Groundwater Pollution Potential	RHS
				effects on human health.		biodegradable by OECD test.		
Ferric Chloride	H410 Very toxic to aquatic life with long lasting effects. H331 Toxic if inhaled. H302 Harmful if swallowed. H315 Causes skin irritation. H318 Causes serious eye damage.	Liquid	Poor Water solubility	Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.	Low – due to poor water solubility	Will not bioaccumulate.	Low- Has potential to penetrate soil causing soil and ground water contamination.	Y
Sodium Bisulphate	H318 Causes serious eye damage	Crystalline Powder	Miscible with water	No known ecological damage caused by this product	High – likely to be mobile due to its water solubility	Unknown	Low - Has potential to penetrate soil causing soil and ground water contamination due to high mobility.	Y
Acrylate Polymer	Not classified as hazardous to the aquatic environment.	Solid	Practically insoluble in water	No ecological damage caused by this product	Unknown	Unknown	Low- Has potential to penetrate soil causing soil and ground water contamination.	N
Nitric Acid	H290 – May be corrosive to metals. H318 Causes serious eye damage. H331 Toxic if inhaled H270 Oxidising Liquids H314 Skin corrosion / irritation	Liquid	Miscible with water	Toxic to aquatic organism in large quantities.	Will likely be mobile in the environment due to its water solubility.	Unknown.	Medium – Has potential to penetrate soil causing soil and ground water contamination due to high mobility. The product may affect the acidity (pH) of groundwater.	Y

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## 7 STAGE 3 – ASSESSMENT OF THE SITE SPECIFIC POLLUTION POSSIBILITY

- 7.1.1 Each of the relevant hazardous substances identified in Stage 2 are to be considered in Stage 3 in the context of the site itself to determine whether circumstances exist which may result in the release of the substance in sufficient quantities to represent a pollution risk, either as a result of a singular emission or as a result of accumulation from multiple emissions.
- 7.1.2 Circumstances under which emissions may occur include:
- Planned emissions;
  - Accidents and / or incidents; and
  - Routine operations.
- 7.1.3 RWE has an existing Environmental Management System (EMS) in place for the site. The EMS identifies potential incidents that could have an environmental impact, the cause and consequences; measures taken to avoid the incident happening and actions to minimise the impact on the environment from the event.
- 7.1.4 In the event of an incident on site, RWE will undertake investigations in order to resolve the issue and/or report the event to emergency services and NRW, as required.
- 7.1.5 After the immediate actions have been undertaken to resolve the incident a non-conformance report shall be completed along with a health, safety and environment report. This shall be reviewed by RWE's health safety and environment committee, and preventative measures will be implemented.

### 7.2 Potassium hydroxide (KOH)

- 7.2.1 Potassium hydroxide will be stored in the electrolyser unit with secondary containment and is planned to be replaced every 5 years. In the event of a leak it will be contained within the secondary containment and as the electrolyser unit is located on hardstanding, within sealed drainage. Given these precautions and the infrequency of KOH replacement, the risk of pollution is low.

### 7.3 Hydrogen

- 7.3.1 Hydrogen or propane will be used to fuel the flare pilot light. Hydrogen will be supplied from a buffer tank.
- 7.3.2 Given hydrogen's nature if it is released into the surrounding environment it will dissipate into the air. Therefore, considering this and the infrequent use of hydrogen, the risk to ground or groundwater from hydrogen is deemed low.

### 7.4 Propane

- 7.4.1 As above, hydrogen or propane will be used to fuel the flare pilot light. It will be stored and supplied from a sole storage tank. In the event of a leak of propane into the surrounding environment it will dissipate into the air. Therefore, the risk to ground or groundwater from propane is deemed low.

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## 7.5 Sodium Hydroxide

- 7.5.1 Sodium hydroxide (NaOH) will be used in a polishing unit for AEL technology which will consist of a mixed bed ion exchange. NaOH will be stored in IBC containers each equipped with secondary containment and stored on a hardstanding surface. In case of leaks or spills, these will be contained within a sealed drainage system preventing the chemical from entering surface or groundwater systems. Given these storage measures the risk of NaOH pollution is considered low.

## 7.6 Hydrochloric Acid

- 7.6.1 Hydrochloric acid (HCl) will be used in a polishing unit for AEL technology which will consist of a mixed bed ion exchange. HCl acid will be stored in IBC containers each equipped with secondary containment and stored on a hardstanding surface. In case of leaks or spills, these will be contained within a sealed drainage system preventing the chemical from entering surface or groundwater systems. Given these storage measures the risk of HCl pollution is considered low.

## 7.7 Sodium Hypochlorite (Biocide)

- 7.7.1 Biocide will be used in the hybrid cooling tower. It will be stored on site in 2 x 1m<sup>3</sup> IBC containers equipped with secondary containment and stored on a hardstanding surface. In case of leaks or spills, these will be contained within a sealed drainage system preventing the chemical from entering surface or groundwater systems. Given these storage measures the risk of pollution is considered low.

## 7.8 Corrosion Inhibitor

- 7.8.1 Corrosion inhibitor will be stored in a single 1 m<sup>3</sup> IBC container with secondary containment in place. The storage area will be on an impermeable surface with sealed drainage ensuring that any leaks or spills are contained, preventing any route to groundwater or surface water. Considering the quantity of solution to be stored on site and the implemented controls it is unlikely that soil or groundwater contamination could occur. Therefore, the potential pollution risk is deemed low.

## 7.9 Hardness Stabiliser

- 7.9.1 Hardness stabiliser will also be stored in a single 1 m<sup>3</sup> IBC container with secondary containment in place. The storage area will be on an impermeable surface with sealed drainage ensuring that any leaks or spills are contained, preventing any route to groundwater or surface water. Considering the quantity of solution to be stored on site and the implemented controls it is unlikely that soil or groundwater contamination could occur. Therefore, the potential pollution risk is deemed low.

## 7.10 Glycol

- 7.10.1 Glycol will be dosed into the closed-loop cooling water and will not be stored on site. Since there is limited inventory, the glycol is diluted with cooling water and contained within the closed-loop cooling system, the risk of pollution is considered low.

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## 7.11 Diesel

- 7.11.1 Diesel will be used to fuel the backup generator. It will be stored in a 1500-litre tank in compliance with the Control of Pollution (Oil Storage) (Wales) regulations<sup>9</sup>. The generator will be tested for up to an hour once a month to ensure it functions properly and therefore usage is low. The storage tank will be regularly maintained and checked for leaks or signs of wear. It will be located on a hardstanding surface, reducing the risk of spills or leaks to ground and/or groundwater. On this basis the risk to ground and groundwater is low.

## 7.12 Deoxo Catalyst

- 7.12.1 The deoxo catalyst is a solid and is fully contained within the deoxidiser reactor and housed within the electrolyser building. Due to the nature of the catalyst being unknown, on a precautionary basis it has been assumed to be hazardous. However, given it is a solid, fully contained and within a building, and only replaced annually the risk to ground and/or groundwater is low.

## 7.13 Adsorbent

- 7.13.1 The adsorbent is a solid and is fully contained within the dryer vessel and housed within the electrolyser building. Due to the nature of the adsorbent being unknown, on a precautionary basis it has been assumed to be hazardous. However, given it is a solid, fully contained and within a building, and only replaced annually, the risk to ground and/or groundwater is low.

## 7.14 Compressor Oil

- 7.14.1 Compressor Oil will be stored on site in a standard 205 litre barrel and will be limited to the inventory of a closed loop system. The internal compressor cycle is equipped with secondary containment with 110% capacity and located on hardstanding. There is no additional storage on site. In the event of a spill, the Site has spill procedures in place and will be cleaned up immediately. Therefore, there is no active pathway to ground and/or groundwater pollution.

## 7.15 Ferric Chloride

- 7.15.1  $\text{FeHCl}_3$  will be stored in IBC containers each equipped with secondary containment will be stored within a bunded area located on a hardstanding surface. In case of leaks or spills, these will be contained within a sealed drainage system preventing the chemical from entering surface or groundwater systems. Given these storage measures the risk of  $\text{FeHCl}_3$  pollution is considered low.

## 7.16 Sodium Bisulphate

- 7.16.1 Sodium Bisulphate will be stored in IBC container equipped with secondary containment within a bunded area located on a hardstanding surface. In case of leaks or spills, these will be contained within a sealed drainage system preventing the chemical from entering surface or groundwater systems. Given these storage measures the risk of sodium bisulphate pollution is considered low.

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<sup>9</sup> [The Water Resources \(Control of Pollution\) \(Oil Storage\) \(Wales\) Regulations 2016 \(legislation.gov.uk\)](#)

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## 7.17 Acrylate Polymer

- 7.17.1 Acrylate Polymer will be stored in IBC container equipped with secondary containment within a bunded area located on a hardstanding surface. Given it is a solid and fully contained, the risk to ground and/or groundwater is low.

## 7.18 Nitric Acid

- 7.18.1 Nitric Acid will be stored in IBC container equipped with secondary containment within a bunded area located on a hardstanding surface. In case of leaks or spills, these will be contained within a sealed drainage system preventing the chemical from entering surface or groundwater systems. Given these storage measures the risk of sodium bisulphate pollution is considered low.

## 7.19 Site Specific Pollution Possibility

- 7.19.1 Whilst a number of hazardous materials are present on site based on the above, the site specific pollution potential for all substances is low as a consequence of the amounts stored and/or containment measures that will be in place.
- 7.19.2 All containment will be designed and constructed to appropriate standards and during the lifetime of the GHPF will be subject to routine maintenance and inspection. Where necessary, action will be taken to ensure appropriate repairs are made to rectify any defects, should they be identified. Records of maintenance and inspections will be kept.
- 7.19.3 On this basis there are no RHS introduced by the GHPF for which site specific baseline data needs to be obtained.

## 8 STAGE 4 – PROVIDE A SITE HISTORY

- 8.1.1 The purpose of Stage 4 is to determine which of the RHS identified in Stage 3 have the potential to be present on site in the soil and groundwater already as a result of activities undertaken at the site to date and to determine whether they are coincident with potential future emission points. Whilst stage 3 does not identify RHS for which site specific data is required, a number of hazardous substances are identified. On this basis information to inform stage 4 is provided for completeness.
- 8.1.2 This section of the report focuses on the additional land to be added to the Pembroke Power Station permit and is based on information taken from Appendix C produced by RPS (August 2022) for the Electrolyser Area. The original site condition report provides similar information on the site condition of the existing Power Station installation prior to this variation.

### 8.2 General Site History

**Table 7-1: Electrolyser Historical Site Uses.**

On Site Land Use and Features	Dates
Undeveloped agricultural land with a footpath running across north-west to south-east. Potential pond / circular feature adjacent to the footpath.	1864 – 1908
Circular feature (potential pond) no longer shown.	1908 – 1972
The site has been developed, associated with RWE Pembroke Power Station, including an electrical sub-station in the northern portion and a second in the central area. The substation appears to be located within cuttings, where the access roads are built up on embankments. An Industrial Hostel is also shown in the west. Given the general topography of the site sloping towards the east, the presence of several embankments, suggests the electrolyser area has been subject to land raising.	1972 – 1975
Slopes are labelled parallel with the northern boundary. Majority of the infrastructure is no longer indicated, and the northern half is labelled a sports ground. One U-shaped building is still present in the central area.	1975 – 1993
Layout of U-shaped pad is now L-shaped and houses two small buildings and a clear hardstanding track around the pad, in a square leading off site to the south.	1993 – 2006
By 2009, no buildings are indicated in the south-east.	2006 – 2012
By 2012, a new track is identified running north from the square area in the south-east, towards the north-east where the AIG has been constructed. There appears to be a hedge-lined embankment in the south of the south-east hardstanding area and general use of storage of materials. By 2013, the embankment has widened, and storage gone, just a few buildings/stores remain.	2012 – 2013
By 2013, there are no materials stored on the hardstanding area in the southeast and the embankment has been grassed over	2013 – present

### 8.3 Previous Ground Investigation

- 8.3.1 RPS has undertaken a ground investigation at the area of land intended for the development of the green hydrogen electrolyser project and the findings are compiled into the report (Appendix B).
- 8.3.2 The key findings from the ground investigation are as follows:
- The investigation has identified the assessment site to comprise topsoil and reworked topsoil over Made Ground, this is in turn directly underlain by weathered bedrock of the Avon

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Group, with the exception of the far north east which encountered Topsoil over Black Rock Subgroup.

- Made Ground generally comprised reworked weather bedrock with inclusions of construction materials with localised clinker encountered.
- Buried structures and redundant services were encountered across the site, relating to the historical development.
- The Avon Group generally comprised interbedded mudstones and calcareous mudstones.
- The distribution of strata in the general vicinity is governed by the east west orientated Pembroke Syncline resulting locally in bedding dipping moderately to steeply to the north.
- Naturally occurring sub surface voiding within the calcareous mudstone of the Avon Group was encountered in two of the boreholes (BH01 (14.60 – 16.30 m BGL) and BH02 (11.30 – 11.70 m BGL)). Both voids appeared below the water table and showed linear orientation and are considered likely to represent solution widened joints within the Vadose Zone. The strike and the volume of these voids was not investigated during this phase of works.
- The water table beneath the site is observed to fall to the north (i.e. groundwater falls towards the Haven).

8.3.3 Section 11 of this SCR includes analysed concentrations for sampled soil and groundwater conditions within the GHPF area.

## 8.4 Potential Historic Contaminants

8.4.1 There has been no known potentially contaminative land uses or records of pollution incidents within the area to be occupied by the GHPF.

## 8.5 Operational History

8.5.1 The GHPF was previously the original Pembroke A Power Station sports and social club. Historic mapping indicates that this area was largely undeveloped agricultural land until the sports and social club was established in the 1970's. The use of this area of land ceased in the early 2000's following the closure of the original Pembroke A Power Station and has since been used for storage of materials. The area is now mostly laid to grass, with trees and other vegetation around the perimeter and in the southern section.

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## 9 STAGE 5 – IDENTIFY THE SITE’S ENVIRONMENTAL SETTING

### 9.1 Site Setting and Sources of Desk Study Information

9.1.1 At the time of permit issuance, there have been no alterations observed in the environmental setting of the site, as documented in the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK). However, the proposed development site situated west of Pembroke Power Station at West Pennar, Pembroke, SA71 5SS, exhibits slight differences in its environmental setting compared to the original SCR and this is addressed within this section.

9.1.2 This section of the report is based on information taken from:

- RPS Ground Investigation Report - Appendix B
- Groundsure Report – Appendix A
- British Geological Survey – Geology of Britain Viewer

### 9.2 Topography

9.2.1 The GHPF, similar to the existing power station has a general flat topography.

### 9.3 Geology and Hydrogeology

9.3.1 The location of the GHPF has similar geology and hydrogeology to that of Pembroke Power Station. Please refer to the description as detailed in the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK).

### 9.4 Hydrology

9.4.1 The location of the GHPF has similar hydrology to that of Pembroke Power Station. Please refer to the description as detailed in the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK).

### 9.5 Environmental Consents, Licences, Authorisations, Permits and Designations for the Site and Surrounding Areas

9.5.1 Please refer to the description as detailed in the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK). This section is an addendum to the original site condition report to cover the area for the proposed GHPF.

#### Water Discharges and Abstraction Licences

9.5.2 There are no new additional waste discharges or abstraction licences issued since permit was issued that need to be included as part of this variation. Please refer to the description as detailed in the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK).

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## Landfill and Waste Sites

9.5.3 There are two recorded licensed or known historical landfill sites within 250 m of the area to be occupied by the GHPF. These are described in the following table.

**Table 8-1: Landfill Sites**

Source of Record	Approx. Distance and Direction	Licence Details	Waste Type and Details
Local Authority	64 m S	Not Supplied	Not Supplied – Refuse Tip
Local Authority	91 m S	Not Supplied	Not Supplied – Refuse Tip

9.5.4 There are four records of waste exemptions within 250 m of the GHPF. Two records are held for National Grid Gas Plc, for the treating and storing of waste. The additional two records are held by Pembroke 21C Community Interest Company, for storing and using waste in construction.

## Statutory Designated / Sensitive Sites within 1 km

9.5.5 No new designated sensitive environmental sites have been identified since the permit was issued. Please refer to the description as detailed in the original Pembroke Environmental Permit Application, Site Condition Report (JP3638LK).

## Mining

9.5.6 The GHPF is within an area that may have been affected by historical non-coal mining.

9.5.7 There are four records of unspecified ground workings at the GHPF mapped between 1975 and 1994. Based on the historical maps available, it is anticipated that these ground workings are likely the cuttings that were made across the Electrolyser Site. There are also a further two unspecified pits recorded at the GHPF mapped between the same dates, in the south-east corner of the GHPF area. The unspecified ground workings are indicated in the north and south-west of the GHPF area.

9.5.8 Two records of unspecified ground workings are indicated at the western boundary of the water pipeline area, dated 1975 and 1994.

## COMAH

9.5.9 There are no records of any operations under the Control of Major Accident Hazards (COMAH) Regulations 1999, located within 500 m of the GHPF.

## Radon

9.5.10 The GHPF is located in an area where the estimated probability of the property being above the Action Level for radon is 10 – 30 %, whereby full radon protection measures will be required should any building require partial, or full-time occupancy.

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# 10 STAGE 6 – SITE CHARACTERISATION

## 10.1 Introduction

- 10.1.1 RPS have developed a Conceptual Site Model (CSM) for the area to be occupied by the GHPF. Full details on the CSM can be found in Section 9 of Appendix B.

## 10.2 Conceptual Site Model

- 10.2.1 The potential source-pathway-receptor linkages and associated risks at the GHPF, as identified following completion of the assessment, are summarised in the CSM below (Table 9-1).
- 10.2.2 As part of the assessment the potential risks to receptors for potential source is given one of the following classification:
- Low risk - it is considered unlikely that issues within the category will give rise to significant harm to identified receptors;
  - Moderate risk - it is possible, but not certain that issues within the category will give rise to significant harm to receptors; and,
  - High risk - there is a high potential that issues within the category will give rise to significant harm to identified receptors.
- 10.2.3 The risk assessment is based upon the available information relating to the site and recommended mitigation measures being implemented. Should ground conditions inconsistent with those outlined in this report be encountered RPS should be contacted to enable further assessment.
- 10.2.4 The CSM for the GHPF has not included the existing Power station which forms part of the installation. The existing power station CSM is presented in the site condition report which this report forms an addendum to.

**Table 9-1: Conceptual Site Model**

Potential Source	Contaminants of Concern	Via	Potential Pathways	Linkage Potentially Active?	Receptors	Qualitative Risk Rating
<b>On site –</b> Made ground, infilled former cuttings (and pond), land raise	Metals, hydrocarbons and asbestos	Soil	Direct contact / ingestion	x	Future site users	N/A
			Inhalation of volatiles	x		N/A
			Airborne migration of soil or dust	✓	Future site Users Off-site users	Low
			Leaching of mobile contaminants	x	Secondary A Aquifer	N/A
	Metals, and hydrocarbons	Groundwater	Direct contact / ingestion	x x	Future site users Off-site users	N/A
			Inhalation of volatiles	x x	Future site users Off-site users	N/A
			Vertical migration in permeable strata	x	Secondary A Aquifer Unnamed stream	N/A
			Vertical migration via future piled foundations	x	Future site users	N/A
			Lateral migration in permeable strata	x	Future site users	N/A
			<b>Off-site –</b> Tanks, limekiln, cornmill and groundworks / land raising	Metals, hydrocarbons, solvents and PCBs	Groundwater	Direct contact / ingestion
Inhalation of volatiles	x	Future site users Off-site users Future and off-site Structures				N/A
<b>On and off-site –</b> Made Ground / natural strata or bio-degradation of contamination	Carbon dioxide and methane	Ground Gas	Inhalation of ground gas	✓	Future site users	Low
			Explosive risk	✓ ✓	Future site users Buildings / structures	Low

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# 11 STAGE 7 – SITE INVESTIGATION

- 11.1.1 The conclusions of Stage 3 are that whilst hazardous substances are present on site, they are effectively managed in accordance with the sites' Environmental Management System and have a low risk of pollution and consequently concludes that there are no RHS for which site investigation data is required.
- 11.1.2 Whilst the conclusions do not require data to be collected a ground investigation has been completed for the additional land to be occupied by the GHPF and this is included as Appendix B.
- 11.1.3 The findings from this report forms the baseline conditions for GHPF area.

## 11.2 Summary of Works Undertaken

- 11.2.1 The intrusive ground investigation works were undertaken between 11th October and 24th October 2023 and comprised rotary cored boreholes (including dynamic sampling), windowless sampling, trial pits, soakaways and Dynamic Cone Penetrometer (DCP). All exploratory locations were agreed prior to their commencement by representatives from RPS and RWE.
- 11.2.2 Upon completion of the intrusive works, three rounds of groundwater level and ground gas monitoring, and one groundwater sampling round were undertaken.
- 11.2.3 The intrusive investigation works comprised the following:
- PAS 128 survey, including ground penetrating radar (GPR) of all exploratory locations, prior to excavation;
  - Drilling of three rotary cored boreholes (utilising dynamic sampling techniques within the shallow deposits) to depths of between 15.00 m and 18.50 m BGL;
  - Drilling of nine window sample boreholes to a maximum depth of 5.00 m BGL;
  - Excavation of eleven machine excavated trial pits to a maximum depth of 3.20 m BGL;
  - Advancement of twenty four dynamic cone penetrometer tests (DCP) to a maximum depth of 1.00 m BGL;
  - Excavation of two hand excavated trial pits to a depth of 1.20 m BGL at the eastern extremity of the proposed pipeline route;
  - Installation of one 50 mm gas and groundwater monitoring well in one borehole, with a response zone between 5.00 – 15.00 m;
  - Installation of temporary casing and flush covers into two boreholes, to allow for groundwater monitoring. Full standpipe installations were not possible due to subsurface voiding;
  - Soil sampling for laboratory chemical analysis to help establish the presence and extent of chemical contamination within the soils and to assist waste classification of soils;
  - Standard Penetration Test(s) in all boreholes to refusal;
  - Hand Shear Vane testing (where applicable);
  - Logging of soil and groundwater conditions;
  - Full time site attendance by geo-environmental / geotechnical consultants from RPS; and
  - Three rounds of groundwater level monitoring following completion of the intrusive works, including sampling and analysis for chemical contaminants on one occasion.

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## 11.3 Laboratory Analysis

### Soil

11.3.1 A total of twenty-six soil samples were submitted to a UKAS / MCERTS accredited laboratory for analysis for a variety of contaminants of concern including:

- Asbestos screen;
- Inorganic determinands including pH, organic matter, arsenic, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium, zinc, sulphide, sulphate and total cyanide.
- Organic determinands comprising speciated Polycyclic Aromatic Hydrocarbons (PAH), Total Petroleum Hydrocarbons (TPH) Criteria Working Ground (CWG) including BTEX and MTBE, and monohydric phenol.

### Groundwater

11.3.2 A total of three groundwater samples were submitted to a UKAS/MCERTS accredited laboratory for analysis for the following suite of contaminants of concern:

- Inorganic determinands including pH, organic matter, arsenic, cadmium, chromium, hexavalent chromium, copper, lead, mercury, nickel, selenium, zinc, sulphide, sulphate and total cyanide.
- Organic determinands comprising speciated PAH, TPH CWG including BTEX and MTBE, and monohydric phenol.

## 12 STAGE 8 – PRODUCE A BASELINE REPORT

- 12.1.1 Based on the hazardous substances identified in Stages 1-3 whilst there are a number of RHS that are associated with the GHPF due to the site specific measures outlined in Stage 3 (Section 7) the pollution potential for all hazardous substances is low.
- 12.1.2 However, a ground investigation within the GHPF area has been completed and provides sufficient data to baseline the site. This data is summarised in the sections below, with full details provided in Appendix B.

### Baseline Conditions of Soil

- 12.1.3 Chemical analysis by a UKAS/MCERTS accredited laboratory was undertaken on 15 samples of Made Ground, six samples of Topsoil and five samples of the natural strata.

### Inorganic Contaminants

- 12.1.4 Results of the metals and inorganic soil analysis from samples taken from the recent ground investigation are used as the baseline concentrations for the GHPF area and are described in Table 12-1 below.

**Table 12-1: Summary of Inorganic Contaminant Soil Analysis**

Contaminant	Min (mg/kg)	Max (mg/kg)
Water Soluble Sulphate as SO <sub>4</sub> 2:1 Extract (g/l)	1.5	354.5
Cyanide	<0.5	<0.5
Phenol	<0.15	<0.15
Arsenic	5.5	22.8
Cadmium	0.1	0.2
Chromium	13.7	31.8
Chromium VI	<0.3	<0.3
Copper	11	45
Lead	16	130
Mercury	<0.1	0.3
Nickel	10.9	68.9
Selenium	<1	2
Zinc	50	241

### Polycyclic Aromatic Hydrocarbons (PAH)

- 12.1.5 Results of PAH soil analysis from samples taken from the recent ground investigation are used as the baseline concentrations for the GHPF area and are described in Table 12-2 below.

**Table 12-2: Summary of PAH Soil Analysis**

Contaminant	Min (mg/kg)	Max (mg/kg)
Naphthalene	<0.04	<0.04

Contaminant	Min (mg/kg)	Max (mg/kg)
Acenaphthene	<0.03	<0.03
Acenaphthylene	<0.05	<0.05
Fluoranthene	<0.04	<0.04
Anthracene	<0.03	0.16
Phenanthrene	<0.04	<0.04
Fluorene	<0.03	0.48
Chrysene	<0.03	0.33
Pyrene	<0.06	0.28
Benzo(a)anthracene	<0.02	0.033
Benzo(b)fluoranthene	<0.05	0.36
Benzo(k)fluoranthene	<0.02	0.14
Benzo(a)pyrene	<0.04	0.23
Dibenzo(a,h)anthracene	<0.04	0.2
Benzo(g,h,i)perylene	<0.04	<0.04
Indeno(1,2,3-cd)pyrene	<0.04	0.21
PAH, Total Detected USEPA 16	<0.6	2.7

## Total Petroleum Hydrocarbons (TPH) & BTEX

12.1.6 Results of TPH / BTEX soil analysis from samples taken from the recent ground investigation are used as the baseline concentrations for the GHPF area and are described in Table 12-3 below.

**Table 12-3: Summary of TPH Soil Analysis**

Contaminant	Min (mg/kg)	Max (mg/kg)
<b>TPH Criteria Working Group (CWG) (mg/kg)</b>		
>C5 to C6 Aliphatic	<0.1	0.1
>C6 to C8 Aliphatic	<0.1	<0.1
>C8 to C10 Aliphatic	0.1	<0.1
>C10 to C12 Aliphatic	<0.2	<0.2
>C12 to C16 Aliphatic	<4	<4
>C16 to C21 Aliphatic	<7	<7
>C21 to C35 Aliphatic	<7	136
>C16 to C35 Aliphatic	<14	143
Total Aliphatic C5-C35	<19	136
>C5 to C7 Aromatic	<0.1	<0.1
>C7 to C8 Aromatic	<0.1	<0.1
>C8 to C10 Aromatic	<0.1	<0.1

Contaminant	Min (mg/kg)	Max (mg/kg)
>C10 to C12 Aromatic	<0.2	<0.2
>C12 to C16 Aromatic	<4	<4
>C16 to C21 Aromatic	<7	<7
>C21 to C35 Aromatic	<7	324
Total Aromatic C5-C35	<19	324
TPH Ali/Aro	<38	432
<b>BTEX (mg/kg)</b>		
Benzene	<0.005	<0.005
Toluene	<0.005	<0.005
Ethylbenzene	<0.005	<0.005
p/m-Xylene	<0.005	<0.005
o-Xylene	<0.005	<0.005

## Baseline Conditions of Groundwater

12.1.7 A total of three groundwater monitoring wells were installed across the GHPF area and subsequently a single round of groundwater sampling was undertaken.

12.1.8 Results of groundwater sampling and analysis are used to baseline the groundwater conditions underlying the GHPF area as described in Table 11-4 below.

Table 11-4: Groundwater Analysis

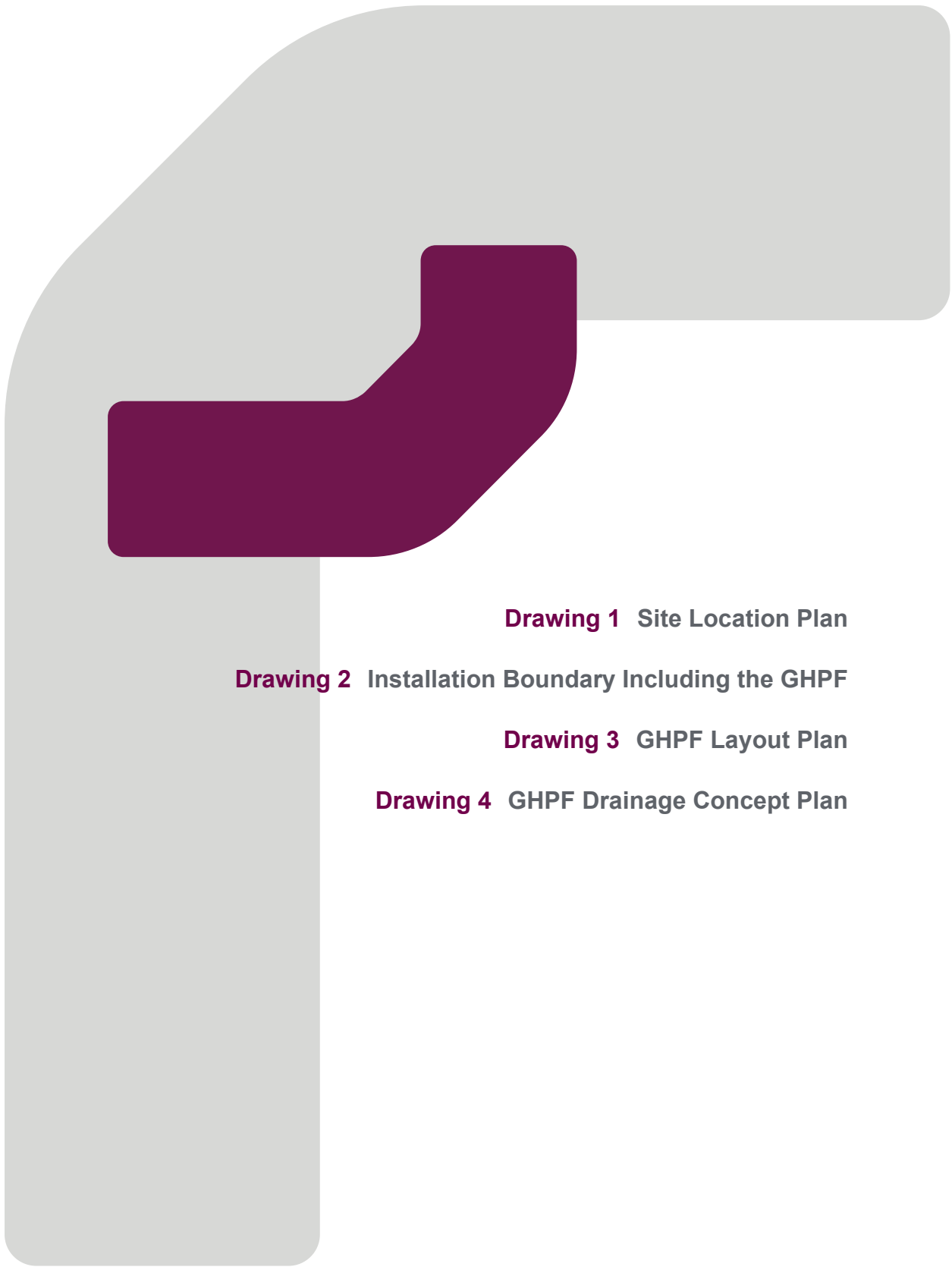
Contaminant	Min (µg/l)	Max (µg/l)
Benzo(ghi)perylene	<0.005	0.009
Benzo(a)anthracene	<0.005	0.015
Benzo(b)fluoranthene	<0.005	0.023
Benzo(a)pyrene	<0.005	0.013
Benzo(k)fluoranthene	<0.005	0.009
Chrysene	<0.005	0.02
Fluoranthene	<0.005	0.026
Indeno(1,2,3-cd)pyrene	<0.005	0.011
Phenanthrene	<0.005	0.017
Pyrene	<0.005	0.019

12.1.9 The groundwater analysis has shown that, in general very low levels of contaminants have been recorded within the groundwater below the GHPF, with the majority of contaminants being recorded at levels below the laboratory limit of detection.

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## 13 CONCLUSIONS

- 13.1.1 A comprehensive list of raw materials to be used on site has been compiled for both of the proposed technologies: Alkaline Electrolysis and Proton Exchange Membrane. The properties of each material have been considered and the risk of contamination of soil or groundwater assessed with regard to the storage and use of each material and the controls and procedures that are to be put in place to mitigate any risk.
- 13.1.2 Of the RHSs identified in section 7 of this report, the risk attributed to the storage and usage are of low risk. Whilst the overall conclusion would lead to there being no RHS for which baseline data is required ground investigation data for the GHPF is available and has been provided to inform the baseline prior to the GHPF becoming operational.
- 13.1.3 It is concluded that sufficient data is available to baseline the GHPF area.
- 13.1.4 During the operational life of the installation following this variation the information set out in Section 3 of this report will be maintained. At site closure the information required by Natural Resources Wales at that time will be provided.



**Drawing 1** Site Location Plan

**Drawing 2** Installation Boundary Including the GHPF

**Drawing 3** GHPF Layout Plan

**Drawing 4** GHPF Drainage Concept Plan

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**Appendix A**  
**GROUNDSURE REPORT**

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**Appendix B**  
**GROUND INVESTIGATION REPORT**

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**Appendix C**  
**PRELIMINARY RISK ASSESSMENT**

# PEMBROKE GREEN HYDROGEN SITE CONDITION REPORT

**RWE**

2024-09-06

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