# Kintore Hydrogen Plant

## Environmental Impact Assessment Report
## Chapter 2: Project Description and Site Setting

**Date:** September 2024

## Environmental Impact Assessment Report

**Volume 2**

**Chapter 2**

Version: Final

Date: September 2024

This report is also downloadable from the Kintore Hydrogen website at:
https://www.kintorehydrogen.co.uk/

Kintore Hydrogen Limited

4th Floor

80 Victoria Street

London

SW1E 5JL

## Qualifications

Prepared by: Tom Dearing

Contributors: -

Checked by: Will Summerlin, Statera Energy

This document has been prepared by Tom Dearing, a Chartered Environmentalist and full Member of the Institute of Environmental Management and Assessment, who has 14 years' experience of environmental impact assessment.

## Table of Contents



## List of Tables



## List of Figures



## Summary

This chapter summarises the baseline environmental setting of the application site and surrounding area, describes the proposed development, and tabulates the maximum design envelope parameters used in the EIA.

# 1 Site Location and Setting

## 1.1 Introduction

1.1.1 This section provides an overview of the existing environment within the application boundary as well as the wider setting of the application site. Environmental constraints overviews are provided in Figure 1.3 and Figure 1.4. Further detail of the baseline environment is provided within each EIAR topic chapter.

1.1.2 The land within the application boundary can be divided into five parts:

- the main electrolysis plant site including temporary construction access and permanent access road;
- the electrical connection from Kintore Substation to the electrolysis plant;
- the underground hydrogen pipeline to a connection and blending point for export into National Gas's existing National Transmission System (NTS);
- the water abstraction and discharge point, pumping and treatment station, and underground water pipelines to and from the River Don; and
- the riparian and other habitat creation and enhancement area on the east bank of the River Don.

1.1.3 These are shown in Figure 1.1. Further details of specific activities which would be carried out in different areas within the application boundary can be found in the Project Description in Section 2 of this chapter.

## 1.2 Site location

1.2.1 The electrolysis plant site is located on land to the west of the existing Kintore Substation, approximately 2.8 km to the southwest of Kintore, Aberdeenshire, 0.3 km northwest of Leylodge and 0.5 km to the west of the B977. This is shown in Figure 1.1 and Figure 1.2.

1.2.2 The hydrogen export pipeline route corridor would run south and eastwards from the electrolysis plant site to a connection and blending point with the existing National Gas NTS. The connection point would be in farm land around 1 km south-west of the A96 and Kinellar.

1.2.3 The raw water pipeline route corridor between the electrolysis plant and the River Don would be through farm land to the south of Kintore, crossing under the A96 at the north edge of Kinellar, with the abstraction and discharge point being located on the south bank of the Don off The Rushlach road, around 1.5 km south-east of the edge of Kintore.

1.2.4 The main electrolysis plant site encompasses an area of approximately 86 ha within the application boundary for this part of the development. Buildings, equipment and access are expected to require up to around 50 ha of the available site, with the remainder being used for landscaping, retained and enhanced habitat, preservation of a Scheduled Monument, and drainage. The overall application boundary is approximately 137 ha in total. The hydrogen pipeline route is around 2.2 km in length and the water abstraction and discharge pipeline route is around 7.7 km in length.

1.2.5 The British National Grid coordinates are NJ762137 for the electrolysis plant site and NJ812153 for the water abstraction and discharge site at the River Don.

## 1.3 Local planning authority

1.3.1 The application site is located within the administrative area of Aberdeenshire Council, in the East Garioch ward.

## 1.4 Site description

1.4.1 The electrolysis plant site is currently agricultural land with a fringe of bog woodland and gorse scrub at the northern edge where it is crossed by Dewsford Burn. There are farm tracks, field boundaries and smaller stands of coniferous trees and scrub in the central part of the site. It is gently undulating, with a low east-west ridge crossing the centre of the site and peaking at The Knock, a low prominence on the western boundary with a small stand of trees and high voltage electricity pylon.

1.4.2 The site is crossed by multiple 275 kV and 132 kV high-voltage overhead power lines from Kintore Substation. The substation is currently being expanded westwards to the edge of the site by Scottish and Southern Electricity Networks (SSEN) to provide new 400 kV bays. SSEN has also consulted on proposals for a new 400 kV overhead power line from Kintore Substation to Tealing via Fiddes, which is expected to cross or be adjacent to the application site in its southern half.

1.4.3 To the immediate north of the site are the Stony Hill, Harthills and Bandshed Moss coniferous plantations on gently rising ground from the burn. Beyond that is a light industrial park with animal rendering plant, exhaust stack and wind turbine. To the south, west and east are farm land with woodland pockets, the B977 road from Kintore, two wind turbines, and scattered residences, farm buildings and rural businesses. Further east, the A96 dual carriageway delimits the edge of Kintore.

1.4.4 Land Capability for Agriculture Scale[1], soil mapping shows that the soils are classified as between classes 3.1 and 5.3 agricultural land. The majority of the application site is underlain by class 3.2 agricultural land which is defined as land capable of average production and where high yields of barley, oats and grass might be obtained. The soils, and their value, are not rare locally or regionally.

1.4.5 The underground hydrogen pipeline connection from the electrolysis plant to the National Gas NTS connection would be through farm land. The existing National Gas high-pressure natural gas pipelines run from north to south, 1.3 km to the west of the A96 and close to Broomhill Plantation.

1.4.6 The water pipeline route would be through farmland, taking a south-easterly loop around Kintore and then turning north to the River Don. Besides farm land along this route, crossings of a number of burns, the A96 and the Aberdeen–Inverness railway line (single track at this location) would be required. The abstraction and discharge point, on the south bank of a meander of the Don known as Dalweary Pot, would be on farm land at the river bank.

## 1.5 Access

1.5.1 Access to the main electrolysis plant site in operation would be taken from an unclassified road off the B977 near Leylodge, with a new junction and new private road within the site to be developed. During construction, a temporary access junction off the B977 closer to Kintore Substation would be used.

1.5.2 Access to the hydrogen pipeline connection point to the National Gas NTS would also be taken from the B977, around 400 m from the roundabout with the B994, using an existing private farm access road.

1.5.3 Access to construct the abstraction and discharge point with pumping station would be taken from The Rushlach road via an existing level crossing and, if necessary, from further east off the B979 with a temporary haul road in farm land adjacent to the railway alignment. This would facilitate access by construction machinery to the north side of the railway.

1.5.4 Access to construct the water pipeline route corridor would be taken at a number of locations from roads along the route.

## 1.6 Site setting

### Residential areas

1.6.1 The locality of the main electrolysis plant site is a rural setting with sparse population. There are approximately 40 properties within a 1 km radius of the electrolysis plant site. The nearest residences along the unclassified road to Bogfold are next to the south edge of the electrolysis plant site and further properties at Leylodge off the B977 are around 380 m east of the site.

1.6.2 There are a further two existing residences at Dewsford, between the proposed electrolysis plant and the extended Kintore Substation. However, Kintore Hydrogen is seeking to acquire these properties, and anticipates that a Grampian condition on the planning permission in principle will specify that commissioning and operation of the hydrogen plant may not occur until these residential properties are vacant.

1.6.3 There is a single residence at north edge of the area in which the above-ground installation for the hydrogen export pipeline connection to the National Gas NTS would be located.

1.6.4 The more densely populated residential area of Kintore, which has a population of 4,700 (mid-2020 estimate)[2], is approximately 2.3 km from the electrolysis plant site and 1.4 km from the gas pipeline connection point. The edge of Kemnay is around 2.6 km to the west of the electrolysis plant site.

1.6.5 The water pipeline route corridor through farm land is generally away from residential areas but passes a number of individual rural residences. The abstraction and discharge point has three residences within around 300 m and permission for holiday cabins, under construction at the time of writing.

### Nature conservation setting

1.6.6 There are no internationally-, nationally- or locally-designated nature conservation sites within a 5 km radius of the electrolysis plant site. Looking further afield, the nearest designated sites are:

- 'Paradise Wood – 1271' Site of Special Scientific Interest (SSSI) approximately 9 km southwest of the electrolysis plant site;
- 'Tilliefoure Wood – 1538' SSSI approximately 10 km southwest of the electrolysis plant site;
- 'The Loch of Skene – 1038' SSSI and SPA approximately 4.8 km south the water pipeline corridor but more than 5 km from the electrolysis plant site;

- 'Arnhall Moss – 8128' Local Nature Reserve approximately 6.2 km south the water pipeline corridor; and
- The 'Ythan Estuary, Sands of Forvie and Meikle Loch' SPA is located more than 16 km from the application boundary but is mentioned as the River Don estuary discharges into the SPA area.

### Landscape or townscape and cultural heritage setting

1.6.7 The landscape context is generally a mixture of relatively flat farm land with frequent drainage channels and burns, occasional deciduous and coniferous plantation woodland, farm buildings and rural residences. The A96 dual carriageway is a key transport corridor and defines the edge of the more built-up area of Kintore, which includes a business park and industrial estate.

1.6.8 Existing energy uses are clearly apparent in the landscape, with eight high-voltage overhead powerlines and their towers radiating in all directions from Kintore Substation[3], and two wind turbines also developed south of the substation.

1.6.9 The whole application boundary lies within the Scottish Natural Heritage (SNH) National Landscape Character Type 26: Wooded Estates – Aberdeenshire. Low hills and wide valleys with dense woodland are consistent features within this character type which covers a large area between the Don and Dee valleys[4]. Within this overall characterisation, further subdivisions into undulating open or forested farmland and more settled or industrial areas can be made based on local landscape character types, described in Chapter 6.

1.6.10 The Stony Hill and Harthill plantations to the north of the electrolysis plant site (outside its boundary) are designated as Ancient Woodland and there are other pockets of Ancient Woodland at locations adjacent to the water and hydrogen pipeline routes.

1.6.11 Designated heritage assets within 500 m of the application boundary are as follows. Further potential undesignated heritage assets are discussed in Section 7.

**Scheduled monuments**

- stone circle 110m W of South Leylodge Steading (SM 12350): lies within the application) boundary, just southwest of Kintore Substation
- remains of Aberdeenshire Canal, south of Dalwearie (SM7675) (100 m south of the water abstraction/ discharge point and adjacent to proposed temporary construction compound, on the south side of the Aberdeen to Inverness line;
- standing stone 480 m W of Cairntradlin Cottage (SM 12328)
- standing stone 75 m WNW of Ferneybrae Croft (SM 12415)
- enclosure 480 m S of The Hedges (SM 12438)
- palisaded enclosure 555 m S of Kilm Cottage (SM 12463)

**Listed structures**

- Aquherton Farmhouse, category B (approx. 1.8 km south-east of the electrolysis site, approx. 600 m south of the gas connection area);
- Boghead Farmhouse, category B (approx. 600 m north-west of the water pipeline crossing of the A96, adjacent to light industrial retail facilities at Kinellar);
- Kinellar House, category B (approx. 500 m southeast of the water pipeline corridor, north of the A96 near Kinellar);
- Old Manse of Kinellar, including walled garden, category B (approx. 750 m east of the water pipeline corridor, Kingsfield Road near Kirkton); and
- Parish church of Kinellar, including churchyard walls, category B (approx. 800 m east of the water pipeline corridor, Kingsfield Road near Kirkton).

## 1.7 Hydrological, hydrogeological and geological environment

1.7.1 The electrolysis plant site is underlain by bedrock comprising the Aberdeen Formation (psammite and semipelite) to the east and the Kemnay Pluton (granite and foliated-muscovite-biotite) to the west.

1.7.2 The bedrock is overlain by superficial deposits of Banchory Till (glacial till). An area of lacustrine deposits (clay, silt and sand) is located within the centre of the site, whilst alluvium and glaciofluvial deposits (clay, silt, sand and gravel) are recorded within the northern extent of the site and adjacent to the main watercourses. The hilltops locally are shown to be absent of any superficial deposits.

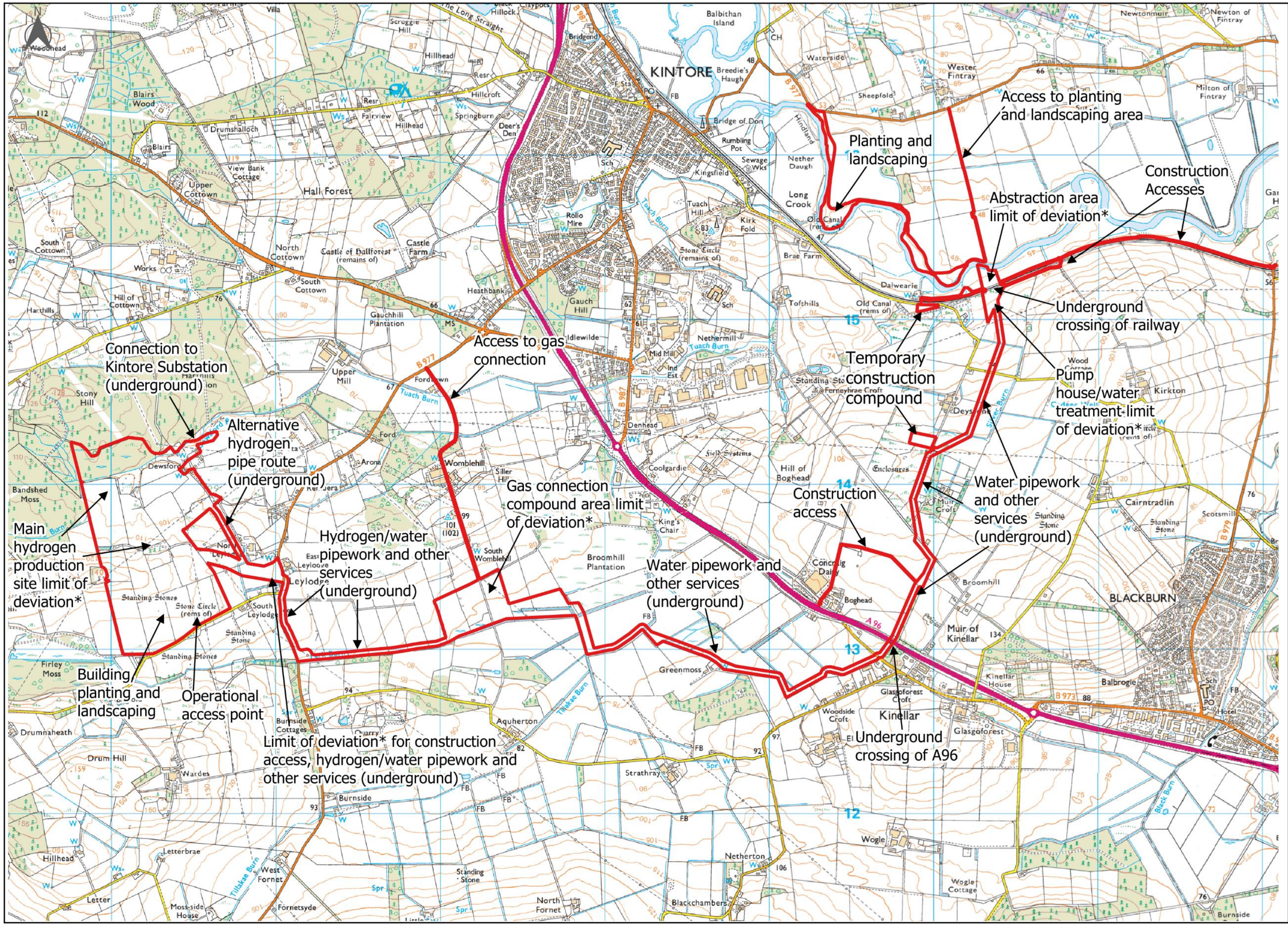
1.7.3 The majority of the superficial deposits as well as the bedrock beneath the site are unlikely to contain significant amounts of groundwater. The bedrock has been classified by BGS as a low productivity aquifer, where small amounts of groundwater may be present within the near surface weathered zone and fractures. The alluvium and glaciofluvial deposits have the potential to contain shallow groundwater and this may be in hydraulic continuity with adjacent surface water.

1.7.4 The proposed development is located within the surface water catchment of the River Don, which flows generally eastwards to the north east of the site. The western and central extent of the site is drained by the Tuach Burn, a tributary of the River Don, which flows eastwards to the north of the site before discharging into the River Don. Several tributaries of the Tuach Burn cross the site including the Dewsford Burn, Park Burn, Tillakae Burn and Sheriff Burn.

1.7.5 The south east of the site is drained by the Black Burn which is located approximately 1.3 km east of the site and flows generally northwards before discharging into the River Don.

1.7.6 There are no Drinking Water Protected Areas (surface water) or Scotland River Basin District Boundary within 5 km of the application boundary. Notwithstanding this, it is recognised that watercourses and groundwater may potentially support local private water supplies or be used as irrigation water by farms locally, which has been considered further in Chapter 13.

1.7.7 SEPA flood mapping confirms flood extents are typically confined to the watercourse corridors with the exception of the centre of the site near the confluence of the Park Burn and Tillakae Burn where a wider floodplain is noted.




## KINTORE HYDROGEN PLANT

| | |
|---|---|
| Date: | 20-08-2024 |
| Paper size: | A3 |
| Scale: | 1:26,000 |

0 100 200 300 400 m

Key:

Planning application boundary

* Where reference is made to a limit of deviation, this is an area in which the described plant is proposed to be sited. However, the actual footprint of the described plant in this area will likely be significantly smaller than the limit of deviation. The limit of deviation enables the flexibility for design that is necessary for phased development such as this for which planning permission in principle is being sought.

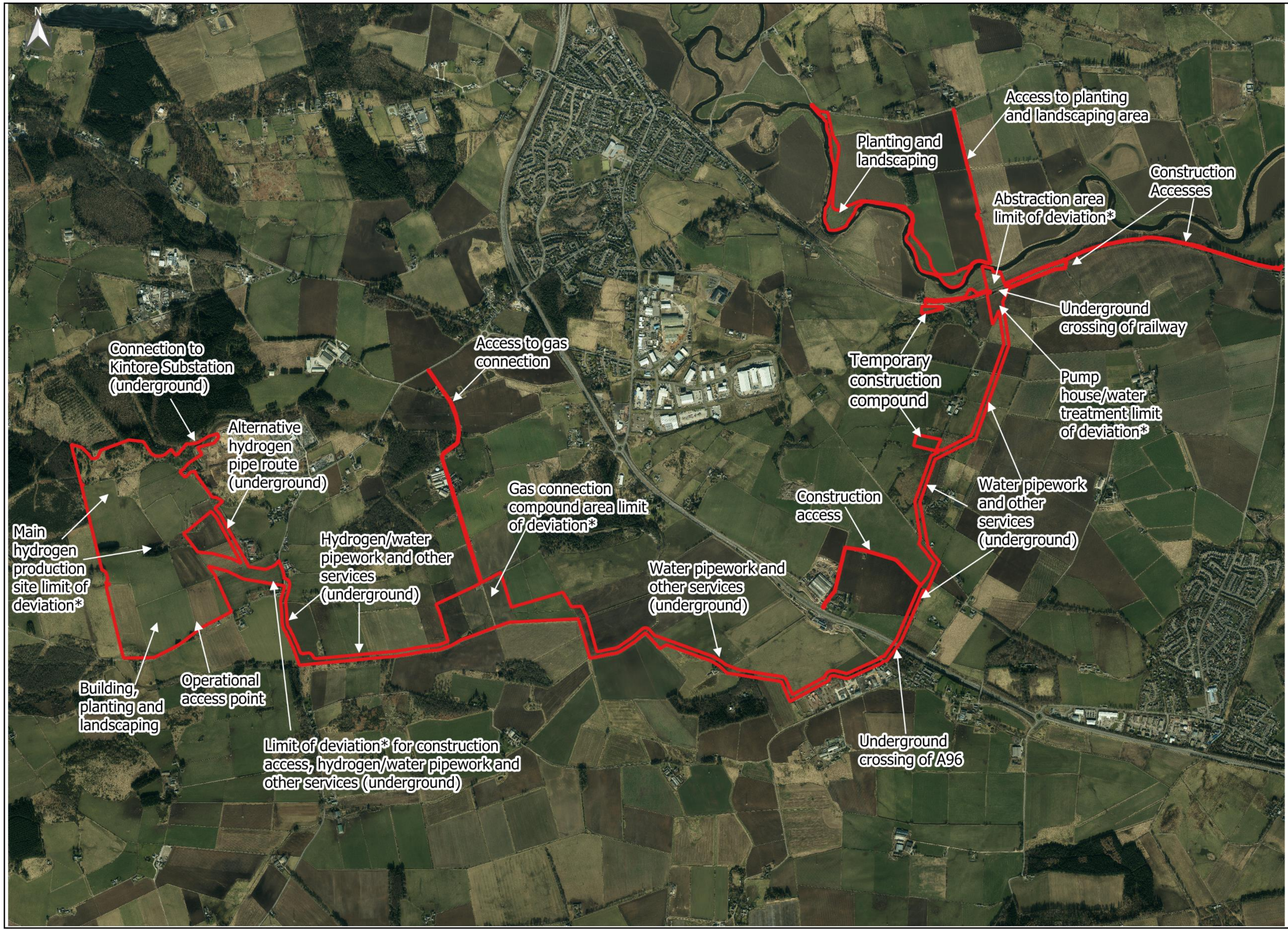
Kintore Hydrogen
A STATERA COMPANY

**Proposed development application boundary and overview – OS map**

| | |
|---|---|
| Status: | Final |
| Revision: | V2 |
| Drawn by: | MP |
| Approved by: | TD |



**Figure 1.1: Proposed development application boundary and overview – OS map**




## KINTORE HYDROGEN PLANT

| | |
|---|---|
| Date: | 20-08-2024 |
| Paper size: | A3 |
| Scale: | 1:26,000 |

0 100 200 300 400 m

Key:

Planning application boundary

* Where reference is made to a limit of deviation, this is an area in which the described plant is proposed to be sited. However, the actual footprint of the described plant in this area will likely be significantly smaller than the limit of deviation. The limit of deviation enables the flexibility for design that is necessary for phased development such as this for which planning permission in principle is being sought.

Kintore Hydrogen
A STATERA COMPANY

**Proposed development application boundary and overview – aerial photography**

| | |
|---|---|
| Status: | Final |
| Revision: | V2 |
| Drawn by: | MP |
| Approved by: | TD |



**Figure 1.2: Proposed development application boundary and overview – aerial photography**

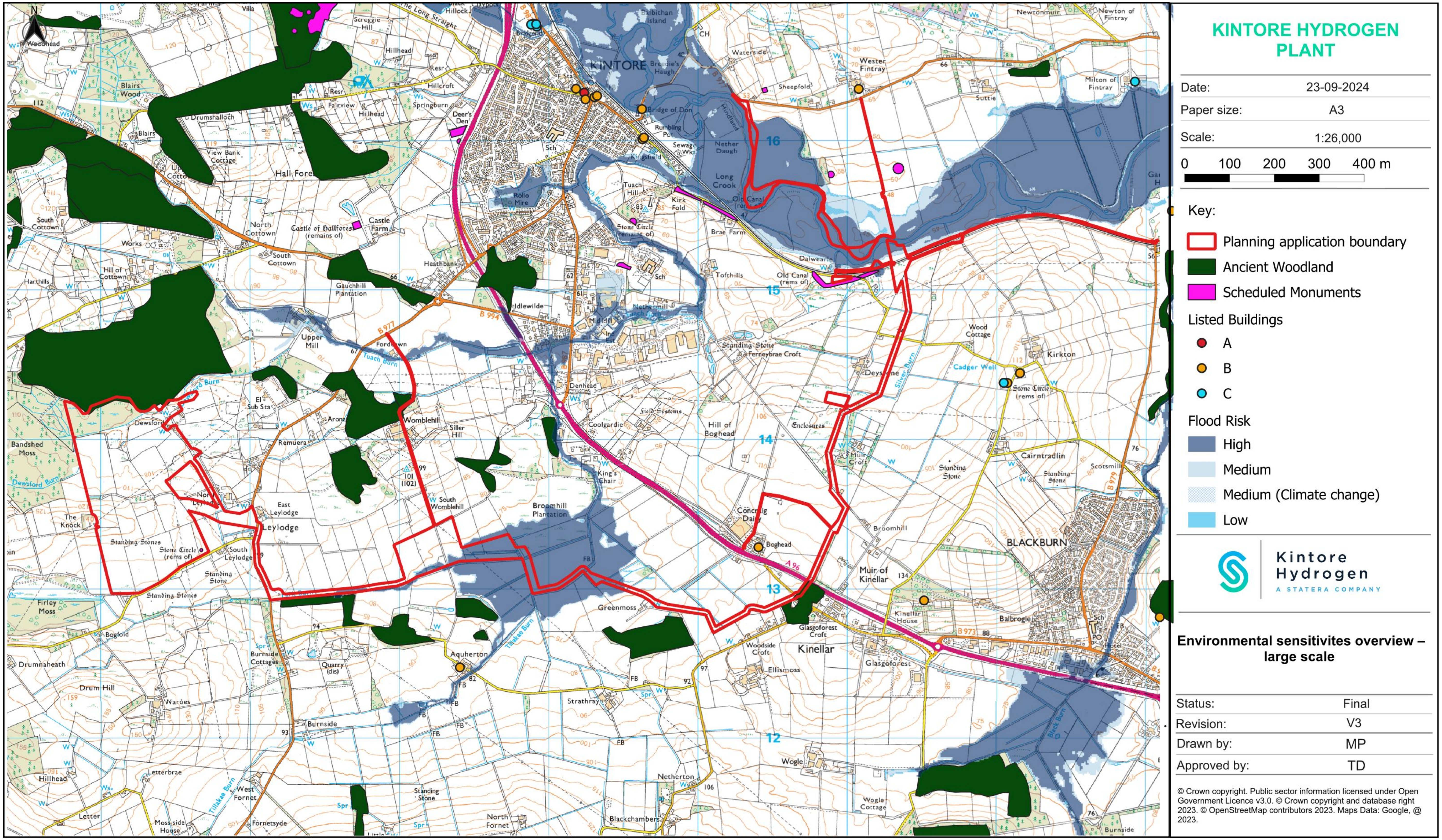



**Figure 1.3: Environmental sensitivities overview – large scale**

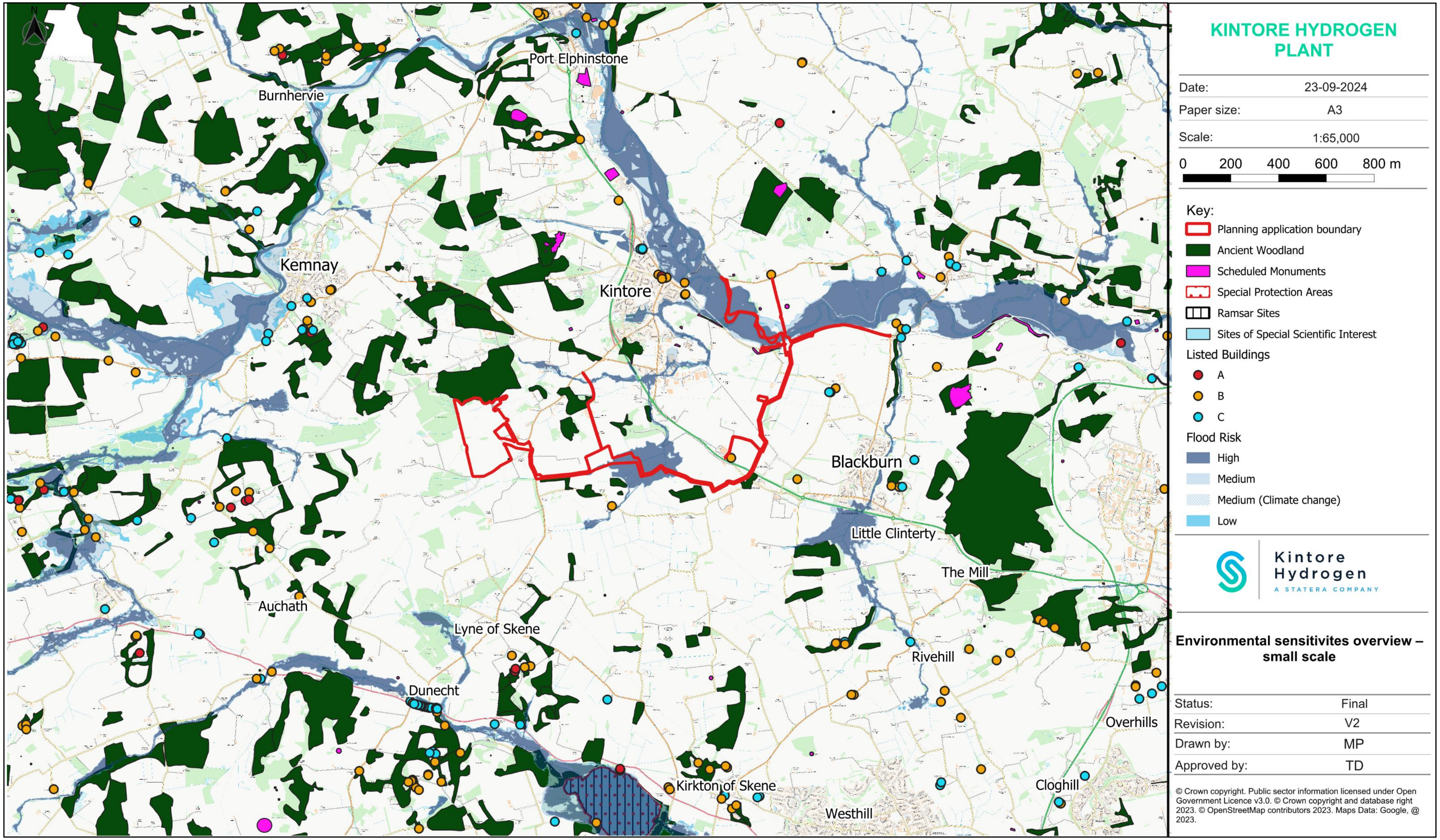



**Figure 1.4: Environmental sensitivities overview – small scale**

# 2 Project Description

## 2.1 Purpose of Kintore Hydrogen Plant

2.1.1 The proposed development produce hydrogen from water by electrolysis using mainly renewable electricity. This is sometimes called 'green hydrogen'. Hydrogen is a zero carbon fuel at the point of combustion.

2.1.2 The hydrogen would initially be supplied for blending with natural gas in the existing National Gas high-pressure gas network in order to aid in decarbonising industrial uses that rely on gas fuel in Scotland and the wider UK, that cannot be easily electrified, as well as facilitating long duration energy storage. Scotland has a policy target for 5 gigawatts (GW) of hydrogen production by 2030 and 25 GW by 2045[5,6].

2.1.3 By the early 2030s, a new hydrogen transmission backbone (repurposing existing pipes) is expected to have been developed under National Gas's 'Project Union'[7], enabling a pure hydrogen supply to industrial clusters across the UK as well as for long duration energy storage. The proposed development could then become a major source of hydrogen for supply via the Project Union pipeline. Funding for the feasibility phase of Project Union was approved by Ofgem in 2023[8].

2.1.4 The electricity would be supplied from Kintore Substation, which provides transmission capacity for the increasing wind power generation in Scotland among other renewable sources. However, notwithstanding SSEN's proposed East Coast 400 kV Phase 2 Project to provide a new backbone electricity transmission line and all other planned transmission infrastructure upgrades (both onshore and offshore), capacity to transmit Scottish renewable power to the areas of high UK demand south of the border is and will be a key constraint. This is leading to renewable generation being curtailed[1], and ultimately could limit the benefits that can be realised from Scotland's wind, wave and tidal power resources.

2.1.5 Producing hydrogen using abundant renewable power generation (some of which would otherwise be curtailed or have capacity not fully realised) provides a solution to balancing the electricity grid, transmitting and storing this energy in a form that can readily be used for industry and heating, making best use of existing natural-gas-adapted infrastructure. National Grid Energy System Operator (ESO)'s 'Beyond 2030' strategy[9] identifies hydrogen production in north east Scotland as important to make best use of Scottish wind power and reduce the scale and cost of electricity transmission network upgrades that would otherwise be needed.

2.1.6 The raw water would be supplied from the River Don, which has sufficient capacity under a range of flow conditions to support the water demand of Kintore Hydrogen. Kintore Hydrogen has been issued an abstraction licence by SEPA under the Water Environment (Controlled Activities) (Scotland) Regulations 2011 (referred to in short form as the Controlled Activities Regulations or CAR within the EIAR) for this water supply.

2.1.7 The location of the proposed development has therefore been chosen due to being adjacent to the newly expanded capacity of Kintore Substation (not requiring a new overhead transmission line), close proximity to the National Gas NTS pipelines (requiring a connection pipeline of less than 3 km) and proximity to a more than sufficient raw water supply from the River Don.

2.1.8 The rate at which hydrogen can be blended with natural gas in the existing transmission network is dictated by a number of factors including the compatibility of gas users' equipment to accept the hydrogen blend. This rate is likely to change over time as the UK's hydrogen transition progresses, and ultimately pure hydrogen transmission is anticipated under Project Union.. Kintore Hydrogen therefore intends to develop the facility and introduce its hydrogen supply in phases, starting with production capacity from up to 500 megawatts of electricity (MWe) and then developing further phases to reach a planned 3,000 MWe capacity in total (3 GWe).

## 2.2 Electrolysis process

2.2.1 The electrolysis process uses electricity to split water (2 $H_2O$) into hydrogen (2 $H_2$) and oxygen ($O_2$). A simple process diagram is illustrated in Figure 2.1.

[1] a temporary deliberate reduction in generation below the available capacity, due to factors such as low power demand or insufficient transmission capacity

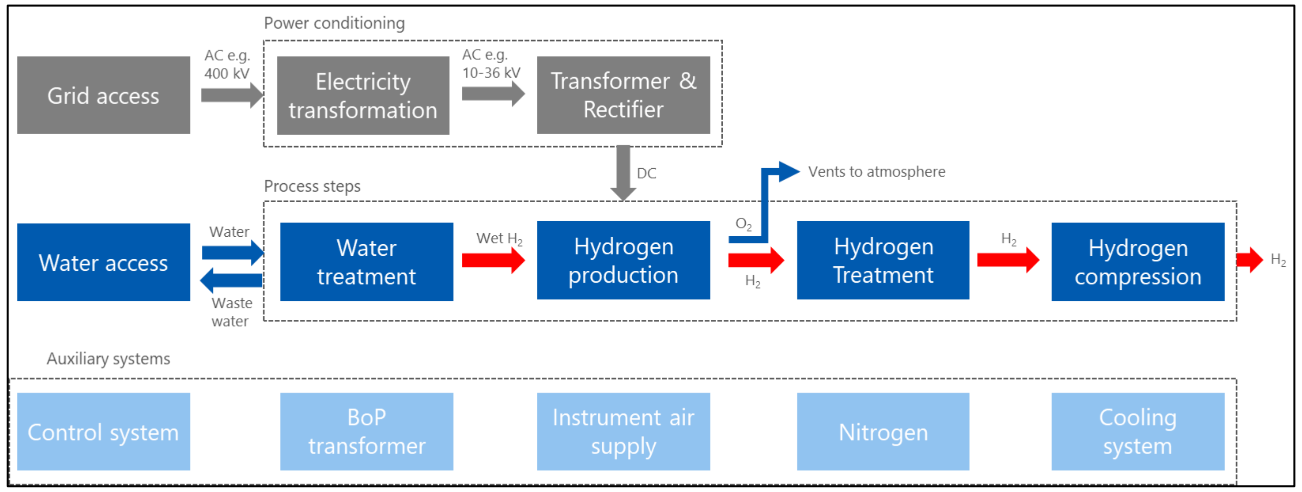



**Figure 2.1: Electrolysis process diagram**

2.2.2 The key steps of the hydrogen production would be as follows.

1. The incoming high-voltage alternating current (AC) power is converted to into lower voltage direct current (DC) power and distributed to the electrolyser modules.
2. An inlet water supply to a water treatment plant is used to produce demineralised water.
3. The electrolyser modules use the water and electricity to generate hydrogen and oxygen.
4. Hydrogen is treated to ensure its quality requirements for export are met. This can include cooling, drying and oxygen removal.
5. Hydrogen is compressed to reach the pressure level allowing it to be injected into the high-pressure gas transmission network.
6. Oxygen is safely vented to atmosphere.
7. Auxiliary systems, such as the control system, cooling system, instrument air system, and an inert gas (nitrogen) system are in place to enable the plant to operate.

2.2.3 Kintore Hydrogen may use either proton exchange membrane (PEM, also known as polymer electrolyte membrane) electrolysis or alkaline electrolysis technology for the electrolyser modules, or a combination of both technologies in different phases of the development. Innovation continues apace in the electrolysis industry so further advancements are expected. Later phases may deploy variants to these technologies. All technologies involve enclosed hydrogen production in a series of electrolysis cells housed within a building. The inputs to the electrolysis cells are fresh water and electricity and the outputs are separate streams of hydrogen and oxygen at the cathode and anode of the cell respectively.

2.2.4 PEM and alkaline electrolysis cells are both flexible systems that are well suited to scaling up production over time in phases, initially for blending into the gas grid and then to supply the Project Union pipeline in due course.

2.2.5 Both systems require similar electricity and water inputs together with other ancillary systems, which are comprise a series of modular electrolysis stacks to provide the desired capacity. For the purpose of defining the 'Rochdale envelope' for the EIA, the main difference between PEM and alkaline systems lies in the alkaline system typically requiring somewhat greater space for its equipment than a PEM system, though this varies depending on the technology supplier. The maximum design envelope parameters for the EIA, set out in Table 2.1 at the end of the project description, have been defined to encompass both potential technology options.

2.2.6 The electrolysis process at full capacity will consume up to 1,836 $m^3$ of water per hour and 3 gigawatt-hours (GWh) of electricity to produce up to 54 tonnes per hour of hydrogen for export, which is equivalent to 1,814 MWh (net calorific value basis). On the assumption of an annual capacity factor for Kintore Hydrogen Plant of around 40%, accounting for variability in the renewable electricity market, this would mean export of up to 190,646 tonnes of hydrogen (6,355 GWh) from 6.43 $Mm^3$ of water and 10,512 GWh of electricity.

## 2.3 Electrolysis plant site

### Structures and equipment

2.3.1 In overview, the buildings, structures and equipment of the electrolysis plant would comprise:

- electrolyser cells and associated infrastructure (including gas treatment equipment) either inside or external to buildings, and oxygen vent pipes;
- electrical switchyard with 275 or 400 to 33 kV transformers;
- hydrogen scrubber (only applicable for the alkaline technology);
- hydrogen compressors and auxiliaries for export;
- an enclosed ground flare for hydrogen;
- nitrogen generation and storage;
- compressed air generation and storage;
- external cooling system with cooling towers and pumps;
- water treatment building and tanks;
- firewater tanks;

- control room, workshop and stores buildings;
- gatehouse, internal access and circulation roads and parking;
- site drainage, runoff attenuation ponds and underground services; and
- perimeter security fencing, lighting and CCTV.

2.3.2 An indicative possible site layout is shown in Figure 2.2. This illustrates the approximate relative footprints of buildings and equipment, and different ways in which they could be laid out on the site, making best use of the more visually screened northern half. However, this masterplan is indicative only: the planning permission in principle application is on the basis of a parameters-based design, with details reserved to be approved at subsequent planning stages and in accordance with the Design Principles Statement accompanying the planning application. Accordingly, the EIA has been undertaken on the basis of the maximum-case design parameters and site development zones that are shown in Figure 2.3 and Table 2.1 at the end of this chapter.

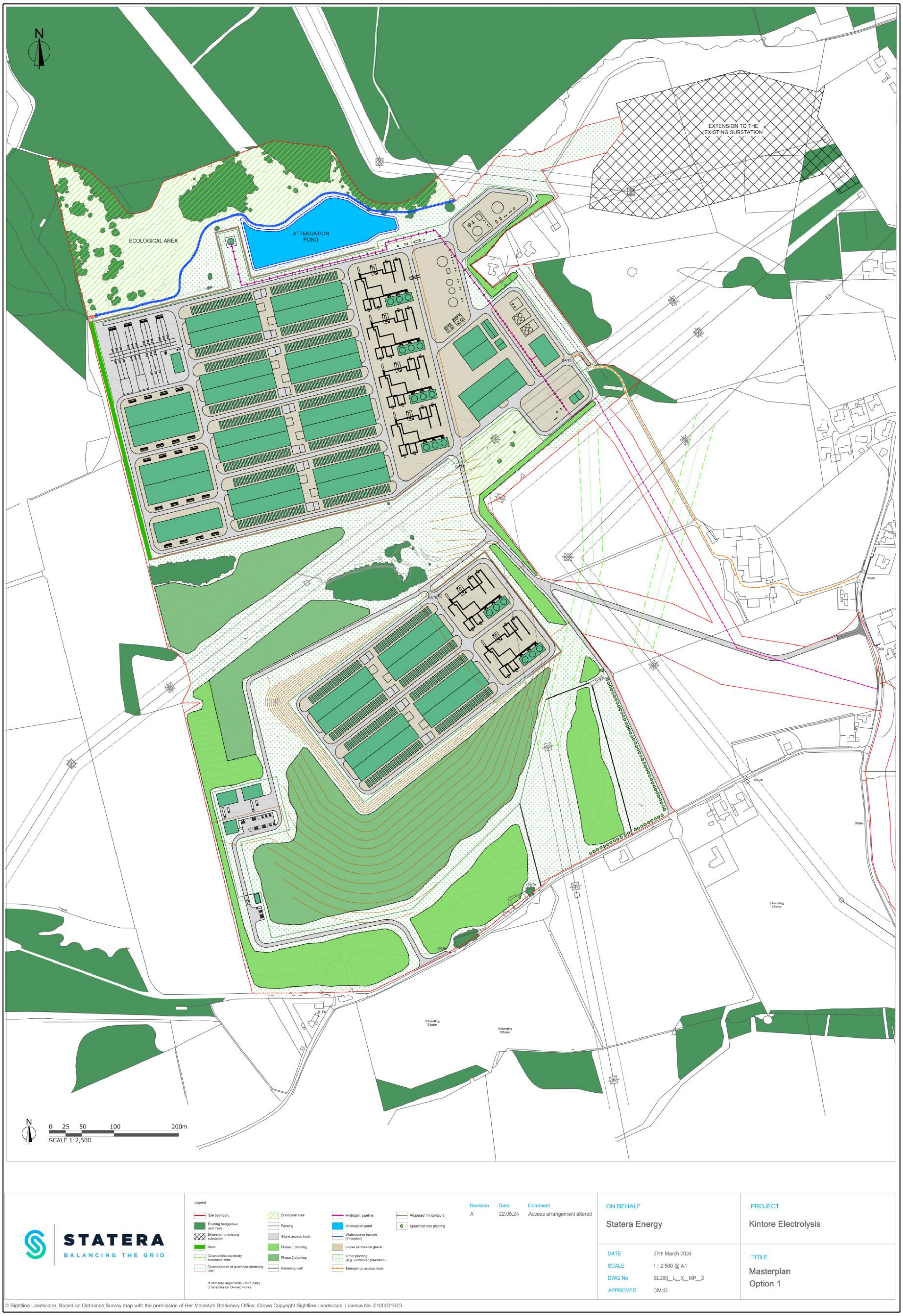



**Figure 2.2: Illustrative electrolysis plant site masterplan**

**Buildings and external equipment**

2.3.3 If buildings are used for the electrolyser units, these would be a series of steel-framed and steel-clad structures of up to around 16 m height to the ridgeline. Each building would contain electrolyser modules with typically around 240 MWe capacity in a building, partitioned internally for fire safety. The total gross internal area (GIA) of the electrolyser buildings for the full 3 GWe capacity of the electrolysis plant would be approximately 60,480 $m^2$. If electrolysis and gas treatment equipment is external to the buildings, it would be up to around 12 m in height.

2.3.4 Oxygen from the electrolysis process would be exhausted via a series of vent pipes which may be on the roof or walls of the electrolyser buildings, with a height of up to around 20 m above ground level to provide around 4 m clear height above the roofline (whether extending from the building roof, or external and adjacent to it) or in vent pipes for external equipment of up to 12 m.

2.3.5 Other buildings such as the workshop, stores, control room and gatehouse would be single storey structures that are lower in height than the electrolyser buildings, no more than 10 m and typically lower. Firewater storage tanks would provide up to 20,000 $m^3$ of storage and also be up to 10 m in height.

2.3.6 The high pressure hydrogen export compressors would be housed in a sound attenuating structure with ventilation system. The compressors with enclosing structure for sound attenuation would have a footprint equivalent to a GIA of 3,600 $m^2$ and height of up to 20 m.

2.3.7 Other freestanding equipment within the electrolysis plant site would comprise hydrogen dryer and chiller systems, nitrogen generators and storage tanks, compressed air generators and storage tanks, potassium chloride storage tanks and firewater tanks, all with associated pipework. These would be located externally and typically around 5 m to 10 m in height.

**Hydrogen flare**

2.3.8 An enclosed ground flare is the preferred solution to safely manage hydrogen should the high-pressure elements of the system need to be de-pressurised and the hydrogen inventory removed during an abnormal operational event, such as National Gas requiring a pause in export of hydrogen to the NTS. Use of the flare in this way would for abnormal events, and hence very rare. Much smaller quantities of low-pressure hydrogen also need to be managed routinely during start-up, shut-down and maintenance events for the electrolysis modules, e.g. where lines within the plant need to be purged. The enclosed ground flare would also be used routinely for this purpose, having internally a series of hydrogen burners which allow it to be flexible to the much varying quantities of hydrogen requiring routine flaring or potentially abnormal event flaring.

2.3.9 An enclosed ground flare is one that, as the name suggests, places the burners themselves close to ground level rather than at the top of an elevated flare stack; the enclosure is a circular heat- and wind-shield around the flame, largely or fully hiding it. In contrast to an elevated flare (with an exposed flame) or a power station chimney stack, an enclosed ground flare is a relatively short but wide structure, up to 17 m in diameter and 30 m in height.

**Water treatment and cooling**

2.3.10 A water treatment plant would filter and demineralise raw water supplied from the River Don to produce very pure deionised water for use in the electrolysis. The treatment plant would have three stages: initial settlement and filtering to remove suspended solids; a reverse osmosis filtering plant to remove salts and other dissolved minerals; and finally an electro-deionisation plant. The water treatment plant would have a discharge water stream post-treatment that would be returned to the River Don. This is discussed further below. The treatment plant building(s) would be up to 10 m in height.

2.3.11 The settlement and sediment filtering stage may be carried out at the intake end of the transfer pipeline from the River Don (to reduce risk of sedimentation of the pipeline) or may be located on the main electrolysis plant site. The remaining treatment stages would be located on the main electrolysis plant site. If the initial filtering stage is located at the intake, it would require an area of approximately 0.6 ha and structures up to around 7 m in height.

2.3.12 A cooling water system is required to keep the electrolysis cells at a stable temperature for efficient operation and also to cool the hydrogen between various stages of compression for export to the gas grid. Options for a wet, hybrid or dry cooling system are available. A hybrid system, combining aspects of wet (evaporative) and dry (air-cooled heat exchanger) has been assumed for EIA, as this involves both cooling water consumption, circulation pumps and fans. This would typically be a series of cooling towers with internal fans, which draw air in through louvres at the base, through a water mist system and then through a heat exchanger with coolant circulated from the electrolyser and compressor systems. Cooling water would use the waste water stream from the water treatment plant and then be discharged to the River Don. Cooling towers of up to 15 m in height are expected to be required, with a footprint equivalent to a GIA of 4,200 $m^2$.

**Electrical equipment**

2.3.13 An external electrical switchyard would have high voltage transformers, busbars and associated switchgear to supply high voltage AC power from the underground cable grid connection to the electrolyser buildings. The switchyard would also contain further transformers to supply other power loads on and off the site including the compressors, cooling system and abstraction water pumps. The electrical switchgear may be either an air-insulated system (AIS, with equipment not enclosed in buildings) or may include gas-insulated switchgear (GIS) inside buildings, or a combination of both for different phases of the development. The EIA has therefore assessed both options, as the AIS option requires greater space but the GIS option would contribute more to the massing of buildings on the site, albeit in a smaller footprint. The maximum height of AIS equipment would be up to 12 m (although much of it is lower) with a footprint equivalent to a GIA of up to 43,125 $m^2$. The maximum height of GIS buildings would be up to 8 m with a GIA of up to 14,175 $m^2$.

2.3.14 Power distribution within the site would be by underground cabling, and an underground cable along the water pipeline route would also supply the abstraction pump. Adjacent to the electrolyser buildings, further smaller transformers and rectifiers would be used to step down the voltage and provide DC power to the electrolysis cells.

**Site levels and foundations**

2.3.15 Concrete raft foundations would be used for the buildings and pads for freestanding equipment, with piling not anticipated to be required. The development platform levels of the site would be established based on the topography, with the intention to achieve an overall cut and fill balance. This may include a cut into the south side of The Knock to establish a platform height lower than the ridgeline, with a bank or retaining wall structure. To encompass flexibility for design in finished ground levels, maximum building and equipment height parameters detailed in Table 2.1 at the end of this chapter are expressed in absolute terms as meters above Ordnance Datum (m aOD) in addition to the building heights relative to ground/platform level.

## Operating hours and staff

2.3.16 The proposed development would be capable of operating on up to a 24/7/365 basis (with periods of downtime for planned maintenance) to enable flexibility in hydrogen production. In practice actual operation of the site would likely be around 30-40% of that time over the course of a year, to respond to intermittency of renewable energy generation peaks.

2.3.17 The main electrolysis site would be staffed in a shift pattern with employees holding a variety of skillsets for operating the control room, undertaking maintenance and providing site security and administration. An operational workforce of typically 30-50 full-time equivalent (FTE) staff in total, across two or three shifts, is expected for the initial 500 MWe phase of development. For the full 3 GWe development this is expected to rise to 200 FTE staff.

2.3.18 At intervals a temporary contractor workforce would also be required during planned maintenance and overhaul of various equipment.

2.3.19 The above-ground installation for the gas network connection and the water abstraction pumping station (discussed below) would not typically be staffed but would require occasional access for inspection and maintenance, which would be undertaken by staff based at the main electrolysis plant site.

## Operational access and parking

2.3.20 Operational access to the electrolysis plant site would be via a security gatehouse and private road in the south of the site, from a new junction to be constructed on the unclassified road off the B977 near Leylodge. The B977 is a two-lane road providing ready access to the A96 via the B994 and B987.

2.3.21 During construction, a temporary access junction off the B977 closer to Kintore Substation would be used, which is discussed further below.

2.3.22 Within the electrolysis plant site, internal circulation roads would be provided for staff and access during maintenance. Parking spaces for up to 40 staff and visitors would be provided within the site, be equipped for electric vehicle charging to at least the required level in Aberdeenshire Council development guidelines. Priority bays for people with mobility impairments and secure and covered cycle storage for cycles would be provided, with changing facilities.

2.3.23 As the proposed development would be a Control of Major Accident Hazards (COMAH) facility, access would be strictly controlled. The security arrangements are subject to detailed design but it is likely that a perimeter security fence with CCTV and motion-activated security lighting would be employed. The private access road would be gated and have a security office and turnstile.

2.3.24 It is not proposed to accommodate car parking within the electrolysis plant site for the full complement operational staff per shift in single-occupancy vehicles. The draft Framework Operational Staff Travel Plan (within Appendix 9.1) sets out the proposed measures to provide modal shift to sustainable transport options, which includes provision of a shuttle minibus service from Kintore Train Station and/or park and ride facilities.

### Landscaping and habitat creation

2.3.25 Proposed landscaping and habitat creation within the electrolysis plant site are described in the Design Principles Statement (incorporating Illustrative Landscape Masterplan) and in the Outline Biodiversity Enhancement and Management Plan (OBEMP) accompanying the planning application.

2.3.26 In summary, the proposed landscaping includes areas of earthworks, tree and hedge planting to aid in screening views of the development together with additional habitat creation and enhancement to provide biodiversity net gain. As described in the Design Principles Statement, it is intended that landscaping that provides visual screening would be implemented as part of Phase 1 of the development (if it is phased), providing the maximum time for planting to become established and achieve its visual impact mitigation as further phases are brought forwards. A Landscape Management Plan incorporating aftercare and maintenance during the short term (2-5 year establishment period) and long term (ongoing maintenance) is proposed as part of the Design Principles Statement commitments.

2.3.27 The existing stands of trees and tree/hedge lines at the site perimeter would be retained, as depicted on the Planning Parameters Plan (Figure 2.3). Throughout the application site, where any temporary loss is required, for example in construction of the construction access road, hydrogen export pipeline or electrical export route, this would be reinstated.

### Drainage

2.3.28 There would be three aspects to the site drainage system:

- clean surface runoff;
- potentially contaminated drainage (from process areas); and
- foul drainage from sanitation.

2.3.29 Clean surface runoff would be managed to ensure no increase in the greenfield runoff rate during a 1 in 200 year rainfall event with a 37% uplift as allowance for climate change. Runoff from impermeable areas in the north of the site would drain, as in the baseline, to Dewsford Burn; this is expected to comprise around two-thirds of the runoff from the developed site. The discharge rate would be managed via attenuation ponds to maintain the greenfield rate. Runoff from the impermeable areas in the south of the site could be managed with soakaways and/or an attenuation basin.

2.3.30 Foul drainage from staff facilities would be managed by an on-site packaged treatment plant, directed to the drainage attenuation system for discharge.

2.3.31 Under the requirements of the PPC Permit, a separate drainage system would be provided for all process and storage areas where there is potential for spills or leakage to cause contamination. Drainage from these areas would would have isolation valves enabling it to be closed off should any spillage occur.

2.3.32 To avoid the risk of potential contamination from firewater runoff, in the event of a fire, to Dewsford Burn or groundwater, the surface water attenuation ponds in the north of the site would be provided with a penstock valve enabling discharge to the burn to be halted; and the ponds would be sized to accommodate firewater in addition to the necessary clean surface water discharge attenuation capacity. Similarly, an interceptor pond with penstock valve would be provided before the soakaways in the south of the site, enabling any firewater from this area to be contained.

2.3.33 The conceptual drainage strategy and design are set out in the Drainage Impact Assessment at Appendix 13.3.

## 2.4 Electricity supply connection

2.4.1 Electricity supply would be via underground cable from Kintore Substation, into which Kintore Hydrogen has a contracted 3GW connection.

2.4.2 The underground cables would supply high voltage AC power from the substation. These would be routed from the west side of the expanded substation to the electrolysis plant, a distance of up to around 300-400 m (depending on the exact connection point within the substation site and electrolysis plant site), avoiding residential properties. The cables would typically be buried in a trench or conduit at around 1–1.5 m depth with soil cover of around 1 m reinstated above the cables. Deeper trenchless techniques such as horizontal directional drilling (HDD) would be used where appropriate to avoid disturbance to existing structures or areas of retained trees.

## 2.5 Hydrogen export

### Pipeline

2.5.1 Hydrogen export would be via up to two stainless steel pipelines, each of up to 510 mm outer diameter (though only one will likely be needed), connecting the electrolysis plant site to the above-ground installation (AGI) where a blending point with the National Gas NTS would be located. They will export hydrogen at up to around 94 bar gauge (barg) pressure to match the existing high-pressure gas transmission network.

2.5.2 The pipeline route may enter the electrolysis plant site either within the same corridor as the temporary construction access or via a route to the north-eastern part of the electrolysis plant site, which is shown in Figure 1.1.

2.5.3 The pipelines would be primarily laid in trenches at around 1.5–2.0 m depth with soil cover of at least 1 m reinstated above the pipes. During construction, a typical working corridor width of around 30 m would be required for machinery access and temporary spoil piles when installing the pipelines.

2.5.4 Crossings of features such as watercourses and roads along the pipeline route may use trenchless techniques such as HDD where required to avoid disturbance from trenching. This involves drilling and casing a tunnel for the pipelines under the obstacle to be crossed, following which the pipe sections can be inserted, without disturbing features at the surface. Where a trenchless technique such as HDD is used, a temporary working compound of up to around 50 m by 50 m for the drilling equipment is likely to be required.

2.5.5 Temporary access points, hedgerow removal, working compounds, pipeline laydown areas and drilling machinery compounds if HDD is employed are likely to be required along the pipeline route during construction.

2.5.6 Kintore Hydrogen will retain land rights to access the pipeline route for potential inspection or maintenance in operation, but land above the pipelines can be farmed, including ploughing.

### Above-ground installation

2.5.7 At the connection point where the hydrogen pipeline tees into the existing National Gas NTS, equipment above ground would be required for the exported hydrogen to be blended into the natural gas supply. This would be located in a fenced and hedged compound of up to around 1.6 ha in size. Within this would be sections of pipeline above ground where the hydrogen is blended into the natural gas, to enable access for maintenance and inspection, together with monitoring equipment. The monitoring and maintenance equipment would require a small stores room and instrumentation kiosks. These would be single-storey structures or containers of up to around 7 m height. A buried power supply and fibre-optic cable for telemetry would be provided along the pipeline route back to the electrolysis plant control room.

2.5.8 As discussed above, the AGI site would be accessed via an existing private road off the B977. The existing private road is partly metalled and partly gravelled; partial resurfacing of it is may be required for construction vehicles. In operation, only occasional and infrequent access would be required, as the AGI is operated remotely and does not require on-site personnel or frequent maintenance visits.

## 2.6 Water supply and discharge

### Supply and discharge volume

2.6.1 Up to 2,800 $m^3$/hr water supply capacity may be required, representing the upper end of the potential water demand of the electrolysis plant (depending on technology choice) and the upper end of the abstraction approved by SEPA under the Controlled Activities Regulations (CAR) license that has been granted for this water supply, which is up to 67,392 $m^3$ per day (subject to a minimum flow rate in the River Don of 4.86 $m^3$ per second).

2.6.2 Under the CAR licence, some of the water abstracted from the River Don must be returned to the river through the discharge pipeline. This would be from the discharge output of the water treatment plant and cooling system. This is necessary because the filtering and reverse osmosis stages of the water treatment plant remove sediment, suspended solids and dissolved minerals in the river water from the cleaned water sent for electrolysis. The filtering stage requires backwash to carry the filtered-out sediments away. The reverse osmosis stage also leaves an increasingly high concentration of minerals in the remaining water as it is recirculated through the treatment plant. After around three cycles, the water cannot be treated further and requires discharge.

2.6.3 The return volume will be based on the number of water treatment plant cycles, temperature of water discharged from the cooling system, and a sufficient volume of flow to ensure that the river water sediments, salts and minerals concentration that are returned to the Don in the discharged water are within acceptable limits for the CAR licence and PPC Permit to ensure no detrimental effects on river water quality or aquatic life.

### Pipelines

2.6.4 The raw water supply from the River Don would be via two parallel pipes each of around 610 mm outer diameter which can supply up to around 2,800 $m^3$ of water per hour in total. The return for water discharge would be via a similar single 610 mm outer diameter pipe laid in parallel with the supply. The return pipeline capacity would be up to around 970 $m^3$ per hour.

2.6.5 The pipelines would be laid in a trench of around 6 m width (at the surface) and around 1.1–1.7 m depth with soil cover of at least 1.1 m reinstated above the pipes. Kintore Hydrogen would require a wayleave to access the pipe route for potential inspection or maintenance but land above the pipelines can be farmed, including ploughing. During construction, a typical working corridor width of around 30 m would be required for machinery access and temporary topsoil stockpiles before reinstatement.

2.6.6 Crossings of watercourses, minor roads, the A96 and the railway may use trenchless techniques such as horizontal directional drilling (HDD) where required, as described above for the gas pipeline. Temporary access points, hedgerow removal, working compounds, pipeline laydown areas and drilling machinery compounds if HDD is employed are likely to be required along the pipeline route during construction.

2.6.7 The elevation difference between the River Don and the electrolysis plant site is around 85 m, requiring a pumped supply but allowing gravity return.

### Abstraction and discharge point, pumphouse and treatment plant

2.6.8 The intake and discharge point would be located on the south bank of the River Don. The buried pipelines would exit the river bank below the normal river water level through a self-cleaning fish and debris screen with a concrete structure to support it. No weir impinging on the river is required but works will be required to the river bed and bank to construct the pipes, screens and supporting structure.

2.6.9 From the intake point, the two intake pipelines would run to a buried pumphouse located outside the flood plain area (1 in 200 year flood extent). The pumphouse would be a vertical shaft belowground with a sump at the buried pipeline level, and pumps located in a building up to 7 m high at ground level.

2.6.10 Depending on further design work of the pump system and ongoing monitoring of sediment loads in the river, it is possible that an initial filtration and settling stage of water treatment at the abstraction end of the water pipelines would be required, to reduce the risk of sedimentation in the pipelines. If required, this would comprise structures of up to 7 m in height in an area of up to around 0.6 ha, including pumphouse).

2.6.11 The pipeline will cross the railway through a tunnel bored under the track. There is an existing access across the railway from the B977 (The Rushlach Road) close to this location via a box tunnel, but its constrained dimensions would not allow HGVs or larger construction plant to pass. In addition to this access point, alternative temporary construction accesses and haul roads north and south of the railway to the east are therefore shown in the proposed development boundary, off the B979. Subject to agreement with Network Rail, these could utilise an existing user-worked farm level crossing. Again subject to agreement, a crane could also possibly also be used to lift plant and equipment across the railway, although this is unlikely to be required.

2.6.12 The pumphouse and (if required) settlement plant would be located south of the railway.

## 2.7 Off-site habitat creation

2.7.1 In addition to landscape planting and habitat management for enhancement within the main areas of the proposed development, Kintore Hydrogen has also proposed a further area of around 7.3 ha of land along the River Don, south of Kintore, within the application boundary for new habitat creation.

2.7.2 The goal of this is to provide high quality riparian habitat with wildflower grassland and lowland woodland, contributing to biodiversity net gain achieved by the proposed development.

2.7.3 The initial proposals for this are set out in the Outline Biodiversity Enhancement and Management Plan (Outline BEMP) at Volume 3, Appendix 8.18. The resultant biodiversity net gain that could be achieved, through the on- and off-site habitat creation, is predicted to be 16% for terrestrial habitats such as wildflower grassland and woodland, 14% for hedgerows and treelines and 3% for watercourses. Details of the BNG assessment are in Appendix 8.15.

## 2.8 Construction workforce, working hours, compounds, and access

2.8.1 During each phase of the development (explained below), an average construction workforce of around 860 FTE is anticipated, with a peak during certain stages of work at 1,430 FTE. The main construction compound and laydown area would be within the main electrolysis plant site, with space available being facilitated by the phased nature of the construction programme.

2.8.2 Construction working hours would be 08:00–18:00 Monday to Saturday, with no working on Sundays or Bank Holidays. Works inside buildings and non-noisy works may be undertaken outside these hours where required, such as during the commissioning phase.

2.8.3 A dedicated construction access road from a new junction off the B977 would be provided. This would be a temporary access, retained for the duration of the phased construction. Following construction, the temporary access road would be removed, but the junction with the B977 would be retained (closed to traffic) in case it is needed in future to bring a large load in as part of site maintenance.

2.8.4 It is not proposed to accommodate car parking within the electrolysis plant construction site for the full complement of construction workers in single-occupancy vehicles. The draft Construction Traffic Management Plan (Appendix 9.1) sets out the proposed measures to provide modal shift to sustainable transport options, which includes provision of a shuttle minibus service from Kintore Train Station and/or park and ride facilities.

2.8.5 The peak construction traffic is anticipated to be 278 daily movements (139 inbound and 139 outbound). Of these 278 daily movements, 212 movements are expected to be HGVs, which would be bringing equipment, construction materials, components etc. to the application site, 56 movements are associated with construction staff arriving at and departing the application site and the remaining movements are car / LGV movements associated with general site deliveries and visitors. This is described further in Chapter 9: Transport and Access.

2.8.6 Abnormal indivisible load (AIL) vehicles will be required for delivery of certain large plant items. An AIL Route Survey Report sets out the route for these, at Appendix 9.2.

2.8.7 Access to the AGI site for construction would also be taken from the B977, around 400 m from the roundabout with the B994, using an existing private farm access road with resurfacing where needed.

2.8.8 Access to construct the abstraction and discharge point with pumping station would be taken from the B977 (The Rushlach Road) and from further east off the B979, if needed, to facilitate access by construction machinery to the north side of the railway via a temporary haul road in farm land adjacent to the railway alignment. From the B977 there is an existing box tunnel under the railway embankment serving the adjacent residence, though this is constrained in width and height. A temporary construction and laydown compound would be located on farmland at this location, and restored to its pre-development condition after construction.

2.8.9 Access to construct the water pipeline route corridor would be taken at a number of locations from roads along the route, with machinery then moving along the pipeline corridor. The AGI site and the electrolysis plant site would provide access for machinery to construct the hydrogen pipeline within the working corridor for this. In both cases, the pipelines would be constructed in sections, with machinery moving across the land to open trenches (or trenchless crossing points), lay pipe and reinstate the trench cover. Machinery would therefore typically be working in one area for a matter of weeks at a time, but with sections of haul road retained for longer to provide access as machinery moves along the route.

2.8.10 A trenchless technique such as HDD would be used for the A96 crossing by the water pipelines. The crossing point would be in the vicinity of Kinellar, south of the Marshall's Farm Shop layby. The HDD drilling compounds would be located within the pipeline corridor, either side of the A96.

## 2.9 Development phasing and construction programme

2.9.1 Kintore Hydrogen expects to develop the facility in at least two phases. The initial phase would provide up to 500 MWe of electrolysis capacity. Subsequently the remaining planned 2,500 MWe capacity could be built in a single second phase or a series of further 500 MWe phases, subject to market conditions, electricity supply agreement with SSEN, progression of hydrogen blending in the UK gas network and progression of Project Union.

2.9.2 Subject to planning permission and a final investment decision, construction start is intended in 2026 (with the possibility of enabling works in 2025). The construction programme for the first phase is anticipated to be around 36–48 months, enabling commissioning by 2029. In this phase the following aspects of the development are expected to be constructed:

- one or more electrolysis buildings or external electrolysis equipment;
- one compressor plant structure/building;
- control room, stores and workshop sized for the full development;
- pads and other external plant sized for the first phase;
- bank of cooling towers sized for the first phase;
- water treatment plant building sized for the full capacity;
- electrical switchyard equipment and underground high voltage cable(s) sized for the first phase;
- B977 junction and temporary construction access route, to be retained for all phases of construction
- permanent operational access road and gatehouse;
- internal roads and car park sized for the first phase;
- all three water supply and return pipelines and pumping station for the full development;
- hydrogen export pipelines and above-ground installation for the full development;
- foul drainage connection sized for the full development; and
- clean surface runoff attenuation and discharge sized for the whole development but implemented in phases as required (subject to detailed drainage design).

2.9.3 In subsequent phase(s), the following further development would be constructed:

- remaining electrolysis buildings or equipment;
- remaining compressor structure(s)/building(s);
- remaining electrical switchyard equipment and further high voltage underground cables;
- remaining pads and external plant;

- any remaining connections and drainage required for the whole development not constructed in the first phase; and
- remaining internal access roads and car parking capacity.

2.9.4 Depending on the number of subsequent construction phases, these may each be of a shorter duration or a single further construction phase of around 36 months' duration to deliver all the remaining capacity.

2.9.5 Overall, completion of all construction is anticipated in the early 2030s. As set out above, construction would be intermittent in phases during the 2026 to early 2030s period.

## 2.10 Decommissioning

2.10.1 Kintore Hydrogen is not seeking a time-limited planning permission. The proposed development has an initial design lifetime of around 35 years. Further operation beyond that timescale would be dependent on prevailing market conditions. The assets, if in continuing use, would be refurbished and upgraded as required, and would follow any necessary approvals process in place at that time.

2.10.2 The facility would be developed in a modular fashion over several phases and would be capable of being decommissioned and deconstructed in a reverse of that process in future. Should the facility be decommissioned, above-ground structures would be removed from the site, with the maximum value being recovered from materials and equipment via re-use or recycling at the time. The decision on how much of the below ground infrastructure (including pipelines, foundations and concrete pads) would be removed or retained in situ would be agreed with the subsequent landowner and any other interested parties, accounting for decommissioning methods and timescales at the time.

2.10.3 Decommissioning activities are therefore expected to give rise to types of potential impact that are similar to construction and which would be no greater in terms of magnitude or duration.

## 2.11 Maximum design parameter envelope

2.11.1 In accordance with the methodology for the EIA set out in Chapter 4, a 'Rochdale envelope' of parameters has been defined for assessment. This delimits the maximum physical or operational aspects of the proposed development, on a conservative or 'maximum-case' basis, to enable robust EIA where design flexibility is encompassed at this stage by the planning permission in principle application.

2.11.2 The maximum design parameter envelope comprises two parts, which should be read together:

- the Planning Parameters Plan submitted with the planning permission in principle application, reproduced as Figure 2.3, overleaf; and
- physical and operational parameters defined in Table 2.1, below the figure, from which each EIA technical topic has selected the maximum parameters relevant to the assessment.

2.11.3 In addition to these general design envelope parameters, certain other specific parameters have been defined where required for modelling and assessment work where required, such as plant noise levels, flare exhaust characteristics, or trip generation and traffic flows on road links. These are detailed in the maximum design envelope parameters tables within the respective topic chapters.

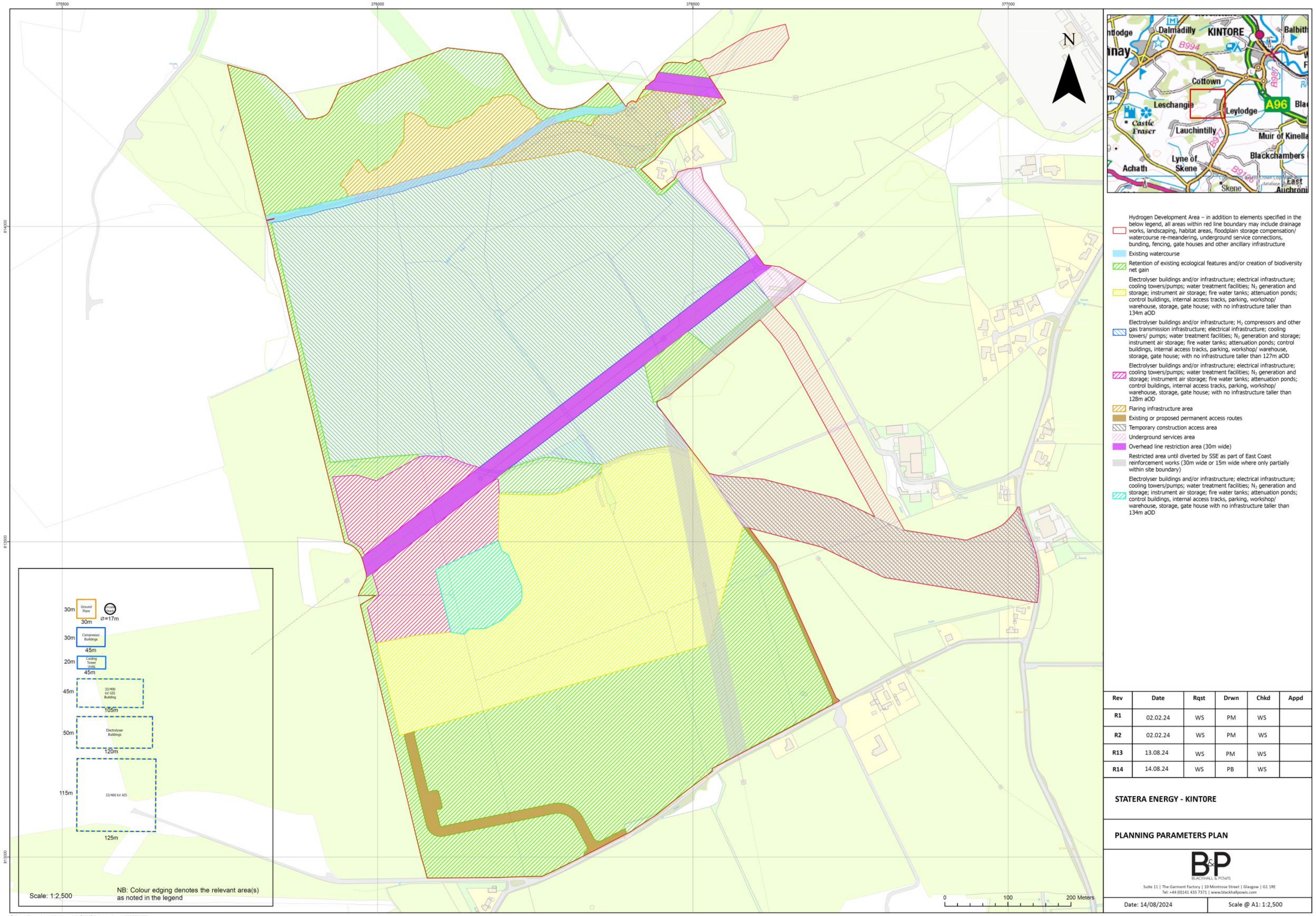





**Figure 2.3: Planning parameters plan**

**Table 2.1: Maximum design envelope parameters – electrolysis plant site main buildings**

| Building | Total footprint or GIA ($m^2$) | Width (m) | Length (m) | Height above finished ground level (m) | Height above Ordnance Datum (m aOD) | Notes |
|---|---|---|---|---|---|---|
| Electrolyser buildings | 60,480 | 50 | 120 | 16 / 14 | Up to between 127 and 134 depending on zone (see Table 2.2) | 16 m north of central site ridgeline and reduced to 14 m above finished ground level south of the ridgeline. Equipment may also be external to no greater height. |
| Compressor buildings | 3,600 | 30 | 45 | 20 | | |
| 33/400 kV AIS substation (open air equipment) | 43,125 | 115 | 125 | 12 | | Option 1. Maximum height of open air equipment is 12m but this would be individual equipment items, not a continuous block. |
| 33/400 kV GIS substation (in building) | 14,175 | 45 | 105 | 8 | | Option 2 |
| Cooling tower units | 4,200 | 40 | 35 | 15 | | |
| Ground flare | n/a | Base up to 30 x 30<br>Flare stack outer diameter up to 17 | | 30 | 132 | Two flare design options with differing heights and diameters – further detailed below |

**Table 2.2: Maximum design envelope parameters – development areas**

| Development zone | Area (ha) | Plan reference |
|---|---|---|
| **Overall application boundary** | | |
| Total area within planning application redline boundary | 137.2 | Figure 1.1 |
| Total area within main electrolysis plant site (including temporary and permanent access) | 85.8 | Figure 2.3 |
| Habitat creation area adjacent to river (including temporary access) | 7.3 | Figure 1.1 |
| **Electrolysis plant site development zones** | | |
| Electrolyser buildings and/or infrastructure; electrical infrastructure; cooling towers/pumps; water treatment facilities; $N_2$ generation and storage; instrument air storage; fire water tanks; attenuation ponds; control buildings, internal access tracks, parking, workshop/warehouse, storage, gate house; with no infrastructure taller than 134 m aOD | 13.7 | Figure 2.3 |
| Electrolyser buildings and/or infrastructure; $H_2$ compressors and other gas transmission infrastructure; electrical infrastructure; cooling towers/ pumps; water treatment facilities; $N_2$ generation and storage; instrument air storage; fire water tanks; attenuation ponds; control buildings, internal access tracks, parking, workshop/warehouse, storage, gate house; with no infrastructure taller than 127 m aOD | 29.0 | Figure 2.3 |
| Electrolyser buildings and/or infrastructure; electrical infrastructure; cooling towers/pumps; water treatment facilities; $N_2$ generation and storage; instrument air storage; fire water tanks; attenuation ponds; control buildings, internal access tracks, parking, workshop/warehouse, storage, gate house; with no infrastructure taller than 128 m aOD | 4.1 | Figure 2.3 |
| Electrolyser buildings and/or infrastructure; electrical infrastructure; cooling towers/pumps; water treatment facilities; $N_2$ generation and storage; instrument air storage; fire water tanks; attenuation ponds; control buildings, internal access tracks, parking, workshop/warehouse, storage, gate house; with no infrastructure taller than 134 m aOD | 1.4 | Figure 2.3 |
| Flaring infrastructure area | 3.9 | Figure 2.3 |
| Existing or proposed permanent access route area | 1.0 | Figure 2.3 |
| Temporary construction access route area | 4.4 | Figure 2.3 |
| Underground services area | 7.2 | Figure 2.3 |

| Development zone | Area (ha) | Plan reference |
|---|---|---|
| Area of land used for landscaping, retained habitat features, drainage and soakaways, existing watercourse, and under existing retained overhead lines (pending SSE diversion of one overhead line as part of the East Coast Reinforcement Works) | 30.2 | Figure 2.3 |

Note: sums of zones do not equal total site areas due to overlaps between zones for multiple uses

**Table 2.3: Maximum design envelope parameters – electrolysis plant, hydrogen export and water supply**

| Parameter | Minimum | Maximum | Description or interpretation notes |
|---|---|---|---|
| **Electrolysis plant site, access and grid connection** | | | |
| **Layout and buildings** | | | |
| External electrolyser equipment | - | 12 m | If this is external to electrolyser buildings |
| Height of equipment and buildings not otherwise specified | - | 10 m | |
| On-site substation technology | GIS | AIS | Either or a combination of AIS and GIS may be used. AIS requires a greater site area and the maximum equipment height is greater than a GIS building; but GIS requires a building with potentially greater massing than open air AIS equipment |
| Cooling system | Hybrid, wet or dry | | Equipment height and noise level parameters used are a maximum case for various technology options |
| Hydrogen storage tanks | Not required | | |
| Firewater tank volume | 5,000 $m^2$ | 20,000 $m^2$ | |
| Oxygen vent pipe height above building roofline | - | 4 m | Release point height above electrolyser building ridgeline; vent stacks may be on the electrolyser buildings (if used) or external equipment |
| Oxygen vent pipe number | 6 | 30 | Per electrolyser building or equipment train |
| Boundary treatment | Steel palisade security fencing 2.1 m high | | Security fenceline and clear area visible to CCTV will be required around operational areas of site. Perimeter landscaping including screening planting will be possible within or outside the security fence and clear area. |
| Electrical export cable working corridor width during construction | 20 m | 30 m | |
| Electrical export cable trench depth | 1 m | 1.5 m | Excluding HDD or other trenchless construction options where required |
| **Operation** | | | |
| Operational workforce (Phase 1) | 30 | 50 | FTE, in a two or three shift pattern |
| Operational workforce (total) | 100 | 200 | FTE, in a two or three shift pattern |
| Operating hours | - | 8,760 hrs/annum | Up to 24/7/365 operation, though capacity factor of hydrogen production over the course of a year will depend on the renewable energy market |
| Hydrogen flare capacity (abnormal event) | - | 54,408 kg/hr | |
| Hydrogen production | - | 54,408 kg/hr | |
| Water consumption | - | 1,836 $m^3$/hr | |
| Electricity consumption | - | 3 GW | |
| **Hydrogen export pipeline and AGI** | | | |

| Parameter | Minimum | Maximum | Description or interpretation notes |
|---|---|---|---|
| AGI compound area | - | 1.6 ha | |
| AGI building / equipment height | - | 7 m | |
| AGI boundary treatment | Fence with hedge and/or screening planting | | |
| Hydrogen pipelines | 1 | 2 | |
| Hydrogen pipeline outer diameter | - | 510 mm | |
| Hydrogen pipeline pressure | 40 barg | 94 barg | |
| Hydrogen pipeline trench depth | 1.1 m | 1.7 m | To top of pipe |
| Working corridor width for trenching | 20 m | 30 m | |
| Trenchless crossing working compound size | - | 50 m x 50 m | |
| **Water pipeline and intake/outfall** | | | |
| Pumphouse footprint | - | 20 m x 30 m | |
| Pump shaft and well depth | 14 m | 18 m | |
| Pumphouse height | - | 7 m | Above ground level |
| Water treatment plant area | - | 0.6 ha | If required at this location |
| Water treatment plant structure height | 3 m | 7 m | If required at this location |
| Pumphouse and treatment plant boundary treatment | Fence with hedge and/or screening planting | | |
| Intake volume | - | 2,808 $m^3$/hr | |
| Discharge volume | - | 972 $m^3$/hr | |
| Discharge temperature | n/a | 40°C | |
| Water pipelines | - | 3 | Two intake, one return |
| Water pipeline outer diameter | - | 610 mm | |
| Water pipeline trench depth | 1.1 m | 1.7 m | To top of pipe |
| Water pipeline trench width | 3 m | 7 m | 3 m at bottom of trench, 7 m at surface |
| Working corridor width for trenching | 20 m | 30 m | |
| A96 and railway crossing method | Trenchless | | HDD, pipe jacking or microtunnelling |
| Trenchless crossing working compound size | - | 50 m x 50 m | |
| **Construction (all elements)** | | | |
| Construction working hours | 08:00–18:00 Mon-Sat | | Works inside buildings and non-noisy works may be undertaken outside these hours where required, such as during the commissioning phase. |

| Parameter | Minimum | Maximum | Description or interpretation notes |
|---|---|---|---|
| Construction workforce (average) | | 857 | |
| Construction workforce (peak) | | 1,432 | |
| Cut / fill balance | Achieved within site | | Including use of material for landscaping bunds and site reprofiling |
| Piling method | Not required | | |
| Construction programme (Phase 1) | 36 months | 48 months | |
| Construction programme (Phase 2) | 24 months | 36 months | |

# References

[1] James Hutton Institute (2014): Digitised Land Capability for Agriculture of Scotland 1:50,000 maps. Published by NatureScot. [Online] https://map.environment.gov.scot/Soil_maps/?layer=6, accessed 22.06.23

[2] National Records of Scotland (2023): Mid-2020 Population Estimates for Settlements and Localities in Scotland. [Online] https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-estimates/settlements-and-localities/mid-2020, accessed 21/06/23

[3] Mapped by SSEN at https://www.ssen-transmission.co.uk/projects/project-planned-areas/?projectId={2f6d092a-1169-4744-836d-68b4faea24df}, accessed 22/06/23

[4] Scottish Natural Heritage (2019): LCT 026 – Wooded Estates – Aberdeenshire. [Online] https://www.nature.scot/sites/default/files/LCA/LCT%20026%20-%20Wooded%20Estates%20-%20Aberdeenshire%20-%20Final%20pdf.pdf, accessed 21/06/23

[5] Scottish Government (2020): Hydrogen Policy Statement. [Online] https://www.gov.scot/publications/scottish-government-hydrogen-policy-statement/, accessed 09/04/24

[6] Scottish Government (2022): Hydrogen Act Plan. [Online] https://www.gov.scot/publications/hydrogen-action-plan, accessed 09/04/24

[7] National Gas (2022): Project Union Launch Report. [Online] https://www.nationalgas.com/document/139641/download, accessed 22/06/23

[8] Ofgem (2023): National Grid Transmission Project Union Feasibility Phase Decision. [Online] https://www.ofgem.gov.uk/sites/default/files/2023-04/PU_decision%20doc%20redacted%20final%20for%20upload.pdf, accessed 09/04/24

[9] National Grid ESO (2024): Beyond 2030. [Online] https://www.nationalgrideso.com/future-energy/beyond-2030, accessed 09/04/24